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YOSEMITE CENTENNIAL SYMPOSIUM PROCEEDINGS

NATURAL AREAS AND YOSEMITE: PROSPECTS FOR THE FUTURE

A Global Issues Symposium Joining
the 17th Annual Natural Areas Conference
with the Yosemite Centennial Celebration
October 13-20, 1990

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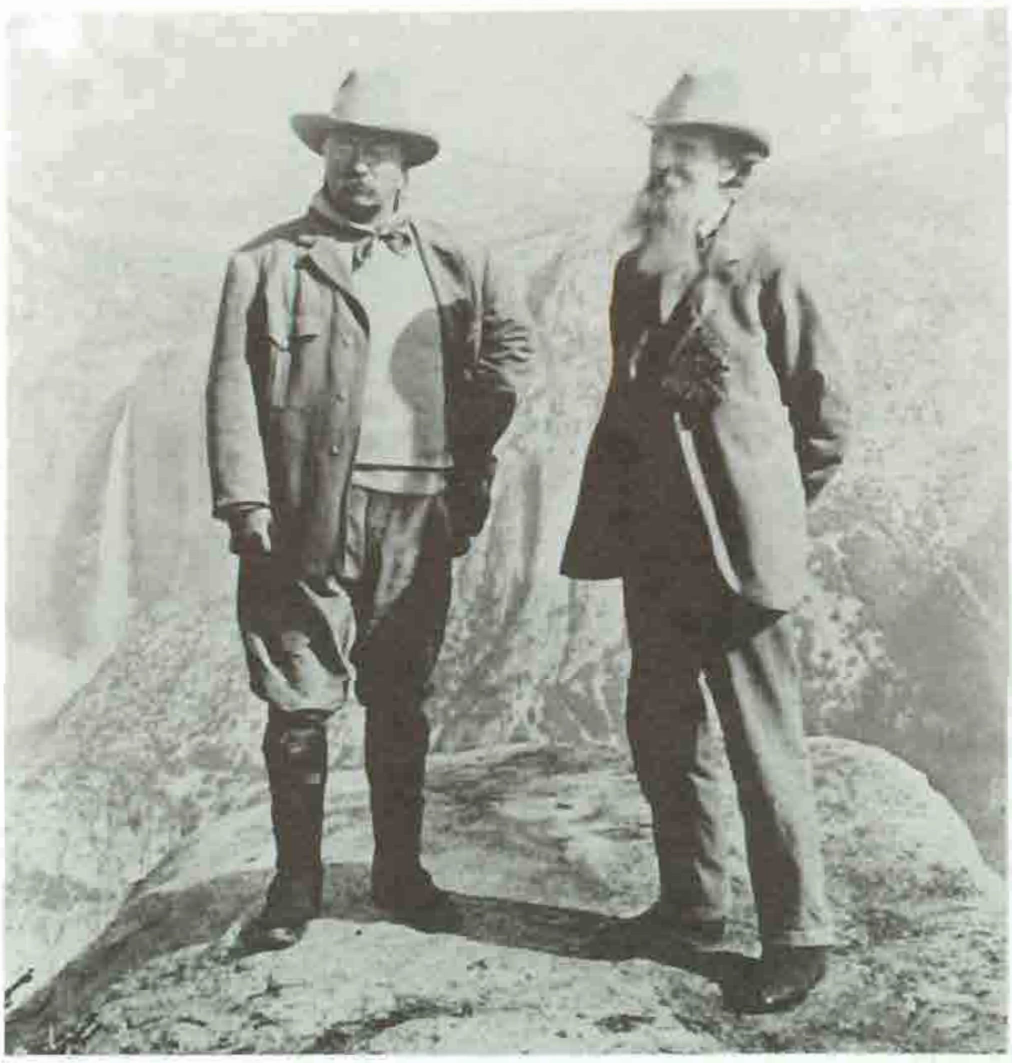

President Theodore Roosevelt and John Muir at Glacier Point in May, 1903.
NPS Photo Collection

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INTRODUCTION

One hundred and one years ago, on October 1, 1890, Yosemite was designated as a national park, to preserve and protect, unimpaired for future generations. During the centennial year, 1990, various activities took place to celebrate the preservation of Yosemite by using the experiences of the past to look to the future.

From October 13 through 19, 1990, a global issues symposium was held to commemorate the Centennial of Yosemite National Park along with the presentation of the 17th annual conference of the Natural Areas Association. Yosemite National Park served as the primary focus of the natural areas conference, to highlight the events, research, and practices that continue to shape the management, protection, and use of this national treasure and to show how these practices relate to other natural areas throughout the United States and the world.

The symposium created a lively forum for discussions and information exchange between over 450 natural area managers, natural and cultural scientists, journalists, environmentalists, business and government representatives, students, and interested members of the general public. The conference also presented the prospects for preserving natural areas and cultural and natural resources into the next century.

The symposium began on October 13, 1990, in Yosemite National Park with a keynote address and two days of specially guided tours of various resource areas and research projects. The main body of the symposium was held in Concord and San Francisco, California, October 14-19, 1990, and included a wide array of topics from various fields of view. Over 150 formal presentations were given during plenary and concurrent sessions, roundtable discussions, and workshops. Topics covered the general areas of natural areas protection and management, natural and cultural resources research and management, landscape preservation, natural areas interpretation and education, art and literature, biological diversity, genetic conservation, and other global issues.

These proceedings are a compilation written material provided for 122 of the presentations. This includes 21 papers presented during the plenary session of the symposium, 77 papers presented during the concurrent sessions, and 45 abstracts for papers presented during the concurrent sessions. Even with not all of the symposium presentations represented in this final published form, these proceeding represent a cross section of the conference.

As noted in the Table of Contents, the proceedings are organized with the seven plenary sessions first, followed by the concurrent session topics listed by nine general topic areas: Natural Areas Management; Wildlife; Vegetation; Aquatic and Riparian Systems; Biodiversity; Cultural History and Native Americans; Geology; Education, Visitor Use, and Volunteerism; and Arts and Literature. The volume is completed with lists of presenters and attendees at the symposium.

As a supplement to the published proceedings, the audio portions of most of the formal presentations during the symposium were recorded and are available for purchase in standard cassette form from Conference Recording Service, 1308 Gilman St. Berkeley, CA, 94706. Complete sets of the recorded tapes are available for review at the Yosemite Research Library, Yosemite National Park.

These published proceedings were made possible by the dedication and perseverance of the authors of each paper. Organization and compilation were accomplished by Jerry Edelbrock and Scott Carpenter. Professional and invaluable editing support was provided by Kay Roush, Dick Morishige, and Janet Stickland of the Branch of Publications and Graphic Design, National Park Service, Denver Service Center. The publication saw fruition with the financial and moral support of John Reynolds, assistant director, design and construction, National Park Service, Jim Shevock of the U.S. Forest Service, and Bob Hansen of the Yosemite Fund.

The symposium was made possible through the generous financial support and general assistance of the following individuals, agencies, organizations, and corporations: Alhambra Water; The Ansel Adams Gallery; California Department of Fish and Game; The Commonwealth Club of California; Exxon; Golden Gate National Recreation Area; L.W. "Bill" Lane, Jr.; Narada Productions, Inc.; National Park Service; The Nature Conservancy; Saint Andrews Society; Seaboard Paper Company; University of California, College of Natural Resources; University of California, Natural Reserve System; U.S. Bureau of Land Management; U.S. Forest Service; U.S. Geological Survey; Yosemite Association; The Yosemite Fund; and Yosemite Park and Curry Co.

Lastly, the symposium realized a century of success only through the dedicated efforts and long-lasting friendships of the following individuals: Steve Nicola (symposium co-chairman), Donald Fox, Jonellen Goddard, Len McKenzie, Margaret Race, David Robertson, and Jan van Wagtendonk, of the Symposium Steering Committee; Michael V. Finley, superintendent, Yosemite National Park; B.J. Griffin, National Park Service; Fran Harty, president, Natural Areas Association; Bob Hansen, Yosemite Fund; Steve Medley, Yosemite Association; Virginia Parks; Rose Lamantia; Michael Brassington; Bill Mott; Bill Lane; Jeanne Adams; Harold Gilliam; Eric Tingstad; Nancy Rumbel; and John Muir. To you, and all of the attendees of the symposium, thank you.

Jerry Edelbrock, Symposium Coordinator
Scott Carpenter, Symposium Co-Chairman

PLENARY PRESENTATIONS

Grizzly Bear (top), Polar Bear (Center), Black Bear (bottom)
© 1981 by Diana Dee Tyler

YOSEMITE NATIONAL PARK
100th ANNIVERSARY
Nathaniel P. Reed[1]

Friends of Yosemite National Park, we are gathered in this majestic valley surrounded by towering cliffs – the whole scene the product of millenniums of ice, water, and rain – to celebrate an auspicious birthday.

More than just the 100th anniversary of the establishment of Yosemite National Park, it is the celebration of a concept, an ideal, an ethic.

Our forefathers established a basic system of national parks on which we have built the most spectacular array of unique areas of our country. Of all the gems, Yosemite is the crown jewel.

The power of the natural forces that carved Half Dome and smoothed El Capitan is not easily comprehended by modern, urban man. We are "instant people." We have difficulty understanding geologic time. Even 1890 is a long time ago; a million years is difficult to comprehend.

My children, sitting at Glacier Point, in wonderment, have muttered "Awesome," and for once they have been accurate.

Yosemite – the valley, peaks, waterfalls, redwood groves, the meadows, the parts and the whole – make up the most spectacular setting in the world.

I was introduced to Yosemite as a teenager by staring at Albert Bierstadt's famous painting *Sunrise in the Yosemite Valley.*

In spite of the fact that I had visited my grandmother Reed in Denver for four consecutive summers during the war years and knew the beauty of the Rocky Mountains' crags, valleys, cliffs, and streams, frankly, I did not believe Bierstadt's painting could possibly be accurate. No painting or even photograph prepares one for the shock of Yosemite's grandeur.

In the spring of 1971, a series of emergencies required my presence here. As the director and I entered the park on the Arch Rock Road, I insisted on stopping by a superb pool on the Merced River. I am a passionate trout fisherman. Imagine my delight as I watched a vast mayfly hatch being devoured by lines of trout.

I remember stopping at the entrance to the forest floor and witnessing an incredible sight. Millions of lady bugs covered the moss and rocks, awakening from their long winter sleep.

The valley, El Capitan, Half Dome, the spectacle!

I was astonished by the number of automobiles; cars everywhere and acres of parking lots. But it did not take me long to discover that a ten to fifteen minute walk away from the crowded parking lots lay a wilderness. All one needed was leg power and the spirit of adventure.

I had recently been confirmed as assistant secretary of interior for fish, wildlife and parks. My boundless enthusiasm for all aspects of the job, combined with a sense of justified awe in a developing

1. Nathaniel P. Reed, Assistant Secretary of the Interior for Presidents Nixon and Ford.

relationship with the National Park Service, led to nearly six years of excitement and, I hope, an era of accomplishment which the service and I will always be proud of.

I had the pleasure of serving with George Hartzog, who was one of the most energetic visionaries that ever led the National Park Service. Our relationship was often considered "tender" by our associates, but that is not accurate. We were two strong-willed men devoted to a mission, with clear views on how to accomplish goals. We rarely fought but when we did, everyone knew about it.

Our common beliefs were much more important than our occasional disagreements. We shared similar interests and passions. What greater passion is there than land, mission, and public service!

You couldn't help liking George Hartzog. He was a Methodist minister who had seen the holy grail, and his mission was to dramatically increase the size of the system of parks and the efficiency and expertise of the National Park Service.

We jointly confronted an era of many problems. The never-ending summer produced a generation of restless, alienated youths who flocked to the parks. A new wave of affluence produced fleets of recreational vehicles, many too big for the park's road systems. Park visitation doubled and doubled again.

We had to invest millions of dollars, the majority of the system's capital dollars, in sewage systems. The concessioners were changing. The "Mom and Pop" operations were run down, underfinanced, overwhelmed. Large corporations specializing in leisure and travel with impressive abilities to finance needed improvements bought the system's concessions. Inevitably, there were conflicts – conflicts of use, conflicts of ideas. The men and women of the National Park Service had to learn new techniques of communication< and they had to learn to listen.

Rogers Morton was the secretary of interior. An urbane Easterner with strong ties to Capitol Hill, Rogers knew that the national park system was the diamond, the crown diamond, not only of the Interior Department but of the federal government. He also had an intense love affair with the men and women of the National Park Service.

Mrs. Morton – Ann, to all of us from assistant secretaries to Park Service rangers – kept a watchful eye out. She disapproved of George Hartzog's management style that often moved superintendents and their assistants on to new challenging assignments without regard to the often traumatic impacts sudden movements, even if advancements, can have on the wives and the children.

He liked to ride, fish and, above all, sit at a campfire and talk. Every young ranger that had the privilege of sharing a campfire with Rog will never forget that experience.

Morton was a friendly, intelligent bear of a man. As an easterner, he had to constantly watch his western flanks. The Rocky Mountain Republican delegation was immune to the new wave of environmental interest and concern. The old school lessons – low-cost grazing, cheap timber sales, federally subsidized dams and cheap water – still played to their western constituency. But so did national parks.

As avowed antifederalists, suspicious of the Park Service's lofty goals, frustrated by management plans that sought to minimize excessive use, the western delegation nevertheless understood the ever-increasing rate of visitation and, most importantly, the cash flow that visitation represented.

The gateway cities near the national parks became rich, but their interests often differed from the parks' missions. Secretary Morton was impressed by the vigor, the depth of interest, and the wide cross section of support the fledgling environmental movement was gaining. Rogers Morton saw that the environmental movement could advance the National Park Service mission – he could use that advance to offset the anti-environmental aspects of his job.

Politically, he had to accelerate oil drilling, strip mining, even support the last mad efforts to continue the long era of federal dam building. The quid pro quo was a huge effort to expand the national park system.

Rogers forgave George Hartzog's relentless zeal and fought for record appropriations for land acquisition and maintenance and manpower to make the parks healthy – at last.

Rogers didn't like direct confrontations. He was a former congressman who knew Capitol Hill's prime rule of combat: compromise.

George and I were idealists – we did not like compromises, we liked and expected to win.

There are confrontations that simply cannot be nor should be avoided.

We demanded excellence from every employee of the service for they are an elite corps in the sea of bureaucracy; excellence in the management of the regions and within the parks; excellence of staff work; excellence in the vital relationship with the Congress; excellence in responding to the Executive Office.

We worked for a secretary who we knew was on our side – sometimes quietly – but in a pinch, 100 percent on our side. We gambled, we dared to dream.

In the past twenty years, only Secretary Cecil Andrus's favorably compares to Rogers Morton's era of stewardship. They both stood tall, combining courage, conviction, and most importantly vision, as they led the service and the Department of Interior.

The mission of the service is clear – the 1916 National Park Service act may present problems of interpretation for some but never for me. Let me read those magical words that I take as seriously as if they were recorded on Moses' tablets:

> ...which purpose of said parks, monuments and reservations is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

The preservation mandate rings through clearly. Preservation does not mean "without change." Landscapes inevitably change; the nation's weather pattern is changing. It does not mean suppressing all fires to prevent natural burns nor does it mean manipulating elk herds. It does mean using the best science and loads of common sense to manage our great parks. During the past decade, successive secretaries have not understood the mandate nor the unique mission of the service nor the role the national parks can play in modern America. They have not understood the meaning of the concept of stewardship.

Frankly, it is not enough to protect and preserve. It's time for repairs and reparations. It's time to accept new challenges. Important experiments on revegetation, stream rehabilitation, and people management are ongoing in this park. Additional manpower is desperately needed. New ideas need to be implemented.

Somewhere along the twists and turns of the past years, the service has been ordered to obey a false god. The service has bowed to the god of use, of visitation, at the expense of resource protection. The Congress has been repeatedly called on by disgruntled conservation-minded advocates to order resource protection measures that should have been the mandate of the secretary, his assistant secretary, and the director. I salute the efforts of deeply concerned and committed congressmen of both political parties who have understood the lofty mission to preserve and protect and leave unimpaired.

During my tenure, I was privileged to work with some of the most distinguished members of Congress that ever served. They shared our dreams; they worked with us on bold new agendas. They had vision and courage.

Successive administrations have failed to maintain our national treasures, cheated on proper payment of the service's employees, and eviscerated the "less-than-full-time employees" who traditionally have served as the educators, the interpreters, and the guardians of our national parks and monuments.

The temporary and seasonal employees are the front line of the parks. Driving into the park, I stopped by a fire crew conducting a prescribed burn. That crew was made up of less-than-full-time employees, but they are the guts and the future of the service.

Discovering the fact that many Park Service families are on welfare and need food stamps to survive is horrendous – I am embarrassed for my country.

Twenty years ago, I sat on a rock at Glacier Point and listened to an interpreter describe the great forces of nature that gouged out Yosemite. The interpreter was a young high school teacher from southern California. He spent his summers educating, yes educating a mass of Americans and overseas tourists about the great forces of nature that have formed and carved Yosemite.

When the Park Service lost these critically important interpreters, it lost the ability to carry out one of its primary missions – to educate.

How can we enter the age of environmentalism without well-managed preserved parks, without interpreters, without good maintenance? True resource protection will require the service to energetically overhaul its faltering science program and aggressively pursue an "outreach program" to the surrounding communities. National parks cannot survive as isolated islands.

Most of our national parks are threatened by the increasing pressures of thoughtless development on surrounding lands. We act as if the national parks are to remain calm islands, surrounded by free fire zones. These galaxies, the Grand Canyon, Everglades, Shenandoah, even Yellowstone – the mother national park – are being seriously, severely, impacted by man-made developments, often for short-term economic return, and are lacking proper environmental planning or review.

While we debate the importance of aesthetics in this park, and aesthetics are important, this park is being bombarded by acid rain and higher levels of ozone. The opportunities for reintroduction of indigenous wildlife from the big horn sheep to the peregrine falcon wait. The meadows need further restoration, the black oak forests need rejuvenation. Let's broaden our focus!

This system of parks, monuments, seashores, battlefields, presidents' homes – they are the best of America. No other country in the world has set aside so many wondrous places. The best of our nation's terrain and our nation's history is preserved within the system.

I spent four years organizing a team of devoted experts who labored, often seven days a week, to define and describe a system of parks and refuges in Alaska, complete with full environmental assessments, for final presidential or congressional withdrawal. President Carter and Secretary Andrus were able to persuade the Congress to pass the Alaskan land legislation with broad environmental support. Even if you can't get to the Gates of the Arctic or float the Noatak River, just knowing they are there protected in well-trained hands is sufficient.

We have ripped and growled at our national landscapes with rare abandon. We need the Yellowstones, Glaciers, Everglades, Yosemites to maintain a sense of balance for our own peace.

I have recently concluded my fifth African expedition. I have inspected the parks, preserves, and refuge systems in Kenya, Tanzania, Ruwanda, Zambia, Zimbabwe, Botswana, Namibia, and South Africa. The leadership of those countries recognize the tremendous fiscal importance of tourism. Their countries' resources are strained. Health problems, tribalism, inexperience – all present major problems.

The future of their countries' parks and game management, including expensive and dangerous programs to control poaching, require tough, expensive commitments. What kind of message do we send to them? They are the stewards of the most important wildlife habitats left on earth. If we won't maintain our park system, our "gift" to the modern world, why should we expect them to sacrifice to protect and preserve their unique areas?

Is there no national consensus to accept the responsibility of maintaining the system of national parks and creating a National Park Service whose mission and goals are so noble that young men and women will again plan their lifes' work around the service? I think the American people are willing to pay for excellence – they are proud of their legacy, proud of the service's men and women who devote their lives to resource protection, science, and education.

Education – far from just pleasure grounds, the national parks must become educational centers. The ripple of excitement, wonderment, and knowledge from a concerned citizenry will make a great difference for America's future.

The national park system is not some dispensable ornament that can be manipulated and left to wither while the economy recovers. Ladies and gentlemen, the economy is going to suffer some serious blows for a minimum of 24 months as the bills for unpaid debts are coming due. Some real shocks are coming that will sorely test the American people.

As we go through the catharsis of deciding what we want to pay for and what we can afford, let me argue the indispensability of the system and the dedicated men and women of the service.

Do we have the stuff that the "giants among men" had when they protected this valley 100 years ago and declared it a national park? Do we have the stuff of the Galen Clarks, the John Muirs and the David Browers?

Are the millions of national park visitors "fair weather friends?"

I think not.

I have walked the redwood groves and crossed the meadows, fished the rivers and alpine lakes, sat in wonderment at Glacier Point, prayed for climbers inching up Yosemite's peaks, and wondered at geologic forces that make man's mightiest efforts look puny.

Yosemite has introduced me to a great cast of California giants: the Lane brothers, the Livermores, Ansel Adams, Edgar Wayburn. These men have loved and worked for a better California, a better country, and a better world. They have given purpose to the words "public duty." Yosemite's future is our duty and responsibility.

Into your hands, Superintendent Mike Finley, is Yosemite, the rarest of jewels in the national park system. Protect and preserve this park with the ferocity that marked your defense of my beloved Everglades.

Protect Yosemite National Park for generations unborn who will wonder as we have wondered over sights, sounds, and smells so primeval and different from the rat race of our freeway-dominated, polluted lives.

Historically, Yosemite has suffered many abuses and yet it is alive and lively. New ideas challenge old precepts. No one generation can decide all the issues. Working together we can make Yosemite National Park a better place – better than it was in the 1890s, better than it is in the 1990s. Slowly, surely, wisely, even scientifically, we must protect and manage Yosemite to improve its role as an educator, an innovator, but always constantly improving its basic mission of being left unimpaired.

The current debate over the relevancy of the "master plan" is delicious good fun. It makes "good press" and is a useful "basher's tool." Master plans should never be static – they should include short-term objectives and long-term aspirations. They should be publicly reviewed and debated frequently.

I am concerned that the current debates over the master plan and the terms of the concessions mask the more important problems which Superintendent Finley and his staff need to confront. Specifically, they are the external threats. The staff here and across the system is stretched far too thinly. The system is straining. Resources are being needlessly damaged. Without the contributors of The Yosemite Fund, vital work would not be accomplished.

I am astonished to learn that this park of lakes and rivers does not have a staff fisheries biologist, nor a plant ecologist, nor an aquatic expert. The superintendent can hardly be held responsible when he doesn't know the condition of the resources under his jurisdiction. Ignorance is not bliss.

The system of parks and a motivated, highly trained service are "one." It's a symbiotic relationship. Cheat on the service and one cheats the system. They are indivisible, mutually interdependent.

Do you share a vision of a future? Can you think of Yosemite or California in the 21st century or 22nd century? Can you dream? Why should the park be so dependent on fossil-fuel driven vehicles? What about electric trams in the valley, and a train up the Merced, and why not drain Hetch Hetchy? That would be reparation with a capital "R"! Dream, think, plan, work.

We must develop short-term, doable goals without limiting long-range visions – and never dashing dreams. This legacy – Yosemite – was given to us. It is to be improved, protected, and passed on – a legacy.

I congratulate you, Superintendent Finley, your staff, and the leadership of the National Areas Association for the vision and work to produce the forthcoming symposium.

I am honored to share this birthday celebration with the men and women of the National Park Service and its armada of friends.

Happy Birthday, Yosemite National Park, and may your second hundred years be as exciting as your first.

YOSEMITE: INSPIRATION, SUCCESS, AND CHALLENGE

Amb. L.W. 'Bill' Lane, Jr.[1]

As many of us watched the Civil War series a few weeks ago, one of the many impressions – or, more properly, revelations – that I experienced was to gain a far greater admiration for the capacity of President Lincoln to so brilliantly administer his horrendous responsibilities. With less than a tranquil family life, working and trying to sleep with the frequent sound of guns from battlefields across the Potomac that are peaceful, suburban areas today, and seeing the dead and wounded returning past the doorstep of the White House, Abraham Lincoln possessed an almost inhuman ability to consider fundamental issues such as succession and emancipation in our country for their eternal consequences that he felt must be pursued for all Americans – and, at the same time the capacity for relating to other priorities that were not critical to the war effort. But they were, in his view, symbolic of future values to fulfill his hopes for a reunited nation and a government of, by, and for the people – and by that he meant *all* the people!

On several occasions during the television series of "The Civil War" producer Ken Burns selected old photographs showing progressive views of construction for the dome on the new Capitol building taking place right through the war. Lincoln's insistence that the work continue on this conspicuous feature of the new home for Congress for all to see was to remind the legislators and the public that his plans had not changed for future representation from *all* the *united* states sitting under that dome. He also wanted to let the people know that the president of a new nation, yet to celebrate its centennial and aware that he had been elected to his first term by *both* the North and South, was confident of victory to reunite the nation.

One of those less-than-auspicious occasions was when he signed the congressional legislation creating the Yosemite Grant on June 1, 1864. It was midway in a two-month period of May and June when the Union suffered 50,000 casualties. Yet in that brief interlude from war duties he was responsible for a historic decision dealing with two of the country's unique natural areas, Yosemite Valley and the Mariposa Grove of Big Trees. And, no matter how irrelevant to the outcome of the war, those not-so-wilderness areas of that time did greatly benefit the future welfare of Americans – and eventually of over a hundred nations around the world that have patterned a philosophical concept for national park systems after the United States.

That single action went far beyond any tangible long-term benefit that resulted from completing the Capitol dome – recognizing, however, that any boost of morale that Lincoln could muster to inspire war-weary Northerners, especially Union politicians and military leaders in Washington, was the highest priority of the day. It helped set the political stage for the creation of the first national park at Yellowstone in 1872.

The timing of this symposium on "Prospects for the future of natural areas and Yosemite" is very fortuitous. I can only hope that the president of the United States and all of his administration, as well as all the members of Congress, were impressed with the outcry of public reaction against closures of many national parks during the recent curtailment of budget spending for government services over the Columbus Day weekend. By far the most publicized reaction in all the media from the general public from across the nation was focused on thousands of disappointed Americans and foreign visitors to national parks from schoolchildren wanting to visit capital parks in Washington, to a family who had traveled a long distance to visit Alcatraz, to campers sent home from Yosemite.

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1. Amb. L.W. 'Bill' Lane, Jr., Publisher, *Sunset* magazine (retired).

Thousands of similar reactions came from American taxpayers who expressed their disappointment in often bitter terms when they were deprived of visiting and enjoying their parks, a privilege that they obviously considered to be an inherited right. For those of us close to the Yosemite scene we were also aware of disappointments during the closing of the park during the earlier tragic fires. But, those disappointments reflected complete understanding by the public and great admiration for the army of fire fighters and the outstanding service given to the emergency by the dedicated staffs of the National Park Service, Yosemite Park and Curry Company, and of course, the other government agencies such as the National Forest Service. And, most of all, deep sympathy for those who lost property and pets. However, between those two unhappy events there is certainly no reason for underestimating the popularity of the national parks. It definitely behooves all interested parties to strive to balance what most Americans consider to be a birthright to visit their parks and at the same time be creative in finding solutions to balance the demands for enjoying the park experience and, at the same time, increasing protection of the environment within the restraints of economic feasibility and holding capacity, which, like river-running on the Colorado, must have limits-of-use under certain circumstances. There are countless examples that these goals are definitely *not* incompatible. They are achievable.

I have had the good fortune to be aware of Yosemite for most of my life and interested, concerned, and involved more or less for nearly two-thirds of its history as a national park. My father visited the park in the early 1920s as a guest of a former secretary of agriculture in the Wilson administration, E. T. Meredith, and my brother and I heard about this magnificent place as young boys growing up in Des Moines, Iowa.

After moving to California, during our first long school vacation in California, Dad saw to it that we visited Yosemite pronto during the summer of 1929. We drove our Packard sedan on board the Delta Queen riverboat at the Ferry Building in San Francisco for an overnight cruise up the Sacramento River under a full moon, drove up to Lake Tahoe from Sacramento, down the Owens Valley and over the still unpaved Tioga Pass Road into John Muir's "Sierra Temple."

Dad probably had another reason for that trip: Yosemite National Park was the subject of the feature editorial in the first issue of *Sunset* magazine when it was founded by Southern Pacific Railroad in May 1898. Interestingly, the cover featured the unbridged Golden Gate with Fort Point on the south, which today is a part of the Golden Gate National Recreation Area and the new Presidio military base addition to hopefully be transferred from the U.S. Army to the Department of Interior as part of our Great Western Gateway National Park. The direction of the critical analysis of the review process is benefited by the experience of Mr. William Penn Mott, former director of the California State Park System and recent director of the National Park System, working with the overall supervision of Stan Albright, as director of the Western Region of the National Park Service, and his capable staff.

The Southern Pacific sold *Sunset* to several employees in 1914, and the magazine was purchased in 1928 by our family. In the more than six decades that we owned the magazine there have been many feature cover articles on Yosemite, such as these two issues of May 1985, "Yosemite: Still Magnificent," and May of this year, "Yosemite's Magnificent Back Country."

In 1938, when I went to college, I began working vacations in Yosemite. Later I went on the board of Yosemite Park and Curry Company when it was still controlled by the Curry family. In the late 1960s, during the Johnson administration with Secretary of Interior Stewart Udall, I served on a commission to study the trends of tourism as they impacted our government lands, especially national parks and BLM lands, both in the Interior Department. The study followed recommendations from the analysis of our national parks during the celebration of the 50th anniversary of the National Park Service in 1966.

In 1971 President Nixon appointed me chairman of the commission to celebrate the centennial of our national parks and I later served on the secretary of interior's advisory board and the subcommittee for concessioners, under the outstanding secretary of interior, Rogers Morton; Nat Reed, assistant secretary for fish, wildlife and parks; and George Hartzog, director of the National Park Service. They were a great troika of team leadership. In the Ford administration, I was appointed to the Department of Interior's Bureau of Land Management Advisory Committee for Conservation of the California Desert, elected its first chairman, and served through the Carter administration and into the Reagan administration. That committee interfaced with federal and state park issues, many that are still being resolved in Congress.

Earlier, during the California state administration of Pat Brown as governor, I was appointed to his Tourism and Recreation Commission and was reappointed by Governor Reagan as chairman. A major focus, of course, for that state group was related to our common interests with national park sites, which are most numerous in California of all fifty states. The interwoven federal and state redwood parks on the north coast are classic examples that demand and receive close cooperation.

During my life-in-Yosemite, so to speak, I have fond memories including backcountry pack trips and hiking, staying at virtually every visitor accommodation in the park, often with my wife, Jean, and our children – two of the latter have also worked in Yosemite – calling the fire fall, playing the role of John Muir at a celebration in the Museum Auditorium long before Lee Stetson made a remarkable professional career of the role, and being honored to play the squire at the fabulous Christmas Bracebridge Dinner.

On that first visit in the summer of 1929, we also visited the Mariposa Grove of Big Trees. I recall the long wait in our Packard that was beautiful but built before sun roofs and provided a very limited view of those majestic tall trees, as the cars chugged ahead of us into single-file for the one-way road through the grove. There were boil-outs that delayed the procession and the exhaust fumes from smoke-puffing cars (when they were running) forced keeping the car windows up. In brief, the "sightseeing" excursion with the master of the household as driver preoccupied and the family passengers with limited vision, no fresh air or air-conditioning, and no interpretation is *not* one of the most enjoyable memories I have of Yosemite!

In contrast, last summer Jean and I enjoyed a far different Mariposa Grove experience, thanks to a completely different and greatly improved management plan for the grove by the National Park Service that has evolved over the years. We were staying at the beautifully restored Wawona Hotel and drove our car, but could have taken a bus from the valley. After parking our car we boarded a very comfortable nonpolluting open-air tram operated by the Yosemite Park and Curry Company, with an unencumbered view that permitted being aware of the full scale and panorama of those amazing tall big trees and the grove, with excellent interpretation by a very knowledgeable guide, and the opportunity to get out and walk about every key site. And our tour included going through the upper grove that, because of new controlled burning practices, has resulted in the tough seed pods of the *Sequoia Gigantia* to burst from the heat and again regenerate young seedling growth in the natural environment.

Believe me, there was no comparison between those two visits to the Mariposa Grove separated by just sixty years – thanks to the partnership and combined efforts of the Park Service and the concessioner. This dramatic change for the best interests of the natural conditions and visitor enjoyment does not mean that more good environmental practices and improved interpretation programs cannot or should not take place. Environmental protection and improvement is a process of eternal vigilance. But, it is an example where more people have a better natural park experience and with far less pollution – and the natural resource is far better off while being enjoyed by the taxpaying public with a variety of values on what gives them a meaningful "wilderness experience."

It concerns me that too many of us – and a large number of Americans regard themselves as "environmentalists" – try to impose our own interpretation and values on what is right or wrong for everyone else. The fact is that highly respected and accepted "environmentalists" including John Muir, Ansel Adams, and David Brower have recognized that a "wilderness experience" should be accessible to a wide range of individuals with a variety of physical capabilities, mental attitudes, and financial status. While there is no question that the scale of values to be perpetuated in national parks must lean predominantly to preserve the natural setting, there is no magic formula that dictates the precise degree of accessibility and level of service that must properly appeal to a growing spectrum of interests as our society becomes more socioeconomically diversified. One man's ice cream is another man's apple pie and for a future majority of Californians eating tacos may be more natural than fried chicken. If river-running on the Rio Grande is acceptable why not the Merced? For John Muir, waking up to the stars at night was as rewarding as his first vision of the "range of light." And, who should be the judge? At least these are debatable questions.

I have a photograph of my father during his first visit, seated in an open White touring sedan, early post World War I model – similar to the beautifully restored 1925 White that, thanks to the efforts of the Park Service chief mechanic in Yosemite, Kenny Fipps, is seen tooting around the valley today. Dad is in the car, as part of Secretary Meredith's traveling party, with the visiting dignitaries, Interior and Park Service officials standing in front of the car.

Like Dad and the group that was parked by an open meadow, I was photographed nearly seventy years later last October 1st with the restored vintage White sedan over the Centennial Celebration weekend. There was one big difference. The photograph in the early '20s has a number of campers and their hodge-podge of cars, tents, and campfires scattered over the open meadow behind the car – perhaps Stoneman Meadow, which has now been restored by the Park Service to its natural state thanks to a gift from The Yosemite Fund. My recent photograph has the north wall to our back to catch the morning sun over Half Dome as our group looked out over the beautiful open meadow by the Ahwahnee Hotel. There was nary a single human in the meadow, but several deer that were right at home. There were countless bicyclists, and hikers on the perimeter trails. And there were no cars in the Ahwahnee meadow, as I could well remember from my working days and visits until a few years ago when the road through the meadow was removed by the Park Service.

On an early walk that same morning around the Ahwahnee, I remembered the long-gone golf course and perimeter fencing to help keep the bear and deer out (and, not too subtly, unwanted non-Ahwahnee guests), and even an outdoor dance pavilion just inside the Ahwahnee entrance gates when I was a schoolboy working in the park. A big date was to go and dance to Sid Hoss and his orchestra.

On my walk I had been interviewed by a television crew up for the centennial weekend and they marveled at the deer on the Ahwahnee lawn surrounded by children, and the natural state of the surrounding natural forest areas, and how the hotel grounds were open for all visitors to walk through and enjoy. The television crew had been to Glacier Point earlier and commented on how inconspicuous the Ahwahnee Hotel was as they looked down into the valley – "We had a hard time finding it, and then it was only a speck in the trees by the big meadow" – I explained that this was not surprising since all of the accommodations and other commercial developments for both Park Service and several concessioners in the valley only covered 10 percent of the valley floor. The reduced area of the public campgrounds and fewer campsites of a few years back only adds a small fraction from the predominantly open natural areas.

I reminded the television crew that the Ahwahnee Hotel was constructed, as a *demand* of the National Park Service given to the Yosemite Park and Curry Company in the mid-1920s, by Stephen Mather, the first director of the National Park Service. It was a condition for the newly created company, from the merger of two competing concessioners, before it could receive a new contract from the government.

Many recent news reports give the impression that the Ahwahnee Hotel is a one-of-a-kind in our national parks. While it is considered by many to be the most appropriately designed, constructed, and sited with its natural materials, decor, and high quality of maintenance, it is similar to many other fine hotels or lodges in other national parks where concessioners were required to provide different types of accommodations to give a variety of services, with a range of reasonable prices far below the level of similar recreation accommodations in the private sector. Today I understand the federal government is in the process of building, at its expense, a beautiful new lodge at Denali National Park, in Alaska.

I congratulate the Natural Areas Association and Yosemite National Park, in cooperation with The Yosemite Fund, for the sponsorship of this symposium. The timing could not be better.

The 1980 General Management Plan is getting intensive review and I would like to make six observations that I feel emerge from careful study of the plan and recommendations, especially the surveys and public response:

1. A great deal has already been accomplished to meet the GMP objectives – far more than acknowledged by media coverage or that the public is aware of. I personally talked with many visitors over the centennial weekend and have discussed Yosemite during the last year with many more out of the park.

2. Both the National Park Service and the lead concessioner have developed a strong record of remarkable and innovative financial support and cooperation in achieving many of these objectives that are already completed or underway. Often essential financial, labor, and in-kind assistance has come from the support organizations and individuals in the private sector.

3. There is a great lack of understanding about the facts. I feel that the members of the general public who have actually visited the park are far more satisfied than indicated by some press coverage, which has in certain instances sought out complaints and tends to accentuate the negative. A telephoto shot across a corporation yard no more reflects what a visitor sees than a close-up blow-up of the average garage or storage closet in our homes which are not what guests normally see. Fortunately the national broadcast media on October 1 was very favorable and reported a happy birthday, which it truly was, and most of the local and regional print media on that occasion gave proper tribute to a truly great national park.

4. Several key issues in the public surveys – "keeping the same number" or "decreasing the number" of housing units – are inconclusive, with about a toss-up of response percentages and a combined response about equal to "No Opinions," which represents nearly 50 percent of the total response. And there is considerable evidence that former guests at concessioner lodging would prefer more facilities with conventional private bathroom facilities – which has the advantage of more capacity for off-season and winter use when the valley floor is very capable of handling more guests and the wilderness is virtually unused except for Badger Pass.

5. The greatest need to meet several major objectives is adequate funding, which must predominately come from Congress. That was the focus of my editorial in the May issue of *Sunset* magazine.

6. I support the management plan and will continue to support it. However, I know of no business that would launch as massive an overhaul in operating procedures, customer service,

relocation of facilities, and requiring huge capital expenditures – with as inconclusive and often-contradicting research and as little hope for adequate financing in the present and foreseeable budgeting environment.

In checking with the Washington headquarters of the National Park Service I confirmed that the high quality of services and generally lower prices for all accommodations is definitely maintained by the Yosemite Park and Curry Company, which must have approval for all pricing from the National Park Service. My close familiarity with comparative industry figures is not as detailed as when I was on the Curry Board or on the concessioner subcommittee of secretary of interior's advisory board. But, over the years, until a few days ago, I have visited with responsible national park officials, key members of Congress, and several long-time and respected concessioners. Naturally, there is not complete agreement on every detail from these responsible references, but together with my own knowledge from a long association with the tourism and recreation industry, there is virtually a unanimous opinion which I definitely share that Yosemite National Park today is very fortunate to have the outstanding group of public utility, banking, medical, accommodation, food, U.S. Postal Service, and other visitor-service concessioners as partners in Yosemite National Park. And the lead member of the concessioner family with a remarkable record of long support for objectives and policies of the National Park Service, including the general management plan, is the Yosemite Park and Curry Company. Its fee was set by the National Park Service identical with procedures and at the government's set timing, similar to many other concessioner fees. It was contingent on a large financial capital investment that the three previous concessioners at Yosemite were not able to meet, which is not an uncommon limitation with some other concessioners in national parks. It is a very special one-of-kind business, I assure you! To refer to it as an improper or special "sweetheart" contract is to ignore the normal government legal process and other critical contingencies. Yosemite Park and Curry Company has far exceeded what was required for reinvestment and has supported the volunteer and other support and conscientious efforts to a degree equaled by few if any concessioners. I have heard its chief executive officer, Mr. Ed Hardy, state that the company is in full agreement that at the termination of this present contract the fee should properly be increased, and I have determined that this position is well understood by the National Park Service. How much of an increase will be a process of recognizing changing policies and procedures set by the secretary of the interior, the demands for reinvestment, and many other proper considerations that can and do vary from park to park. And, naturally, other proposals are possibly going to be submitted by hopefully qualified organizations. My only public statement on that decision is limited to one condition: I will fight in the valley and on the hill to keep the concessioner American-owned, if that becomes a choice!

There are countless superintendents, I promise you, who would thank their lucky stars to have as professional, concerned, supportive, cooperative, and as financially sound a lead concessioner in their own parks. In Yosemite a great deal of money from the concessioner in recent years has been spent to further the objectives of the 1980 management plan and with all kinds of help given to volunteer support groups that cooperate with the Park Service to serve visitors and better preserve well over 94.5 percent of the park that is already designated wilderness. Far more has been reinvested, the Park Service records indicate, to improve facilities, including environmental programs and to remove facilities and restore natural areas, than I would guess the total revenues that have contributed to profits.

If a symphony or football team is filling the concert hall or the stadium you don't fire the musicians or the team – which is not a completely fair analogy as the natural setting in Yosemite is the attraction. But as with the Inside Passage to Alaska or the Galapagos, the great majority of today's tourists want comfortable, convenient, and attractive services. For sure, however, Yosemite Valley must be further "naturalized." But how and how much is a legitimate subject of evaluation and final judgment that will not satisfy all users. As I see it in Yosemite, the performance of the Yosemite Park and Curry Company, and recognizing the need for changes and improvements, it would be very unwise to wash a well-behaved, healthy baby down the tub with the dirty bath water. By that I do not mean the baby doesn't need a spanking now and then, and while some yelling and getting its own way is expected, there is no questions that the parents are in charge.

The Yosemite National Park Centennial Celebration was a very happy birthday and a joyous event as it should have been. In spite of problems and challenges there is so much to celebrate. I am reminded of our country's bicentennial in 1976 as we emerged from Watergate, with the after-effects of the Vietnam War, high energy prices and interest rates, and a host of other unhappy events of the day. But, what a heritage we possess and how indebted we are to the founding fathers, our Constitution, and Bill of Rights for a way of life and beautiful country unequaled around the world. We all shared in and deserved to celebrate a very proud, fabulous bicentennial birthday party for the United States of America. For anyone to suggest that we should ignore similar values and not pay tribute to great individuals in the history of our national parks, and what Yosemite represents on its centennial, is an example of naive, inappreciative, and disrespectful historic myopia.

The setting for the official celebration for Yosemite National Park's 100th birthday party could not have been more wisely chosen by Superintendent Michael Finley. Sentinel Meadows has been one of the oldest sites for visitors in the valley. It was an early campsite for pioneer explorers who wanted a majestic view of Yosemite Falls and later selected as the site for the Sentinel Hotel, Yosemite's finest for many years, and still standing when I was working here in the late '30s. But, more to the point, the beautiful natural outdoor centennial celebration was on the ground where not too many years ago thousands of park visitors congregated, parked, and bought goods and services at the most commercial area in Yosemite until the Old Village was completely removed, except for the Community Church, which remains as the oldest structure in the valley. Today the natural soil and native plant material is being restored by the National Park Service with support from the National Park Foundation. It is too bad that today's generation of visitors could not have seen that rag-tail collection of a general store, movie theater, Degnan family bakery and restaurant, "greasy-spoon" hamburger joint, and two saloons in the early days. The garbage dump was just down the road and the nightly bear feed added to the traffic turmoil.

The Old Village straddled one of the two main roads into the valley on the south, and the old Yosemite Lodge across Sentinel Meadow straddled the other road on the north – both with accident-prone two-way traffic. Believe me, there was far worse congestion of cars and buses then on the few three-day summer weekend holidays than there is now with the one-way circle road system, and Government Center and shopping areas off the main thoroughfares. And most of all, I appreciate traffic improvements from the shuttle buses that the concessioner originally purchased and now operate for the Park Service with interpretation provided by Yosemite Park and Curry Company, staff under the supervision of National Park Service, that has replaced most of the sightseeing traffic by private automobiles and all cars above Camp Curry, eliminating all car traffic at the east end of the valley. And, the Old Village traffic jams were nothing compared to the gridlock I well remember at Mirror Lake and Happy Isles. I was a guide on the old White open-air buses for two summers and we were frequently locked in long lines of honking cars with frustrated visitors.

At the birthday ceremonies, Superintendent Finley acknowledged the support of many volunteer groups, organizations, and individuals that have been good friends to Yosemite to help celebrate the bicentennial. For its entire history – as with virtually all national park sites, today's National Park Service depends on a wide group of volunteer friends and business partners to provide the accommodation and eating facilities, interpretation, transportation, safety, medical, and postal services the public desires and expects. In my observations with many parks, I feel that the broad participation and top quality of this back-up team of people and organizations is at its highest level of dedication and efficiency in my memory and definitely at its very highest peak of concern and commitment for the goal of preserving Yosemite's natural beauty and wilderness experience for the visitor.

The volunteer support groups, advocacy organizations, business firms, and individuals that take a keen interest in and provide generally beneficial mix of support for the National Park Service in Yosemite make a long list. The Yosemite History Association, the Yosemite Institute, Yosemite Association and its very successful Yosemite Foundation and Fund, The Yosemite Research Center, along with the National Park Foundation, the National Park and Conservation Association, the Sierra Club, many corporations, and countless other groups and individuals make up a supportive family that is a remarkable concentration of concern, even if they are not always in harmony. And, they should not be expected to march in lockstep. Let's face it, Yosemite is on the national park's center stage and to stay in the play you have to be able to take the heat in the kitchen. What is crucial, as much as adequate congressional funding, is strong and farsighted leadership by the Department of Interior and the National Park Service.

The 1980 general management plan has had a great deal of publicity and I have examined a great volume of records dealing with the plan. I gave a good deal of assistance ten years ago, as did *Sunset* magazine, to encourage public response to the survey and other aspects of participation in the plan. I have studied the long list of accomplishments reflecting a really amazing record of projects completed or underway that were recommended – and, significantly, a tribute to great cooperation between the Park Service, concessioner, and the volunteer support groups.

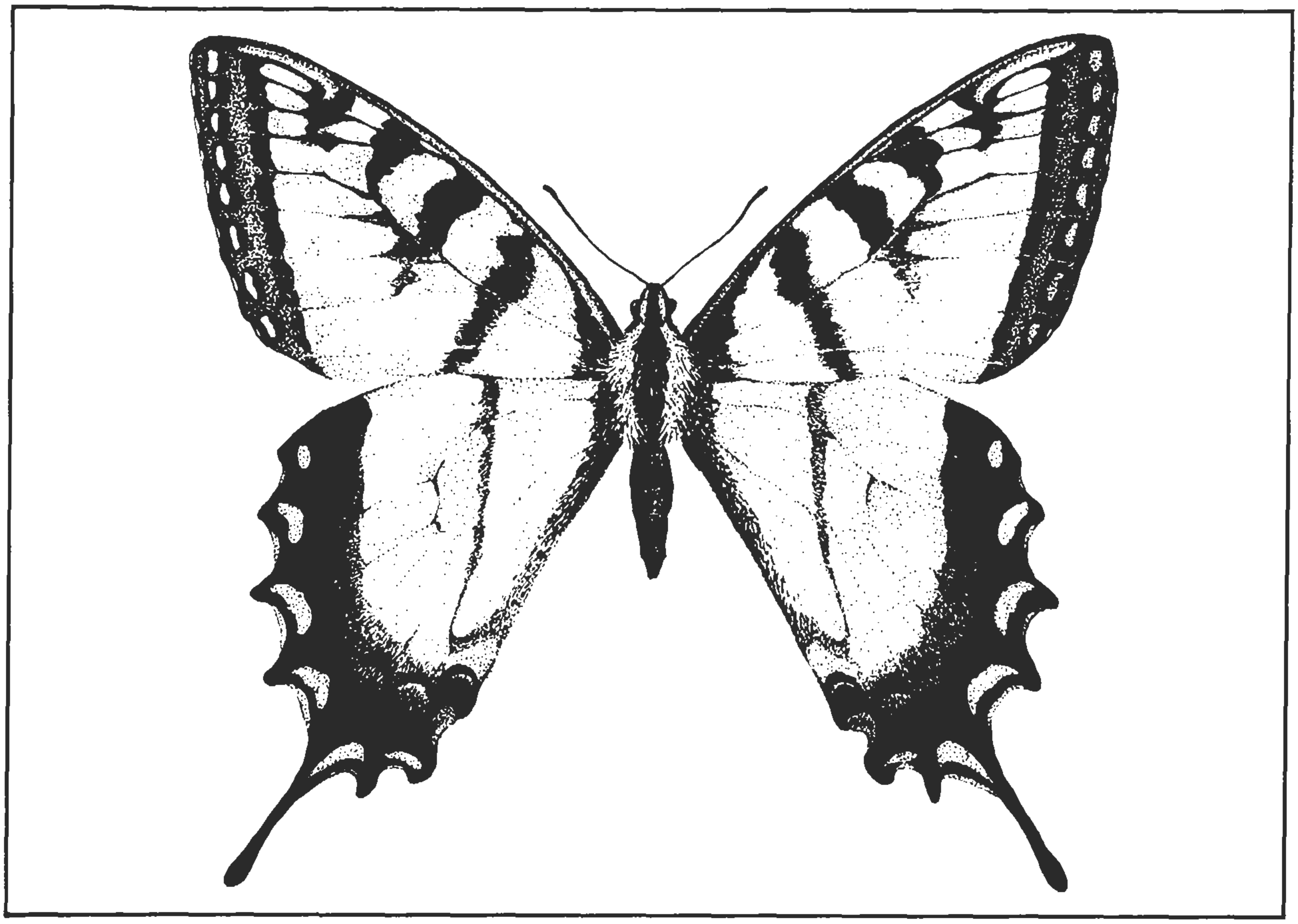
Yosemite's centennial and this symposium have the challenge to help shape the future direction of all natural areas including many of our national parks. Next year, by fortunate timing, another opportunity will be provided by the 75th anniversary of the National Park Service, that will be celebrated with an international symposium and year long program sponsored by the service together with the World Wildlife Fund, the Conservation Foundation, and Harvard University's John F. Kennedy School of Government. The National Parks and Conservation Association is also planning a conference. Both our second national park, Sequoia, and our third, Yosemite, played an important role in creating the National Park Service. In 1915 Stephen Mather, Secretary of the Interior Franklin Lane's assistant in charge of national parks, and his deputy Horace Albright, led what was called the "Mather Mountain Party" by the Giant Forest pack trip from Mineral King, Mount Whitney, to Lone Pine, and by auto to Bishop and Tioga Pass, where the party met a Sierra Club group to dedicate the Tioga Road for public use. It had been a private road and Mather bought it and gave it to the park. The guests were journalists, political office holders, and environmentalist who were subsequently helpful to getting the National Park Service approved the following year. Horace Albright later said that the 1915 mountain party was the most important single effort in Mather's campaign to create the National Park Service.

I began these remarks with a reference to President Lincoln. Perhaps his greatest words were spoken following the Battle of Gettysburg almost to the year before he signed the Yosemite Grant. I am going to use 1864 as a benchmark to paraphrase his first sentence: "Six score and six years ago, President Lincoln brought forth on this continent a new concept, conceived in war, and dedicated to the proposition that all men can best survive where peace and the wonders of nature thrive."

We must hope and pray that all Americans who appreciate, love, and can be educated to understand what Yosemite and all national parks mean to our country will work together to improve our natural areas that are essential to our national way of life that men and women have died for beginning with the Revolution "four score and seven years" before Lincoln spoke – and are, even now, prepared to fight for.

Thank you!

OPENING PLENARY



Tiger Swallowtail, *Papilio glaucus*
© 1985 Diana Dee Tyler

NATURAL AREAS ASSOCIATION

320 South Third Street
Rockford, Illinois 61104
815/964-6666

Dear Friends of Nature:

During June, 1864 the Civil War was raging into its third year, and it was also an election year. But on June 25, 1864, President Lincoln signed a bill that ceded the Yosemite Valley and the Mariposa Grove to the State of California to preserve it "for public use, resort and recreation ... inalienable for all time." Because the state did not wish to spend money on it, Yosemite did not flourish as a "state park" so it was deeded back to the federal government and on October 1, 1890 Yosemite became a national park.

Included in Yosemite National Park was Hetch Hetchy Valley, the twin sister of Yosemite Valley. But on December 19, 1913, President Wilson signed legislation granting San Francisco all rights to the Hetch Hetchy gorge and a dam was built destroying the Hetch Hetchy valley.

Management of the growing national park system was essentially neglected by the federal government until the National Park Service was created on August 25, 1916, 44 years after Yellowstone became the first national park.

I welcome you to the 17th Annual Natural Areas Conference with a brief history lesson to illustrate that there are three steps to preserving biodiversity: 1) inventory, 2) protection, and 3) management. Historically, steps 1 and 2 have been straightforward -- we find the "good stuff" and we protect it through acquisition, deed restriction, or proclamation. History has also shown that finding and buying natural areas is not enough to preserve them over the long run. The long term preservation of natural areas and biodiversity is dependent on <u>good government</u> and <u>good management</u>.

The annual meeting of the Natural Areas Association provides a forum for managers, administrators, volunteers, citizens and politicians to discuss the issues surrounding the past, present and future efforts to preserve what's left of our vanishing natural heritage. I encourage you to take every opportunity to interact with your fellow conferees, and on behalf of the Board of Directors of the Natural Areas Association I thank you for attending this year's conference.

I am,

Sincerely yours,

Francis M. Harty
President
Natural Areas Association

The mission of the Natural Areas Association is to advance the preservation of natural diversity.
The association works to inform, unite, and support persons engaged in identifying, protecting, managing, and studying natural areas and biological diversity.

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October 15, 1990

Mr. Jerry Edelbrock
Natural Areas/Yosemite
Centennial Symposium
Golden Gate Nat. Rec. Area
Fort Mason, Building 201
San Francisco, CA 94123

Dear Friends:

I'm disappointed I can't be with you today.

As many of you know, Yosemite National Park holds a special place in my heart. Over the years, my family and I have enjoyed the beauty and grandeur of the Park. We've hiked its trails, camped and explored, and experienced its splendor.

The spectacular beauty of Yosemite -- granite domes, ancient trees, pristine alpine areas, waterfalls, and wildlife -- make visiting this park a truly special and moving experience.

October 1st was Yosemite's 100th birthday. It was a time for great celebration. How fortunate we were that people such as John Muir had the wisdom and foresight to preserve this area.

It is fitting that your meeting is only a few miles from the John Muir Historic Site. With the strong support of many of you, I was able to move legislation through Congress to expand the Muir Site -- and in so doing, to pay further tribute to this great man and his legacy. We are in the final stages of securing funds to carry out this acquisition.

As we observe the Yosemite centennial, it is appropriate that we look back. But we should also look forward to the next 100 years.

We should renew and strengthen our commitment to work together to protect Yosemite and other special natural areas. We have a clear responsibility to insure that people 100 from today will be able to enjoy Yosemite and other natural areas much as John Muir did for us.

Your symposium, with its impressive gathering of dedicated people, is a good place to make this commitment and begin the process.

Your agenda is a difficult one. Like many units of our national parks system, Yosemite faces relentless pressure of increased visitation, continuing pollution problems, and other problems. It will provide you a challenging agenda for your symposium.

Even though I can't be with you today, you have my commitment that I will work with all of you to meet the challenges of the next 100 years.

Sincerely,

Geo Miller

George Miller
Member of Congress

United States Department of the Interior

NATIONAL PARK SERVICE

P.O. BOX 577

YOSEMITE NATIONAL PARK, CALIFORNIA 95389

IN REPLY REFER TO:

1890-1990

YOSEMITE NATIONAL PARK CENTENNIAL CELEBRATION

Dear Friends of Yosemite:

As we begin the second century of managing and protecting Yosemite National Park, it has become increasingly clear that preserving Yosemite or other natural areas in today's world requires a greater application of science, increased public awareness of threatened values, greater emphasis of systems and restoration ecology and a greater reliance on state and local governments for the needed protection.

We are pleased that on the occasion of Yosemite's 100th birthday the Natural Areas Association has joined with the National Park Service in support of this timely and worthwhile symposium. On behalf of the National Park Service, we hope you will share your knowledge and concerns with our staff members and other interested parties and help us formulate new applications and strategies for the future.

M.V. Finley

Michael V. Finley
Superintendent

Earth Island Institute

By FAX
From Continental Hotel Lausanne, Switzerland
October 15, 1990

Dear Yosemite Centennial Celebrants,

The opportunity to meet university presidents from various parts of the world in the French Alps, and to talk to them about environmental restoration and the International Green Circle, kept me from your celebration. It also allowed me to visit Zermatt, which has just celebrated the 125th anniversary of the first ascent of the Matterhorn, in 1864 — a year after Yosemite Valley and the Mariposa Grove were set aside and the national park idea was born (1864, well ahead of Yellowstone).

In Zermatt, heaven help them, there are 113 hotels, 3,000 flats and chalets (18,500 beds in all), 122 restaurants, 35 bars, 10 "dancings" (their term), 4 cinemas, 2 gambling places, 1 campground, 37 railways/cableways/funiculars/chairlifts/ski lifts, 2 ice rinks, 8 curling rooms, 175 ski intructors, 15 swimming pools, 20 saunas, 19 tennis courts, minigolf, 4 galleries, 2 churches, 4 doctors, 1 dentist, food stores, sport shops galore, and Radio Matterhorn. Horses are kept twelve minutes away. Private cars are kept out, and little electric cars haul tourists from the railroad station to their hotels, one and a half hours away from the mainline.

With all this, they handle <u>less than half</u> Yosemite's annual visitor count!

Please celebrate what the national park idea, the National Park Service, and Y. P. & C. Co. have done to spare Yosemite, keeping development and visitor impact miraculously low. A revived and carefully planned Yosemite Valley Railroad could spare Yosemite still more! Sign up for the revival! Let's hear it for rails, shuttles, bicycles, and footprints!

Persevere – and a million thanks!

Dave Brower
David R. Brower, Chairman

300 Broadway, Suite 28 • San Francisco, CA 94133-3312 • USA • Telephone: 415-788-3666 • FAX: 415-788-7324 *recycled paper*
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SETTING THE STAGE FOR THE FUTURE OF YOSEMITE AND OTHER NATURAL AREAS

John J. Reynolds[1]

I am John Reynolds, assistant director, National Park Service, Design and Construction. But I am here this morning as a park professional who has had one of the most exciting and challenging careers the National Park Service has had to offer. I have been fortunate to have had extensive and highly varied experiences related to planning and management of natural areas.

My experience ranges from Cape Cod to new area studies in Alaska, from the urban/wildland interface in the Santa Monica Mountains of Southern California to the largely unrecognized international North Cascades ecosystem, and from the Gulf of Mannar in southern India to Yosemite and its incomparable valley.

It is, of course, because of my previous involvement with Yosemite that I am so honored to be here today. After all, my wife was born in Yosemite Valley, and I met and married her there! I was also team captain for the existing long-range plan for the park.

My presentation is drawn from my experience, from observations of related activities in other places, and from correspondence with over 100 colleagues in the National Park Service, conservation and other organizations, and universities preparing for today.

Setting the stage for the future of a natural area requires knowing and understanding four factors:

1) Knowledge of the history – the roots – of the place – how it came to be, what has happened there, what it means to people who have visited it, and how it has changed or stayed the same.

2) Knowledge of what exists, what constitutes its important elements, where everything is, and what its condition is.

3) Knowledge of the sociopolitical context in which the area lies.

4) A vision for the future of the place – what it can be, and what it will take to get it there.

Let's look at each one of these factors.

Knowing the roots of a natural area is important. It sets the stage for future action. Knowing that Yosemite Valley was first protected as a landscape feature (not a part of a natural system) for its scenic beauty and for recreation helps us understand why it was developed as it was. Knowing that Frederick Law Olmsted drew an imaginary line across the valley within which to contain man-made features is essential to understanding the patterns that exist and the reluctance to letting them change much.

Knowing the roots is a necessity because it helps explain ingrained and strongly held attitudes (e.g. "My family has come to Camp Curry for three generations now – how can you think of changing it!?). These kinds of attitudes exist both within traditional constituencies and the agency itself.

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1. John J. Reynolds, Assistant Director, Design and Construction, Denver Service Center Operations, National Park Service, Denver, CO.

If change is to occur it is imperative to be able to consciously and rationally address these attitudes. If things are to stay the same, these roots can assist.

Consider some examples as illustration. Can it ever be possible to return Hetch Hetchy to its natural condition without addressing the unquestioned assumption by San Franciscans that in order for them to have clean, cheap drinking water a part of the function of Yosemite is to house a dam?

Would it be possible to preserve the great animal reserves of Africa without addressing the traditional cultural needs of the native people?

Will it ever be possible to preserve substantial parts of ecosystems in the American West when we have trained an entire culture that natural parks are for the "worthless" areas (as Alfred Runte says) and the rest of the land must be "productive," as in, say, a national forest, or in private lands?

Knowing what the roots are and the cultural biases and perceptions that result are essential to setting the stage for the future.

Generally speaking, as we set the stage for the future we don't much value knowing the past. This can be a dangerous insensitivity, resulting in unnecessary roadblocks and derailments. Perhaps ethnographers and historians can play a more enlightened role than they have or than we have asked in our usual hurry to "get it done."

Let's look at the second ingredient: knowing what we've got and what condition it is in.

There are few natural areas where we really know what we've got and can communicate about it. For most of their history, parks have been viewed as scenic or scientific wonders. The resources have been for the most part defined as single things (e.g. the Grand Canyon) or collections of things (such as Yellowstone's thermal features and its assemblage of "good" wildlife – obviously not including wolves!).

National forests were most importantly collections of "useful" resources, such as timber, huntable wildlife, or minerals.

Management philosophy in both was geared toward protecting and making available those things. And so the only resources one needs to know about were the ones that made up those things. Think about it – there was no vegetation map for Yosemite Valley when we began the park plan in 1975, but it sure was easy to list the "scenic wonders"!

As our cultural tradition defining what natural areas are has begun to change since the first Earth Day, the need to know what those areas are composed of has begun to increase. However, it has been slow to be realized. Even today integrated, sustainable efforts to inventory natural area resources are few and far between. Agency budgets and organization structures have not changed substantially to match the need.

Consider, as an example, the truth in what the National Fish and Wildlife Foundation says in their *1991 Federal Agency Needs Assessment* about the National Park Service:

> The . . . assessment of natural resource-related programs within the Park Service reveals a very weak program identity. . . . Historically, the service has emphasized visitor services and the related development to accommodate this use. . . . Only in recent years has concern for natural resource management been given some emphasis.

One of the few truly thorough programs for inventorying and monitoring the condition of a natural area in the national park system is at Channel Islands National Park, and it exists only because the superintendent got it written into law on his own! Only a handful of parks even yet have had research staffs for any meaningful length of time. Even at Yosemite, the commitment has been recent and is woefully small.

Setting the stage for the future of natural areas implies a much greater commitment to resource inventory and monitoring programs, and to research, than currently exists.

The third factor in setting the stage is "knowing the playing field." By this I refer to the socio/cultural/political factors that bear on a natural area.

I've already spoken of the need to know the roots, what the past has left us. That idea needs expansion to present and potential future conditions.

Questions like the following need to be asked and answered:

- What are the cultural norms regarding natural areas?
- What effects do changing public perceptions and concerns have?
- Who comes to your area and what do they expect when they get there?
- What will visitation be like in the future, and how will it affect the area?
- Where will support come from when we pass from "temporarily able bodied" backpackers to "physically challenged" seniors?
- What will we do when what used to be a fairly secluded beach visited entirely by suburban upper-middle-class whites changes to a weekend mecca for 20,000 Hispanic visitors?
- What happens when we realize that talking to all-white audiences like today isn't reaching the power structure anymore?
- What happens to Yosemite Valley when an aging population arriving mostly by bus merges with an overpopulated San Joaquin Valley emptying out into the Sierra every weekend?
- What happens to our traditional way of doing business?
- What happens to the natural areas we supposedly protect?

There are also economic consequences to consider and deal with – our hopes and dreams may not jibe with those on the board of supervisors in a rural, relatively poor county, for example.

On a recent assignment in India I heard and participated in a great deal of discussion about eco-tourism and its relationship to natural area preservation. The substance and tone stood in sharp contrast to the active recreation and wide-ranging services orientation and tradition of American parks. Where do these two concepts come together in the future?

And of course there are politics. In the context of setting the stage for the future of natural areas, politics must not be seen as a "dirty word." Our national political structure is our life blood (though each October it takes on a different cast) and must be recognized and dealt with forthrightly. Understanding the political setting and setting the future political stage are essential ingredients in preserving our national heritage.

Finally, the fourth factor: having a vision for the future. In my way of thinking, getting to and implementing a vision for the future is the crux of it all. In more common terms, the issue is the relationship between planning and management. It is here that it all comes together, the stage gets set, and the play goes on.

The relationship between planning and management is often not well understood. Managers want action – planning, like research, takes time. Even when it is understood, it and implementation of it are often nettlesome. It is this way because it implies – even requires – discipline by individual managers on issues that they may or may not have addressed in the decision-making stages themselves.

In our system of natural area management decision makers are likely to move every four to seven years. Yet reaching long-range management decisions and implementing them takes far, far longer. Natural area management also requires a high degree of management autonomy to be effective, yet ecosystem or regionally cooperative management requires continuity in management direction, sometimes difficult to achieve with changing managers.

Notable examples of both continuity and discontinuity of goal and implementation emphasis exist. The sustained unwavering direction in the Everglades stands in counterpoint to the seeming lack of consistency of purpose from actions over the past decade in Yosemite Valley.

Natural area management, no matter which agency or group of agencies is doing it, has changed dramatically during the span of my 25-year career. As Alfred Runte discusses in his book *National Parks and the American Experience*, we in the National Park Service are moving away from managing "things" (i.e., monumental landscape features and scenic or scientific objects) to managing the processes of which these "things" are a part. The change is slow, and painful. The rest of the land managing agencies, federal and state, are undergoing similar metamorphoses in natural area management philosophy.

It used to be a lot easier when we didn't understand ecology and global interdependence, and when concerns were bounded by neat and precise lines on a map. And during that time of blissful ignorance we, each of us, trained ourselves, our agencies, and the body politic to think that way.

Today we are beginning to know differently, but our institutions, planning processes, and management regimes haven't changed as quickly as the informed knowledge base and decision-making requirements have. Combine that with what is likely to happen to our global ecosystems and our social fabric in the not-distant future and the urgency of a new era in which reliable, widely held senses of purpose become all the more important.

The relationship between planning and management is just that – the establishment and carrying through of a rational, widely agreed upon sense of purpose and activities to achieve it.

Examination of a couple of examples of natural area management can illustrate this concept.

First, the Everglades, perhaps one of the most successful examples to date. Why the success?

Everglades has a relatively straightforward, easily expressible, widely agreed upon problem: There is not enough water; what there is comes and goes at the wrong times, and its quality is poor.

There are reliable, provable (i.e., based in good science) consequences to not "fixing" the problem.

There is widespread public support for fixing what is wrong.

There is a set of objectives, a plan if you will, that are commonly held by all of the major players involved.

There has been and continues to be consistent management commitment to implementation over time, even as individual managers come and go.

And certainly not least, there is a strong science base to decision making and the communication of effects.

Second, let's look at the Greater Yellowstone Area.

There is a strong and durable high-level commitment to a long-term cooperative management concept between the major land managers in the area, even though these agencies often have strongly differing mandates and competing interests.

The Yellowstone experiment possesses a complexity and variety of issues and interests and controversiality that is unprecedented.

The absolute necessity of commonly held objectives and long-range approaches combined with cooperative day-to-day decision making is also unprecedented. What it takes to make a concept like this work in practice in institutions that historically have been virtually autonomous is perhaps the Greater Yellowstone's greatest contribution to date.

Now, let's look at Yosemite.

The major issues to date in Yosemite have been different from those in the Everglades and Yellowstone. They have been primarily internal, mostly development issues, not broad ecosystem issues.

This difference should not suggest that they are less important in terms of planning or management or that they are any less related to critical relationships with organizations and individuals than are ecosystem issues. (Incidentally, ecosystem issues will grow dramatically in the near future in Yosemite).

The most controversial, expensive, and difficult issues revolve, obviously, around Yosemite Valley.

For our purposes today, the most instructive issue at Yosemite is the diminution of consistent support by constituent organizations and the interested public to implement a plan, which was widely agreed upon when it was approved.

This fracturing of support has been caused by erosion of confidence related to National Park Service inactivity and the perception of inactivity in implementing the highest priority parts of the plan in the minds of the public for more than a decade. In other words, the ability to act gained from the strength of a strongly held consensus has been largely dissipated due to lack of action. The direct tie between planning and management has been broken, at least in the eyes of the interested and influential public.

Such lack of significant action leads the supporting public to distrust the agency, which leads to reduced ability to act. Regardless of cause, this is the most instructive lesson of the Yosemite experience related to planning and management over the last decade and a half.

There are, as we are all aware, many more instructive examples around. They exist in all land management agencies as they struggle to incorporate new knowledge about how the natural environment really works, unprecedented demographic changes, and a tremendously increased public concern for the quality of the environment.

One factor related to this increase in public awareness and sophistication is that when this public sees an "environmental" agency acting less responsibly toward the environment than they know is possible they will withdraw their support from that agency. Obvious recent examples include the Forest Service (and even President Bush!) in the spotted owl issues and the Park Service in Yellowstone over hauling logs cut in a national forest through the park. The current controversies in Yosemite are fraught with the same issue. Agency administrators are often having a hard time dealing with the fragility of public trust toward what used to be "white hat" agencies. A strong ongoing relationship between planning and management is essential to maintenance of trust, and thereby support.

There are also some nontraditional examples that can be instructive. I'll illustrate with two examples.

The first is at the urban/wildland interface, such as the Angeles National Forest or the Santa Monica Mountains National Recreation Area in Southern California. I'll use the Santa Monicas since I'm more intimately familiar with it.

If you look at the area objectively, you'll realize that it is an important ecosystem remnant, still supporting populations of bobcat and mountain lions, more species of birds of prey than are found in the Birds of Prey Reserve in Idaho, and remnants of an oak woodland/chaparral ecosystem rapidly disappearing in the United States and found in only six regions of the world. It has areas of solitude as quiet as any place in Yosemite – some places more so, given the air routes over Yosemite. It is a fire-dependent ecosystem. And it is within the fabric of one of the most dynamic urban areas in the world.

The instructive opportunity in how to manage human-caused impact on natural systems is unparalleled, and largely unrecognized and unfulfilled. Clear enunciation of plans and objectives is essential, as are strong, trustful long-term relationships – literally with over 200 directly affected agencies and interest groups. Abilities and activities that are daily habit for effective management at places like this are ones that are becoming more and more essential in all of our natural areas, no matter how remote they might seem. The direct and visible relationship between planning and management is essential in places like this, or virtually all ability to manage effectively disappears.

The second example is America's Industrial Heritage project in southwestern Pennsylvania. It is a new breed of park effort, often called a cooperative park. A few years ago the local people asked the Park Service to help them determine what of their heritage was important to protect. The Park Service helped do that, but a more important concept emerged – the idea that all levels of government and private enterprise working together could do more that all working separately. They worked together to agree on common objectives, and individual responsibilities to achieve those objectives – in other words a plan, with management direction and commitment. The results are overwhelming. Perhaps most important are the mutual trust and respect that developed. Second was the acceptance of individual responsibility related to action and funding in the context of common goals. The on-the-ground and in-the-bank results are already impressive.

The applicability of this story to natural area management is in the approaches that are being used to decide on commonly held plans of action and implementation of those plans – i.e., planning and management.

Incidentally, the leader of the Park Service involvement in this project is an ex-Yosemite ranger!

It is time to begin summing up. What are the primary points that can be drawn from this discussion?

First, successful long-range management requires planning as an essential function. Planning is the vehicle through which all the parts are considered, related one to another, tested, and which then allows rational decisions to be made. All this means is deciding where to go before going. As an old proverb says, "If you don't know where you are going, you'll get to where you end up." Obviously, with no assurance that's where you wanted to go.

Second, planning – and management – of natural areas requires reliable, accurate data. This includes both resource and social data. A reliable data base means two important things – parties can talk to each other on equal, reliable terms, and testing of outcomes can be done consistently and with an improved degree of confidence in accuracy.

The ability for managers to effectively incorporate science into decision making is a rapidly increasing requirement. Decisions that reflect personal preference and may apparently be easily justified on environmental grounds need to be carefully based on solid evidence. If not, an increasingly aware and astute public will figure out the inconsistency, resulting in loss of confidence and ability to manage.

Third, planning, if accomplished properly, can help assure consistent public support. Long-term management is impossible without such support. Planning must be rational, deliberative, and inclusive for such support to be built.

Fourth, planning allows testing of hypotheses and alternative management actions, a process that is not only legally required but which leads to greater understanding by all parties of what is possible and what is important to each other. Such public testing is also essential to achieving long-term commitment.

Fifth, planning allows for the communication required to establish the commonly held goals that are the crux of the cooperative management activities required to effectively manage natural areas. Establishing these common, long-term goals is, at best, tricky business. It requires honest communication, respect among parties and of each other's mission, deliberation, and decisions that in one way or another benefit the whole. As stated in the draft *Vision for the Future, A Framework for Coordination in the Greater Yellowstone Area:* "The Greater Yellowstone Coordinating Committee does not impose decisions, but helps identify and resolve common management problems and communication gaps. It then sets up mechanisms for resolving those problems."

Sixth is the age-old dilemma of vision versus practicality. Both must be present, and planning allows that to happen. Management then knows where it is heading in the long run, and has the context in which to place daily actions and decisions. A warning: If there is vision without practical means to achieve the vision, then management has no ability to act, and sooner or later no matter how laudable the vision, public confidence will wane, resulting in even more decreased ability to manage. A good example is the day-use parking issue in Yosemite Valley.

Seventh, planning is a tool in public education, in three contexts: from the agency to the public, from the public to the agency, and between agencies. All are essential for long-term management of natural areas to occur effectively – especially now that we know that what we taught the public in the first three-quarters of a century of natural area management is dramatically different from what we know now! The results of excellence in communication are understanding, support, and enhanced ability to manage effectively.

Eighth, planning creates a legal framework in which management action can take place. This factor is becoming even more important in effective management of natural areas.

Last, planning is a continuous activity in managing natural areas. Communicating, testing alternatives, incorporating new knowledge, responding to new opportunities or limitations, educating, relating the parts to the whole – all are continuous activities in making management decisions. Plans are not static, decision making is a continuous process. Planning is an essential ingredient in that process. Planning is weaving the threads together.

The need for a common vision of the future, for management activity that is consistent through time, for solid scientifically based decision making, and for intelligent, open, honest involvement of constituents is now and will continue to be more important than has ever been the case in managing natural areas. Populations are growing, human needs and effects are affecting more and more of our country and world than ever before, and will continue to do so. What is happening at the urban/wildland interface yesterday and today will be happening in Yosemite and our traditional natural areas in an hour or so. In fact, it has already begun with air pollution and unprecedented visitor demand. New alliances even farther from home will have to be made, maintained, and nurtured. New expectations and relationships that recognize the interrelatedness of us all will have to be reached. For example, perhaps we'll have to say that there can be good water from the Sierras only if there is good air from the cities.

Let's close with a story, prepared by Dick Cunningham, regional chief of interpretation, Western Region, National Park Service. It projects the future.

The story is *The Saga of Joe Toolate.*

Joe was born in 1977 and raised in the San Francisco Bay area as a child. He visited Yosemite National Park many times with his family. He becomes a graduate of the University of California, Davis, with a degree in Biology in 1998.

In 1997, 1998, and 1999 Joe works as a seasonal ranger at Yosemite.

In the year 2000, as the new century starts, Joe gets his career-conditional permanent appointment at Golden Gate National Recreation Area in San Francisco. He is a GS-5 park ranger.

Three years prior to leaving Golden Gate he is promoted to GS-7. In 2006 he becomes a district ranger, GS-9 at Cape Hatteras National Seashore, and serves two years there.

In 2008 he is transferred and promoted to chief ranger, GS-11, Great Basin National Park, Nevada.

Three years later, in 2011, he transfers to become the superintendent of Coronado National Monument in Arizona.

After serving there for four years, in 2015 he transfers and is promoted to be the chief ranger, GS-12 at Lassen National Park in northern California.

He works there for four years and in 2020 he accepts a transfer and promotion to Great Smoky Mountains National Park as chief ranger, GS-13.

Four years later, in 2024, he transfers and is promoted to become the assistant superintendent at Everglades National Park.

After five years at the Everglades, in 2029, he transfers and is promoted to be the superintendent, GS-15, of Yosemite National Park, where he began his career as a seasonal years before. After five years as superintendent of Yosemite, he retires in 2033.

What happens during Joe's illustrious career?

By 2007, as Joe leaves Cape Hatteras, sea levels have risen sufficiently to impact coastal estuaries. Several marine species are dying off and being replaced by more southern warm-water species. Coral reefs are expanding northward from Florida and are expected to reach the Hatteras area in another 50 years.

By 2010, as Joe is about to leave Great Basin, the last remnant pockets of spruce and fir occur only at the highest elevations of Wheeler Peak, the highest point in the park. In another 20 years they will be gone.

By 2020 as Joe is arriving in the Great Smokies, sugar maples are already extinct in southern Appalachia and are no longer found in the Smokies. As a result, the fall colors are not nearly as spectacular, resulting in changing tourism patterns. Spruce and fir forests are disappearing and deciduous hardwoods are colonizing the former conifer stands.

By 2025, while Joe is at the Everglades, about half the park is covered by salt or brackish water due to an almost one foot rise in sea level. Fortunately, only the conservative predictions of sea-level rise have occurred by then. Winter feeding resources for wood storks and many other wading birds have been greatly altered. The extensive visitor facilities at Flamingo have been abandoned.

By 2030, Joe's second year back in Yosemite, the oak woodlands in the Sierra Nevada Mountains are being replaced by chaparral. The oaks are moving to higher elevations, replacing pine and fir forests. The range of the acorn woodpecker is expanding, but that of the northern goshawk and the blue grouse is rapidly contracting.

When Joe's grandchildren come to visit him just before his retirement in 2033, they go camping at Tuolumne Meadows. Joe explains to them that this place was once actually a meadow – he remembers it well because it was where he worked his first summer in Yosemite in 1997. He has to describe the old meadow in great and loving detail. That night they sleep amid the small but rapidly growing hardwood forest. There is no need for sleeping bags or down jackets (Joe still had an old one!) as the night was warm and balmy here at the 7,000-foot elevation.

By the time Joe Toolate ended his 32-year career, the parks were ecologically different than when he began. And the changes were only just beginning.

Think about Joe Toolate and the many men and women like him who will be leaders and implementers in taking us and our natural heritage into the future.

What can we do to help set the stage for them as our own time runs out? At the very least we can leave them a legacy that gives them a sense of the past, a record of what they've got, what its condition is, and what direction it is heading, a sense of the playing field, and a vision in which to work.

We will have to change some of our traditional ways of doing things; we will have to change budgetary priorities; we will have to change organizational structures. We will also have to change the expectations and perceptions of our publics. We will have to establish visions far beyond what we usually do today, and work together in an intensity and aura of cooperation seldom demonstrated so far.

The vision for Yosemite, especially its incomparable valley, is one of the most important challenges in setting the stage for the future of natural areas throughout our country, perhaps everywhere. Yosemite has always been the crucible of experimentation and evolution. Very often, what happens first in Yosemite becomes the eventual norm everywhere. This conference, then, is an important event in the history of Yosemite and natural areas.

We face a difficult but noble challenge. The stakes are unprecedented in human history. The results can contribute measurably to the health and welfare of us and our planet.

I truly believe with work, sensitivity, and cooperation the challenge can be met. And, if so, perhaps Joe won't be too late.

As the Umatilla Indians teach, "To care for the earth, learn to think seven generations ahead when deciding what to do in matters that affect the earth."

This, I think, is what is meant by "setting the stage for the future."

Thank you.

EVOLUTION OF NATIONAL PARKS IN THE SOVIET UNION

Dr. Andrei V. Rybakov[1]

Abstract

This paper will trace the development of the national park idea in the Soviet Union from its inception in the late 19th century to its realization in the early 1970s. Included is a discussion of the divergent and dominant development of a system of strict research nature reserves, zapovedniki, *and the contrasting role to be played by a system of national parks. Several of the newer national parks are described.*

INTRODUCTION

Ladies and gentlemen, first of all I would like to express my gratitude to organizers of the symposium and to the Student Conservation Association for the wonderful opportunity to attend the Centennial Symposium of Yosemite National Park.

I was a first-year university student when I learned about the oldest national parks in the United States. All of them are considered to be objects of world cultural and natural heritage. Creation of the parks became a marking point of the new "conservation" era for mankind.

It is not for nothing that Yosemite National Park is traditionally mentioned in this context. I am very pleased to convey our best greetings to the park celebrating its centenary.

My presence in this hall resulted from Soviet-American environmental cooperation. Our working group, "Conservation and Management of Natural and Cultural Heritage," was formed in 1985 by the Joint U.S.-Soviet Environmental Protection Commission. Co-chairmen of the group are, on the U.S. side, Deputy Director, National Park Service, and, on the Soviet side, Deputy Director, Goscomarchitektura.

There are several main areas of our group's activities:

- research and management of the heritage of Beringia;
- technical assistance to the U.S. side on Russian historical architecture in America;
- cooperation in park management;
- university student exchanges; and
- youth exchanges for national parks service work.

One of the most significant results of the cooperation became the agreement between our two countries on establishing a U.S.-Soviet international park in the Bering Sea region in 1991. The joint statement on the subject was endorsed by Presidents Bush and Gorbachev at the summit in Washington, DC, in June of this year.

I suggest that the agreement on the U.S.-Soviet international park is not only a very important contribution to a new kind of U.S.-Soviet relationship, but serves to strengthen the peace process in the Pacific region as well. It is also a good model for international environmental, scientific, and cultural cooperation. This initiative also seems to be a very promising way to eliminate territorial conflicts in the region.

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It should be observed that the idea of joint parks needs firm coordination of both countries' approach to parks theory and practice. I'd like to make my contribution useful from that perspective.

Thus, there are three subjects which I hope are of interest:

- the common history of Soviet national parks;
- the parks' modern status and main tendencies of development;
- the establishment of the Pereslavl Natural-Historical National Park.

COMMON HISTORY OF NATIONAL PARKS IN THE USSR

National parks' history in the USSR is a part of the complex history of all conservation areas of our country.

The main conservation system of the Soviet Union is comprised of *zapovedniki;* which are similar to wilderness in the USA, except that they are only for scientific research, and not for public recreation. The distinct element of zapovedniki is a complete ban on all kinds of human activities except scientific research on a limited scale. Normally a zapovednik is a territory of scientific or cultural interest as a unique landscape or, say, a habitat of species on the point of extinction.

I used to participate in research led by Dr. Vera Chizhova of the Moscow University. According to Dr. Chizhova, we can distinguish six periods in the development of the zapovedniki system.

The first period, which occurred near the end of the 19th and beginning of the 20th century, saw the establishment of the first zapovedniki. Most of them were similar to wildlife preserves. The most famous of them were as follows: Askania-Nova (a wildlife area in the wild steppe, established in 1898), Lagohedsky (established in 1912 in the Caucasus by a prominent Russian botanist, Mr. Kuznetsov), Kedrova Pyad (established in 1916 in the Far East), Barguzin (established in 1916 in the Trans-Baikal area), and Sayany Sable (established in 1915 in Siberia).

The second period started in 1921 with the new Soviet state decree on "Protection of Natural Monuments, Gardens, and Parks." The decree provided legal procedures for establishment and operation of new zapovedniki.

Institution of the State Committee on Environmental Protection in 1924-25 was followed by a rapid development of the zapovedniki system, which lasted 24 years. During that period, 83 sites were established, including half of the existing mountainous zapovedniki, two-thirds of the steppen ones, and half of the desert ones.

The rate of zapovedniki development was reduced two times during the course of the second period, in 1933-35, and during World War II. In 1933, the principle of "untouched nature" of zapovedniki was criticized at the first All Union Congress on Environmental Protection and substituted with the principle of "environmental and economic balance." Supporters of the new approach were not going to involve zapovedniki in something more destructive than research, but the "change of banners" slowed development of the zapovedniki system.

The third period (1948-56) was really dramatic for the whole system of conservation areas in the USSR. In 1951 alone, 49 zapovedniki (52 percent) were liquidated without any reasonable grounds. Seventeen of them have not been reestablished up to now because of serious losses in ecosystems during economic expansion, which followed the liquidations. At that time, zapovedniki were considered to be nothing but "paralyzed resources."

Such famous zapovedniki as Altai, Zhigulevsky, Central-Lesnoy, and Berezinsky were abolished. In Georgia alone as many as 13 of 15 zapovedniki were abolished.

The elimination of zapovedniki was criticized later, and during the fourth period, 1956-61, 25 of 49 of them were reestablished. At the same time establishment of new zapovedniki started again.

But unfortunately, in the fifth period, the idea of exploitation of conservation areas looked very inviting and seized politicians once more in 1961, when 14 zapovedniki were closed. Most of these were in Tadjikistan and the Trans-Caucasus.

The sixth (positive) period started in 1962-63. the rate of zapovedniki system development was equal to the second period: three to three and a half per year. But if before World War II mainly refuge-type zapovedniki were established, now preference was given to ecosystem-type zapovedniki, such as Zeya and Hyngan in the Far East and Pinega in the Arkhangelsk area.

Priority was given to zapovedniki in the extreme environments of deserts, semideserts, and Arctic tundra: Kara-Kul, Vrangel Island, Taimyr, and others.

Today, there are 165 zapovedniki in the USSR, covering 57 million acres.

The six periods mentioned above were defined by Dr. Chizhova in the 1970s. However, I am inclined to think that now we witness a new period of conservation area system development – the seventh one. There are two distinct elements of the period. One of them is an international tendency, establishment of biosphere reserves. The internationally accepted approach to this kind of conservation area is similar to the Soviet concept of zapovedniki. From my point of view, zapovedniki must become part of a global system of biosphere reserves.

The second element is of national importance: the emergence of the first Soviet national parks, which creates the necessity to distinguish them from the traditional zapovedniki.

National parks in Russia were mentioned for the first time in 1917 when a prominent geographer, V. Semyonov-Tyanshanski, submitted a report to the Environmental Protection Committee of the Russian Geographical Society. The report was entitled, "About the areas where zapovedniki like American national parks might be established." But this initiative was not supported because of the social upheaval which happened soon in the USSR.

In 1921, a similar idea was proposed in the previously mentioned state decree on Protection of Natural Monuments, Gardens, and Parks. But again, the idea did not receive any support.

A wide-scale public campaign in the 1960 and 1970s resulted in emergence of the first national parks in the USSR. It should be observed that by that time many existing zapovedniki had started practicing tourism and education programs, for example, in the Caucausian, Teberdinsky, Kronotsky, and Krasncyarskie Stolby zapovedniki. In fact, these zapovedniki had turned into national parks.

The first official-status national park was established in northern Estonia on June 1, 1972, Lahemaa National Park, covering approximately 162,500 acres. It was followed by establishment of Gaujas National Park, Latvia, in 1973, and by the Lithuanian National Park in 1974.

There are 20 national parks in the USSR today: four in the Baltic, four in the Caucasus, two in the Kappaty, three in Central Asia and Kazakhstan, four in Central Russia, one in the Urals, and two in the Baikal and Trans-Baikal area. Also, there was a governmental decision on establishment of a national park in Altai.

The amalgamation of bureaucratic structures of Russia and the Soviet Union which was taking place at that time resulted in a paradoxical situation: national parks were formed in all of the Soviet republics except in Russia.

This changed only in 1981 when the standard regulations on national parks in the USSR were adopted by the government. The regulations legalized the internationally accepted concept of what national parks should be like. Also the document included many compromises intended for successful adaptation of this new kind of conservation area.

Today, there are nine national parks in the Russian republic.

MODERN STATUS AND THE MAIN TENDENCIES OF DEVELOPMENT OF SOVIET NATIONAL PARKS

According to the standard regulations, national parks of the Soviet Union are established for "protection of natural systems of particular ecological, historical, or aesthetic value, and use of park's territories for recreational, research, cultural and public education activities."

Economic activities are not authorized unless they are compatible with ecological systems and cultural heritage of the territory. Traditional subsistence economies and relevant uses of resources are authorized in some particular areas.

Among the main tasks of national parks are the following:

- conservation of landscapes, water bodies, wildlife, historical and cultural heritage for recreation, public education, and research;
- organization of tourism and recreation;
- development and introduction of modern conservation methods and tactics for areas used for recreation.

Normally there are several zones in a national park that differ by conservation regime:

a. Zapovedniki or wilderness regime zones that are organized for natural systems maintenance and rehabilitation. No kind of human activities are authorized.
b. Controlled recreation zones that provide conditions for sightseeing tours.
c. Guests' areas where such facilities as hotels, motels, campgrounds, shops, etc., are established in their own zone.
d. Territories of other land-users whose activities are compatible with the national park's tasks.

Generally, Soviet national parks are administered by governmental bodies of the republics charged with environmental protection. But Russia is a strange exception again. In all other republics of the Soviet Union, parks are subordinate to committees for environmental protection, but Russian parks are subordinate to the Ministry of Forestry of the Russian Federation.

Administrative systems of parks themselves differ from one park to another. Say, authorized staff of the Lithuanian National Park is 10 persons, but for Karpaty National Park, it amounts to 600 persons. Lithuanian National Park's budget is 100,000 rubles (about $170,000) per year, but Karpaty National Park's budget reaches 700,000 rubles (about $1.2 million). Also the share of the budget provided by the republic is very different, ranging from 20 percent for Lahemaa, to 100 percent for Karpaty and Sevan National Parks.

As you can see, the Soviet national park history is very short, but full of events and its course is determined by the following crucial tendencies:

a. Increasing the touristic functions of the parks: the flow of tourists grows rapidly. For example, Gaujas National Park, Latvia, receives 1.5 million visitors per year.

b. A shift to mountainous regions: 11 of 20 national parks are located in such regions. It can be explained by a growing tourist interest in mountains.

c. National parks are near big settlements: Sevan National Park is a favorite recreation area of citizens of Yerevan, the Armenian capital. Tbilissi and Losiny Ostrov National Parks are partially located inside the two capitals of Tbilissi and Moscow respectively.

d. New parks often cover the territory of more than one republic, autonomous republic, or region: Examples of this include Mecshersky National Park, which is being planned now, and newly established Pereslavsky National Park.

e. The fifth tendency is a very peculiar one – the exclusive role of ladies in national park development. Today, the leading experts in the field are Dr. Natalia Zabelina, of the Institute of Environmental Protection, Moscow; Dr. Vera Chizhova, of the Moscow University; Dr Aya Melluma, of the State Committee for Environmental Protection of Latvia; and Mrs. Inese Grundule, superintendent of Gaujas National Park, Latvia. Contributions of the persons mentioned have made the existence of Soviet national parks a reality.

As mentioned, there are different approaches to national parks theory and practice, but some types of problems are common for the majority of the world's national parks. Let me mention some of them:

- land tenure problems;
- the relations with native people, especially if a park covers the territory of several administrative jurisdictions;
- the contradictions between conservation and development of natural resources.

In addition to this there are some problems specific to my country:

- the uncertain legal status of parks;
- the lack of adequately trained personnel;
- the absence of scientific methods of parks' projecting and planning;
- the lack of administrative experience.

As you can see we are far from being complacent with our national parks, which is why my colleagues from the Moscow University, the State Institute of Town Planning, and I proposed a new concept of national parks. We attempted to explore our ideas with Pereslavsky National Park. I would like to acquaint you with the results of this experiment a bit later, and now to say a few words about some specific details of the Soviet national parks development processes:

a. Usually creation of conservation areas in the USSR is a result of resources management crises. Designation of a conservation area (say, a national park) is considered to be a compromise between economic development and resources conservation. However, such an approach doesn't eliminate the roots of the crisis, doesn't prevent negative effects, and doesn't seem to be efficient.

b. There is an absence of a reliable legislative basis. The previously mentioned standard regulations cannot be regarded as such a basis. The only legal act particularly providing the necessary legal procedure is the Law of Property in the USSR. The law guarantees that the land of national parks is owned by the state. The right of full-scale land possession is now delegated to national parks.

c. Budget shortages create a widening range of problems for national parks.

d. Very often in establishing a national park, officials regard it as one tool of economic development of a region, as a source of subsistence for native people. As far as I know, national parks in the United States are never considered in that way.

PERESLAVL NATURAL-HISTORICAL NATIONAL PARK

Pereslavl National Park establishment experience is a good illustration of the situation described above.

In 1985, the public in Moscow and Yaroslavl managed to draw the attention of the government to the dramatic situation in the complex of natural and cultural resources of Pereslavl, a part of the well-known "Golden Ring" of Russia.

The main natural feature of the area is Plescheevo Lake, a unique natural monument of central Russia. The lake is surrounded by pine and oak woods, and the area contains several endemic species.

The town of Pereslavl-Zalessky was founded in the 10th century by Russian Prince Yuri Dolgoruki – the famous founder of Moscow. The history of Peresalvl is a part of Russian history – it is associated with such names as Alexander Nevski, Peter the Great, Ivan the Terrible, Fyodor Shalyapin and others.

There are six monasteries and convents in Pereslavl. The most ancient one – Nikitsky Monastery – was built in the 11-12th centuries.

Pereslavl is considered as a cradle of the Russian Navy: Peter the Great built his first boat in a small shipyard on Plescheevo Lake about 300 years ago. One of his original ships from this fleet is still preserved there today.

However, the cultural and natural resources of Pereslavl were deteriorating because of inefficient management, poor protection measures, and budget shortages.

Numerous and continuous discussions, which followed the campaign of 1985, resulted in the decision to establish a national park. The total area of the park was determined to be 55,000 acres. In addition, 75,000 acres were given the status of the park's conservation area, in the upper watershed of the main river feeding the lake.

Pereslavl National Park is an extremely sophisticated object. It includes Plescheevo Lake, the town of Pereslavl-Zalessky (population 40,000), several small villages, and 15,000 acres of farming areas.

A very important detail – Pereslavl National Park is the first natural-cultural park in the USSR. For the first time in the country, two different kinds of conservation activities meet in the same territory and are considered of equal importance.

However, troubles began from the very beginning. There is no particular official institution in the USSR charged with national parks matters. For Pereslavl, it played a crucial role – different resources were administered by different agencies. Under such circumstances the park could not be efficiently operated as a single system.

A group of scientists (including myself) proposed an unusual concept of administration. We opposed subordination of the park to several agencies that had nothing to do with each other. The only way to keep Pereslavl park in one piece was to make it an independent department of the regional executive committee. Eventually, Pereslavl was organized in the way proposed in our concept.

The rules of the national park are being developed now. Some positions included into the rules seem to be important for us:

a. The national park should be the only owner of the land to effect management of resources on behalf of the government. The land purchases must be financed by the state budget.

b. Several self-finance bodies may be organic to the park's structure – a research center, an information center, tourist facilities, etc.

I have to make a comment here. Very often U.S. national parks experts, sharing their experience with us, insist that parks should become models of resource management. But I wonder what kind of model a national park can serve if it cannot provide self-sufficiency? So, if human civilization follows the resources management approach of parks, it will disintegrate.

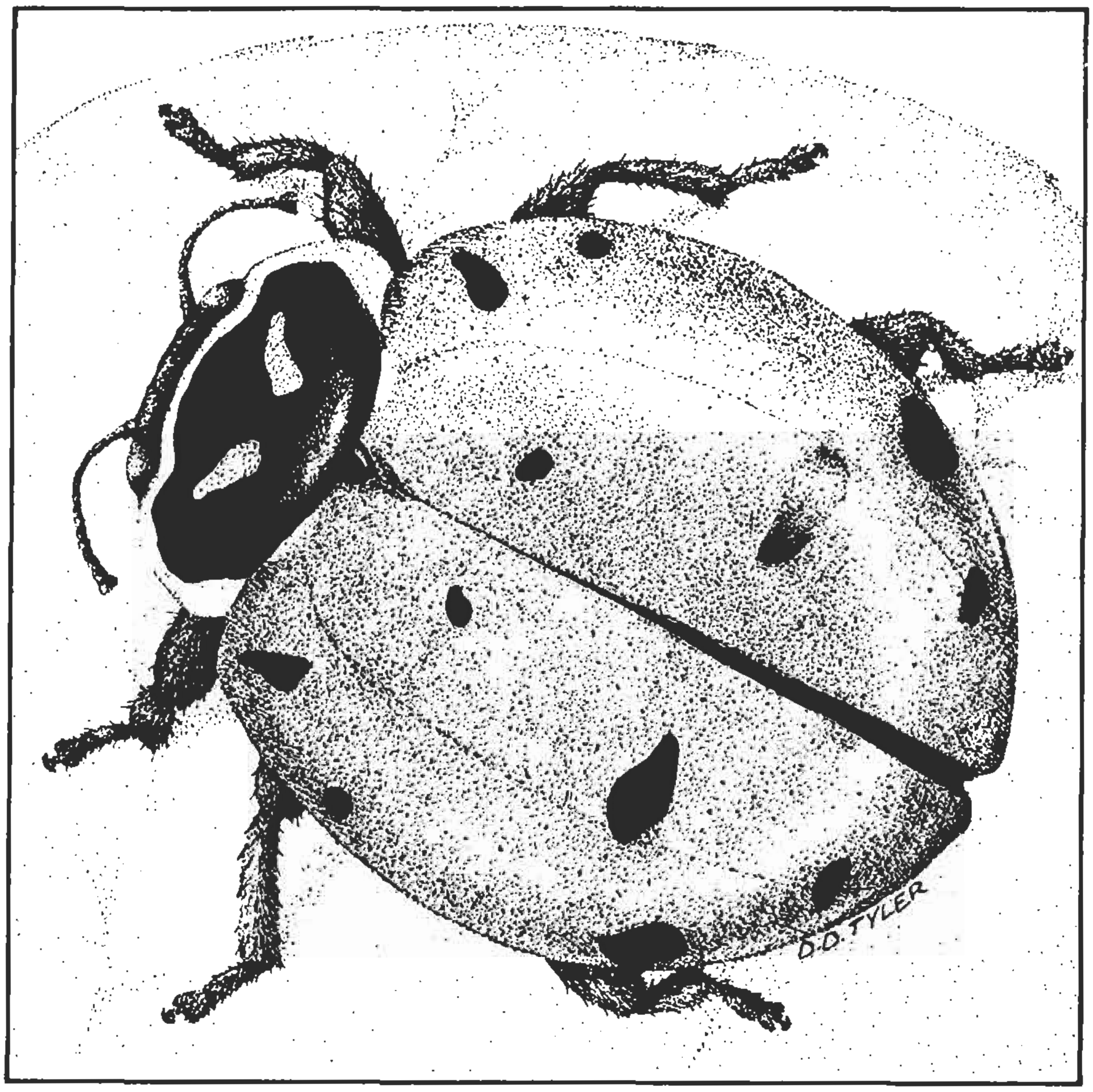
We suppose that parks do not display models of resources management, but accomplish a social order. This order is given by the state via a particular agency (the National Park Service in the United States). The volume and quality of results depend on finance. Thus, financing of parks is a part of the domestic political process.

c. Protection of heritage is hardly possible without raising the living standards of the people, and first of all, of native people. For that purpose, a private firm named Park Service was established in Pereslavl – to provide the necessary information, research, commercial consulting, and other services to Pereslavl National Park. The firm will participate in different park economic projects, develop programs, and attract investments.

And now on behalf of Pereslavl National Park and Park Service, let me invite all of you to visit Pereslavl and to get acquainted with one of the nicest places in Russia.

Thank you for your attention.

REFLECTIONS OF THE PAST



Ladybird Beetle
Illustration by Diana Dee Tyler, © 1978 by Dell Publishing Co., Inc.

FREDERICK LAW OLMSTED'S CONCEPT FOR YOSEMITE

Charles E. Beveridge[1]

Abstract

As chairman of the first Yosemite commission in 1864-65, Frederick Law Olmsted set forth a cogent analysis of the scenery of the reservation and a well-conceived plan for its management. His later work at Niagara Falls in the 1880s also provides important insights into his approach to the management of scenic reservations. Taken together, his writings on Yosemite and Niagara contain a valuable set of principles for managing areas set aside for public use because of their scenic qualities.

INTRODUCTION

In his report of 1865 on the management of the Yosemite grant, Frederick Law Olmsted addressed two basic issues that have remained important to this day. First, he identified the special character of the area ceded to the state of California by the federal government, consisting of the Yosemite Valley and the Mariposa Big Tree Grove. Second, he defined a policy of construction and management that would make the grant accessible to the public without compromising the special qualities for which it had been set aside. In his report of 1865 and additional commentary in 1890, further illuminated by his work at the Niagara Reservation in the 1880s, Olmsted set forth a series of principles for the treatment of scenic reservations that are still relevant to current debate about the future of Yosemite.

BODY

Assessment of the Qualities of the Yosemite Grant

In his report of 1865, Olmsted noted the scientific significance of the grant – the geological interest of Yosemite Valley, the great variety of plants found within the boundaries of the grant, and the impressive age and size of the giant sequoias in the Big Tree Grove. After his first visit to the grove, he wrote of the trees, "You feel that they are distinguished strangers [who] have come down to us from another world" (Olmsted, *Papers*, 137). However, it was the scenic qualities of Yosemite that he found most impressive.

Olmsted based his analysis of the Yosemite grant on the extended visits, totaling more than a month, that he made there with his family in the summer of 1864. What he came to value most in the valley was not the individual features of towering rocks and great cascades, but rather the total effect of the scenery. "I felt the charm of the Yosemite much more at the end of a week than at the end of a day," he reported," much more after six weeks when the cascades were nearly dry, than after one week; and when . . . I was going out, I said, 'I have not yet half taken it in'" (Olmsted 1890). In his most comprehensive statement on the question, he declared:

> There are falls of water elsewhere finer, there are more stupendous rocks, more beetling cliffs, there are more awful chasms, there may be as beautiful streams, as

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1. Charles E. Beveridge, series editor of the papers of Frederick Law Olmsted, Department of History, American University, Washington, DC.

> lovely meadows, there are larger trees. It is in no scene or scenes the charm consists, but in the miles of scenery where cliffs of awful height and rocks of vast magnitude and of varied and exquisite coloring, are banked and fringed and draped and shadowed by the tender foliage of noble and lovely trees and bushes, reflected from the most placid pools, and associated with the most tranquil meadows, the most playful streams, and every variety of soft and peaceful pastoral beauty.
>
> This union of the deepest sublimity with the deepest beauty of nature, not in one feature or another, not in one part or one scene or another, not any landscape that can be framed by itself, but all around and wherever the visitor goes, constitutes the Yosemite the greatest glory of nature. (Olmsted, *Papers*, 500)

Management Policies for Yosemite

It was the experience of constantly changing views of the towering sides of the chasm interspersed with glimpses of the Merced River and the meadows along its banks that produced the special charm of the valley. One implication of this for management of the reservation was that the character of the vegetation must be retained. This meant preservation of what Olmsted described as "a series of magnificent trees, and meadows of the most varied, luxuriant and exquisite herbage," where "flowering shrubs of sweet fragrance and balmy herbs" abounded (Olmsted, *Papers*, 490, 491).

Olmsted had an opportunity to elaborate on management of the trees many years later, during a controversy over practices of the Yosemite commission that coincided with creation of the national park. One of the leading critics of the commission was Robert Underwood Johnson, editor of the *Century* magazine, who in 1889 asked Olmsted to comment on a proposed plan for the systematic removal of all the young trees in the valley. In keeping with the views he had expressed twenty-five years before, Olmsted responded that such a program "would be equivalent to the destruction, in course of time, of just what the State of California stands voluntarily pledged to *'hold, inalienably, for all time.'*" He added that "a proper system of management for woods valued because of their effect in scenery, must be directed as much to the renewal and perpetuation of the constituent trees as to anything else; a common rule being that for every hundred or thousand trees going off, there shall be a hundred or a thousand more, advancing to take their place" (Olmsted 1890) .

Olmsted felt that such replenishment of trees was particularly important in Yosemite Valley because of the constant ravages of fire. Instead, over time, control of fire and lowering of the water level of the Merced by blasting the moraine across the lower end of the valley had the opposite result: the groves of trees in the valley became increasingly dense, losing the open quality that is so evident in the photographs of Carleton Watkins and his contemporaries. (For a revealing comparison, see the photographs of the valley taken from Glacier Point in 1867 and 1974 in Ted Orland's *Man & Yosemite: A Photographer's View of the Early Years*, pages 44 and 45.) Management decisions in the valley created a condition the reverse of the one anticipated by Olmsted, but with a result that was also detrimental to the scenic experience that he felt it was the duty of the park's managers to preserve.

Olmsted's primary concern was to ensure preservation of the scenery of Yosemite "because the millions who are hereafter to benefit by the Act have the largest interest in it, and the largest interest should be first and most strenuously guarded" (Olmsted, *Papers*, 508). His second concern was to provide public access to the Yosemite grant. What he most desired was construction of an approach road from the town of Mariposa. Such a road would shorten from four days to one the journey to the valley from the head of river navigation at Stockton. Until such a road was built, he believed, Yosemite would be visited primarily by persons of leisure and wealth. The route he proposed to Clarence King, whom he engaged to survey it, would follow the most scenic course. Between Mariposa and Clark's Camp

(Wawona) it would run briefly along the path of Route 49, then turn eastward and, near present-day Darrah, ascend the ridge on the western edge of Devil's Gulch, pass Devil's Peak, and descend to Wawona with views into the valley of the south fork of the Merced (Olmsted, *Papers*, 270).

While the 40-mile approach road from Mariposa to the valley was planned for rapid travel and scenic views, the problem of building roads and other facilities in the valley itself raised more difficult issues. Here, in the heart of the scenic reservation, the problem was to provide access to the scenery while intruding as little as possible upon it. Olmsted set forth his basic planning principle as follows:

> The first point to be kept in mind then is the preservation and maintenance as exactly as is possible of the natural scenery; the restriction, that is to say, within the narrowest limits consistent with the necessary accommodation of visitors, of all artificial constructions and the prevention of all constructions markedly inharmonious with the scenery or which would unnecessarily obscure, distort or detract from the dignity of the scenery. (Olmsted, *Papers*, 506)

Accordingly, he proposed to construct a one-way carriage route that would run for the most part along the edge of the valley, crossing the meadows occasionally to reach important scenic views. To make the carriageway as little intrusive on the scenery as possible, he proposed that it be simply a "double trail" consisting of two parallel tracks for carriage wheels. Occasional turnouts would enable carriages to pass each other. In addition, Olmsted proposed to construct a few footpaths for access to views inaccessible to carriages. The total length of the paths and carriage trail was to be 30 miles. He also sought construction of five cabins whose tenants would rent camping equipment and provide free resting places for visitors.

Olmsted remained convinced that such careful restriction of "artificialities" was necessary in Yosemite. By the time that he spoke out again concerning Yosemite in 1890, he had recently completed a comprehensive report on the Niagara Reservation in New York State, created after a fifteen-year campaign in which he had played a leading role. In the pamphlet he published on the Yosemite question at that time, he quoted with special emphasis the following statement from his Niagara report of 1887:

> *Having regard to the enjoyment of natural scenery, and considering that the means of making this enjoyment available to large numbers will unavoidably lessen the extent and value of the primary elements of natural scenery, nothing of an artificial character should be allowed a place on the property, no matter how valuable it might be under other circumstances, and no matter at how little cost it may be had, the presence of which can be avoided consistently with the provision of necessary conditions for making the enjoyment of the natural scenery available.* (Olmsted 1890)

The Example of Niagara

The Niagara Reservation is a valuable demonstration of Olmsted's approach to planning scenic reservations, amplifying as it does many of the ideas he set forth in his Yosemite report of 1865. Olmsted's general approach to Niagara was similar in many ways to his approach to Yosemite two decades previously. Although dealing with an area noted for its awesome visual impact and spectacular vistas, he emphasized the importance of immersion in the whole scenic effect of the area. The falls themselves were only one part of a total landscape experience that he appreciated there; other important elements were the lush and varied vegetation bordering the falls and the dramatic rapids on either side of Goat Island, which separated the American and Canadian falls. Added to these elements were the special qualities of light and mist found just above the falls. Comparing the American reservation with its counterpart on the Ontario side of the gorge, he declared that

> it has incomparably greater beauty of a kind depending on refinement and delicacy, and subtle qualities of natural elements of scenery . . . incomparably greater beauty of a kind in which the nearness to the eye of illumined spray and mist and fleeting waters, and of the intricate disposition of leaves, with infinitely varied play of light and shadow, refractions and reflections, and much else that is undefinable in conditions of water, air and foliage, are important parts. (Olmsted and Vaux 1887, 21)

As with Yosemite, it was the combination of awesome and subtle elements of scenery that produced a unique experience. Also, as with Yosemite, the botanical richness of the place gave additional reason for preserving it: Olmsted observed that the eminent botanists Sir Joseph Hooker and Asa Gray agreed that there was greater variety of vegetation on Goat Island than at any single place in this country east of the Sierra Nevada (Olmsted 1880, 29).

Already in the first years of the Niagara Reservation its planners faced the problem of heavy and concentrated visitor use that would come only later to Yosemite. Trains carrying tourists to Niagara arrived only a few times a day, and many visitors went directly to the reservation, crowding one another for views of the falls. There was ample viewing space on the Canadian side, but only three limited areas in the American reservation permitted even oblique views of those dramatic features. The need for controlling such crowds of visitors while still preserving the opportunity for "contemplativeness" challenged Olmsted from the start. As he began his work he declared that "if not the most difficult problem in landscape architecture to do justice to, it is the most serious – the furthest above shop work – that the world has yet had" (Olmsted 1879).

One part of Olmsted's solution was to place a visitor center at the entrance to the reservation on Prospect Point, near the American Falls. This was a wooded area with no view of the falls, and was the closest point in the reservation to the railroad station. There the visitors could pause and refresh themselves after their long train ride and use picnic facilities to be placed in the grove. The superintendent's office and sheds for wagons, horses, and tools would also be in this area. This concentration of buildings meant that in the rest of the reservation only a few absolutely necessary structures would be erected: a small shelter at a boat landing above the American rapids and two large shelters on Goat Island, as well as the entrance-building for the already existing inclined railroad on Prospect Point that led to the base of the falls, and the entrance to a new elevator on Goat Island leading to the Cave of the Winds. Olmsted proposed the latter in order to get rid of the unsightly wooden stairway already constructed down the cliff at that point.

No other structures or decorative features should be put on Goat Island, Olmsted insisted:

> Suppose, for instance, that a costly object of art, like that of the Statue of Liberty, should be tendered to the State on condition that it should be set up on Goat Island, the precept to which our argument has tended would oblige a declension of the gift as surely as it would the refusal of an offer to stock the Island with poison ivy or with wolves or bears. (Olmsted and Vaux 1887, 16)

While Olmsted wished to provide only the minimum number of buildings in the scenic part of the reservation, he realized that it would be necessary to engage in extensive construction of walks and drives. In part these would serve to structure the visitors' experience of the scenery, but an equally important function was to protect the vegetation from harm. "I have seen a great vigorous oak tree killed in two years by the trampling of the ground over its roots," he observed. "No turf in our summer climate will remain in any spot where a hundred footsteps have fallen in rapid succession" (Olmsted

1883). The resulting system of ways for Goat Island, the heart of the reservation, is shown most clearly in figure 4. So long as visitors kept to the trails and drives, several thousand persons could be on the reservation at one time without causing damage. As an additional precaution, the plan provided large carriage concourses on the Goat Island bluffs overlooking the American and Canadian falls, with viewing areas for pedestrians at lower levels.

A final significant aspect of the Niagara Reservation is that implementation of the plan that Olmsted and his ex-partner Calvert Vaux drew up required removal of a large number of commercial and industrial buildings that had grown up along the American rapids. In 1879, Olmsted had collaborated on a study of Niagara with James T. Gardner, director of the New York State Survey, whom he had engaged fifteen years earlier to do the official survey of the Yosemite reservation. Their report graphically described the way that extraneous structures had spoiled the beauty of the American rapids:

> In place of the pebbly shore, the graceful ferns and trailing vines of former days, one now sees a blank stone wall with sewer-like openings through which tail races discharge; some timber crib work bearing in capitals a foot high the inscription, "Parker's Hair Balsam;" then further up stream, more walls and wing dams. Overlooking this disfigured river brink stands an unsightly rank of buildings in all stages of preservation and decay; small "hotels," mills, carpenter shops, stables, "bazaars," ice-houses, laundries with clothes hanging out to dry, bath houses, large, glaring white hotels, and an indescribable assortment of miscellaneous rookeries, fences, and patent medicine signs, which add an element of ruin and confusion to the impression of solid ugliness given by the better class of buildings. (Gardner 1880, 20-21)

While Goat Island was still pristine, removal of the multifarious structures on the mainland was a necessary part of creating the Niagara Reservation. Recovery of lost scenic elements was as much a part of the process of creating the reservation as was preservation of existing scenery.

CONCLUSION

Olmsted's writings on Yosemite and Niagara contain many concepts that are still relevant today and should be re-examined as Yosemite National Park observes its centennial year and plans for the future. The importance of keeping artificial elements in the park to an absolute minimum is even greater now than it was in the 1860s, and transportation technology of today makes it possible to remove from the valley even some features like hotels that were necessary a century ago. Olmsted's writings are also valuable because they spell out in detail the means by which adequate access to scenery can be provided in such a way that visitors do not destroy what they have come to enjoy. The principles of design for paths, drives, and structures that he set forth in his reports on scenic reservations deserve serious consideration from those responsible for the future management of Yosemite.

REFERENCES

Gardner, J. T. 1880. "Report of the Director," New York (State). State Survey, *Special Report . . . on the Preservation of the Scenery at Niagara Falls, and Fourth Annual Report on the Triangulation of the State. For the Year 1879.* Albany: C. Van Benthuysen & Sons.

Olmsted, F. L. 1879. Olmsted, F. L., to James T. Gardner, October 3, 1879, James Terry Gardner Papers, New York State Library, Albany, NY.

Olmsted, F. L. 1880. "Notes by Mr. Olmsted," New York (State). State Survey, *Special Report . . . on the Preservation of the Scenery at Niagara Falls, and Fourth Annual Report on the Triangulation of the State. For the Year 1879.* Albany: C. Van Benthuysen & Sons.

Olmsted, F. L. 1883. Olmsted, F. L., to Howard Potter, March 16, 1883, Frederick Law Olmsted Papers, Manuscript Division, Library of Congress, Washington, DC.

Olmsted, F. L. 1890. *Governmental Preservation of Natural Scenery.* Brookline, MA: [no publisher]

Olmsted, F. L. 1990. *The Papers of Frederick Law Olmsted.* Vol. 5, *The California Frontier, 1863-1865.* Edited by Victoria Post Ranney. Baltimore, MD: Johns Hopkins University Press.

Olmsted, F. L., and Vaux, C. 1887. *General Plan for the Improvement of the Niagara Reservation.* New York: Martin B. Brown.

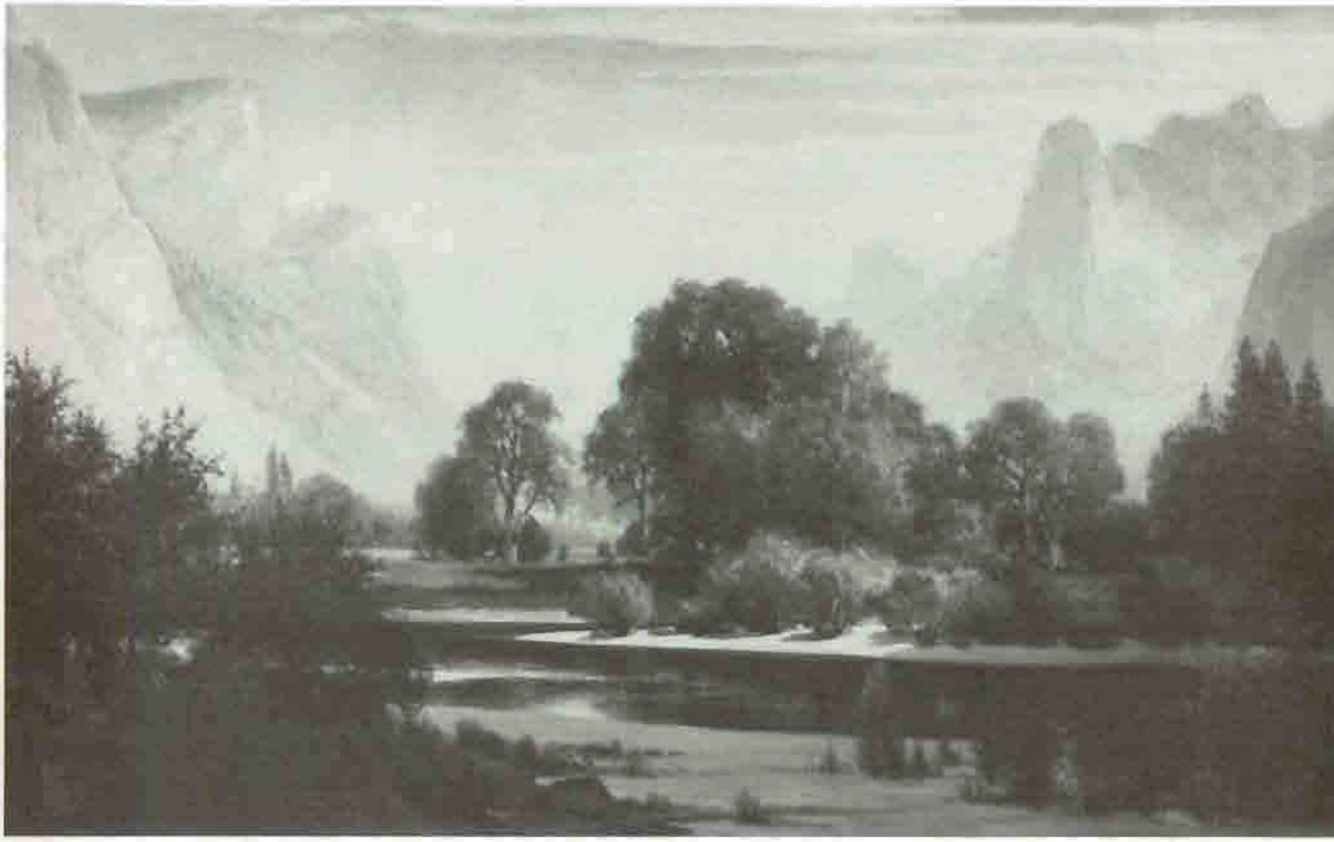

Figure 1. *Yosemite Valley, 1867*. Painting by Thomas Hill. Courtesy of Paul and Alice Elcano.

Figure 2. Yosemite Valley Meadow and Bridal Veil Fall. *Tohono, the Bridal Veil*. Photograph by Carleton Watkins. Courtesy of Gray Herbarium Library, Harvard University.

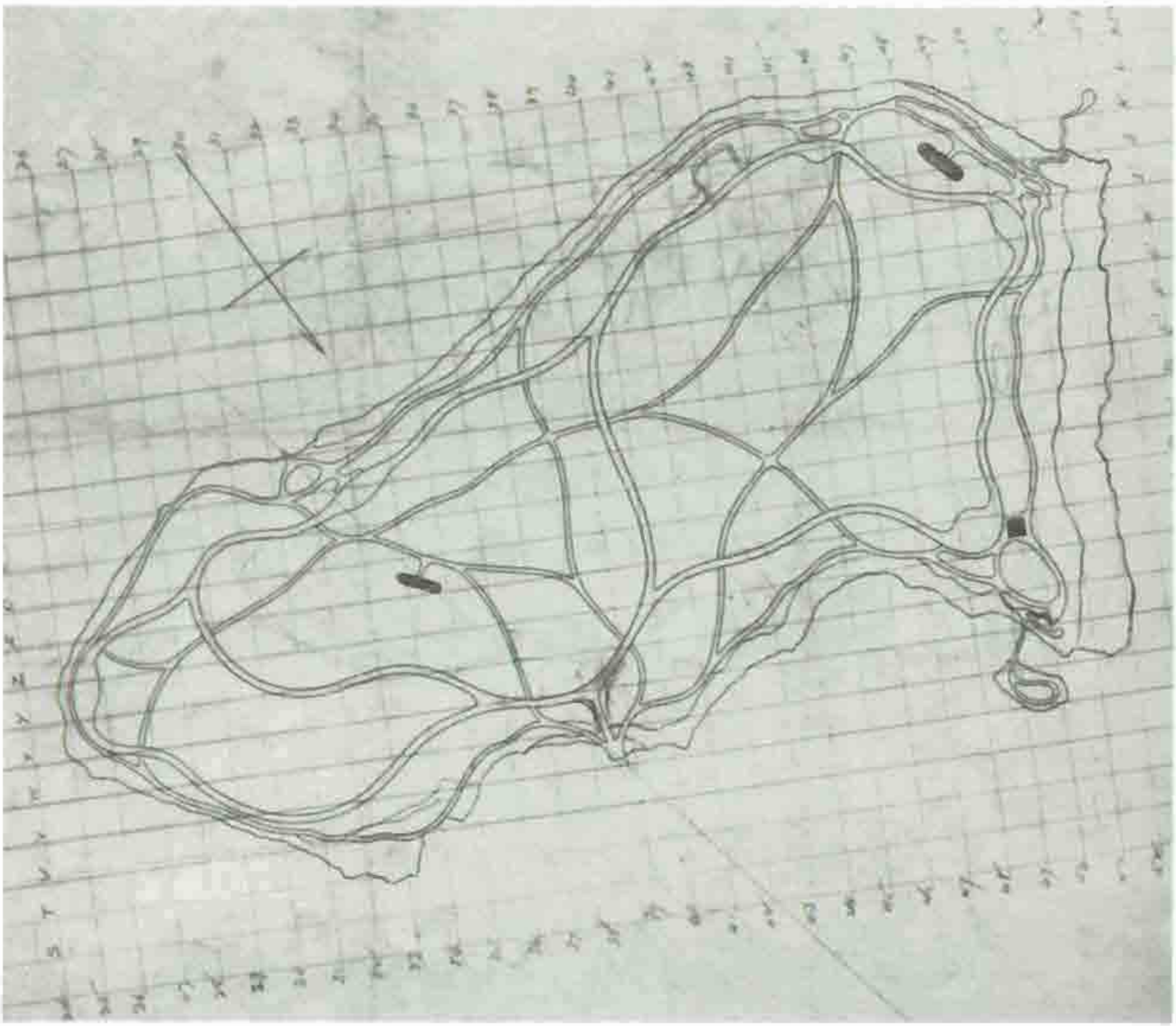

Figure. 4. Study for System of Walks and Drives on Goat Island, c. 1886. Plan by Frederick Law Olmsted and Calvert Vaux. Courtesy of Manuscript Division, Library of Congress.

FREDERICK LAW OLMSTED AND THE FIRST YOSEMITE COMMISSION

Victoria Post Ranney[1]

Abstract

As head of the first Yosemite Commission in 1864 and 1865, Frederick Law Olmsted, American's foremost landscape architect, laid out a rationale for government protection of wilderness scenery. Recognizing both Yosemite's scientific value as a natural area and the aesthetic value of its scenery, he expected scientists and artists to work together in protecting it.

INTRODUCTION

The significant part that Frederick Law Olmsted, American's greatest landscape architect, played in the history of Yosemite, the country's first scenic wilderness reserve, has long been forgotten by all but a few. But the public and private papers that Olmsted wrote while he was living on the California frontier from 1863 to 1865 – recently published by the Johns Hopkins University Press – reveal Olmsted's important role as head of the first Yosemite Commission. *The Papers of Frederick Law Olmsted, Volume Five: The California Frontier, 1863-1865* also makes available for our time the suppressed first report of the Yosemite Commission, in which Olmsted lays out his far-sighted guidelines for the management and preservation of Yosemite.

BODY

In 1864, Congress deeded the Yosemite Valley and the Mariposa Big Tree Grove to the state of California "for public use, resort and recreation" in perpetuity. These two tracts, the 11-square-mile nucleus of today's 1,200-square-mile Yosemite National Park, were to be managed by a commission that the governor of California would appoint. By fortunate coincidence, Frederick Law Olmsted, co-designer and architect-in-chief of New York's Central Park, had recently moved to California to manage the gold mines of the Mariposa Estate, 20 miles down the Merced River from the Yosemite Valley. The governor seized this opportunity and appointed Olmsted head of the first Yosemite Commission.

Olmsted readily accepted, for he was fascinated by the Yosemite region, and during his first year in California had lost no time in exploring it. Although the valley and the grove had only been discovered by white men in the 1850s and were still inaccessible to wagons in the summer of 1864, Olmsted took his wife and four children there by pack train. They camped for several weeks with Galen Clark at what is now Wawona, frequently visiting the giant sequoias in the Mariposa Big Tree Grove. From a second base camp opposite Yosemite Falls they explored Yosemite Valley. Later Olmsted and his twelve-year-old son, John Charles, rode up into the high Sierra on the eastern border of the present park. Olmsted soon concluded that Yosemite was "far the noblest public park, or pleasure ground in the world." (Olmsted, F. L., to Olmsted, J., July 5, 1865)

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1. Victoria Post Ranney, associate editor of *The Papers of Frederick Law Olmsted*, Vol. 5, *The California Frontier, 1863-1865*, published by the John Hopkins University Press, 1990.

Not only did Olmsted know Yosemite scenery firsthand; he also appreciated the political significance of the grant. It was the first time anywhere that a government had set aside an area of scenic beauty for preservation and enjoyment by the people. Olmsted pointed out in his report that in Great Britain there were "more than one thousand private parks and notable grounds devoted to luxury and recreation." These parks were open only to their owners and their families or guests – less than one in 6,000 of the population. In Britain "the enjoyment of the choicest natural scenes in the country" was a monopoly of "a very few, very rich people."

Olmsted argued that the government of a democracy, by contrast, had a responsibility to establish great public grounds for the free enjoyment of the people. Unless government withholds such areas from the grasp of individuals, he wrote, "all places favorable in scenery to the recreation of the mind and body will be closed against the great body of the people." (Olmsted, *Papers*, 504-505) Scenic preservation was thus a duty of the democratic state.

Olmsted also saw the potential of Yosemite as "a field of study for science and art." (Olmsted, *Papers*, 510) Perhaps this was because he visited Yosemite in the company of some of the most eminent American artists and scientists of his day. He appreciated their careful training, and expected that their different visions of the place would safeguard the grant in complementary ways. He valued the advice of scientists and artists enough to recommend that they comprise half the members of the Yosemite Commission.

Most of the scientists he encountered in Yosemite were members of the California Geological Survey, which in the 1860s was mapping much of the state and the Sierra Nevada for the first time. Head of the survey's field party in 1864 (see fig. 1) was William Brewer, a Yale-trained botanist who escorted Olmsted and his son on their expedition into the high Sierra. Clarence King, who later founded the U.S. Geological Survey, and his friend James Terry Gardner, were 23-year-old volunteers with the California Geological Survey that year. Olmsted hired the two young men to survey the boundaries of the Yosemite grant.

Another scientist Olmsted met in the valley was the veteran botanist, John Torrey, who had written many of the botanical reports for the railroad surveys and other early expeditions to the American West. Professor Torrey noted that because there was nearly a mile difference in elevation within the Yosemite grant, "there is a larger number of species of plants within the district than can probably be found with in a similar space anywhere else on the continent." He found about three hundred species "on a few acres of meadow land," and reported that "within sight of the trail usually followed by visitors, at least six hundred may be observed, most of them being small and delicate flowering plants." (Olmsted, *Papers*, 493)

Advised by these scientists, Olmsted realized the need for preservation. Having seen the Yosemite grant in nearly pristine presettlement condition, he called it "a museum of natural science." He warned that "without care many of the species of plants now flourishing on it will be lost and many interesting objects defaced or obscured, if not destroyed." To illustrate the danger he told how large numbers of the native plants of the Atlantic states had almost wholly disappeared, having been choked out by weeds of foreign origin. He gave examples of trees and rocks already defaced. He also worried about fires set by Indians. He lived in California during two years of record drought, and like his white contemporaries, failed to understand the part that fire plays in the growth of giant sequoias. He even proposed to run a road all the way around the Mariposa Big Tree Grove that could serve as a firebreak. (Olmsted, *Papers*, 506-509)

Although Olmsted recognized the Yosemite Valley and the Mariposa Big Tree Grove were important as natural areas, his primary concern was for their scenery.

To understand and protect the scenery, Olmsted felt the commission needed the advice of landscape artists. The painter Albert Bierstadt and the landscape photographer Carleton E. Watkins had first alerted the nation to Yosemite and advanced the movement to preserve it. After Olmsted reached California, he met Watkins, bought his prints, and loaned him mules to transport his bulky equipment. The painters Thomas Hill and Virgil Williams were also working in Yosemite (see fig. 2). In 1865, on behalf of the Yosemite Commission, Olmsted asked these three young artists, already engaged in the study of landscape, to advise the commission on how to manage its scenic trust. (Olmsted, *Papers*, 433)

As a measure of the importance that Olmsted accorded both scientist and artists in Yosemite, he proposed that the governor of California appoint either "students of Natural Science or Landscape Artists" to four of the eight positions on the Yosemite Commission. He suggested that, "Yosemite being a trust from the whole nation," the positions should not be limited to citizens of California, and that those from out of state should be offered a travel allowance to induce them to come.

CONCLUSION

When Olmsted proposed to identify and safeguard the essential features of Yosemite by weighting the commission with artists and scientists, he assumed that the two disciplines would complement each other. Today those interested in scenic landscape and ecology often seem to follow divergent paths, hardly communicating. We would do well to follow Olmsted's lead, and join forces in ongoing ways to protect our scenic wilderness reserves.

REFERENCES

Olmsted, Frederick Law. *The Papers of Frederick Law Olmsted*. Series edited by Charles E. Beveridge. Vol. 5, *The California Frontier, 1863-1865*. Edited by Victoria Post Ranney. Baltimore, MD: Johns Hopkin University Press, 1990.

Olmsted, Frederick Law. Letter to John Olmsted, July 5, 1865.

Olmsted, Frederick Law. Papers. Manuscript Division, Library of Congress, Washington, DC.

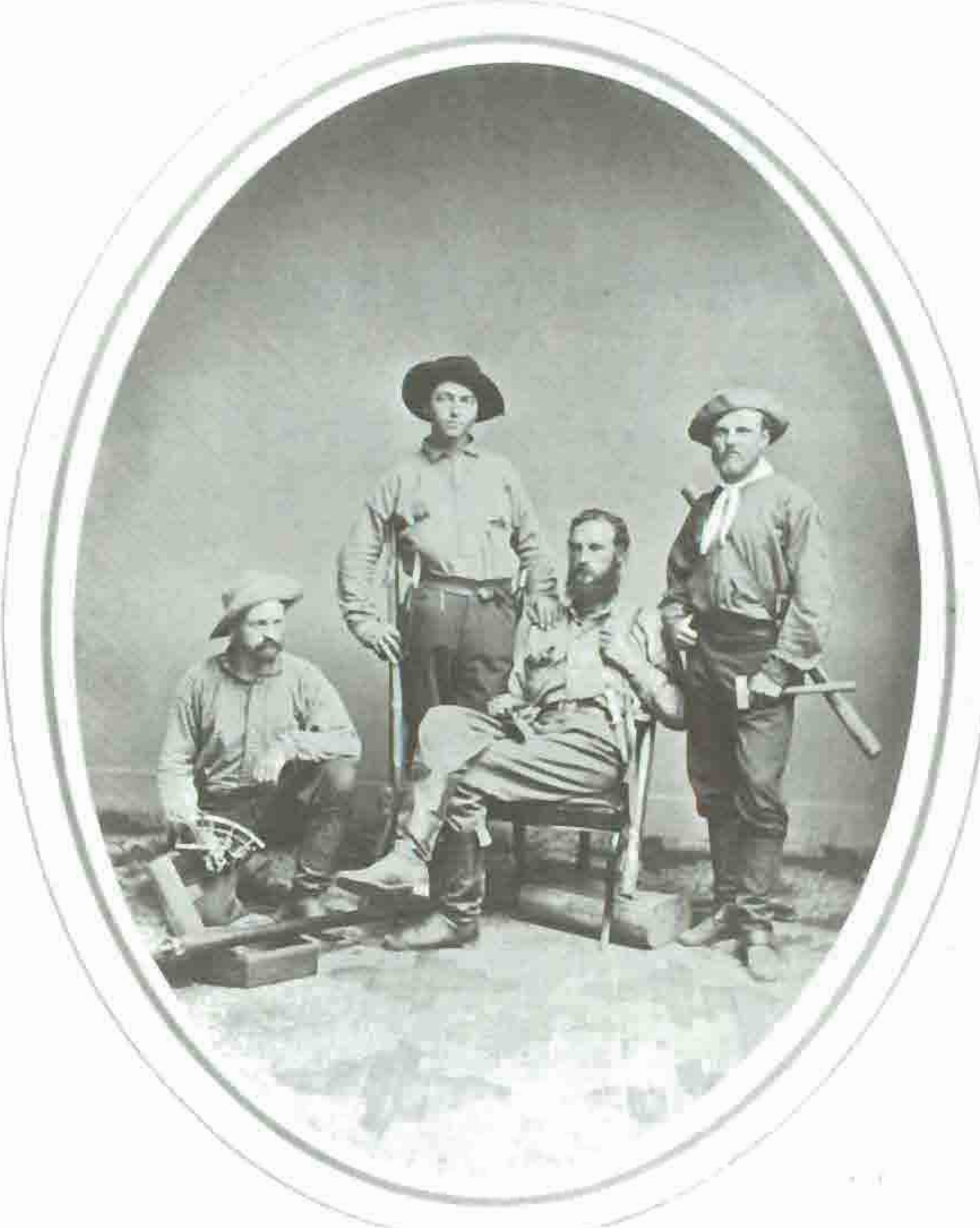

Figure 1. California Geological Survey Field Party, 1864. Left to right: James Terry Gardner, Richard D. Cotter, William H. Brewer, Clarence King
Courtesy of the Bancroft Library, University of California, Berkeley, CA

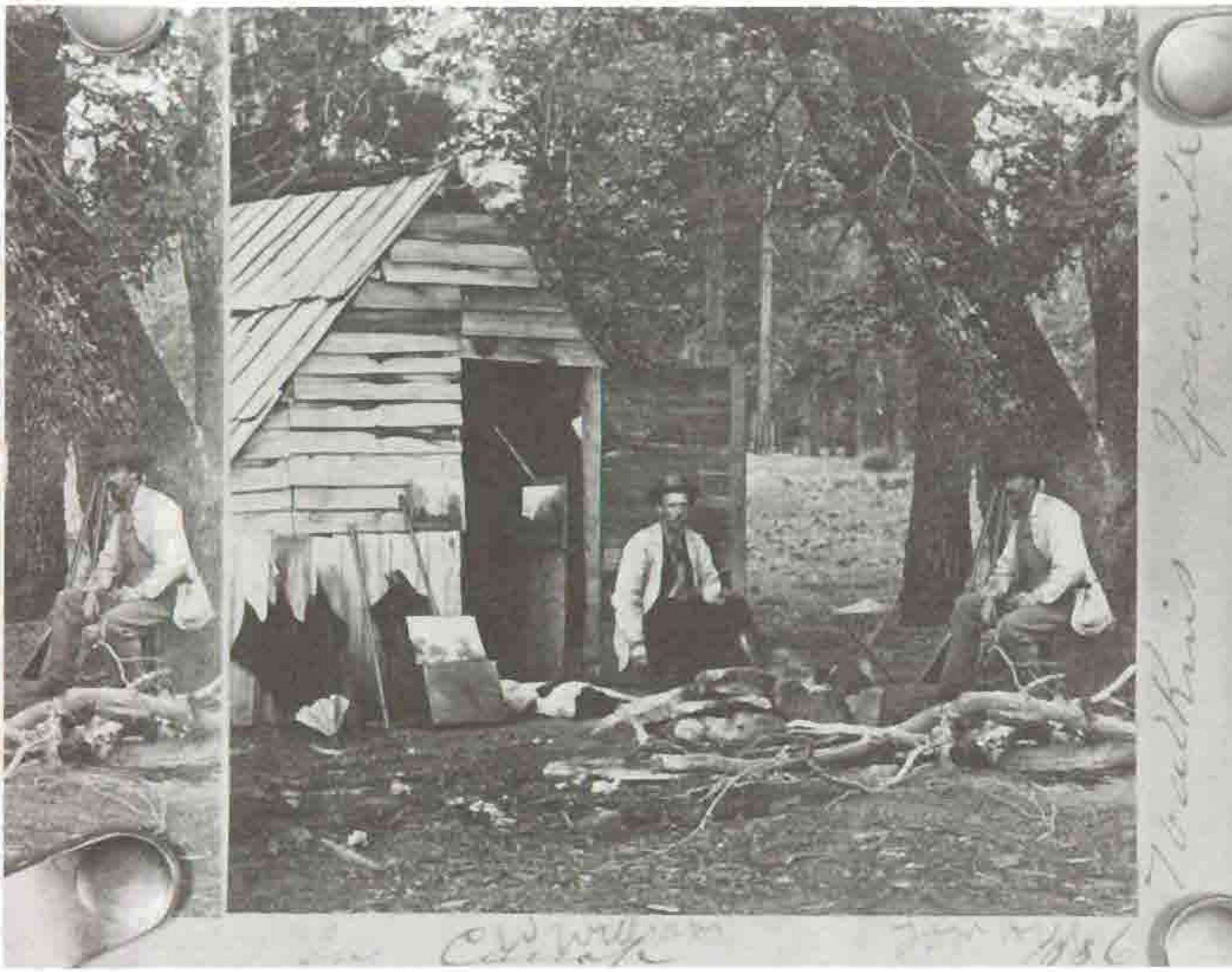

Figure 2. Virgil Williams and Thomas Hill in Yosemite Valley, Summer 1865. Stereograph by Carleton E. Watkins
Courtesy of the Research Library and Museum, Yosemite National Park, CA

THE INTIMATE ASSOCIATION OF THE SIERRA CLUB AND YOSEMITE NATIONAL PARK

Edgar Wayburn, M.D.[1]

As the historian Holway Jones has pointed out, from its very beginning the Sierra Club has had an intimate relationship with Yosemite National Park. The early club was inspired by Yosemite. The goal of Yosemite's health, well-being, and preservation took precedence over all the club's early objectives. The club continued as champion of the park. It should be noted that it was occasionally rebuffed and was at times the victim of unrequited love. For throughout this love story between a magnificent park and its devoted friend there has run the persistent theme of the basic conflicts in values between utilitarian and preservationist breeds of conservationists. This conflict involved Yosemite first as a "state park" under state commissioners who began their difficult task in high purpose, headed by Frederick Law Olmsted – and second as a national, federally administered park, plagued by enemies from within and without who did not understand why pioneer privileges of settlement and use could not persist unhampered.

Although the Sierra Club was actually founded two years after the passage of the act establishing Yosemite National Park in 1890, early leaders of the club had been intensely interested in Yosemite for many years before that time. The idea that lands should be set aside and preserved solely for their esthetic qualities and enduring value as places for natural recreation of body and soul found translation in organized programs of exploration and fellowship in the mid-19th century. And Yosemite Valley was a principal focus for this idea. As historian Alfred Runte puts it: "Yosemite became a substitute for American history . . . it was the icon of American culture." The 27 men who signed the articles of incorporation of the Sierra Club in mid-1892 were certainly influenced by this concept. And the club they founded was the first organization on the Pacific coast formed specifically to a perceived public need to guard against private degradation of such a scenic land as Yosemite.

Of course, there was also another important factor in the close relationship of Yosemite and the Sierra Club. That was John Muir, the man who was at home in the wilds of swamp, forest and mountain, the man who would never become reconciled to man's "ugly commercialism." It was Muir who engendered enthusiasm for the preservation of natural wonders for their own sake. It was Muir's impassioned pen that made people see the value of preserving parts of the natural world from civilization's domination. It was also Muir who early on grasped – and then publicized – the important scientific aspect of scenic areas; his study of the glaciation as the shaping factor of Yosemite turned on its ear the earlier work of Josiah Whitney when it was published in 1871 in the *New York Tribune*. The Sierra Club, in fact, had its birth in the growing scientific and scenic curiosity about Yosemite and what Muir named the "Range of Light;" it was again Muir's gifted pen that was awakening public consciousness. That pen needed a national forum to be successful and in 1889 Muir met Robert Underwood Johnson, associate editor of *Century* magazine. Underwood opened the pages of *Century* to Muir and it was primarily through the influence of Underwood and Muir that the government set aside a large area as a "federal forest reserve" surrounding the state-controlled Yosemite Valley, thus launching Yosemite National Park. The new Sierra Club immediately found itself in the active role of Yosemite's defender. With the park less than two years old, the club directors learned that Congressman Anthony Caminetti from Jackson, California, had introduced a bill to eliminate a large number of townships on its west, north, and east sides. Representative Otis of Kansas then introduced another bill that went even further and would have repealed the entire 1890 reservation. The club responded and these bills failed to pass. And the club went on to challenge all attempts to reduce the

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size of Yosemite during the 1890s. But there was a growing effort to confirm private property rights in the park and between 1898 and 1904 no fewer than nine bills were introduced into Congress to return lands from the national park to private ownership and the public domain. When, in 1903, Secretary of the Interior Hitchcock appointed the Chittenden Commission to review the boundaries of Yosemite, Sierra Club leaders – John Muir, Joseph LeConte, and William Colby – made strong pro-park recommendations to the commission, but failed to make their case. The act of February 7, 1905, redrew the map of Yosemite National Park establishing roughly the present boundary. While this boundary decision added 113 square miles to the park, it lost the park 542 square miles, and the club accepted the new boundary with only the greatest reluctance. But it had learned a lesson in the field of political strategy and had established its voice on the conservation scene. And even as it suffered a loss it won an important victory the same year: in 1905, it succeeded – after thirteen years of determined effort – in seeing through the recession of the state-controlled Yosemite Valley to federal control. A year later, in 1906, both the state of California and the federal government approved the club's proposal and a whole Yosemite National Park was established.

The club continued in its supporting role of Yosemite during the next few years, even as it mounted an all-out battle to save Hetch Hetchy Valley from being dammed and flooded. In 1912, in a little recognized transaction, the Sierra Club purchased a 160-acre homestead in the heart of Tuolumne Meadows to prevent its exploitation. The club held this property, known as Soda Springs, until 1968 when it transferred it to the national park. It is now, of course, an integral part of Tuolumne Meadows.

The most disastrous defeat in the Sierra Club's early efforts to protect Yosemite National Park occurred in 1913, culminating the club's many years of struggle to protect the integrity of the Yosemite National Park. That year, President Woodrow Wilson signed the Raker Act that led to the construction of O'Shaughnessy Dam and the Hetch Hetchy Reservoir on the Tuolumne River's Hetch Hetchy Valley. As we all know, this was a superlative scenic area – a smaller Yosemite Valley, if you will – and it was drowned.

However disastrous the Hetch Hetchy campaign of the club's had been, it proved to have its positive aspects. It proved to the Sierra Club and to preservationists generally that there was need for greater coordination in gaining protection for our national parks; there was need for *national* as well as *local* organization and initiative. Even more importantly, the influence of the club in conservation matters was firmly established by the Hetch Hetchy controversy. This was to lead to advisory and policy-making roles for the club in future decisions involving public lands. (This role was particularly accented under the leadership of the first director of the National Park Service, Stephen P. Mather, who had joined the Sierra Club in 1904 and remained a member all his life.) The Hetch Hetchy campaign also confirmed the ideas on which the club was founded.

Whether the loss of Hetch Hetchy played a major role in the founding of the National Park Service in 1916 may be moot. But both Mather and Horace Albright, the original leaders of the National Park Service, foresaw a need for bringing the public to the national parks – particularly to Yosemite. This was following an idea enunciated by John Muir long before. In fact, the Sierra Club had in its original statement of purpose "to render accessible" the Sierra Nevada. The best way to get public support for the national parks was to make it easy for people to get to them and to be comfortable once they were there. This was in line with the dual charge of the National Park Service to provide for the public enjoyment of the parks in such manner as to leave them unimpaired for the enjoyment of future generations. From this evolved the twin objectives of ready accessibility and the development of comfortable accommodations. The Sierra Club of the 1920s and 1930s supported the park service in its implementation of these objectives. It gave its blessing first to the railroad to El Portal and then to its supplanting by the three main highways to the park from the west. Of course, these roads increased visitation to the park as access was much easier. Ready access from the east was another matter. Although an old mining road bisected the Sierra over the heights of Tioga, it was an adventure to drive it, particularly some 21 miles of it that were only wide enough for one car. In 1934, the Sierra Club approved the improvement of the Tioga Road. Much of the modernization and realignment of the road was completed before World War II. But in the 1950s, when the automobile-oriented Mission 66 was launched by the National Park Service, the Sierra Club became the most vigorous opponent of blasting the walls of Merced Canyon and opening up Tioga Pass. The road was reconstructed over the vigorous objections of the Sierra Club. (In the early 1960s, as it happened, it fell my lot to represent the club at the ceremony marking the completion of the "improved" road from Crane Flat over Tioga Pass. That road not only defaced some of the most magnificent parts of Yosemite National Park but it opened up the high country in a way that had been inconceivable before. It brought a variety of impacts detrimental to the natural values of the park. It would have a lasting impact. But I'm getting ahead of myself.

What caused the change in the attitude of the Sierra Club? What caused it after many decades of loyal service to become not only the dearest friend but the severest critic of the National Park Service in Yosemite National Park? Why did the club assume its new and critical position? And why, incidentally, did it change its statement of purpose to delete "to render accessible the Sierra Nevada?"

As much as any single event, the impact of World War II and the post-war period, which saw an enormous inflow of people into California and especially into Yosemite, were major influences. (In 1954, visitation to the park passed 1 million people; 13 years later, it topped 2 million, and now, of course, it's over 3½ million.) Along with this, the Sierra Club had expanded its affections to embrace the national parks on a broader, *national* level. The club was becoming more and more interested in the broad picture. Yosemite was still, and would remain, the Sierra Club's first love. But now, the broader policies of the National Park Service were evolving in a way that the club found incompatible with wise administration and limits to use. These policies were affecting Yosemite in a negative way, and the leaders of the club would have to assume a new position. During the past fifty years, in fact, the Sierra Club has frequently held views that diverged from those of the National Park Service. And, as park service views impacted Yosemite, the Sierra Club has fought for this special place over and again, but in a new role.

Which brings me to the subject of concessioners in Yosemite National Park, an area where the Sierra Club has been increasingly critical. Concessioners have, of course, played a major role in Yosemite; they have been involved since the earliest beginnings of the park. Two enterprising squatters – Hutchings and Lamon – in fact, in the 1860s, strove hard to establish private property within the Valley so that they could develop it for tourists. They thereby inadvertently precipitated a first crisis for the whole park idea: Hutchings took his case to the Supreme Court before he gave up, and in that process gained a victory for the park's innate integrity. The Supreme Court ruled for the park. Hutchings went on to pursue his tourist attractions as a concessioner and thereby laid the groundwork for future concessioners.

Since 1925, the Yosemite Park and Curry Company (YPCC) has had a virtual monopoly of the Yosemite concessions; in 1973, the company was bought out by the Music Corporation of America. YPCC has been regulated by the National Park Service but it has also been accommodated by the service over and over again. It has sought and secured expansion of facilities and profitable visitor services, whether or not they were appropriate in a jewel of a national park. (Do we really need pizza parlors and bars in Yosemite?) It has labeled amusements and other distractions as "needs." It has campaigned vigorously for increased park development, more accommodation for automobiles, and more parking areas.

The visitation in Yosemite Valley has been increasing exponentially, and the enterprise of YPCC has become that of a resort to which people are attracted for reasons other than the experience of the natural scene. The company cannot be entirely blamed: probably because of political pressures on both the local and national levels, the National Park Service has acquiesced in this increase of tourist attractions and visitation – indeed some within the service refer to the number of visitors as a measure of the park's success.

THE PRESENT

The present relations between the Sierra Club and Yosemite National Park can be said to be coincident with the development of the 1980 General Management Plan (GMP). This GMP actually has roots reaching back into the 1970s when master plans drafted by the National Park Service were subjected to vehement criticism by conservationists and by the public at large. This criticism resulted in a six-year study which, in turn, led to the preparation of the 1980 draft. It is noteworthy that some 60,000 people gave comments before this final draft was issued. The substance of the 1980 GMP can be summarized briefly. It proposes the following:

1. To allow natural processes to prevail.
2. To reclaim priceless natural beauty.
3. To reduce crowding.
4. To markedly reduce traffic congestion.
5. To promote visitor understanding and enjoyment. (We can assume that the word "enjoyment" means more than fun and frolic, that it means a quality visitor experience based on understanding and appreciation of the values of a unique natural resource.)

When the Park Service issued this 1980 Yosemite master plan, it was greeted with enthusiasm. The Sierra Club applauded it, as did other conservation organizations. But as time passed, the Park Service seemed to encounter increasing difficulties in implementing this plan. The concessioner raised strong objections; it did not want to relocate facilities and it did not want to reduce its accommodations by the 17 percent recommended. If, however, reduction was pursued, it wished to upgrade and consolidate its lower cost accommodations, replacing them with higher priced facilities. The concessioner also wished to increase – once again – the amount of parking in the valley, this to avoid inconveniencing its guests. Such a step would obviously go against, not facilitate, the mandate of the GMP to work toward minimal automobile use.

In 1989, the Park Service released two documents. One was a draft analysis of its "accomplishments" on the 1980 GMP to date, and the other was a draft examination report. The Sierra Club was deeply disturbed by the overall negative tone of these documents. The documents claimed that the 1980 plan was too ambitious – that employees of both the National Park Service and the concessioner could not be efficiently relocated outside of the valley because of the "need" to have them near the facilities they served. (The obvious answer to this, of course, is to move the facilities outside of the valley, too!)

The National Park Service went further, as well: it endorsed the request of YPCC to upgrade the concession accommodations.

The Sierra Club reacted by stating that Yosemite Valley had too long been inappropriately used for many purposes other than the pure enjoyment of its magnificent natural features. It was time that the National Park Service seriously consider eliminating use of Yosemite Valley for marginally related distractions that impose unnecessary impact on the valley. The Sierra Club urged the National Park Service to actively consider relocation of campgrounds in the valley and to eliminate all open campfires in the valley. (This simple step alone would reduce air pollution in the valley and might, as well, reduce the demand for valley campsites.) Sufficient camping space at areas on the border and outside the park could retain campfires as an option.

The Sierra Club further urged that general automobile use be strictly curtailed in the valley. The present bus system works well and could be expanded. Parking space should be located on the periphery of the park.

THE FUTURE

Times have changed! The days when national parks were hard to reach, remote, special places far from the cities have given way to the fact that parks are all too easy to get to; they have become weekend close-by escapist destinations. They are increasingly threatened by the encroachment of urban and suburban facilities, all the paraphernalia of modern city life that, ideally, should be temporarily shed by the visitor seeking to leave city routines. After all, the experience of walking over the blacktop surface of Yosemite Village is no different from the experience of walking on the blacktop of any suburban mall. The traffic on the valley roads is distinctly urban in character. Amenities offered – from film development to bar service to banking – are just like those at home. The pall of smoke rising from campfires, buildings, and automobiles on busy holidays and summer weekends is not so different from the smog around other urban developments. The desire of the concessioner to press for year-round development is ominous.

We can picture four possible scenarios for the future of Yosemite National Park:

1. No active intervention will take place. The population of the valley will rise with increased demand; overdevelopment will increase. The present 3.5 million visitors a year will increase to as many as 10 million.

2. The perceptions offered in the 1989 National Park Service documents – the draft analysis of accomplishments and a draft reexamination of the 1980 GMP – can be followed. This would mean slightly less growth and slightly less impact on the valley.

3. The recommendations of the 1980 GMP can be forcefully carried out with a vast improvement over the present situation. If this happy development should occur, we recommend that the National Park Service study the recent remarks of architectural critic Allan Temko. Temko envisions architectural development of El Portal that would result in transforming "ragged El Portal into a unified whole on the steep slopes overlooking the Merced River." If El Portal were properly developed with innovative planning and architecture, Temco goes on, the "Park Service and concessions employees would then have a positively beautiful alternative to the Valley where they really do not have a right to live."

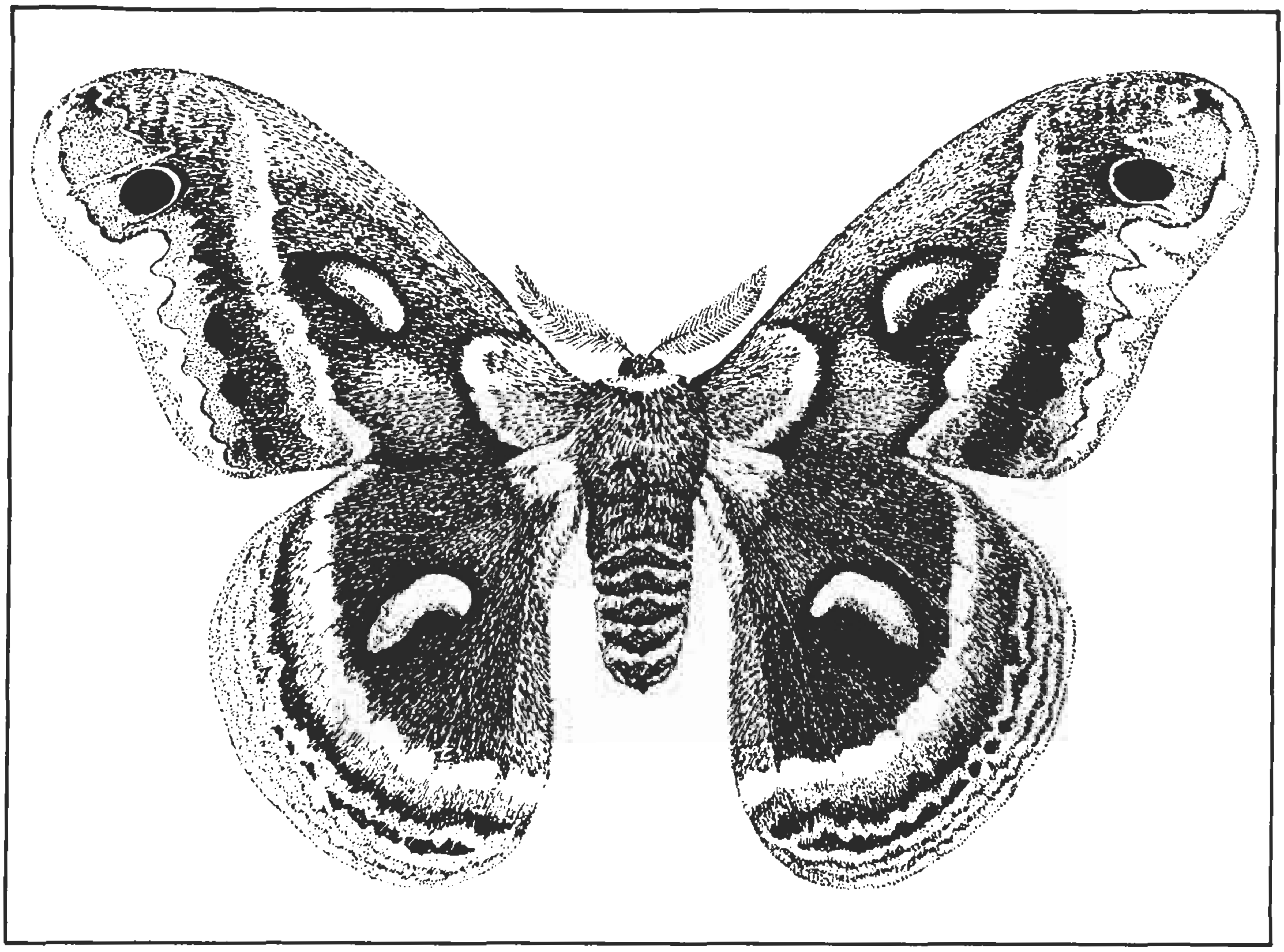
4. A new vision for Yosemite Valley can be pursued. This is the course that the Sierra Club urges the National Park Service to pursue. We urge the Park Service to look ahead creatively and to move ahead boldly. We urge it to discard certain old ideas and implement certain new ideas as it does so. We urge the service to stop measuring park success by the size of park visitation. We urge the service to define what the park experience should mean to the visitor, that is, to define a truly quality visitor experience; this will involve gauging the carrying capacity of the park that is consistent with maintenance of the park's great natural resources and such a quality experience. We urge the service to stop equating "wants" with "needs." We are cognizant that this last will not be easy to do. There has been more than a century of overdevelopment in Yosemite Valley – in 1889 there were already a luxury hotel, cabins, stores, studios, campfires, etc. The time has come to re-evaluate the role of the concessioner.

The Sierra Club would also like to remind the National Park Service of the crucial role that Yosemite plays in the national park system. Yosemite was, after all, the bellwether of all the national parks – in reality, the first park that embodied the national park idea. As Yosemite has evolved it has become, as it were, a microcosm of national park service problems, both present and future. As Yosemite goes, so will the other parks, for what Yosemite does now, the path that Yosemite chooses, will influence perhaps disproportionately the way that many other parks will take. As the Park Service meets the serious challenges that this poses, we urge it to keep in mind the precepts of some of the great men who founded and attempted to guide the young Yosemite. Remember the words of Senator John Conness who introduced the Yosemite Park bill in 1864: the place, he said, should be ". . . used and *preserved* for the benefit of mankind." Recall the words of Israel Ward Raymond, who wrote Conness that Yosemite Valley and the Mariposa Grove should be kept *"inalienable forever."* Keep in mind what Frederick Law Olmsted said – that "the first thought to be kept in mind" in the development of Yosemite Park "is the *preservation* and *maintenance* as exactly as possible *of the natural scenery."* In 1865, Olmsted realized that "the interest of uncounted millions" and *"the rights of posterity"* needed to be taken into account, and he urged that the parks values should not be "sacrificed . . . to *convenience, playfulness, bad taste, carelessness* or *wanton destructiveness."* John Muir could not have said it better.

In closing, the Sierra Club would remind the Park Service to expect the active participation of the club in developing – and implementing – a bold vision for the future of Yosemite National Park. Expect the Sierra Club to work for the quality visitor experience, and for the utmost protection of Yosemite's integrity and remarkable natural values. Expect the club to speak on behalf of the Yosemite plants and animals, as well as on behalf of future visitors. Also, expect the Sierra Club to work for a bigger budget to protect the magnificent treasure that is Yosemite National Park.

The Sierra Club is still the devoted champion of Yosemite National Park, even as it has been since the park was established. We're still the faithful one in this century-old love affair. And we intend to remain so. Thank you.

THE STATE OF THE PRESENT



Cecropia Moth, *Samia cecropia*
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THE PUBLIC LANDS – AN ENDANGERED SPECIES

Gaylord Nelson[1]

My remarks are addressed in general to the status of our federal public lands system and to those forces that influence the management of that system. Those forces are the Congress, the statutory mandates applicable to those lands, the philosophy of the land managers, economic interest groups, multiple organized user groups, the general public, the media, the president and key decision-makers in the executive branch, and more.

This is an incredibly complicated social, economic, and political mix. Very often it isn't clear what factors went into the decision-making process resulting in a bad land management decision. What is clear is that there are many bad management decisions resulting in serious, adverse impacts on our parks, forests, refuges, and Bureau of Land Management (BLM) lands. It is also clear that we must reverse the current downward trend if we are to save this rare heritage.

The nation, at best, might possibly be dimly aware that something bad is happening to our public lands. What is needed is a forum that will both inform and arouse the Congress, the public, and the media to demand action that will protect the uniqueness, the special character of the public lands system.

It should be noted that special economic interest and user groups supported by members of Congress from the region and local politicians have more influence over the management policies of our parks, forests, refuges, and BLM lands than Congress as a body or the general public.

This is all by way of saying there is an urgent need for a comprehensive evaluation of the multiple threats that endanger our whole public lands system. To develop a clear picture of what is happening to these lands they must be approached and evaluated in their totality as a public lands system, rather than a divisible bunch of parts and pieces.

The federal public lands are a rare national treasure whether found in the parks, forests, refuges, or on BLM lands. It is important to recognize that these lands are part of an inter-related mosaic and to understand that any degradation of natural areas on these lands is in fact an attack on the whole system. Tragically this priceless heritage is being compromised and degraded bit by bit and is, in fact, slowly but steadily approaching the threshold of a precipitous decline. The whole system is endangered by threats, pressures, and intrusions which need to be addressed before it is too late.

While we all are mightily concerned about endangered species we tend to forget that among the most important endangered species of all is America's unique heritage of wildlands, wilderness, and natural landscapes. At stake is 610 million acres – almost a million square miles – 25 percent of America's total land base. This remarkable inheritance is found in our national parks, wildlife refuges, national forests, and BLM lands. No other country has preserved such a vast estate for public use and enjoyment; for wildlife, habitat, scenic beauty, watershed protection; for education and scientific study; for varied and endless opportunities for recreation in a natural setting remote from the intrusions of modern society. Here within these lands are some of the last untouched remnants of nature's works, a million years of evolving landscapes unaltered by human activity.

1. Gaylord Nelson, Counselor of The Wilderness Society, Washington, D.C.

Only on the public lands have we preserved such vast areas representing every land form from deserts to grasslands to forests to mountain peaks and valleys. If a significant portion of natural America is to be preserved for this and future generations, it must be here on these lands.

Though we tend, complacently, to assume that the laws, the public land managers, and congressional oversight assure the protection of these areas, the fact is that tremendous pressures for expanded use and more exploitation are changing the character of these lands. Under this constant pressure the land managers tend to yield here and there, little-by-little, year-by-year. The changes are gradual, subtle, and little-noticed from one year to the next, but the cumulative impact over the past three or four decades is beginning to alter the face of these landscapes in significant and unintended ways. The fact is, most of this degradation could be avoided or minimized if the spirit of the law were faithfully implemented, as Congress intended, by those responsible for managing our public lands.

In short, the national parks, national forests, wildlife refuges, Bureau of Land Management lands, and the wilderness areas within their borders are all at least prospective candidates for the endangered species list. All are being compromised and degraded in manifold ways – soil erosion, air pollution, water pollution, aircraft noise pollution, overcrowding, excessive roading, excessive timbering, excessive grazing, stream siltation, overdevelopment, habitat destruction, scenic degradation, and the disappearance of biological diversity.

Ideally congressional oversight would, on some regularized schedule, review and evaluate the impact of all threats to the public land system as a whole. Irregular, periodic, oversight by several congressional committees each with jurisdiction over part of the public land system is inadequate to monitor and evaluate the cumulative impact of hundreds of decisions and legal interpretations made by these individual agencies each year. Further complicating matters, each agency tends to interpret the letter of the law and congressional intent to suit its own institutional desires and biases.

The U.S. Forest Service is a classic case in point. For example, as one reviews the provisions of the Multiple-Use Sustained Yield Act of 1960 and the National Forest Management Act of 1976, one is struck by the brazen effrontery with which the Forest Service evades, misinterprets, or ignores provisions of the law that do not suit its own bureaucratic purposes.

The Multiple Use Act of 1960 mandates that the forests shall be "administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes." Balanced multiple use is the objective of the statute. However, in practice the Forest Service considers its timber program as the dominant purpose of the forest with all other purposes of secondary importance and whenever there is a conflict, timbering almost always prevails. Repeatedly, the Forest Service has destroyed wildlife habitats, watersheds, and trout and salmon streams in order to subsidize the sale of timber that should have been left alone.

The reality is that the Forest Service pays only minimal lip service to the concept of balanced multiple use as intended by Congress. Arbitrarily selected timber goals drive the planning process. Once the goals are selected everything left is considered by the Forest Service to qualify as balanced multiple use.

Probably the Forest Service's most flagrant abuse of common sense and the law is its policy of massive below-cost timber sales. The intent of the law is clear. Section 6(K) of the National Forest Management Act provides that the "Secretary shall identify lands" that are not economically suited for timber production and "no timber harvesting shall occur on such lands for a period of ten years." It further provides that such lands shall be reviewed every ten years and shall not be returned to production until it is determined that they have become suitable for timber production.

What is meant by economic suitability is subject to interpretation, and the Forest Service contrives to interpret this law and the concept of "multiple use" in such a way as to justify massive sales of below-cost timber.

Half of the national forests lose money every year because of below-cost timber sales. In the past six years, below-cost timber sales have cost the taxpayer in excess of $2 billion.

Another provision of the 1976 act specifies that "timber will be harvested from National Forest System lands only where soil, slope, or other watershed conditions will not be irreversibly damaged." Despite the clear language of the law the Forest Service regularly timbers steep slopes with highly erosive soil causing severe and permanent damage to watersheds, salmon spawning grounds, and trout streams.

Again it must be recognized that economic and political interest groups are powerful forces in determining the timber harvest. Congress is vaguely aware of what is happening. The general public is simply unaware. Neither is well informed about the full cost of subsidized timber sales nor the environmental damage as a consequence.

These are but a few examples of a Forest Service timber program that is out of control.

Another case in point is the national park system. If, for example, we are going to save our national parks then we must more faithfully comply with the clear and specific mandate of the 1916 congressional act that created them. That law provides that the parks shall be managed "to conserve the scenery and the natural and historic objects and the wildlife therein, and provide for the enjoyment of same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Slowly, but surely, that mission is being compromised. If the current trend is not soon reversed, these parks will not be left "unimpaired for the enjoyment of future generations." Many have already been significantly impaired.

Indeed, the state of the parks report to Congress prepared by the Park Service in 1980 concluded:

> It is clear that events are taking place that are causing demonstrable and severe damage to the natural and cultural resources of the nation's national parks, monuments, historic sites and other units. Although some impacts are subtle and not immediately obvious, long-term consequences can be disastrous.

We must begin soon to address these threats, or the next generation will see the end of the parks as Congress conceived them.

A few recent headlines and news stories are revealing:

> Everglades' slow death blamed on cane growers
> Orlando *Sentinel*
>
> New coalition declares open season on public lands
> *The Examiner*
> Missoula, Montana
>
> Yosemite concessioner fighting conservation plan
> San Luis Obispo *Telegram-Tribune*

The Yosemite Park and Curry Co., is using its guest list to contact 93,000 people and ask them to lobby the National Park Service to abandon its 1980 plan to ease crowding.

Two Visions Blur Yellowstone's Future
The Washington Post
by John Lancaster

One is the Yellowstone that nature built...the other is the recreational Yellowstone, where . . . the visitor can rent a motorboat or snowmobile, rough it in a $95 a night hotel . . . .

One proposal involves a planned 350-mile snowmobile trail linking Lander, Wyoming and West Yellowstone, Montana. The trail would traverse Yellowstone for 37 miles. Heavily backed by the Wyoming Congressional Delegation, the project is considered key to state efforts to boost winter tourism in the area.

. . . Park authorities in the 1970s agreed to remove stores and campgrounds from the area known as Fishing Bridge, which is heavily used by grizzlies, in order to compensate for the building of a new village elsewhere. But the Park Service backed down – only part of the development was removed – after bitter opposition from the Wyoming congressional delegation, the local tourist industry and motor home owners.

If the public lands are to be managed to carry out their statutory responsibilities with minimum depreciation of their natural values and characteristics, then Congress must actively reassert its leadership. The letter and the spirit of the law are not self-enforcing. The only effective counterweight to pressures for more exploitation of our public lands is Congress itself and an informed and concerned public.

It is time now for a comprehensive reevaluation of our public land uses and a clear and unequivocal restatement of their purposes.

What kind of questions should we ask? What kind of answers do we want? The issues are complicated because the public lands are vast, varied and complicated, and because each of the four categories of public lands have different missions. The role of the national parks and the wildlife refuges is relatively clear and uncomplicated compared to the national forests and BLM lands.

Administration of forests and BLM lands is complicated by the fact that they have both a conservation-environment responsibility and a commodity-supply responsibility, and frequently they are in conflict. Managing that conflict to minimize environmental damage was clearly the intent of Congress, but it has failed to work because the agencies have strongly tended to give first priority to commercial exploitation of the resources over any other multiple use.

In reexamining the role of the public lands it is vital to recognize from the start that these lands provide a wide range of unique experiences, services, amenities, opportunities, and special environments that cannot be supplied by the private sector from private lands because they no longer exist there.

Preserving the uniqueness of this huge estate of natural landscapes should be a first priority of our society. If we continue to permit overuse, overdevelopment, excessive and unnecessary commercialization, then, finally, these lands will lose their special character. Once lost it can never be recovered and there will be nothing left to replace it.

"Carrying capacity" is the appropriate general standard of measurement for activities to be permitted on these lands. Those activities that do not degrade the natural quality of the resource base are generally acceptable and those that do are not.

Ironically, current law would generally be adequate to protect this resource base if the land managers consistently resolved conflicts in favor of preserving the integrity of the resource base instead of yielding to pressure for uses that degrade it.

A recent example of this relentless nibbling away of the very essence of our public land system is the Forest Service's announced plan to introduce privately constructed and operated commercial facilities in some of the national forests as a trial experiment as soon as they can attract interested developers. Among the many facilities the Forest Service consider appropriate are swimming pools and full utility hook-up campsites.

Once commercialization of recreation activities starts in some forests it will spread to the rest with increasing pressures for more facilities and more commercialization. In campsites where full utility hook-ups for 50 trailers and recreation vehicles is not sufficient to meet the demand, the Forest Service will build 100 or 200 or whatever it takes, justifying the program simply as response to the wishes of the public. There will be no turning back.

The uniqueness of the public lands will be destroyed if we are going to duplicate on public lands the goods and services provided by the private sector on private lands. The law did not intend that the national forests would be used as tree farms or modified theme parks, but that is the direction they are headed.

Like the current problem of air tour flights over the Grand Canyon, twenty years from now Congress, too late, will wonder how we got into the theme park business and how to get out of it.

The lesson to be learned is that once an activity is permitted within any category of public lands, it becomes difficult if not impossible to control or stop it even though that activity is seriously degrading the basic resource itself. In 1987 Congress belatedly attempted to deal with such a situation in the Grand Canyon with the adoption of some mild palliatives that left the problem mainly unsolved. The problem – intrusive noise from air tour flights over the Grand Canyon.

In 1985 Governor Bruce Babbitt testified that noise in the Canyon is "equivalent to being downtown in Phoenix at rush hour or listening to an alarm clock go off, and that's not what a national park is for." That's a far cry from Zane Grey's description of the Grand Canyon in 1906 when he wrote: "One feature of this everchanging spectacle never changes, its eternal silence."

With a little bit of foresight and a little bit of leadership it could all have been prevented by not permitting the activity to start in the first place.

Unfortunately, we are now left with almost 50,000 noisy, intrusive air tour flights annually over the canyon and a sadly diminished park. Obviously, this is another park that will not be left "unimpaired for the enjoyment of future generations" as mandated by the 1916 Organic Act.

Unfortunately, the Grand Canyon debacle is not just an isolated accident of history. Rather it is a quite typical example of an ongoing process that is depreciating the unique quality of our whole public land system.

National parks are being overpressured by visitations that have risen from 30 million to 300 million annually in the past 40 years. Wildlife refuges are being deprived of water for wetlands and poisoned by selenium and dieldrin from agricultural runoff. BLM lands continue to be degraded by overgrazing subsidized by the taxpayer and seriously damaged by off-road vehicles.

It is not my purpose here to compile a compendium of those activities that are changing the character of our public land system in undesirable ways and doing so without changing the laws, without public discussion, and without congressional debate.

If we are to protect this rare estate some dramatic action must be taken soon to focus national attention on the problem. Ideally the president should step up front and address the nation, warning of the unfolding tragedy that is fast upon us. That would bring the country, the Congress, the general public, the interest groups, and the press into a national dialogue over the purpose and future of these lands.

Congress, of course, has a vital role to play in the whole process. Comprehensive joint House-Senate hearings would identify the major threats to the public lands system as a whole and, for the first time, provide the Congress and the public with a comprehensive view of what is happening to these lands.

The American public treasures its public lands with their scenic beauty, wildlife habitats, and exceptional recreation opportunities in natural and varied landscapes.

Once the public perceives that the uniqueness of these lands is being eroded, that they are in jeopardy, there will be a ground swell of support for action and for more careful stewardship of this gift of nature that cannot be replaced.

We have gotten where we are because we have paid attention mainly to bits and pieces of the public land system without paying adequate attention to what is happening to the system as a whole.

THE EMBATTLED WILDERNESS

Alfred Runte[1]

It may hardly seem appropriate to begin a speech about Yosemite by quoting from a movie starring W.C. Fields. It may not seem appropriate; my point is that we cannot fully appreciate the trials and tribulations of Yosemite without first comprehending the larger national issues of which its preservation has become an integral part. If I were quoting John Muir, I would probably choose his line to the effect that any one thing in the universe is hitched to everything else. O.K., so we've acknowledged the timelessness of John Muir after all. My point is that we shouldn't forget the many other philosophers, both great and small, whose wisdom we sorely need and yet whose contributions are often dismissed as irrelevant. Which is why I have chosen W.C. Fields – he is about as opposite to Muir as anyone could get. I believe it is near the end of Field's classic, "Never Give a Sucker an Even Break," when he shrewdly observes, "You can't cheat an honest man." Let's go to *Webster's* for a moment: *Honesty:* a. "Fairness and straightforwardness of conduct." b. "Adherence to the facts." "Honesty implies a refusal to lie, steal, or deceive in any way." The honest man or woman, then, is "free from fraud or deception." And so the truth of Field's observation: "You can't cheat an honest man."

Now, consider the state of the American republic in this, the centennial year of Yosemite National Park. Is there any quality more lacking in government, in industry, in education, indeed, in society at large, than that one precious commodity – *honesty*? "Read my lips. No new taxes." Another recent U.S. president was further moved to exclaim: "I am not a crook." But as we all know, it was not long afterward that Richard Nixon resigned from office. *His* interpretation: "I was hounded from office." The press was the guilty party, not Richard Nixon. That, too, is the excuse of one Charles Keating, a man alleged to have bilked his Arizona-based savings and loan of $2 billion. A million or so of that flowed into the coffers of five United States senators, among them California's own Alan Cranston, and no less than our Charles Lindbergh of space, Ohio's John Glenn. I am immediately reminded of a letter I saw in the Yosemite Archives. The letter was to Jack Morehead, the former park superintendent and at the time its chief ranger. The writer was protesting the extermination of bears in Yosemite, specifically, the callous dumping of bear carcasses off a cliff along the Big Oak Flat Road. Morehead had rambled on and on about property damage, words to the effect that bears cost visitors tens of thousands of dollars annually. "But what about the *bears?*" the protester replied, then concluded, obviously pained and disillusioned: "I guess all our heroes have feet of clay."

But so *many* clay feet? When in American history have we ever seen the likes of the wholesale sellout of honesty and integrity that has characterized this republic over the past three decades? Can anyone recall when leadership was so visibly absent, and when corruption, in contrast, hit so frightfully close to home? As American historians, we used to teach that Teapot Dome was the scandal of the twentieth century.

For those of you who might need a refresher, in 1922 President Warren Harding's secretary of the interior, Albert B. Fall, secretly and improperly leased the nation's petroleum reserve at Teapot Dome, Wyoming, to the Sinclair Oil Company. As I said, Teapot Dome *used* to be the government scandal of the century. Today, Teapot Dome seems to have been little more than a tea party, compared to the feast at the taxpayers' trough – compared to the corruption of American institutions and government – that has gone on over the past ten and more years.

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1. Alfred Runte, Environmental Historian-Author, Seattle, WA.

Where, then, the outcry? Where indeed? If we are to believe W.C. Fields, it hasn't happened because all of us are crooks, dishonest men. We've been too busy cheating one another to notice that we too have been cheated. Cheated of good and honest government. Cheated of deep and meaningful personal relationships. Cheated of pride in the knowledge that our lives can make a difference, and that we are leaving a better world – not a lesser one – to those who follow behind. "You can't cheat an honest man." We suffer; our nation suffers; our national parks suffer – all because, in the final analysis, we are loath to face the truth.

Ultimately, the rise or fall of any culture may be directly linked to that culture's ability – indeed willingness – to tackle its inconsistencies. Historically, America's most crippling inconsistency was the institution of slavery. The United States declared, and emphatically, that "all men are created equal," and yet – in truth – millions of Americans were still held in bondage. The Civil War resolved the issue of slavery, but it did not resolve the issue of civil rights. That problem is still with us, and, in combination with our other growing problems of cultural assimilation, in the end the series of contradictions that began with American slavery may indeed rise up and overwhelm us after all.

The point is that a culture, or an institution, or an individual cannot survive indefinitely the corrosive powers of inconsistency. At this time last year, Yosemite's friends and managers looked *forward* to the coming centennial, to a celebration – unblemished by controversy – of Yosemite's contributions to the national park idea. To reemphasize, no one wanted controversy; I know, because every time one of my suggestions even *hinted* at the prospect of opening a debate, that suggestion got lost in the shuffle of the Park Service's bureaucracy. That was bad enough; even worse, however, was the fact that one of the projects that I lost was a $500,000 PBS special, "The Future of Yosemite." But to talk about the future I had to begin with Yosemite's past and present. In a word, that was too controversial. Indeed, by the time everyone had insisted on seeing the script, the film wasn't worth showing, and in fact, was no longer even about Yosemite.

In contrast, *Yosemite: The Embattled Wilderness* went to press exactly as I had written it. That is the wonderful thing about a university press; you run a gauntlet of your peers rather than a committee of nervous bureaucrats. That is not to say that every scholar accepts my research, either; it is simply to underscore that an open debate - an honest debate - depends on the free exchange of information. As scholarship, *Yosemite: The Embattled Wilderness* is taken from the record. I took nothing out of context; moreover, I quoted or cited nothing as fact unless a series of documents backed up that observation. There is no oral history in *Yosemite: The Embattled Wilderness*, none of that "slippery" documentation that so visibly changes over time. If it didn't exist on paper, it simply isn't in the book.

Now, what is the meaning of this research, this controversy? In short, what does the history of Yosemite suggest about the future of the national parks? I wish I could be optimistic, but then, there is not only that nagging evidence from Yosemite's embattled past, but also the question: How will Park Service budgets fare now that every man, woman, and child in the United States owes between $5,000 and $6,000 in principal and interest to pay off the Teapot Dome in the savings and loan industry? And that's only *one* Teapot Dome. The bill is also coming due in American transportation, decades of deferred maintenance and heavy trucks on the nation's streets and highways; decades of allowing our public transportation to be carried to the scrap heap; in short, years and years of overreliance on the internal combustion engine. Yet another Teapot Dome is the spiralling federal deficit. And then there are the commercial banks, many of them inundated with Third World IOUs. Pick your reason why education, health, housing, and the environment should all be fully funded by the federal treasury. Pick your reason why a healthy, happy, and well-educated citizenry should be the primary concern of every civilized nation-state. Pick your reason, but don't be surprised that even your best arguments won't make any difference. The fiscal crises are rolling in, like cyclones across the nation, and no amount of good intentions will hold off the storm any longer.

Is it any wonder, then, that Americans are finally starting to ask: How did we get into such a mess? Is it any wonder that every institution, even the national parks, has come under scrutiny these past several months? Like Watergate, the controversy simmered for a couple of years, and then suddenly caught fire. Barely 2 years ago, the American people slept through another presidential election, and but a few months ago awarded President Bush an 80 percent approval rating. Suddenly, George Bush is in trouble. American society is like that; we flit, like social butterflies, from one irreconcilable issue to another. But for now, there can be no question why Yosemite is itself headline news. Like any cultural icon – like any great milepost of national identity – Yosemite is a lightning rod, another focal point for discussing everything right – and wrong – in the American experience. And so in asking about the future of Yosemite we ask, in effect, about the future of the United States. What everyone has been groping for, but can't quite put their finger on, is how Yosemite has come to symbolize that larger national question: How do we reverse, and overcome, our enveloping trap of inconsistency?

For starters, we know what Yosemite is *supposed* to mean. As I have written in *Yosemite: The Embattled Wilderness:* "Every conflict in Yosemite's history, and therefore every suggestion of those conflicts yet to come, can be traced to some compromise of the ideal that a national park first and foremost should exist for the protection of its natural heritage." An ideal and its compromise. Is that not the sad tale of every fall from grace, that an ideal, however noble, is somehow corrupted?

How do we corrupt a national park? Simply that way – by corrupting its ideal. Those of you who have read *Yosemite: The Embattled Wilderness* know that one of its subthemes is the introduction of alcoholic beverages to the national parks. Now think about this for a moment, that is, put the presence of alcohol in the national parks into a wider national context. But a few years ago, the first lady of the United States admonished us: "Just say no to drugs." By drugs, of course, she meant cocaine, speed, heroin, and crack; in other words, the kinds that criminals "push" rather than sell over the counter. To be sure, our nation's War on Drugs does not include alcohol. The "enemy" is in Columbia, or Bolivia, or Panama – the enemy is not Anheuser-Busch in St. Louis, Missouri. Yet look at the statistics – the worst drug is not crack, or speed, or cocaine, or heroin. Although, by government estimates, some 2 million Americans are hopelessly addicted to those drugs, in marked contrast, there are at least 14 million alcoholics in the United States of America. Alcoholism is *seven times* the human tragedy.

Put these statistics back into personal terms. How many of you know a drug addict? I've seen some, but I don't know any. In contrast, my father was an alcoholic. The tragedy of alcoholism cuts deeply into my family's interpersonal relationships. And so it does for millions of American families, each and every day. And that is just for starters. Today alone, seventy Americans will die on the nation's highways in alcohol-related accidents. Tomorrow another seventy will die, and another seventy the day after tomorrow. Seventy people a day – every day – without fail. That's nearly five hundred people a week, more than 25,000 a year. A Vietnam War of fatalities every two years. Then why, the question begs itself, hasn't the nation's so-called war on drugs begun by banning the sale of alcohol inside our national parks?

But of course, it's making someone a profit. Again, isn't that how ideals get corrupted? "Just say no," that is, as long as the profit taking is in Bolivia or Columbia. Say "yes" when the profit taking is in Golden, Colorado. Say "yes" to alcoholism but "no" to drugs. There's a word for that kind of cultural inconsistency – the word is hypocrisy. *Webster's.* Hypocrisy: a. "A feigning to be what one is *not* or to believe what one *does not, esp.,* the false assumption of an appearance of virtue or religion." "Just say no??!!" Look at the hypocrisy in that message. Look at America's roadsides, once, as promised by the Highway Beautification Act of 1965, built not only for motoring safety but also for esthetic beauty. But Americans don't own their roadsides – the *advertisers* do. The interstate highway system is a forest of billboards, a million more than when the Highway Beautification Act was passed in 1965. It's a jungle out there, a constant parade of 30- by 70-foot panels pitched high on gargantuan steel columns. And who are the biggest advertisers – the alcohol and tobacco companies. Drive to a national park; discuss with your children on the way why drinking and driving and healthy living don't mix. Tell your children: "Just say no." But all around you, practically up to the very gates of your national park destination, society is telling your children: "Alcohol is cool."

Newspapers, television, national sporting events – all convey the same hypocrisy. Test the athletes for drugs, but who is sponsoring the event? Tell the young people in the stadium, "Know when to say when," but include in their college newspaper a poster celebrating alcoholic beverages, for their dorm room. On Labor Day, September 3, the tragedy hit close to home. Chad Martinson of Tacoma, Washington, the 18-year old son of two of my dearest friends, was killed by a drunken driver who, having run a red light at 60 miles an hour, smashed into Chad broadside. Chad died within minutes, but you guessed it, the drunk was out of the hospital the very next day. Who was Chad Martinson? He was an artist, a deep thinker, an environmentalist, and a scholar. He was 6 feet 2 and very good looking. He was bright; he was good; he was going places in life. Until, that is, the night of September 3. Now his ashes lie scattered on the slopes of Mount Rainier.

You would have thought that alcohol would have been banned from the national parks years and years ago. It was, during national prohibition, but then prohibition was repealed in 1933. And so the question was raised: Should the sale of alcoholic beverages also be resumed in the national parks? Under intense pressure from the concessioners, Secretary of the Interior Harold Ickes gave in. But listen to how Donald B. Tresidder, president of the Yosemite Park and Curry Company, interpreted the decision: "In response to a recognizable public demand on the part of our guests and upon the written authority of the secretary of the interior, who has sole and exclusive jurisdiction, our company is planning to make alcoholic beverages available to our guests. We wish to state emphatically, however, that this company is not going into the liquor business with the intention of developing a trade that will be as profitable as possible. . . . We have sought to provide facilities under such conditions that families with children would feel free to live in tents or open quarters without any fear of being molested or exposed to many undesirable elements and practices found in large cities. . . . It is believed that an intensive and aggressive selling of liquor would jeopardize the goodwill which has been built up among our guests and in the end would have disastrous effect on our investment in hotels, transportation, etc. . . . In stores, liquor should be made available for guests in the same manner that we sell canned goods or other items. No special emphasis should be placed upon it. No window displays or alluring showcase displays will be permitted. . . . Any employee seeking to promote the sale of liquor beyond meeting the legitimate and unsolicited quests of our guests will be considered to have violated the clearly defined policy of this Company. . . ." Barely weeks after the appearance of this memorandum on June 20, 1934, Tresidder began construction of the El Dorado Room at the Ahwahnee Hotel, without so much as a peep to Superintendent Charles Goff Thomson, and no, Tresidder did not fire himself for having violated "the clearly defined policy" of his company not to accentuate liquor in any way.

That is but one example, although a striking one, of the corrosive and debilitating powers of inconsistency, how it is that hypocrisy, however small and seemingly innocent at the time, can wear away at the fabric of any institution. We know, in general, how any inconsistency is justified by its practitioner: public demand. It's not *my* decision to make; who am I to say.

How often has it been argued that the development in Yosemite Valley comprises but 1 square mile of territory out of more than a thousand in the national park? One wonders what defense those same statisticians would bring to the vandal who is hired to hold a burning match to the lips of the Mona Lisa. Would they say that because only one small part of the painting was destroyed, the painting had not been harmed?

Guaranteed, the defense of development without our national parks will always fall back on that kind of twisted logic. Otherwise, the public might wake up to the inescapable truth – development has laid hold to the best of the best. The stake of development has been driven into the heart of our national parks, in the case of Yosemite, into the Incomparable Valley. The lips of the Mona Lisa have been torched. Land is conceded to wilderness, to the preservation of the natural environment, only where development has laid no claim. Which is why, the more the landscape of Yosemite Valley has been altered for commercial profit, the more the Park Service has had to pretend that the park is still meant for preservation.

Which is how we often get superintendents in our major national parks who sound more like politicians, or even worse, spokesmen for the concessioners rather than like *stewards* of the natural environment. Environment? Here again, perhaps the larger problem exists with American society. Everything has been bought; everything has been politicized. We used to have one of the best governments that a free people could elect; now we have one of the worst governments that money can own. A recent network broadcast indicates that the typical United States senator needs to raise $15,000 each and every day just to run for reelection. No wonder that our congressional representatives are never on the floor, debating the great issues of this country, but rather off chasing the Charles Keatings and making the rounds of the cocktail circuit. California's Alan Cranston will spend $20 million – or more – in his bid for reelection. Is it any wonder, then politics has taken such hold of national parks as well? The whole country is politicized.

People of principle, of conviction, are no longer rising through the ranks. They are stuck, and worse, every time they look up and see who is occupying the higher offices – and how those people got there – they are left to conclude that W.C. Fields was wrong. You can cheat an honest man, and indeed you must.

It's called careerism, getting ahead, whatever the price. "We current citizens have learned to show so little of ourselves;" writes Allan Gurganus in the *New York Times*; "we're walking safe-deposit vaults. We're now accustomed to smooth-faced, trust-funded national leaders. We fear that, uneasy as these guys are with deeper metaphors and others' pain, they privately say, 'Let's go the whole nine yards in the Middle East, yo!' Their banal statements are too much *ours*.

"We long for a leader who can tell us stories that are not subcontracted, personal content ceded to young Ivy League speech writers. We'd love someone who thinks in narrative beginnings, middles, ends; someone who has held at least one job previous to being rich, then vice president, then president. Our leaders' features are praised as 'boyishly handsome.' This means untouched by experience. Such fear of maturity proves our contradiction as a people; middle aged yet forever adolescent."

The moral of Gurganus's story – Abraham Lincoln probably could not be elected in the twentieth century. His beaten, time-worn face would repel us; his wisdom and revealing humor would be lost in 10-second sound bites. What is more the irony, it was Abraham Lincoln who signed the Yosemite Park Act of 1864, deeding to us – those so-called future generations – Yosemite Valley and the Mariposa Grove, "inalienable for all time."

I agree with Alan Gurganus; it's time to grow up, time again to act our age. We've had this latest experiment with mediocrity and frivolity – why is it that we never learn until the *bills* – not the tragedies – start falling due? Which keeps bringing us back to that basic question about the meaning of the national parks. If the parks are not special places why even have them at all? If they are not to stand for a better America, why even make the pretense? Why visit upon the national parks the nation's worst habits rather than its loftiest ideals?

If alcohol is the nation's worst addiction, what is it doing in the national parks? If public transportation would ease congestion and pollution, why don't we have more of it to the parks? I've said for sixteen years now, let's rebuild the Yosemite Valley Railroad, right up to the gates of Yosemite Valley, if need be. We might invite the Swiss, or the Germans, or the Austrians to show us the latest technologies in the construction of mountain railroads. We've waited long enough to have safe, sound, and economical public transportation in the United States. I see nothing comforting in the statistic that 50,000 Americans die on our highways every year; here again, why can't the national parks be setting a better example, as they were allegedly intended to do?

With the Yosemite Valley Railroad back in place, there will be no more need for excuses, for corrosive contradictions. Everyone who wants to see the park can come in by train. If you want to bring along your martini shaker – and it fits within your luggage – fine. But you're the one who has to carry it. As for the criminal element, I hardly think that anyone is going to steal who has to ride a train. "Where did you get that television set on your lap, sonny?" "I bought it at the village store." No you didn't, because the store provides only food and rents camping equipment. And the last bars – and television sets – were dismantled as part of the new concessioner's contract of 1993. Step right this way, sonny. You're going to jail – in Merced.

Indeed, of all the facilities to underscore the *truth* about Yosemite, the valley jail – and courthouse – truly stand apart. I agree with my colleague, Ranger Fermin Salas; someone who is a jerk at sea level is not going to change at 4,000 feet. But why jail the jerk in Yosemite, in the incomparable valley? Are there jails in the Louvre? In the Smithsonian Institution? Ah, you say, but those museums are in major cities. They don't need to have their own jails. Nor does Yosemite, *if*, but only if, it is managed as a national park and not a destination resort. Garrett Hardin is right – you get the behavior you select for. Build a city in the wilderness and you'll get city problems. Manage that wilderness *as* a wilderness and, guaranteed, the criminal element will find a more lucrative – and easier – pocket to pick.

That should do for starters – alcohol out, public transportation in. Just say "no" to booze; just say "yes" to trains, and Yosemite, within a decade, will be well on the spiritual and esthetic road to recovery. Elitism? Perhaps, but that is what Yosemite is, by nature, an elite juxtaposition of the great forces of the natural world, an incomparable valley and an incomparable national park. Why keep apologizing for a standard of conduct, for what keeps Yosemite whole? Every institution of merit practices one form of behavior to the exclusion of every other kind. That isn't elitism; that's common sense. Granted, no one, rich or poor, weak or strong, should be excluded from Yosemite, but it is perfectly legitimate – and necessary – to make the forms of entry and the facilities consistently ask the question: Is the purpose of your visit in fact to see Yosemite? Is the privilege of your being here recreation enough?

I know full well the historical rebuttal: But not everyone thinks Yosemite has really been harmed. "Like it or not," I was recently reminded by a Park Service official, for example, "the status quo is widely popular." But again, is that the criterion, simple popularity? When I was teaching in the university, I undoubtedly would have been more "popular" had I given every student an A. But would I have been doing my job? Was I supposed to be popular, or was I supposed to make a difference, to teach the young people in my charge the discipline – and the rewards – that come with self-sacrifice? If it's a simple matter of popularity, all of us can well imagine that Nevada's infamous Mustang Ranch, plopped down in Yosemite Village, would be immensely "popular" among thousands of self-indulgent men. It might even keep a few of them out of the jail. Absurd, you say? No less absurd than what exists now, the notion that Yosemite, Yellowstone, the Grand Canyon, or any other park should be governed by what is popular, that is, by what is predictable – and marketable – to the widest possible audience.

"You can't cheat an honest man." Nor can you cheat Yosemite, provided that you read its history honestly, and then, once again, extrapolate that history honestly into the future tense. The lessons of history are clear: You can't say one thing and mean another: You can't preach an ideal and then constantly undermine it. You can't nibble an ideal to pieces and expect any piece, however large, to be representative of the former whole. You can, but you will pay for it. Sir Walter Scott may have said it best: "O, what a tangled web we weave, when first we practice to deceive!"

The recent history of America is one deception after another. Yosemite hardly could have been immune. But now, in government – in industry – in education – in all affairs, it's time to grow up. If only we were still a frontier. If only our mistakes, and our waste, could be covered by our wealth. If only our institutions could remain all things to all people all of the time. But those are the wishes of an infant nation state. With maturity comes responsibility and the need for making choices. Time, then, to make those choices. For Yosemite, the message of history remains simple and eloquent. Yosemite by every imaginable standard is only one of a kind. In that perception, and no other, lie the only tried and true principles – the only reasonable and honest standards – for guiding the future of the park and its natural heritage.

PROSPECTS FOR THE FUTURE

Grizzly Bear, *Ursus arctos,* in Huckleberry Bushes
© 1981 Diana Dee Tyler

IN OUR OWN HANDS: A STRATEGY FOR CONSERVING BIOLOGICAL DIVERSITY IN CALIFORNIA

Deborah B. Jensen, Margaret Torn, and John Harte[1]

California's bountiful natural resources are the wellspring of the state's economic wealth and worldwide fame as a desirable place to live. To the public, these resources are often thought of as logs to cut, soil to plow, clean water to drink, fish to catch, and redwoods to view with awe. But, in fact, these are only a few of the benefits we receive from California's biological diversity. This diversity is sometimes splendidly apparent, as when the deserts flower in the spring or when, in the winter sunset, a phenomenal variety and abundance of bird species descend on the coastal lagoons or inland wetlands. More often, however, these riches go unperceived, for California's patchwork diversity of habitats can best be grasped by a trained eye aloft and its diversity of genetic information can best be viewed with microscopic vision.

Biodiversity comprises three scales – ecosystems, species, and genes. Together these sustain both the quality of life in California and the great economic wealth that we derive from our land and water. The existence and interplay of diversity on all three levels are as essential to the life-support system of the state as are the existence and interplay of the organs of our bodies to the maintenance of our health.

CALIFORNIA HAS ALREADY LOST BIODIVERSITY

Unfortunately, as more and more people have sought to derive more and more wealth and other benefits from the state's biological bounty, we have contaminated the air and water, dammed and diverted the rivers, filled in the wetlands, and plowed under the native vegetation. As a result, many species and habitat types have been nearly eradicated. Nearly 90 percent of the interior wetlands and Central Valley riparian forests have been destroyed, and nearly all the aquatic habitats in the state have been altered or degraded. A few species are already gone forever, and with them their unique, distinguishing genetic characteristics. At least 73 species of native plants and animals have been lost from the state. Even more sobering are the numbers of species on the edge of disappearing. Two hundred and twenty (29 percent) of the vertebrates and 663 (10 percent) of the native plants may merit listing as threatened or endangered species.

MANY THREATS ARE INCREASING

Looking ahead, threats to biodiversity are increasing. Many threats increase in association with California's population growth, which is one of the fastest rates in the country. Activities such as water diversion, pesticide application in agriculture, logging of old-growth forest, industrial waste discharge, and spreading suburbanization into native grasslands and oak woodlands have already caused significant losses. Without a new approach to managing our resources and using our land, the effects of these activities will increase with easily foreseen consequences: numerous species and entire habitat types are likely to be lost. New threats, such as global climate change, will also exert profound stresses on California's ecosystems and will severely reduce biodiversity, but the complexity of these problems precludes an accurate prediction of their repercussions.

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NUMEROUS BARRIERS TO CONSERVATION EXIST

Numerous impediments to effective protection of biodiversity persist despite well-meaning laws and government programs created in the past ten years to address some of these problems. Some obstacles are rooted in the nature of the threats themselves. For example, the magnitude and extent of some threats are so great and the synergies among them are sufficiently strong to challenge our ability to address any one in isolation. While some threats, such as large oil spills, result in dramatic impacts that cannot fail to attract attention, many sow destruction in small but accumulating steps. As a result, biodiversity gets "nickeled and dimed" away before appropriate regulatory action can be taken. Solving the complex problems posed by interacting and slowly accumulating stresses will be difficult, and new approaches are required.

Other impediments to effective conservation are institutional, rooted in the way the federal, state, and local governments are authorized and organized to deal with issues of resources and environment. The absence of a clear statewide governmental mandate to protect biodiversity, a lack of coordination among agencies, and inadequate provision for land-use planning hinder successful action. Additional institutional barriers stem from limited coordination of authority between state and federal, and also state and local, governing bodies. Several well-conceived laws designed to protect biological resources have failed to meet their objectives due to incomplete implementation and inadequate enforcement. The state's Endangered Species Act has loopholes, allowing imperiled species to fall through this legal safety net. In other cases, such as protection of critically rare habitats, the needed legislation is lacking.

These problems are largely the legacy of the commonly held perception that resources are inexhaustible and ecosystems are resilient to any assault. This belief shaped the goals and operations of the state's first agencies established to manage resource exploitation, and has biased our economic analyses. Alternatives to many of the practices that threaten biodiversity already exist but have not been fully implemented. While the subsequent generation of environmental agencies has a different mandate – to protect the public and the environment against pollution – there is yet no effective agency empowered to protect biodiversity.

A third set of barriers involves the research and educational communities. Major scientific concerns remain unanswered in conservation biology and environmental science. While university and government scientists have contributed to filling some of these knowledge gaps, a vast amount of exploration lies ahead. Within the universities, such applied research is often undervalued in comparison with more fashionable trends in science. Within the agencies, the day-to-day needs for quick responses to crises often overwhelm efforts to develop a deeper knowledge base. Educational barriers to effective protection of the state's biological resources are part of a much bigger national problem – environmental illiteracy. A people who do not know how their food is produced nor how their water reaches their faucets cannot make the wise decisions required if their grandchildren are to live as well as they do.

Parks and preserves are an essential component of biodiversity protection. Despite the state's many parks, the protection provided is uneven; the protected acres are largely found in the High Sierra, while several low elevation habitat types are gravely underrepresented in preserves. This problem can be addressed only by acquisition of additional critical acreage. But the mind-set that parks are the *only* answer needed can be part of the problem rather than the solution. Parks and preserves are of limited value in protecting the state's biological riches from pollutants that are transported across park boundaries or from climate change. Nor can parks protect migratory species or the aquatic habitats of our state. To maximize the protection afforded by the parks acquired with scarce conservation dollars, we need to focus on critical habitats and wildlife corridors. New approaches to reducing biological degradation outside of parks and preserves are also essential complements of an expanded park and preserve program.

RECOMMENDATIONS

Reducing threats and addressing the multitude of scientific, social, and institutional problems that currently impede effective conservation of the irreplaceable biological resources of the state will require coordinated and concerted efforts by many sectors of society. Effective governance to achieve any goal, including conservation of biodiversity, requires three ingredients: knowledge of what to do, empowerment to do it, and an administrative capacity to manage its execution. There is ample evidence that all three ingredients are currently deficient. To correct this situation, we propose a strategy with ten recommendations. Some recommendations are designed to address immediate needs; others focus on longer-term institutional change, where planning and anticipatory action are integrated into the existing regulatory and largely reactive structure.

1. Mandate that protection of biodiversity is state policy.

   Overarching all our recommendations is the need for a *Biodiversity Mandate.* The protection of biodiversity belongs on a par with public education and public safety as fundamental to the well-being of the state's citizens. Declining biodiversity will diminish the opportunities for future Californians to enjoy the economic, ecological, and aesthetic benefits it provides. The missions of all state agencies should reflect the need to protect biological diversity.

2. Establish a California Habitat Protection Act.

   While imperiled species are afforded a measure of protection under state and federal endangered species legislation, the state has no means of protecting rare habitat types or of preventing habitats from becoming critically rare. A *Habitat Protection Act* that identified critical habitats and established a means of protection through regional approaches to land-use planning would fill one of the most significant gaps in the existing system of state laws and regulations. A California Biodiversity Conservation Board would play a key role in administering the act, but the primary land-use planning responsibilities would continue to reside with local and regional government.

3. Establish a California Biodiversity Conservation Board.

   Creation of a *California Biodiversity Conservation Board* is at the core of our proposed strategy, for it addresses the most serious problem at the level of state government, namely, the absence of a coordinated approach to biodiversity protection. Without such a board the domains of responsibility of the various state agencies will continue to be blurred and critical issues will continue to fall through the cracks between jurisdictions.

4. Establish a California Biodiversity Research Institute.

   Far too often policymakers lack the information needed to make decisions about threats to biodiversity. To successfully implement statewide conservation planning, some of the knowledge gaps about the status of particular habitats and the mechanisms of endangerment must be filled. A *Biodiversity Research Institute* is proposed to answer the need for accurate and timely information and to assist in coordinating information among existing state agencies and between agencies and the Biodiversity Conservation Board.

5. Ensure implementation and enforcement of existing laws.

   Both unenforceable laws and inadequate funding and staffing diminish the effectiveness of existing laws for biodiversity conservation. The legislature must strengthen existing laws to enhance enforcement capabilities. To ensure the laws are carried out requires augmenting the capacity of resource and environmental agencies to collect data and enforce laws by increasing staff allotted to those purposes.

6. Acquire significant natural areas.

   While parks and preserves cannot be the sole solution, they are an essential part of any strategy to protect biodiversity. Acquisition of critical natural areas is needed to ensure that the state's portfolio of protected areas contains examples of the diversity of California. Special attention should be given to protecting key habitat corridors and to filling the gaps in the existing collection of natural areas. Particularly in areas of rapid growth, new parks, preserves, and green belts will protect biological diversity and provide both solace and educational opportunities about the wonders of nature to urban dwellers.

7. Reduce environmental illiteracy through education.

   Ultimately all efforts to protect biodiversity will fail if the public does not understand the fundamentals of ecology and environmental science as well as the importance of biodiversity to their lives. To fill this important gap, two initial steps should be taken. Education about fundamental concepts of ecology and environmental science using California examples is needed in the public school system. Professional training is a second critical step. Technical understanding of environmental issues is changing rapidly. To enable the staff persons of state and local agencies to keep up with changes in their fields and related disciplines, minicourses covering issues in environmental science and resource management need to be developed and made available to the people responsible for administering resource protection laws and regulations.

8. Broaden representation on state policy-making bodies.

   Many state policy- making bodies make decisions that dramatically affect the long-term health of California's bio logical resources. To ensure a balancing of the costs and benefits of their actions, these boards and commissions should – by statute – contain members representing conservation interests.

9. Close the loopholes in the California Endangered Species Act.

   The California Endangered Species Act has loopholes that hamper its ability to protect native species from extinction.

10. Protect biodiversity in the face of global atmospheric change.

    Global atmospheric changes threaten the environment of every species and habitat, not only in California, but throughout the world. California is in an ideal position to provide international leadership in the solution to both the depletion of the stratospheric ozone layer and global climate warming. California must take a two-pronged approach to protecting biological diversity, emphasizing both managing the impacts and prevention.

SUMMARY

In recent years we have seen a change both in the public's awareness of the importance of the natural environment and in resource specialists' knowledge about the fragility of ecosystems and the methods of sustainably managing them. Together these have led to a call for a new focus on biological diversity. Our proposed ten-part strategy for state action provides a framework for a future California where growth and development can occur in concert with the conservation and enhancement of the state's biological resources. Biodiversity conservation must be an ongoing process for the state, and as such will require an ongoing commitment of time, energy, funding, and wisdom. The state is at a critical juncture – the decisions made in the next ten years will decide the fate of many of the species and ecosystems in California. In doing so, we decide our own fate, and the fate of Californians forever. The choice is in our hands.

THE NATIONAL PARK SERVICE: UNPREPARED FOR THE FUTURE?

Steven Whitney[1]

I appreciate this opportunity to share my thoughts on two things I care very much about, the National Park Service and the national park system. The *Service* is the agency, comprised of 15,000 dedicated and talented people trying their best to do the right thing. The *System* is the conglomeration of parks, monuments, recreation areas, seashores, lakeshores, preserves, historical parks, battlefields, national rivers, parkways, military parks, and more – 356 individual units at last count – all managed to a very high standard, with the highest standards reserved for those 50 crown jewels, the national parks. For six years I have worked almost exclusively on national park issues. In that time I have been to many of the parks, and in my view the jewel called Yosemite holds a special place in the Park System crown.

I say this not because my parents had the vision to conceive me there, although they did, and not because I have a long list of very good memories from my visits to the park over the years, although I do. I say this because Yosemite is an extraordinarily powerful place. The Yosemite landscape, not just the valley, but in particular the valley, can grab receptive visitors by the collar and shake them up, saying, "Look at me, this is nature, this is the environment, *wake up* and be more responsible to the earth," and often . . . they do.

Unfortunately, not all visitors are receptive, and in Yosemite Valley our receptors get too much interference from what my friend T.H. Watkins has referred to as "commercial gimcrackery" on the valley floor. In our efforts to provide for visitor enjoyment at Yosemite, I believe we have tarnished that which visitors come to see, or more importantly, experience. It's a wonder anyone gets shaken by the collar any more. Some do, more must.

Four years before there was a National Park Service, former British Ambassador to the United States James Bryce had some thoughts on Yosemite. In a 1912 speech before the American Civic Association he warned, "What Europe is now, is that toward which you in America are tending." "Presently," he noted, "the steam cars stop some twelve miles away from the entrance of the Yosemite . . . surely development should come no closer. There are plenty of roads for the lovers of speed and noise without intruding on these few places where the wood nymphs and the water nymphs ought to have the landscape to themselves. If Adam had known what harm the serpent was going to work, he would have tried to prevent him from finding lodgement in Eden; and if you were to realize what the result of the automobile will be in that wonderful, that incomparable valley, you will keep it out."

Well, 1990 has been an interesting year for Yosemite and the National Park Service. In this centennial year, Yosemite was closed, not once, but twice. The first, of course, was due to the fires. The second was due to a leadership void inside the Washington beltway. In D.C. we have seen the concessions policy and general management plan (GMP) debate heat up, even while it was doused in El Portal. The environmental community is working with remarkable unity on these issues, as evidenced by the widespread support for the Yosemite Restoration Trust, a new organization which brings a powerful new weapon to the concessions reform campaign – competition.

Outside the parks, ominous trends continue that threaten to undermine these very areas Congress set aside to protect. Olympic and Crater Lake await the verdict on the few remaining scraps of ancient forests on their boundaries. In the Everglades, recent action on the part of water managers will not

1. Steven Whitney, Director, National Park Programs, The Wilderness Society, Washington DC.

stem the tide of tainted water flowing off the sugarcane fields. At Glacier, concern is rising over proposals for massive coal-fired power plants across the border in British Columbia.

Inside the parks, research is considered a luxury, interpretation discretionary, conventions appropriate, and crowding inevitable. Money and morale are down, crime and commercialism are up. Politics permeate. Leadership is lacking. Other than that, everything is fine. Don't worry, be happy.

Now I am not what anyone would call a religious man - I still feel more spiritual on a mountain top or on a wilderness beach than I do in a church. This may account for why I was daydreaming about this speech a few Sundays ago when, unexpectedly, the preacher said something relevant. He was talking about a lesson in the Old Testament about responsibility. In the lesson, Ezekiel refers to what he calls "an old proverb" that says "when the fathers eat sour grapes, it sets the children's teeth on edge for three or four generations." What Ezekiel was talking about, of course, was intergenerational responsibility – that the decisions made long ago affect us today, and those we make today will affect those who follow us – "for three or four generations." In the land game, we would call this stewardship.

Stewardship is a popular word in Washington these days. The secretary of interior even uses it, although it is not at all clear to me he knows what it means. And, of course, this concept of stewardship serves as the basic purpose of the National Park Service, according to the agency's organic act. It is, very simply, what it is supposed to do:

> . . . to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

The Congress established this challenging mandate in 1916, but the National Park Service is unable to comply with it. They have the clear *obligation* to protect the parks, but lack the necessary authorities and are unwilling to seek them. They have the *inclination* to protect the parks, but lack the necessary political support and are unwilling to court it. They have the *capability* to build an effective organization to protect the parks, but lack necessary funding and the resolve and political influence required to compete effectively for limited dollars. In short, as a protector of land, inside or outside the system, the Park Service is relatively impotent.

Right now, I have a man in Washington working to secure permanent protection for the Antarctic continent as a global park, scientific and wilderness preserve. We are allied in our effort with the governments of Australia, France, and New Zealand, all of which must ratify the convention, along with other Antarctic Treaty consultative parties and conservationists around the globe. We are opposing the views of Great Britain and, you guessed it, the United States, or more accurately, the Bush administration. We are quickly gaining the upper hand.

I take this tangent because it serves to illustrate a few important points. First, in Antarctica we are talking about preserving an area of land and water sufficient in size to perpetuate natural systems and processes unimpaired by human actions. We have not done so in the case of our national parks, not even close. Indeed, the parks are fast becoming islands in a sea of multiple abuses. Yellowstone's boundaries are plainly visible from space due to clear-cutting. Death Valley's natural springs are threatened by groundwater withdrawal to quench the thirst of Las Vegas revelers, while condos crowd Rocky Mountain National Park's wildland boundary.

Second, we are optimistic about the opportunity to permanently protect Antarctica because there is not yet an organized constituency for development. Without such a constituency, it is far easier for policymakers to consider the long view. Unfortunately, short-term economic interests are well organized here and routinely prevail over the long-term interests of the parks.

And third, we are optimistic about our chances in Antarctica because the unique construction of the Antarctic Treaty System requires multiple government approval of any major change in management. Unfortunately, it has been the United States favoring preservation not of resources but of development opportunities on the Antarctic continent, a view that permeates our domestic land management policies as well. Australia may help us in the Antarctic debate, but Australia will be of no help to us at Yosemite or Yellowstone.

In 1949, Aldo Leopold wrote:

> The National Parks do not suffice as a means of perpetuating the larger carnivores . . . neither do they suffice for mountain sheep; most sheep herds are shrinking. Many animal species, for reasons unknown, do not seem to thrive as detached islands of population. The most feasible way to enlarge the area available for wilderness fauna is for the wilder parts of the national forests, which usually surround the parks, to function as parks in respect to threatened species. That they have not so functioned is tragically illustrated in the case of the grizzly bear.

The more things change, the more things stay the same. Last month, The Wilderness Society appealed a timber sale on the Targhee National Forest, just 3 miles from Yellowstone's border. The sale is not only located within grizzly bear habitat deemed essential for recovery of the bear, but would also lose money. This is a common scenario, made even more familiar by the absence of any National Park Service involvement in the administrative decision, even though "park" bears are likely to be affected. Where is the Park Service? you might ask. Where is the leadership? Where is the stewardship? Answer, the Park Service has proven itself virtually incapable at Yellowstone of taking any major action that would run contrary to the objectives of the American Cattleman's Association, the National Forest Products Association, the American Mining Congress, or their brethren in the United States Senate. Despite news accounts to the contrary, management of the Yellowstone ecosystem has not been measurably improved, and without new leadership I am not optimistic change will be forthcoming.

Unfortunately, this problem of management of federal lands outside Yellowstone is not an isolated case. I live near the Potomac River in an area that was once dense forest. A hundred years ago it would not have been unusual to see the wood thrush, the American redstart, the yellow-throated vireo, or the Louisiana waterthrush. These songbird species were once relatively common in my neighborhood, and indeed throughout the forests of the Atlantic coastal plain. But now, with the loss of our local forested lands to urban development, the black and white warbler has been replaced by the blue and white bungalow.

In the case of these songbirds, however, local extirpation has not yet meant extinction, for there remains in the southern Appalachian highlands a forested remnant of their former range. At the heart of this vast landscape, comprising only seven percent of the total, is Great Smoky Mountains National Park. The balance of the acreage is within the national forests and intermingled private tracts. Of the total, approximately one-half is federally owned and managed.

The forest plans for these spectacular mountainous lands call for substantial increases in logging and related road construction. By 1995 logging levels on the six national forests would double. By 2030, logging would increase more than 350 percent. The plans determine that 60 percent of the forest land is suitable for timber production and they schedule clear-cuts on most of that land. To support its expanded timber program the Forest Service would build nearly 3,300 miles of additional permanent logging roads, bringing the total road system on the six forests to 8,200 miles – approximately the diameter of the earth.

And this timber program is proposed in spite of the fact that these forests consistently lose money selling timber, $5.5 million in 1987 alone. Most importantly, the roads and logging will further fragment the remaining contiguous forest habitat with predictable adverse effects on those species of wildlife, such as the black bear and the songbirds, associated with late successional plant communities.

Meanwhile, in South Florida, Everglades National Park is on the critical list. In this case, the problems primarily lie not with the Forest Service, but with state and local authorities, most prominently the South Florida Water Management District. Playing a supporting role, of course, is the U.S. Army Corps of Engineers – the folks who never saw a canal they didn't like.

To restore and preserve Everglades National Park is a noble but difficult task. The park is but a small piece of the large natural system. Upstream, everglades waters are diked, ditched, drained, pumped, and polluted. The ecosystem has suffered, the national park has suffered. Wading bird populations are down 90 percent, Florida panthers are on the brink of extinction, and exotic plants proliferate. Opportunities to mitigate the damage are limited, and even those limited opportunities are resisted by local water authorities and their masters in agriculture, mainly sugar.

And, as you might guess, South Florida has a small problem with urban development as well. The normal Florida progression goes like this: agricultural lands are created from wetlands, planted to row crops, further drained for tree crops, and ultimately prepared for Florida's final cash crop, condominiums.

But this problem, this private land conservation problem, is rearing its ugly head all across United States. The rural landscape in this country is being suburbanized, often right up to park boundaries. North of Yellowstone, the Paradise Valley is now 90 percent subdivided – at least on paper, and this scenario repeats itself throughout the privately owned and ecologically important valley bottoms in the Yellowstone region. In the desert southwest, at areas like Saguaro National Monument, whole new towns are proposed adjacent to natural area parks. The NPS response has been mixed at best, nearly always reactive, and in general, not too sophisticated.

Even at Yosemite this private land trend is apparent. Oakhurst is becoming a bedroom community for Fresno, and tourism services are becoming a more prominent component of local economies. This points out the need for the National Park Service to be an active player in local government decision making, *and* the need for local government to consider the concerns of the national park in their land planning and development decisions. Local residents should become advocates for the park, *human buffers*, guarding the park from the adverse effects of sloppy development.

Which brings us to the subject of Yosemite Valley. Last Saturday, when in the valley, I saw a bicycle traffic jam outside Degnan's – now that's progress! To me, Yosemite Valley resembles a . . . sort of a cross between Carmel and Club Med. Want to play golf? No problem. Want to play tennis? No problem. Want some time with a ranger naturalist learning about the natural history of the park? Big problem. This summer the National Park Service had one nightly campfire program, to serve 7500 overnight visitors in the valley. Most rangers spend more time arresting drunks than they do interpreting the resource; drinks aren't hard to find in Yosemite either.

Yosemite is not alone, of course. At Yellowstone they put 14 acres of asphalt, three hotels, four restaurants, a grocery store, gift shop, photo shop, gas station, *and* a cloverleaf, all within a quarter mile of the Old Faithful geyser. At Yellowstone Lake, they put a grand lodge right on top of critical grizzly bear spring range, and they developed another at Fishing Bridge on even better grizzly habitat.

Then to "compensate" for reducing development density at Old Faithful, they built the Grant Village complex in grizzly bear habitat, on the condition that Fishing Bridge would be closed. It wasn't. Now we've got 'em all. We have Lake, Fishing Bridge, Grant Village, *and* proposals to upgrade facilities at Old Faithful to accommodate more winter use -- mostly snowmobilers. And then, for all you "Park Mart shoppers," there's Canyon Village, the NPS prototype of a suburban shopping mall, and at Mammoth, a building dedicated to the year-round sale of . . . you guessed it, Christmas tree ornaments. No wonder many conservation activists no longer consider the National Park Service the preservation agency of choice.

In 1934, Secretary of the Interior Harold Ickes gave his gathered park superintendents a prophetic warning saying:

> I don't want any Coney Island . . . I think the parks ought to be for people who love to camp and love to hike and . . . wander about and have . . . a renewed communion with Nature . . . I am afraid we are getting gradually alienated from that ideal. We are becoming a little highbrow; we have too many roads. We lie awake at night wondering whether we are giving the customers all of the entertainment and all of the modern improvements that they think they ought to have.
>
> But let's keep away from that, because if we once get started, there will be no end . . . the greatest service that we can do the people who come to our parks is to get them back to the simpler things in life . . . we can give people generally a renewal of the fundamentals of life and the worthwhile things in life. That is what our parks are for. They are to be the great outdoor temple. And we ought not desecrate them or permit them to be desecrated.

To me, Yosemite is one of the most extraordinary natural areas on earth, but as a rule we have not treated her well. For that I lay some of the blame on the Park Service, and some on the Congress, but much on the Yosemite Park and Curry Company. The fact of the matter is, notwithstanding press releases to the contrary, the Curry Company has not done very much to benefit the park. And, that which they *have* accomplished has largely been in their own business interest. In our present system of concessions law and policy, this is to be expected. There is no incentive for altruistic behavior on the part of Music Corporation of America (MCA). As a result, since 1980 accommodations have increased, not decreased, profit centers abound, the concession headquarters remains, and Curry executives still wake up with a view of Half Dome out their picture windows.

Now I know that one or two "noted conservationists" have come to Curry's defense claiming the valley is in better shape now than it was in 1932. To that, with all due respect, I say, *so what?* Since when is 1932 the benchmark against which we measure the quality of Yosemite Valley? Frankly, I don't care whether we give the Curry Company bouquets or bricks, but while we're at it, let's give them a damn bulldozer so they can start doing their part to implement the GMP.

All of this has been perfectly legal of course, either under the Curry Company's present contract with its "mutual consent" or what I call the "you can go to hell" provision, or under the Concessions Policy Act, a law which serves to protect the business interests of incumbent concessioners, often at the expense of national park resources.

Now, you may have heard that Secretary Lujan is going to fix this concessions problem. Not true. Certainly, some of the changes he proposed would, over time, improve the program. However, this high-level attention to the concessions issue has been driven primarily by concern over ridiculously low franchise fees, not by a recognition that the existing concession program ties the hands of park managers, damages park resources, and impairs park values. Real reform will require a fundamental rewrite of the Concessions Policy Act.

In our view, the business interests of the concessioner must always and forever be subservient to the resource interests of the National Park Service. Indeed, the Concessions Policy Act itself says as much in Section 1. Here's what it says:

> . . . public accommodations, facilities, and services as have to be provided within those areas should be provided *only under carefully controlled safeguards* against unregulated and indiscriminate use, so that the heavy visitation will *not unduly impair these values* and so that development of such facilities can best be *limited to locations where the least damage* to park values will be caused.

The act goes on to say:

> . . . It is the policy of the Congress that such *development shall be limited to those that are necessary and appropriate* for public use and enjoyment of the national park area in which they are located and that are *consistent* to the highest practicable degree *with the preservation and conservation of the areas.*

Yet, despite this apparently strong language in Section 1 of the Concession Policy Act, concessioner accommodations, facilities, and services often do not meet these standards, and they certainly do not at Yosemite. And, when the National Park Service attempts to force compliance with these standards, it is rarely successful. This is why the concession system is broken, and why it must be fixed.

Ten years ago the National Park Service adopted a General Management Plan for Yosemite National Park. It is a plan that acknowledges changes are needed at Yosemite; that Yosemite Valley has become overdeveloped, overpaved and overused; and that certain concessioner functions are no longer, if they ever were, necessary and appropriate. The plan acknowledges that compliance with the service's fundamental obligations to future generations means it is time to begin reducing traffic, reducing clutter, and moving development out of Yosemite Valley. But there's not been much movement. Some have suggested the GMP needs to be re-opened and revised. Frankly, they may be right. And as you might have guessed, we have a few changes we would like to see as well. And we intend to pursue them.

At this point, you might be wondering if all the news is bad. Certainly not. Last December, President Bush signed into law an important expansion of Everglades National Park. Two years ago, legislation was passed designating as wilderness most of Olympic, North Cascades, and Mount Rainier national parks. Just recently, the House of Representatives passed legislation requiring the National Park Service to study the boundaries of its units and to make recommendations for needed modifications. Last month, Senator Bumpers introduced the National Heritage Conservation Act, sort of a new generation park protection act, intended to reduce the opportunity for damage to park resources from external sources of disturbance.

Inside the Park Service there has been good news as well, but it seems the service routinely takes two steps backward for every step forward. Good off-road vehicle (ORV) regulations were retained at Cape Cod National Seashore, while the director waived snowmobile prohibitions and wilderness policy at Voyageurs. Logging trucks were prohibited from routing through Yellowstone as an inappropriate commercial use, yet the service openly ignores illegal commercial fishing at Glacier Bay. When a superintendent in Montana vigorously defended his park from external threats, he was rewarded with a lecture from Congressman Marlenee, who said ". . . get back inside your park and quit trying to manage my state."

Frankly, when I look at the record, I am pretty much underwhelmed. The problem lies not so much with the quality of the people in the service, although recruitment and retention of good people has become a problem due to low wages. The real source of the problem lies in the fact that we have asked the service to do far too much, with far too little. We simply have not given the good people in the service the tools necessary to do the job.

In the past 20 years, total park visitation has more than doubled. The system has increased in size from 252 areas to 356 areas. And acreage increased from 27 million acres to the 80 million acres the National Park Service administers today. In that time frame, new types of units were added, urban units – expensive, labor intensive, and challenging units. Compliance with NEPA and other environmental laws became a normal part of daily NPS operations. Planning requirements became more sophisticated, congressional reporting requirements increased, and external sources of disturbance have become more complex and commonplace. The service is stretched to the limit – probably beyond.

And what about the future? Not long ago I was talking to the director of the service abut next year's 75th anniversary of the National Park Service and the Organic Act. My suggestion to him was that he use the 75th anniversary as a leadership opportunity to look ahead to the year 2016 and to lay out his vision for the National Park Service and the national park system – and then to articulate a near-term plan of action to begin working toward that vision.

To do so, the director will need to visualize the parks in a very different physical and social context. The population of the United States has been growing at a rate of 3 million persons every year. It is often said that the United States will be an increasingly aged population due to the graying of the baby boom generation. While this is true, what is often forgotten is that the baby boomers' babies will be young adults in the year 2016, and they'll be having their own families. More children were born in the United States in 1986 than in any year in the past twenty. 3.5 million people will visit Yosemite in 1990. How many will want to visit in 25 years? How many will the Park Service choose to accommodate, and at what level of comfort? These are the tough questions before the director.

The director will also need to visualize the parks in a nation composed increasingly of people of color – people without European ancestral roots – new Americans, who may not understand our pioneer history or appreciate our land ethic or concepts of stewardship. How can the Park Service help teach the value of land – the spiritual, biological, and social value of land – to this new segment of our society? What new programs must be established? How should our priorities change? After all, these are the voters of tomorrow, an increasingly potent force in American politics. They will have much to say about the future of the parks. The Park Service cannot afford to ignore them.

And lastly, Director Ridenour better understand that the parks will unalterably change if current fragmentation of wildlands outside their boundaries continues unabated. The suburbanization and industrialization of the rural landscape must stop where that seemingly unstoppable trend threatens to undermine the integrity of our national parks. To preserve unimpaired is what the law says, but we're losing ground, both in the field and on the Hill.

In my view, to meet the obligations of today and to respond to the challenges of tomorrow, the Park Service needs new legal authorities, new money, a few new programs, and a whole lot of leadership.

Authority is needed to reign in the concessioners and to hold them in check, even as more and more visitors demand more and more services and modern comforts. Authority is needed to require other federal agencies to consider the effects of their actions on park resources, and to mitigate those effects or forego the actions. Authority is needed to empower the Park Service to be an active player in non-federal external affairs, particularly local zoning and development decisions. This may require more carrot than stick, but it's time to bite the bullet and admit there is a proper federal role when such decisions affect nationally significant resources. And, authority is needed to bring new lands into the system, both entirely new areas for which representation is inadequate, or more frequently, adjacent lands integral to an existing area.

New money is needed, very simply, because we can no longer allow our parks to be run on a shoestring. We have come to the end of the decade of deferral, the decade of neglect, and we know it was a mistake. Improved funding is essential.

Now, some budgetary improvement might be possible by reevaluating the allocations within the existing NPS budget. For example, on the expense side, the maintenance budget for the Park Service exceeds the budgets for resources management, visitor protection and safety, interpretation and visitor services, information and publications, international park affairs, volunteers in the parks, water resources, and general management planning . . . *combined!* Nearly $300 million dollars, almost one-half of the operations budget, goes to maintenance.

I've got to tell you that I find it unfortunate that maintaining the built environment is the highest fiscal priority of the service. Perhaps it is time to reconsider the need for all this construction inside the parks. Maybe the private sector can take some of the burden for providing infrastructure such as housing and administrative building *outside* the parks. One simple fact seems too little considered: construction in year one becomes a maintenance burden in later years. Indeed, in some ways, the real legacy of Mission 66 is a maintenance bill the Park Service is unable to pay.

But, even after such a reevaluation, the annual NPS budget will require significant enhancement, perhaps to the tune of $300 million dollars annually. With $300 million, you can bring the NPS budget up to an appropriate level, or you can buy half of a B-2 bomber. You pick.

A few new programs will be needed as well, particularly in the international realm; the Park Service has much to offer there. But mostly what the NPS needs is to return to basics, to return to the Organic Act.

The 1916 Organic Act lays it out fairly clearly to me. It says the Park Service is to protect the parks forever, from any source of damage, inside or outside, loggers or lodgers. It also says the service is to provide for visitor enjoyment. And, while some have suggested that these two mandates – preserve and use – are co-equal, they are not.

I like to think of the Organic Act as a stool with three legs. The first leg represents research, or the need to understand that which the agency is charged with protecting. In my view, research is the activity most fundamental to the service's ability to comply with the 1916 act. We must put a priority on research.

The second leg of the stool is resources management, or the application of scientific information to management decision making. All of the science in the world will be of little value unless it is put to good use by managers.

And third is interpretation – the sharing of that resource knowledge with national park visitors. "To provide for visitor enjoyment" does not mean cater to every whim. It means to establish programs necessary to help visitors understand that which they have come to see, to develop that pride and patriotism inspired by a rich cultural history or scenery unmatched on earth; to develop the deeper understanding, and yes, *enjoyment,* that comes from really experiencing our great parks. The parks cannot be all things to all people. They should be places where visitors can have a unique experience, a remarkable experience, an experience unavailable elsewhere. Without access to quality interpretation, visitors are short-changed, the nation is short-changed, and the three-legged stool is weakened.

New authorities, new money, a few new programs, and leadership to refocus on the basics. There are lots of NPS people that wish it would happen, but it will not, unless we help. There is a huge constituency for the national parks – nearly 300 million people will visit the system this year – but they are not mobilized. If only half of those people knew the challenges facing the parks, and if only half of them acted on that knowledge, you can bet our government would respond, and fast. That's how our political system works; we've just not made it work for the parks.

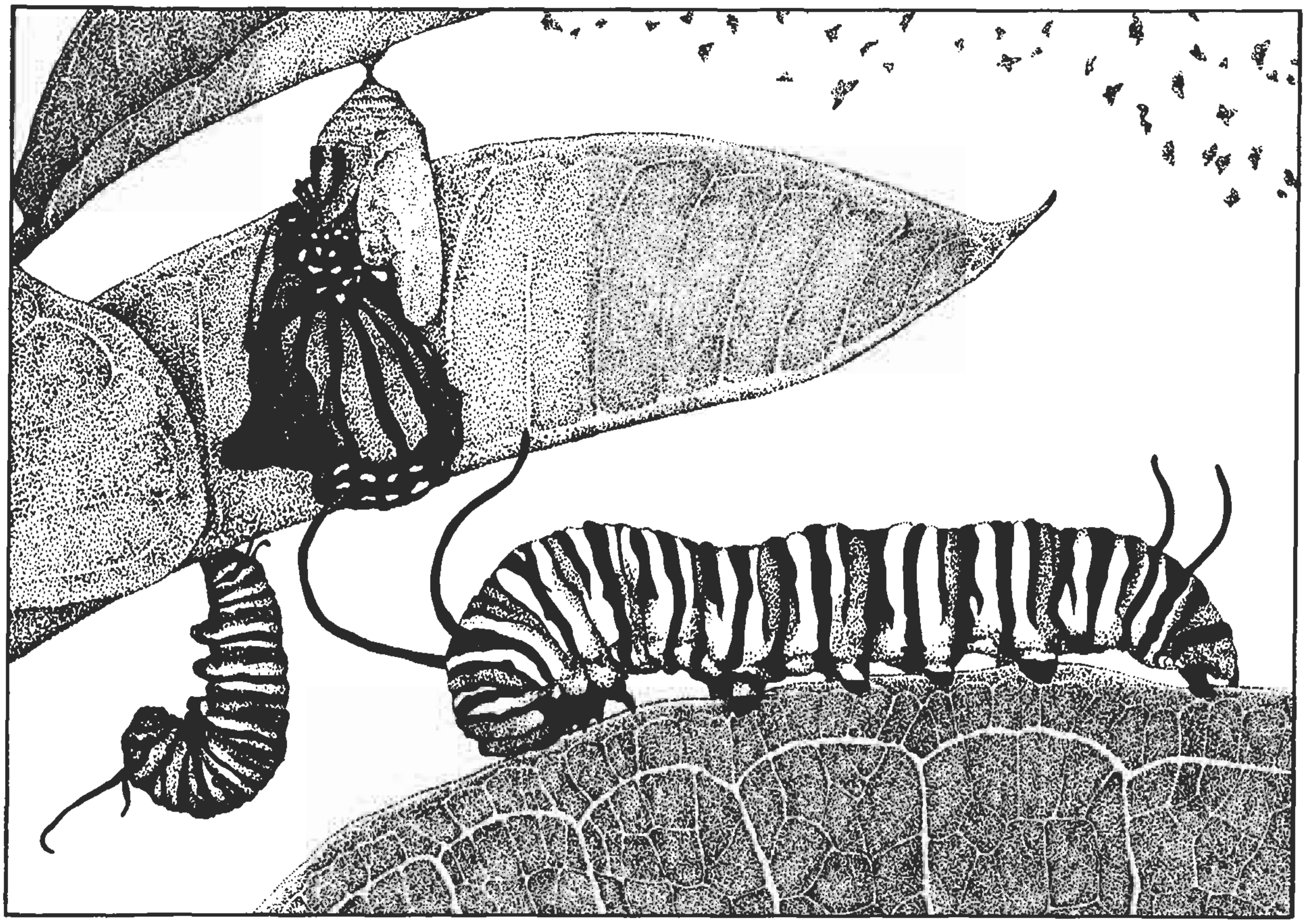
Old Ezekiel was right. Politicos and Park Service leaders generations ago made decisions that seemed like a good idea at the time, but now cause our teeth to stand on edge. But there was more to Ezekiel's message. He went on to point out that present generations cannot escape responsibility simply by blaming the problems of today on sour grapes eaten long ago. While our concessions problems had their start in the days of Stephen Mather and the powerful railroads, that does to relieve our responsibility to right the wrongs, so that three or four generations from now, Americans and friends from around the globe will be able to experience Yosemite as we have, to be awed by her magnificence, to be shaken by her grandeur, and to hear her message of stewardship.

In the early 1950s, NPS Director Newton Drury got it right when he said, ". . . if we are going to succeed in preserving the greatness of the national parks, they must be held inviolate. They represent the last stand of primitive America. If we are going to whittle away at them we should recognize at the very beginning that all such whittlings are cumulative and that the end result will be mediocrity. Greatness will be gone."

Friends, I don't know about you, but in my vision for Yosemite, and for the rest of the parks, the word mediocre simply *has no place*. But, at the same time, I fear the window of opportunity is closing on land protection in this country – time is plainly running short. Our generation has a choice: we can choose to empower the Park Service to protect the parks, or we can ignore Newton Drury and accept mediocrity. For Yosemite and Yellowstone, the Great Smokies and the Everglades, for my children and yours, I hope we make the right choice.

Thank you.

BIOSPHERE RESERVES



Feeding and Pupating Monarch Caterpillars, and Emerging Monarch Butterfly, *Danaus plexippus*
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BIOSPHERE RESERVES: SYMBOLIC DESIGNATIONS OR NEW CONSERVATION MODELS FOR THE FUTURE

William P. Gregg, Jr.[1]

It has been suggested that the loss of biological diversity may be the legacy for which future generations will be the least likely to forgive us. The 1990s may well be the last decade for exercising our options to prevent the loss of much of the heritage. Biosphere reserves are a flexible approach for natural areas to become active participants in addressing the complex causes of the loss.

Nearly 20 years ago, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) published the blueprint for its Man and the Biosphere Program, or MAB (UNESCO 1971). MAB's goal was to facilitate and implement an intergovernmental program of interdisciplinary research that would emphasize an ecological approach to understanding interrelationships between humans and the environment. One of MAB's thirteen original projects focused on the conservation of natural areas and their genetic resources. An important component of this project called for the establishment of a coordinated global network of "biosphere reserves." The biosphere reserves would conserve representative ecosystems as ecological standards against which to assess the effects of human activities. The designation of these areas would encourage scientific uses and recognize the international interest in developing effective conservation programs in these areas. After the 1972 Stockholm Conference on the Environment endorsed the concept of a global network of protected ecological areas, UNESCO began coordinating an international planning effort that led to the establishment of the biosphere reserve program in 1974 (UNESCO 1973, 1974) and the designation of the first biosphere reserves in 1976.

The program's architects recognized that successful stewardship of natural areas as ecological benchmarks would require consideration of human uses in the surrounding areas. Biosphere reserves therefore would help link strictly protected core areas for studying natural systems with surrounding or nearby areas that could be experimentally manipulated and managed for sustainable ecosystem uses. Through their research, education, and demonstration programs, biosphere reserves would promote types and patterns of human uses that would help maintain and restore natural processes and biotic diversity. In regions long settled by traditional or native peoples, biosphere reserves would include areas illustrating harmonious cultural practices and patterns of rural land uses. This would enable traditional knowledge to be documented and incorporated in developing conservation approaches.

The bottom line then as now is that biosphere reserves should be geographic areas of outstanding conservation and scientific value. They should be "landscapes for learning." They should help build the knowledge, skills, and attitudes required for integrating conservation and the rational use of natural resources in representative biogeographical regions. They should be areas for international cooperation in developing and applying information to address practical conservation and resource use problems. They should help natural area managers respond to regional and global issues by providing a framework for cooperation. Habitat fragmentation, climate change, regional pollution, and other complex interacting influences upon natural areas require unprecedented coordination on scales ranging from local to global. Biosphere reserve should help natural areas shape solutions by helping their managers and constituencies become more active participants in planning and implementing relevant programs at the appropriate scales.

In the long run, maintaining biological diversity will be achieved substantially within the context of holistic regional landscape planning and management. If biosphere reserve programs are to help build

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new paradigms for conservation and sustainable use of landscapes, they must involve agencies and organizations representing conservation, science, and economic development sectors. The programs will usually need to involve many different administrators and sites to provide the support base needed to integrate the conservation, development, and logistic/information-sharing roles of the biosphere reserve (Batisse 1986). Finally, local people – particularly indigenous resource users with cultural or spiritual ties to the ecosystem – must be active and supportive stakeholders. A biosphere reserve can give natural area managers and these interests an aegis to find common ground and work together on cooperative programs and projects that demonstrate the practical value of conservation (Gregg 1989). It can provide the focus for building informal partnerships and formal MAB organizations to marshall technical capabilities, funds, and a broad base of institutional and public support for solving regional problems. These organizations can foster a common stake in sustaining the long-term research and educational programs needed to achieve biosphere reserve objectives.

As of January 1991, there were 293 biosphere reserves in 73 countries. About two-thirds are located in developed countries and in biomes that are particularly well represented in the United States. The United States has the largest domestic network, with 46 biosphere reserves that together include 90 administrative sites under federal, state, local, and private ownership. The Soviet Union, with 20 biosphere reserves and a much more limited base of participation, holds second place. The U.S. biosphere reserves represent nearly all biogeographical provinces wholly or partially within the United States and its territories.

During the program's first decade, UNESCO emphasized expansion of the network to increase the representation of biogeographic areas. Most countries nominated existing national parks and similar strictly protected areas. In designating these sites as biosphere reserves, UNESCO recognized their value as core areas for ecosystem conservation and baseline studies. However, during the first decade of designations, UNESCO did not require the nominations from national MAB organizations to show how these areas would actually implement biosphere reserve concepts within the larger region. In the United States, the early proponents of biosphere reserves realized the limitations of narrowly focused protected areas in implementing the multiple roles of biosphere reserves. National parks, serving largely as core areas, were therefore paired with experimental research areas in the same biogeographic area to encourage comparative research involving human uses and management practices. However, the early designations were invariably overlain on existing administrative units. This made it difficult to establish the separate identity of the biosphere reserve. To many, the boundaries and management goals of the designated protected areas determined the de facto limits of concern for the biosphere reserve. This problem later became a constraint in developing biosphere reserve programs and a broad constituency for biosphere reserves.

A few developing countries, such as Mexico, established biosphere reserves by law as new protected areas, which were funded and staffed to develop programs (Halffter 1984). These countries often had less well-developed systems of nature protection. The biosphere reserve proved to be a politically attractive model for integrating ecosystem protection and sustainable use goals, and for obtaining international assistance in conservation programs. However, most countries, particularly those with highly developed systems of resource protection and management, have relied on voluntary initiatives involving existing protected areas to implement biosphere reserve programs. In the United States the lack of legal requirements or obligations has been an important consideration in administrators' decisions to seek biosphere reserve designation, and, in recent years, to participate in biosphere reserve organizations and in developing cooperative programs.

Unfortunately, many countries do not yet have government policies to promote biosphere reserves. Site administrators have looked to national MAB organizations for assistance. These organizations have generally been unable to meet the need for funding and technical support of projects involving designated sites. The national U.S. MAB programs, for example, depend on the discretionary contributions of participating federal agencies, none of which has a budgetary line item specifically for MAB. In recent years, the number of contributors (10 agencies in fiscal year 1990) and the total budget (about $1 million) have increased. However, U.S. MAB's resources limit its ability to achieve its mission, of which the functional development of biosphere reserves is but one component. Given these conditions, U.S. policymakers and biosphere reserve managers have sometimes considered biosphere reserve designation as a gratuitous honor rather than a call to action.

In 1984, the first World Congress on Biosphere Reserves called for an action agenda to develop biosphere reserve functions. UNESCO incorporated the Congress's recommendations in an international Action Plan for Biosphere Reserves (UNESCO 1984). Since then, UNESCO has progressively emphasized capability and commitment to implement biosphere reserve functions in evaluating new nominations (UNESCO 1987, 1989). "Overlay" designations are discouraged. Designations involving large geographic areas, complementary sites and multiple administrators, and a coordinating structure are encouraged. The result has been twofold. First, because biosphere reserve status is now less easily conferred, it is more highly valued. Sites designated during the past few years identify strongly with biosphere reserve concepts and are, in most cases, actively developing biosphere reserve programs. Second, national MAB organizations, such as in the United States and the United Kingdom, are increasingly working with previously designated sites – mostly national parks and similar areas – to explore ways to implement biosphere reserve concepts.

A new generation of biosphere reserves based on biogeographical areas rather than individual protected areas is beginning to emerge. The southern Appalachians, the Champlain-Adirondack region, and the central California coast exemplify this approach.

In each region, a biosphere reserve organization is in place or being developed, and programs are getting underway. These areas illustrate different approaches to organizing and implementing biosphere reserves to help address conservation and development issues in upland, coastal, and marine areas under a wide range of ecological, cultural, socioeconomic, and institutional conditions. U.S. MAB and outside sources are supporting feasibility studies for developing biosphere reserve programs in other areas as well. In addition to these efforts, many existing biosphere reserves are informally exploring possibilities for developing regional programs and cooperative projects (see figure).

This year, the nation and this conference celebrate the centennial of the establishment of Yosemite National Park, and, in so doing, the particular role of California and Californians in conservation. California has more biogeographic provinces, ecosystems, and species than any other state, and is blessed with a wealth of universities, public agencies, and private organizations concerned with conservation and sustainable use of California's ecosystems. Not surprisingly, California also has the most biosphere reserves (8). The recently designated or recently expanded biosphere reserves among them include clusters of sites in the northern California coast ranges, the central California coast, the Colorado and Mojave deserts, and the Channel Islands. All are developing cooperative biosphere reserve programs or are actively exploring the possibilities. Earlier "overlay" designations (the San Joaquin experimental range, the Stanislaus-Tuolumne and San Dimas experimental forests, and the Sequoia and Kings Canyon national parks) provide additional possibilities. The central and southern Sierras may provide an exceptional opportunity to demonstrate biosphere reserve concepts in practice. The large area of national parks, national forests, and other managed lands provides a logical geographic framework for building a functional network for better understanding and management of this ecologically sensitive and biologically rich region.

The National Park Service has recently designed its global change research program on biosphere reserve concepts. The program seeks to provide basic understanding of the effects of global climate change in particular biogeographic areas through coordinated studies at the species, community, watershed, and landscape levels. At the same time, the program seeks to improve the scientific basis for cooperative management of potentially unprecedented changes in ecosystem processes and species distributions in these biogeographic areas. At full funding the program will support cooperative research involving many agencies in up to 20 biogeographic areas. The National Park Service has selected the central and southern Sierras as one of seven biogeographical areas for initiation of global change research programs in 1991.

The biosphere reserve network provides particular opportunities for coordinated research on biological diversity, sustainable use, and global change in similar ecosystems in different parts of the world. Several U.S. biosphere reserves are participating in MAB-funded studies of biological diversity and ecological processes in paired biosphere reserves, most notably with the Soviet Union with which MAB has established an operational computer link for exchanging ecological data.

Last month, the U.S. MAB National Committee approved official guidance for regional program organizations that wish to be affiliated with the national MAB program. The national committee recently established a Biosphere Reserve Coordinating Committee to guide the U.S. biosphere reserve program. The latter is preparing an action plan to set forth the mission, goals, and action agenda for the U.S. Biosphere Reserve Program.

The jury is out on biosphere reserves. The verdict will depend on whether emerging biosphere reserve programs can successfully demonstrate principles of conservation and sustainable use, strengthen the links between research and management, broaden the constituency for conservation, and strengthen institutional and public support for MAB as a framework for governmental cooperation at the local, regional, and international levels. In the 1980s, the issues that biospheres reserves were established to address became important global issues, and important priorities for natural area managers. In the 1990s, those with a stake in demonstrating how to maintain biological diversity within the context of sustainable ecosystem uses will determine whether biosphere reserves will be standard-bearers for these efforts in the next century. That potential stakeholders are thoughtfully considering the benefits of biosphere reserves in more than 20 biogeographical areas of the United States is cause for optimism that future contributions will be significant.

REFERENCES

Batisse, M. 1986. Developing and focusing the biosphere reserve concept. Nature and Resources 22(3):1-10.

Gregg, W.P., Jr. 1989. On wilderness, national parks, and biosphere reserves. In *Proceedings on the Symposium on Biosphere Reserves, Fourth World Wilderness Congress*, W.P. Gregg, Jr., S.L. Krugman, and J.D. Wood, Jr., eds. September 14-17, 1987, Estes Park, Colorado. U.S. Department of the Interior, National Park Service, Atlanta.

Halffter, G. 1984. Las reservas de las biosfera: conservacion de la naturalenza para el hombre. *Acta Zoologica Mexicana* 5:4-48.

UNESCO. 1989. *Report of the Scientific Advisory Panel on Biosphere Reserves.* MAB Report Series N. 61. Paris.

UNESCO. 1987. *A practical guide to MAB.* Paris.

UNESCO. 1984. Action plan for biosphere reserves. *Nature and Resources* 20(4):1-12.

UNESCO. 1974. *Report of the task force on criteria and guidelines for the choice and establishment of biosphere reserves.* MAB Report Series No. 22. Paris.

UNESCO. 1973. *MAB Expert Panel on Project 8: Conservation of Natural Areas and the Genetic Material They Contain.* MAB Report Series No. 12. Paris.

BUILDING BIOREGIONAL INSTITUTIONS: THE SOUTHERN APPALACHIAN MAN AND THE BIOSPHERE PROGRAM

Hubert Hinote[1]

Abstract

Regional Man and the Biosphere (MAB) programs provide the aegis for cooperation among agencies, institutions, and organizations in developing the knowledge, skills, and attitudes to support a continuing process of integrating conservation and sustainable economic uses in a particular biogeocultural region. Thus, a regional MAB program provides a framework for achieving the purposes of MAB and developing the multiple roles and objectives of biosphere reserves.

The first regional MAB program was established in August 1988 – the Southern Appalachian Man and the Biosphere (SAMAB) program. The program involves an interagency agreement establishing a cooperative to coordinate the participation of federal and state agencies representing the science, conservation, and economic development sectors; the designation of permanent and ad hoc committees to plan and implement MAB research, education, and demonstration projects; the creation of a not-for-profit SAMAB foundation; and the provision of an institutional framework for demonstrating the practical benefits of biosphere reserves.

INTRODUCTION

The southern Appalachian region is scenic and biologically diverse. It is also a region of contrasts, with extreme poverty in some areas but also with a wealth of scientific and management expertise in the agencies and institutions of the region. Parts of the region have experienced rapid growth of communities, industry, and tourism in recent years. This has resulted in poorly planned land development and degradation of natural resources in some areas. The complex attendant problems of atmospheric pollution, decline in water quality, and degradation of natural habitats have caused growing concern about the potential of the area to meet the needs of people in the future. Therefore, there was an urgent need for a regional program that would better utilize existing experience and expertise to help solve these problems and sustain economic development in the region.

The basic concept is that natural resource managers must take into account the nature and condition of natural resources to develop prudent, lasting solutions to sustain the resources. Resource management agencies' abilities to sustain resources and yield greater benefits for society could be increased through systematic cooperation on a regional scale, rather than through separate agency "outreach" programs. The southern Appalachian highlands is a natural arena for holistic planning and management, because many of the issues are regional in scope and character. It could be characterized as a "bioregion" because of the related flora, fauna, climate, geology, and human cultures. The region is defined, for the purpose of an integrated program, as the mountain, ridge, and valley portion of southwestern Virginia, eastern Tennessee, western North Carolina, western South Carolina, northern Georgia, and east-central Alabama (fig. 1). However, many natural resource problems extend well beyond the region – for example, migratory species, air pollution, and global climate change. Use of the MAB program offers an additional means, through its program and biosphere reserve network, to deal with issues that extend beyond the region.

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Although unifying characteristics such as geography and ecology are necessary for developing an integrated regional program, they are not sufficient. People must also feel they belong to a socially distinct area if such a program is to be supported. This is true of the southern Appalachian highlands, for many people feel their "home" is the region. There is also a growing pride in the area and concern about its future. This is an asset in developing a cooperative program, because people will get involved in grass roots activities.

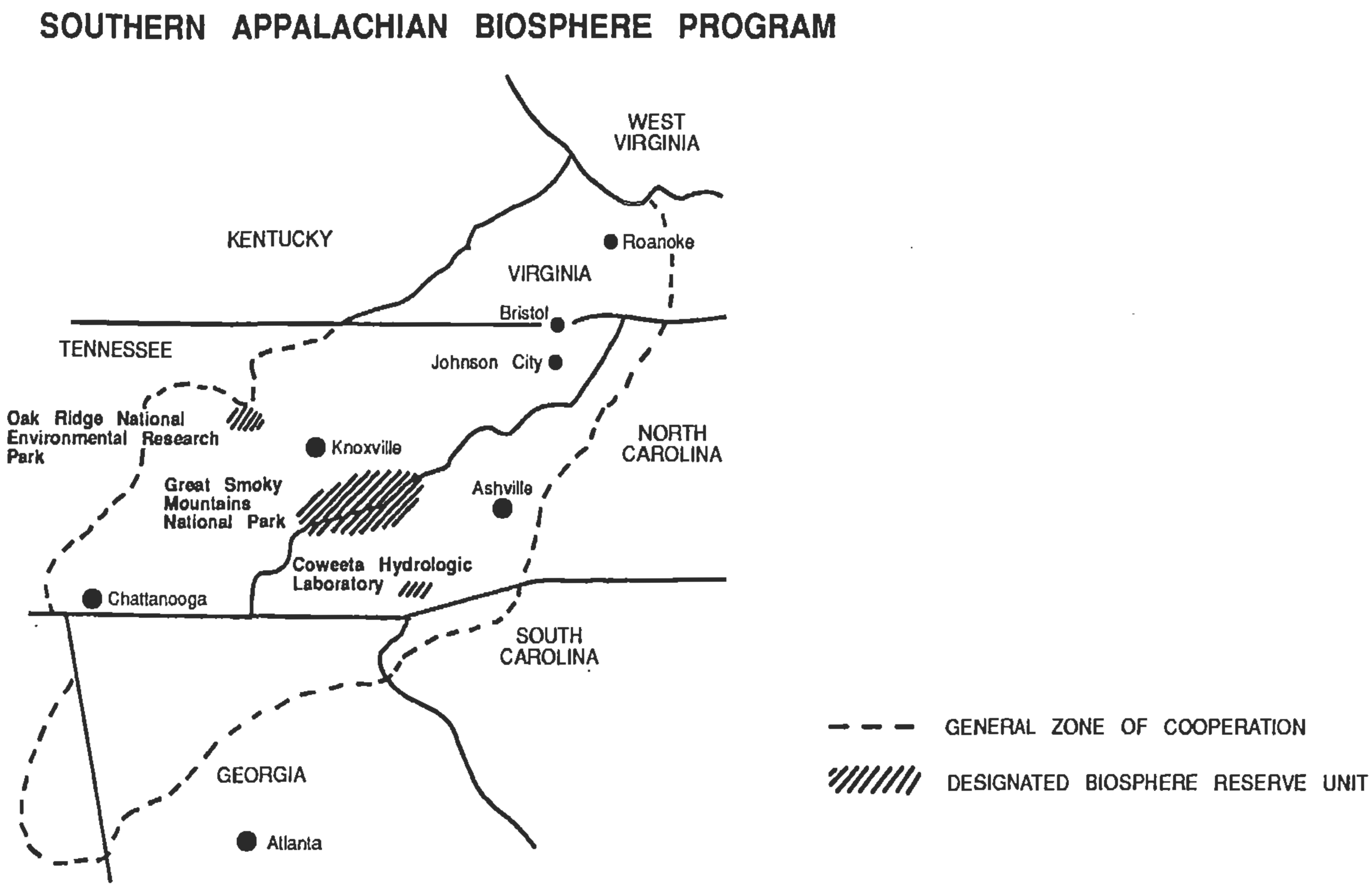

Figure 1. Southern Appalachian Biosphere Reserve

MAB PROGRAM AND BIOSPHERE RESERVES

The Man and the Biosphere program was begun in 1971 (by UNESCO) to provide an integrated, scientific approach to the management of the natural resources of the biosphere. One of the program's major objectives is to enhance regional conservation, planning, and development. An important part of this has been the development of an international network of biosphere reserves – protected and environmental areas representative of different biotic regions of the world and linked through a coordinated international network. The program is innovative because it is creating a network of protected areas that demonstrate that conservation can be combined with scientific research, environmental monitoring, training, environmental education, and economic development.

In 1975 the U.S. Biosphere Reserve Committee developed the concept of multiple reserves to provide biosphere reserve pairs or clusters representing a particular biotic region. In southern Appalachia, Great Smoky Mountains National Park – operated by the National Park Service and located in eastern Tennessee and western North Carolina – and the Coweeta Hydrologic Laboratory – operated by the USDA Forest Service and located in western North Carolina – were among the first biosphere reserve pairs in the world to be officially designated by UNESCO (1976).

Over the next decade (1976-1986), a number of MAB-related activities occurred in southern Appalachia:

- In 1976 the first bioregional MAB workshop was held at Great Smoky Mountains National Park (GSMNP).

- In 1977 the first pilot study sites to develop the criteria and methodology for pollutant monitoring in biosphere reserves were selected in the Great Smoky Mountains.

- In 1978 the Southern Appalachian Research and Resource Management Cooperative was formed – a cooperative of six major state universities and three federal agencies. This cooperative was based on MAB principles.

- In 1978 an international workshop (sponsored by U.S. MAB, UNESCO, and UNEP) was held in the southern Appalachians to develop recommendations for long-term ecological monitoring in biosphere reserves around the world.

- In 1980 GSMNP was selected as a prototype for a U.S. MAB report series on the history of scientific activities in biosphere reserves.

- In 1981 GSMNP was selected as a MAB pilot study site for land use/land cover mapping using aircraft-based multispectral scanner.

- In 1984 the Conference on the Management of Biosphere Reserves was convened as a major event in the 50th anniversary celebration of establishment of GSMNP as a national park.

- In 1985 a U.S. MAB Biosphere Reserve Selection Panel on Biosphere Reserves in the Eastern Forests recommended expansion of the biosphere reserve network.

- Also in 1985, the *U.S. Strategy on the Conservation of Biological Diversity*, an interagency task force report to Congress, recommended that support might be directed toward "the potential role of Biosphere Reserves as centers for developing the information and skills needed for sustainable conservation of regional ecosystems and for the continuing assessment and improvement of resource management through research."

- In 1986 the U.S. MAB endorsed the nomination of the Southern Appalachian Biosphere Reserve and initiated the planning of a model biosphere regional project. UNESCO recognized the southern Appalachians as one of two areas in the United States that best exemplified biosphere reserve concepts.

The National Park Service's Southeast Regional Director Robert Baker proposed pilot projects in cooperative system planning, and he agreed that the MAB approach should be used in the southern Appalachians. He described the critical problems facing this region as "increasing urbanization, pollution, competition for consumptive resources, and the shrinking of personnel and fiscal resources." He stressed the need to begin a process of identifying regional issues and developing objectives and strategies to address them on a scale reaching beyond park boundaries, indicating that "these efforts should draw their strength from interagency cooperation aimed at achieving common goals – an ecosystem approach which should be discussed with leaders in the area."

THE FORMATION OF SAMAB

Given the background briefly discussed above, a feasibility study based on the concept of a biogeocultural region was initiated. Moreover, it had been suggested that other units be nominated to form a Southern Appalachia Biosphere Reserve cluster. The cluster would provide additional areas for carrying out coordinated research, resource management, and training activities in the region and for sharing of information through the national and international MAB networks. In fact, another unit was added in 1988 – the National Environmental Research Park, operated by the Department of Energy at Oak Ridge, Tennessee. Other units are currently in the process of being added, for example, Mount Mitchell State Park in North Carolina.

In August 1987 site managers and administrators from federal and state agencies met at Clemson University to explore the development of a cooperative organization based on the MAB framework and the aforementioned biogeocultural regional feasibility study. Those present agreed that in order for any activity or organization to be successful it would

- recognize the need for both economic development and natural resource conservation
- have the capability to generate economic and natural resource data relevant to specific regional issues
- become recognized as a voice of reason by all involved with the various issues, moderates as well as extremists
- become a source of information for elected officials seeking to enact legislation that would protect and enhance the interest of all parties

These stipulations, utilizing the MAB framework, ultimately became the operational guidelines for SAMAB.

In August 1988 seven federal agencies and bureaus signed an "Interagency and Cooperative Agreement for the Establishment and Operation of the Southern Appalachian Man and the Biosphere Cooperative." Those signing the agreement were the Southeast Region, National Park Service; Southeast Region, U.S. Fish and Wildlife Service; Southern Region, U.S.D.A. Forest Service; Southeastern Forest Experiment Station, U.S.D.A. Forest Service; Atlanta Regional Office, Economic Development Administration; Tennessee Valley Authority; and Ecological Research Division, U.S. Department of Energy. More recently, Region IV, U.S. Environmental Protection Agency, and the Southeast Region, U.S. Geological Survey became members of the SAMAB Cooperative. Other federal agencies – the U.S. Army Corps of Engineers, Soil Conservation Service, and Appalachian Regional Commission – are considering membership. In addition, six states (shown in fig. 1) are being invited to become full and active partners.

With this extensive level of membership, expertise, and diversity of interests, SAMAB easily has and will expand to thoroughly comply with its stated mission for the Southern Appalachian Biosphere Reserve, which is to foster harmonious relationships between humans and their environment through programs and projects that integrate the social, physical, and biological sciences to address actual problems.

To accomplish this mission, SAMAB is promoting environmentally sound, sustainable resource management and economic development through research, management, and educational activities. These involve participation by all levels of government and private interest groups in the southern Appalachians.

THE SAMAB PROGRAM

The SAMAB program is made up of two organizational entities: the SAMAB cooperative, consisting of federal and state agencies that have signed the interagency and cooperative agreement and their participating organizational representatives; and the SAMAB Foundation, a nonprofit organization made up of university, corporation, governmental, and private organizational representatives. Figure 2 displays the organizational structure of SAMAB.

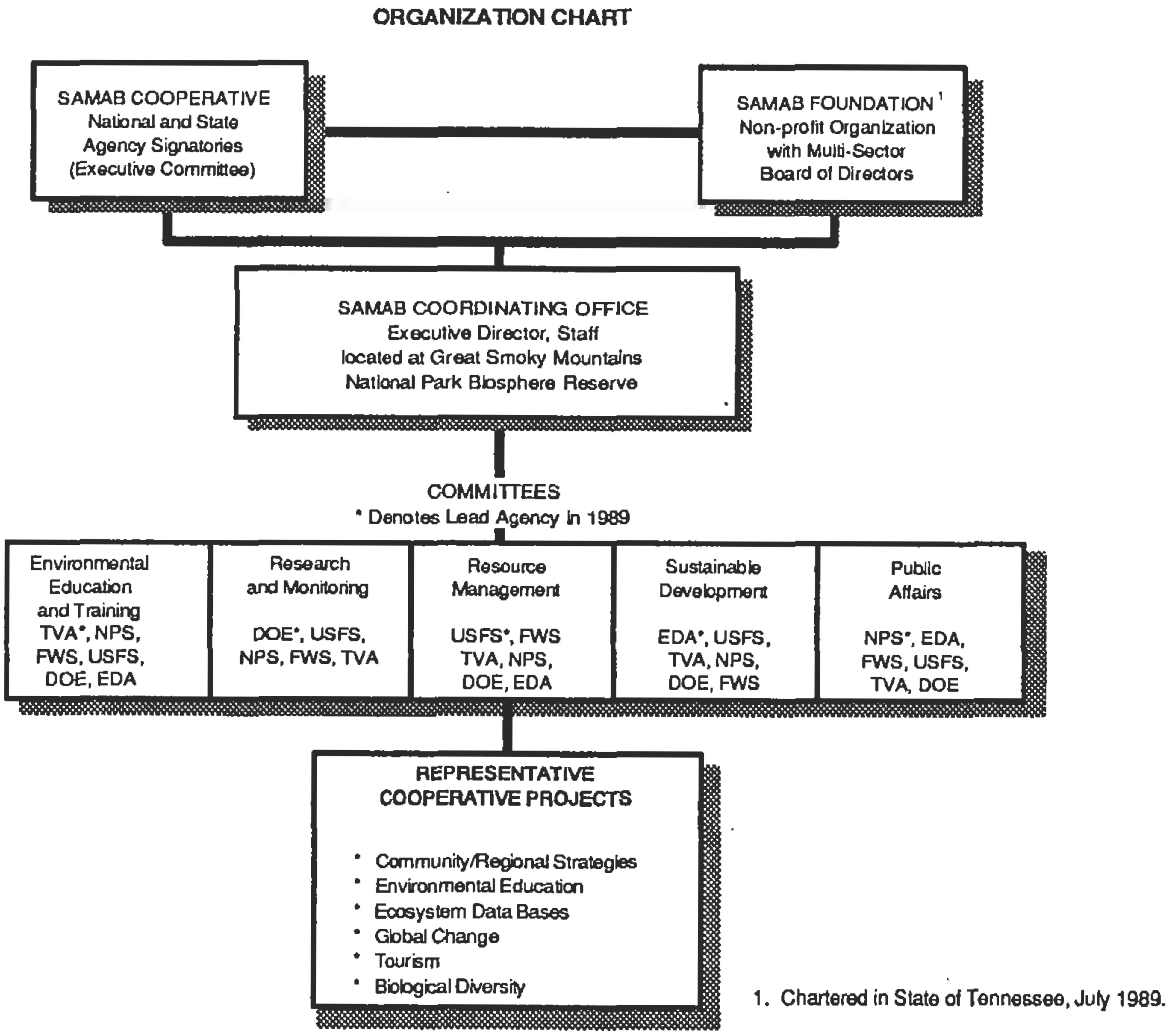

Figure 2. SAMAB organizational structure

In June 1989 the SAMAB program established a secretariat to coordinate the work of both the SAMAB cooperative and the SAMAB foundation. These SAMAB organizations are responsible for developing their own programs of work and priorities consistent with the objectives of the participating agencies and institutions and the mission of MAB. Special emphasis is placed on major issues in the Southern Appalachian Biosphere Reserve. Initial funding for the programs is supplied by the participating federal agencies in the form of direct contributions, grants, and in-kind services. The long-term funding support is expected to be through the nonprofit SAMAB Foundation, which will enable the private sector and other institutions to be more directly involved.

Although the program is less than two years old, commitment and support for the program is growing, both from the members of the cooperative and the foundation. In spite of limited direct contributions, SAMAB has made significant progress and has had some successes it can be proud of, including the following:

- Being accepted as a prototype model for the rest of the country – the first regional program to be adopted formally by the U.S. MAB program. This gives SAMAB recognition and status, but what it means in practical terms is that SAMAB has ready access to biosphere reserve data from around the world, which can help it tackle Appalachian problems such as biodiversity, global change, and sustainability. It also gives SAMAB a broader sphere of influence internationally and nationally.

  For example, in working with the U.S. MAB temperate ecosystem directorate a research proposal has been funded by U.S. MAB. With this project, land-use patterns in southern Appalachia and in the Olympic Peninsula of Washington State are being examined to determine what implications the patterns of land-use might have for long-term sustainable development and environmental vitality.

- Publishing a brochure and other materials and working closely with the major media of the region in an effort to inform the public of SAMAB's role and mission and enlist its acceptance and support.

- Developing a model community program to demonstrate that tourism development and natural resource protection can be compatible – Pittman Center, Tennessee was used as the model community. The model program was completed and 500 copies of "Sustainable Development Strategies for Communities with Tourism-Based Economies in the Southern Appalachian Highlands" were printed. This model is expected to become a model for other communities and form the basis for developing a regional tourism strategy.

- Organizing a workshop on the use of native plants for botanical and pharmaceutical purposes. Research on the use of native plants for pharmaceutical purposes has revealed two basic concepts. One recommends increased harvesting of the plants for economic purposes; the other calls for enhanced protection of the species involved. The conflict is obvious, but there is not a data base adequate to address the opposing views.

- Organizing a two-day SAMAB planning conference in April 1990, with recognized speakers, to define issues, establish priorities, and develop cooperative projects.

- Cooperating with the Tennessee Valley Authority to produce the First Annual SAMAB Conference (at Gatlinburg, Tennessee) in November 1990. A range of environmental issues and problems throughout southern Appalachia were addressed.

- Providing support for the establishment of a national Center for Oak Studies, which is initially located at the University of Tennessee-Knoxville.

- Compiling a directory of environmental education activities within the SAMAB organizations, which will be published in early 1991.

- Holding two successful workshops (Knoxville, Tennessee, and Asheville, North Carolina) to help inform the public about the threat of dogwood anthracnose (a fungal disease affecting the flowering dogwood). Each conference was attended by approximately 125 persons and was well received. Follow-up work suggests that (1) additional conferences in cities such as Atlanta, Georgia, Raleigh, North Carolina, and Roanoke, Virginia, might be desirable, and (2) additional research and public information is needed.

- Assisting the Southeast Forest Experiment Station in producing an educational video for the Bent Creek Experimental Forest.

- Completing the establishment of the SAMAB Foundation, with its charter in Tennessee, an IRS ruling for nonprofit status, a set of approved by-laws, and an initial board of directors. At the beginning of FY 1991, the SAMAB Foundation was in a position to solicit funds, develop a program and projects, and accept membership. The foundation provides an avenue for corporations, universities, and other nongovernmental organizations to support and participate in the SAMAB program.

The SAMAB program uses both permanent and ad hoc committees (fig. 2) to identify issues and implement its work program. Some highlights of activities that the committees continue to work on are as follows:

- The model community program mentioned above demonstrated that tourism development and natural resource protection can be compatible, but strategic planning, resources inventory, and a concept plan is required for it to happen. The development of an outreach program into other communities surrounding protected areas, such as national parks and monuments, is contemplated.

- Funding to develop a data base on the use of native plants for pharmaceutical purposes is being sought.

- The directory of environmental education activities will be printed and widely distributed.

- Several follow-up activities are progressing on the dogwood anthracnose issue. Among these are the printing and distribution of 500,000 copies of a pamphlet, "How to Grow and Maintain Healthy Dogwoods," a cooperative effort of the SAMAB program, the Izaak Walton League, Champion International Corporation, and the Southern Nurseryman's Association. The establishment of a speaker's bureau on this subject within SAMAB and repeating the workshop in other cities is also in progress.

- A 30-minute television program, sponsored by SAMAB, on the reintroduction of the endangered red wolf into the wilds of Great Smoky Mountain National Park will be produced and shown in prime time by the Knoxville NBC affiliate in September 1991 – 400 copies of this program with associated educational packages developed by SAMAB will be distributed to local schools.

- A cooperative global change initiative for the members of the SAMAB Cooperative is being developed.

- A pilot environmental education network in several public schools will be completed.

- In cooperation with the Southeast Region of the National Park Service, a cultural resources workshop is being planned for April 1991. The regional biosphere reserve is being proposed as the integrating mechanism for preserving and promoting these resources in the southern Appalachians.

- The continued planning a forest stewardship conference for private, nonindustrial forest landowners in the SAMAB region; "Best Management Practices" for forestry and agricultural production will be promoted during this conference.

CONCLUSIONS

As a bioregional institution the SAMAB organization

- must continue to build on the growing confidence the public has in it and its activities; there is much more to be accomplished before it is fully accepted and respected as a fixture in deliberations about regional environmental affairs

- must consistently provide an example and leadership by demonstrating what government can do by working together to protect and enhance an area's environmental, social, and economic potential

- should become an established and respected source of mitigating strategies (conservation/science/development) for managers when projected social, economic, and environmental trends indicate significant change

- intend to continue to provide an example and leadership for other regional MAB organizations throughout the country

THE CHAMPLAIN-ADIRONDACK BIOSPHERE RESERVE: THE ROLE OF THE STATES IN BUILDING COOPERATION AND CONSTITUENCIES FOR CONSERVING OUR ECOLOGICAL HERITAGE

Edward J. Hood[1]

Abstract

The 10-million-acre Champlain-Adirondack Biosphere Reserve in New York and Vermont is the fourth-largest biosphere reserve in the world and the largest in North America. Its boundary encompasses the Lake Champlain drainage basin, except for a small portion in Quebec, and New York's Adirondack Park, the largest state park in the contiguous 48 states and the largest wilderness area east of the Mississippi River. With a permanent population of some 500,000 and annual visitation exceeding 10,000,000 people, the Champlain-Adirondack Biosphere Reserve is the world's most populated biosphere reserve.

Conservation, protection, management, and use of the vast natural resource base is provided through complex planning, research, and regulatory programs and activities administered at various levels of government. New York and Vermont have a long record of joint resource planning and management programs, as exemplified by a recent bistate agreement on the management of their shared resource, the sixth "Great Lake" – Lake Champlain.

The biosphere reserve is predominantly managed at the state and local level, but has a rich and varied national interest and serves as a model biosphere reserve by providing opportunities for

- *addressing and recognizing the national interest in megascale protected landscapes and securing the technical and financial resources from national agencies and nongovernmental entities for state and locally directed programs*
- *developing a practical framework for citizen and private sector participation in the planning and implementation of programs to integrate conservation and development in a large biogeocultural area*
- *facilitating interstate and international cooperation in the areas of environmental education, scientific data exchange, and development of regional policies to address water and related land resource issues*

INTRODUCTION

As Yosemite begins its second 100 years, it stands as an example and reminder to us all of the great responsibility we share in helping preserve and protect our rich and diverse natural legacy for future generations.

This responsibility extends beyond the public landscape to its human and natural setting. I would like to focus my comments on the role of the biosphere reserve program in fostering the environmental education, research, and public understanding that help us meet the challenges and responsibilities for conserving our ecological heritage.

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1. Edward J. Hood, Assistant Director of Planning, New York State Adirondack Park Agency.

THE CHAMPLAIN-ADIRONDACK BIOSPHERE RESERVE

New York and Vermont are proud of their rich and varied natural heritage. Vermont's western border is America's sixth "Great Lake" – historic Lake Champlain, stretching north for over 100 miles from its beginning in New York State to its outlet in Quebec. Here in New York we are blessed with one of the most important and outstanding park areas anywhere in the country. I am speaking of the 6-million-acre Adirondack Park, the largest park in the contiguous 48 states and largest wilderness area east of the Mississippi River.

New York will also celebrate a centennial in 1992: the 100th anniversary of Adirondack Park. The legislation creating Adirondack Park in 1892 was one of the first laws in the nation to recognize the special value of wilderness. In enacting this legislation, New York became a pioneer in development of a new attitude toward the environment.

It was recognition of these great resources, Lake Champlain and Adirondack Park, that led the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in April 1989 to formally designate the Champlain-Adirondack Biosphere Reserve.

As shown in figure 1, the Champlain-Adirondack Biosphere Reserve includes an area of some 10 million acres in New York and Vermont. It is a vast area; the fourth-largest biosphere reserve in the world and the largest of the 45 biosphere reserves in North America. It also has the distinction of being the most populated reserve in the world; some 500,000 people live here year-round. Additionally, the reserve hosts over 10 million visitors annually and is within a day's drive of 55 million.

The boundary of this outstanding example of the northern lake forest biogeographical province encompasses the Lake Champlain drainage basin and the entire Adirondack Park (fig. 2). The principal integrating elements of this reserve are the water resources of Lake Champlain and the large protected landscapes in the Green Mountain National Forest and the Adirondack Forest Preserve.

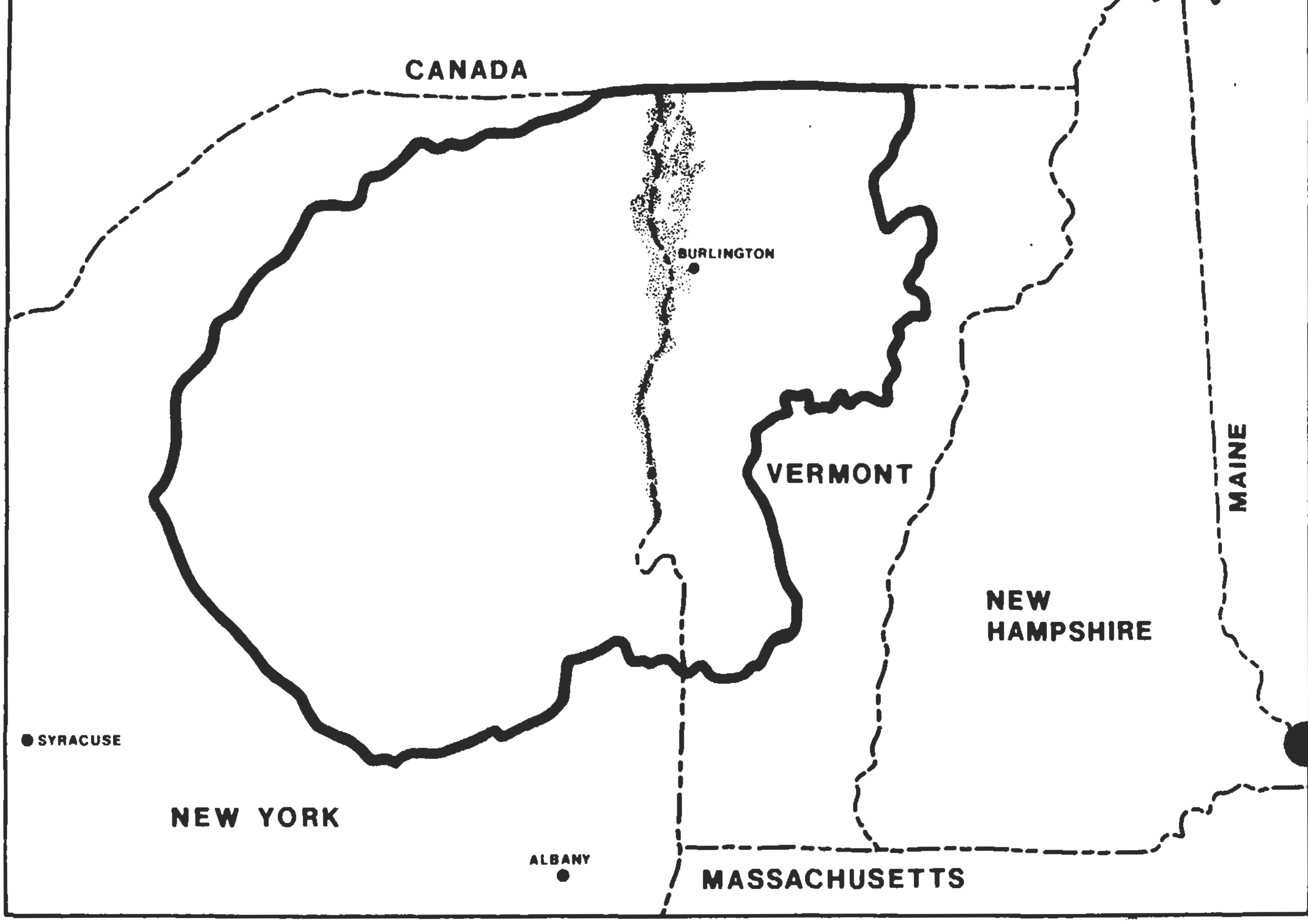
Within the reserve are some 2.5 million acres of largely undisturbed core areas. Most of these are in the state forest preserve lands of Adirondack Park, 1 million acres of which are managed as wilderness and the balance for primitive recreation; in Vermont, they include the four wilderness areas within the Green Mountain National Forest (fig. 3). In the biosphere reserve program, the core areas are used to monitor biological evolution and natural processes – the core area serves as a benchmark for monitoring the ecological health of the reserve and man's impact on the environment.

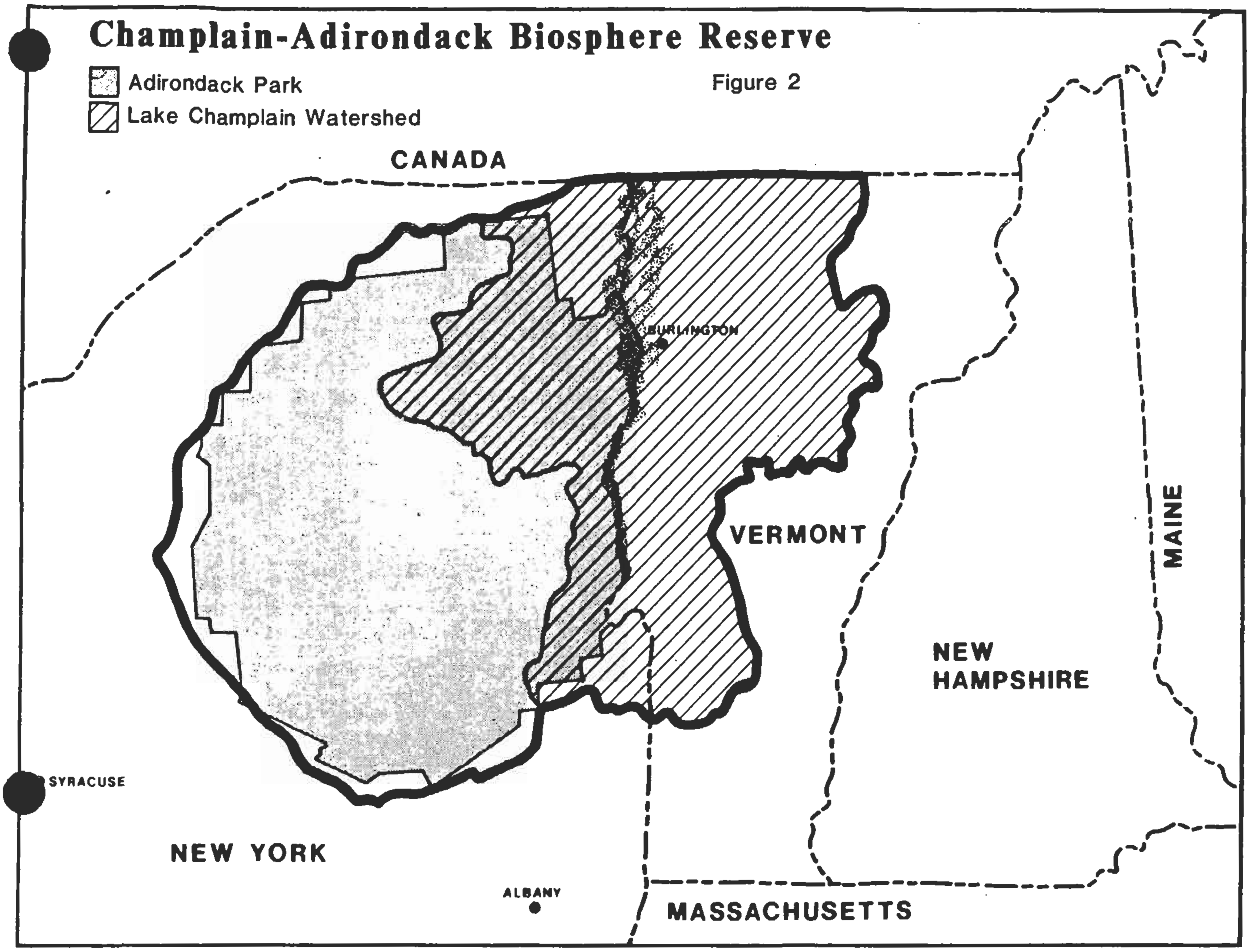
Most of the remaining 7.5 million acres in the Champlain-Adirondack Biosphere Reserve are privately owned; these areas include human settlements, many of which contain ecosystems similar to the core areas but which have been modified by different forms of land use.

The Champlain-Adirondack Biosphere Reserve is a unique area – a special place. What makes it unique and special are not just the facts that is home to over 3,000 lakes, 1,300 miles of state-designated wild, scenic and recreational rivers, and nearly 50 peaks that rise above 4,000 feet, and that it contains nearly 1 million acres of wetlands and boasts an almost unrivaled plant and animal species diversity. Equally important here, especially to the biosphere reserve program, is the fact that it is a real-world, large-scale example of how man lives and interacts with nature in an environmentally rich area.

Champlain-Adirondack Biosphere Reserve

Figure 1

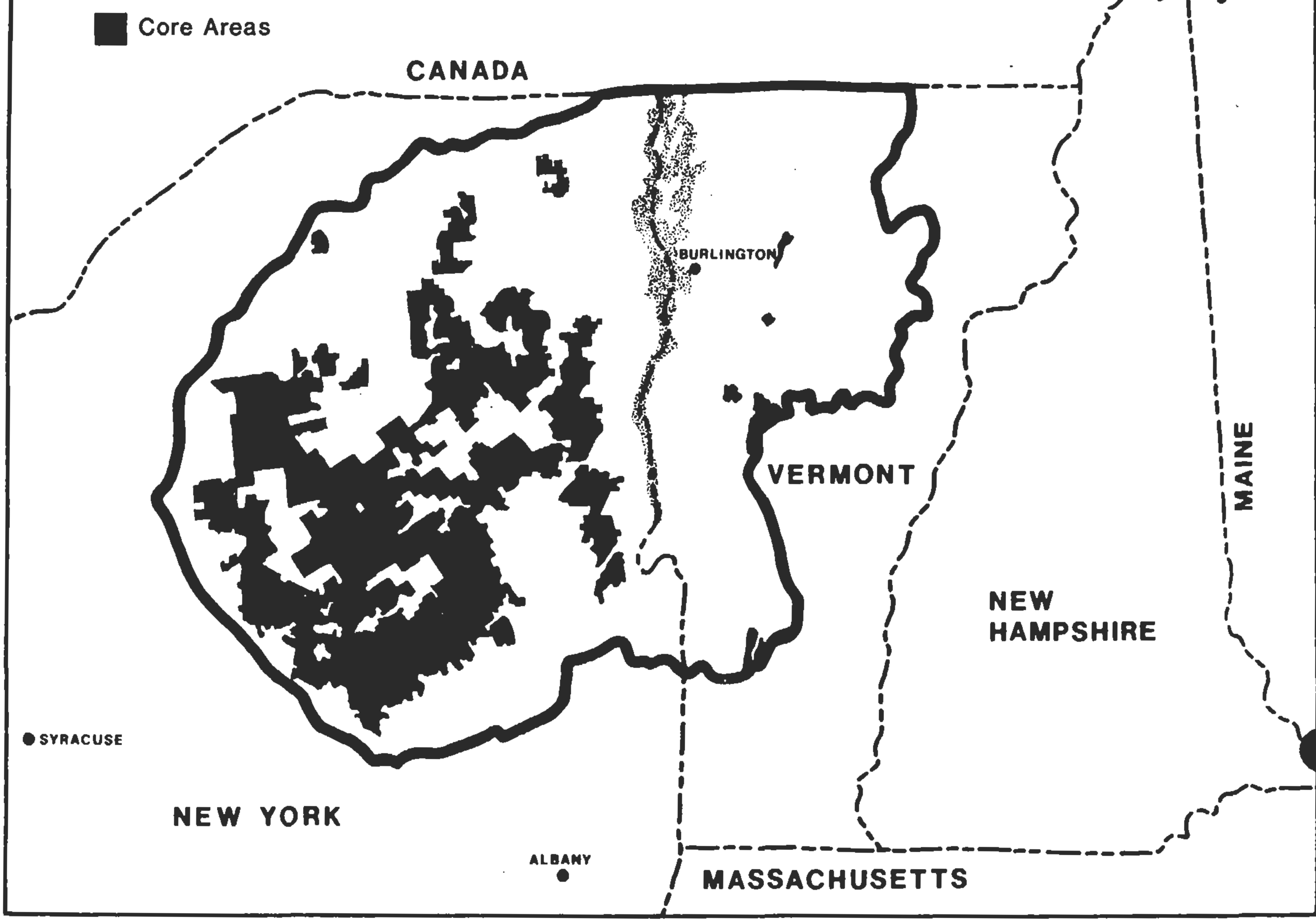




Champlain-Adirondack Biosphere Reserve
Adirondack Park
Lake Champlain Watershed
Figure 2
CANADA
BURLINGTON
VERMONT
MAINE
NEW HAMPSHIRE
SYRACUSE
NEW YORK
ALBANY
MASSACHUSETTS

Champlain-Adirondack Biosphere Reserve

Figure 3



The presence of some 500,000 residents and many more visitors is what makes the Champlain-Adirondack Biosphere Reserve so unique among the world's biosphere reserves and what also serves as the basis for one of its principal challenges: in a reserve that is a mix of public and private lands, where private lands comprise nearly 75 percent of the 10 million acres in the reserve, how do you build public interest and support for a program that advocates a citizen/government partnership for resource conservation and development?

One way we are attempting to meet this challenge in the Champlain-Adirondack Biosphere Reserve is by taking full advantage of the established institutional frameworks, cooperative agreements, and programs in the reserve area. In the New York portion of the reserve, which comprises nearly 7 million of the 10 million acres, conservation, protection, management, and use of the reserve's vast natural resource base is provided by the New York State Adirondack Park Agency and the Department of Environmental Conservation. In Vermont, this responsibility is shared largely by the Agency for Natural Resources and the Green Mountain National Forest.

The constitutional protection given the 2.5 million acres of public lands in the New York portion of the reserve is among the strongest such laws in the United States.[2] Within New York, the Adirondack Park Agency is charged with developing and maintaining a master plan for the public lands.[3] The plan sets policy for the management of the state-owned public lands in the park. Actual management of the state-owned lands is carried out by New York State Department of Environmental Conservation.

The Adirondack Park Agency also has legal authority and regulatory responsibilities for developing, maintaining, and implementing a plan for use and development of the 3.5 million acres of private lands in Adirondack Park.[4] Under the plan, all private lands are mapped into six land use classifications, each allowing a different intensity of development based on the character of the land and the capacity to withstand use. Vermont provides similar state guidance to larger scale development of regional significance and local government planning for future growth and development.[5]

Although this bistate regulatory structure provides a basis for protection of the reserve's resources, given the predominance of private lands in the reserve, it is also a source of public controversy.

In New York, for example, a specially appointed commission convened in response to threats from increased development pressures, acid rain, and changing economic conditions, among other issues; the commission completed a comprehensive study in April 1990 on the future of the Adirondack Park.[6] Nearly 250 sweeping recommendations, some calling for stronger regulatory controls, have been proposed. Various public and private interests are in the process of hammering out compromise positions on issues ranging from access to public lands to protection of open space and backcountry areas and shoreline development controls, to name a few. The overall intent here is on reaching a balance between environmental protection and economic growth and development.

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2. New York State Constitution, Article XIV, §1 (as amended 1987).

3. New York State Adirondack Park State Land Master Plan (as revised 1987).

4. Adirondack Park Agency Act, New York State Executive Law, Article 27 (as amended 1981).

5. Vermont Act No. 200, 24 V.S.A. Section 4302(a)(2), 1988; Vermont Act No. 250, Land Use and Development Law, 1970.

6. Commission on the Adirondacks in the Twenty-First Century, *The Adirondack Park in the Twenty-First Century*, 1990.

The success of the Champlain-Adirondack Biosphere Reserve will in large part depend on its ability to be aware of these issues and public concern related to management of public and private lands, and similarly to strive with its programs to reach a balance between the demands for protection and growth. Without this awareness and sensitivity, the Champlain-Adirondack Biosphere Reserve program will have a difficult time gaining necessary public support.

The interim steering committee guiding the development of the new Champlain-Adirondack Biosphere Reserve recognizes this challenge and is focusing its early efforts on finding opportunities for

- developing a practical framework for citizen and private sector participation in the preparation and implementation of programs emphasizing a marriage of conservation and development

- facilitating interstate and international cooperation in the areas of environmental education, scientific data exchange, and development of regional policies addressing the full range of functional water and related land resource issues

One of the several ways we are attempting to meet these opportunities is through development and coordination of interpretive education programs within the biosphere reserve.

New York and Vermont have long recognized the role of natural history education and information programs in helping preserve and protect the magnificent treasure of resources that exists within the reserve boundary. Both independently and in cooperation with other state agencies, local governments and academic institutions, they have over the years provided and promoted numerous educational activities, programs, and materials on the diverse resources of the region.

Within the past three years, the Adirondack Park Agency has embarked on an ambitious program of development of a coordinated parkwide interpretive education program. With $5 million in help from the New York State Legislature, the agency has constructed two major environmental education centers in the park to provide a focal point for an overall park interpretive and information system. The major objective of this unique interpretive program, and key to the functions of both centers, is to provide the public with an opportunity to better understand, enjoy, and protect Adirondack Park and to stimulate people to develop a sense of balance between use and protection of this special resource. Similar efforts are under way in Vermont.

A principal feature of this program is ongoing public and private cooperation in development and delivery of educational and interpretive programs and materials in conjunction with the biosphere reserve program. The program utilizes the resources of other state agencies, local governments, colleges and universities, business and industry, and chambers of commerce. A not-for-profit Adirondack Park Institute has been established to assist in fund-raising activities and development of an ongoing public support and membership program. Also, a computer-based information system linked to cooperating organizations will help ensure coordination with overall biosphere reserve programs.

Included among the major goals anticipated within the interpretive education program are developing mechanisms for increasing communication and collaboration between educators in New York, Vermont, and Quebec; increasing student awareness and understanding of the significance of the Champlain-Adirondack Biosphere Reserve; developing and enhancing the ability of students to act as stewards and participate as educated citizens in critical decisions affecting the biosphere reserve; and providing opportunities for staff development for educators, including interaction with the many research scientists within the biosphere reserve.

It is our hope that programs such as these will help build and strengthen that necessary public/private partnership required to meet the goal of establishing within the reserve a balance between conservation and development.

The Champlain-Adirondack Biosphere Reserve is more than a badge of honor for a region blessed with enlightened land and environmental management institutions. It is a tool for research, public participation, and environmental education. It is also a clear, direct statement of national interest in supporting the various state and local institutions active in the Champlain-Adirondack Biosphere Reserve.

COOPERATIVE STRATEGIES FOR SUSTAINABLE CONSERVATION

by Laurie Wayburn[1]

Originally, I was going to entitle my talk today "Life after legislation and regulation for parks and protected areas," for I think that biosphere reserves are one of the most useful process-oriented tools for long-term conservation. Then I thought that this might be a little boring. Instead I would like to ask you to think briefly about trends in national defense and international security, Iraq, and how we as a global community are learning to change.

Before you ask, "How does this relate to the environment, conservation, and biosphere reserves?", give me a moment. Just a year or even months ago, our and the world's response to the actions of a country such as Iraq – or many others before – would have been to first consider military action, seeking to control the situation through force. A point-oriented, regulatory action. Today, we are also seeking cooperative solutions through a longer, less clear-cut cooperative process and processes of persuasion including embargoes, ostracization, and negotiation. We have moved towards process-oriented negotiation, over the broad regional and global community affected. We are trying to work with all the stakeholders involved to find a long-term solution for a difficult problem where each side thinks it has a – or *the* – rightful position. We have even called in a former adversary – the U.S.S.R. – for its knowledge base and cooperation. This marks a shift in geopolitics – from single, point-oriented actions, to complementing these with long-term cooperative and negotiating processes which cover a broad region and with wide participation. An analogous shift is needed in conservation.

In conservation, we must now move to complement the power of legislation in establishing parks and the control of regulations by also establishing long-term, cooperative frameworks to work with the broad stakeholder community, pull in diverse interests and knowledge bases from those in rivaling agencies, or from for-profit institutions in economic development, to those of the academic world in the natural, physical and social research sectors to help solve shared problems. This is the essence of the biosphere reserve. This approach is what can be used as an excellent tool to help a protected area's sustainable life *after* legislation and regulation.

Just as in traditional politics one needs several different tools – from threat or use of force to a wide range of diplomatic approaches – in conservation we now need more than the laws that establish protected areas and the regulations that are to enforce them. We need additional flexible tools to deal with the unanticipated process and change that the future inevitably brings. The best example for this needed shift is perhaps the formation and implementation of the EEC and a united Europe, countries that formerly used war to "solve" problems and now utilize cooperation. They have used these principles for how to work with common resources and common problems to some success. Biosphere reserves offer this framework for parks and protected areas.

All of you here are familiar with the reality that borders, no matter how large, are rarely enough for what is needed in conservation – whether for parks or watershed management or landscape protection or protection of the full foraging areas for an endangered predator species, not to mention maintaining ecosystem processes. Equally, these borders, no matter how well protected, can't stop cross-boundary problems, such as pollution of fluid resources of air and water, or declines of migratory species, introduction of exotics both intentional and unintentional, poaching, squatting, drug cultivation or any other nondesirable, nonintended human uses of protected areas. Parks and protected areas – be they

1. Laurie Wayburn, executive director, Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, CA 94970.

wildernesses like Yosemite National Park or urban like the Golden Gate National Recreation Area – increasingly share people-derived, people-control, and people-impact problems. Clearly, natural resource protection must move to the top of the social, or people-oriented, agenda if we are to succeed in long-term conservation.

Increasingly, one can see the continuous blending of the borders of urban or rural interfaces with parks and protected areas. Protected areas established 100 years ago, such as Yosemite, face a very different surrounding context and set of problems today than they did when established. What was semiwild or rural may now be urban. Sets of problems like poaching, which threaten species survival, are made more complex by pollution and climate change that will alter habitats. To be successful, all three problems must be solved, which requires knowledge, information, and community cooperation. Effective, long-term management for conservation must concentrate on building cooperative management strategies that are people- and community-oriented, integrative, and regional. As the contexts around any park or protected area boundary change all the time, such strategies will help provide a strong information and community basis to help solve problems. These protected areas cannot survive and thrive if their management is approached in isolation of these regional and community factors – both natural and human.

This is a key reason why we have moved to establish just such a regional cooperative framework in the Central California Coast Biosphere Reserve just across the bay from here (Concord). This biosphere reserve was dedicated one year ago, in fall 1989, and consists of nine management units on the local, state, and federal jurisdictional levels, with four proposed additions of private, state, and federal units. It covers almost 500,000 hectares of pelagic ocean, island, coastal, and terrestrial habitats from watershed to outer continental shelf. It is located in San Mateo, San Francisco, and Marin counties and will involve Sonoma County soon. The units involved are Golden Gate National Recreation Area, Point Reyes National Seashore, three state parks, Gulf of the Farallones National Marine Sanctuary, two public utility companies (Marine Municipal Water District and San Francisco Water Department), and Farallon Natural Wildlife Refuge. Proposed are Stanford University, University of California's Bodega Field Research Station, Cordell Bank National Marine Sanctuary, and Audubon Canyon Ranch Preserve.

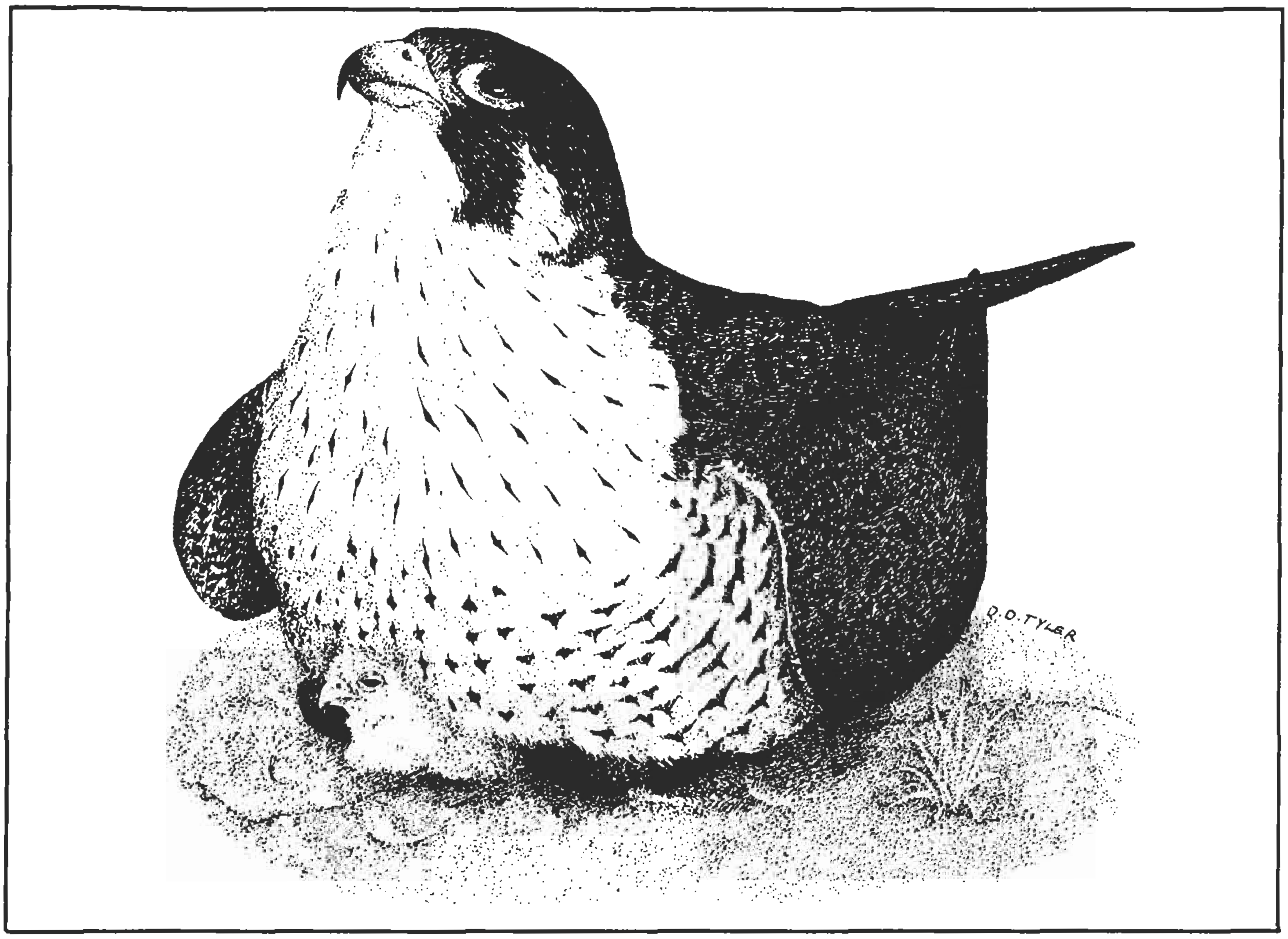
It is an area of intense extra-boundary influences – both natural and human. These include natural impacts like those of our weather patterns that are driven by the global oceanographic forces beginning in the western tropical pacific, such as El Niño, and are coupled to the Sierra Nevada watershed processes. They also include social and economic processes of immigration and trade which help drive our cultural diversity as well as resource development – such as export fisheries, agricultural crops, and service industries. Further, some six million people live in the immediate area of influence and some 20 million visit each year. This is the human overlay above spectacular natural diversity – over 400 species of birds, 20 species of marine mammals, several centers of plant endemism . . . the list goes on. It is clearly an extremely complex situation containing people and natural resource factors with significant problems to which point-oriented, individual management and regulation alone will not provide solutions. Further, it requires numerous knowledge bases from the physical, natural, and social sciences working together.

The range of problems and demands of special interests that we have ("challenges" as they are so often called by good managers) are quite impressive, from what to do with toxic and radioactive waste, to how to accurately assess and manage problems of overgrazing and overfishing, prioritizing intense competition for recreational use, restoration of native grasslands and wetlands, to having interpretative programs in languages that our diverse user audiences can understand. A few common problems across interior borders of the reserve include endangered species and migratory species management, exotic vegetation and feral animal control, drug enforcement, and traffic control. Demographic growth and resource-demand affects the entire region. One unit alone cannot solve these shared problems. The key aspect is that there is a belief that shared problems often have shared solutions. We have this year established a Council of Managers which is meeting regularly. We have agreed to set up a series of other councils (science, education, etc.) and establish an independent, nonprofit secretariat to help coordinate and fund reserve projects. We have established a board of trustees and are fortunate to have many community, scientific, economic, and conservation leaders on it.

This is a tool beginning to be developed, more in process than perfected. It has great promise as a linking of areas to create one large enough that, with harmonized management approaches, can be successful in large-scale projects such as endangered species management or sustainable restoration of degraded habitat areas. It also should aid in developing simpler tools such as compatible data bases or constant communication, as all stakeholders involved seek to maximize the benefit of integrative strategies. We are building a wide constituency beyond our actual borders by seeking involvement with information and other nonland resource agencies such as the Bay Area Air Quality Management Board, the EPA, the National Marine Fisheries Service, and United States Geological Survey. We have over 20 nonagency partners involved, from nongovernmental organizations to private landholders and community groups – even the United Nations Association!

In conclusion, the CCCBR is building a framework for cooperation on a regional, ecosystem level . . . putting in place pro-active mechanisms for negotiation over problems to achieve shared solutions (often more cost-effective) and a forum for discussion between neighbors and partners involved in protecting and managing this broad regional natural area. It is an experiment in "control as cooperation" and "management by persuasive information" rather than regulation alone. We are, after all, now in the Information Age. Given the diversity of players involved, the CCCBR will take some time to prove its full value, but it has had an interesting beginning and significant enthusiasm from both the management and the public community as we start this ongoing process. We are demonstrating that cooperation is key to biosphere reserves as an effective tool in sustainable conservation. As so often seen in science, complex problems have startlingly simple solutions in terms of how something works. However, the hardest process is to understand it and then replicate it and make it work!

CONCLUDING PLENARY



Peregrine Falcon, *Falco Peregrinus,* and Chick
Illustration by Diana Dee Tyler, © 1978 by Dell Publishings Co., Inc.

NATURAL AREAS AND YOSEMITE: PROSPECTS FOR THE FUTURE

Harold Gilliam[1]

During the several days of this symposium I have been asking myself how John Muir, who more than any other person was responsible for the creation of Yosemite National Park 100 years ago, would have reacted to this gathering. Fortunately, the sponsors from the beginning had in mind far more than the usual self-congratulatory centennial celebration; they extended the subject matter beyond Yosemite to all natural areas; they solicited research providing new data on the problems faced by all parks and natural areas; they invited speakers representing diverse views on controversial matters.

I am quite sure that Muir would have been highly pleased with the results, particularly the friendly clash of conflicting ideas about the past and future of Yosemite and natural areas in general. There is a stereotype of Muir as a benevolent saint who wrote rapturously about the happy ? and glorious sunsets, but he was a man of unshakable conviction. He had a fierce Scottish temper that flared into righteous wrath when he contemplated the damage done to Yosemite's high meadows by grazing sheep and the effrontery of proposals to drown Hetch Hetchy Valley.

So I am certain he would have welcomed not only the fresh data revealed here but the sometimes heated debates that have taken place on the management of Yosemite and other natural areas. No effective planning for the future of such areas can be accomplished unless it is preceded by a free exchange of conflicting ideas and efforts to resolve them.

One of the great benefits of such a conference is serendipitous: It occurs not only in the planned speeches and discussions but in ideas that crop up in casual corridor talk or mealtime conversations, no matter how "off the wall" such ideas may be. I'll give only one example: Mary Jefferds of Audubon, indignant that many visitors to the parks do not seem sure what the parks are for or how to behave in them – thoughtless littering, vandalism, and trampling are among the results – suggested that admission to a park require a "park privilege pass," certifying that the bearer had passed a prescribed school or adult class in ecology and ethics. A visitor should have to prove his or her qualifications for the park privilege just as automobile drivers must have certain qualifications and pass tests for competence. Whether such ideas are immediately feasible is not the point; they need to be tossed into the hopper if only to stimulate similar off-beat thinking.

To summarize the cornucopia of facts and ideas presented at the symposium and to do them justice is an impossible task that I shall not try to accomplish, so I will confine myself to pointing out certain highlights or common themes that have consistently been discussed. Despite the diversity of topics, there were certain threads that emerged repeatedly, designated by key words or phrases such as these:

Impairment. The congressional act creating the National Park Service in 1916, using the words of Frederick Law Olmsted, Jr., mandated that the service provide for public use and enjoyment of the parks but also keep them "unimpaired for the enjoyment of future generations." The contradiction between use and impairment has vexed park officials since the beginning. It is generally agreed that too much public use and enjoyment of the wrong kind can drastically impair the natural scene with buildings, pavement, parking lots, and erosion of the meadows and other sensitive areas by too many feet and horses' hoofs.

1. Harold Gilliam, Writer, *San Francisco Chronicle*, San Francisco.

But are meadows impaired by the invasion of trees that grow as a result of the suppression of fires or man's interference with natural drainage patterns? Are meadows impaired by asphalt laid across them to accommodate bicyclists? Is a forest impaired when it is scorched by prescribed burning – or is it impaired by fire suppression?

There is ample room for differences of opinion, and many have been expressed during the symposium. Yosemite Valley is either seriously impaired by overdevelopment or has been well managed to preserve the natural scene while accommodating visitors, depending on your point of view.

Public Demand. Many early developments in the national parks began under the guidance of Stephen T. Mather, first National Park Service director, at a time when the parks were relatively little known and in Mather's view required special attractions (golf courses, swimming pools, luxury hotels) to lure visitors – a situation scarcely believable today, when a principal problem is overcrowding.

More recently, additional developments have been rationalized not by the need to attract more visitors but by "public demand." In ordinary commerce, the fact that an entrepreneur successfully sells goods or services indicates there is a demand for them. But clearly the ordinary canons of commerce cannot be applied to the parks. If bars, pizza parlors, and souvenir shops make money for the concessioner, is their profitability proof of a demand for them, or is the demand created by the enterprises themselves? An overhead tramway from the Yosemite Valley floor to Glacier Point has been proposed many times and might well be very profitable, but there is no sign that the public is demanding any such facility.

Views have been expressed at the symposium that it is the primary responsibility of the National Park Service to protect the natural scene and not to cater to asserted public "demands."

Carrying Capacity. The carrying capacity of a range for deer, for example, is the number of animals that can graze the range without diminishing the food supply or otherwise upsetting the ecological balance. The human carrying capacity of a park or natural area is the number of people it can accommodate without damaging the landscape or natural processes. Natural area managers have recently found it necessary in some respects to prohibit further entry after the carrying capacity has been reached. For example, some national park trails are closed after a certain number of visitors have entered from a given trailhead. Campers headed for Yosemite Valley campgrounds are diverted away from the valley when the campgrounds are full.

But it is easier to determine the carrying capacity of a campground than of a park. Some speakers suggested that Yosemite Valley, for example, had already exceeded its carrying capacity. The evidence: air pollution resulting from automobile exhausts and campfires; the erosion of trails by too many hikers and horses; the trampling of vegetation along the Merced River to the point that bank erosion has in some places doubled the natural width of the channel. Remedies suggested include a reservation system to enter the parks: no reservation, no entry.

Restoration. Some notable restoration has already taken place in Yosemite Valley, including the elimination of certain roads through meadows; the abandonment of certain camping areas; the importation of the native mountain sheep (which had become extinct in the park); the protection of nesting sites of peregrine falcons, which had returned to the park voluntarily after also having become extinct there; the current attempts to restore the banks of the Merced River.

But there are still problems. Will the riverbanks become trampled again after restoration, in the absence of restrictions on visitation? Does restoration involve removing trees that have invaded the meadows as a result of fire suppression and altered drainage patterns? Should Mirror Lake be restored by dredging to halt the natural filling? (The Park Service in recent years has stopped the dredging.)

Should trees be cut to preserve or restore the famed view of Yosemite Valley from Inspiration Point? There is no single formula that fits every case. There is a legitimate question as to whether restoration can outpace visitation. It may be, as some speakers have suggested, that some of the most overused areas in the parks should be closed entirely for a sufficient time to let nature repair the damage.

Biodiversity. The alarming loss of species in many natural areas has been well documented, and the public is becoming better informed on the subject, but there are still problems when plant or animal species that may be endangered stand in the way of some development project, as we know from the cases of the snail darter and the dune tansy, not to mention the spotted owl, whose habitat is threatened by logging. The foresters who advocate clear-cutting resulting in even-aged stands of trees may calculate the greater quantity of wood harvested but seldom factor into the equation the consequent loss of other species of plants and animals. One of the highlights of this symposium was the announcement by a representative of the Forest Service that the agency would no longer permit clear-cutting.

It was once a "rule of the road" in natural areas to kill rattlesnakes on sight. But every species is a link in the chain of life. Symposium speaker Roderick Nash noted that John Muir was once asked: "What good is a rattlesnake?" His reply: "What good are you?" Muir was not being flippant; but he was indicating that humans are one among many species, each with its own intrinsic value and right to exist.

Outside Threats. Gilbert Grosvenor of the National Geographic Society told the symposium: "No park is an island." Other speakers mentioned that Everglades National Park is being drained of its water by upstream irrigation. Grand Canyon is made noisy by planes from the nearby airport, and its once clear air is besmogged by emissions from a distant power plant. Nearly one-third of Yosemite's trees have been affected by smog from Central Valley cities. Global warming and ozone depletion would damage parks as well as urban areas.

Subdivisions and commercial developments near park boundaries inevitably influence the parks and natural areas themselves. Compromises that permit nearby development under certain restrictions recall the dictum of geographer Daniel C. Luten: "Whenever nature is compromised, nature loses."

Managers of parks and natural areas cannot limit their activities to park boundaries but need continuous contact with officials with jurisdiction over areas outside those boundaries. Park management cannot be separated from overall environmental management – local, national, and global. Symposium participant Jeanne Adams of the Ansel Adams Gallery suggested the creation of a biosphere reserve to include Sierra Nevada national parks, national forests, other land agencies, and local communities to deal with mutual environmental problems that do not respect boundaries.

Budgets. National park budgets are starved and lack adequate public understanding or support. Many national park rangers are paid less than manual laborers and find it impossible to support a family on their wages. Former National Park Service Director William Penn Mott, Jr., told the symposium that there was a great need for better understanding of the budget process and public backing when the park budget is before Congress. If last year's national park attendance of 300 million had resulted in 300 million letters to Congress, the parks would be in much better condition.

Education. Some corporations have commendably fostered public education about natural areas by sponsoring "adopt-a-park" programs for schools. Some of the world's most effective educators are the national park ranger-naturalists, who always have an eager audience, including many people who have never before been exposed to ecology. But like other park needs, the interpretive program has been greatly restricted by inadequate budgets. Symposium panelist Martin J. Rosen of the Trust for Public Land told the conference that the highest purpose of the national parks is "to teach people to live lightly on the Earth." That is perhaps the most important concept the human race needs to learn in the coming century.

Recognizing that the natural area experience is not one that can be defined or communicated solely in conceptual or cerebral terms, the sponsors of the conference wisely provided an artistic and musical component, adding greatly to the depth of communication. Singer and composer Rita Cantu gave voice in one of her songs to a poignant theme: "Where is the prophet who speaks for the land?" And her conclusion: "We are the prophets who speak for the land."

If we all are the prophets who speak for the land, our model may be John Muir, and I would like to close, as I began, with some of his thoughts:

> Yosemite Park is a place of rest, a refuge from the roar and dust and weary, nervous wasting work of the lowlands. . . . Only by going alone in silence, without baggage, can one truly get into the heart of the wilderness. . . . Why should man value himself as more than a small part of the one great unit of creation? . . . Sit down in climbing and hear the pines sing. . . . Like an ardent life this day was full of very bright and very dark places, meeting grandly and godly like deep experiences of a noble character. . . . Life seems neither long nor short, and we take no more heed to save time or make haste than to the trees and starts. This is true freedom, a good practical sort of immortality.

YOSEMITE AT 100 – NO LONGER AN ISLAND

Gilbert M. Grosvenor[1]

A lot has happened since our great-grandparents saw fit to create the National Geographic Society and Yosemite National Park, and we have much to be thankful for and celebrate. But we have plenty to be concerned about, too, and geography has a great deal to teach us as we try to address those concerns.

Our mission at the National Geographic Society is to look at the world through the unique lens of geography, and to invite others to look through that lens with us. The future of the park, as well as the future of the global environment, depends on just how well we learn our geography lessons.

The charter of the National Geographic Society commits us to increasing knowledge about the world, and sharing that knowledge as widely as we can. An important part of our mission is to help people not just to understand and value this country's unique wilderness heritage, but to see how that wilderness relates to everything around it. Because at its heart, geography is about making connections and seeing relationships.

CONNECTIONS AND RELATIONSHIPS

National Geographic has had a special relationship with the national parks since the early part of this century. In 1915 my grandfather, Gilbert H. Grosvenor, was the magazine's young editor. He became concerned about the fate of California's giant sequoias, which were threatened by the lumber industry. That's not a new story in the West; there was plenty of controversy back then, even without the spotted owl.

On a camping trip in the High Sierra, my grandfather was moved by what he called the "majesty and friendliness" of the magnificent huge trees.

When he got back to Washington, he campaigned tirelessly for the creation of Sequoia National Park. When Congress's budget problems put the park plan in jeopardy – that's not a new problem either – the society bought a private stand of the big trees and gave it to the American people as part of the new park.

The next year, just when Congress was getting ready to create the National Park Service, *National Geographic* magazine published an issue called "The Land of the Best'" and every congressman got a copy. That issue rhapsodized about the national parks, saying they rivaled the greatest cultural landmarks of Europe.

While that continent was darkened by one of the most terrible wars of history, "The Land of the Best" called us to consider our own history and geography. It reminded us to celebrate America's grand and unique wilderness heritage, it urged us to see the parks as sources of strength and inspiration in a troubled world, and it helped us to understand how we are connected to the rest of the world.

That's a geographic message, and it is as true today as it was in 1916. But back in those days, many Americans still hadn't made the connection. The idea of wilderness preservation was just beginning

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1. Gilbert M. Grosvenor, President, National Geographic Society.

to catch on. We had more than 30 national parks and monuments, but we had very mixed feelings about them. Many of us still couldn't see the point of setting aside vast reaches of wild territory when they held uncounted treasures in the form of timber, water, and minerals.

That discussion isn't over yet, either. We are a nation of pioneers, and a big part of our history and our national character has been tied up in conquering the land and converting it to our use.

GRAND EXPERIMENT

As recently as 150 years ago the idea of setting aside parks of wilderness would have been laughed at by most people. By 1890, we still didn't agree on what it meant, but we were willing to experiment with the idea of preservation – and what a grand experiment it has been.

Yosemite is the place where we first began to experiment with our new ideas about protecting the wilderness. And for all the controversy that the park has known since its founding, it's a grand idea that has worked better for a whole century than anyone could possibly have predicted.

Photographer and mountaineer Galen Rowell has been exploring and photographing Yosemite for more than 30 years. He reminds us how much of the park is still just as John Muir first saw it in 1868.

The idea of wilderness preservation that was born in Yosemite has worked so well that it's not only led to a network of parks and monuments all over this country, but has been embraced around the world. Since Yosemite was founded, more than 120 nations have followed our lead and created national parks of their own. Pat Noonan at the Conservation Fund says that America's greatest contribution to the future of the world may well turn out to be not democracy, but conservation.

UNREASONABLE EXPECTATIONS

Yet the national park idea was born out of conflict and controversy, and in 10 years we still haven't managed to agree on exactly what we want Yosemite to be – or what we want any national park to be. If we're going to figure it out, we must learn geography, because geography brings the global perspective we so desperately need.

Since 1916 we've asked the National Park Service to do two conflicting things: to make sure we can all enjoy the parks, and to see that they don't ever change. And now, I might add, to do it all a shoestring. We have set aside 94 percent of Yosemite as permanent wilderness, but we let 3.5 million people a year drop by.

We want the park to have something for everyone – backpackers, rock climbers, hang gliders, bird watchers, campers, kids from the inner city, senior citizens, even busloads of foreign tourists looking for a scenic place to have lunch and buy a souvenir. Yet we want the place to look exactly the way it did a century ago when the Miwok Indians called it home.

Our unreasonable expectations and conflicting views about the environment are on center stage in Yosemite, but they are the same expectations and views that we struggle with, not just throughout the national park system, but throughout the nation and the world.

Because as much as we wish it were, Yosemite is not an island – no national park is. Geography teaches us that everything on earth is related to everything else, and we must know geography before we can resolve the deeply felt controversies that rage not just in Yosemite, but around the world as we race to shore up a dangerously deteriorating global environment.

LENS OF GEOGRAPHY

Now if you're like most people, when you think about geography, you probably remember memorizing the state capitals in elementary school, or coloring in a map of the world with crayons – if you were lucky enough to have had geography at all.

But knowing where things are on the map is only the beginning – it's like learning the alphabet before you can read. Geography is the endlessly fascinating science that studies the natural world, not by itself but in relation to people, and tries to make sense of the whole of it.

When we look at Yosemite through the lens of geography we see in a whole new way just how intimately the park is connected to the world around it. Take the problem of air pollution. We like to think of our national parks as pristine islands of untouched wilderness, but smog doesn't read maps.

It's not just the peak summer crowds in Yosemite Valley, with their campfires and car fumes, that are creating the haze and obscuring the views. City smog from miles away is drifting into the park, injuring the pines and streams and animal life. The acid rain that's beginning to affect the park's forests and streams isn't just Yosemite's problem – it's global.

POLLUTION AND POPULATION

This is true in parks all over the country. We've heard a lot about smog in the Grand Canyon, but a recent Park Service study reported that air pollution obscures views in all of the parks more than 90 percent of the time. It's worse back East, where visibility in the parks has been cut more than 50 percent in the last 40 years.

It's a serious and complicated problem. To even begin to understand it, you have to know about such things as the chemical origins of ozone, movements of global air masses, effects of pollution on plant and animal life, and industrial and transportation needs of people – to name just a few.

You can gather mountains of data in any one of these fields and never see how it relates to the others. But put your data on a map and suddenly you can see things you never saw before.

When the park was created, the state's population was just over 1 million – in 1890 the whole U.S. population was only 63 million – and the people who did live in California had to be persuaded to go to the trouble of visiting the park.

Needless to say, crowds in the valley were not a big problem, and arguments – like how we use the land versus how we preserve it for future generations – took on a bit of a philosophical quality.

Well those days are over. California's population today is half again as big as it was 1970 – it's grown from 20 to nearly 30 million. One in every nine Americans now lives in California. It has a bigger population than most of the world's countries – bigger than Canada, Venezuela, and Australia. I don't doubt that places like Yosemite are a big part of the attraction.

Now we worry about loving Yosemite to death. But the bigger problem lies beyond park boundaries, where we take more and more land to build and pave and log and divert water and create smog – all the things that people do – practically right up to the park's boundaries. Yosemite's real population problems are as much outside the park as inside, but we can't begin to address them unless we know how to use the basic tools of geography.

GEOGRAPHIC ILLITERATES

And when it comes to geography, alarming numbers of Americans are completely lost. A few years ago the National Geographic Society became concerned about reports like the one that said half the students in the graduating class of a high school in Dallas could not name the country that borders the U.S. to the south.

Even we found it hard to believe this, so we asked the Gallup organization to conduct a survey for us. They uncovered a level of ignorance about the world that was more horrible than the horror stories we had been using.

For example: 24 million Americans, one in seven adults, couldn't even find the United States on a map of the world; and one in four couldn't find the Pacific Ocean on a map.

Of the 10 countries surveyed, the United States was in the bottom third in geographic knowledge. Worse news was that in the youngest age group we surveyed, 18- to 24-year-olds, the most recent products of our educational system, the U.S. came in dead last – behind the Swedes, Germans, Canadians, French, Japanese, British, Russians, Italians, and Mexicans.

Then just this year the National Assessment of Educational Progress released another study of geographic knowledge – this time of the nations's high school seniors. The results were equally disappointing; the average score was 57 percent, a failing grade in any teachers' book.

So along with the discouraging news that Johnny can't read, can't add, and can't do science, we found out that Johnny has no idea where in the world he is.

GRASS-ROOTS GEOGRAPHY

What could this mean for the nation that created environmental preservation? Among other things, that we had simply failed to make the vital connection between knowing geography and preserving the earth that sustains us.

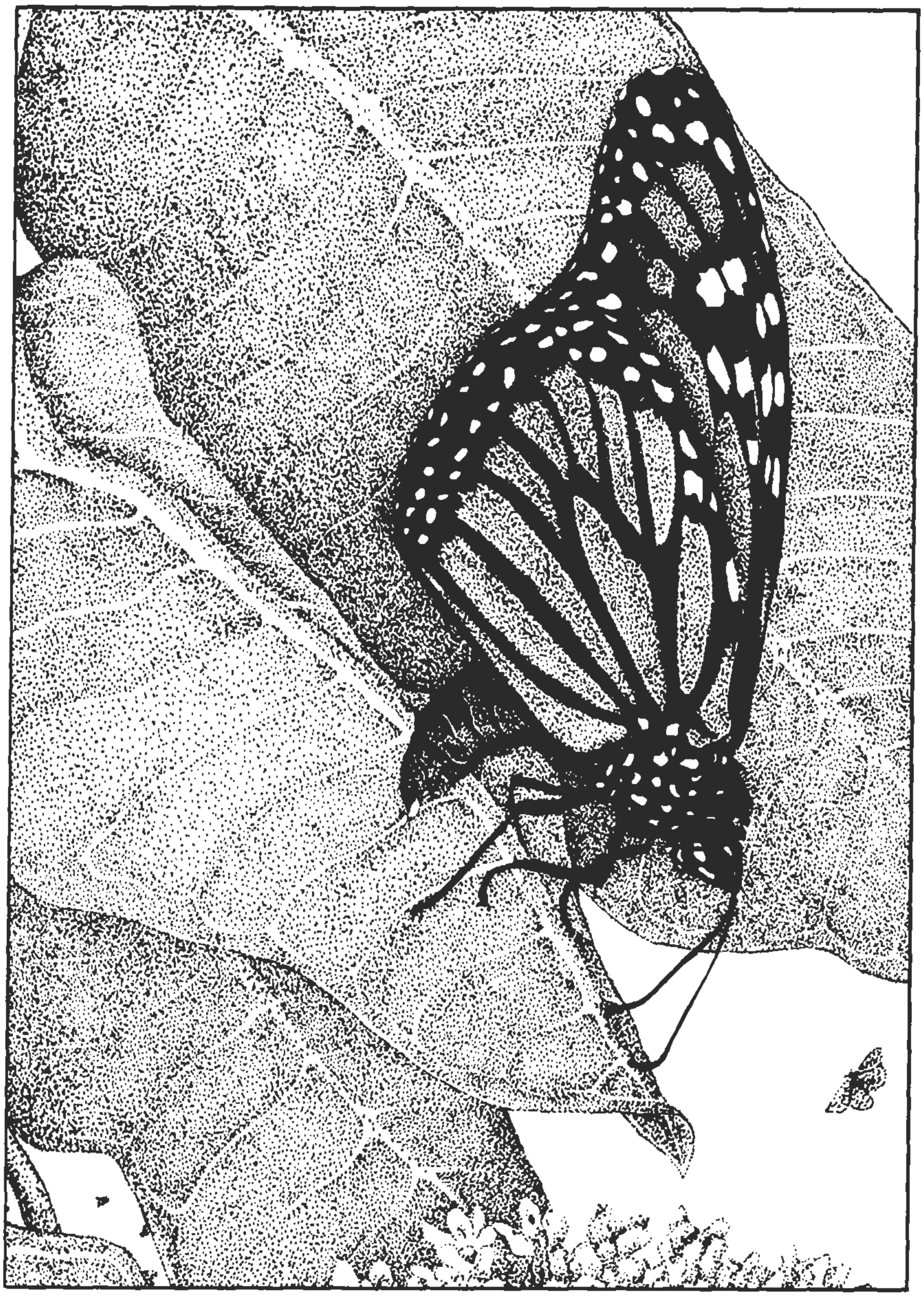
Something had to be done. So the National Geographic Society launched a national, grass-roots effort to restore geography to our nation's classrooms. We've started geographic alliances in 40 states, and in a few years we'll reach all 50. These alliances are centers of energy and enthusiasm. They bring together teachers, geographers, community groups, and state and local governments to make sure that the next generation learns geography.

When we announced our program a few years ago, California was one of the first states to sign up, and things have really been moving out here ever since. You've not only put geography back into your social studies curriculum, you've made it a requirement for admission to the University of California. But there is so much more to do. Our need to see the world we live in from the whole perspective of geography is more urgent than it has ever been in human history.

As we celebrate 100 years of Yosemite, we are reminded of the precious and irreplaceable inheritance that has been placed in our trust. We have an awesome responsibility to bequeath that inheritance intact to our children and grandchildren. Geography is the key to that trust. The future of Yosemite – indeed the world's future – depends on how well we learn our lessons.

CONCURRENT SESSION TOPICS

NATURAL AREAS MANAGEMENT



Monarch Butterfy, *Danaus plexippus*, Laying Eggs on a Milkweed Leaf

ECOSYSTEMS: ONLY CHANGE IS CONSTANT

THE CONCEPT OF ECOSYSTEM MANAGEMENT FOR NATURAL AREAS

James K. Agee[1]

Abstract

The dilemma of the future for natural area managers is to simultaneously educate the public about the inevitability and desirability of change in natural systems, while protecting those systems against unwanted, human-induced change. The concept of ecosystem management provides a framework for planning. A four-part ecosystem management strategy includes: defining precise objectives, identifying ecosystem components of major concern, developing and implementing a protection strategy, and monitoring the results of that strategy.

INTRODUCTION

The decade of the 1990s provides us an opportunity to rethink goals and strategies for preservation of natural areas into the 21st century. The preservation system across federal, state, and private institutions has significantly grown in the last two decades, simultaneously expanding both our opportunities and our problems. The problems cover the spectrum from local to global, and show no sign of diminishing in the future. We are attempting to preserve dynamic natural systems within a larger set of systems that in many cases are changing in ways incompatible with natural area preservation. Strategies for preservation must reach out beyond the boundaries of natural areas in both direct and indirect ways.

THE ONLY CONSTANT IS CHANGE

Perhaps the most important indirect means to improve conditions for natural areas is public education, the basis for political support. Too many times we have allowed ourselves the easy answer when natural areas are established: "This area is now preserved forever." We explicitly foster in the public's mind a perception that there is a balance of nature that humans upset but somehow nature never does.

In a recent symposium at the Ecological Society of America, Dr. Steward Pickett alluded to this snow job we have perpetuated on the American public (Pickett 1990). He contrasted the ease with which the earth scientists were able to provide factual, informative explanations of the Loma Prieta earthquake to the public with the difficulty ecologists had in explaining the Yellowstone fire events. He explained this difficulty by suggesting that the public has a perception of a balance of nature, and that the idea of natural change in ecosystems has not been properly interpreted.

We know that ecosystems, in the presence of natural disturbance by wind, water, fire, earthquakes, etc., are variables moving towards a variable rather than a static entity. Of course, this was a concept enunciated by H.C. Cowles in 1910, when he compared plant communities to a braided stream, merging and diverging over time. His ideas were overwhelmed by the equilibrium theory of vegetation propounded by Fredric Clements: all communities would eventually reach a regional climax with stable, self-perpetuating vegetation. Even into the late 1960s, the "strategy of ecosystem development" of Eugene Odum (1969), which was highly criticized, suggested that late successional ecosystems had

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higher diversity and were therefore more stable. We have known for several decades that stability and diversity are not necessarily linked (and are difficult to easily define). We also have known that disturbance may be a key process in maintaining diversity at the stand (alpha), watershed (beta), and landscape (gamma) level. Current ecological thought has drifted away from a grand unifying theory of ecosystem development (Christensen 1988) for decades. It is frustrating to recognize that the lack of a balance of nature has been clearly articulated for the last twenty years in the scientific literature but remains to be effectively interpreted to the general public (those not visiting national park evening campfires).

The issue of change in natural ecosystems is only one interpretive challenge. One of the most important factors of disturbance in these ecosystems is fire, which has a long association with human culture. The Yellowstone fires were not simply an act of God but involved humans, who either set fires accidentally or allowed them to begin and spread under a natural fire policy (about half the area was burned by each kind of ignition). Humans are "fire animals" (Komarek 1972), so that the Yellowstone fire interpretation not only seemed complex, but was complex. Humans are an inextricable part of natural ecosystems, and as natural area professionals we had better come to grips with that concept. The future of natural area preservation lies in the concept that humans are clearly part of the problem, but also part of the solution, in natural area management. One step in that direction is a process called ecosystem management (Agee and Johnson 1988).

ECOSYSTEM MANAGEMENT FOR NATURAL AREAS

Ecosystem management is a process by which lands are managed in cooperation with adjacent lands. Nature preserves can be the core of such networks, but the concept of ecosystem management is just as applicable to lands managed for timber production, quarried for minerals, or otherwise exploited. Some interest groups may try to capture the phrase "ecosystem management" as a biocentric philosophy that excludes humans, rather than as a more generalized management process. Neutrally defined, ecosystem management can be a valuable tool in the natural area manager's kit.

One of the key elements of an ecosystem perspective is that different ecosystem components (elk range, or the range of an owl species) will have different boundaries, implying a set of overlapping and interacting systems. Another important aspect of the ecosystem concept is that no static equilibrium is likely to exist. Although periods of stability may occur, the constant in these systems is change. Plant species in today's preserves are a reflection of past climatic shifts and differential migration rates for the various plant species, rather than reflecting some stable, highly coevolved vegetation mosaic. With potential global warming on the horizon, accelerated anthropogenic shifts in vegetation are possible. Similarly, equilibrium levels of animal populations are not the norm. Natural area management is the management of change, where the basic values and knowledge underlying management may also change.

The dilemma we now face – what are the real goals of natural area management and how are we to achieve them – has been generated by the evolution of biological and social thought in this century about how ecosystems and their components – among them plants and animals and people – function. At the same time, scientists are realizing that many implications of their research require policy decisions driven more by values than directed by scientific fact.

Nature preserves can no longer be considered ecological or social islands. They are inextricably tied to neighboring areas, for better or for worse. We can no longer rely on the myth of natural process management as the sole means of achieving natural area goals because these are not, in a cybernetic or systems context, closed systems. The "walls" of natural area boundaries are political realities, but not social or biological barriers.

First, let's admit that our preservation goals, although worthy, are elusive. Separating natural from human-induced change will be nearly impossible. We need to frame our preservation goals in a regional framework, looking at larger, regional goals for biodiversity at species and landscape levels. Large parks and smaller preserves are part of the solution, part of a network of lands managed for multiple goals and not just preservation goals . . . through ecosystem management. This approach is intended to be neither a threat to adjacent land managers nor a deliberate compromise of natural area values. Rather, it recognizes that the boundaries of nature preserves are permeable membranes, and that in the future, cooperative management approaches are most likely to preserve the values for which these areas were established, given the inevitable changes we foresee in and around nature preserves.

A four-part ecosystem management strategy is envisioned: First, defining precise objectives, incorporating our knowledge of the natural world and our recognition that humans are a part of the problems and solutions; second, defining components of concern, each of which may have a different boundary overlapping different adjacent lands – implicit in this second step is the need for updated inventory and management systems; third, developing cooperative management strategies; and fourth, monitoring the results of such strategies.

The changing physical, biological, and cultural environments in and around these truly great nature preserves will force us to more specifically define the values we wish to preserve and actively pursue them with our neighbors, or we are likely to see them erode. As we celebrate the centennial of Yosemite, it is appropriate that our management goals and the values that drive them are debated at forums like this. For us as well as the preserves, only change is constant.

REFERENCES

Agee, J.K., and D.R. Johnson. 1988. *Ecosystem management for parks and wilderness.* Seattle, WA: University of Washington Press.

Christensen, N. 1988. Succession and natural disturbance: paradigms, problems, and preservation of natural ecosystems. In *Ecosystem management for parks and wilderness,* ed. J.K. Agee and D.R. Johnson. Seattle, WA: University of Washington Press.

Komarek, E. 1972. Lightning and fire ecology in Africa. *Tall Timbers Fire Ecology Conference Proceedings* 11: 473-512.

Pickett, S. 1990. Earthquakes, fires, and communicating ecology. *Bulletin Ecological Society America* 71: 159-161.

THE CHANGING NATURAL LANDSCAPE OF YOSEMITE VALLEY

J.W. Bartolome[1]

Abstract

This paper describes the changing landscape of the Yosemite Valley since discovery by Europeans in 1851. A state-transition model is introduced to organize the complex process of landscape dynamics and to better describe natural and human-caused changes in vegetation. For hundreds of years humans actively intervened in natural vegetation dynamics. Management of vegetation will likely continue to protect desirable landscape characteristics like meadows and open forests.

INTRODUCTION

Landscapes are heterogeneous collections of homogeneous land units called ecosystems (Bartolome, 1989). The landscape discussed in this paper is the 890 ha Yosemite Valley of California's Sierra Nevada. The valley was formed by pleistocene glaciers, creating the spectacular landscape of sheer cliffs and hanging valleys that attract visitors to one of the world's great natural parks. The ecosystems and associated soils and vegetation making up the Yosemite Valley landscape are described using a state-transition model to help understand the complex interactions of natural and human influences on landscape change.

ECOSYSTEMS

Heady and Zinke (1978) divided the Yosemite Valley landscape into five major ecosystems found on distinctive substrates, each with distinctive soils and potential vegetation: 1) recent alluvium, 2) older alluvium, 3) colluvium, 4) moraines, and 5) alluvial fans (fig. 1). Alluvium is deposited following winter or spring flooding of the Merced River, which flows through the valley. Colluvium is material from the valley walls, often falling suddenly and in large amounts (Muir 1912). Moraines were deposited following retreat of the valley-forming glaciers, and alluvial fans form an extensive ecosystem below tributary streams and waterfalls along the valley rim. An important characteristic of these ecosystems is the vegetation.

VEGETATION

Vegetation in the Yosemite Valley can be described as five major types: 1) annual weeds, 2) dry meadows, 3) wet meadows, 4) mixed conifer forest, and 5) hardwood forest. Annual weeds occupy areas of recent disturbance such as recent alluvium, colluvium, campgrounds, and parking lots. Meadows have decreased in area since the first Europeans entered the valley in 1851, from about 350 ha to less than 150 ha (Gibbens and Heady 1964). Of the remaining meadows, many can now be classed as dry rather than wet, because of extensive efforts to reduce flooding and lower the water table. These activities included vegetation removal along the Merced River, ditching of meadows, and blasting of moraines (Heady and Zinke 1978). The original wet meadows were probably dominated

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by sedges (*Carex* spp.) with associated grasses and herbs. Sedges are still common, but introduced species are abundant, especially Kentucky blue grass (*Poa pratensis*). Dry meadows are more grass and herb dominated, with fewer sedges than wet meadows.

Mixed conifer forests are dominated by ponderosa pine (*Pinus ponderosa*) and other conifers with black oak (*Quercus kelloggii*) a common associate. Mixed conifer forests in the Valley were kept open by the native Awahnichee people, probably by burning. The original inhabitants also actively favored acorn-producing black oaks (Heady and Zinke 1978). The hardwood forest type, which has increased greatly in density and extent since 1851, is dominated by California bay (*Umbellularia californica*) and canyon live oak (*Quercus chrysolepis*), with associated conifers and black oaks. Trees have invaded meadows and become denser since 1851 in valley ecosystems (Gibbens and Heady 1964).

THE STATE-TRANSITION MODEL

A state-transition model helps organize information about vegetation change and its causes. These simple models have proven useful in range science as an extension of traditional range condition models (Westoby et al. 1989). To use the model one defines states (in this case vegetation types), and possible transitions between states (fig. 2). Then one catalogs the factors producing transitions and characteristics of interest for the major ecosystems. In the following example I draw heavily on data from the vegetation studies of Gibbens and Heady (1964) and Heady and Zinke (1978).

In figure 2 vegetation types are states. Note that not all possible transitions are in the model, either because they are of little interest or not observed. Table 1 catalogs the transitions for natural succession, the states of vegetation and dominant transitions in the five major ecosystems at the time of discovery by Europeans in 1851, and states in 1990.

THE ALLUVIAL FAN ECOSYSTEM

If we consider the case of the alluvial fan ecosystem (table 1), the transitions (T1), (T2), and (T3) represent classical natural succession without disturbance. Disturbances in the form of flooding and deposition or wildfire cause transitions (T4), (T5), and (T6). At discovery in 1851, alluvial fans were in two major states: dry meadow, and mixed conifer forest with abundant black oak. The Awahnichee who lived in the valley apparently maintained the alluvial fan ecosystem by using fire to kill small trees and cause (T5), thus countering the natural tendency for (T2). Once fires were reduced after settlement, succession produced the changes toward denser mixed conifer forest and more hardwood forest (T3).

Without active human intervention to alter (T2) by cutting and burning, meadows decrease. The transition (T3) from conifers to hardwoods currently dominates the process of vegetation change on alluvial fans. States and transitions for other ecosystems are listed in table 1.

Table 1. Catalog of Vegetation States and Important Transitions for Five Yosemite Valley Ecosystem Types

Codes for vegetation types: AW=annual weeds; DM=dry meadow dominated by perennial grasses; WM=wet meadow dominated by Carices; MCF=mixed conifer forest dominated by ponderosa pine and other conifers with black oak; HWF=hardwood forest dominated by canyon live oak and bay, with conifers and black oak. The ">" indicates direction for succession. Codes T1 through T11 refer to most significant transitions described in state model, figure 2.

Ecosystem Type	Natural Succession	State in 1851	State in 1990
Moraines	MCF > HWF T3	MCF	MCF, HWF T3
Alluvial Fans	AW > DM > MCF > HWF T1,T2,T3	DM, MCF T2,T5	MCF, HWF T3
Colluvium	MCF > HWF T3	MCF	MCF, HWF T3
Alluvium (well-drained)	AW > DM > MCF > HWF T1,T2,T3	AW, DM T1,T6,T7,T10	DM, MCF T2,T5
(poorly-drained)	WM > DM > MCF > HWF T2,T3,T10	WM, AW T7,T8,T9,T10,T11	DM, WM, MCF T2,T5,T8,T9

CONCLUSIONS

What can this kind of analysis tell us about change in the Yosemite landscape? Change is part of the landscape. The major lesson is that although natural successional changes can be identified and are important to understand, they only once formed the dominant processes of change during the last 300 years. That was a short period when the Awahnichee temporarily left the valley around 1800. Before and since, active human intervention has been the rule. Active management appears necessary to protect desirable vegetation types like meadows on alluvium.

ACKNOWLEDGMENTS

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REFERENCES

Bartolome, J.W. 1989. Ecological history of the California Mediterranean-type landscape. In *Landscape ecology: study of Mediterranean grazed ecosystems. Proceedings Man and the Biosphere Symposium, XVI International Grassland Congress, Nice, France, Oct 7, 1989,* ed. W.J. Clawson. pp.2-15.

Gibbens, R.P. and H. F. Heady. 1964. The influence of modern man on the vegetation of the Yosemite Valley. *California Agricultural Experiment Station Manual 36.*

Heady, H.F. and P. J. Zinke. 1978. Vegetational changes in Yosemite Valley. *National Park Service Occasional Paper 5.*

Muir, J. 1912. *The Yosemite.* NY: The Century Co.

Westoby, M., B. Walker, and I. Noy-Meir. 1989. Opportunistic management for rangelands not at equilibrium. *Journal of Range Management* 42:266-274.

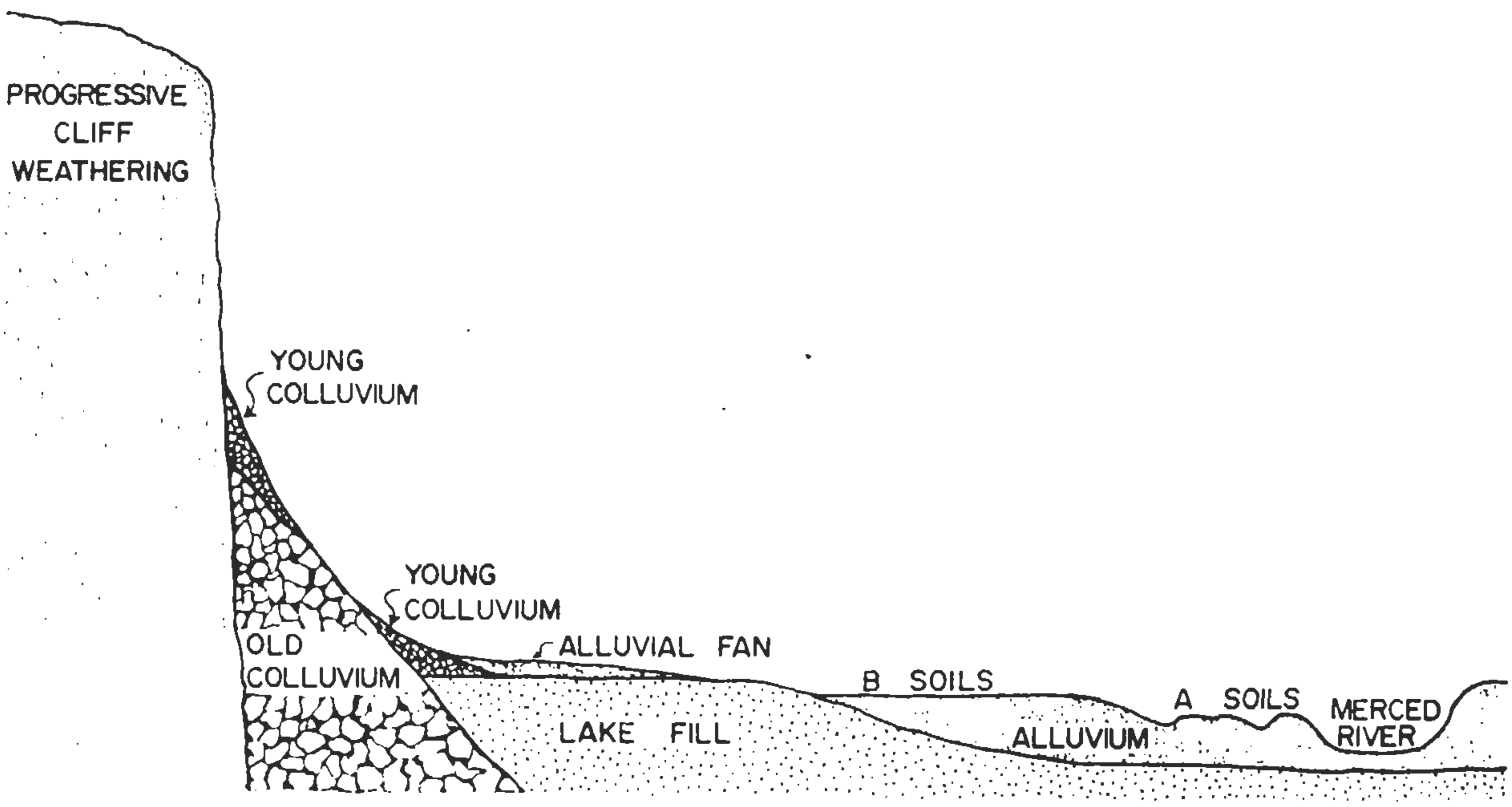

Figure 1. Cross section of Yosemite Valley showing typical locations of ecosystem types described in the text (from Heady and Zinke 1978). "A" soils are without profile development on recent alluvium. "B" soils are on older alluvium and show profile development.

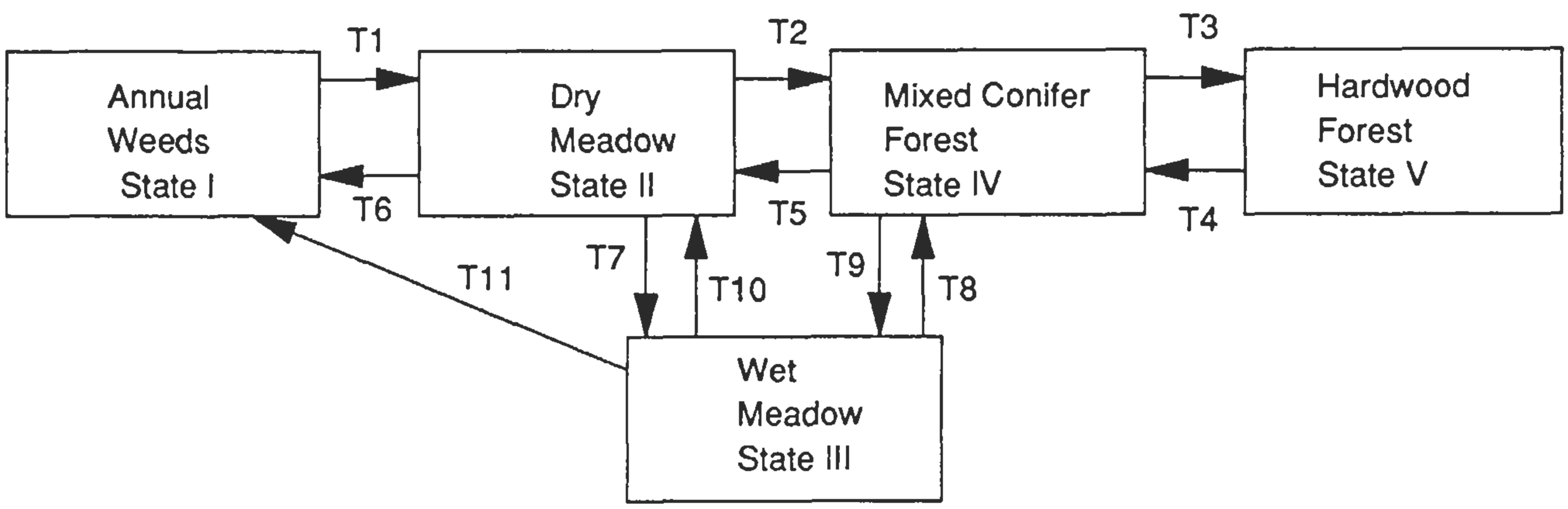

Figure 2. State-transition model for five vegetation types in Yosemite Valley with 11 associated transitions.

PREPARING THE SIERRAN PARKS FOR GLOBAL ISSUES OF THE 21ST CENTURY

David J. Parsons[1]

Abstract

Created primarily to protect selected objects, species, or vistas, the national parks of the Sierra Nevada now represent some of the largest protected ecosystems remaining in the western United States. Yet, such global threats as atmospheric pollution and climatic change place these parks in increasing jeopardy. Boundaries and policies that made sense a century ago may now be inadequate to protect increasingly sensitive ecosystems from global scale threats. An improved information base, together with cooperative planning and management with neighboring landowners and agencies, will be required to assure the protection of these areas. Specific examples of the need to take a regional, landscape perspective in preparing the Sierran parks for such threats as air pollution, fire, and climatic change are discussed.

INTRODUCTION

Historical Perspective

For many years national parks were managed largely to protect objects, species, or vistas. Park management focused on "protecting" park resources while providing opportunities for public enjoyment. Resource protection consisted largely of suppressing fires, destroying predators and pests, controlling ungulate populations, and minimizing visitor impacts. Threats were seen as local and easily controllable. In the Sierra Nevada, management of Sequoia, Yosemite, and General Grant (later incorporated into Kings Canyon) national parks – created in 1890 as our second, third, and fourth national parks – focused largely on the protection of big trees and high mountain wilderness (Dilsaver and Tweed 1990; Runte 1990). Resource management activities included fire suppression, blister rust control, fish planting, bear feeding (largely as a visitor attraction), and the elimination of domestic sheep and cattle grazing. High priority was given to building roads, trails, and visitor accommodations.

In a 1963 special report to the secretary of the interior, A. S. Leopold and others (1963) recognized the importance of moving beyond the era of resource protection. The Leopold Report recommended that active management be used to preserve and, where necessary, recreate native habitats and biotic associations. These ideas were soon incorporated into National Park Service policy and practice. In recent years this approach has further evolved from an emphasis on static scene management to one of managing for the perpetuation of natural ecosystem processes (see Graber 1983). In the Sierran parks this emphasis has included the restoration of vegetation, fauna, fire effects, and fire as an ecological process, together with expanded research and monitoring of air quality, aquatic ecology, and wilderness impacts (e.g., Duriscoe and Stolte 1989; Parsons et al. 1986; van Wagtendonk et al. 1988).

As we enter the 1990s there is a growing recognition of the dynamic nature of natural ecosystems. The ecological paradigm of succession leading to an equilibrium or climax community has been largely displaced by a new paradigm of disequilibrium that recognizes change as an integral part of natural ecosystems (Christensen 1988, 1989). Similarly, the new discipline of landscape ecology emphasizes the importance of looking beyond geographic or administrative boundaries. Pollution, animal migration patterns, fire spread, and climatic change cross park boundaries with impunity. The importance of

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considering disturbance and landscape issues in park management policy and practice has been the subject of recent scholarly and applied reports (Knight and Wallace 1989; Grumbine 1990, NPCA 1989). Specifically, recent research in Yosemite, Sequoia, and Kings Canyon National Parks has documented close association between past variability in climate, fire regime, and vegetation (Anderson 1990; Graumlich 1990; Scuderi 1987; Swetnam, pers. comm.). Lessons from this work must provide direction in preparing the Sierran parks for the next century.

Implications for the Future

In developing future management policy for the Sierran parks we must recognize the importance of the inherent variability of natural ecosystems as well as their sensitivity to regional and global influences. The temporal and spatial scales we are used to must be reevaluated. The time perspective on which we make decisions is simply too short. It is unrealistic to expect park ecosystems to remain static over time. They have and will continue to change, and we must prepare to manage that change. Spatially, we can no longer view the parks as independent entities. Increasingly the Sierran parks are being impacted by threats originating well beyond park boundaries. Managers must recognize the potential of such threats and develop cooperative scientific and management programs. This need is particularly acute in California where burgeoning population and economic growth and associated environmental change threaten even the remotest wilderness ecosystem.

THE SETTING

Situated on the west slope of the central and southern Sierra Nevada, Yosemite, Sequoia, and Kings Canyon national parks contain tremendous natural resource values. Managed largely as wilderness, these three large parks include as close to pristine foothill woodland, chaparral, mixed conifer forest, subalpine forest, and alpine environments as can be found anywhere in the western United States. Elevation gradients of over 13,000 feet create a diversity of micro-climates, soils, and aquatic and terrestrial communities. Although immediately surrounded largely by national forest and BLM lands, the parks lie at the western edge of the San Joaquin Valley. As changed by human activity as any landscape in the world, the valley is characterized by urban sprawl, industry, transportation systems, extensive agriculture, oil fields, and essentially every other conceivable accoutrement of agro-urban development. The juxtaposition of the large Sierran parks and the San Joaquin Valley creates a tremendous paradox: how to preserve a semblance of natural ecosystems in the face of ever-expanding human impacts.

ENVIRONMENTAL THREATS

Atmospheric Pollution

The long distance transport of atmospheric pollutants is probably the greatest assault to both ecosystem integrity and human enjoyment in the Sierran parks. Air pollution ignores geographic and political boundaries. It obstructs vistas, damages vegetation, disrupts aquatic systems, and threatens the health of wildlife and humans. Products of fossil fuel consumption in urban and industrial areas of the San Joaquin and Sacramento valleys and greater San Francisco Bay area are transported eastward into the Sierra Nevada (Miller et al. 1983). Photochemical oxidants (primarily ozone – a product of NO_x and hydrocarbons) are known to impact the growth and physiology of Sierran conifers (Peterson et al. 1987; Grulke et al. 1989). Visibility is seriously impaired throughout much of the summer season when a Pacific high pressure system creates a strong inversion that effectively traps pollutants. The San Joaquin Valley and west slope of the Sierra Nevada are already widely recognized as having one of the worst air pollution problems in the country. Ozone and particulate levels commonly exceed state and federal standards in the three national parks and can only be expected to get worse. Considerable research on the effects of ozone on park resources has been supported by the National Park Service Air Quality Office in recent years.

Concern over potential impacts of acidic deposition on Sierran ecosystems has stimulated a major cooperative, interdisciplinary research program (Parsons and Graber 1985). Dominated by long distance transported nitric and sulfuric acid compounds, acidic precipitation occurs in the Sierra in the form of rain, snow, fog, and dry deposition. Temporary acidification of high elevation lakes and streams has been documented following snow melt and particularly acidic summer thunderstorms. And whereas biological studies have found little actual impact from acid deposition to date, there is strong evidence that Sierran ecosystems are highly sensitive to acidic input and future increases in deposition could cause considerable biotic change (California Air Resources Board 1989). Projected increases in urban, industrial, and vehicle emissions of acid precursors threaten the integrity of many Sierran ecosystems.

The impacts of pollutants to park ecosystems, documented air pollution damage to agricultural production, concerns over health effects and declining visibility, and projections for continuing population growth throughout the state demand immediate attention. Expanded interpretive efforts, involvement in recent permit hearings for cogeneration plants and other new emission sources, and efforts to establish a valley-wide air quality regulatory authority symbolize a new level of National Park Service involvement in air quality issues.

Climate Change

The growing consensus that human-induced global climatic change may cause unprecedented stress on biotic systems has potentially serious implications for the Sierran parks. Increased temperatures and shifting atmospheric circulation patterns would likely diminish water storage capacity (due to an increase in both the elevation of snowline and the frequency of rain on snow events) as well as impact distributions of species and habitats (California Energy Commission 1989). Climatic induced changes in the frequency and severity of fire can likewise have significant influence on biotic communities (Clark 1988). Such change has serious implications both for surrounding communities (decreased water supply for urban and agricultural use) and park resources (will species at the margin of their range survive?). While the causes of global climate change are beyond the capacity of the Sierran parks or their neighbors to significantly influence, the threat does call for an unprecedented level of cooperation in research, education, and planning. The Sierran parks have recently taken the lead in designing a biogeographically based research program to study the potential effect of global climate change on the southern and central Sierra (Stephenson et al. 1990). This program, which is designed as a cooperative venture with agencies and institutions interested in Sierran resources, is funded largely through the National Park Service's Global Change Program. The study will focus on understanding and predicting changes in hydrology, plant succession, and habitats under changing climatic regimes. We will investigate historical relationships between climate, disturbance (largely fire), and biota as well as build predictive models to guide future planning efforts. The program is designed as a truly bioregional effort with little regard for park boundaries.

Fire

The summer drought climate that characterizes the Sierra Nevada is especially conducive to the spread of wildland fire. Recognizing the significant impact of nearly a century of fire suppression on fuel accumulation and plant succession, the Sierran parks have pioneered the effective reintroduction of fire as a natural ecosystem process (Parsons 1990). However, as fire is a process that frequently transcends administrative and ecosystem boundaries, interagency cooperation is required in making many fire management decisions. For example, what are the ramifications of immediately suppressing a high elevation lightning ignition just outside a park boundary as opposed to permitting that fire to cross the boundary and burn itself out? Similarly, the severity of the 1990 Yosemite fires raised considerable concern over the need for a more aggressive and coordinated prescribed fire program (Monastersky 1990). It is obvious that any effective effort to restore fire to its native role in the Sierran parks will require cooperation between adjacent landowners as well as more sophisticated modeling of potential fire behavior and spread (van Wagtendonk 1985). Potential effects of global climate change on Sierran fire frequency and intensity further emphasize the importance of a regional approach to fire management.

Other Concerns

A number of other more local influences will also require improved regional cooperation to assure full resource protection in coming years. The destruction of winter habitat or blocking of migration corridors by conflicting land use practices on adjacent lands can threaten animal populations. A regional approach to protecting deer migration corridors and winter range will be required to assure the long-term health of west slope deer herds. Similarly, the long-term protection of the Sierra bighorn is dependent on an interagency effort to reestablish ancestral herds through relocation from existing populations. Cooperation between federal, state, and private interests has been required to assure protection of the remaining bighorn from excessive predation and the threat of disease transmitted from domestic livestock. The disappearance of significant numbers of amphibian populations from the Sierra will likewise require unprecedented cooperation in determining both cause and the potential for mitigative action.

Minimizing the impact of growing numbers of visitors on park resources will also require significant cooperative efforts. Outreach education programs are needed to contact visitors regarding park values and appropriate behavior before they reach their destination. Because a high percentage of park wilderness users actually begin their trips on other agency lands, improved cooperation in wilderness management and education will also be required. Growing populations of southeast Asians and other minority groups in California will likewise require expanded outreach to communicate the purpose and proper use of park and other federal lands in the Sierra.

AN INTEGRATED PROGRAM

In recognition of the regional nature of many of the challenges facing the Sierra Nevada, the area managers of the National Park Service, U. S. Forest Service, and Bureau of Land Management in the southern Sierra meet on a regular basis to discuss issues and programs. To date a special working group has specifically dealt with issues of mutual interest related to wilderness management. Additional working groups have been proposed to deal with air quality and fire related issues. This framework, together with the growing regional focus on the scientific study of global change, provides an excellent basis for directly confronting the major issues that will face the Sierra Nevada in the 21st century. This management group provides a strong base for making decisions and cooperative actions critical to the future of the region. It will be critical that local park and forest managers recognize that the traditional view of national parks will not be adequate to assure their preservation into the next century. It is no longer possible to manage such areas in isolation. An unprecedented level of cooperative research, education, monitoring, and management will be required to address the regional and global issues that are now upon us. We must think in terms of a "greater Sierran ecosystem" where administrative boundaries are increasingly blurred and cooperative management is the norm.

REFERENCES

Anderson, R. S. 1990. Holocene Forest Development and Paleoclimates within the Central Sierra Nevada, California. *Journal of Ecology* 78:470-489.

California Air Resources Board. 1989. *The Health and Welfare Effects of Acid Deposition in California: Technical Assessment.* Sacramento: State of California.

California Energy Commission. 1989. *The Impacts of Global Warming on California.* Sacramento: California Energy Commission.

Christensen, N. L. 1988. "Succession and Natural Disturbance: Paradigms, Problems, and Preservation of Natural Ecosystems." In *Ecosystem Management for Parks and Wilderness*, pp. 62-86. Seattle: University of Washington Press.

Christensen, N. L. 1989. "Wilderness and Natural Disturbance." *Forum for Applied Research and Public Policy* 4(2):46-49.

Clark, J. S. 1988. "Effect of Climate Change on Fire Regimes in Northwestern Minnesota." *Nature* 334:233-235.

Dilsaver, L. M., and W. C. Tweed. 1990. *Challenge of the Big Trees.* Three Rivers: Sequoia Natural History Association.

Duriscoe, D. M., and K. W. Stolte. 1989. "Photochemical Oxidant Injury to Ponderosa Pine and Jeffrey Pine in the National Parks of the Sierra Nevada of California." In *Effects of Air Pollution on Western Forests*, pp. 261-278. Air and Waste Management Association.

Graber, D. M. 1983. "Rationalizing Management of Natural Areas in National Parks." *The George Wright Forum* 4:48-56.

Graumlich, L. J. 1990. "Interactions Between Climatic Variables Controlling Subalpine Tree Growth: Implications for Climatic History of the Sierra Nevada, California." In *Proceedings Sixth Annual Pacific Climate (PACLIM) Workshop*, pp. 115-118. Sacramento: California Department of Water Resources.

Grulke, N. E., P. R. Miller, R. D. Wilborn, and S. Hahn. 1989. "Photosynthetic Response of Giant Sequoia Seedlings and Rooted Branchlets of Mature Foliage to Ozone Fumigation." In *Effects of Air Pollution on Western Forests*, pp. 429-441. Air and Waste Management Association.

Grumbime, E. 1990. "Protecting Biological Diversity through the Greater Ecosystem Concept." *Natural Areas Journal* 10(3):114-120.

Knight, D. H., and L. L. Wallace. 1989. "The Yellowstone Fires: Issues in Landscape Ecology." *Bioscience* 39(10):700-706.

Leopold, A. S., S. A. Cain, C. Cottam, I. N. Gabrielson, and T. L. Kimball. 1963. "Wildlife Management in the National Parks." *American Forests* 69(4):32-35, 61-63.

Miller, P. R., M. H. McCutchan, and M. P. Milligan. 1972. "Oxidant Air Pollution in the Central Valley, Sierra Nevada Foothills and Mineral King Valley of California." *Atmospheric Environment* 6:623-633.

Monastersky, R. 1990. "Burning Questions." *Science News* 138:264-266.

National Parks and Conservation Association. 1989. *National Parks: From Vignettes to a Global View.* Washington D. C.

Parsons, D. J. 1990. "Restoring Fire to the Sierra Nevada Mixed Conifer Forest: Reconciling Science, Policy and Practicality." In *Proceedings Annual Meeting Society Ecological Restoration and Management* (in press).

Parsons, D. J., and D. M. Graber. 1985. "Integrated Watershed Research Undertaken at Sequoia National Park." *Park Science* 5(2):22-24.

Parsons, D. J., D. M. Graber, J. K. Agee, and J. W. van Wagtendonk. 1986. "Natural Fire Management in National Parks." *Environmental Management* 10(1):21-24.

Peterson, D. L., M. J. Arbaugh, V. A. Wakefield, and P. R. Miller. 1987. "Evidence of Growth Reduction in Ozone-injured Jeffrey Pine in Sequoia and Kings Canyon National Parks." *J. Air Pollution Control Association* 37(8):908-912.

Runte, A. 1990. *Yosemite: the Embattled Wilderness.* Lincoln: University of Nebraska Press.

Scuderi, L. A. 1987. "Late-Holocene Upper Timberline Variation in the Southern Sierra Nevada." *Nature* 325:242-244.

Stephenson, N. L., D. J. Parsons, D. M. Graber, and J. W. van Wagtendonk. 1990. "Global Climate Change Research Capabilities and Interest Statement: Southern and Central Sierra Nevada." Unpublished National Park Service manuscript.

van Wagtendonk, J. W. 1985. "Fire Suppression Effects on Fuels and Succession in Short-Interval Wilderness Ecosystems." In *USDA Forest Service General Technical Report INT-182*, pp. 119-126.

van Wagtendonk, J. W., D. J. Parsons, and E. P. DeGraff, Jr. 1988. "Wilderness Management in the Sierra Nevada, California: Years of Interagency Cooperation." In *Proceedings 4th World Wilderness Congress*, pp. 1-7.

BRINGING PEOPLE IN: THE SOCIAL CONTEXT OF ECOSYSTEM MANAGEMENT IN NATIONAL PARKS AND WILDERNESS AREAS

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Abstract

Facing unprecedented challenges, managers of many national parks and wilderness areas are considering implementation of ecosystem management models. The idea of ecosystem management is appropriate because it focuses on the interrelationships between ecosystem components, the interaction with external systems, and the long-term structure and function of ecosystems themselves. Attention is also directed to social systems as components of park and wilderness ecosystems. Continual change is an intrinsic characteristic of both social and biological systems. Awareness of social and demographic changes may be increasingly important as managers serve larger numbers of diverse people and as the politics supporting natural areas evolve due to population increases, a changing age structure, ethnic diversification, social fragmentation, and possibly increasing awareness of class differences. Given that national parks and wilderness areas are used primarily by a select group of highly educated, white-collar, urban professionals, biocentric antihumanist polemics from advocacy organizations supporting national parks and wilderness, or from land management agencies themselves, may have the paradoxical end result of eroding political support and therefore be detrimental to the very areas such advocates seek to protect. Future national park and wilderness managers may have to articulate common symbolic meaning derived from these places to increasingly different user groups and to accommodate use not characteristic of current management philosophy, while protecting natural resources and carrying out democratically inspired management. Ecosystem management models composed of both social and biological elements will be invaluable as managers cope with a changing and challenging world.

INTRODUCTION

The writers of the recent report, *National Parks: From Vignettes to a Global View,* observe: "The National Park System is a magnificent and uniquely American gift to the American people and to the world" (NPCA 1989). Today this system, comprising most of the great natural wonders of our country and many of the cultural treasures that define us as a people, faces unprecedented challenges. From one perspective, national parks and wilderness areas are threatened islands in a rising sea of development and population growth.

It is not surprising, therefore, that astute national park and wilderness managers are looking for alternate ways to conceptualize the complex interactions between legally designated natural areas and their surrounding environments. The notion of ecosystem management is appropriate because there is a focus on the interrelationships between system components, the interaction with external systems, and the long-term structure and function of ecosystems (Agee and Johnson 1988; Johnson and Agee 1988).

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Ecosystem Management[2]

Most national park and wilderness managers quickly grasp the advantages of the ecosystem approach because attention is focused upon external threats to nonhuman park systems and toward the fact that different components of the park ecosystem have different boundaries, many of which do not correspond to park boundaries. For example, attention may be directed toward the fact that if wolves and grizzly bears are to be protected, in most instances management must have some influence on activities outside protected area boundaries. Moreover, external pollutants may be carried into an area and have negative effects upon protected biological systems. Attention might also be drawn to the awesome prospect of global warming.

Systems-oriented thinking immediately forces us to come to grips with the fact that protected natural area ecosystems are a series of inextricably linked subsystems that may include the slug, the flea, the grizzly, the tiniest fungus, and the giant redwood. But overlying them all are social systems.

Social Systems and Ecosystem Management

Indeed, the very notion of a national park or wilderness is a cultural construction, most frequently occurring among humans in relatively wealthy industrialized societies. For example, the legal concept of "wilderness," as it is defined in the United States, is confined to about five countries (Eidsvik 1987). All of these countries have European cultural roots and relatively affluent economies.

Ironically, the social institutions that represent sources of the most pernicious external threats to national parks and wilderness are also those that produce surplus wealth for research on the ecology of iceworms, for park rangers and for conferences such as the present.

Because national parks and legally designated wilderness areas are cultural creations, it is appropriate that the people who create them, and who pay the bills for their management, reserve rights for their use. The oft cited Park Service organic legislation states clearly that parks are intended for the enjoyment of people. In fact, the first parks were politically defended and advocated by virtue of their ability to provide unique recreation to society's elite (Freemuth 1989). While national parks and wilderness areas today receive widespread support in the U.S. population, their patrons are still an educated elite, disproportionately drawn from the urban, white-collar, upper middle class.[3]

Protected natural areas are politically possible because certain strong vested interests support them to the exclusion of others. Legally designated natural areas are simply another type of human use of space institutionalized by the culture of those who control it. We have farmland, clear-cuts, industrial areas, and we have national parks and wilderness. Even a superficial look at the land area of the United States, and the entire globe, shows very few spaces where humans do not directly or indirectly dominate the landscape. Politically organized societies control space and utilize it consistent with their values and needs for comfort and sustenance. There are few large truly wild and undisturbed areas

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2. "Ecosystem management involves regulating internal ecosystem structure and function, plus inputs and outputs, to achieve socially desirable conditions. It includes, within a chosen and not always geographic setting, the usual array of planning and management activities but conceptualized in a systems framework: identification of issues through research, public involvement, and political analysis; goal setting; planning development; use allocation; activity development. . . ." (Johnson and Agee 1988).

3. See Salvi and Johnson 1984; Salvi and Johnson 1985; Mills 1986; Manning 1987; Ditton, R.B. and Gramann, J.H. 1987; Roggenbuck and Lucas 1987; Lee et al. 1987a; Lee et al. 1987b; Johnson and Barton 1989; Lee et al. 1989; Gramann et al. 1989; Stewart 1990; Johnson 1990a; Johnson 1990b; Thoennes and Key, date unknown.

on the planet – to some extent all easily utilizable space is occupied by human cultures and its use is dictated by them.

Given a planet dominated by humans, the frequent discussion of differences between values of primitive societies (emphasizing a simplistic "harmony" with nature) and those of modern, especially Christian societies (emphasizing "conquest" of nature) is moot. The idle debate as to whether humankind is a part of the natural ecosystem is also largely irrelevant. The planet (at least North America) is conquered, occupied, and controlled by humans. Whether humans are conceptualized in or out of natural systems is secondary to the fact that humans, within a broad realm, dominate almost all other life forms, and that the protection of natural areas must be accomplished through cultural institutions.[4]

The outlines of policy pertaining to the use and preservation of protected natural areas involve an exchange between groups with values in conflict, wherein differences over the use of scarce resources are resolved by political power and established institutional processes. In a pluralistic democratic society, the creation of legally designated natural areas and their management is driven by trade-offs between people with competing values, political and economic interests, and perhaps by class differences. Even today there is sharp disagreement on the desirability of establishing these areas and the management philosophy that should guide them (e.g., Carroll 1988).

Given the social dynamics surrounding park and preserve management, it is not surprising that approaches to management change with time. We no longer build railroads into parks for the eastern rich. We do not kill predators in national parks, except when they kill or maim us. We do not feed garbage to bears to attract them to tourist observation points. We do, however, maintain a network of hiking trails for young, highly educated urban recreationists. And we do construct expensive human waste management facilities near mountain summits for a handful of climbers.

To some people these changes are evidence of evolution to an ideal which is accompanied by the belief that natural resource management ideology will now remain constant. However, even a superficial understanding of social change in general leads to the conclusion that the belief that contemporary resource management thinking is the epitome of social evolution is as absurd as Marx's belief in the eternity of the classless state; or, as silly as the belief that natural ecosystems will persist in static equilibrium. Only change itself is constant in both social systems and natural systems.

Good national park managers have always understood the social and cultural relativity of natural resource management. Successful superintendents of large natural areas are usually good politicians and public relations people, as well as natural resource managers. They realize that the financial resources to maintain parks and natural areas come from the larger society and the powerful interests supporting them. Consequently, they understand that natural resource management decisions must not only be biologically sound but socially acceptable.

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4. Further, it is difficult to conceive of a likely future global scenario in which the trend toward more human control and consumptive-oriented domination of the landscape does not continue. Current demographic momentum appears to guarantee a doubling of Earth's population in the next century (Ehrlich and Ehrlich 1990). Despite the Earth First! slogan, "Back to the Pleistocene," large numbers of people are not likely to voluntarily regress to subsistence level conditions, in which they live "harmoniously" but very precariously with nature.

Democracy, Radical Biocentricity, and Ecosystem Management

That American natural resource management decisions must be socially acceptable is hardly unfortunate, because this is the essence of democracy. This consideration, however, does lead to the identification of some of the most perplexing questions facing public land managers in general and national park and wilderness managers in particular. Those questions include, How can we democratically manage public lands, especially in situations where there is also a mandate for resource preservation? Given a pluralistic society, how can we guarantee appropriate access to public lands by all subcultures and avoid "tyrannies of the majority" by those capable of exerting the most political influence? How we assure fairness to "local interests" while carrying out national policy pertaining to national parks and wilderness areas?

While we will not attempt to answer these questions, we do assert that their answers can only be found through an awareness and appreciation of both the social and natural dimensions of the ecosystem. We also assert that political and social support for legally designated natural areas in the United States will likely erode if their maintenance is perceived as antithetical to egalitarian values and humanistic ideals. That is, if such areas are perceived as playgrounds for an elite, wherein the managing bureaucracy and the special interest groups supporting them have views hostile to large segments of humanity, widespread political support will probably eventually decline.[5]

Tragically, rather than focusing on the social context of resource preservation and its relativity to other cultural values such as democratic ideals, some biocentric radicals are taking positions that are more characteristic of religious zealots awaiting the Apocalypse than of socially aware land stewards. Consider the following by a person identified as a NPS employee (Graber 1990):

> Human happiness, and certainly human fecundity, are not as important as a wild and healthy planet. I know social scientists who remind me that people are part of nature, but it isn't true. Somewhere along the line – about a billion [people] ago, maybe half that – we quit the contract and became a cancer. We have become a plague upon ourselves and upon the Earth. It is cosmically unlikely that the developed world will choose to end its orgy of fossil-energy consumption, and the Third World its suicidal consumption of the landscape. Until such time as Homo sapiens should decide to rejoin nature, some of us can only hope for the right virus to come along.

Consider also the following by Captain Paul Watson (1990), who is founder of the Sea Shepherd Conservation Society and Captain of the Sea Shepherd:

> Therefore, I conclude that it [tree spiking] was a perfect tactic. . . . It could not even be considered as damaging property, since trees, being living sentient creatures, are not human property. . . . The hands of the individual who has destroyed a tree are the hands of a person who has murdered a sacred citizen of this planet. . . . the logger is a rot, a disease, and an aberration against nature. I, among others, will not weep a single tear at his demise.

The tone of these comments exudes a hatred of modern humans and their institutions. Even if population growth is a problem (which it is), those who appear to champion a malady such as the

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5. Freemuth (1989) astutely observes that the widespread attempt of environmentalists to establish a biocentric management view of western national parks makes it much easier to justify policies that discourage development and visitation. If successful and carried to an extreme, this philosophy may erode support for the areas themselves.

AIDS virus[6] or to define loggers as "social rot" will not likely attract more support for conservation or preservation.[7] (To the world's poor such statements must be reminiscent of the utterances of a well-known German dictator and perceived as a prelude to genocide by eco-fascist stormtroopers).

It is true that the United States, despite lower birthrates, is adding at least 20 million people to its population every 10 years. We are becoming more culturally diverse; we are on the average older. We are also "filling up" certain parts of the country. California is projected to have 34 million people by the year 2000, Texas 18 million, and Florida 16 million (U.S. Census 1990).

Thirty-three percent of the California population will be Hispanic by the year 2000; for Texas, the figure is projected to be 31 percent; for Florida 22 percent (*Oxford Analytica* 1986). Asian-Americans from various cultures are the fastest growing minority in America. From 1980 to 1989, Asian-Americans increased their numbers 80 percent compared to 4.4 percent for non-Hispanic whites (O'Hare 1990). The population of Hispanics is expected to equal that of blacks sometime during the first decade of the next century when both groups will number approximately 33 million people (Oxford Analytica 1986).

Assuming processes of decentralization and fragmentation in social, political, and economic dimensions of American society, the character of use of many national park and wilderness areas and the politics surrounding allocation of resources to them could change significantly as we go into the next century.[8] Thus, the awareness of social and demographic aspects of national park and wilderness ecosystems could be as important as the scientific biology of natural resources in the management of many natural areas in the future.

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6. See also Daniel Connor, "Is AIDS the Answer to the Environmentalists Prayer?" *Earth First!* Dec. 22,1987: 14-16.

7. Ehrlich and Ehrlich (1990) point out that world population, which was 3.5 billion in 1968, had increased to 5.3 billion in 1989 and is growing now at a rate of 93 million per year. These authors persuasively argue that population growth is inextricably linked to the most pressing environmental problems of our time and advocate action to avert global disaster. While we do not agree with all of the Ehrlichs' positions, we note with approval that their advocacy is done in a largely humanistic framework.

8. Regarding American social fragmentation, *Oxford Analytica* (1986) states

> We find abundant evidence of continuing diffusion and decentralization through the coming decade, affecting traditional patterns of social, political and economic cohesion. . . . There is a broadening retreat from goals of collective fulfillment towards those of individual fulfillment. . . .
>
> Socially the same process of diffusion and fragmentation underlies the shift away from belief in the efficacy of institutions. . . . Growing Hispanic influence will bring another ethnic influence to American culture. . . .
>
> . . . our inquiry finds in America's future: more separate ethnic identities, the "Balkanization" of America as the major regions experience different economic and political life and have more distinct and divergent interests.

Future National Park and Wilderness Management

National park and wilderness management of the future will emphasize the preservation of natural resources as they are culturally understood – as always. The services of dedicated men and women will be necessary – as always. However, astute park managers will increasingly need to see the natural resources they protect in terms of the social and political realities of the time. They will need to understand that park ecosystems, by their very essence, involve social systems. They will need to understand that natural resource management must be perceived in several social contexts. These contexts range from profiles of the visitors who consume the services of the areas, to the impact of parks and preserves upon regional economies, to the politics that allocate scarce financial resources to natural area management, to the ability of land management agencies to attract employees from society's best and brightest and the composition of agency work forces themselves.[9]

Future national park and wilderness managers and advocates must understand and communicate the social relevance of these areas in a crowded, increasingly urban, and perhaps more culturally diverse, socially fragmented, and class conscious world.[10] Eventually they will administer the adaptation of human use of national parks and wilderness areas in very different social conditions and perspectives. Perhaps they will accommodate people who do not ascribe to the park norms of today.

Thus, the natural area resource management challenges of the future will include understanding not only how external events threaten park resources, but how parks affect lifestyles, the quality of life within and economies of surrounding areas, and how natural, social, and demographic trends affect natural resource management in general. To protect all areas of the national park system, managers may have to find ways to provide increased social benefits for more diverse visitor groups, and to allow more use while protecting natural resources and maintaining quality visitor experiences.

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9. For example, note Director Ridenour's April 5, 1990, testimony on personnel management issues before the Subcommittee on National Parks and Public Lands, the House Committee on Interior and Insular Affairs, the Subcommittee on Civil Service, and the House Committee on Post Offices and Civil Service: "The Park Service is losing its ability to compete, especially for the pool of young, highly qualified recent college graduates. In 1989, the service hired 250 new park rangers: 60 percent were over the age of 30 at the time they were hired, and over 33 percent lacked a four-year college degree. Among those with degrees, only 50 percent held them in concentrations related to parks and recreation management, history, and the natural and biological sciences."

10. *Oxford Analytica* (1986) points out that the U.S. government is increasingly unable to reach consensus on how to alleviate economic problems and that many traditional manufacturing industries are in decline. "The gap between the rich and the poor will thus widen as the opportunities in this middle ground recede. . . . As social mobility decreases, class lines are likely to become clearer and class barriers harder to leap. Class consciousness – historically weak in America – would thus become significant, in attitudes and perhaps in politics." Many other studies support the hypothesis of a shrinking middle class (e.g., Bluestone and Harrison 1986; Bradbury 1986; and Horrigan and Haugen 1988). Although these studies show mixed results as to whether those leaving the middle class are disproportionately going into the upper or lower class, the results consistently show increasing disparity in income between the lower and upper classes.

CONCLUSIONS

If the trend toward increasing cultural diversity and social fragmentation continues, national parks and legally designated wilderness areas, to survive in a healthy fashion, may become places that symbolize the values of diverse groups – not only those that walk in awe in the footsteps of John Muir. Although no one place can be all things to all people, the national park and wilderness systems must symbolize something of importance for many types of people, including Hispanic-Americans, Asian-Americans, urban blacks, blue-collar workers, white middle class professionals, farmers, ranchers and loggers, aging Yuppies, local business people, the rich upper class, bird-watchers, hunters, and fishers. The challenge for managers and for advocacy organizations is discovering and articulating these meanings and managing for more diverse visitor experiences than has been characteristic of the past. An ecosystem management model that includes both social and biological components is a logical first step in accomplishing these objectives. From such a perspective, national parks and wilderness areas are more than nature preserves; they are cultural repositories for diverse groups whose members' pilgrimages allow not only opportunities for respite from the confines of civilization but a context for contemplation, discovery, and a reenactment of ancient human struggles for meaning.[11]

On the other hand, radical biocentric diatribes invite social retaliation and political disasters that ultimately may risk the very resources we seek to protect. Antisocial thinking, like that displayed in the previous quotes (Graber 1990; Watson 1990), will at best eventually result in the perception by many people of the preservation movement and its public counterparts being no more than guardians of the king's deer and at worse no different than history's worst demagogues.

Much work is ahead of us – especially in places like Yosemite. Yes, people are problems and threats to natural resources. Nonetheless, people, cultures, and social institutions are also the only source of solutions to these problems.

REFERENCES

Agee, J. K., and D. R. Johnson. 1988. "A Direction for Ecosystem Management." *Ecosystem Management for Parks and Wilderness*, pp. 226-232. University of Washington Press.

Bluestone, B., and B. Harrison. 1986. *The Great American Job Machine: The Proliferation of Low Wage Employment in the U.S. Economy.* U.S. Congress, Joint Economic Committee.

Bradbury, K. L. 1986. "The Shrinking Middle Class." *New England Economic Review* (September/October): 41-55.

Carroll, M. S. 1988. "A Tale of Two Rivers: Comparing NPS-Local Interactions in Two Areas." *Society and Natural Resources* 1: 317-333.

Ehrlich, P. R., and A. H. Ehrlich. 1990. *The Population Explosion*. New York: Simon and Schuster.

Exeter, T. 1990. "The West in the 1990's." *American Demographics* 12(10): 52.

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11. Mantell (1990) notes that there are increasingly important situations where park management issues focus on "preserving opportunities for visitor enjoyment of park resources. In these situations, there may be demand for protective measures that go beyond what science or resource management seem to require. If these demands grow they may increasingly shape not only new laws but the context in which present laws are interpreted."

Freemuth, J. 1989. "The National Parks: Political Versus Professional Determinants of Policy." *Public Administration Review*. May/June: 278-286.

Graber, D. M. 1990. Review of *The End of Nature*, by Bill McKibben. *The Los Angeles Times*, as reported in *Reason*, April 1990.

Horrigan, M. W., and S. E, Haugen. 1988. "The Declining Middle-Class Thesis: A Sensitivity Analysis." *Monthly Labor Review* 5: 3-11.

Johnson, D. R., and J. K. Agee. 1988. "Introduction to Ecosystem Management." In *Ecosystem Management for Parks and Wilderness* 3-14. University of Washington Press.

Kosters, M. H., and M. N. Ross. 1987. "The Distribution of Earnings and Employment Opportunities: A Re-examination of the Evidence." In *Studies in Economic Policy*. Washington American Enterprise Institute.

Manning, R. E. 1987. *Visitors and Neighbors of Acadia National Park: Planning for the Future*. University of Vermont.

Mantell, M. A. 1990. "Frontier Issues." In *Managing National Park System Resources*, 235-253. Dexter, Michigan: Thomson-Shore, Inc.

National Park Service, Cooperative Park Studies Unit. 1984. *Glacier Bay Backcountry User Study 1984: Statistical Abstract*, by Salvi, W. and D. R. Johnson. University of Washington.

National Park Service, Cooperative Park Studies Unit. 1985. *The 1985 Mount Rainier General Visitor Survey: Statistical Abstract*, by Salvi, W. and D. R. Johnson. University of Washington.

National Park Service, Cooperative Park Studies Unit. 1986a. *A Market Oriented Analysis of Visitors to the Lyndon B. Johnson National and State Historical Parks*, by Mills, A. S., D. E. Wegner, and D. B. Fenn. Texas A & M University.

National Park Service, Cooperative Park Studies Unit. 1986. *1986 Fort Clatsop Visitor Study*, by Lee, M.E., D.R. Field, and C. Johnson. Oregon State University.

National Park Service, Cooperative Park Studies Unit. 1986. *1986 Fort Vancouver Visitor Study*, by Lee, M.E., D.R. Field, and C. Johnson. Oregon State University.

National Park Service, Cooperative Park Studies Unit. 1987. *A Survey of Down-Island Visitors and their Use Patterns at Padre Island National Seashore*, by Ditton, R. B. and J. H. Gramann. Texas A & M University.

National Park Service, Cooperative Park Studies Unit. 1988. *1988 Great Basin Visitor Survey Great Basin National Park Statistical Abstract*, by Lee, M. E., R. Schreyer, P. J. Brown, and D. R. Field. Oregon State University.

National Park Service, Cooperative Park Studies Unit. 1989. *Katmai National Park and Preserve Brooks Camp Visitor Survey*, by Johnson, D. R. and A. Barton. University of Washington.

National Park Service, Cooperative Park Studies Unit. 1989b. *Visitor Response to Concession Management Alternatives at Carlsbad Caverns National Park*, by Gramann, J. H., W. P. Stewart, and Y. Kim. Texas A & M University.

National Park Service, Cooperative Park Studies Unit. 1990a. *A Sociological Study of Wintertime Backcountry Users at Everglades National Park,* by Stewart, W. P. and M. I. Ivy. Texas A & M University.

National Park Service, Cooperative Park Studies Unit. 1990a. *A Study of Visitor Attitudes Toward Initiation of a Visitor Transportation System at Mount Rainier National Park,* by Johnson, D. R. University of Washington.

National Park Service, Cooperative Park Studies Unit. 1990b. *1990 Lava Beds Visitor Survey: Statistical Results,* by Johnson, D. R. University of Washington.

National Parks and Conservation Association. 1989. *National Parks: From Vignettes to a Global View,* Washington, D.C.

O'Hare, W. 1990. "A New Look at Asian Americans." *American Demographics* 12(10): 26-31.

Oxford Analytica. 1986. "America In Perspective." Boston: Houghton Mifflin Company.

Thoennes, N. A., and W. H. Key. n.d. *An Inventory of Social Science Research in the National Parks.* University of Denver.

U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 1053, "Projections of the Population of States, by Age, Sex, and Race: 1989-2010. Washington, D.C.: U.S. Government Printing Office.

United States Department of Agriculture, Forest Service. 1987. "Wilderness Policy – An International Perspective" In *Proceedings – National Wilderness Research Conference: Issues, State of Knowledge, Future Directions,* by Eidsvik, H.K., 54-58. Intermountain Research Station.

United States Department of Agriculture, Forest Service. 1987. "Wilderness Use and User Characteristics: A State of Knowledge Review." In *Proceedings – National Wilderness Research Conference: Issues, State of Knowledge, Future Directions,* by Roggenbuck, J. W. and R. C. Lucas, 204-245. Intermountain Research Station.

Watson, P. 1990. "In Defense of Tree Spiking." *Earth First!* Sept. 22, 10(8): 8-9.

NATURAL AREAS RESTORATION AND MONITORING

MONITORING RECOVERY PROCESSES AFTER WILDFIRE IN THE MOOSE CREEK PLATEAU RESEARCH NATURAL AREA: PART 1 – METHODOLOGY

Susan Bernatas[1]

Abstract

Using RNAs to monitor the effects of a natural perturbation such as wildfire allows us to determine how an ecosystem recovers from catastrophic events. Primary consideration in locating plots was to be sure that in the future a two-person crew could relocate and remeasure the plots within a one-week period. For a long-term monitoring study to be successful, the methods must withstand time. The plot must be permanent and easy to relocate and remeasure. Type of data collected, data file format, and analyses must be simple enough for others to use with minimal instruction.

INTRODUCTION

Research natural areas (RNAs) have been established in national forests across the United States to preserve and protect relatively undisturbed parcels of biological diversity for research, education, and baseline monitoring. Because both unique and common habitat types and community types are represented in RNAs, these areas are particularly valuable aids in determining the effects of management activities on ecosystems.

Using RNAs to monitor the effects of a natural perturbation such as wildfire allows us to determine how an ecosystem recovers from catastrophic events. Understanding forest succession requires information on species' responses to disturbance and subsequent successional changes. With this information, managers can evaluate successional responses to management practices by comparing plots on managed lands to plots in RNAs of similar habitats. Furthermore, this information could help determine treatments following wildfires.

Thus far, studies of forest succession in the northern Rocky Mountains have largely relied on reconstructing community changes by sampling forest stands of different ages (U.S. Department of Agriculture 1980). This results in successional models on perceived rather than observed changes. In one study, only one out of 12 plots remained undisturbed by management activities after the 21-year study (U.S. Department of Agriculture 1984). RNAs are the ideal location for permanent plots, offering long-term protection and uninterrupted monitoring opportunities, without the conflicts associated with lands managed for timber production, livestock grazing, and recreation.

Located in the Yellowstone ecosystem, the Moose Creek Plateau RNA, Targhee National Forest, was burned in the 1988 North Fork fire and provided an opportunity to establish permanent plots in a natural ecosystem after a natural disturbance. As a RNA, Moose Creek Plateau will not be subject to human-caused disturbances or cultural management treatments, thus allowing natural successional changes to occur.

The first step toward studying successional change is to establish a baseline community structure by quantifying the composition and diversity, as well as cover, density, and frequency of individual plant

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species (Aldon and Barstad 1987). Subsequent changes in community can be determined by comparing baseline measurements to future measurements of the same plot.

OBJECTIVES

The general objectives were to establish permanent monitoring plots in Moose Creek Plateau RNA and develop baseline data and preliminary information on recovery of the RNA following a stand destroying wildfire. A second goal was to initiate monitoring efforts on RNAs in Idaho. Although it is generally agreed that not all RNAs need monitoring or other research activities, initiating baseline monitoring in RNAs highlights their value. Most RNAs are set aside without baseline monitoring in mind, but rather they are saved as "biological individual retirement accounts," for future studies.

The specific objectives are to (1) establish permanent baseline monitoring plots in Moose Creek Plateau RNA, (2) collect and compile baseline data on cover, density, and frequency of individual plant species to quantify post-fire plant community structure, (3) collect data for second growing season to compare to the baseline condition to develop a first assessment of the impact of and early recovery from the 1988 North Fork fire, and (4) evaluate the sampling design and inventory methods used in terms of suitability and for potential use on other RNAs.

LOCATION AND SITE DESCRIPTION

Moose Creek Plateau RNA is in the Targhee National Forest in the Yellowstone ecosystem (fig. 1). The eastern boundary coincides with the Yellowstone National Park boundary. The northern boundary is the Continental Divide along the Idaho-Montana border.

Moose Creek Plateau is a rolling, high-elevation plateau (ca. 8,000 ft). The substrata is very porous obsidian sand, and as a result retains no perennial water. Three habitat types intermingle in the RNA: subalpine fir/grouse whortleberry (*Abies lasiocarpa* (Hook.) Nutt./*Vaccinium scoparium Leiberg*)[2]; subalpine fir/bluejoint (*Calamagrostis canadensis* (Michx.) Beauv.); and whitebark pine/Ross sedge (*Pinus albicaulis* Engelm./*Carex rossii* Boott) (U.S. Department of Agriculture 1983). Subalpine fir/bluejoint occurs in the intermittent stream courses, subalpine fir/grouse whortleberry occurs widely on adjacent drier sites, and whitebark pine/Ross sedge occurs on the severe south and west exposures.

2. Nomenclature follows Hitchcock and Cronquist 1973.

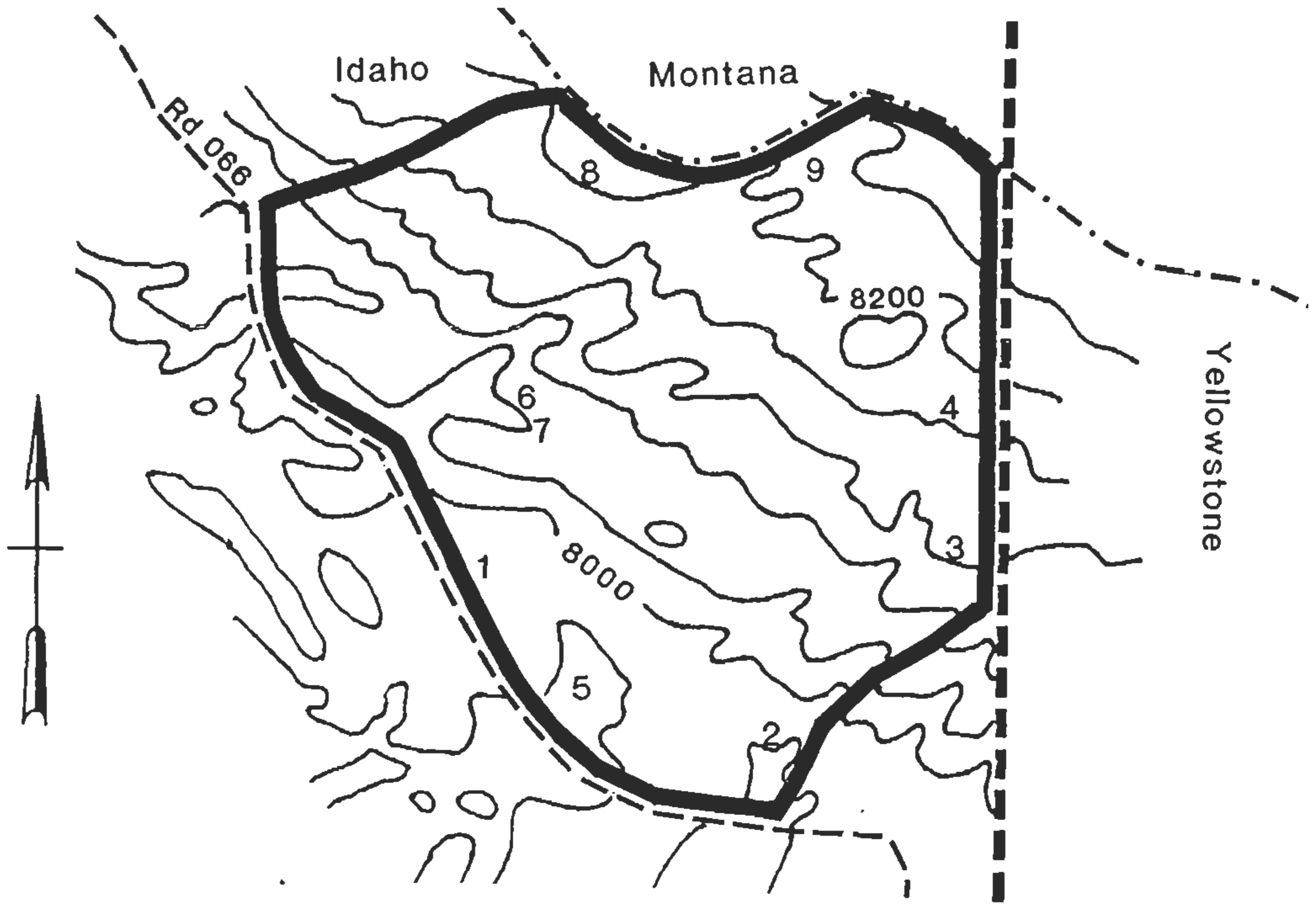

Figure 1. Location of Moose Creek Plateau RNA and the nine macroplot locations.

METHODS

The sampling methodology had to be simple enough so that someone could perform the data collection with minimal instruction. Furthermore, the primary consideration in locating plots was to be sure that in the future a two-person crew could relocate and remeasure the plots in a one-week period.

Because of the difficulty in determining habitat types after the burn, I decided to sample according to fire severity. Roughly 80 percent of the RNA was severely burned by a crown fire, 19 percent was partially burned, and only one small area was left unburned. To capture the range of fire severities, nine macroplots were located within the RNA with five in severely burned stands (crown fire), three in intermediate burned stands (underburn and partial crown fire), and one in the unburned stand. The plot's fire severity was determined by assessing the fire damage to the crown, bole, and root for all of the trees in the plot (Ryan 1982).

Plot Locations

The RNA is likely to develop into a dog-hair thicket of lodgepole pine (*Pinus contorta* Dougl.) over the next 20 to 30 years, making plot relocation difficult. Therefore, plots were located near the perimeter or obvious physical features such as drainages to facilitate relocation. Additionally, the plots were located to avoid annual rye (*Lolium* spp. L.), which had been aerial seeded along with timothy (*Phleum pratense* L.), orchard grass (*Dactylis glomerata* L.), and smooth brome (*Bromus inermis* Leys.) in areas surrounding the RNA. In 1989, only annual rye was found within the RNA along the south and west boundary.

Sampling Design

A 25 m x 50 m macroplot was located along the contour wholly within one of three burn severities. The macroplots were permanently monumented with 1" x 18" angle-iron on all four corners placed so that the inside of the plot is "bracketed" by the angle-iron. The lower left-hand corner (as you look uphill) and lower right-hand corner have 5 ft iron fence posts located 10 ft from the angle-iron parallel to the 25 m axis (posts A and B). Each 5 m interval along the 25 m axis was monumented with ½" x 12" rebar. This hardware was painted with orange heavy-equipment paint to facilitate relocation. A compass was used to obtain bearings for two sides of the macroplot. A relocation schematic was drawn for each macroplot. See figure 2 for plot design.

A third post (post C) was placed to assist in relocating the macroplot. Post C was placed along the road, the Yellowstone National Park boundary trail, or in the bottom of a draw to facilitate relocating the macroplots. Distance and direction to post A is etched into post C as well as noted on the relocation schematic.

Three sampling strategies are nested within the macroplot:

(1) the 25 m x 50 m macroplot was used to determine overstory mortality in the unburned and intermediate burn areas; (2) tree and shrub aerial crown cover and the crown volume data were collected in two contiguous 5 m x 25 m plots (U.S. Department of Agriculture 1980); and (3) understory layer was sampled using 100 0.5 m x 0.5 m microplots. These three sampling strategies are described below.

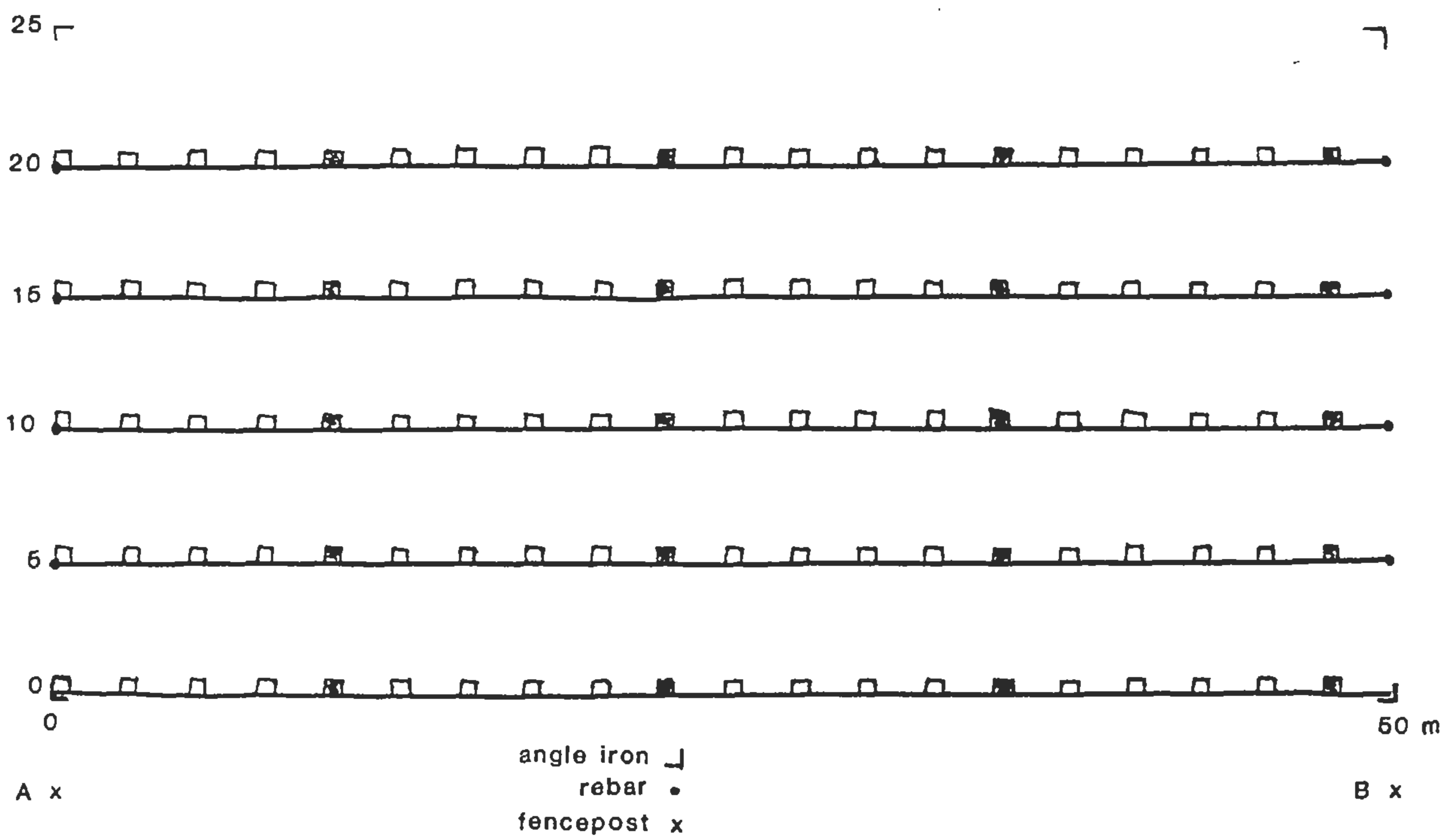

Figure 2. Plot layout showing location of microplots (density collected at dark microplot locations).

Overstory Mortality

Within the one unburned and two of three intermediate burn macroplots, only trees with green or partially green crown over 4 inches DBH was marked at breast height with a numbered aluminum tag held in place by an aluminum nail. The tags face the downhill side of the macroplot. In 1989, the species, DBH, percent crown scorch (ocularly estimated), and char height on the bole was recorded. In 1990, each tree was revisited to determine if it had any green crown remaining.

Aerial Crown Cover and Crown Volume

Two contiguous 5 m x 25 m subplots were located within the macroplot. The subplot was randomly chosen from one of the five 5 m intervals along the 25 m axis. Stickney's methods (U. S. Department of Agriculture 1980) were used to collected data on the aerial crown cover and crown volume.

Understory Species

Herbaceous species were sampled along the five 50 m transects. Twenty microplots (0.5 m x 0.5 m) were located at 2.5 m intervals along the uphill side of the transects for a total of 100 microplots. Cover was ocularly estimated by species for shrubs, forbs, and graminoides. Four microplots were chosen from each transect for a total 20 microplots per macroplot to determine density (see fig. 2).

Moss, Litter, Rock, Wood, and Bare Ground

Percent cover of moss, litter, bare ground, rock, and wood greater than 2.5 cm in diameter was estimated within each microplot using the same methods described above.

Photographic Records

Each plot was recorded photographically. Black and white prints and color slides were taken from each of the four corners focusing across the plot at the opposite corner.

DATA ANALYSIS

Overstory Mortality

Percent mortality will be calculated by size class. Chi-squared analysis will be used to determine if there is any significant difference between type and extent of fire damage and mortality.

Aerial Crown Cover and Crown Volume

The 1989 and 1990 data for aerial crown cover and crown volume will be compared using Chi-squared analysis to determine if there is a significant change.

Understory Species

The 1989 and 1990 data for herbaceous species and shrubs will be summarized using SAS (1988). Cover, density, and frequency values for each species can be determined from the microplots. Importance values will be calculated for each species (Mueller-Dombois and Ellenberg 1974). Species diversity index will be calculated from density using the Shannon-Wiener index of diversity (Whittaker 1975; Aldon and Barstad 1987). These values will then be used to characterize the vegetation within each plot and determine if there has been a statistically significant change.

Determining successional changes on a permanent plot over time is comparable to determining the similarity or dissimilarity among plant communities. Although difficult to establish a generally accepted degree of similarity among plant communities, "similarity relations can be expressed mathematically, and one can set arbitrary limits on a mathematical basis" (Mueller-Dombois and Ellenberg 1974; Aldon and Barstad 1987). To quantify successional changes from year to year or to the baseline community, the similarity of the plant community's structure will be determined using Sorensen's index of similarity.

RESULTS AND DISCUSSION

For a long-term monitoring study to be successful, the methods must withstand time. The plot must be permanent and easy to relocate and remeasure. Type of data to be collected, data file format, and analysis methods must be simple enough for others to use with minimal instruction.

All plots were intact and relocatable in 1990. Because plots were near physical features such as drainages and schematic diagrams had been drawn noting distances and directions, others unfamiliar with the plots were able to relocate the plots the second year. The two fence posts marking the plots facilitated the relocation effort; however, the fence posts may fall over if not maintained. In the future, a metal detector may be useful to find the angle iron and rebar.

Evaluation of these methods for future use suggests some changes. Four people assisted with data collection; their skills ranged from intern to professional ecologist. All found data collection for percent cover and frequency for the understory species to be easy and quick to remeasure; however, density took considerable time to tally. Furthermore, the rules for tallying may change over time as the plants mature. For example, it is easy to tally individual stems of grouse whortleberry, a rhizomatous species, when they are small and located relatively far from another plant; however, as the stems converge, it will be more difficult to determine individuals. Comparing density data from one year to the next may be impossible because of changing tally rules. Thus, I recommend that density data collection not be continued in this study.

I also recommend discontinuing the tree and shrub aerial crown cover and crown volume data collection, which are time-consuming and cumbersome to measure. The only shrub presently in the RNA is grouse whortleberry, which stands 8-10" tall. Sufficient data is collected for this species during the understory sampling.

For the trees, I recommend tallying by size class (seedling, sapling, pole, and mature) and collecting basal area measurements. These data would be more compatible with other forest research and stand exam data. If percent cover is desirable, this data could be collected via the line-intercept method for seedlings and saplings and by measuring canopy closure with an overhead telescope for poles and mature trees.

ACKNOWLEDGMENTS

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REFERENCES

Aldon, E. F., and J. F. Barstad. 1987. "Escudilla Mountain Research Natural Area: A Study of an Undisturbed Montane Grassland in Arizona. *Natural Areas Journal* 1(3):107-117.

Hitchcock, C. L., and A. Cronquist. 1973. *Flora of the Pacific Northwest.* Seattle: University of Washington Press.

Mueller-Dombois, D., and H. Ellenberg. 1974. *Aims and Methods of Vegetation Ecology.* New York: John Wiley and Sons.

Ryan, K. 1982. "Techniques for Assessing Fire Damage to Trees." In *Proceeding of the Symposium: Fire – Its Field Effects,* edited by J. E. Lotan. U.S.D.A., Forest Service, Intermountain Research Station, Ogden, UT.

SAS Institute Inc. 1988. *SAS User's Guide: Statistics 6.03 Edition.* SAS Institute Inc. Cary, North Carolina.

U.S. Department of Agriculture. 1980. *Data Base for Post-fire Succession, First 6 to 9 Years, in Montana Larch-fir Forests,* by Stickney, P.F. Gen. Res. Rep. INT-62.

U.S. Department of Agriculture. 1983. *Forest Habitat Types of Eastern Idaho-Western Wyoming,* by Steele, R., S. V. Cooper, D. M. Ondov, D. W. Roberts, and R. D. Pfister. Gen. Tech. Rep. INT-144.

U.S. Department of Agriculture. Forest Service. 1984. *The Sleeping Child Burn – 21 Years of Postfire Change,* by Lyons, L. J. Res. Pap. INT-330.

Whittaker, R. H. 1975. *Communities and Ecosystems.* New York: MacMillan.

COASTAL DUNE RESTORATION

Andrea Pickart[1]

In cooperation with Humboldt State University, The Nature Conservancy is completing three years of research into coastal dune restoration. Areas of applied research include the effects of the invasive yellow bush lupine (*Lupinus arboreus*) on soil and vegetation of coastal dunes, methods of reversing these effects, methods of eradication of invasive European beach grass (*Ammophila arenaria*), an inventory of vesicular-arbuscular mycorrhizae in natural and degraded dunes, methods of inoculation of native dune species with VA mycorrhizae, the effective of fertilizers on mycorrhizal infection, germination requirements of coastal dune species, and revegetation techniques (using both seeds and greenhouse propagated plants). I will present the results to date of these experiments and discuss their application to management of a coastal dune preserve.

Tuesday, October 16, 3:30 pm

1. Andrea Pickart, Lanphere-Christensen Dunes Preserve, The Nature Conservancy, 6800 Lanphere Road, Arcata, CA 95521.

THE LANDSCAPE RESTORATION OF BARRENS AND WOODLANDS WITHIN THE OAK-HICKORY FOREST MOSAIC OF THE SHAWNEE NATIONAL FOREST

Lawrence R. Stritch[1]

In 1988 personnel from the Shawnee National Forest and the Illinois Department of Conservation-Division of Natural Heritage developed management prescriptions and accompanying environmental assessments to conduct woody removal and prescribe burning a few existing barren remnants at Cave Hill and Simpson Township Barrens. This management was a traditional microsite approach wherein these small openings were treated as isolated tracts. Results from the application of these prescriptions, from a qualitative observation, were excellent, with increased diversity, frequency, and flowering of species. Analysis of the landscapes in which these treatment sites occur, in conjunction with the analysis of historical aerial photography, led us to determine that this management approach needed to be expanded to eliminate the potential long-term effects associated with island biogeography theory. Two years of landscape management has resulted in the restoration of a highly-diverse mosaic of variously sized patches of barrens and woodland vegetation within the existing oak-hickory forest matrix. Increases in frequency, diversity, and distribution of species associated with barrens and dry woodlands have occurred. These increases are a result of both survivorship as sterile individuals and germination from the seed bank. This paper will look at the results and effects of elevating our natural area's management and environmental analysis to an ecosystem approach applying concepts of landscape ecology.

Wednesday, October 17, 1:30 pm

1. Lawrence R. Stritch, Shawnee National Forest, 901 S. Commercial Street, Harrisburg, IL 62946.

GIS AS A TOOL FOR IDENTIFICATION AND MANAGEMENT OF NATURAL AREAS

COMPARISON OF NATIONAL WETLAND INVENTORY AND A WINTER SATELLITE INVENTORY FOR THE CALIFORNIA CENTRAL VALLEY

Richard G. Kempka and R. Peter Kollasch[1]

Abstract

In the spring of 1989, the California Department of Fish and Game (CDFG) established a contract with Ducks Unlimited, Inc. (DU) to inventory the critical waterfowl wintering grounds in the Central Valley. The major goals of this project were to develop waterfowl habitat evaluation techniques for the California Central Valley and to establish a timely evaluation system/product.

US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) digital data for the Central Valley, Klamath Basin and South Coast, were acquired, rasterized, and loaded into DU's data base. A winter inventory of a majority of the Central Valley (195 1:24,000 scale or over 6.4 million acres) was conducted using LANDSAT Thematic Mapper (TM). Seven different waterfowl habitat types were classified and produced in a format suitable for use in a Geographic Information System (GIS).

Statistics gathered from the TM winter inventory (Sacramento Valley and Delta, 24 January 1989 and San Joaquin, 8 November 1986) indicated the presence of 258,156 acres of flooded habitat in the project area. The rasterized NWI yielded 896,053 acres for the same region. The results showed that TM data are useful for regional inventory and monitoring of wetlands (non-jurisdictional) in the Central Valley of California.

INTRODUCTION

Agricultural and urban development in California have seriously affected the state's wetland resources. For example, of the 5 million acres of historic wetlands in the Central Valley of California, only 319,000 wetland acres remain (Gilmer et al. 1982; Frayer et al. 1989). Central Valley wetlands, along with unidentified amounts of seasonally flooded and nonflooded agricultural land, support 60 percent of the Pacific Flyway's waterfowl (20 to 30 percent of North America's waterfowl). In the spring of 1989, the California Department of Fish and Game (CDFG) established a contract with Ducks Unlimited, Inc. (DU) to inventory these critical waterfowl wintering habitat grounds in the Central Valley. The term "wetland" in this report is not used in a jurisdictional context but to describe waterfowl habitat. No jurisdictional delineations were conducted.

DU has conducted satellite inventories of the Primary Waterfowl Production Area (PWPA) throughout Canada and the north-central United States since 1985 at DU national headquarters in Long Grove, Illinois (Koeln et al. 1988). In January 1989, DU established a remote sensing capability at the Western Regional Office (WRO) in Sacramento, California. This office will service remote sensing/GIS work that is needed in the Pacific Flyway (Kempka and Kollasch 1991).

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1. Richard G. Kempka, Remote Sensing Coordinator, Ducks Unlimited, Inc. Western Regional Office, 9823 Old Winery Place, Sacramento, CA 95827 and R. Peter Kollasch, Systems Programmer, Ducks Unlimited, Inc. National Headquarters, One Waterfowl Way, Long Grove, IL 60047.

USFWS NATIONAL WETLAND INVENTORY

The NWI is the most detailed, comprehensive wetland mapping effort being conducted in California and also on a national scale. The output products of NWI include maps and NWI digital data that can be easily integrated into a GIS. The benefit of the NWI data is that it represents an accurate baseline wetland inventory for a given date. A drawback of using this data for analysis in the Central Valley is that many habitats have changed. Many of these changes will be reflected as new updated (1984-1987) NWI maps when generated, but this is dependent of the availability of future funding.

This inventory program, which began in the mid-1970s, uses photo interpretation of various scales of stereo aerial color photography to delineate detailed wetland type classes. The Cowardin classification (Cowardin et al. 1979) is used because a comprehensive classification system is necessary to map wetlands and deepwater habitats. To achieve this classification not only requires high quality photographs and skilled photo interpreters, but also ancillary data regarding the habitat. Photo-interpreted wetland boundaries are placed on photos and transposed to maps based on the USGS 1:24,000 series topographic maps. Selected maps are then digitized and stored in a computer data base. The five major Cowardin classes (systems) are described below:

1. Palustrine – This group includes the vegetated wetlands traditionally called marsh, swamp, bog, fen and prairie. It also includes small, shallow, permanent, or intermittent ponds.

2. Lacustrine – The lacustrine class includes permanently flooded lakes and reservoirs, intermittent lakes, and tidal lakes with ocean-derived salinities generally less than 0.5 percent.

3. Riverine – Basically, this class includes all wetlands and deepwater habitats that contain a channel that usually has flowing water, such as rivers, streams, and man-made canals.

4. Estuarine – Generally consists of tidal habitat, usually semi-enclosed by land.

5. Marine – The marine group generally consists of open ocean overlying the continental shelf and its high energy associated coastline.

Table 1 shows a summary of the digital NWI data which DU has acquired for this project. Additionally, 36 map sheets recently updated with 1980s photography have been ordered for the Central Valley.

Table 1. Number of NWI 1:24,000 Map Sheets in DU's Data Base

Area	Number of Map Sheets Acquired	Scale	Comment
Central Valley	195	1:24,000	1970s photography
Klamath Basin	18	1:24,000	1970s photography
South Coast	78	1:24,000	1970s and 1980s photography
TOTAL	291		

LANDSAT THEMATIC MAPPER WINTER INVENTORY

The procedures used to establish NWI data provide a very accurate baseline data set for a one-time period (i.e., the late 1970s). Recent NWI data are not available in many areas of California, due to funding constraints and the time consuming, labor intensive, nature of manual photo interpretation. DU's Habitat Inventory and Evaluation (HI&E) program has determined that wetland classifications derived from Landsat TM data are useful for depicting waterfowl habitat conditions at a single point in time (Jacobson et al. 1987). LANDSAT TM data were chosen for the California waterfowl habitat inventory for the following reasons:

1. Large Regional Coverage – One scene covers 115 X 110 square miles or approximately 8 million acres.

2. Repeatability – Each satellite pass covers the same point on earth every 16 days, although not every pass produces useful data because of clouds and fog.

3. Wetland Isolation – The TM sensor collects data in seven different spectral bands. Band 5 has been determined the most useful for identifying water features. Table 2 presents a list of TM spectral ranges and their principal applications.

4. Cost Effective – The cost of the inventory is less than 2 cents per acre.

5. Detailed Resolution – TM's pixel (picture element) size or smallest distinguishable unit is 30 X 30 meters (0.2 of an acre). Although not as good as that of the French satellite SPOT (0.02 of an acre), the improved spectral resolution is very useful for wetland identification.

Table 2. Landsat TM Spectral Ranges and their Principal Applications

TM SPECTRAL RANGE	PRINCIPAL APPLICATION
Band 1 (Blue .45-.50 um)	Water body penetration, soil and vegetation differentiation.
Band 2 (Green .52-.60 um)	Vegetation vigor assessment.
Band 3 (Red .63-.69 um)	Chlorophyll absorption band good for vegetation discrimination.
Band 4 (Near Infrared .76-.90 um)	Useful for determining biomass content and delineation of waterbodies.
Band 5 (Middle Infrared 1.55-1.75 um)*	**Indicative of vegetation and soil moisture content.**
Band 6 (Far Infrared 2.08-2.35 um)	Geologic applications.
Band 7 (Thermal Infrared 10.40-12.50 um)	Vegetation stress analysis and thermal mapping.

*No other existing satellite-borne sensor provides this important Middle Infrared data.
The thermal band was not used in this project due to its lower spatial resolution.

Data Processing and Results

LANDSAT scenes were purchased from EOSAT (Earth Observation Satellite Company) for the areas listed below. The location of TM scenes is described by a path and row number in terms of the World Reference System.

PATH/ROW	LOCATION	DATE
44/32 Quad 3	Vina Plains	24 January 1990
44/33	Sacramento Valley	24 January 1990
44/34	San Francisco Bay and Delta	24 January 1990
43/35 Quad 2	Grasslands	9 November 1986
43/34	San Joaquin Valley	9 November 1986

The scenes were sent to DU headquarters for preprocessing on the super-minicomputer with the aid of an array processor. A traditional unsupervised classification technique was used to analyze these data. The classified images were georeferenced to the Universal Transverse Mercator (UTM) projection utilizing a nearest neighbor resampling technique. The final waterfowl habitat classes that resulted from the winter scene inventory of the Central Valley are described below:

1. Open Water – This includes all open water areas, except for riverine habitats, which had a width of two or more open or turbid water pixels. Lakes, reservoirs, ponds, estuaries, sloughs, the delta area, and small rivers are part of this class.

2. Turbid Water – These areas of open water contain a large quantity of suspended sediments or dissolved solids. In the Sacramento Valley (44/33 Jan. 24, 1989), much of this habitat type coincides with the presence of swamp timothy, pricklegrass, watergrass, and other waterfowl food production plant areas. In the delta (44/34 Jan. 24, 1989), most of the turbid water occurs on the west side of the delta Area.

3. Senescent Emergent Vegetation – Physically, this class represents perennial emergent vegetation in various stages of dormancy. The plants are past the summer growing period and are no longer actively producing chlorophyll. The lack of water and cell structure causes the plant to reflect radiant energy different than that of growing vegetation. The major wetland vegetation types found in this class include hardstem bulrush (Tule), cattails, and other waterfowl cover plants. Additionally, some forest and scrub habitats in the floodplain of rivers are part of this class.

4. Growing Emergent Vegetation – Generally, these are any wetland plants that are still producing chlorophyll. These species are still growing or not completely dormant and include hardstem bulrush (Tule), cattails, scrubs, small trees, etc.. The plants were found in both freshwater and saltwater marsh habitats.

5. Riverine Water – These are river habitats that have two or more pixels of open or turbid water. The Sacramento River, San Joaquin River, and California Aqueduct are examples of locations where this class occurs.

6. Riverine Vegetation – This class includes any vegetation (growing or senescent) that occurs immediately adjacent to riverine water.

7. Flooded Agriculture – This class represents agricultural fields with standing water on them. The predominant crop in this class is rice, although winter wheat, orchards, and a few other assorted crops were detected throughout the Central Valley.

A total of 215 map sheets, primarily in the Central Valley, were analyzed and had output products generated.

Accuracy Statement

DU has conducted statistical analysis for wetland classifications completed in the prairie pothole province, but no quantitative statistical correlations were applied to measure the accuracy of the winter inventory. The figures included in this section are derived from the results of the prairies, but due to the systematic nature of TM data the results are likely to be similar for the Central Valley.

The TM classifications produced for this project are not intended for jurisdictional wetland delineation. An attempt was made only to delineate those wetland classes which we consider to constitute prime waterfowl habitat. Some land cover areas which are legally considered wetlands will not be identified by this classification. It is also possible that some areas, which are here identified as wetlands, may not be identified as such in a jurisdictional delineation.

There are two primary ways of describing the accuracy of this type of data. One is to indicate what percentage of wetland basins are detected, the other is to indicate what percentage of the wetland pixels are accurately classified. Based on the best information available to us, we feel that the accuracy of the data is as follows: Those data that are identified as Open Water, Turbid Water, and Riverine Water we consider to be about 95 percent accurate on a pixel basis; the pixels identified as Perennial Emergent, Riverine Vegetation, and Flooded Agriculture are considerably less accurate.

When looking at the accuracy of detection of wetland basins, the accuracy of detection decreases with the size of the basins. Larger basins are nearly always detected and their acreage is generally accurately estimated. On the other end of the scale, detection of the smaller basins is quite variable depending on the quality of the source data. In a comparison between National Wetlands Inventory data and DU's wetland classification, only 22 percent of the wetlands under 2 acres were detected by DU's discrimination (Jacobson et al. 1987). More than 96 percent of the wetlands over 10 acres were detected. Table 3 shows the percentages of NWI wetlands detected by size class in that study. Wherever the detection of a wetland is more dependent on the presence of vegetation than on a "wetness" response, the accuracy is likely to be less. This is most true of very small basins and of areas identified as Perennial Emergent, Riverine Vegetation, and Flooded Agriculture in general. In the intermediate basin sizes, accuracy is significantly better than in very small wetlands. There is a general tendency to underclassify total acreage of wetlands.

Ideally, the TM data used for wetland inventories should be acquired during average to above average water conditions, in early winter and spring when the temporary and semi-permanent wetlands are fullest. Often, National Wetlands Inventory data provides the best source of wetland information where it is available. LANDSAT TM data is best used to ascertain the current availability of water in the wetlands at the time of data acquisition.

Table 3. Percentage of Wetlands Detected by Size Class

Basin Size Class (Acres)	DU Coincident	DU Omission	Commission
0 – 2	22%	78%	4%
2 – 5	70%	30%	<1%
5 – 10	91%	9%	<1%
10 – 25	96%	5%	1%
25 –999	100%	–	–

Omission – wetland basins omitted by DU but detected by NWI
Commission – wetland basins detected by DU but not by NWI

NWI/LANDSAT TM Overlay Display System

Integration of various data layers is a very important aspect of having a functional GIS. For this project it was necessary to integrate two spatial data sets derived from two entirely different sources. The NWI data were collected via manual aerial photography interpretation and digitized by the USFWS using a coordinate digitizer. These are expressed in vector format as points, lines, and polygons that represent wetlands. The TM data are derived from a huge block or array of data that are collected in digital format via the TM sensor on the LANDSAT satellite. This digital array or grid (raster data), known as a scene, is made up of many cells called picture elements (pixels). To integrate these different data types properly, individual TM scenes must be in register with the corresponding NWI file.

The system established for this contract allows the NWI raster data to be superimposed on the TM digital raster imagery. These utilities allowed an interactive comparison between the wetland types and locations established by the USFWS with the TM wetland classification generated by DU. This proved to be a useful analytic tool in the TM classification procedure, particularly in areas in which little ground truth exists and in areas of confusion. For example, in areas where clouds were present or the relief was enough to cause terrain shadowing, NWI digital data aided in determining the boundaries of the wetlands. The software that allows this overlay has been loaded and is currently used in the analysis of the TM data. DU software allows features extracted from one raster image to be displayed over another of the two overlap spatially.

In the future this type of overlay system may allow other airborne raster data sets (i.e., multispectral video, scanned CIR photography, TMS, etc.) to train the satellite data based on known wetland locations. This process may aid in the achievement of a more diverse and accurate classification of wetland areas. Another technique being explored is the use of raster imagery to update existing vector GIS information. This software would theoretically allow raster data (satellite and airborne) sensors to update existing NWI wetland boundaries or other vector-based wetland boundaries.

The NWI and TM data can also be compared statistically. Summary statistics were generated for each mapsheet, both for the TM data and for the NWI. These were loaded into a single dataset using the dBASE© data base management software.

RESULTS AND CONCLUSIONS

The majority of DU's previous inventory work has been conducted in the Primary Waterfowl Production Area (PWPA) through the prairie pothole provinces of Canada and the northern United States. Let it be noted that this area, covering more than 350,000 square miles, is relatively pristine with regard to control of water. The major ecological impact to wetlands has been a succession of drought years, draining, tilling, and the other modification of potholes for agricultural purposes. The typical hydrologic succession of a pothole is fairly predictable across an annual period. Basins are usually filled with water in the spring and dry by mid-summer. For this reason spring satellite scenes are used for inventory and evaluation. DU's standard wetland classes from summer scene imagery are as follows:

1. Open Water
2. Shallow Marsh – These are areas of emergent vegetation in approximately **one foot or less** of water.
3. Deep Marsh – These are areas of emergent vegetation in approximately **one foot or more** of water.

Wetland habitats in the critical wintering waterfowl areas in northern California are vastly different from those located in the prairie pothole provinces. Very few natural wetland areas remain in the northern Central Valley and nearly all are on an intricate water delivery system. This system consists of reservoirs, canals, dikes and levees, and thousands of floodgates that release water onto various tracts of land. The predominant agricultural type is rice, which needs a shallow layer of sheet water to mature through an approximately 90-day summer growing season. These vast expanses of agriculture vie for precious water with the wildlife refuge areas and private duck clubs where the majority of the wetlands exist.

Each individual refuge in the Sacramento Valley is managed slightly differently to provide seasonal marshes that produce food for and are attractive to waterfowl. For instance, the Sacramento National Wildlife Refuge was historically an upland area (dry soils, upland vegetation, etc.). The area has tracts that are managed for watergrass production by flooding them in late May or early June. Most of the remaining portions of the refuge stay dry until August, when they are flooded for the return migration of waterfowl. Gray Lodge Wildlife Management Area (WMA) is a more natural wetland area containing hydric soils and an abundance of groundwater near the land surface. Most of the area is in a climax marsh situation with scattered clumps of emergent wetland vegetation (hardstem bulrush and cattails) interspersed with seed producing annual grasses (swamp timothy and pricklegrass). Generally, this region remains wet from winter rains until late spring. As it dries, the emergents senesce and the grass seeds germinate and mature until flooding begins in mid-August. Emergents become so dense in this area that they are often mowed to accommodate the birds (i.e., pintails) that like open areas of sheet water.

The transition of habitat described above makes the classification of wetland vegetation very difficult. Ideally, a scene for each of the four seasons (winter, spring, summer, and fall) would be desirable for use in the identification of various wetland types. Each season would provide a clue to help further refine the constantly changing habitat. The ideal season for determining the extent of water is winter. The optimal time for vegetation analysis is spring/summer, when many of the species are alive and growing.

Inventory of winter waterfowl habitat was successfully conducted using LANDSAT TM satellite imagery. The prevalence of man-altered hydrology made it extremely difficult to establish a single inventory time frame or season that would best characterize habitat conditions year-round. Additionally, the lack of typical pothole succession that characterizes the waterfowl breeding grounds in the prairie pothole provinces made it necessary to modify the standard DU classification procedures. The abundance of an agricultural crop (rice) with physical properties similar to wetland species and with fair waterfowl habitat value caused the inclusion of a flooded agriculture category within the classification.

LANDSAT TM/NWI Inventory figures for the 195 1:24,000 map sheets were compared in the Central Valley. DU determined there is approximately 258,156 total acres of wetland habitats and 383,576 acres of flooded agriculture land, based on winter TM imagery collected from two dates, November 9, 1986 and January 24, 1989. The USFWS identified a total of 896,053 acres of wetlands and deepwater habitats for the same map sheets from data collected from the mid to late 1970s. Table 4 is a summary listing of the TM and NWI classes.

Table 4. Summary Statistics for the TM Inventory and NWI

NWI CLASS	ACRES	TM CLASS	ACRES
Open water (Lacust. & Est.)	87,373	Open water	79,989
Riverine perennial	116,459	Turbid water	64,232
Riverine intermittent	27,485	Riverine water	14,691
Palustrine temporary	75,419	Riverine vegetation	10,281
Palustrine seasonal	214,427	Senesced emergents	79,002
Palustrine semipermanent	352,325	Growing emergents	9,961
Palustrine artificial	22,565	Flooded agriculture	383,576
TOTALS	**896,053**		**641,732**

In general, more acres of palustrine, lacustrine, and riverine wetland are reported in the NWI data, but more flooded agriculture lands were reported by TM. Flooded agricultural lands were not mapped by NWI. The major disparity of 637,897 acres (896,053 NWI minus 258,156 TM [TM total minus flooded agricultural lands]) is a result of sensor resolution, classification procedure, and drought conditions. First, LANDSAT TM has been found to be accurate down to two acres, so any wetlands (e.g., vernal pools, seasonal wetlands, ponds, etc.) smaller than this size limit may have not been recorded accurately. There is a sizable open water acreage difference of 56,848 acres (TM open and turbid water minus NWI open water). This may in part be due to classification difference. Under the Cowardin et al. (1979) system all lacustrine habitats that exceed 20 acres are in the NWI open water class listed above. Any non-coastal bodies of water smaller than this size limit are considered palustrine. In DU's TM classification scheme, any standing water not located in a major river (i.e., Sacramento and San Joaquin) is considered an open water class. Thus, the NWI open water class is a merge of the Cowardin lacustrine and estuarine (only one map sheet contained estuarine) habitat types. Conversely, the TM classification does not separately group open water, unless it is in a major river.

The reason TM has 118,973 less riverine acres than NWI riverine is that any rivers or stream habitats that were not at least approximately 65 feet wide were not included in the TM riverine class. The palustrine class comparison shows a huge difference of 575,773 acres (four NWI palustrine classes minus two TM emergent classes). A portion of this difference may be attributed to the NWI classification procedure. Most of the state and national wildlife refuges are classified entirely as a palustrine emergent class. Traditionally, the majority of these areas were wetlands as determined by the presence of hydric soils and hydrophytic plants. However, large areas of the refuges have not been inundated for many years and many acres are currently managed as upland habitat as detected by the LANDSAT TM data. State and federal wildlife refuges are managed to achieve a desired wetland/

upland mix of habitat. The TM acres more accurately depict this habitat mix. In addition, a drought trend has been prevalent in the California Central Valley in the past few years. The TM figures may simply be a quantification of the loss and degradation of habitat that has occurred since the NWI photography was collected in the mid-1970s. The results indicate the value of TM imagery in association with the more detailed but older NWI data.

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REFERENCES

Gilmer, D. S., M. R. Miller, R. D. Bauer, and J. R. LeDonne. 1982. "California's Central Valley Wintering Waterfowl: Concerns and Challenges." *Transactions of the Forty-seventh North American Wildlife and Natural Resource Conference*, 47: 441-452.

Heitmeyer, M. E., D. Connelly, and R. Pederson. 1989. "The Central, Imperial, and Coachella Valleys of California." *Habitat Management For Migrating and Wintering Waterfowl In North America.* Editors L. Smith, R. Pederson, and R. Kaminski. Texas Tech University Press. pp. 475-505. Lubbock.

Jacobson, J. E., R. A. Ritter, and G. T. Koeln. 1987. "Accuracy of Thematic Mapper Derived Wetlands as Based on National Wetland Inventory Data." *American Society Photogrammetry Remote Sensing Technical Papers*, 1987 ASPRS-ACSM Fall Convention.

Kempka, R. G. and R. P. Kollasch. 1990. "California Waterfowl Habitat Evaluation Using Remote Sensing Techniques." *Mimeo.* Sacramento.

Kempka, R. G. and R. P. Kollasch. 1991. "Recommendations for Using Remote Sensing Techniques to Evaluate Waterfowl Habitat in California." *Natural Areas/Yosemite Centennial Symposium Proceedings.*

Koeln, G. T., J. E. Jacobson, D. E. Wesley, and R. S. Rempel. 1988. "Wetland Inventories Derived from LANDSAT Data for Waterfowl Management Planning." *Transactions of the Fifty-third North American Wildlife and Natural Resource Conference.* 53:303-310.

North American Waterfowl Management Plan – Central Valley Habitat Joint Venture Implementation Plan. 1990.

United States Department of Interior, U.S. Fish and Wildlife Service. 1979. *Classification of Wetlands and Deep Water Habitats of the United States*, Cowardin, L. M., V. Carter, F. C. Golet, and E. L. LaRoe. FWS/OBS-79/31.

_______. 1987. *Wetlands of the California Central Valley: Status and Trend 1939 to Mid-1980's.* Frayer, W. E., D. D. Peters, and H. R. Pywell. Region 1, Portland.

RECOMMENDATIONS FOR USING REMOTE SENSING TECHNIQUES TO EVALUATE WATERFOWL HABITAT IN CALIFORNIA

Richard G. Kempka and R. Peter Kollasch[1]

Abstract

In this project, the utility of satellite data for evaluating wetlands in the Central Valley of California was documented. Nearly all major Central Valley wetland areas were covered with five TM scenes. TM scenes were used for classification of seven different waterfowl habitat classes. Habitat maps as well as data layers for a Geographic Information System (GIS) were developed. GIS format is very useful for conducting habitat analysis with other existing spatial data.

Recommendations include using remotely sensed data to develop and monitor agricultural incentive programs that will help retain maximum flooded habitat after closure of waterfowl hunting season. Further recommendations were the continued maintenance of the Wetland Atlas; digitization of NWI data for new areas; development of upland classifications for identifying major land use categories for use in improving wetland assessment; use of airborne MS video or scanned CIR classification as a monitoring tool to evaluate the success of tract management on Wildlife Management Areas (WMA); the collection of quality ground truth to aid in classification; interaction with the end users of the map products to ensure the usefulness of future classifications. Finally, it was suggested that wetland classifications be standardized, new upland classifications be conducted, and other pertinent data layers (i.e., waterfowl populations, state WMAs, etc.) be collected and integrated into a Geographic Information System. CDFG is requested to support the California wetlands GIS that would include these data sets and others consolidated in a central location. DU believes this data base will greatly benefit proactive management of the water habitat resource in the future.

INTRODUCTION

Geographic Information Systems (GIS) are an emerging technology with great potential for aiding work in various diverse fields of environmental management and monitoring (Woodcock et al. 1990). The unique ability of GIS to store, retrieve, and analyze data involving computer-based methods has revolutionized traditional mapping techniques. Building urban and rural land information systems, for example, has significantly influenced the role GIS and remote sensing play in providing alternatives and scenarios for environmentally sound planning (Nellis et al. 1990; Star and Estes 1990; Dueker 1987; Somers 1987). In the state of California there exists a need to monitor land use activities and changes, specifically in addressing the dwindling wetland resources.

Agricultural and urban development in California have seriously affected the state's wetland resources. For example, of the original five million wetland acres in the Central Valley of California, only 319,000 wetland acres remain. This drastic wetland loss has stimulated efforts to develop uniform jurisdictional wetland definitions (e.g., Unified Federal Method), wetland inventories (e.g., USFWS National Wetland Inventory [NWI]), a variety of regulatory constraints on activities impacting wetlands (e.g., Clean

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Water Act 1974 and 1977), and wetland development programs (e.g., U.S. Farm Bills 1985 and 1990 swampbuster provisions).

The remaining wetlands in the Central Valley, along with unidentified amounts of seasonally flooded and nonflooded agricultural land, support 60 percent of the Pacific Flyway's waterfowl (20 percent of North America's waterfowl). The importance of the Central Valley to waterfowl has made this region a priority area for the North American Waterfowl Management Plan (NAWMP 1990). If fully implemented, the Central Valley Habitat Joint Venture (CVHJV) of the NAWMP will oversee programs with a capital cost of over $500 million and an annual cost of $30 million. A systematic and objective evaluation of the existing waterfowl habitat base will be very useful in prioritizing CVHJV habitat programs and incorporating waterfowl values into wetland protection efforts from the private and public sectors.

Regulatory agencies, conservation organizations, and local governments require wetland inventory information for use in planning, protecting, and mitigating for wetlands affected by development or other land use actions. However, lengthy mapping procedures and the complex anthropogenic hydrology in areas like the Central Valley hinder the determination of accurate and timely wetland inventories. To aid in such determination, this project proposes interfacing GIS and remote sensing technologies, in combination with landscape ecological research, for providing a basis for assessing broad-scale changes of California's remaining wetlands. A GIS will allow land use planners and managers to effectively manipulate large data sets to analyze various management alternatives for wetlands.

In California, wetland data are scattered and exist in several different formats (e.g., NWI map, historic state land commission maps, several published reports, electronic data sets, etc.). This project proposes to assemble a data base of California wetlands organizing data sources in a GIS in one central location. The establishment of an integrated GIS would allow for a comprehensive management tool from which the production of rapid, accurate, and cost-effective wetland inventories could be achieved. Wetland information extracted from this GIS will be converted to geographic output products for a variety of scales and jurisdictional boundaries (e.g., by county or legislative district) as management tools and decision-making products. Potential users of these services will include public agencies such as U.S. Fish and Wildlife Service, Bureau of Land Management, Forest Service, California Fish and Game (CDFG), and California Coastal Conservancy, as well as private sector groups such as The Nature Conservancy (TNC), The Trust for Public Lands, private duck clubs, and wetland consultants. In addition to specific users for waterfowl habitat, the GIS analysis can be used for other wetland planning programs (i.e., endangered species, habitat degradation evaluation, surface water patterns, etc.).

RECOMMENDATIONS

Scene Acquisition Timing/ Habitat Transition

To put the future recommendations into perspective, a background discussion on data merits and scene acquisition time is necessary. Most of DU's previous inventory work has been conducted in the prime waterfowl breeding area of the prairie pothole states and provinces (Koeln et al. 1988) A different set of criteria affect habitat in the Central Valley. Water regimes in the northern prairies are predominantly natural, which means water is accumulated naturally in wetlands from winter snowmelt and spring rains. This is not the case in the Central Valley of California where man has substantially modified hydrologic flow patterns, pathways, and rates. Snowpack accumulated during the winter months in the mountains is collected in reservoirs where it is distributed to irrigation districts. The irrigation districts provide water to large expanses of agriculture as well as to the wildlife refuges or private duck clubs that contain most of the wetlands. Water is put on and taken off the land at different times of the year depending on crop or wetland management scheme.

Permanently flooded ponds contain standing water (2-3 meters) year round and are dominated by dense stands of tule and cattails (Heitmeyer et al. 1989). In areas that are managed for summer water, ponds are flooded from approximately June through March and over the years have developed dense stands of tule and cattail. Seasonally flooded habitats are flooded from early fall (usually just prior to hunting season) through late winter or early spring. Early spring drawdowns encourage germination of smartweeds, dock, and aster. April and May drawdowns germinate swamp timothy, pricklegrass, and watergrass. Drawdowns in May and June encourage tule and cattail growth, as well as stimulate the production of alkali bulrush and cocklebursx. Ponds managed strictly for watergrass are flooded from October to mid-spring and are irrigated at least once during summer. This complex array of management practices makes choosing an optimum scene very difficult.

In this project, the utility of satellites for evaluating wetlands in the Central Valley of California was documented. Nearly all major Central Valley wetland areas were covered with five TM scenes. TM scenes were used for classification of seven different waterfowl habitat classes. Habitat maps as well as data layers for a Geographic Information System (GIS) were developed. GIS format is very useful for conducting habitat analysis with other existing spatial data.

In retrospect, the use of winter TM scenes for the baseline inventory in this project was a good decision because it provided the maximum extent of the flooded habitat at least for the January 1989 date used in the Sacramento Valley. Conversely, although the November 1986 date did fit the prerequisite of winter imagery (November-December), it was a very dry year in the San Joaquin Valley and the extent of flooded habitat was limited. An expanded delineation of wetlands may have been achieved using even older historic data (e.g., 1982-1985), but it was determined that more recent data would be more useful. Absence of good data quality is presently one of the foremost problems with using TM imagery for habitat assessment in the Central Valley. Acceptable quality data was available for the entire study area from March of 1988, but these did not fall in the desired November-January window. It was necessary to go back to November 1986 to find the first adequate coverage of the San Joaquin Valley. After viewing satellite film archives, in many cases it was determined cloud cover or fog in the valley rendered the available scenes useless. Nevertheless, as new LANDSAT and other satellite systems become operational and the market becomes more competitive, the problem of data availability should be lessened. A disadvantage of using winter TM data is that the majority of wetland vegetation is senescent (dormant), so that winter imagery alone will not reveal vegetation groups. For this reason spring and summer imagery were acquired to conduct wetland vegetation analysis.

TM scenes from March 1988 and June 1989 were used for multitemporal analysis. These two dates clearly illustrated the transition of habitat that can occur in a relatively short period of time (three months). Basically, wetland basins are still flooded in March and most of the same areas are dry in June. The June scene also provides a stark contrast between the rice fields and the wetlands in the Sacramento Valley. Some of this detail was lost in the merging of the two scenes and thus was not reflected in the classification results. Secondly, the many "dry" wetland areas on the June scene were not homogeneous. Many different plant growth stages were evident at this date. For example, swamp timothy and pricklegrass ranged from extremely dry dead plant areas to vigorously growing mature plant expanses. Some of these areas were still even covered with water. It is this type of scenario that makes wetland discrimination at any given date difficult. Additionally, it is necessary to develop an upland classification to account for the many wetland areas that may be dry during summer scene acquisition.

Table 1 illustrates the optimal time for scene acquisition to determine the full extent of wetland basins. Optimal acquisition dates will vary somewhat depending on the amount of spring precipitation.

Table 1. Optimal Timing for Scene Acquisition to Detect Flooded Habitat

HABITAT TYPE	J	F	M	A	M	J	J	A	S	O	N	D	
PFP	X	X	X	X	X	X	X	X	X	X	X	X	Permanently Flooded Ponds
SWM	X	X				X	X	X	X	X	X	X	Summer Water Management
SFH	X	X	X						X	X	X	X	Seasonally Flooded Habitats
WM	X	X	X			X				X	X	X	Watergrass Management

Winter (November-January) scenes are optimal for determining the extent of flooded habitat before spring migration. Spring (March-June) scenes are best for "dry basin" wetland vegetation discrimination. Late June or early July may be the best time to identify flooded watergrass tracts.

The degree to which waterfowl wintering areas are used depends in part on weather conditions further north in the flyways. In general, the birds tend to be very concentrated in the wintering wetlands. Flooded agricultural fields, natural freshwater wetlands, and coastal brackish marshes comprise most of the California wintering habitat. During dry winters, most of the flooding of agricultural fields is associated with hunting. Much of this habitat disappears at the end of hunting season due to the high cost of maintaining flooded conditions.

A mosaic of wetland and upland habitats is critical for waterfowl management. Effective management not only requires evaluation of existing habitat, but also preserving key habitat areas and monitoring the changes in those areas. Habitat evaluation and monitoring systems need to be general in nature for coverage of large regions and very detailed for selected smaller areas.

There is a need to monitor waterfowl habitat with remote sensing techniques at two different levels in California. First, regional or valley-wide assessment needs to occur to track annual habitat transition and water availability. This type of information is valuable for CDFG wetland policy decision making and for environmental documents that support the setting of waterfowl hunting seasons. Secondly, site specific analyses are needed to provide monitoring to determine the effectiveness of management practices on public and private wetland areas.

Regional Wetland Assessment

The next steps in developing a comprehensive monitoring tool for waterfowl habitat in California include the following:

1. Standardize mapping – standardized wetland classifications used for mapping.

2. Change detection – once classifications are standardized, multitemporal imagery may be used to precisely quantify change over time.

3. GIS integration – other data sets related to wetlands and waterfowl habitat need to be added to the GIS for more comprehensive area analysis.

STANDARDIZATION OF CLASSIFICATIONS

Minimum classification requirements must be established to ensure classifications can be duplicated from scene to scene and from season to season. This is especially important as new earth resource satellites become operational (Japanese JERS-1, SPOT, RADARSAT, etc.). This methodology is valuable because once a desired classification is established it can be used as a baseline. Subsequent scenes collected for the same area can then be used to simply update the boundaries of wetlands locations that previously existed. Additionally this would make the method of data collection transparent to updating the GIS. For example, TM, SPOT, airborne TMS, multispectral video, scanned air photos, etc., could all be used in analysis. The only prerequisites for using an image would be that it is georeferenced to the earth and that the desired classification level be derived from the imagery.

CHANGE DETECTION

The constantly changing nature of California's Central Valley habitat dictates the need for analysis on more than one date. There are two optimal coverage time periods for analyzing the critical wintering waterfowl habitat grounds in the Central Valley. Winter scenes (November-January) are best for measuring the maximum extent of flooded habitat. Spring/summer scenes are needed to determine wetland vegetation mix (i.e., perennial emergents (cover types) and seasonally flooded annual grasses (food types)). Scenes from two dates are valuable for assessing not only the total amount of wetland acreage, but also the recent trends in habitat composition. For example, there may have been many acres of open water gained due to the construction of a reservoir, but the same amount of seasonal marsh may have been lost elsewhere in the watershed.

The vast majority of the wetland basins are flooded during winter months when the TM sensor is able to identify the full extent of the basins. Conversely, in the spring/summer months most of the wetland areas are dry or not inundated. This allows for germination of plants that will produce food for waterfowl in the fall months. During these drawdown phases, these seasonal wetland or moist soil unit management areas are usually very similar to nonwetland or upland areas in regard to spectral reflectance characteristics. To accurately monitor these dry areas, an upland classification needs to be established. Upland classifications will result in regional data on the availability of food production. This type of information may effect the distribution and conservation of water in the next year. It will also provide accurate acreage figures regarding the mix of vegetation with the wetlands.

GIS INTEGRATION

Once up-to-date wetland data are compiled in the data base it may be used in a variety of ways. Other data sets should be digitized and integrated to provide the basis for more comprehensive habitat analysis. State WMAs and the tracts within these areas should be digitized so acreage statistics can be gathered for individual tracts. This is done by overlaying tract boundaries and habitat classes. CDFG Duck Club Surveys, which contain Duck Club boundaries on a map, should be made digital to better track habitat availability on private lands. Legislative boundaries in a GIS would allow CDFG to tell the local legislator the number and status of projects in his jurisdiction.

Waterfowl Habitat Assessment on WMAs

Techniques for site specific analysis have been identified in a larger project (Kempka and Kollasch 1990). Airborne multispectral video and scanned CIR photography have provided habitat data on a WMA tract level. Both were relatively similar in their ability to discern waterfowl cover types and food production classes. It was discovered that the MS videos were best for detecting and separating hardstem bulrush from cattail. Scanned CIR provided a larger coverage format that allowed more tracts to be analyzed in one image with a comparable degree of accuracy. Either of these types of data would provide an effective monitoring tool for CDFG's WMAs and USFWS's NWRs.

Airborne data acquisition provides a distinct advantage over satellite imagery for site specific monitoring because it can be collected virtually any time the weather permits. Thus flights can be planned for critical management periods throughout the year. Winter imagery may be used to determine the extent of flooded habitat during hunting seasons. Late spring data could provide an indication of how much food production will occur in individual WMA tracts. Zones of undesirable monocultures, such as tule choked areas, may also be identified and targeted for thinning when the tract becomes dry enough to access with maintenance equipment. Late summer/early fall imagery would provide acreage statistics regarding the success of watergrass production and the amount of flooded habitat available as the wintering waterfowl return to the Central Valley.

One of the major problems with data collected from airborne sensors is image rectification due to the motion of the aircraft. Image rectification can be the most time-consuming portion of analysis. It is a necessary step if the information is to be integrated into a GIS. Although useful maps were generated for this report, products from the airborne sensor data were not rectified to a geographic base. These types of data should prove even more useful if they were registered to points with known coordinates on the earth. Similar analysis in the future should include a registration step that matches image points to digitized WMA tract locations. Another alternative would be to use the new Global Position System (GPS) which records the precise location of image collection based on a satellite triangulation system. These steps will help ensure more accurate map generation and GIS analysis.

Other types of airborne scanners may also be useful for coverage of WMAs. A recent project conducted jointly by the Environmental Protection Agency (EPA) and Washington State Department of Natural Resources uses Aircraft Multispectral Scanner to classify wetlands habitats (EPA 1990). A regionalized version of the Cowardin et al. (1979) classification was used for the project. Recommendations were given for future mapping of wetland habitats using similar data.

Several specific recommendations are in order. These are based on the experiences gained from this investigation and on previous experience with wetland assessment.

1. The California Wetland Atlas should be maintained to allow CDFG to continually determine current status of mapping. DU could maintain this data base for a nominal fee because since the majority of the data sets are already in place.

2. Continue to support the National Wetlands Inventory program of the USFWS, specifically to support the digitization efforts in new areas. These data represent a useful baseline for comparison and are a valuable part of any waterfowl habitat inquiry.

3. For conducting regional large-scale waterfowl habitat assessments, thematic mapper data represent the best, most cost-effective choice. The inventory of wetland habitats costs less than one cent per acre and can be done over very

large areas at a time. A disadvantage of using satellite data is that, if one is choosing from a library of available data, it can be difficult to find cloud-free scenes. SPOT XS data represents a viable alternative for regional wetland assessment, if TM scenes are not available. With SPOT data, the spatial characteristics are better than TM, but data costs are considerably higher and it does not contain the important mid-infrared information available from LANDSAT. In the work done in this study, it was felt that the information gained from increased spatial resolution nearly compensated for the decreased spectral resolution.

4. This type of regional wetland assessment using LANDSAT data, should be repeated at regular intervals in order to track waterfowl habitat availability during the critical winter months. This type of assessment could become a key element in an incentive program to encourage landowners to keep water on the seasonally flooded rice fields after the end of the waterfowl hunting season. Such a program, keyed to appropriate management initiatives, would be a powerful force for insuring adequate waterfowl wintering habitat conditions.

5. A one-time upland classification based on TM data would be a very useful adjunct to the wetland assessment. The multitemporal approach used for the vegetation assessment would be more effectively utilized in this context, and would be the approach of choice. This type of assessment would identify the major land use categories, which could then be maintained in a GIS system for use in improving the more frequent wetland assessments. This, too, would need to be repeated, but on a somewhat less frequent basis.

6. Airborne TV video was useful in only a relatively narrow context, such as determining the extent of flooding at a given point in time. It is capable only of relatively crude vegetation discrimination. Improved sensors and processing techniques could make this technology more useful in the future.

7. For regional vegetation assessment, a merge of SPOT PAN provided the best satellite-based procedure, being better than a simple multitemporal analysis. However, the increased cost of acquiring two scenes may not make it a cost-effective procedure. The SPOT PAN data used alone provide exquisite detail for generation of maps for field use.

8. For conducting site-specific (small-scale) assessments of vegetative communities, both airborne MS video and scanned CIR photography provided acceptable results. Either of these techniques provide good vegetation discrimination at the tract level. They provide similar resolution. Scanned CIR provided a larger coverage area and, hence, reduced data acquisition costs for similar sized areas. MS video has more potential for detecting vegetation stress with its extra sensitivity to the thermal infrared portion of the spectrum. Whether to use MS video or scanned CIR for site specific assessments is best determined on a project by project basis, depending on the application and the output products needed. It should be noted that other factors such as direct visual interpretation and compatibility with existing software may make the use of scanned CIR preferable. In some circumstances, the traditional manual interpretation of aerial photography may be the best choice and should be acquired.

9. Any use of remote sensing techniques for habitat assessment must provide for the availability of adequate ground truth data. The accuracy of these assessments greatly increased with reliable ground truth. It will also become desirable in the future, as GIS technology becomes more widely used, to insure that remotely sensed data sets are available in geocoded form.

CONCLUSION

Based on the recommendations above it can be concluded that many data sets need to be gathered and stored in a central location to be used for planning purposes. The following list of data layers would be valuable for CDFG to have in a GIS:

1. LANDSAT Thematic Mapper (TM) Satellite Data
2. USFWS National Wetland Inventory (NWI)
3. California Natural Diversity Data Base
4. Land Use
5. Hydrology
6. Waterfowl Distribution
7. Land Ownership/Management
8. Cultural
9. Public Land Survey System
10. Soils
11. North American Waterfowl Management Plan Central Valley Habitat Joint Venture Projects

A more detailed description of these data sets may be found elsewhere (Kempka and Kollasch 1990 and 1991). DU believes the integration of the above listed data layers would be of great benefit to several government and private organizations who require up-to-date wetland information to guide wetland management and planning.

ACKNOWLEDGMENTS

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REFERENCES

Dueker, K. J., 1987. "Multipurpose Land Information Systems: Technical, Economic, and Institutional Issues." *Photogrammetric Engineering and Remote Sensing*. 53 (10): 1361-7.

Gilmer, D. S., M. R. Miller, R. D. Bauer, and J. R. LeDonne. 1982. "California's Central Valley Wintering Waterfowl: Concerns and Challenges." *Transactions of the Forty-seventh North American Wildlife and Natural Resource Conference*, 47:441-452.

Heitmeyer, M. E., D. Connelly, and R. Pederson. 1989. "The Central, Imperial, and Coachella Valleys of California." *Habitat Management For Migrating and Wintering Waterfowl In North America.* Editors L. Smith, R. Pederson, and R. Kaminski: pp. 475-505. Lubbock: Texas Tech University Press.

Kempka, R. G. and R. P. Kollasch. 1990. "California Waterfowl Habitat Evaluation Using Remote Sensing Techniques." *Mimeo.* Sacramento.

Kempka, R. G. and R. P. Kollasch. 1991. "Comparison of National Wetland Inventory and a Winter Satellite Inventory for the California Central Valley." *Natural Areas/Yosemite Centennial Symposium Proceedings.*

Koeln, G. T., J. E. Jacobson, D. E. Wesley, and R. S. Rempel. 1988. "Wetland Inventories Derived from LANDSAT Data for Waterfowl Management Planning." *Transactions of the Fifty-third North American Wildlife and Natural Resource Conference.* 53:303-310.

Nellis, M. D., K. Lulla, and J. Jensen. 1990. "Interfacing Geographic Information Systems and Remote Sensing for Rural Land-use Analysis." *Photogrammetric Engineering and Remote Sensing.* 56 (3): 329-33.

North American Waterfowl Management Plan – Central Valley Habitat Joint Venture Implementation Plan. 1990.

Somers, R. 1987. "Geographic Information Systems in Local Government: A Commentary." *Photogrammetric Engineering and Remote Sensing.* 53 (no. 10): 1379-83.

Star, J. and J. E. Estes. 1990. *Geographic Information Systems: An Introduction.* Prentice-Hall. Englewood Cliffs, NJ.

United States Department of Interior, U.S. Fish and Wildlife Service. 1979. *Classification of Wetlands and Deep Water Habitats of the United States,* Cowardin, L. M., V. Carter, F. C. Golet, and E. L. LaRoe. FWS/OBS-79/31.

_______. 1987. *Wetlands of the California Central Valley: Status and Trend 1939 to Mid-1980's.* Frayer, W. E., D. D. Peters, and H. R. Pywell. Region 1, Portland.

United States Environmental Protection Agency. 1990. *Classification of Puget Sound Nearshore Habitats Using Aircraft Multispectral Scanner Imagery.* F. Mynar Environmental Monitoring Systems Laboratory, Las Vegas, NV.

Woodcock, C., C. H. Sham, and B. Shaw. 1990. "Comment on Selecting a Geographic Information System for Environmental Management." *Environmental Management.* 14 (3): 307-15.

TECHNIQUES AND LIMITATIONS OF SPATIAL ANALYSIS FOR DIVERSITY STUDIES

Nancy Tosta[1]

Over the last several years, geographic information systems (GIS) have become common tools in the analysis of habitat and identification of species distributions. The technology has proven itself extremely useful for developing and analyzing spatial relationships among numerous variables that affect the distribution of animal and plant species. However, the main limiting factor in the use of GIS continues to be the availability of digital data at resolutions and accuracies adequate to answer the questions being posed. This paper will explore the use of GIS for analysis of species diversity in habitats in California. The discussion will specifically address requirements for data, issues relating to data scale and resolution, and efforts currently underway to improve digital data availability for GIS use.

Tuesday, October 16, 3:30 pm

1. Nancy Tosta, State of California, Stephen P. Teale Data Center, P.O. Box 13436, Sacramento, CA 95813-4436.

NATURAL AREAS IDENTIFICATION AND MANAGEMENT I

AN INTERAGENCY APPROACH TO PROTECTING CALIFORNIA'S SIGNIFICANT NATURAL AREAS

Marc Hoshovsky[1]

California is both simultaneously blessed with enriched biological diversity and plagued by a rapid population growth rate that places tremendous demands on this diversity. Many public and private organizations are concerned about the loss of biological diversity, but they often pursue their own goals with little coordination with others. The result is often unnecessary duplication of effort and oversight of important elements of natural diversity.

To improve the situation, the State Legislature mandated that the California Department of Fish and Game (DFG) improve natural area coordination. DFG has developed a working list of significant natural areas that other organizations find valuable in identifying priorities. It has also organized an interagency committee to help coordinate the natural area programs of nine federal and state agencies and The Nature Conservancy. This presentation describes the interagency approach to identifying and protecting natural areas, as well as highlighting current progress and future planning needs.

Tuesday, October 16, 1:30 pm

1. Marc Hoshovsky, California Department of Fish and Game, 1416 Ninth Street, 12th Floor, Sacramento, CA 95814.

NATURAL AREA DESIGNATION AND MANAGEMENT ON BUREAU OF LAND MANAGEMENT LANDS IN CALIFORNIA

John W. Willoughby[1]

Natural area establishment has been a high priority with the California State Office of the Bureau of Land Management (BLM) for the better part of two decades. A total of 95 natural areas are currently being managed by BLM in California. These range in size from 40 acres to 180,000 acres. Until recently there was no systematic process guiding the identification and designation of natural areas on BLM lands. Natural areas were established either because of public concern expressed through the land-use planning process or because BLM resource specialists recognized that a particular area was unique or unusual. This has resulted in a system of natural areas that emphasizes rare species. The bureau's natural area system must include areas supporting rare species, and natural areas will continue to be established to conserve the habitat of these species. At the same time, however, it is necessary to set aside areas supporting good examples of more common plant communities, primarily for research purposes. Toward this end BLM in California recently adopted the classification developed by Holland for the vegetation of California as its target for the identification of research natural areas. The goal is to ensure that good examples of all of those Holland plant communities found on BLM lands are part of the bureau's natural area system. BLM's process for designating natural areas and management following designation are discussed.

Tuesday, October 16, 1:30 pm

1. John W. Willoughby, Bureau of Land Management, 2800 Cottage Way, Sacramento, CA 95825.

U.S.D.A. FOREST SERVICE REGION 5 GAP ANALYSIS OF THE RESEARCH NATURAL AREA PROGRAM

Ayn J. Martin[1]

Forest Service Research Natural Areas (RNAs) are established to preserve representative examples of all ecosystems on Forest Service lands. Establishment of RNAs maintain unmodified ecosystem conditions and natural processes for genetic conservation, educational opportunities, baseline monitoring, and comparison with results from manipulative research in other areas. The early Forest Service RNA target system focused on timber types, while other vegetation types were considered only secondarily for representation. Built into the RNA Program, however, was a requirement for periodic analysis of the target system as delineated in the responsibilities of the interdisciplinary Regional RNA Committee (RNAC). In the mid-1970s, the importance of all vegetation types to the RNA Program was realized, and a more comprehensive target system was developed, which not only included forest types, but also a few woodland, scrub, chaparral, grassland, meadow, marsh, bog, and other unique ecosystems. The target system was reviewed again in the late 1980s to determine its adequacy in targeting noncommercial values, concurrent with a gap analysis of established and candidate RNAs throughout the region to determine the completeness and adequacy of target element representation. Emphasis was put on a review of the program for riparian type representation. A refined RNA target system, based on the gap analyses, was recommended for use throughout the region by the RNAC in 1990, and forests have begun to survey areas on the ground that have the potential to fill gaps in the RNA system.

Tuesday, October 16, 1:30 pm

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1. Ayn J. Martin, Pacific Southwest Region and Pacific Southwest Forest and Range Experiment Station

NATURAL AREAS IDENTIFICATION AND MANAGEMENT II

THE IDENTIFICATION, PROTECTION, AND MANAGEMENT OF VITAL NATURAL RESOURCE AREAS IN COLLIER COUNTY, FLORIDA

Mark A. Benedict and David Addison[1]

Abstract

Located on the southwest coast of Florida, Collier County is the fastest growing metropolitan area in the United States. In less than 50 years, urbanization and the expansion of local agricultural activities have degraded nearly 20 percent of the county's abundant natural areas through either direct destruction or hydrological alteration. Projected growth for the next decade bodes disaster for the county's natural systems and biological diversity.

The Conservancy, Inc., a 5,500 member nonprofit conservation organization in Naples, Florida, was formed over 25 years ago by local citizens who united to protect southwest Florida's natural environments. Over the last 5 years, The Conservancy, Inc., has focused on three priority work objectives in an effort to create a bioregional conservation program to preserve Collier County's natural systems. This directed focus on the identification, protection, and management of functional ecological units is the result of the organization's experience that neither land acquisition nor land use regulation alone can succeed in protecting the county's natural resources for the future.

INTRODUCTION

Collier County adjoins the western edge of the Big Cypress-Everglades Region and is characterized by diverse natural systems containing species-rich blends of tropical and temperate flora and fauna. It is the second largest county in Florida equaling Rhode Island in size. The county's coastal zone consists of 39 miles of barrier island shoreline, which, in undeveloped areas, is bordered on the east by an extensive mangrove estuarine system. Along the southern coast, this mangrove wilderness forms the 10,000 Island Region, which extends into Everglades National Park. The interior of the county is characterized by widespread, interconnected wetland watersheds containing 399,653 acres of cypress swamp, 192,560 acres of freshwater marsh, and 70,673 acres of hardwood and shrub swamp. The best known interior wetland area is the Big Cypress Swamp.

Abundant undisturbed natural resources and favorable climate are major reasons why people and businesses move to Collier County. The county, which was primarily a resort area composed of small, scattered villages until the 1950s, is now experiencing the highest growth rate in the United States. According to data from the Collier County Planning Department, between 1950 and 1985 the population grew from 6,488 to 85,971. From 1970 to 1980 the population of Collier County increased 143 percent compared to 43 percent for the rest of the state and 11 percent for the United States. Collier County's population is projected to grow from its current population of 169,400 to 260,000 in 2000 and 477,601 in 2020. This growth has resulted in intense urban residential and resort development in western Collier County. In the north central section of the county, agricultural development, especially citrus, has also increased dramatically.

Although this growth is considered by many as an economic boom to the community, the county's natural resources are showing the adverse effects of geometric population growth, urbanization, and

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1. Mark A. Benedict and David Addison, The Conservancy, Inc., Naples, FL.

expanding agriculture. Consequently, degradation, alteration, and dissection of the county's natural systems are occurring at an increasing rate. Nearly 20 percent of the county's natural areas have been lost in less than 50 years. The projected intensification of population and agricultural growth forecasts a dismal view for remaining natural areas and associated species diversity.

In 1964, a group of 20 citizens concerned with the impact of local growth united to work for the preservation of southwest Florida's natural environments. This group, which was later incorporated as the nonprofit Collier County Conservancy, initially chose acquisition as the way to ensure preservation of the Rookery Bay estuary south of Naples. Between 1965 and 1975, the organization raised over $1 million to purchase 5,000 acres in the Rookery Bay area and raised additional funds to acquire land in the 10,000 Islands Region and along Collier County's southwestern coast. Although they continued their acquisition activities, the Collier County Conservancy's efforts between 1975 and 1985 focused on environmental protection through the development review process and applied ecological research.

CREATING A BIOREGIONAL CONSERVATION PROGRAM FOR COLLIER COUNTY

In the mid 1980s, the organization, now named The Conservancy, Inc., critically reviewed its progress in over 20 years of work to protect Collier County's natural resources. Conservancy staff concluded that local regulatory and natural resource management efforts were not effective in protecting the county's key natural resource areas in the face of rapid population growth and development. Local government regulatory programs were too focused on resource protection through reactive, site-specific project review with little emphasis on proactive steps to address the maintenance of "greater ecosystem" habitat relationships. Conservancy staff also concluded that the organization's own conservation efforts were not being fully effective. Rising land values were making The Conservancy, Inc.'s acquisition activities cost prohibitive and involvement in reactive environmental issues spread out and diluted the organization's effectiveness.

As a result of this analysis, The Conservancy, Inc., made a pragmatic decision to focus the organization's environmental efforts on a more directed and proactive environmental protection approach that would result in the preservation of functionally significant natural areas. To accomplish this, The Conservancy, Inc.'s Environmental Protection Division has pursued three priority work objectives: (1) to identify, map, and rank vital natural resource areas; (2) to undertake cooperative natural areas acquisition and resource management projects; and (3) to create a Collier County Natural Areas Protection Program. All work under these objectives was geared toward the preservation of Collier County's vital natural resources through the creation of an effective bioregional conservation program.

The Identification, Mapping, and Ranking of Vital Natural Resource Areas

A critical component of any conservation program is the identification, mapping, and ranking of natural resource areas and features. Such analysis not only helps to identify key natural areas but also provides the information necessary to increase public awareness of an area's importance and protection needs. To address this objective The Conservancy, Inc., utilized two one-year grants from the Laurel Foundation to create a Collier County natural areas identification and evaluation program.

The Conservancy, Inc., used the first Laurel grant to create a Collier County Natural Areas Inventory modeled after The Nature Conservancy's Natural Heritage Program. The purpose of the inventory was to identify and rank rare, unique, or endangered species and communities in the county. Following established natural areas inventory procedures, Conservancy staff obtained resource data from a variety of sources including the Florida Natural Areas Inventory, government agencies, and its own 10-month field survey. The Conservancy, Inc., then screened the data for accuracy and entered it into a dBASE III data base.

The first grant included two activities that are beyond the scope of many natural areas inventories. First, the dBASE III data files were linked to The Conservancy, Inc.'s AutoCAD computer mapping system. This made the Collier County inventory more interactive and, for example, allowed Conservancy staff to call up the system and map the location of all mesic hammocks on the county base map. In addition, a procedure was set up to prioritize natural areas sites. This was accomplished by first using local experts to create a county rank for each inventory element based on the state and global element ranks used in the Natural Heritage Program. A county prioritization score was then created whereby the rarest elements were given the highest priority for protection. Finally, county ranks and priority scores were added to all inventory elements and then the database was used to map the sites in order of priority ranking.

The Conservancy, Inc., used the second Laurel grant to add regional biological resources, water resources, hydrological and geological features, and land-use planning information to the natural areas database. Conservancy staff gathered and digitized appropriate data into a common scale Integrated Watershed Planning and Management map series. The resulting 16 map series contained biological information such as panther habitat, water resources data including areas with good potential for future potable water supply, hydrological/geological information, for example, historic and current County watershed boundaries, and land-use planning and resources management information including a map of vacant urban uplands. In addition, Conservancy staff overlaid wetland, panther habitat, groundwater pollution susceptibility, future potable water supply, and natural areas element location maps in order to identify regionally significant natural resource areas.

Cooperative Natural Areas Acquisition and Resource Management Projects

The key to any bioregional conservation strategy is the acquisition of core preserve areas to maintain species diversity and regionally significant natural resource features. Also critical is the preparation of integrated resource management programs to ensure the long-term viability of the core preserves and their component plant and animal communities. To promote and create well-managed core preserves covering whole ecosystem units, The Conservancy, Inc., under its second natural areas objective, has worked over the last five years on two cooperative natural areas acquisition and management projects.

Rookery Bay National Estuarine Research Reserve Project

The objective of the Rookery Bay National Estuarine Research Reserve (RBNERR) project is the protection and long-term management of an undisturbed coastal island and estuarine system located south of Naples and north, east, and south of Marco Island. The project is built around the Rookery Bay Reserve, the core of which was purchased cooperatively by The Conservancy, Inc., The Nature Conservancy, and the National Audubon Society. The reserve is currently managed jointly by the Florida Department of Natural Resources (DNR), the National Oceanic and Atmospheric Administration (NOAA), The Conservancy, Inc., and National Audubon. The Conservancy, Inc., is working with the other reserve management agencies in three areas.

Acquisition

A review in 1985 of the lands contained within the state's Rookery Bay Conservation and Recreation Lands (CARL) acquisition project revealed that the reserve and its proposed acquisition areas did not include Gulf-fronting barrier islands critical to the already protected estuarine habitats. In addition, the acquisition project did not contain key wetland, transition, and upland areas. In cooperation with DNR and the reserve's staff, The Conservancy, Inc., undertook a drive in late 1985 to expand the CARL project boundary to include acquisition of these additional areas. During this drive The Conservancy, Inc., provided technical information, which supported project expansion and worked to generate support by local elected officials and citizens groups. Following adoption of the expanded project design, The Conservancy, Inc., worked with DNR to facilitate the acquisition of Cannon Island, a key barrier island parcel, and is currently working with the reserve staff to increase the priority ranking for the Rookery Bay CARL project. In addition, The Conservancy, Inc., continues to work with reserve staff, The Nature Conservancy, and a local land trust to acquire other critical island and wetland parcels.

Management

For some time, NOAA and the Reserve Management Board have been concerned about the scope of the reserve's current management plan. Of particular concern is the plan's inadequate treatment of offsite development and its potential adverse impacts on the reserve. The Conservancy, Inc., is currently working with DNR, NOAA, and National Audubon to draft a revised management plan that emphasizes identifying and developing specific management responses to on- and off-site activities that would adversely affect reserve resources.

Expansion

A third concern that is being addressed cooperatively through the Rookery Bay project is that administratively the reserve has management control over only part of the undeveloped coastal island and estuarine system south of Naples, despite the fact that the state owns or has public lands proprietary authority over more than 120,000 island and wetland acres in this area. As a result, the Reserve Management Board is a major proponent of combining all state holdings around Marco Island into one functional management unit to be administered and managed under RBNERR, its staff, and its board.

Corkscrew Regional Ecosystem Watershed

The other cooperative natural resource area acquisition and management project The Conservancy, Inc., is involved in is the Corkscrew Regional Ecosystem Watershed (CREW) project. This project's purpose is to acquire and provide long-term management for the wetland, wildlife, and water resources of the Corkscrew Watershed, the last remaining, predominantly undisturbed and functional watershed in northwest Collier County. The CREW project encompasses the headwaters and downstream flowageways of National Audubon's Corkscrew Swamp Sanctuary. This area was identified during the second Laurel grant as the interior area ranked highest for resource protection. Coordinated acquisition and management action are needed for this watershed now because this large natural area is being threatened by agricultural development to the east and urban development to the west. The Conservancy, Inc., has been working on this project since 1986. The project is a cooperative effort between state, regional, and local government officials, and The Conservancy, Inc., National Audubon, The Nature Conservancy, and the Trust for Public Lands.

Initial Save Our Rivers (SOR) Acquisition Proposal

In 1986, in cooperation with National Audubon's Corkscrew Swamp Sanctuary staff, The Conservancy, Inc., prepared and submitted a 13,000+ acre Bird Rookery Swamp acquisition application for consideration under the South Florida Water Management District SOR Program. This initial project application, which covered the most development-prone areas of an anticipated larger project, was accepted by the Water Management District and added to its five-year SOR program priority acquisition list.

Expansion of Project to Cover Watershed

In 1987, The Conservancy, Inc., assisted consultants hired by Lee County to prepare an application to add Lee County's Flint Pen Strand to the Bird Rookery Swamp SOR project. In 1988, The Conservancy, Inc., provided technical input and raised public support for the final CREW project design. As accepted and approved for priority funding, the final expanded project covers 40,000+ acres that include the entire Corkscrew watershed as well as a wetland/wildlife corridor, which connects with the Florida Panther National Wildlife Refuge. Laurel grant information was used extensively for the CREW project.

Creation of the CREW Land Trust

In 1989, the Water Management District assembled representatives of state, regional, and local government entities, the Trust for Public Lands, The Nature Conservancy, National Audubon, Florida Audubon, The Conservancy, Inc., local landowners, and representatives from the development community to create a multifaceted, nonprofit organization that would advocate and coordinate the acquisition and long-term resource management planning for the CREW project. The Conservancy, Inc., has been active in the CREW Trust, particularly in the development of resource management objectives and the generation of local support. A key accomplishment of this unique, multi-agency, private/public partnership to date has been to obtain commitments for a four-way land acquisition funding split between the Water Management District's SOR program, the state's CARL program, and Lee and Collier counties. To date purchase contracts have been signed for over 7,000 acres.

Creation of a Collier County Natural Areas Protection Program

In a bioregional conservation program it is not enough to acquire core preserves and plan for their long-term management. It is essential to ensure that activities undertaken on lands within the preserves' "zones of influence" are compatible and will not result in degradation of core resource areas. The passage of the Florida Growth Management Act of 1985 provided an important opportunity to better tie local government land regulations and environmental programs to the protection of vital natural resource areas. The act requires local governments to create comprehensive management plans to address growth-related issues. By actively participating in this process, The Conservancy, Inc., worked with Collier County staff, elected officials, and local citizens to create a local environmental program that focused on the protection of the county's vital natural resources areas.

The first step in this process was the creation in 1987 of an Environmental Task Force as one component of a broadly based citizen initiative to ensure proper growth management for western Collier County. Over a six-month period the 10-member task force studied and provided 122 environmental protection and resource management recommendations on seven local environmental issue areas ranging from native species and habitats to environmental education. In addition to these issue-specific recommendations, the Task Force drafted seven growth management recommendations to guide the county's environmental protection program. Recommendations directly relating to the identification, protection, and management of Collier County's natural areas were (1) utilize integrated watershed planning in growth management, a key component of which is the systematic collection of natural resources data; (2) protect vital natural resource areas, giving highest priority to continuous, interconnected wetland/upland systems; (3) establish a local nonprofit land trust to provide open space for resource protection, education, and research; (4) undertake coordinated resource management programs; and (5) provide sufficient funding for environmental initiatives, especially for "green" or "eco" infrastructure.

The second step was the drafting and adoption of a new County Growth Management Plan. Through this effort The Conservancy, Inc., worked to include key Environmental Task Force recommendations in the plan's Conservation and Coastal Management element. Of particular importance was to ensure that the element (1) emphasized the identification and designation of key natural systems for protection and long-term management; and (2) mandated specific county actions to protect linked, functional natural systems. This effort resulted in County Commission adoption of a new Conservation and Coastal Management Element in early 1989 that requires, within a specific time frame, the creation of a County Natural Resource Protection Areas (NRPA) program. Under the Conservation element, the NRPA program (1) is recognized as a key environmental protection program that goes beyond locally adopted, site-specific development standards; (2) emphasizes identifying, mapping, and designating boundaries for multi-resource benefit NRPAs; (3) gives top priority to core resource area protection via a local NRPA acquisition program; and (4) utilizes innovative tools and more restrictive land-use standards to ensure uses compatible with identified NRPA resource features.

Plans for Future Bioregional Conservation Efforts

Over the next five years, The Conservancy, Inc., will continue to focus its environmental protection efforts on the implementation of a bioregional conservation program for Collier County. The work will emphasize four areas. First, Conservancy staff will work to establish a Collier County Natural Areas Resource Data Center. The center will be a cooperative, jointly supported effort to collect and enter resource data into a standardized Geographic Information System format. The center's data base will build upon the data base created through The Conservancy, Inc.'s two Laurel grants. Second, Conservancy staff will work to expand our cooperative acquisition and management projects. In addition to the ongoing work with the Rookery Bay and CREW projects, The Conservancy, Inc., will also work toward setting up a third project for the Belle Meade watershed east of the Naples urban zone. Third, The Conservancy, Inc., will continue to push for timely implementation of Collier County's Natural Areas Protection program, both the acquisition of core preserve areas and the adoption of land-use standards to ensure compatible activities in adjacent zones of influence. The Conservancy, Inc.'s fourth work objective will be to generate community support for the bioregional conservation program through a new nonprofit land trust created as a result of citizen growth management efforts. This trust, known as the Southwest Florida Land Preservation Trust, is already working to accelerate local greenspace planning and acquisition efforts.

CONCLUSIONS

During its 25-year history, The Conservancy, Inc., has utilized a variety of tools in its efforts to protect the natural environments of southwest Florida. In its first decade, The Conservancy, Inc.'s efforts were focused on resource protection through the acquisition of environmentally sensitive lands. In its second decade, The Conservancy, Inc., shifted its emphasis to environmental protection through land use review and applied ecological research. In the mid 1980s, the organization set out to create a bioregional conservation strategy, focused on the identification of vital natural resources areas, which included cooperative core preserve acquisition and management projects, and the creation of a local Natural Areas Protection program.

As The Conservancy, Inc., has discovered through its revised approach over the last five years, to be successful in protecting natural resources, the 1990s must be a decade of cooperation and partnerships. To this end, land acquisition/land-use regulation partnerships must be geared toward the purchase of core natural resource preserves and to the use of innovative land use standards to ensure that only compatible activities are allowed in the core preserves' zones of influence. In addition, private/public partnerships at local, regional, and state levels must provide acquisition funding and technical support for resource management planning and implementation. Fundamental to the success of these partnerships is the availability of an accurate, common scaled, multifeature resource data system that permits the evaluation of relative site values, the design of functional reserve complexes, and the education of public officials and citizens. It is also very important to create a forum for obtaining broad-based citizen support and involvement in bioregional conservation initiatives. Local, nonprofit land trusts, such as the CREW Trust and the Southwest Florida Land Preservation Trust, are ideal vehicles for citizen participation.

THE USE OF LANDSAT THEMATIC MAPPER DATA TO IDENTIFY HIGH QUALITY GRASSLANDS AND RARE SPECIES HABITAT IN EASTERN KANSAS

Chris L. Lauver[1] and Jerry L. Whistler[2]

Abstract

The purpose of this study was to evaluate the effectiveness of using LANDSAT Thematic Mapper data to identify natural grasslands and rare species habitat in eastern Kansas. A hierarchical classification strategy was developed and used with ground reference data to identify significant biological sites. Two methods of digital image classification were combined with discriminant analysis to produce a map of high- and low-quality native grasslands. Map overlays were produced that delineated potential high-quality grassland sites. Nearly 60 percent of the 135 sites field checked were found to be in good to excellent natural condition. Additionally, nine of these high-quality sites contained populations of the federally threatened Mead's milkweed (Asclepias meadii). *Utilizing digital satellite data to identify high-quality grasslands and rare species habitat in eastern Kansas appears to be faster, cheaper, and more accurate than traditional methods.*

INTRODUCTION

Native grasslands in eastern Kansas are part of the tallgrass prairie ecosystem of the central United States (Kuchler 1974). High-quality tallgrass prairies contain high levels of biological diversity and are among the most diverse ecosystems of all grassland types in the nation. However, the tallgrass prairie ecosystem is one of the most highly altered systems in the United States, and some estimates suggest as little as 1 percent of the pre-European settlement acreage of tallgrass prairie remains. Most of the tallgrass prairie habitat has been plowed for cultivation (Sims 1988), and many native sites have been fragmented and severely disturbed by land development and grazing. Fortunately, many native tallgrass areas remain in the Great Plains region, particularly in eastern Kansas and in parts of Nebraska and Oklahoma. Information on the extent and distribution of the remaining habitat in northeast Kansas is available (Kansas Biological Survey 1989), but data on these areas across the Great Plains region are sparse. A systematic survey of the remaining natural grasslands in this region would provide valuable information on the state of biological diversity in the Great Plains.

Methods to survey or monitor the earth's natural resources can be collected in three main ways (Clarke 1986): (1) on the ground; (2) from the air by human observers in low-flying aircraft and/or interpretation of aerial photographs; and (3) from space using satellite data and imagery. Currently, many survey approaches are based on the methods developed by White (1978). A natural areas inventory of Illinois was completed in 1978 with the use of this multistage approach. These stages were (1) compiling existing information; (2) examining maps and aerial photographs to select potential natural areas (PNAs); (3) aerial reconnaissance of PNAs; and (4) ground surveys (White 1978).

An inventory of natural areas in Douglas County in northeast Kansas was recently completed using the approach developed by White (1978). During the ground survey phase, over 400 potential natural

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2. Jerry L. Whistler, Remote Sensing Specialist, Kansas Applied Remote Sensing Program, The University of Kansas, Lawrence, KS 66045.

areas were field checked in this county, but only 123 sites were found to be high-quality grasslands (Kansas Biological Survey 1989). Since the vast majority of the PNAs were potential grassland sites, the field accuracy for identifying high-quality grasslands using White's (1978) methodology was roughly 30 percent. An analysis of the cost-effectiveness of this approach is beyond the scope of this paper. However, alternative methods that use a variety of remote sensor data are being investigated for improved efficiency of identification of natural areas. This paper presents a technique for identifying high-quality grasslands and rare species habitat in eastern Kansas with the use of digital LANDSAT imagery.

Satellites have been acquiring digital data of the United States since the launch of LANDSAT 1 in 1972 (Jensen 1986). The first three LANDSAT satellites are equipped with a multispectral scanner (MSS) system that simultaneously records energy from four areas or bands of the electromagnetic (EM) spectrum. The two most recent satellites, LANDSATs 4 and 5, carry an improved scanner system known as the thematic mapper (TM). The TM scanner system records reflected and emitted energy from seven discrete spectral bands in the visible and infrared regions of the EM spectrum (Jensen 1986). Six of the seven TM bands have a spatial resolution (i.e., ground area) of 30 X 30 meters. These combined spatial and spectral properties are known as a pixel. Each TM pixel contains six values that represent the energy reflected from six bands for a given 30 x 30 meter ground area. Since one LANDSAT image covers approximately 185 x 185 kilometers, each band of the TM image contains over 38 million pixels.

The objectives of this study were (1) to determine the TM bands or band combinations most useful for differentiating high- from low-quality grasslands, and (2) to assess the effectiveness of using LANDSAT TM data to identify unknown high-quality grasslands in eastern Kansas.

STUDY AREA AND DATA

The grasslands of Anderson County in east-central Kansas were selected for analysis. Anderson County is in the Osage Plains section of the Central Lowland physiographic province (Schoewe 1949). The landscape consists of gently rolling prairies on low hills with well-defined drainage patterns (USDA, Soil Conservation Service 1977). Land use in the county is mostly farming and ranching, with over 50 percent of the land in cropland and 36 percent used for pasture and rangeland (USDA, Soil Conservation Service 1984). Kuchler (1974) classifies the potential natural vegetation of Anderson County as mostly tallgrass or bluestem prairie (*Andropogon-Panicum-Sorghastrum*), with oak-hickory forest (*Quercus-Carya*) to the northeast.

Field surveys have recently been conducted in Anderson County to locate populations of rare species, such as Mead's milkweed (*Asclepias meadii* Torr.) (U.S. Fish and Wildlife Service, in prep.) and prairie mole crickets (*Gryllotalpa major* Saussure) (Kansas Department of Wildlife and Parks 1990). These surveys have yielded data on the location of high- and low-quality grasslands. High-quality grasslands are defined as relatively undisturbed grassland sites with moderate to high levels of native plant species diversity. In contrast, low-quality grasslands have been disturbed by grazing and agricultural practices. These sites are dominated by mostly native species, but contain low levels of native plant species diversity. Grassland data from these surveys form the ground reference database for this study.

To test the effectiveness of using digital satellite data to identify high-quality grasslands in Anderson County, a LANDSAT TM scene from 6 June 1988 of east-central Kansas (scene ID = 515591631) was purchased and analyzed. The decision to acquire a scene from June 1988 was based on the high potential to identify the target class with this scene date. All of the known high-quality grasslands in the study area are dominated by warm-season grasses, and most sites are used primarily as prairie haymeadows. The traditional haying time for these prairies is in early July. Thus, in June these grasslands typically contain healthy and vigorous plants that form relatively dense canopies of grasses and forbs. In addition, the impacts of the 1988 drought were hypothesized to aid in classification efforts to eliminate areas dominated by non-native, cool-season grass species (e.g., *Bromus* and *Festuca* spp.).

METHODS

A hierarchical classification strategy for the LANDSAT TM data was developed and used with ground reference data to identify unknown high-quality grasslands. The classification is hierarchical since it uses unsupervised and supervised classification techniques sequentially to classify (and eliminate) non-grassland areas and to produce a map of high- and low-quality native grasslands. The strategy also employs discriminant analysis to determine the original and transformed TM bands that are significant in differentiating high- from low-quality grasslands.

Discriminant analysis was performed with the NCSS software package on a micro-computer. The LANDSAT TM raster data were processed and classified using the ERDAS image processing software while the vector ground reference data and map overlays were processed and produced using the pc ARC/INFO geographical information system (GIS) software.

Unsupervised Classification

The first step in the hierarchical strategy was to produce a Level 1 land use/land cover classification (U.S. Geological Survey 1976) for Anderson County. To accomplish this, an unsupervised classification was performed on the original LANDSAT TM data. This technique identifies unique spectral classes that are inherent in the original TM data.

Using a statistical clustering technique, 78 spectral classes of the original TM data were formed. A maximum likelihood classifier assigned each pixel to one of these spectral classes. Each spectral class was analyzed visually with the aid of color infrared photographs and assigned to one of the following seven land use/land cover types: (1) urban; (2) agricultural land; (3) grassland; (4) woodland; (5) water; (6) mixed-inert; and (7) mixed-organic. Spectral classes were assigned to cover types on the basis of the cover type that dominated the class, but classes with low to high proportions of grass pixels were assigned to the grassland cover type. The nongrassland cover types were then eliminated to form a map containing only those areas classified as grassland. Using this map as a mask, original image pixel values coincident with the grassland cover type were extracted for further analysis.

Discriminant Analysis

Researchers have shown that certain satellite band ratios and linear combinations of bands are correlated with quantitative estimates of plant parameters, such as height, biomass, and cover (Pearson and Miller 1972; Wiegand et al. 1974). However, many of these transformed bands are functionally equivalent (Perry and Lautenschlager 1984). In our efforts to identify high-quality grasslands, we investigated the utility of the original TM bands, four transformed bands, and one band ratio (table 1) through discriminant analysis.

The purpose of discriminant analysis was to select the bands or transformed bands that were significant in distinguishing high- from low-quality grasslands. Known sites of high- and low-quality grasslands were digitized and overlaid on the original and transformed images. Data values for the six TM bands and the transformed bands were then extracted for the pixels that were coincident with the digitized sites. The original TM values plus the computed values (table 1) formed 11 data values per grassland pixel. The 11 independent variables were subjected to discriminant analysis to determine those that were significant in discriminating the dependent variable, grassland quality. Results from this analysis were used to create a grassland image that contained only the significant variables.

Supervised Classification

A supervised approach was used to create a map of potential high- and low-quality grasslands. This technique relies on the image analyst to interactively select groups of pixels that best represent the known land cover types to be classified. Using the digitized ground reference data to guide selection, training samples were taken for the two grassland quality types. Contingency table analvsis of the selected training samples was performed to eliminate samples that provided low classification accuracy. A total of 1,896 pixels from eight sites were selected as the training set for high-quality grasslands, while 2,196 pixels from six sites formed the set for low-quality grasslands. Using the statistics provided by these training samples, a maximum likelihood classifier was used to assign all grassland pixels to one of the two quality types. The pixels classified as low quality were then eliminated to create a map of potential high quality grassland areas. Map overlays of these potential high-quality sites were produced for use with USGS 1:24,000 topographic maps and used for field surveys.

Table 1. One band ratio and four band transformations (from Perry and Lautenschlager 1984) used in discriminant analysis of LANDSAT TM data of low- and high-quality grasslands in eastern Kansas. Computed values were scaled from 0 to 255.

Band Ratio – Normalized Difference:

ND = (Band 4 – Band 3) / (Band 4 + Band 3)

Band Transformations:

SBI[a] = .406 Band 1 + .60 Band 2 + .645 Band 3 + .243 Band 4

GVI[b] = -.386 Band 1 – .53 Band 2 + .535 Band 3 + .532 Band 4

YVI[c] = .723 Band 1 – .597 Band 2 + .206 Band 3 – .278 Band 4

NSI[d] = .404 Band 1 – .039 Band 2 – .505 Band 3 + .762 Band 4

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[a] SBI = soil brightness index
[b] GVI = green vegetative index
[c] YVI = yellow vegetative index
[d] NSI = nonsuch index

Post-Classification Processing

Post-classification processing of the high-quality grassland map was conducted to reduce errors of commission. Two potential sources of error were (1) the assignment of spectral classes composed of non-native grasses to the grassland cover type during unsupervised classification; and (2) the absence of a training sample for non-native grasslands during supervised classification. The objective was to refine the high-quality grassland map to more accurately reflect the actual land coverage of this cover type while minimizing the reduction of classification accuracy. The techniques of thresholding and cluster analysis were applied to the map to address this objective. Thresholding is a technique to identify and eliminate pixels that have a low probability of being assigned to the correct class. Cluster analysis is a method to identify and eliminate spectral classes that have a high level of confusion with other classes.

RESULTS AND DISCUSSION

Discriminant Analysis

The bands that were significant in distinguishing high- from low-quality grasslands in Anderson County were bands 2, 4, 5, 7, and the band ratio ND. These results are not surprising since bands 4, 5, and 7 and the band ratio ND contain information from the infrared region of the EM spectrum, and it is well established that infrared imagery (e.g., color infrared photographs) can be used to discriminate vegetative cover types.

Classification Accuracy for Known Sites

Using ground reference data that was withheld during training sample selection, the initial classification accuracy was 77 percent (table 2). However, since the predicted land area coverage for this classification (table 2) was thought to be an overestimate of the actual coverage, post-classification processing was conducted using the techniques of thresholding and cluster analysis. We selected and applied a threshold (at the one-percent level) to the high-quality grassland map. The application of this threshold resulted in a significant reduction of the predicted coverage of high-quality grasslands at a greater accuracy than cluster analysis (table 2).

Classification Accuracy for Previously Unknown Sites

Potential high-quality grassland sites ranging from 5 to over 300 acres were field checked during the summer of 1990. Of the 135 sites field checked that were previously unknown, parts or all of 77 sites were judged to be in good to excellent natural condition. These preliminary results indicate that on an area basis, this technique is 57 percent accurate in identifying unknown high-quality grasslands.

Table 2. Classification results of known sites[a] in Anderson County, Kansas and the resulting contribution by stage of the county land area classified as high-quality (HQ) grassland.

Stage	Classification Accuracy (pct)	HQ Grasslands as a percent of Anderson County
1. Initial classification	76.7	16.6
2a. Thresholding	63.4	8.0
2b. Cluster analysis	61.8	10.4

[a] Accuracy figures based on known pixels that were not included in the training samples.

Of the 77 high-quality grassland sites that were identified by LANDSAT TM data, 9 were found to contain small populations of the federally threatened Mead's milkweed. This species occurs only on unplowed native tallgrass prairies, usually with high species diversity (Missouri Department of Conservation 1980; U.S. Fish and Wildlife Service 1988). Although systematic surveys for rare species were not conducted in this study, these preliminary results indicate high potential for utilizing LANDSAT TM data to collect primary data on rare species that require high-quality native habitat.

Errors of omission were low for this study. Of the 135 sites field checked, 3 additional high-quality sites were located during the field surveys that were classified with LANDSAT TM data as low-quality grasslands. Since field surveys were intensive and systematic, the potential number of other low-quality grassland sites in the study area that may have been misclassified is low.

CONCLUSIONS

Using digital satellite data, this study presents a new method for identifying natural areas. The method described here replaces two stages of the traditional approach (i.e., stages 2 and 3 of White 1978) with a hierarchical classification of satellite data to determine PNAs. Whereas the traditional approach uses ground reference data to develop qualitative "signatures" to identify PNAs, these data (i.e., training sites) are used statistically in the hierarchical classification to develop quantitative signatures to identify potential high-quality sites.

Three conclusions can be drawn from this study:

1. NA Extracting detailed biological information on specific land cover types with the use of digital satellite data is a complicated process and requires a multidisciplinary approach;

2. Theoretically, the methods described here can be used to identify other natural cover types, such as high-quality forests and wetlands; and

3. Given that the current cost of a digital LANDSAT TM full scene that covers approximately 185 by 185 kilometers is $3,600 (EOSAT 1989, price list), and that computer image processing time was

about two weeks for Anderson County, we conclude that using this new method to identify high-quality grasslands and rare species habitat over large areas in eastern Kansas appears to be faster, cheaper, and more accurate than traditional methods.

ACKNOWLEDGMENTS

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REFERENCES

Clarke, R. (editor) 1986. *The handbook of ecological monitoring*. Clarendon Press, Oxford.

EOSAT. 1989. EOSAT Price List, EROS Data Center, Sioux Falls, SD.

Jensen, J.R. 1986. *Introductory Digital Image Processing: A Remote Sensing Perspective.* Prentice-Hall, Englewood Cliffs, New Jersey. Kansas Biological Survey. 1989. Final report on the natural areas inventory of Douglas County, Kansas with a progress report on the inventory of other Kansas counties, C.L. Lauver. Report No. 38, Lawrence.

Kansas Department of Wildlife and Parks. 1990. An inventory of three prairie animals in eastern Kansas, W.H. Busby. Nongame Program Report, Pratt.

Kuchler, A.W. 1974. A New Vegetation Map of Kansas. Ecology 55:586-604.

Missouri Department of Conservation. 1980. Status report on *Asclepias meadii* Torr., S.W. Morgan. Jefferson City.

Pearson, R.L. and L.D. Miller. 1972. Remote mapping of standing crop biomass for estimation of the productivity of the shortgrass prairie. Eighth International Symposium on Remote Sensing of Environment, University of Michigan, Ann Arbor.

Perry, C.R., Jr. and L.F. Lautenschlager. 1984. Functional equivalence of spectral vegetation indices. *Remote Sensing of Environment* 14:169-182.

Schoewe, W.H. 1949. The geography of Kansas, part 2 – physical geography. *Transactions of the Kansas Academy of Science* 52(3):261-333.

Sims, P.L. 1988. Grasslands. In *North American Terrestrial Vegetation.* M.G. Barbour and W.D. Billings (eds). Cambridge University Press.

U.S.D.A., Soil Conservation Service. 1977. *Soil Survey of Anderson County, Kansas*, K.H. Sallee. Salina, KS.

U.S.D.A., Soil Conservation Service. 1984. Kansas Resource Inventory, Data for Anderson County. Salina, KS.

U.S. Fish and Wildlife Service. 1988. Endangered and threatened wildlife and plants; determination of threatened status for *Asclepias meadii* (Mead's milkweed). *Federal Register* 53(170):33992-33995.

______. in prep. Recovery plan for Mead's Milkweed (*Asclepias meadii* Torr.).

U.S. Geological Survey. 1976. *A Land Use and Land Cover Classification System for Use with Remote Sensor Data*, J.R. Anderson, E.E. Hardy, J.T. Roach, and R.E. Witmer. Geological Survey Professional Paper 964, Washington: U.S. Government Printing Office.

Wiegand, C.L., H.W. Gausman, J.A. Cuellar, A.H. Gerberman, and A.J. Richardson. 1974. "Vegetation density as deduced from ERTS-1 MSS response." *Third ERTS-1 Symposium, Vol. 1.*

White, J. 1978. Illinois Natural Areas Inventory Technical Report, Volume I: Survey methods and results. Urbana, IL: Illinois Natural Areas Inventory.

NATIONAL NATURAL LANDMARKS IN ACADIA NATIONAL PARK, MAINE

Harry R. Tyler, Jr.[1]
Tammis E. Coffin[2]

Maine's Critical Areas Program is conducting a pilot project for the National Natural Landmark (NNL) Program of documenting NNLs in Acadia National Park in Maine. The state's natural areas data base of the Critical Areas Program is the primary reference source for preparing NNL evaluations. This project is also a pilot for using the NPS's new comparative evaluation methods. In 1989, twelve candidate NNLs were evaluated in Acadia National Park. These areas include coastal islands for their significant geological features, a coastal raised peatland, and jack pine and spruce fir forests. In 1990, significant coastal mountain plant communities, glacially modified valleys, and pitch pine woods will be evaluated. The preparation of each evaluation synthesizes information from past research and the Critical Areas Program's data base. The information collected on NNLs will be incorporated into the General Management Plan, which Acadia National Park is now preparing. Management and interpretive recommendations are being made for each area.

Thursday, October 18, 1:30 pm

1. Harry R. Tyler, Jr., Maine State Planning Office, Station #38, Augusta, ME 04333.

2. Tammis E. Coffin, P.O. Box 414, Bar Harbor, ME 04609.

POLICIES, PROBLEMS, AND OPPORTUNITIES IN THE MANAGEMENT OF SCENIC RESERVATIONS

POLICIES, PROBLEMS, AND OPPORTUNITIES IN THE MANAGEMENT OF SCENIC RESERVATIONS

Charles E. Beveridge, Moderator[1]

Abstract

The session will consider ways of managing scenic reservations for both ecological and scenic values and will explore ways to provide necessary roads, paths, and structures with minimal intrusion on the scenery. Because the session is being provided under the auspices of the National Association for Olmsted Parks and the Frederick Law Olmsted Papers project, it will begin with presentations concerning a group of national parks, state reservations, and metropolitan scenic reservations where Olmsted and his successors addressed these issues. Following the presentations there will be a working session for the purpose of identifying means by which park managers, ecologists, landscape architects, and interested members of the public can collaborate in the restoration and maintenance of areas set aside for public use because of their scenic quality.

INTRODUCTION TO THE SESSION

This year's conference observing the centennial of Yosemite National Park provides a significant opportunity to consider issues relating to management of areas that have been set aside for public use because of their scenic beauty. Yosemite itself provides a particularly valuable example because constantly increasing visitation is raising urgent questions concerning the extent to which facilities can be added in the valley without damaging the scenery for which it was originally set aside as a public reservation. Yosemite Valley and Mariposa Big Tree Grove, ceded to the state of California by the federal government in 1864 primarily because of their scenic wonders, eventually became part of the national park, which was created in 1890 primarily for wilderness and watershed preservation. Here, as in numerous other places in the country, the problem now confronting park managers is how to preserve the historic scenic qualities of public reservations while at the same time managing wilderness areas associated with them for primarily ecological purposes.

It is hoped that this session can mark the beginning of an exchange of ideas and information among persons concerned with maintaining the visual integrity of scenic reservations, particularly historic ones. Questions that the presenters have been asked to address when relevant to their subject and the research materials available are as follows:

1. What evidence exists that the area in question was set aside to preserve its scenic qualities?

2. What suggestions does the historical record provide concerning methods for retaining (or enhancing) the particular scenic qualities of the area – particularly treatment of vegetation?

3. What suggestions does the historical record contain concerning ways to provide access to scenery without harming it or its component elements?

4. What suggestions does the historical record contain concerning the design and placement of structures, and the decision process for deciding what structures are needed in the reservation?

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1. Charles E. Beveridge, series editor of the Frederick Law Olmsted Papers, Department of History, American University, Washington, DC.

5. What methods have been evolved by managers of the area for educating users in the proper use of scenic reservations, and for helping users to appreciate the scenic qualities for which the area was set aside for public use?

6. What methods have been developed for combining or balancing ecological and aesthetic concerns in the management of the area?

7. What political activity is needed to preserve the scenic integrity of the reservation?

8. What methods of exchange of information and networking are desirable between interested groups and design and management professionals involved with the reservation?

9. What are the special issues, problems, and opportunities currently being addressed at the reservation?

NATURAL AREAS FRAGMENTATION: SALVAGING THE REMNANTS

FOREST FRAGMENTATION IN THE KLAMATH MOUNTAIN PROVINCE: ASSESSING THE THREATS, DEVELOPING STRATEGIES, AND TAKING ACTION

Felice Pace[1]

I will begin with a description of the province focusing on the high incidence of endemic plant species, its remarkable biodiversity, and its important location as a link between West Coast bioregions. The importance of the area's wild anadromous fisheries, the fact that to date it retains larger populations of certain species which have been extirpated or are more seriously threatened in other parts of the western coastal United States, and its conifer diversity (unmatched elsewhere in the world) will be highlighted.

Next we will discuss the actual and potential impacts of logging, road building, and other developments on these characteristics, utilizing mapping work completed by Marble Mountain Audubon on the Klamath National Forest to graphically display the extent of forest fragmentation. My final topic will be a discussion of how to move from theoretical and strategic thinking to action on the ground.

Thursday, October 18, 1:30 pm

1. Felice Pace, Hurd's Gulch Road, Ft. Jones, CA 96032.

SOUTHERN SAN JOAQUIN VALLEY ECOSYSTEMS PROTECTION PROGRAM: PROTECTION STRATEGIES AND OPPORTUNITIES FOR A FRAGMENTED LANDSCAPE

Richard L. Anderson and Linda K. Spiegal[1]

Rapid expansion of agriculture, oil development, and urban areas during the past several decades has resulted in a 95 percent loss of natural lands in California's Southern San Joaquin Valley. The remaining 5 percent of natural lands are highly fragmented and of varying quality. A six-phased program was implemented by the California Energy Commission to provide current inventory information on the remaining natural lands and to develop a strategy to protect these ecosystems and the associated threatened and endangered species. The investigatory phases of this program provided sufficient information to develop plans to protect five vertebrate and five plant species listed as threatened or endangered. This type of program with a regional perspective is a wise investment for the future protection and recovery of multiple threatened and endangered species and for obtaining maximum benefit from precious conservation funds. Coordination and implementation of a regional protection program require the commitment and cooperation of all local, state, and federal agencies in order to be successful.

Thursday, October 18, 1:30 pm

1. Richard L. Anderson and Linda K. Spiegal, California Energy Commission, 1516 Ninth St., Sacramento, CA 95814.

ISLANDS AMIDST CLEAR-CUTS: DOES ISOLATION WEAKEN THE SURVIVORS OF OLD-GROWTH FRAGMENTATION?

L. Scott Mills[1]

Understanding the dynamics of small populations and their susceptibility to extinction is fundamental to the management of natural areas. We expect that isolated animals will lose genetic variation, resulting in inbreeding depression and an inability to adjust to fluctuating environmental conditions, but tests are needed to illuminate causes of extinctions on relatively isolated nature reserves. I have designed a study to test whether a forest obligate, the California red-backed vole (*Clethrionomys californicus*), loses genetic variation and suffers decreased demographic vital rates as expected from theory. Following trapping of *C. californicus* on a number of forest "islands" (forest surrounded by clearcut) in southwest Oregon, I have determined an extinction threshold in which size and time since isolation affect whether populations persist. Also, I have begun to compare genetic variation between islands and nonfragmented areas, with the goal of determining the most significant threats to isolated populations.

Thursday, October 18, 1:30 pm

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1. L. Scott Mills, Biology Department, University of California, Santa Cruz, CA 95064.

ANALYZING PATTERN IN A FRAGMENTED OLD-GROWTH FOREST LANDSCAPE FOR PRESERVE DESIGN

David J. Mladenoff, Mark A. White, and John Pastor.[1]
Thomas R. Crow[2]

We are using a geographic information system to analyze the current and desired spatial pattern in a northern Wisconsin forest landscape (11,000 ha), dominated by second-growth forest, which also contains scattered remnants of old-growth forest. We have used landscape information derived from spatial statistics to compare the fragmented landscape with another similar area of undisturbed old-growth forest, to determine the desired design configuration for a preserve which can link and enhance the old-growth patches.

We believe that this analysis results in more realistic designs for restoration of forest ecosystems that link old-growth remnants and that have a greater likelihood of restoring levels of natural ecosystem functioning and habitat values similar to the original landscape.

Thursday, October 18, 1:30 pm

1. David J. Mladenoff, Mark A. White, and John Pastor, Natural Resources Research Institute, University of Minnesota, Duluth, MN 55811.

2. Thomas R. Crow, USDA Forest Service, North Central Forest Experiment Station, Forestry Sciences Laboratory, Rhinelander, WI 54501.

NATURAL AREAS PRESERVATION IN URBAN LANDSCAPES

CASE STUDIES IN NEW YORK CITY"S PARK SYUSTEM

NATURAL AREAS PRESERVATION IN THE URBAN LANDSCAPE

Moderator: Nicholas Quennell F.A.S.L.A.
Co-Chairman, National Association for Olmsted Parks

INTRODUCTION

My name is Nicholas Quennell. I am a landscape architect from New York City and Co-Chairman of the National Association for Olmsted Parks (NAOP), the leading advocacy organization for the understanding and preservation of the legacy of landscapes designed by Frederick Law Olmsted and his successors.

Today's topic, the restoration of urban forests, has been organized by NAOP to focus on issues that concern those of us who are working in Olmsted parks. It is important to make the connection between Yosemite and the urban parks with which today's speakers are involved. Olmsted spent much of his life designing and promoting urban parks all over the country and he saw them as mirror images of the wilderness landscapes of which he was so fond and which he promoted. Another aspect emerges from this conference – the risk of overuse of wilderness parks like Yosemite. One way in which this risk can be moderated is to ensure that our urban parks still contain the qualities of wilderness that Olmsted intended and that can, therefore, satisfy some of the public's needs for open space, taking pressure off the true wilderness.

Today's panel is made up a variety of disciplines, people who are all working at restoring urban parks. The first speaker, Jane Schacat, a natural resource manager for New York City's Department of Parks in Manhattan, has worked there for nine years. She brings to her job dedication and love of horticulture and natural resources, combined with a remarkable eye for beauty.

Sandy Parisky, previous chairman of NAOP, heads the firm of Parisky Associates in Hartford, Connecticut, which provides project planning, management, and development services to cities nonprofit and corporate clients involved in restoring historic parks and structures. His projects have included the restoration of New Haven Green, Hartford's Soldiers and Sailors Memorial, and Bushnell Park. Sandy will speak about restoring urban parks through public-private partnerships.

Ed Toth is a botanist and entomologist. He is currently the director of landscape management in Brooklyn's Prospect Park, where he has worked for five years. He will talk about the challenging process of restoring woodlands.

Marc Matsil is director of New York City's Natural Resources Group, which is responsible for the management, acquisition, and restoration of the city's woodlands, wetlands, and meadows.

I would like to introduce today's subject by reminding you of Olmsted's attitude to nature in the city. He believed that parks should provide those experiences that he considered essential to human well-being and that are normally absent in the urban environment. These included such things as fresh milk from cows kept right there in the park and sheep grazing in meadows, as well as forests and lakes where one could hike and boat. These elements had to fit into a scenic vision for the landscape, a vision that differed in many instances from the landscape that existed on the site at the time. Olmsted and his partner had no qualms about changing nature to fit their vision. Along with the cows and sheep and fresh milk, that vision has too often been lost over time. We have too often forgotten what that vision meant and how it has changed.

To illustrate this point, I have chosen to show a few slides of Fort Tryon Park where my firm has been working for about ten years. Designed by the Olmsted Brothers firm in the 1930s, it exemplifies the design philosophy enunciated by Olmsted, Sr., and contains many problems we face in virtually every major urban park.

The first slide dramatically shows how the park has changed since its construction. In two views of the park from the Cloisters Museum taken fifty years apart, it is possible to see how much of the park has been closed in with tree growth during that time.

The Olmsted Brothers design for Fort Tryon Park recognized the importance of the automobile. This was one of the first urban parks that accepted the fact that the automobile was a vital element in society and one that was here to stay. Scenic roads were laid out to allow views that could be appreciated by car as well as on foot and that wound up the steep bluffs to the Cloister Museum and continued along the ridge to the south. These roads, and the footpaths parallel to them, all give wonderful views up and down the Hudson River. The second slide of a photograph taken in the 1930s indicates the importance the designers felt for the carefully framed views of the river. The next slide shows that same view today with the view completely filled in with trees, many of which have volunteered in the last fifty years.

Further images show other views from the Heather Garden – a magnificent terraced garden of heaths, heathers, and perennials, which slopes down toward the Hudson River – as they were intended to be in the 1930s and how they had vanished by the 1980s.

Fortunately, through the help of the Rockefeller family and an enlightened parks commissioner who decided that this was a park that deserved to be saved, a talented and dedicated team of gardeners and horticulturists, led by Jane Schacat, was brought in to undertake restoration. Slides show how after a few years of work, views to the river have re-emerged; fine specimen trees and shrubs, as well as elegant stone walls and benches, have been revealed.

This effort has not gone on without its critics and detractors. Alert neighbors, trained to watch out for depredations by overenthusiastic tree pruning and not understanding the ultimate purpose of the work, saw the removal of trees and shrubs – which they assumed where original to the park – as a form of official vandalism. It took a great deal of patient explanation and, ultimately, the completion of the restoration to convince this vocal group that the removal efforts had indeed been right.

At Fort Tryon, we had a relatively easy task of demonstrating how thoughtful and sensitive management can bring about a better environment. It was clear to most observers that the heather garden's beauty had been restored. The task of restoring woodlands is a bigger challenge, both horticulturally and politically, and one that may not be readily seen as beneficial by the general public.

As Jane, Ed, and Marc describe their work, I think you will see the magnitude of the challenges they face. Forest management in urban areas is a new science that involves understanding the complex ecological relationship between plants, with their special environmental needs, and human beings.

I think you will also see how fortunate we are to have people like them involved in the effort.

RESTORING HISTORIC PARKS THROUGH PUBLIC-PRIVATE PARTNERSHIPS

Sanford Parisky[1]

Abstract

In hundreds of U.S. cities, virtually thousands of acres of parkland – the legacy of 19th-century park planners and civic visionaries – are at risk. Ponds and watercourses have stagnated, park woodlands have become overgrown and littered, and physical elements of these designed landscapes are in serious distress. This situation, like most problems facing urban centers, has placed demands on governments beyond their financial capability.

Two historic parks in Connecticut, Hartford's Bushnell Park and New Haven's Green, have received major financial support for their restoration through efforts led by public-private partnership groups formed in these cities. Established with the full support of local officials, these nonprofit organizations have provided the necessary leadership, direction, and financial know-how to obtain funding for planning and implementing multimillion dollar improvements.

How were these partnerships established? How are they funded? What are their management structure and their relationship to local government? And what mechanisms were employed to reverse park deterioration? These issues will be discussed in a presentation of the work of Parisky Associates, project management and development advisors for these two successful park restoration models.

INTRODUCTION

In scores of U.S. cities, a valuable legacy of parks fashioned by Frederick Law Olmsted and other noted landscape designers are seriously threatened. Ponds and watercourses have stagnated, woodlands are overgrown and littered, and design features such as formal entryways, bridges, and monuments have deteriorated. This situation, like other problems facing older urban centers, has placed financial demands on local governments far beyond their capacity to respond.

Two historic parks in Connecticut, Hartford's Bushnell Park and New Haven's Green, have recently succeeded in reclaiming their legacy. Both parks have been fully restored through the efforts of well-organized public-private partnership groups. Established as nonprofit organizations, these groups were formed with the full support of local park administrators and elected officials. What these groups have in common is strong board leadership, a professional management team, and a plan that has brought in millions of dollars to finance park improvements.

Restoring New Haven's Green

In New Haven, the nonprofit Foundation for the New Haven Green was created after the mayor appointed a special task force to develop a plan of action. Led by Alfred W. Van Sinderen, a retired CEO from Southern New England Telephone Company, and a 42-member board representing business, government, civic, education, and religious organizations, the foundation developed a multiphased restoration plan for the Green.

1. Sanford Parisky, President, Parisky Associates and Trustee of the National Association for Olmsted Parks.

Located in the heart of the central business district, adjacent to Yale University, the 16-acre Green was first laid out in 1638, when the New Haven Colony was originally divided into nine square blocks (the central square being the common). This park has retained much of its original character over its 350-year history. Design features include a public library, a courthouse, and other civic buildings, which frame the square – first recommended by architects Cass Gilbert and Frederick Law Olmsted in 1910. Surrounded by a cast-iron and granite fence and crisscrossed by a series of pathways, much of the Green had deteriorated in the mid-80s due to heavy foot and bus traffic, age, and insufficient maintenance.

As a first step, the task force obtained a $58,000 planning grant from the New Haven Foundation, the major community fund for south central Connecticut. The plan and fund-raising strategy, which they commissioned, were prepared by a multidisciplinary team consisting of Quennell Rothschild Associates, landscape architects, and Parisky Associates, restoration management and development consultants. The plan addressed five contemporary problems that seriously compromised the beauty and use of this park: the impact of cars and buses, the issue of public safety and security, the problem of deferred maintenance, previously uncoordinated improvement efforts, and insufficient funding.

In the spring of 1986, the task force was reconstituted into a nonprofit foundation to raise the necessary funds, implement the physical plan, and create an endowment fund to enhance ongoing maintenance. The foundation's dollar goal of raising $5 million from public and private sources was considered ambitious, given New Haven's size and other pressing problems (pop. 126,000; sixth-poorest city in the nation).

Initially, the foundation asked over 100 local corporations and businesses to support this campaign. This appeal resulted in over 50 major firms contributing nearly $1 million to restore the Green and create an endowment fund. The following fall, the foundation approached the Connecticut General Assembly for $1.5 million for the Green. Over a 3-year period, nearly $1.6 million was provided by the state of Connecticut through existing entitlement grants, two special act bonding appropriations, and a matching grant from the State Department of Transportation. The latter was used to leverage $934,000 in federal funds for public transit improvements – bus waiting areas, shelters, and seating – from the U.S. Urban Mass Transit Authority.

In addition to raising money, the foundation was responsible for preparing working drawings and specifications and for securing required approvals from city, state, and federal agencies. Construction work was completed in five separate projects, phased over a four-year period as grants and pledge payments were received. The majority of pledge commitments to support this effort were secured within the first 24 months, with most donations payable within one to three years.

According to Foundation President Alfred W. Van Sinderen, "All improvements to the Green – including refurbished entryways, the plazas in front of the three churches, new bus shelters, and lighting – would never have been possible without the city's cooperation, professional management, and a plan of action. The business community, religious and civic organizations, Yale University, and city, state, and federal governments joined together to make this community-wide effort truly a public-private partnership."

As funds came in, work began. First, Bennett Plaza, a large pedestrian area and fountain across from the Chapel Square Mall, and four park entryways were rebuilt. Next, turn-of-the-century lighting fixtures were installed and paths throughout the park were repaired. Finally, major pedestrian and mass transit safety improvements along thoroughfares were undertaken and the World War I memorial and fence surrounding the Green were renovated.

By completion in the fall of 1990, the total breakdown for financing the overall project was $3.1 million, or 63 percent, from local, state, and federal governments; $1 million, or 20 percent, from corporations and businesses; $425,000, or 9 percent, from private individuals, and $375,000, or 8 percent, from charitable foundations.

In addition to funding brick and mortar projects, the Green campaign also included establishing a permanent endowment, the funds of which are now held by the New Haven Foundation. Over $325,000 was initially raised, and today over $500,000 is available for this purpose. The income generated from the endowment fund will be directed toward those "extraordinary" maintenance expenses in the future that may be necessary to supplement the city's annual budget for this purpose.

Hartford's Bushnell Park

In Connecticut's capital city, the nonprofit Bushnell Park Foundation – led by a 32-member board representing neighborhood, civic, cultural, business, and government interests – developed a two-phased capital campaign for Hartford's premier park. Listed on the National Register of Historic Places, this 37-acre park was originally established through a referendum in 1853, making Hartford the first city in the nation that voted to spend public funds to plan, design, and build a municipal park. It is also interesting to note that the taking of land for this park, made possible by a city charter revision, was the first example of urban renewal in Connecticut.

The park's original design reflects the early vision and political perseverance of the Reverend Horace Bushnell, acting as the lone proponent for the idea and, later, recommendations to the Parks Commission in 1858 by Frederick Law Olmsted of Hartford. Preoccupied with building New York's Central Park, Olmsted recommended that Swiss-born architect and horticulturalist Jacob Weidenmann of New York be hired to create a public park for Hartford.

Today, the park still reflects an Olmstedian style of landscape design, featuring smoothly sculpted and undulating contours and graceful paths that follow these landforms. Weidenmann selected over 157 varieties of trees and shrubs, including many unusual varieties which, even today, give Bushnell Park great botanical interest. Unfortunately, the park was dramatically modified in the 1940s when the Park River, a major feature, was removed. The Olmsted Brothers firm of Brookline, Massachusetts, was retained during this period to redesign pedestrian entries and add new landscape.

Currently the park is used by more than a million people annually – from picnicking, jogging, and socializing to concert going and rallies. Surrounded by an expanding central business district and the state capitol, the park first started to exhibit serious problems in the late 1970s. As park usage and fiscal pressures increased, age and inadequate maintenance began taking their toll. Formal entryways, fountains, monuments, and a pond, which no longer held water, became major eyesores.

The nonprofit Bushnell Park Foundation was created in 1981, thanks to a large degree to the supportive efforts of Victor Jarm, then director of parks. Its formation served as the mechanism for concerned corporate and community leaders to begin helping the city address the park's many pressing problems. As a first step, the nonprofit foundation hired landscape architects, Quennell Rothschild Associates, and restoration managers, Parisky Associates, to prepare the "Bushnell Park Improvement Plan." Underwritten by a grant from a local company, the plan identified 18 different improvement projects that, in total, constituted a comprehensive plan to guide future park renovations.

The group used the plan to seek funds from public and private sources for needed improvements: refurbishing the Soldiers and Sailors Memorial Arch – a 115-foot high Civil War monument built in 1886; renovating a former pumping station into a mini art gallery; renovating Corning Fountain and the reflecting pond designed by the Olmsted firm; refurbishing four park entrances; and installing new benches, trash receptacles, and lighting throughout the park.

Having raised over $3 million from local corporations, foundations, private citizens, and government sources for rebuilding these architectural features, the foundation recently embarked on an ambitious $1.6 million campaign to save aging trees and replant the park's landscape. With a grant from a small local foundation, the group hired Parisky Associates and Quennell Rothschild Associates to prepare a tree care and rehabilitation plan. The plan addresses three major objectives: (1) rehabilitate and protect existing plantings; (2) recreate the spirit and feeling of the park's original design; and (3) provide an ongoing tree care and replanting program. Using a $100,000 gift from the Hartford Foundation for Public Giving, the major community fund for central Connecticut, the foundation recently installed the first phase of an underground irrigation sprinkler system.

"Trees in Trust" is the popular name used by the foundation to solicit funds and promote the replanting effort. It encourages charitable donations that the foundation uses to protect the existing trees and replant large specimen shade and flowering trees. Nearly 1,000 trees, many lost throughout the park's 134-year history, will be planted over the next few years. With state bond funds recently approved by the Connecticut legislature and grants from private donors, the foundation has raised over $1.1 million toward its $1.6 million goal.

According to Sandra Sharr, foundation president, "Without the foundation's intervention to protect this landscape, large lawn areas and great stands of shade trees would be lost. It's really a silent crisis which must be addressed if this legacy is to survive."

CONCLUSION

The restoration of New Haven's Green and Hartford's Bushnell Park are two successful examples of public-private partnerships. Spearheaded by a nonprofit foundation, these organizations have the requisite leadership, professional management, and restoration plan to make these efforts work. For additional information about how to create a strategy for your community and park, contact Parisky Associates, 750 Main Street, Hartford, CT 06103, (tel. 203-522-3668).

TECHNIQUES FOR URBAN FOREST RESTORATION

Edward Toth[1]

Prospect Park, a national and local scenic landmark located in Brooklyn, New York, was designed by Frederick Law Olmsted and Calvert Vaux in 1866. Located at the heart of one of the densest urban areas in the United States, it receives approximately five million visitors a year.

Its landscape is subjected to many intense pressures unique to urban parks. Chief amongst these have been past clearing of large areas of understory growth for reasons of public safety, erosion of steep slopes caused by "desire line" paths, soil compaction, and invasion of aggressive, non-native weedy plant species that threaten the native vegetation.

This presentation will highlight the planning process and concepts adopted for the first phase of restoration, Ravine I, 20 acres of woods and ponds, scheduled to begin in the spring of 1991.

Thursday, October 18, 3:30 pm

1. Edward Toth, City of New York Parks and Recreation, 95 Prospect Park, Brooklyn, NY 11215.

URBAN RESTORATION: PROTECTING NEW YORK'S NATURAL HERITAGE

Marc A. Matsil[1]

New York City Parks Natural Resources Group (NRG) develops management, acquisition, and restoration policy for the city's wetlands, woodlands, and meadows. At the cutting edge, NRG has developed unique urban natural area management plans to protect its rare serpentine barrens, oak-hickory forests, and wetlands, including 25 rare and endangered species. NRG restoration crews have restored impacted ecosystems – grants have been awarded for wetlands and woodlands restoration. Hundreds of acres of endangered habitat have been protected from development and are now included in the department's refuge system. Marc Matsil will discuss restoration management, acquisition strategies, and protection of this surprising urban oasis.

Thursday, October 18, 3:30 pm

1. Marc A. Matsil, Natural Resources Group, City of New York Parks and Recreation, New York, NY 10021.

SEQUOIA AND KINGS CANYON NATIONAL PARKS: A COMPARATIVE MODEL OF NATIONAL PARK MANAGEMENT IN CALIFORNIA'S SIERRA NEVADA

William Tweed, David Graber, and David J. Parsons[1]

Sequoia and Kings Canyon National Parks, located in the Sierra Nevada south of Yosemite National Park, also celebrate their centennials in 1990. Biologically, these two parks share many elements with Yosemite. The human history of these two parks, however, differs strongly from that of Yosemite. The first segment of this session will explore theories as to why National Park Service management of Sequoia and Kings Canyon have taken a path distinctly divergent from that followed by the same agency in Yosemite. This segment will be presented by Dr. William Tweed, co-author of the recently published *Challenge of the Big Trees: A Resource History of Sequoia and Kings Canyon National Parks.* The second session segment, presented by Richard Stowell, will present the recommendations of the *Sequoia and Kings Canyon Second Century Conference,* a recent government/public sector conference that sought directions for the Parks' second century. The final segment of the session will be a roundtable discussion of these and related issues with an opportunity for audience participation.

Thursday, October 18th, 3:30 pm

1. William Tweed, David Graber, and David J. Parsons, Sequoia and Kings Canyon National Parks.

FIRE ECOLOGY: BURNING FOR THE FUTURE

GIANT SEQUOIA FIRE HISTORY IN MARIPOSA GROVE, YOSEMITE NATIONAL PARK

Thomas W. Swetnam, Ramzi Touchan, Christopher H. Baisan,
Anthony C. Caprio, and Peter M. Browns[1]

Abstract

We reconstructed a 1,438-year history of wildfire in the Mariposa Grove of giant sequoias (Sequoiadendron giganteum). *Partial cross sections were taken from 18 dead fire-scarred trees, and the tree rings and fire scars were dated. The resulting master fire chronology shows that fires recurred at intervals ranging from 1 to 15 years. Changes in fire frequency on time scales of centuries are also apparent. This fire history documents the long-term importance of fire in sequoia-mixed conifer ecosystems and illustrates the temporal variability of fire regimes.*

INTRODUCTION

Episodic surface fires have swept through giant sequoia groves for many centuries. Nearly all of the largest and oldest sequoias have huge basal fire scars that bear witness to these ancient flames. Although park naturalists have long accepted that fire was a frequent visitor to sequoia groves before arrival of Anglo-American settlers around 1850, real concern about negative effects of suppressed natural fire regimes did not arise until the early 1960s. Ecologists noticed that there were few sequoia seedlings or saplings within the groves, while the density of other shade-tolerant tree species was increasing. Research suggested that elimination of episodic fires during the past century had also eliminated necessary conditions for sequoia regeneration; sequoia seeds germinate and establish best in mineral soils exposed by surface burns (Harvey et al. 1980). Concern about changes in the structure of sequoia-mixed conifer forests was an important stimulus to reintroducing fire to some groves as early as 1968. Many prescribed burn areas within the groves now have abundant sequoia seedlings and saplings.

Although managers generally embraced the concept of reintroducing natural fire regimes, programs with the Sierran national parks have proceeded slowly (Parsons et al. in press, Underwood, this volume). This caution is due to the obvious hazards of "escaped" fires and limited specific knowledge about giant sequoia fire ecology and effects. A key information base that was identified as necessary for improving the design and long-term objectives of fire management plans was fire history that encompassed the very long life spans of sequoias (Christensen et al. 1987).

Early tree-ring investigations of fire history in Mariposa Grove were conducted by Clifford Presnall (1933a, 1933b), a park naturalist. Presnall took increment cores from basal scars of sequoia trees and counted the rings from bark into the wound. He observed that some fires were very ancient; his earliest approximate fire date was 450 A.D. Presnall observed that intervals between fires were as short as 15 years, but his data were too incomplete to provide a definitive assessment of fire frequencies in the Mariposa Grove. The most informative fire history work in the sequoia and mixed-conifer type was carried out by Kilgore and Taylor (1979). They collected fire scar specimens from nonsequoia species and estimated fire frequencies in two watersheds near Kings Canyon National Park. Their history extended back to approximately 1478 A.D. They found mean fire intervals varied between about 8 and 18 years.

1. Thomas W. Swetnam, Ramzi Touchan, Christopher H. Baisan, Anthony C. Caprio, and Peter M. Browns, Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ 85721.

This paper describes a fire history study conducted within the Mariposa Grove of giant sequoias in Yosemite National Park. This work is part of a larger project that includes development of fire histories for five sequoia groves (Mariposa, Big Stump, Giant Forest, Atwell Mill, and Mountain Home). Our aim is to reconstruct temporal and spatial variability of fire frequencies, areal extent, and intensities in different sequoia groves. Results from the Mariposa Grove are described here and used to illustrate several implications for management of fire regimes within protected sequoia groves.

METHODS

Partial cross-section samples were obtained from 18 dead trees. A chain saw with an approximately 1-meter-long bar was used to excise the sections from fire-caused basal wounds. Parallel cuts were made through the basal wounds and sections were extracted with dimensions of about 5- to 10-cm thickness and up to approximately 2 meters on a side. Large sequoias often have deep fire scar cavities at multiple locations around the stem. Quantity and quality of fire scar information preserved within a cavity is highly variable. Thus, the sampling procedure usually required cutting in several different cavities around the tree bole. A maximum of eight partial sections were removed from a single log. We found that optimum sampling included (1) selection of trees with maximum numbers of visible scars on outer surfaces and (2) sampling close to the original ground level of the tree (estimated from butt flare and location of the root crown). When removing partial sections from the dead stems, we often observed many fire scars completely buried within the tree bole.

The ring-width patterns of the specimens were crossdated with the 3,200-year giant sequoia chronology originally developed by A. E. Douglass (1945) and updated sequoia chronologies (Hughes et al. 1990). This procedure involved plotting the relative ring widths of an undated specimen and comparing this plot with a similar plot from one of the absolutely dated sequoia chronologies. Points of synchrony between the plots were used to establish correct dating in the specimen (Douglass 1919, Stokes and Smiley 1968). Once the annual rings were exactly dated, then the dates of fire scars recorded within the rings were noted.

In addition to fire scars, we observed other ring features that appear to indicate past fire occurrence. We call these features "other indicators." The other indicators are (1) expanded latewood – a characteristic band of latewood-type cells often observed following a fire scar (it appears as a second layer of latewood cells overlapping a fire scar that is within or on the boundary of an earlier formed band of latewood); (2) growth release – an obvious positive change in ring growth rate; and (3) traumatic resin ducts – a proliferation of resin ducts within a ring (this is probably a physiological response to an injury).

These indicators, especially types 1 and 2, are consistently associated with fire dates determined from actual fire scars on the same or other sampled trees. For example, it is possible to observe a ring with expanded latewood or abundant resin ducts on one part of a partial cross section and to follow the affected ring(s) around the section and locate a fire scar in the same year. In general, we believe that fire frequencies based on combined fire dates from both fire scars and other indicators provide a more complete estimate of past fire occurrence within the groves. All fire dates were compiled into a master fire chronology, and fire frequencies for different time periods were computed.

RESULTS

The Mariposa Master Fire Chronology is shown in figure 1. Individual sequoia trees contain very long and detailed records of past fires. A maximum of 47 fire scar dates was recorded on a single tree (MPU 6). Including both fire scars and other indicators, a total of 104 fire dates were recorded on another tree (MPU 9). The oldest fire scar date was A.D. 553 (MPU 8), while the oldest exact annual ring date was A.D. 262 (MPU 9). Due to declining sample depth at the beginning and end of the chronology, the fire history from about A.D. 850 to 1900 is best represented and most reliable for comparing relative changes in fire frequency.

Changes in frequency of past fires can be seen in the composite bar graph shown at the bottom of figure 1. Periods of highest frequency show close spacing of fires, while lower fire frequency periods show longer intervals between fires. The longest period between fires was 15 years. Between A.D. 850 and 1900, three 15-year fire-free intervals were recorded (979 to 994, 1185 to 1200, and 1637 to 1652). One-year intervals between fires were recorded about 50 times, but these fires were apparently very patchy; the consecutive-year fires were usually recorded by different trees in different parts of the grove.

Figure 2 shows a summary of temporal changes in fire frequency. Maximum frequencies were observed from about A.D. 1000 to 1400. A decline in fire frequency was observed from about 1400 to 1700. Fire frequencies increased to another maxima during the 1700s, then declined again. The end of episodic fires in the late 1800s has been observed in many other sites in the western United States. This was probably initially due to grazing by domestic livestock, which removed the fine fuels important to fire spread, and subsequently due to organized fire-fighting efforts by government agencies.

DISCUSSION AND CONCLUSION

Fire scar chronologies from giant sequoia groves are the longest precisely dated disturbance histories ever developed for any forest ecosystem. The Mariposa chronology clearly shows repeated fires for many centuries before settlement of this area by Anglo-Americans. Because of high fire frequency, the intensity of fires in most areas was probably limited to surface burns. It is also possible that locally intense burning created gaps in the forest canopy, leading to establishment of groups of sequoias (Parsons et al. in press; Stephenson et al. 1990). These fire-created gaps may also partly explain the observed fire-related growth releases. Reduced competition from killed trees would probably result in increased ring growth of surviving trees. Thus, localized tree mortality within prescribed burn areas, which has generated considerable criticism and public controversy (Christensen et al. 1987; Bonnicksen; this volume) may well be within the range of conditions created by pre-settlement fires. We plan to further investigate the association of growth releases and fires of different intensity by analyzing tree-growth response in areas of recent prescribed burns and wildfires.

Although the Mariposa fire history shows that fires were frequent throughout the past 1,000 years (until 1864), changes in fire frequency between centuries were also observed (fig. 2). This variability may have important implications for understanding the dynamics of sequoia groves. Did more sequoia seedlings establish during the higher or lower fire frequency periods? Investigation of sequoia age structure is under way in the same areas where we are reconstructing fire histories, including the Mariposa grove (Stephenson et al. 1990). This research should provide some of the needed information. Knowledge of this response will be critical for managers faced with the daunting task of designing and implementing prescribed fire programs whose fundamental goal is to reintroduce natural process.

Other pressing questions about fire management in sequoia groves are raised by these data. Do we want to reintroduce fire regimes that would have persisted in the sequoia groves had not

Anglo-Americans arrived on the scene in the 1800s? What would the 20th-century fire regime have been without our interference? This leads us to ask what were the sources and mechanisms of fire in presettlement sequoia groves? Were the changes we observe in fire frequency during presettlement times largely driven by climate and fuel dynamics, or did Native Americans also contribute by setting fires? We may never obtain satisfactory answers to these questions. However, we expect that this puzzle will slowly be pieced together in coming years. The millennial-scale history of giant sequoias will become richer as we pull together information from fire scars, tree-ring-based climate reconstructions (Graumlich 1990, Hughes et al. 1990), sequoia age structure (Stephenson et al. 1990), and sedimentary records (Anderson 1990).

ACKNOWLEDGMENTS

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REFERENCES

Anderson, R. S. 1990. Holocene forest development and paleoclimates within the central Sierra Nevada, California. *Journal of Ecology* 78:470-489.

Christensen, N. L., L. Cotton, T. Harvey, R. Martin, J. McBride, P. Rundel, and R. Wakimoto. 1987. Review of fire management program for sequoia-mixed conifer forest of Yosemite, Sequoia and Kings Canyon National Parks. Final Report to U.S. Department of Interior, National Park Service. Unpublished Report.

Douglass, A. E. 1945. Survey of sequoia studies. *Tree-Ring Bulletin* 12(2):10-16.

Graumlich, L. J. 1990. Interactions between climatic variables controlling subalpine tree growth: Implications for climatic history of the Sierra Nevada, California. In Betancourt, J. L. and A. MacKay (eds.), Proceedings of the Sixth Annual Pacific Climate (PACLIM) Workshop, March 5-8, 1989, California Dept. of Water Resources, *Interagency Ecological Studies Program Technical Report* 23:115-118.

Harvey, H. T., H. S. Shellhammer, and R. E. Stecker. 1980. Giant Sequoia Ecology: Fire and Reproduction. USDI National Park Service, *Scientific Monograph* No. 12, Washington, DC.

Hughes, M. K., B. J. Richards, T. W. Swetnam, and C. H. Baisan. 1990. Can a climate record be extracted from giant sequoia tree rings? In Betancourt, J. L. and A. MacKay (eds.), *Proceedings of the Sixth Annual Pacific Climate (PACLIM) Workshop, March 5-8, 1989*, California Dept. of Water Resources, Interagency Ecological Studies Program Technical Report 23:111-114.

Kilgore, B. M. and D. L. Taylor. 1979. Fire history of a sequoia-mixed conifer forest. *Ecology* 60(1):129-142.

Parsons, D. J., N. L. Stephenson, and T. W. Swetnam. In press. "Restoring natural fire to the sequoia-mixed conifer forest: Should intense fire play a role?" In *Proceedings of 17th Tall Timbers Fire Ecology Conference*, Tallahassee, Florida, May 18-21, 1989.

Presnall, C. C. 1933a. Translating the autobiography of a big tree. *Yosemite Nature Notes* 12(1):5-6.

Presnall, C. C. 1933b. Fire studies in the Mariposa Grove. *Yosemite Nature Notes* 12(3):23-24.

Stephenson, N. L., D. J. Parsons, and T. W. Swetnam. 1990. Effects of fire history on forest age structure in sequoia-mixed conifer forests. *Bulletin of the Ecological Society of America* 71(2):336.

Stokes, M. A. and T. L. Smiley. 1968. *Introduction to Tree-Ring Dating.* University of Chicago Press, Chicago.

Swetnam, T. W., C. H. Baisan, P. M. Brown, A. C. Caprio, and R. Touchan. Late holocene fire and climate variability in giant sequoia groves. *Bulletin of the Ecological Society of America* 71(2):342.

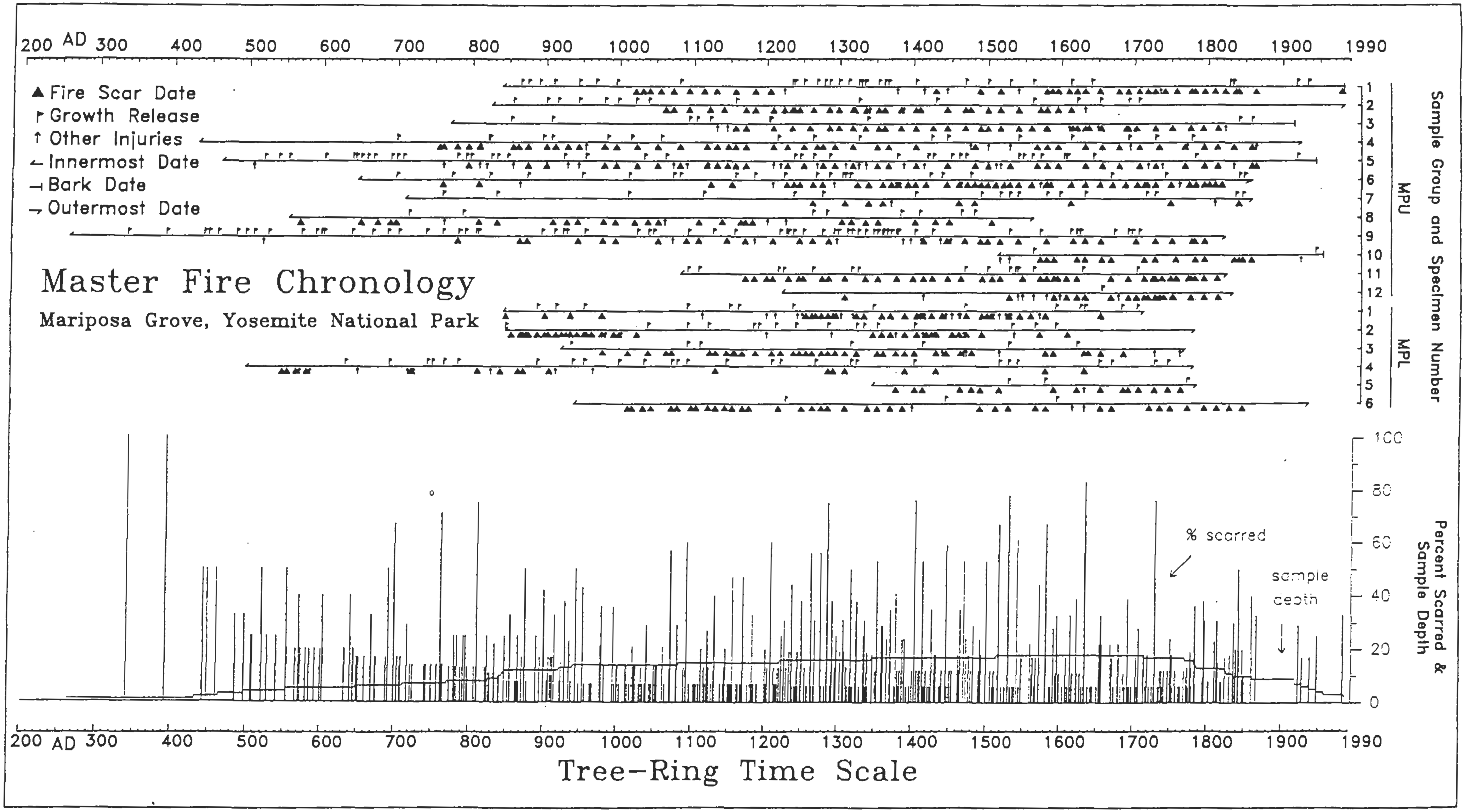

Figure 1. Master Fire Chronology, Mariposa Grove, Yosemite National Park. The horizontal lines represent sampled life spans of individual trees, and symbols on the lines indicate fire dates determined from fire scars and other indicators. The bar graph at the bottom shows percentage of trees recording fire dates. The horizontal line running through the bar graph shows the number of trees included in the chronology.

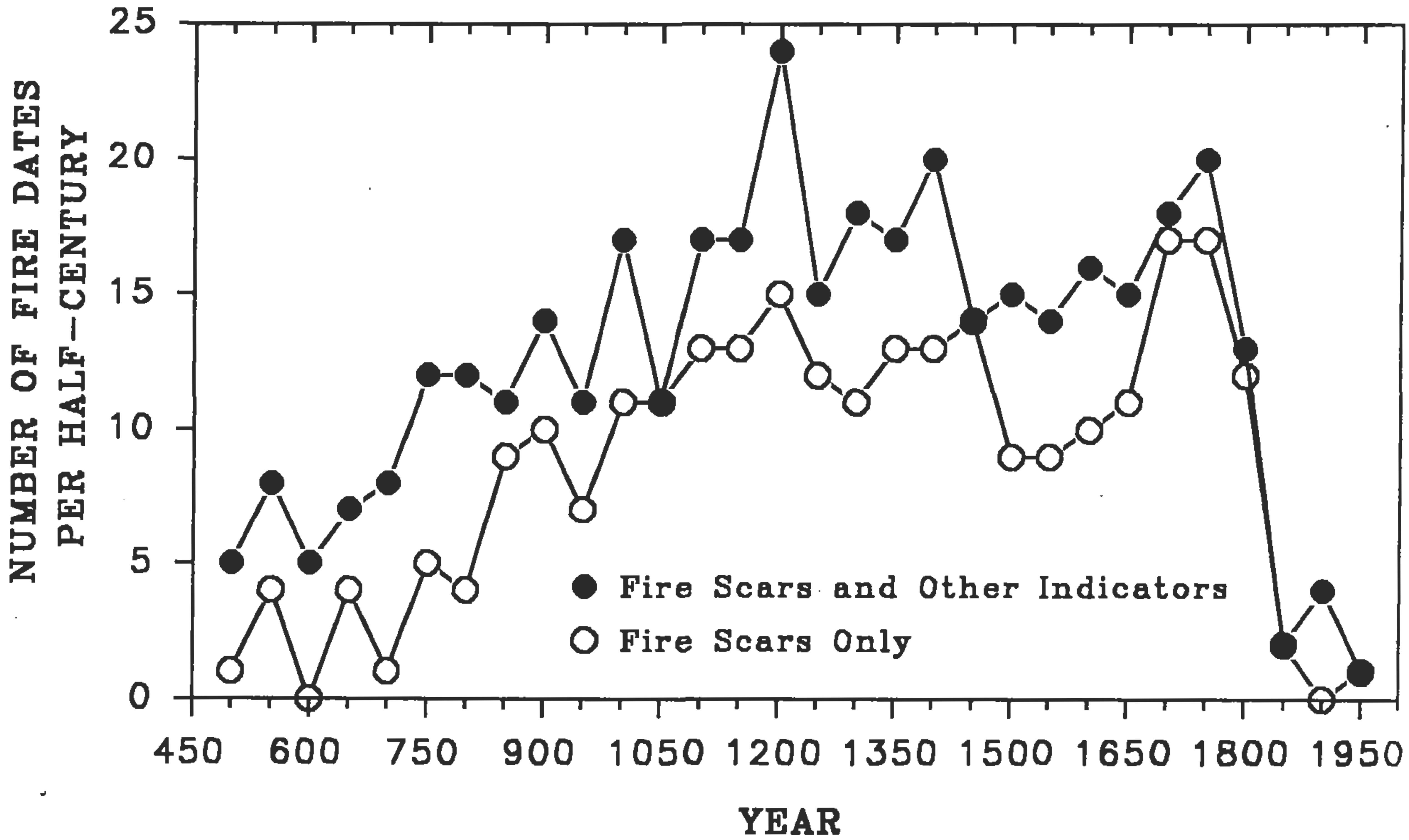

Figure 2. Estimated fire frequency in Mariposa Grove. Numbers of fire dates are shown per half century, estimated from fire scars plus other indicators, and fire scars alone. Selection of the 50-year periods was arbitrary. The data points represent the 50-year period from the indicated date and the subsequent 49 years. For example, the number of fire dates shown at 1200 represent numbers of fires recorded from 1200 to 1249 A.D. Estimated fire frequencies before about 800 are of lower confidence because sample depth is low before this point.

MAKING CONTACT: WORKING WITH PEOPLE WHO AREN'T LIKE YOU

Lynn Lozier[1]

Abstract

Landowner contact has proven itself as a tool for natural area preservation. However, much of the material available on the subject deals more with the structure of such programs than with the process of working with landowners or the skills required. These skills have applicability not only to the work of those in landowner contact and registry, but also to land managers, negotiators, and others interested in making conservation happen with a wide variety of people. This presentation outlines useful groundwork for landowner contact, reviews processes of interaction and communication, touches on the important range of human character and temperament types, and focuses on techniques for establishing productive relationships with people who hold different values.

INTRODUCTION

Landowner contact, or "registry," programs were first characterized as a tool for conservation by Hoose (1981). An entire issue of the *Natural Areas Journal* was dedicated to the subject in July 1984. Programs vary, but most are focused on eliciting a commitment to voluntary protection from a property owner whose lands include one or more significant biological resources, typically rare species or communities. The structures of these programs have been described (Hilts and McLellan 1984; Hoose 1984; Lozier 1987), as well as their techniques (McFall 1984; Van Patter et al. 1990). Although case studies and anecdotal material, (Meyer 1982, 1984; Lozier 1988) have been available, these do not directly address the process of landowner contact or the skills needed to be effective.

This paper describes a workshop conducted to provide landowner contact/registry workers, and others, with some direction on not only *what* to do, but *how* to do it. It draws heavily on the fields of interpersonal communication and negotiation and includes references that may be of value to individuals interested in pursuing these subjects farther. The intention of this effort is to help the conservationist avoid common pitfalls and create the best possible environment for success by increasing awareness and developing skills.

Although they are presented in the context of landowner contact/registry, these materials have application in a broad range of circumstances. Dealing effectively with property owners or managers in other contexts, whether they be the neighbors of your local nature center, or fellow staff in a public agency, requires the same skills and perception.

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1. Lynn Lozier, Director of Landowner Contact, The California Nature Conservancy, 3152 Paradise Drive #203, Tiburon CA 94920.

THE PROGRAM

Three things set landowner contact/registry[2] programs apart from those using other conservation techniques. Although they are directed at private owners of significant biological resources, they do not involve payments or purchases. In addition, they are not legally binding and so require the establishment and maintenance of a long-term relationship. Most important, for both of those reasons, they depend on the *elective* decisions of *individuals.*

Goals of The California Nature Conservancy's
Landowner Contact Program

1. Assess the risk to the resource
   =*information gathering* on owner and site

2. Prevent inadvertent destruction
   =*information giving* about the resource

3. Encourage informed stewardship
   =*empowerment and reinforcement* of the owner

4. Position for future permanent protection
   =*relationship building*

You will note that for each programmatic goal there is a process noted in italics. To work with any individual you need to know whom and what you are dealing with, and they need to know what you want and why. From there you can encourage action and establish a mutually beneficial relationship. The material that follows is focused on these processes. This is the *how* of landowner contact.

2. Programs involving contact with private landowners and voluntary protection agreements have many local names. Some maintain a "register," an honorary listing of owners who have made an agreement. In most cases, there is a distinction between simply educating an owner, sometimes called notification, and eliciting a commitment, usually called registration. Hereafter, I will refer to the entire process, and the programs that engage in it, as landowner contact. It should be noted, however, that this process is integral to other land protection actions, often as a first step. This paper focuses on the portion of that spectrum that does not involve payments or legally binding contracts.

PREPARE YOURSELF PHYSICALLY:
Make a Good First Impression

Whether your first contacts with owners are by letter or phone,[3] the key is always to arrange to meet with them personally. Because voluntary protection agreements are held only by personal agreement, they require personal interaction.[4] For it to work, the worker has to feel confident that owners[5] understand the materials, and the owners have to feel comfortable with the organization they have agreed to work with. One way owners can do this is to evaluate that group's representative, the landowner contact worker. This is important to remember as you prepare for your meeting.

Think positive, but make a *neutral* first impression. First impressions cannot be taken back. You can save yourself a lot of grief by not using your landowner contact calls to make a "fashion statement." This is also not the place for your favorite piece of dramatic costume jewelry. At the same time, I do not recommend that you affect the local uniform, be it cowboy boots or pinstripes, unless it is part of your normal wardrobe and you are comfortable wearing it.

Some workers, particularly college interns and others who have had the luxury of dressing entirely to their own tastes, choose their clothing to tell the world who they are. They need to realize that when they make an owner call they are representing not only themselves but also their program and organization. The most knowledgeable and well-intentioned workers will get nowhere if owners do not take them seriously, or if their appearance makes it easy for owners to interpret them in stereotypical ways.

John T. Molloy, in his famous *Dress For Success* (1976), conducted controlled experiments on the effect of clothing on the reactions of sales "prospects." Molloy determined that the appearance of a person making a sales call had a dramatic and predictable effect on that person's success in getting the prospect's time and attention. That book, and those which followed (1977, 1985, 1988), are excellent reading. Although landowner contact is not limited to the corporate world, the tips, particularly on what *not* to wear, are timeless and enlightening.

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3. In preparing for any contact with an owner all of the principles here apply. This is true whether it be a letter, a phone call, or a personal visit. Pay special attention to the section entitled "Deal in Information, Not Judgments." Keep in mind also that the owners are going to want to know about your basic interests, as you are theirs.

4. First telephone conversations with owners can be particularly traumatic. Often the owner is unclear about who you are and what you want. They may be defensive or belligerent. A few suggestions follow: Remember that you are beginning a relationship. The longer you interact, the more likely it is that they will consent to see you personally. If they have something to say, be it about their love of nature, or their most recent conflict with "environmentalists," listen attentively. It will give you clues to their character and temperament and give you a sense of your starting point. Above all, be courteous and polite throughout and under *no* circumstances take offense. Give people the space to be who they are and you will know that your relationship has a sound basis.

5. In order to remain gender-neutral and still grammatically correct, the plural form of owner has been used whenever possible. This is not to imply that all, or even most, contacts involve multiple owners.

Cultivate a Respectful, Undramatic Appearance

In California I have found two comfortable "uniforms" to be effective and surprisingly versatile.[6] They are practical, respectful, and just professional enough to command attention without being intimidating. A sport jacket, plaid shirt, slacks or good jeans, and outdoor shoes will pass in an office and still function well in the field. The outfit can be easily be toned down by simply removing the jacket and turning back the cuffs of the sleeves.

I always wear leather shoes, which won't embarrass me in the field. My favorites are a moccasin-cut, oil-tanned leather with a sturdy grip sole. They can hold their own in the morning on a steep hillside, and still pass with slacks in an office later in the day. Athletic shoes, despite their comfort and utility, are so casual that they "dress down" anything else you wear, and in some environments, they are simply not respectful enough.

In very warm weather, and in southern California,[7] I wear well-pressed, pleated-front khaki slacks. In the winter, and in all rural areas, I wear *new*-looking, nondesigner blue jeans.[8] With either goes a long-sleeved[9] plaid[10] shirt in a coordinated color. Each outfit is topped with a traditional-cut sport coat, a blue wool tweed with jeans, a tan silk-blend tweed with khakis.

The sport coat is the most important part. For people who have never met me before, it says that I am a professional and that my time is valuable. In wet weather, I add a blue hooded rain shell that opens down the front.[11] I top it all with a sturdy canvas briefcase[12] trimmed in leather. I carry it without the shoulder strap, usually tucked under one arm.[13]

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6. The specific suggestions offered here are based on my own five years of experience doing landowner contact. Although I am a woman, I believe that this advice will hold equally well for either gender.

7. Molloy (1977 105-107) notes significant differences in how garments, and especially colors, are perceived in different parts of the country. My experience has been that lighter colors go over better in the southern part of my state.

8. They will keep their dark blue color for a long time if washed only in cold water and drip dried. As soon as they begin to fade, replace with a new pair for owner calls.

9. Long sleeves are more formal than short sleeves. They are also more versatile in that they can be turned up for comfort or, if necessary, to appear more casual. Be sure the shirt has a traditional pointed or button-down collar.

10. Plaids are unassuming and friendly. Pick one that is not so large that it overwhelms you or so bright that it competes with your jacket for attention.

11. Avoid over-the-head garments. They are awkward to take on and off and require you to empty your hands to do so. This can disrupt the flow of conversation.

12. A briefcase is a symbol of professionalism. A backpack is likely to suggest a college student, or even a vagrant. Remember, we're talking first impressions.

13. Avoid "city-slicker" hard-side cases, which must be placed in your lap or on the table to open. With these you lose the "bag of tricks" suspense, as well as the ability to control the flow of information.

Learn to be an Active Listener

Another aspect of preparing yourself physically for your meeting with the landowner is dynamic. You must learn to be an active listener. A great deal has been written about body language since Julius Fast's book, *Body Language* (1970). Most focus on the more dramatic aspects of nonverbal communication, particularly courtship, but recently there has been more attention to body language in business (Molloy 1985).

Unconsciously sending the "wrong," or conflicting, nonverbal messages is a common pitfall of interpersonal communication. At the same time, the worker who is not fluent in body language will miss a lot of valuable information by not being able to interpret the messages the owner is sending. This is particularly important because, for most people, body language is unconscious. They can be telling you things they may not intend to, or even more importantly, they may be communicating reservations *they* are not even aware of.

Nonverbal communication skills come more naturally to some people than to others. However, we know that they can be learned. Anyone who has taken a workshop in public speaking, negotiation, or even in being interviewed has heard about recognizing individual distance, leaning forward, making eye contact, nodding, lifting the eyebrows in an "open face," "steepling" with the fingers to indicate interest and attention, and "mirroring" the gestures and postures of others. You should be familiar with these techniques and proficient in using them.

The keys to the effective use of body language are perception and comfort. Almost everyone already has some unconscious fluency. Pay attention to it so that it becomes a tool that you can use deliberately. Practice in environments where you are comfortable, at home or with friends, until it comes easily. As always, be perceptive. Are you "saying" what you want to? Get some feedback.

Nonverbal communication is one of your strongest tools in landowner contact. As you begin a conversation with someone new, you will have to constantly evaluate how you are doing by the verbal and nonverbal responses you receive. Remember that, unlike most of the contacts you have in your personal life, you may have very little in common with these people to start. They didn't initiate the contact, and they don't know what to expect. You will have to lead. Be sure to *look* and listen as you do so.

Very shy people may appear hostile simply because they lack the confidence to interact. They can be drawn out by lowering the voice, cutting down on the frequency and duration of eye contact, and asking simple nonthreatening social questions that any guest might be interested in. It is usually safe to inquire about how long they've lived there, whether they like it, and if so, what they enjoy about it. Subjects that reflect your astute perception and the owner's obvious pride, such as a well-kept garden or the family pets (only if *you* like animals), are also good bets.

Be careful not to interrupt timid speakers and to offer plenty of encouragement in the form of nods, "a-huhs," etc. In extreme cases this may seem like playacting, but you have to remember that you may be dealing with someone who has few opportunities for social contact and may simply be out of practice. By all means accept anything offered (short of a cigarette or alcohol if you don't indulge). Food and drink are timeless symbols of hospitality and excellent opportunities to begin a relationship. You are missing a chance to make a valuable social bond if you turn one down simply because you don't feel like it.

PREPARE YOURSELF MENTALLY
Recognize That People Are Different

One thing that is clear to anyone who has worked in a landowner contact program is that every owner is different. For many new workers, owners contacted through their programs represent the most diverse group of people they have ever interacted with. In any case, you undoubtedly will meet people who hold different values and different views of the world. To interpret their words and actions entirely from your own perspective simply will not work. You cannot assume that others see things as you do. However, just because you are different doesn't mean that you can't work together or come to an agreement.

I strongly recommend that you read David Keirsey and Marilyn Bates' *Please Understand Me: Character and Temperament Types* (1984). It is a taxonomy of human approaches and responses to the world. Answer the 70 questions in the "Keirsey Temperament Sorter" and you will see how the way you view the world, how you take in and interpret information, what you consider important or significant, and the value you do or do not place on it come together to help to define your particular type of character and temperament. The rest of the volume will help you learn to recognize other types and to understand how they differ from your own.

There Are Many Kinds of People
Recognize the Differences and Make the Most of Them

– Many people are very *sociable*,
while others are *reserved* and *territorial*.

– Most folks work from *past experience*,
but some use *speculation* and *imagination*.

– Some hold objective *standards* and *principles*,
and some feel strongly about *personal values*.

– To some it is important to *reach a decision*,
and others prefer to be *flexible* and *adaptable*.

Some folks who work effectively with a broad range of people seem to come by it naturally. They may not even be aware that they are making mental decisions or drawing on past experience. However, you don't have to be a "natural" to be effective if you take the time to learn about how other, different people operate. The beauty of the Myers-Briggs Type system, described and adapted by Keirsey and Bates, is that it recognizes the value of intuition and puts it in a perspective that is accessible to those of us who weren't born with it. Intuitive folks will also benefit from learning about why other people operate the way they do.

The take-home message in understanding and being understood is that there is no right and wrong, no good or bad. There is only *different*. Learning about those differences will help you to accept them, the most important first step in gaining someone's confidence and respect. Beyond that, familiarity with the patterns will help you to recognize them in your contacts and *tailor* your interactions to focus on those approaches and techniques that are most likely to be effective with the people involved.

Bring Energy to Your Meeting

Immediately before a first meeting with an owner, take the time to prepare yourself mentally. If possible, stop your car somewhere quiet. Clear your mind of other things. Review your goals and materials. Don't overdo it. Just remind yourself of what you'd like to communicate and what you hope to accomplish.

The most important thing you can bring to a first contact, after information, is energy. You asked for the meeting. You will be expected to supply the energy. This is not to suggest that you must be a cheerleader, although your personal enthusiasm is often very persuasive. It does mean that if you are very tired, preoccupied, or otherwise diverted, you will be less likely to engage the interest of the owners or to inspire them to make a commitment. This is an important consideration in planning your schedule.[14]

Give yourself a pep talk and focus your attention and energy on the subject at hand. In particular, concentrate on being *open* and *perceptive.*

DEAL IN INFORMATION, NOT JUDGMENTS

This sounds easy, but it may be the hardest part of learning to work with landowners. The principles are the same as in any negotiation. Roger Fisher and William Ury, in their beautiful little volume *Getting to Yes: Negotiating Agreement Without Giving In* (1985), describe this step as "separating the people from the problem." You may be concerned that a species is threatened by activities the owner is participating in – grazing, stream impacts, planting exotics, etc.. Don't focus on the owner, focus on your concern. The species is declining; certain land use practices are implicated. You are hoping to find ways to reduce or prevent this decline.

Fisher and Ury (1985) also emphasize the importance of "insisting on objective criteria." Since Nature Conservancy and state-run landowner contact programs are driven by objective information from state Natural Heritage programs (Hoose 1981), we have a unique advantage. We can go to owners with the most complete information available,[15] material that is already a matter of public record. On this basis we can objectively communicate the conservation status of a species or community. It is very

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14. Three new owner contacts a day is tops for me. It is not a pace I can sustain for more than two or three days and still maintain an acceptable energy level.

15. Owners are sometimes suspicious of information they think may have been acquired through trespassing. Although it isn't always possible to know where a particular site record came from, I can usually offer some reassurance. It may have been submitted by a college professor who had permission to visit, or the record may reference plants visible from a public road. In the most ambiguous cases I look for a historical record that precedes the tenure of the current owner. Specimens sent off to a distant university for identification fifty or even a hundred years ago from the *vicinity* are usually enough to reassure an owner. Most of the lay public is unaware of the magnitude or the persistence of research herbaria.

persuasive to be able to tell an owner that he or she owns one of only four sites known to remain for a species in the state, or in the world!

Provide Your Information Objectively

Props help. Some landowner contact programs prepare custom-made packages of information in lay language for each owner (Lozier 1987). These useful references relieve owners of the burden of immediately understanding and remembering everything they are told about the biological resources on their property. It also makes it possible to hit just the high points. Avoid the temptation to fill the time by overwhelming the owner with technical information.[16]

This folder is introduced early in the conversation. With maps and photographs, it serves to impress owners with the organization's professionalism. Once the owner knows that it will be left with them, they can focus on the conversation. This is important, because you want the flow of information to go *both* ways.

Take in Information Objectively

Unlike a traditional acquisition, voluntary protection does not involve money. However, it is still very much a negotiation. This makes it essential to learn as much as possible about the owners and their land. Fisher and Ury (1985) call this step "focus[ing] on interests, not positions," and note that "the most powerful interests are basic human needs." They list five:

* *security*
* *economic well-being*
* *a sense of belonging*
* *recognition*
* *control over one's life*

Landowner contact has the capacity to provide for three of these interests. All programs are designed to give an owner recognition, and most also help to supply a sense of belonging. The empowering aspects of voluntary protection apply directly to control over one's life. Be especially alert for indications that the owners may have one or more of these interests.

There are as many different kinds of interests as there are people, and most folks have multiple interests. Listen carefully to everything the owner says.[17] In addition to being critical to your work, it is a respectful way to treat a person with the potential to make a very valuable conservation

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16. The purpose of the packet is clearly spelled out in the third paragraph of the cover letter:

> *This booklet has been prepared with you in mind, to share what we know about the rare features on your property. We hope that it will help you to understand the special needs of the site and its rare species; why it is so rare and how it can be protected for the future.*

It is important to make your interests, your reasons for making the contact, clear up front.

17. With potentially belligerent owners it is very important to remain positive. Don't take the bait. Don't let them get to you. In those cases, I find it helpful to think of myself as a matador. Each time the bull charges, you deftly step aside. However, you have no intention of sticking him, and eventually he will tire out and be ready to talk. By then you will have proved that your intentions are friendly.

commitment.[18] Draw them out with verbal active listening. Repeat their points and explore the reasons with them. Remember, what they say they want may be a position rather than an interest. To identify the interest, you need to know *why*.

You will never know what their interests are if you aren't perceptive and if you don't take in information nonjudgmentally. Be careful with your body language. If you are passing judgment, they will perceive it and be less responsive. Reasons that might appeal to them for protecting rare species may have no meaning for you. If you judge them, you'll miss them.

Interpret Interests in Light of Owner Characteristics

As you talk, look also for *clues* to the character and temperament of the owners and to the values they hold. This is where you will weigh what you have learned about their interests against the kind of people you perceive them to be. What arguments they find persuasive *will* vary with who they are and how they view the world, as well as with the interests they have. Conservation workers tend to lean heavily on economic arguments for the preservation of the tropical rain forests in convincing others, even though their personal values may be very different (Murray 1990). You must get beyond your *assumptions* about what motivates people and customize your approach for each owner in order to be effective. What you have learned about the owners, their interests and their characters and temperaments, will be the currency of your negotiation.

Keep in mind that you want a broad view of each property and its owner. It is important to learn about not only what you might view as positive (if you were to judge, which you should not), such as a person's love of the land, long family history, etc., but also things that you might view as contrary to conservation potential. These might include economic conflicts, the declining profit in ranching operations, increasing age of the owners, or plans for changes in land use. Identify the interests here. To develop a relationship, you will need to get all the cards on the table. Don't *assume* anything!

EXPLORE OPTIONS
Empower the Owner

Up to this point, you have been working on the first two goals of landowner contact: information gathering and information giving. In order to create an environment in which something positive can happen, it is necessary to empower the owner. The cover page of the owner's packet used by California Nature Conservancy's Landowner Contact Program is a letter. The first paragraph reads as follows:

> Certain places in our state support plants, animals, or natural communities which are so rare, threatened, or endangered that the decision about whether they will survive for the future or disappear from the face of the earth can fall to a single individual – you, the landowner.

It is critical that the owner understand that what they have the capacity to do is unique. Many people find it hard to believe that they may own one of only a few sites in the *world* for an endangered plant or animal. Even when I have told them several times, it takes them a while to get it. Few people ever

18. I have met several owners of important rare plant sites who have been deeply offended by the conservation suggestions of knowledgeable visitors. The comment I hear from these owners is, "they wanted me to give my land away!" To some folks this was a slap in the face. Not only were their interests not considered, but the implication was that the plants would be better off if they no longer owned them!

have the opportunity to do something with such "cosmic" significance. This is the reason that landowner contact work has been described as quietly evangelical.[19]

Get the Owner to Work with You

Once the groundwork has been laid, if you haven't already been asked,[20] it is time to solicit a protection commitment from an owner. It is important to do this in a nonjudgmental way in order to maintain the new relationship, as well as to look for options if there are conflicting uses to be resolved. You should have made a good case for the biological needs, and you should have a some insight into the owner's interests. This takes you to what Fisher and Ury, in negotiation parlance, call "invent[ing] options for mutual gain" (1985).

In voluntary agreements, the key is to *ask*, not tell. You could begin by asking owners what could be done to meet a specific conservation need on the ground. This way they are, indeed, empowered. For less talkative owners you might think of something specific (fencing or whatever), and ask if it would be possible. Try not to be pushy. Ask them what they would consider and give them the time to think, and talk,[21] about it. If you don't receive a positive answer, then you need to find another question to ask. When you get to this point, you have already established something valuable – a relationship.

Once you empower owners, you have to follow through. You can't just turn around and then tell them what they must do. Give them some ideas and, using what you have learned about them already, *help* them find their *own* reason to participate. I have had owners commit to voluntary protection agreements and changes in management activities for a variety of reasons. All were very personal. They ranged from community pride to the desire for a cure for cancer. Interestingly, in several cases the owners told me that they were not convinced that the species was truly as rare as I believed it to be, yet they still participated. Logic didn't move them, but empowerment did. At this point, the toughest thing to do is *not* look surprised!

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19. It is very important that you believe in the owner's capacity to act in positive way. Some people achieve to the level of expectation. Still others have so little self-confidence that they will need your support to act. Even those whom you might perceive as unethical may behave in a positive way to meet their need to belong in their community. Anticipating and adapting to these differences are why it is so important to learn to perceive not only an owner's circumstances but the kind of person they are as well.

20. Some folks will be so excited, and empowered, that they will ask you about how the resource could be protected. With others you will have to raise the question gently yourself. These differences are likely to be much more a reflection of varying personality and temperament types than of the nature of the owner's interests. Don't make the mistake of assuming that the person who has to be asked will be any less committed. Be perceptive, and use your understanding of nonverbal communication to decide how to approach this question.

21. At this point you will be helped immensely by a familiarity with Keirsey and Bates' Character and Temperament types. Some people need to talk through new ideas. Others won't verbalize until they have figured out where they stand in their own minds. They may feel pressured if expected to respond before they are ready. Obviously you would treat these people differently.

BUILD THE RELATIONSHIP

Provide Lots of Positive Reinforcement

A key feature of landowner contact work, and one of its four goals, is relationship building. When owners consent to voluntary protection agreements, you have a structure through which to encourage and support them.[22] Most programs have a structured system of feedback, which may include the presentation of a plaque, local publicity if desirable, a personal letter from the director, honorary membership in The Nature Conservancy, and regular, usually annual, contact with the worker.

It is important to continue to place their commitment in a broader conservation *context*. Keep them informed, either through your state newsletter or a separate mailing, about others[23] who also commit to voluntary protection and about the continued importance of their participation. Include information on opportunities for permanent forms of protection such as conservation easements, etc. In California, registry owners receive VIP invitations to the dedication celebrations on new preserves, as well as to the annual meeting and picnic.

Be Accessible and Responsive

Continue to express your respect by taking the time to deal with these people when they contact you. Most owners become well informed about the organization and are remarkably restrained in their demands on staff time. You are counting on them to do an important job. If they need you, it is your responsibility to respond. This accessibility will pay off in future upgrades of protection status. It is important that these folks be comfortable contacting you if they plan to sell or transfer their property. You will also want to know when they need help with estate planning or wish to discuss a gift or easement.

Interestingly, the relationship that you initiate when you contact a property owner is significant even when the owner does not consent to participate in voluntary protection. If you agree to disagree, without being judgmental, you leave the door open. I have had owners agree to register two and three years after my first contact.[24] Some people need more time than others to get used to the idea. Other owners who would not agree have actually used the presence of rare plants on their property as a selling point! The subsequent owners, in these cases, have been more interested in those biological resources than their predecessors.

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22. As noted earlier, this serves a *basic human need* for recognition.

23. This serves the need for a sense of belonging.

24. I am not usually able to actively pursue agreements into a third year. However, if there are other protected sites in the area I will check in when I come through. Your continued, respectful interest in their biological resources can sometimes win over owners.

IMPROVING YOUR SKILLS

The combination of information giving, information getting, analysis, interpretation, synthesis, and imagination needed to make the most of an owner contact is learned only by doing. Developing the ability to interpret different kinds of people, perceive and utilize the subtleties of body language, while at the same time adjusting pace and tone, and deciding on direction sounds like a pretty tall order. Fortunately, like many dynamic activities, it is a lot easier to do than to describe.

I strongly recommend that you use role playing as a tool to develop and hone your skills. This is especially true for those who are new to the job. As tough as it is to be "on the spot" in that way, getting through it will increase your confidence immensely and make you much more comfortable and capable. Role playing with a good observer will also help the "old hand" identify missed opportunities and eliminate idiosyncrasies. Either way, its a great opportunity to get even better with practice.

Practice and Have Fun

You can use an entirely hypothetical interaction or one from your own experience. One useful variation is to take the part of the person you expect to be meeting. That way you explore how you think they might react and how you would respond to those reactions. Even if you don't have a partner knowledgeable enough to play your part, it isn't difficult to find, at home or in the office, people who are willing to play themselves. Just call them landowners.

ROLE PLAYING IS EASY

Choose Roles.....one owner and one contact

Set a Time Limit....begin with five minutes

Have a Conversation.....make up details as you go

Stay in Character..........you'll survive!

Have a Good Laugh...........then compare notes

Be *positive.* Ask yourselves who was an active listener. How could you tell? What techniques worked? How did you adjust to the feedback you received? How was your concentration? Did your partner understand the information you wanted to communicate? Finish debriefing and then pick up the conversation where you left off or begin another one.

Eventually you should ask yourself questions that bear directly on the goals of landowner contact work: What kind of information did you gather about the site? about the owner? Did you identify interests, or positions? Were you able to suspend judgment? How was your timing? Did the owner feel empowered, or a little bit rushed? Experience gained in role playing translates directly into skills and confidence in the field. It is well worth doing.

CONCLUSION

To work effectively in landowner contact, you must have strong communication and negotiation skills. In addition, you must be able to deal with interests and people nonjudgmentally. An owner who feels empowered to participate in the protection of an endangered species is a valuable ally. The process, skills, and perception used to involve that owner can also be applied to elicit cooperation and assistance from others in the service of conservation. Public servants, neighbors, and coworkers will respond to this respectful, interest-oriented approach.

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REFERENCES

Fast, J. 1970. *Body Language.* New York: Simon and Schuster.

Fisher, R., and W. Ury. 1985. *Getting to Yes: Negotiating Agreement Without Giving In.* New York: Penguin Books.

Hilts, S.G. and P.W. McLellan. 1984. A Landowner Contact Pilot Project in Ontario. *Natural Areas Journal* 4(3)22-25.

Hoose, P.M. 1981. *Building an Ark: Tools for the Preservation of Natural Diversity Through Land Protection.* Covelo, CA: Island Press.

_______. 1984. Features of The Nature Conservancy Registry Programs. *Natural Areas Journal* 4(3)26-28.

Keirsey, D., and M. Bates. 1984. *Please Understand Me: Character and Temperament Types.* Del Mar, CA: Prometheus Nemesis Book Company.

Lozier, L. 1987. The California Nature Conservancy's Landowner Contact Program: Voluntary Protection for Rare Plant Sites. In T.S. Elias ed., *Conservation and Management of Rare and Endangered Plants: Proceedings from a Conference of the California Native Plant Society*, pp. 567-571. Sacramento, CA: California Native Plant Society.

_______. 1988. Private Landowners Protect Rare Plants. *Fremontia* July:13-15.

McFall, D. 1984. Six Years of Landowner Contact in Illinois. *Natural Areas Journal* 4(3)15-21.

Meyer, L.S. 1982. Illinois Landowner Contact Program – A Personal Point-of-View. *Natural Areas Journal* 2(1)3-6.

_______. 1984. Landowner Contact – A New Profession for Natural Area Preservation. *Natural Areas Journal* 4(3)6-14.

Molloy, J.T. 1976. *Dress For Success*. New York: Warner Books.

_______. 1977. *The Woman's Dress For Success Book*. New York: Warner Books.

_______. 1985. *Live For Success*. New York: Warner Books.

_______. 1988. *The New Dress For Success*. New York: Warner Books.

Murray, M.G. 1990. Conservation of Tropical Rain Forests: Arguments, Beliefs and Convictions. *Biological Conservation* 52:17-26.

Van Patter, M., H. Geerts, and S. Hilts. 1990. Enhancing Private Land Stewardship. *Natural Areas Journal* 10(3)129-133.

Grizzly Bear (top), Polar Bear (Center), Black Bear (bottom)
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ANIMAL POPULATION RESTORATION: MANIPULATING FOR NATURALNESS

INTERAGENCY COORDINATION AND THE RESTORATION OF WILDLIFE POPULATIONS

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Abstract

*Interagency coordination is an extremely important, but often overlooked, aspect of wildlife restoration efforts. In the Sierra Nevada of eastern California, a model example of interagency coordination has resulted in the restoration of mountain sheep to three historical ranges from which they had been extirpated. The restoration of mountain sheep to the Yosemite ecosystem is used to exemplify the importance and desirability of interagency coordination. Predator control, in an effort to salvage a declining population of mountain sheep (*Ovis canadensis californiana*), was facilitated by the close working relationship and common objectives of those agencies working to restore mountain sheep to formerly occupied historical ranges. Interagency coordination not only is desirable; it is essential if wildlife restoration programs are to be successful.*

INTRODUCTION

Translocation has been described as, "the release in a new location of free ranging animals that come from anywhere other than the place in which they are released" (Caldecott and Kavanagh 1983, 185). Indeed, translocations are becoming increasingly common (Boyer and Brown 1988), and are carried out for a multitude of purposes (Nielsen 1988), particularly the restoration of populations of wild animals to lands from which they have been extirpated. Translocations are, in fact, such a commonplace wildlife management option that a recent book (Nielsen and Brown 1988a) is dedicated exclusively to the subject, with the overall objective of enhancing the success of future translocations (Nielsen and Brown 1988b).

Nielsen (1988) provides a substantial list of recommendations that should be followed when carrying out wildlife translocations. Although Nielsen (1988) emphasizes proper planning and preparation, and notes the need to obtain necessary permits, licenses, and authorizations, the role of interagency coordination is not addressed. The purpose of this paper is to use the translocation of mountain sheep (*Ovis canadensis californiana*) to the Sierra Nevada of California to (1) emphasize the importance of interagency coordination, (2) explain the role of private organizations in the success of these

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translocations, and (3) provide an example of how agencies with widely differing management philosophies have worked together to ensure the success of their efforts to reestablish mountain sheep on historical ranges in eastern California.

BACKGROUND

Mountain sheep historically inhabited the Sierra Nevada in eastern California, and occurred from Jawbone Canyon, near Mojave, Kern County, to Sonora Pass, Mono County. Thus, they presumably were widespread in the Sierra Nevada, and apparently occurred where rocky terrain and suitable winter range existed in close proximity (Wehausen 1980).

Mountain sheep were nearly extirpated from the Sierra Nevada during the late 19th and early 20th centuries; in fact, only two populations remained by the 1970s. In 1971, sanctuaries, in the form of U.S. Forest Service (USFS) Zoological Areas, were established in the vicinity of these populations (Dunaway 1971) and, shortly thereafter, the California Fish and Game Commission classified the subspecies *californiana* as Rare (later changed to Threatened) (California Department of Fish and Game [CDFG] 1974). Simultaneously, the desirability of reestablishing mountain sheep populations in the Sierra Nevada. Ironically, that was the only published call for the reintroduction of mountain sheep populations in California prior to the passage in 1986 of Assembly Bill 3117, which authorized a limited harvest of desert-dwelling mountain sheep (*O. c. nelsoni*) in California for the first time since they were legally protected in 1878 (Wehausen et al. 1987).

INTERAGENCY COORDINATION

Translocation of wild animals often is complicated by the fact that state wildlife agencies (e.g., CDFG) traditionally retain the responsibility for population management, and land owning agencies (e.g., Bureau of Land Management [BLM] and USFS) traditionally retain the responsibility for habitat management. Thus, in almost every instance, close interagency coordination is necessary to ensure the successful translocation of wildlife. The matter, however, is complicated further by the requirements of the National Environmental Policy Act: decisions affecting federal lands must be addressed in either an environmental assessment (EA) or an environmental impact statement, depending on the magnitude of the proposed action. Presumably, Nielsen (1988) was alluding to the differing roles of state and federal agencies, as well as the environmental review process, when he advocated obtaining appropriate permits, licenses, and authorizations.

The translocation of mountain sheep in the Sierra Nevada is further complicated by complex land ownership patterns. Along the east side of the Sierra Nevada, the floor of the Owens Valley is owned largely by the Los Angeles Department of Water and Power (LADWP). A band of land managed by BLM occurs on either side of the valley floor, and above that lie lands managed largely by USFS (Inyo National Forest). To the west of the Sierra Crest are found Yosemite, Kings Canyon, and Sequoia national parks, as well as several national forests.

Much of the suitable summer range for mountain sheep lies west of the Sierra crest, either in the national parks or on lands managed by USFS. The management objectives of the National Park Service (NPS) differ somewhat from those of multiple use agencies in that the primary objective is to restore and perpetuate the natural processes and inherent integrity of the natural resources of national parks. In contrast, USFS and BLM adhere to multiple use policies, whereby conservation, in lieu of preservation, is an important management objective. Although lands managed by LADWP lie primarily below the mountain sheep range, their role, and that of other landowners, in the translocation of mountain sheep within the Sierra Nevada has been an important one. Finally, CDFG must work within the management guidelines of all of these agencies.

By the 1980s it was apparent that the management of mountain sheep in the Sierra Nevada was an important issue. In 1979, the formation of an interagency management team was recommended (Wehausen 1988) and, at the request of the Director of CDFG, such an organization was formalized in 1981 (Keay et al. 1987). The group consisted of biologists affiliated with the aforementioned agencies and the University of California. Working within the constraints of their agencies, members of this group realized the need to reestablish as many populations of mountain sheep in the Sierra Nevada as was feasible. Thus, the Sierra Nevada Bighorn Sheep Interagency Advisory Group (SNBSIAG) began to meet annually, and in 1984 it produced a Memorandum of Understanding (MOU) that was signed by administrators from USFS (Inyo National Forest), NPS (Sequoia, Kings Canyon, and Yosemite national parks), and CDFG. That MOU identified the need for, and made a commitment to, cooperation and coordination between the agencies. Moreover, it outlined specific agency responsibilities regarding mountain sheep habitat management and population management in the Sierra Nevada.

Pursuant to completion of the MOU, SNBSIAG (1984) completed the Sierra Nevada Bighorn Sheep Recovery and Conservation Plan. That plan identified three primary objectives: (1) ensure the health of the two remaining native populations, in order to provide reintroduction stock for future translocations and to preclude extirpation of the subspecies from the Sierra Nevada; (2) establish, via translocation, at least two additional, isolated large populations (> 100 animals); and (3) translocate mountain sheep to all former ranges within the Sierra Nevada from which they had been extirpated, where it was ecologically, politically, and economically feasible. A total of three sites that conceivably would support large populations were identified, as well as five other sites that would support smaller populations (SNBSIAG 1984). Two sites, Lee Vining Canyon and the Great Western Divide, involved NPS to a large degree; sheep translocated to USFS lands in Lee Vining Canyon hopefully would summer west of the Sierra Crest, in Yosemite National Park (YNP), and sheep translocated to the Great Western Divide would spend their entire annual cycle within Sequoia National Park. Ultimately, the decision was made to translocate sheep to Lee Vining Canyon because (1) it would create a large, isolated population in the central Sierra Nevada, and (2) the YNP master plan called for the reestablishment of this extirpated subspecies (Keay et al. 1987).

RETURN OF MOUNTAIN SHEEP TO YOSEMITE

In March 1986, 27 mountain sheep were translocated from the Mt. Baxter population, located near Independence, Inyo County, to Lee Vining Canyon, Mono County. Keay et al. (1987) provided a detailed history of the events leading directly to that translocation. It is important to note, however, that not one hoof could have clattered up Lee Vining Canyon had it not been for the high level of communication and interagency coordination among all concerned parties. The translocation was facilitated by (1) the wildlife management goals of CDFG and NPS; (2) the understanding and cooperation of a grazing permittee; (3) the cooperation of landowners, LADWP and the Southern California Edison Company, with the decision reached by USFS in an EA; and (4) the willingness of the Sacramento Safari Club and the Yosemite Association to seek and commit funds.

As a result of intense monitoring, the demography of the Lee Vining population is well known; 13 of the original 27 animals died within a year of the initial translocation (primarily of malnutrition associated with winter storms) or were killed by mountain lions (*Felis concolor*), and five animals moved to Bloody Canyon, 13 km south of Lee Vining Canyon. By 1 December 1987 only five reproductively aged females remained in Lee Vining Canyon (L. Chow and P. Moore, unpublished data).

Again, substantial interagency coordination was needed to determine whether the herd should be augmented. A second translocation would reduce a subpopulation of the Mt. Baxter herd to fewer than 52 adult females, a minimum level that SNBSIAG previously had agreed would be maintained. It would also delay the planned translocation to the Great Western Divide by at least two years to allow the Mt. Baxter population to recover. This decision would affect all three national parks, USFS, and CDFG. Through SNBSIAG, the concerns of all affected agencies were discussed, and the agreement was made to translocate a maximum of 10 adult females and up to 10 rams to the faltering Lee Vining population. Simultaneously, SNBSIAG determined that it was in the best interest of that population to remove any mountain lions that had killed mountain sheep. As a result of these decisions, seven adult females, one yearling female, and three rams were translocated to Lee Vining Canyon in March 1988 (Bleich et al. in press).

PREDATOR CONTROL

The decision to translocate additional sheep to Lee Vining Canyon was a critical one for both the Mt. Baxter population and the Lee Vining Canyon population. Moreover, the agreement to move sheep in 1988 was contingent upon a plan to protect mountain sheep in Lee Vining Canyon from predators.

Mountain lions have accounted for numerous losses to the Lee Vining Canyon population (Chow et al. 1988). At the time of the initial translocation, predator control was not considered to be necessary; in fact, the subject never was considered because it was (incorrectly) assumed that the mountain lions would be absent in winter, when mule deer (*Odocoileus hemionus*) migrated eastward into Nevada. However, as the population size plummeted, first as a result of stochastic events, then from predation, it became evident that the loss of even a single animal was critical to the survival of the translocated population. Demography suggested that this population was caught in a "predator pit" in which recruitment was negative and a population decline was inevitable (Van Ballenberghe 1987, 454).

Because of differing agency policies and the controversy over mountain lions that was then aflame in California (Mansfield 1986, Mansfield and Weaver 1988), much discussion took place among SNBSIAG. However, the agencies were able to work together toward the common goal of establishing the Lee Vining population. In concert with management policies for NPS to restore and protect natural resources, the superintendent of YNP authorized the pursuit and take of depredating lions that entered the park after pursuit began. Clearly, that decision was in keeping with what Peek (1981) referred to as preserving (in this case, first restoring) natural dynamic processes in national parks. In order to restore a large, native ungulate to the Yosemite ecosystem (and, hence, the natural integrity of that ecosystem), it temporarily was necessary to alter ongoing "natural" processes in an effort to maximize the probability of the success of the translocated mountain sheep population.

Thus, in 1987, a limited program of removing lions that had preyed on mountain sheep began. In 1988, following the loss of two additional sheep to mountain lions, the policy was expanded to include the removal of any lions detected in Bloody Canyon, Lee Vining Canyon, or Lundy Canyon. This change was based on the precarious status of the translocated population, as well as of mountain sheep in the Sierra Nevada, in general. Mountain lions are major predators of mountain sheep in the Sierra Nevada, substantially reducing the availability of translocation stock from the Mt. Baxter population and probably controlling the Mt. Williamson population (J. Wehausen unpublished data).

Mountain lions are abundant in the Sierra Nevada, and readily colonize vacant habitats. In contrast, mountain sheep are absent from the majority of their pristine range in the Sierra Nevada, and are poor colonizers. Removing lions to ensure the reestablishment of mountain sheep in Lee Vining Canyon clearly was in the interest of managing for an intact ecosystem, including both prey and predators. To date, a total of three mountain lions have been removed from the vicinity of Lee Vining Canyon. Once the population has reached a size capable of maintaining itself in the presence of predation, lion control will be terminated.

CURRENT STATUS

Approximately 330 mountain sheep inhabit the Sierra Nevada. P. Moore and L. Chow (unpublished data) recently determined that a minimum of 42 individuals composed the Mt. Langley population, a population that was established on historic range in 1980 and augmented in 1982. In 1986, L. Brown and R. Ramey (unpublished data) accounted for a minimum of 34 animals in the Wheeler Crest population, established by translocation in 1979 and augmented in 1980, 1982, and 1986. The Lee Vining population potentially consists of 47 individuals, and 4 remain in Bloody Canyon, 13 km to the south (L. Chow and P. Moore, unpublished data). Of the two native herds remaining in the Sierra Nevada, the Mt. Williamson herd remains static at approximately 30 individuals, and the Mt. Baxter herd contains about 150 individuals (J. Wehausen, unpublished data). Thus, the number of populations of mountain sheep in the Sierra Nevada has been increased by 150 percent since 1979, and the total number of individuals has increased by about 35 percent.

Pending an increase of the Mt. Baxter population to a level that will allow for additional removals, plans have already been completed to translocate mountain sheep to the Great Western Divide of Sequoia National Park. The completion of the management plan and the subsequent EA laid the groundwork for that future translocation. Assuming that no extant populations suffer major declines in the Sierra Nevada, mountain sheep probably will be translocated to the Great Western Divide sometime during the 1990s, and possibly to other previously identified locations in the Sierra Nevada (SNBSIAG 1984).

CONCLUSIONS

The restoration of mountain sheep to three areas of the Sierra Nevada is a noteworthy example of interagency coordination. It began with a sound data base, and has been affirmed with the formal commitment of concerned agencies to work toward the return of mountain sheep to those areas of the Sierra Nevada where translocation is ecologically, politically, and economically feasible. Further, a comprehensive management document has been prepared and actions have been initiated according to the plan.

In California, the translocation of mountain sheep to historic ranges is a stated objective of the California Department of Fish and Game (CDFG 1983) and, in fact, is mandated by state law (see Wehausen et al. 1987). Since 1970, efforts have been made to restore 13 historic populations of mountain sheep (Bleich et al. in press), and only two are known to have been entirely unsuccessful. Translocations are extremely expensive undertakings (Bleich in press) and those who support such efforts, be they taxpayers or sports enthusiasts, deserve prudent and fiscally responsible actions by management agencies. Prudent decisions and fiscal responsibility are inherent in close cooperation and good planning.

Not all mountain sheep translocation efforts in California have gone as smoothly as those that have been carried out in the Sierra Nevada. A major area of concern has been the difficulty for managers to undertake translocation projects, or to trap mountain sheep, within wilderness areas or wilderness study areas. For example, a former supervisor on the Angeles National Forest stated that he, ". . . would not compromise the integrity of the Sheep Mountain wilderness . . ." by allowing wheeled vehicles to utilize an existing road that is used on a daily basis by a crew operating a mine inside the wilderness boundary. In fact, the trapping site for that project was located on the claims of the mine operator, who had volunteered his heavy equipment to prepare the site for the use of a drop net. Much to the consternation of those involved in the translocation, approval was given to land a helicopter at the trapsite, in order to facilitate the translocation. Costs of the project were extremely high relative to other projects (Bleich in press), but the translocation was successfully completed. The capture occurred as bulldozers and ore trucks operated a few meters from the trapsite.

In another case, a BLM wilderness specialist, providing input to an environmental assessment for a translocation of mountain sheep to the Bristol Mountains, San Bernardino County, wrote that the presence of mountain sheep would ". . . not enhance wilderness values . . ." in the Bristol Mountains, and recommended denial of an application to develop a water source that would allow a translocation to occur. The BLM resource area manager denied approval of that project, even though it would have facilitated the restoration of a large native herbivore to an area from which it had been extirpated, likely as a result of human activities. Although the resource area manager adopted the wilderness specialist's recommendation, the district manager sought additional information and, ultimately, approval was given for the project to proceed. Plans are now being finalized for that effort, and the subsequent translocation of mountain sheep to the Bristol Mountains.

Keay et al. (1987) concluded that, as biologists, our obligation to the resource must continue to be to (1) develop the scientific knowledge, (2) identify resource needs, (3) generate sound management programs, and (4) present recommendations to administrators in an effective way. Further, we would emphasize involving private organizations, wherever possible, because of their intense and sincere interest in those activities for which they are advocates. It is entirely possible that the Lee Vining translocation would not have occurred, were it not for the efforts of the Yosemite Association and the Sacramento Safari Club.

Finally, as stated by Keay et al. (1987), "Cooperative programs, in spite of the obvious obstacles, often provide the best possible information for the manager. We must step beyond the boundaries of our respective agencies and work together to achieve common goals." The successful management program for mountain sheep in the Sierra Nevada exemplifies that commitment, as well as the importance of interagency coordination, in translocation projects. All ongoing mountain sheep management programs in California are based on that premise, as are ongoing translocation programs for other wildlife species including pronghorn (*Antilocapra americana)* (Pyshora 1987; Goldsmith 1988) and elk (*Cervus elaphus nannodes)* (Koch 1987; Gogan and Barrett 1988). Ultimately, interagency coordination will account for the success or failure of wildlife translocations: its importance cannot be overemphasized.

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REFERENCES

Bleich, V. C. In press. "Costs of translocating mountain sheep." *Proceedings of the Symposium on Managing Wildlife in the Southwest.*

Bleich, V. C., J. D. Wehausen, K. R. Jones, and R. A. Weaver. In press. "Status of bighorn sheep in California, 1989 and a summary of translocations since 1970." Desert Bighorn Council Transactions.

Boyer, D. A. and R. D. Brown. 1988. "A survey of translocations of mammals in the United States 1985." In L. Nielsen and R. D. Brown (editors). *Translocation of Wild Animals*, pp. 1-11. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

Caldecott, J. O. and M. Kavanagh. 1983. Can translocation help wild primates? *Oryx* 17:135-139.

California Department of Fish and Game. 1974. *At the Crossroads: A Report on California's Endangered and Rare Fish and Wildlife.* H. R. Leach, J. M. Brode and S. J. Nicola. Sacramento, CA: The Resources Agency.

_______. 1983. *A Plan for Bighorn Sheep.* Sacramento, CA: The Resources Agency.

Chow, L. S., P. E. Moore, D. M. Graber, and J. W. Van Wagtendonk. 1988. "Seasonal movements and distribution patterns of a reintroduced California bighorn sheep herd following transplant in the Sierra Nevada, California." *Biennial Symposium of the Northern Wild Sheep and Goat Council Proceedings* 6:210-218.

Dunaway, D. J. 1971. "Bighorn sheep habitat management on the Inyo National Forest, a new approach." *Desert Bighorn Council Transactions* 15:18-23.

Gogan, P. J. P. and R. H. Barrett. 1988. "Lessons in management from translocations of tule elk." In L. Nielsen and R. D. Brown (editors). *Translocation of Wild Animals*, pp. 275-87. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

Goldsmith, A. E. 1988. "History and research on reintroduction of pronghorn in California." In L. Nielsen and R. D. Brown (editors). *Translocation of Wild Animals*, pp. 288-97. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

Keay, J. A., J. D. Wehausen, C. D. Hargis, R. A. Weaver, and T. E. Blankinship. 1987. "Mountain sheep reintroduction in the central Sierra: a cooperative effort." *Western Section of the Wildlife Society Transactions* 23:60-64.

Koch, D. B. 1987. "Tule elk management: problems encountered with a successful wildlife management program." *Western Section of the Wildlife Society Transactions* 23:1-3.

Mansfield, T. M. 1986. "Mountain lion management in California." *North American Wildlife and Natural Resources Conference Transactions* 51:178-182.

Mansfield, T.M. and R. A. Weaver. 1989. "The status of mountain lions in California." *Western Section of the Wildlife Society Transactions* 25:72-76.

Nielsen, L. 1988. "Definitions, considerations, and guidelines for translocation of wild animals." In L. Nielsen and R. D. Brown (editors). *Translocation of Wild Animals*, pp. 12-63. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

Nielsen, L. and R. D. Brown. 1988a. *Translocation of Wild Animals*. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

_______. 1988b. Introduction. In L. Nielsen and R. D. Brown (editors). *Translocation of Wild Animals*, pp. xv-xvii. Kingsville, TX: Caesar Kleberg Wildlife Research Institute.

Peek, J. M. 1981. "Comments on Caughley's comment." *Wildlife Society Bulletin* 9:234-237.

Pyshora, L. B. 1987. "Pronghorn management in California." *Western Section of the Wildlife Society Transactions* 23: 75-80.

Sierra Nevada Bighorn Sheep Interagency Advisory Group. 1984. *Sierra Nevada Bighorn Sheep Recovery and Conservation Plan.* Bishop, CA: Inyo National Forest.

Van Ballenberghe, V. 1987. "Effects of predation on moose numbers: a review of recent North American studies." *Swedish Wildlife Research*, Supplement 1, Part 2:431-460.

Wehausen, J. D. 1980. Sierra Nevada bighorn sheep: history and population ecology. Ph.D. Dissertation, University of Michigan, Ann Arbor.

_______. 1988. "A history of bighorn sheep management in the Sierra Nevada." In D. Bradley (editor). *Proceedings of the state of the Sierra Symposium, 1985-1986*, pp. 99-105. San Francisco, CA: Pacific Publications Company.

Wehausen, J. D., V. C. Bleich, and R. A. Weaver. 1987. "Mountain sheep in California: a historical perspective on 108 years of total protection." *Western Section of the Wildlife Society Transactions* 23:65-74.

AN AVIAN BIOMONITORING PROGRAM FOR THE NATIONAL PARKS AND OTHER NATURAL AREAS TO DETECT LARGE-SCALE, LONG-TERM CHANGES IN THE PRODUCTIVITY AND SURVIVORSHIP OF LAND BIRDS

David F. DeSante[1]

Abstract

An avian biomonitoring program was established in 1990 in Yosemite National Park to provide annual estimates of productivity, adult survivorship, and adult population levels of common land birds by means of constant effort mist-netting during the breeding season. The program emphasizes the importance of national parks and other natural areas for the long-term biomonitoring of the effects of large-scale environmental changes such as global climatic change, loss of stratospheric ozone, widespread toxic pollution, and accelerating habitat loss. The program is currently being expanded into other national parks and natural areas as part of the Monitoring Avian Productivity and Survivorship (MAPS) program, a cooperative continentwide network of constant effort mist-netting stations designed to detect large-scale, long-term changes in the productivity and survivorship of land birds. Critical data on avian productivity and survivorship are not currently available from any other avian biomonitoring program in North America, and are crucial for the testing of hypotheses regarding the causes of recent population declines in land birds. Data from the 1990 Yosemite station and limited data from the first two years of the North American MAPS program, along with previous results from a single station on the Point Reyes National Seashore and a network of such stations in Great Britain, provide a positive indication that the method will produce meaningful information on the productivity and survivorship of North American birds.

INTRODUCTION

It is becoming increasingly apparent that Earth's biosphere, and its bird populations, are facing a growing number of environmental threats of ever increasing severity. Many of these threats are truly global in scale. They include global climatic change due to the atmospheric accumulation of greenhouse gases; loss of stratospheric ozone due to chlorofluorocarbon pollution of the atmosphere; toxic pollution of marine, aquatic, and terrestrial ecosystems from acid rain, industrial and agricultural wastes, and low-level radiation; accelerating habitat loss from the deforestation and fragmentation of tropical and temperate forest ecosystems, the desertification of scrub and savanna ecosystems, and the filling and degradation of estuarine, wetland, and riparian ecosystems; and the simple overfishing, overhunting, and overharvesting of living resources. Indeed, the human species seems to have embarked upon a global ecological experiment, the ramifications of which may challenge the greatest extinction rates and fastest rates of range change ever recorded in the fossil record. And the scientific community has barely begun to put into place the effective means for recording the data from this experiment. Clearly, the need for a continuing and comprehensive program of biomonitoring is justified.

The monitoring of complex terrestrial ecosystems, such as the forests that are protected in national parks and other natural areas, is a difficult task that necessitates monitoring at many levels and at many scales, both spatial and temporal. I suggest that the land bird populations that inhabit our parks

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and other natural areas have a number of characteristics that make them excellent candidates for monitoring the effects of large-scale, long-term environmental changes on upper level consumers. Indeed, because of their high body temperature, rapid metabolism, and high ecological position on most food webs, birds have long been regarded as among the better indicators of the effects of environmental change (Temple and Weins 1989).

First, land birds are present in most terrestrial ecosystems in considerable abundance and with substantial diversity; thus, they can provide solid statistical data upon which changes in their population parameters can be inferred. Second, they are diurnal and have distinctive and persistent vocalizations; thus, they can be relatively easily observed and sampled. Third, they have distinct breeding seasons that produce discrete age classes, thereby making it relatively easy to monitor their productivity. Fourth, they have an intermediate longevity of several but not many years, which facilitates the determination of the age structure and survivorship of their populations. And finally, they enjoy great popularity among humans; the beauty of their plumage, song, and behavior has long made them favorite objects of human attention, study, and love. Truly, the "canary in the mine" analogy can accurately be applied to the biomonitoring of land birds.

It is not surprising, therefore, that a number of large-scale, long-term biomonitoring programs for land birds are already in place in North America. They include the Breeding Bird Survey, the Breeding Bird Census and Winter Bird Population Study, and the Christmas Bird Counts. All of these efforts provide annual estimates of population trends for land birds, and many of these trends are pointing to serious and accelerating declines in many species of North American land birds, particularly forest-inhabiting, neotropical migrant species (Terborgh 1989).

All of these current avian biomonitoring programs, however, suffer from a major shortcoming: they fail to separate the effects of productivity (birth rate effects) from the effects of survivorship (death rate effects). Without these critical data on productivity and survivorship, it is difficult, if not impossible, to test hypotheses to account for observed population changes, or to determine whether the population changes are being driven by causal agents that affect birth rates or death rates or both (Temple and Weins 1989). In particular, the current avian biomonitoring programs have generally been unable to determine to what extent deforestation and forest fragmentation on the temperate breeding grounds and on the tropical wintering grounds are causes for declining populations of neotropical migrant land bird species (Wilcove 1985; Holmes and Sherry 1988; Hutto 1988; Morton and Greenburg 1989; Robbins et al. 1989). An additional sampling method that can provide accurate estimates of changes in land bird productivity and survivorship is a real necessity.

The purposes of this paper are (1) to describe a new avian biomonitoring program that can provide useful long-term information on the productivity and survivorship of land birds, (2) to provide confirmation of the value and effectiveness of the proposed methodology by reference to studies already completed, and (3) to present the results of the first year of this program at a single location in Yosemite National Park.

THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM

The Basic Methodology

The MAPS program is a cooperative effort, established and coordinated by The Institute for Bird Populations, to provide critical, long-term data on select avian population parameters that are crucial for the conservation of avian diversity in North America. In particular, the program is designed to provide annual regional estimates of productivity, adult survivorship, and adult population size for various common land birds, including resident, short-distance migrant, and long-distance neotropical migrant species. The basic methodology employed in the MAPS program is that of a capture-recapture experiment utilizing standardized, constant effort mist-netting and banding during the breeding season at a continentwide network of banding stations. Considerable advances have been made in recent years in both the theory and application of data from capture-recapture experiments (e.g., Clobert et al. 1987; Pollock et al. 1990). A modified Jolly-Seber model for multiple recaptures of adult birds in subsequent years will serve as the basic analytical model from which annual estimates of adult survivorship, adult population size, and recruitment into the adult population can be determined. This model will allow age and/or time dependence to be built into survival and capture rates, permit some parameters to be set equal to fixed *a priori* values, and allow any of the parameters to be related to external variables. Furthermore, by simultaneously banding the young birds that are captured during the breeding season, another measure of post-fledgling productivity, the proportion of young birds captured, can be obtained.

Validation of the Methodology

(1) At a Single Station – The value of constant effort mist-netting, at even a single station, has been confirmed in a 15-year ongoing study by the Point Reyes Bird Observatory at the Palomarin Field Station, located on the Point Reyes National Seashore. Data from this study were used to show the relationship between the productivity of land birds and annual rainfall in central coastal California, and to document a massive and unprecedented reproductive failure of most species of land birds in 1986 (DeSante and Geupel 1987). This study showed that the apparent driving force behind much of the annual variation in the numbers of young birds at Palomarin during the first 10 years (1976-1985) was the amount of annual (winter) rainfall that occurred in this Mediterranean ecosystem. In particular, maximum numbers of young birds were produced in relatively average rainfall years, while low productivity occurred in both very dry years (1976, 1977) and in very wet years (1983, a year characterized by a severe El Niño southern oscillation).

In 1986, however, a relatively normal number of adults produced a very low number of young. In fact, the number of young birds captured in 1986 was only 37.7 percent of (and significantly below) the mean of the previous 10 years, while the number of adults captured in 1986 was 91.7 percent of (and not significantly below) the previous 10 years' mean. Indeed, analysis of the young to adult ratio indicated that productivity in 1986 was highly significantly reduced ($P < .001$) compared to that of the previous 10 years. Although the cause of this 1986 reproductive failure is not yet completely clear, its timing, its geographical extent, and the species most affected, led DeSante and Geupel (1987) to hypothesize that it could have been caused by radioactive fallout of Iodine-131 from the Chernobyl nuclear power plant accident in the U.S.S.R.

(2) At a Network of Stations – The idea of a network of constant effort mist-netting stations to monitor the productivity and survivorship of birds over a large geographical area is not really new. The British have had such a program, the Constant Effort Sites (CES) program, in operation since 1981. In 1986, the CES program was endorsed by the British Trust for Ornithology, which made it one of the cornerstones of the trust's avian biomonitoring strategy (Baillie et al. 1986). By 1989, more than 90 constant effort sites were in operation in Great Britain (Peach and Baillie 1989). Data from the British CES program showed that the proportion of young birds increased between 1986 and 1987 for 18 of the 23 species considered (Baillie and Holden 1988). Moreover, significant changes between 1986 and 1987 were recorded for 10 of the species; 9 of these 10 registered increases. These data thus suggest that productivity was either inordinately low in 1986 or unusually high in 1987. Analysis of additional years of British CES data suggest, in fact, that both phenomena did occur (Peach and Baillie 1989). Thus, some degree of reduced reproductive success in 1986 appeared to extend over large areas of the

Northern Hemisphere. These results illustrate the potential usefulness of a network of standardized constant effort mist-netting and banding stations. Indeed, other constant effort banding projects are currently being established in Finland, France, the Netherlands, and Denmark and are being considered for New Zealand, Australia, Spain, and Israel.

The Proposed Network of Stations in North America

A constant effort mist-netting and banding program has now been established in North America, the MAPS program. The program has existed on a very limited basis since the summer of 1989, when 14 stations were established and operated. At least 35 stations were operated during the summer of 1990. The long-term goal for the program is the operation of about 180 stations, about 30 in each of six major regions of the continent: northeast, southeast, north-central, south-central, northwest, and southwest. The delineation of these regions was based upon the average location and apparent east-west periodicity of the jet stream. Seasonal weather in a given year generally tends to be similar at points within one of these regions, but often tends to vary considerably from region to region.

The basic assumption of the proposed MAPS methodology is that significant changes in population parameters (productivity, adult survivorship, and adult population levels) between a given pair of years or over a longer time period will tend to be similar for a given species at several banding stations within a region. Thus, data on a given species can be combined from all of the banding stations in a region, thereby greatly increasing the resulting sample sizes and the precision of the population parameter estimates. By this method, local changes in the population parameters will tend to be ignored, while large-scale changes will tend to be emphasized. This is in accord with the basic objective of the proposed program. Inferences regarding local changes in population parameters can be obtained by combining the data on a number of species at one or a few nearby stations into an appropriate species group (e.g., arboreal insectivorous species, neotropical migrant species, ground-nesting species), and testing for the significance of annual changes or long-term trends.

The strategy for the development of the MAPS program in North America calls for the establishment of a four-year pilot project (1991-1994) to test and evaluate the ability of the methodology to produce useful (precise) data. Indeed, one of the purposes of the pilot project is to determine empirically the capture probabilities that actually can be obtained. Analyses of data from the limited 1989 and 1990 field seasons suggest that capture probabilities in excess of 0.33 can be obtained. If this is indeed the case, samples from 30 stations in each of the six regions are expected to generate enough data for some 15 to 20 common land bird species so that the resulting estimates of survivorship will have adequate precision, and the statistical tests based on these estimates will have sufficient power, to be biologically meaningful and useful.

I suggest that the national parks, the Research Natural Areas of the national forests, and other protected natural areas can provide ideal locations for a network of MAPS stations, because they provide large areas of diverse and relatively pristine ecosystems that promise to be maintained in an undisturbed manner indefinitely into the future. I further suggest that such a network of stations can help forge a partnership among the federal agencies responsible for the stewardship of protected public lands (i.e., National Park Service, U.S. Forest Service, Bureau of Land Management) and those responsible for the conservation of avian diversity in North America (U.S. Fish & Wildlife Service), and the bird banders of North America.

The Operation of a MAPS Station

The establishment and operation of a MAPS station is straightforward. First, a study area is established in an appropriate habitat and location that will allow for the operation of the station indefinitely into the future, or at least for five to ten years, and that will permit the mist-netting of substantial numbers of many of the common land bird species present in the area. Stations can be sited in scrub habitats, in riparian and lowland woodland and forest habitats, or in upland woodland and forest habitats, but should be sited in relatively mature habitats so that the effects of successional change upon the population parameters of the species studied will tend to be minimized.

Next, mist nets are to be erected at 5 to 20 sites (preferably about 10) in the study area. Because a primary aim of the project is to capture and recapture in subsequent years a relatively high proportion of the breeding populations, nets should generally be placed reasonably close together over a medium-sized study area rather than spread widely over a very large study area. A density of about two 12-meter nets per hectare of study area may be ideal.

The operation of the nets should be standardized, if possible, for about six hours per day, for 1 to 10 days per 10-day period, and for up to 12 consecutive 10-day periods from May 1 to August 28. A minimum of one day of operation within each 10-day period is required, although three to six days of operation per 10-day period is suggested. We recommend opening the nets about 15 minutes after sunrise and running the nets for about six hours during each day of operation. While we recommend standardizing the netting operation each day, rigid standardization within the year is not required. The total effort and timing, however, must be kept essentially constant for all years at each station.

All birds captured throughout the season (including recaptures) must be identified to species, banded with U.S. Fish and Wildlife Service numbered aluminum bands, and correctly aged, if possible, by the extent of skull pneumatization and/or other appropriate plumage, mensural, or molt characters (Pyle et al. 1987). If possible, the sex, breeding condition of adults (presence or absence of a cloacal protuberance or brood patch), and extent of juvenile plumage in young birds should also be recorded.

To provide additional information on the population levels of birds at each station, and to sample species that are not captured efficiently by mist nets, a series of from 4 to 12 standardized eight-minute point counts, 60 to 200 meters apart, should be conducted along a route through the habitat at each station. This series of point counts should be conducted three times during the early part of the breeding season when the amount of singing is near its peak.

Finally, because changes in the type and structure of the vegetation at a given station can affect both the number of breeding birds present and their productivity and survivorship, as well as the efficiency with which they can be monitored by mist nets, standardized habitat maps and descriptions must be prepared each year. These maps and descriptions will identify, locate, and characterize the major habitat types present in an area that extends at least 100 meters beyond the outermost net locations.

A MAPS STATION IN YOSEMITE NATIONAL PARK

A MAPS station was established in 1990 in Yosemite National Park for a three-year pilot study. The station was located at Hodgdon Meadow, elevation 1,414 meters, at the ecotone between a wet meadow and a mixed coniferous forest/black oak woodland (fig. 1). Ten permanent nest sites were established at Hodgdon Meadow, three in willows in the meadow itself, three along the meadow edge, and four some 10-30 meters inside the adjoining forest and woodland. One 12-meter long, 30-mm mesh, four-tier nylon mist net was erected at each of the 10 sites. The station was then operated for

Figure 1. A view of Hodgdon Meadow, Yosemite National Park.

ten 10-day periods, from May 21 through August 28, for a total of 56 days of netting and banding. Because of the extremely high density of birds at Hodgdon Meadow, only five nets could be operated on any given day. Thus, we alternated days, operating the five eastern nets one day and the five western nets the next day. Nets were opened each day at about 0630 AM, and were operated from four to six hours per day depending upon the weather conditions; several weeks of extremely hot weather necessitated the closing of nets by 1030 or 1100 AM rather than at the scheduled time of about 1230 PM. A total of 1,279 net-hours were thus accumulated during the season. A summary of the timing, effort, and results of the 1990 MAPS station at Hodgdon Meadow is presented in table 1.

A total of 989 individuals of 49 species were captured during the season, and various individuals of these were recaptured a total of 173 times. Thus, 1,162 captures were recorded. The number of newly captured birds increased from about 60 birds per 100 net-hours early in the season to over 100 birds per 100 net-hours late in the season, and averaged 77.3 birds per 100 net-hours. This was nearly six times the average summer capture rate at the Palomarin Field Station and speaks to the extremely high density of birds along the edges of Sierran montane meadows during the summer months.

As expected, the number of newly banded adult birds decreased from a high of 63.5 birds per 100 net-hours at the start of the season to a low of only 6.8 birds per 100 net-hours in early August, and then increased in mid- to late August to 19.3 birds per 100 net-hours, possibly a result of fall migration (fig. 2). Young birds, in contrast, increased throughout the season from none in late May to 88.8 birds per 100 net-hours in late August (fig. 2). A peak in the number of young birds in late July could represent a synchronous burst of dispersal of young from first brood nests, while a second peak in mid- to late August could again represent fall migration. The proportion of young birds in the catch thus increased from none in late May to a peak of 0.900 in early August and then declined slightly to 0.821 in late August (fig. 3). The overall seasonal mean proportion of young was 0.567.

The proportion of young birds captured, however, varied greatly among individual species (table 2), from as high as 90 percent for orange-crowned warblers that breed only at elevations lower than Hodgdon Meadow and disperse up-mountain after the nesting season, to as low as 6 percent for hermit warblers that breed in the forest at Hodgdon Meadow but stay primarily high in the trees. The proportion of young for most species was about 35-60 percent. These data illustrate the fact that the proportion of young cannot be used directly to compare productivity between species, but can be used to provide indications of year-to-year (or longer) changes in productivity for each species, and can permit accurate comparisons of changes in productivity between species. The 14 species for which more than 15 individuals were captured (table 2) will provide key information on changes in productivity (the proportion of young in the catch) and survivorship (from capture-recapture analyses) in subsequent years.

Of additional interest was the fact that several major fires burned considerable areas of Yosemite National Park to within one mile of the Hodgdon Meadow banding station during mid-August. Our data, however, indicate that these fires had no obvious effect on either the capture rates of birds at Hodgdon Meadow or the proportion of young birds captured.

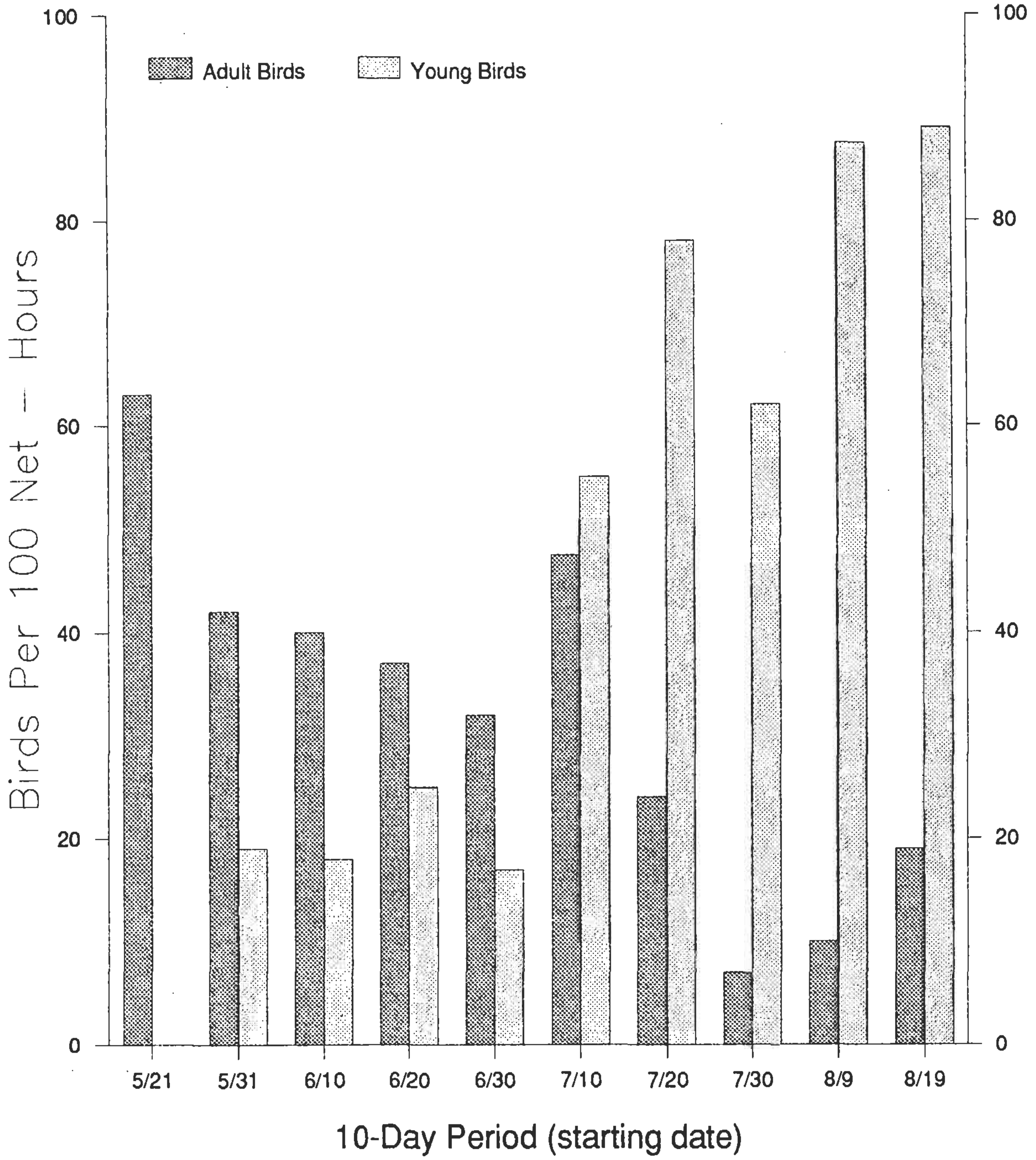

Figure 2. Numbers of newly captured birds per 100 net-hours (excluding hummingbirds) at Hodgdon Meadow during the summer of 1990.

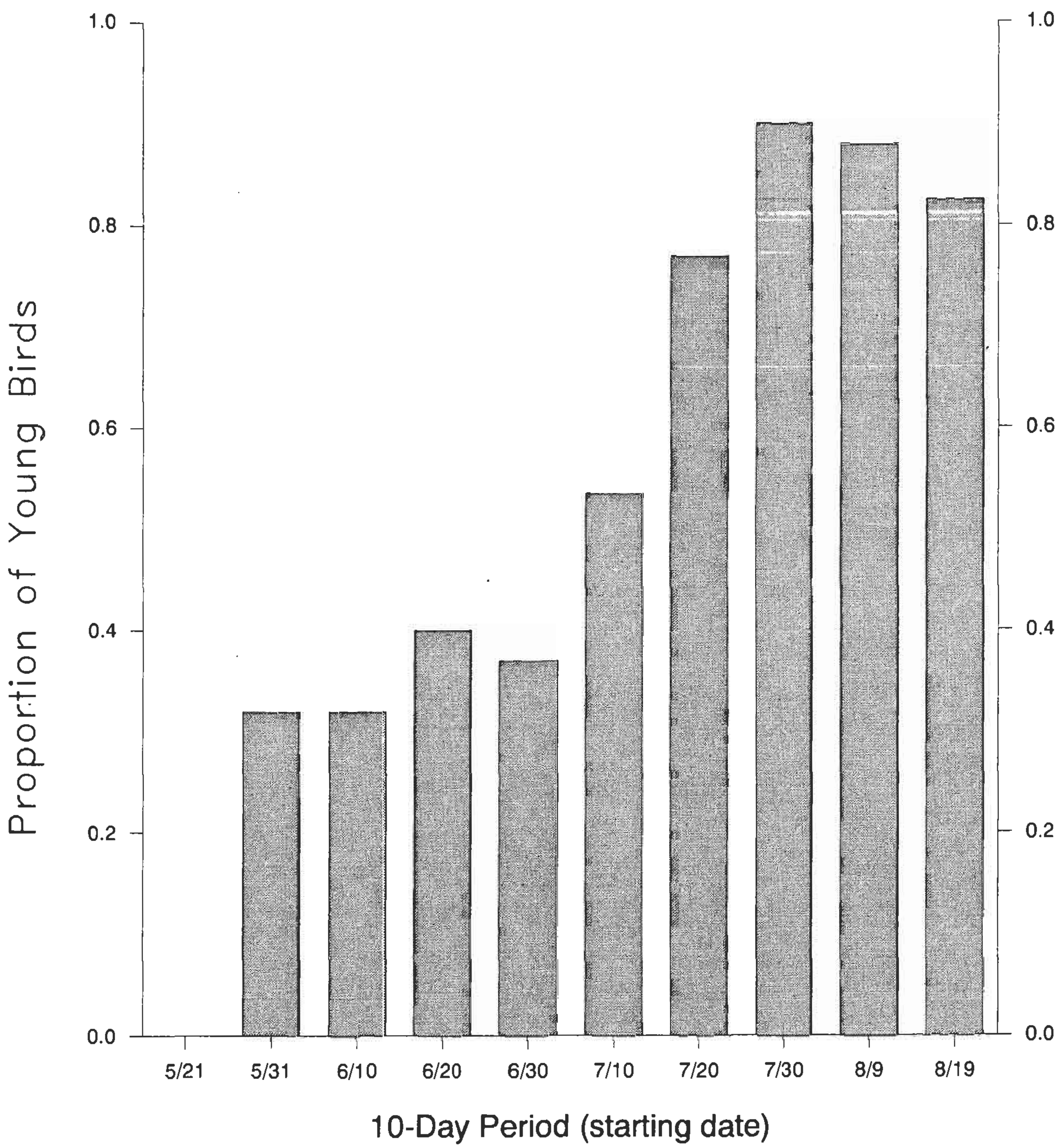

Figure 3. Proportion of young among all newly captured birds (excluding hummingbirds) at Hodgdon Meadow during the summer of 1990.

Table 1. Summary of the effort and results of the 1990 Yosemite National Park MAPS station located at Hodgdon Meadow

Period	No. of banding days	Total net-hrs	No. of species	Number of individuals: Newly captured	Number of individuals: Recaptured	Newly captured birds per 100 net-hrs
3: May 21-30	4	72.4	19	46	1	63.5
4: May 31-Jun 9	6	198.5	33	124	24	62.5
5: Jun 10-19	5	140.0	23	82	27	58.6
6: Jun 20-29	5	160.0	28	99	24	61.9
7: Jun 30-Jul 9	7	135.0	25	72	20	53.3
8: Jul 10-19	5	103.3	25	114	21	110.3
9: Jul 20-29	9	186.4	27	191	27	102.5
10: Jul 30-Aug 8	7	132.8	20	93	15	70.0
11: Aug 9-18	2	36.7	17	40	4	109.1
12: Aug 19-28	6	113.8	17	128	10	112.5
Total	**56**	**1,278.9**	**49**	**989**	**173**	**77.3**

Table 2. The fourteen most commonly captured species at the Yosemite National Park MAPS station located at Hodgdon Meadow

Species	Number newly captured: Total	Adults	Young	% young
Orange-crowned warbler *(Vermivora celata)*	226	22	204	90.3
Purple finch *(Carpodacus purpureus)*	142	71	71	50.0
MacGillivray's warbler *(Oporornis tolmiei)*	82	41	41	50.0
Dusky flycatcher *(Empidonax oberholseri)*	69	43	26	37.7
Warbling vireo *(Vireo gilvus)*	63	47	16	25.4
Nashville warbler *(Vermivora ruficapilla)*	52	11	41	78.8
Dark-eyed junco *(Junco hyemalis)*	31	9	22	71.0
Song sparrow *(Melospiza melodia)*	28	11	17	60.7
Lincoln's sparrow *(Melospiza lincolnii)*	26	16	10	38.5
Red-breasted sapsucker *(Sphyrapicus ruber)*	24	14	10	41.7
Yellow warbler *(Dendroica petechia)*	21	15	6	28.6
Solitary vireo *(Vireo solitarius)*	17	10	7	41.2
Yellow-rumped warbler *(Dendroica coronata)*	16	9	7	43.7
Hermit warbler *(Dendroica occidentalis)*	16	15	1	6.3
All species (except hummingbirds)	954	413	541	56.7

CONCLUSIONS

(1) Current avian biomonitoring programs have failed to provide the critical annual estimates of productivity and survivorship of land birds that are crucial for testing hypotheses regarding the causes of the recent declines in North American land bird populations.

(2) The MAPS program, a cooperative network of constant effort mist-netting and banding stations operated during the breeding season and located primarily on protected public lands, has been designed to provide these critical estimates through modified Jolly-Seber analyses of capture-recapture data.

(3) Previous results from a single constant effort banding station on the Point Reyes National Seashore, and a network of constant effort banding stations in Great Britain have provided validation of the effectiveness of the methodology for the long-term monitoring of land bird productivity.

(4) Data from the first year of a three-year pilot study in Yosemite National Park and from the first two years of the North American MAPS program have provided a positive indication that the method will produce meaningful information on the productivity and survivorship of North American birds.

ACKNOWLEDGMENTS

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REFERENCES

Baillie, S. R., R. E. Green, M. Boddy, and S. T. Buckland. 1986. *An Evaluation of the Constant Effort Sites Scheme.* Tring, U.K.: British Trust for Ornithology.

Baillie, S. and B. Holden. 1988. Population changes on constant effort sites 1986-1987. *British Trust for Ornithology News* 155:8-9.

Clobert, J., J. D. Lebreton, and D. Allaine. 1987. A general approach to survival rate estimation by recaptures or resightings of marked birds. *Ardea* 75:133-142.

DeSante, D. F. and G. R. Geupel. 1987. Landbird productivity in central coastal California: the relationship to annual rainfall, and a reproductive failure in 1986. *Condor* 89(3):636-653.

Holmes, R. T. and T. W. Sherry. 1988. Assessing population trends of New Hampshire forest birds: local vs. regional trends. *Auk* 105(4):756-768.

Hutto, R. L. 1988. Is tropical deforestation responsible for the reported decline in neotropical migrant populations? *American Birds* 42(3):375-379.

Morton, E. S. and R. Greenberg. 1989. The outlook for migratory songbirds: "future shock" for birders. *American Birds* 43(1):178-183.

Peach, W. and S. Baillie. 1989. Population changes on constant effort sites 1987-1988. *British Trust for Ornithology News* 161:12-13.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. *Wildlife Monographs* 107.

Pyle, P., S. N. G. Howell, R. P. Yunick, and D. F. DeSante. 1987. *Identification Guide to North American Passerines.* Bolinas, CA: Slate Creek Press.

Robbins, C. S., J. R. Sauer, R. S. Greenberg, and S. Droege. 1989. Population declines in North American birds that migrate to the neotropics. *Proceeding of the National Academy of Sciences USA* 86:7658-7662.

Temple, S. A. and J. A. Wiens. 1989. Bird populations and environmental changes: can birds be bio-indicators? *American Birds* 43(2):260-270.

Terborgh, J. 1989. *Where have all the birds gone? Essays on the biology and conservation of birds that migrate to the American tropics.* Princeton, NJ: Princeton University Press.

Wilcove, D. S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. *Ecology* 66(4):1211-1214.

UNGULATE POPULATIONS AND SPECIES DIVERSITY

James M. Peek[1]

Abstract

Ungulates comprise a species group that is capable of altering vegetative composition, especially on winter ranges where populations concentrate. In situations where biotic diversity is an issue, such habitat alteration needs to be considered. Questions concerning whether such alterations occur in areas where man's influence is minimal need to be addressed. National parks and wilderness areas are typically too small to encompass total ranges of populations of large mammals, so a broader land base must be included within a designated ecosystem if these species are to be considered.

INTRODUCTION

Wildlife management is proceeding slowly toward a broader based approach that addresses ecosystems and species groups, and away from single species management. That is to say, some agencies and groups are considering this broader-based approach. Certainly, many state wildlife agencies, concerned primarily with hunted game species, continue to devote most of their effort to single species management. The trend toward a more broad-based management isn't necessarily widespread, but I believe there is a trend, however faint.

There are many who probably interpret this to mean that nongame species, most particularly the nongame birds, are the issue. As we become more concerned with preservation of biotic diversity, the need to focus on species that are most jeopardized by man's activities becomes more critical, and often these are the species, including many nongame birds, that have low reproductive rates and/or highly specific habitat requirements. But realistically, when we become concerned with ecosystems, we must consider the entire wildlife complex, even the deer and the elk.

Maintenance of biotic diversity at the broad level means preservation of ecosystems in biosphere reserves, management of multiple-use lands to consciously maintain diversity, assessment of "gaps" in our system of reserves (Scott et al. 1987, 1990), presumably with subsequent changes in management to accommodate the needs. Of course, retention of biotic diversity also means conservation of endangered species, which may mean single species management, but should mean ecosystem management that includes the target species. But another issue involves lands that are identified as being suitable for management for natural biotic diversity, and the conditions on the landscape that should be managed for within these lands. National parks, although not specifically managed to maximize diversity, contain some of the best examples left of natural areas with intrinsically high diversity minimally influenced by man and are appropriate places for consideration of this issue.

Many people who have made a career out of trying to understand the ecology and management of specific species or species group are being encouraged in various ways to view their task in a broader perspective and a more holistic manner. This is particularly true for those concerned with ungulates. The old criticism that the white-tailed deer and the elk are the most-studied species reflects a certain amount of disenchantment with further expensive study, particularly when viewed from the

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perspective that other species groups need investigation, there is a limited conservation budget, and many ungulate populations are currently at high levels. Ungulates are, as a group, highly adaptable and tolerant of man's activities in comparison to other species. Some of this criticism is obviously well-justified, even if more incisive investigations on certain aspects of ecology and population dynamics of these species are urgently needed.

There are only a few species of wildlife that are capable of altering the landscape, thereby affecting habitats for other species, and potentially affecting biotic diversity. The beaver is an obvious example, but large herbivorous mammals also have this capability. Elephants are capable of changing arid shrublands to grasslands (Laws 1970), although whether this happens in the natural state or not is questionable (Parker 1983). There is evidence that the grazing pressures placed upon the East African plains by one species alters vegetation in a manner that favors other species (Bell 1970, McNaughton 1976). There are numerous examples of ungulates in North America altering vegetation when these species occur at high densities (Ross et al. 1970), or are isolated on islands (Krefting 1974; Klein 1968). Caughley's (1970) investigation of an introduced ungulate population into New Zealand also provides this type of evidence. However, in all cases man has intervened in some pervasive manner, and whether the ungulate-vegetation interaction results in an alteration of the habitat where man's presence has not been intrusive needs more investigation, even for deer and elk!

Nevertheless, in areas where biotic diversity is to be maintained and managed for, the ungulate-vegetation complex must be considered in context of the broader goal. I know of no investigations that compare the diversity of flora and fauna of ungulate winter ranges with similar areas not used by ungulates in winter. There are obvious inferences to be drawn from information that demonstrates shifts in plant species composition, production, and density attributable to ungulate foraging. As we become more concerned with managing ecosystem processes and preserving biotic diversity, we should learn more about the effects of vegetation change associated with ungulates, particularly at high densities. To be specific, how are the observed changes affecting biotic diversity of associated flora and fauna, and are they a natural and expected consequence of prolonged occupation of an area by ungulates?

Fundamental to all of this is the old question of what in nature regulates ungulate species. A corollary to this fundamental question is, is there sufficient land for the dynamic processes that are known to be involved in affecting ungulate populations to operate without man's influence, or at least with minimal influence? Another corollary is, if there is not sufficient land for these dynamic processes to operate without man's intervention, what forms of population management might be appropriate to best mimic the perceived natural condition?

Obviously, many private and public lands containing ungulates may not have to be managed with these issues in mind, although an understanding of them can certainly refine population management and place it in a more appropriate context when managing the landscape for multiple uses. Further, in a society increasingly sensitized to environmental issues, recognition of the effects of management practices emphasizing biotic diversity may ultimately be very useful. But the issue is critical in national parks, wilderness areas, and other places where natural processes are emphasized. The ungulate component needs to be maintained in its most nearly natural status as possible within these areas. Obviously, this ideal will not be even approximated in most areas simply because there is insufficient area involved for the natural condition, whatever that is determined to be, to exist.

NATURAL REGULATION OF UNGULATES

Ten years ago I wrote an article entitled "Natural regulation of ungulates: what constitutes a real wilderness?" (Peek 1980). This was criticized, with justification, by Caughley (1981) and Messier and Crete (1985). It was also interpreted to be a criticism of National Park Service policy concerning elk in Yellowstone National Park (Rolston 1990), although I consider it a continuation of a dialogue. So much for clear, concise writing. Basically, that article pointed out that two hypotheses involving natural regulation of ungulates were generally accepted, namely that numbers were regulated by a forage-weather complex or by predators (disease and parasites could be included but were not). I also concluded that national parks and wilderness areas would be excellent places to investigate these relationships if natural fire and predators could be restored. Caughley (1981) countered that the food limitation and predation hypotheses were not necessarily mutually exclusive, and I tend to agree. One major area of disagreement centered on whether "natural regulation may take place only in ecosystems where predators, prey and habitat are uninfluenced by human activity" (Peek 1980). Caughley (1981) doubted that the set of controlling mechanisms differs according to whether man has or has not perturbed the system. In retrospect, I would agree that some degree and kinds of perturbation probably do not alter a natural system sufficiently to affect the mechanisms controlling ungulate numbers, but I remain unconvinced ten years later that we know enough about our alterations to do more than conjecture on this. For instance, if predation is important, then how many areas have wolves to do the preying, and do other predators compensate for the absence of the wolf? The vegetation-ungulate interaction model developed by Caughley (1970) implies that vegetation change is expected and a dynamic equilibrium between ungulate density and vegetation production will evolve if left alone. But his supporting work was with a species introduced into a habitat that evolved in the absence of ungulate herbivore, and investigations attributing vegetation alteration to ungulate grazing are typically done in areas where man's presence has been intrusive.

Perhaps the biggest issue Caughley (1981) raised was that wilderness and national parks would quite likely be inappropriate places to study regulation because ungulate populations would be at equilibrium. While one may be able to measure the variables affecting ungulates, the forces holding these variables at levels that were measured would remain unknown. The analogy he used is that one does not learn much about gravity by studying an apple at rest, or at equilibrium, and some sort of disturbance or perturbation is necessary before we learn something about the forces keeping that apple at equilibrium. Since one justification for national parks and wilderness areas is that they provide a baseline information source by which we may view our effects on other areas (Leopold 1941), this criticism becomes significant, if valid.

Caughley's concerns about the utility of national parks and wilderness areas to investigate regulation of ungulates should be heeded, not because there are no perturbations in the natural world, but because these may not happen in a magnitude sufficient enough to be of consequence to a population, except infrequently. My response to his comments (Peek 1981) pointed out that wilderness areas and national parks are not typically stable environments. The fire year of 1988 in Yellowstone and of 1990 in Yosemite should be sufficient evidence of that, and many of these natural ecosystems in western and northern North America are subject to burning at irregular intervals.

Still, Messier and Crete (1984, 1985) reported that a moose-wolf system in southwestern Quebec was fairly stable and that predation was regulating numbers of moose, in apparent conflict with my conclusion that these systems are dynamic. The time frame involved is at issue. Studies of natural regulation, particularly of long-lived species occupying habitats that may not change rapidly, must include long time frames, as the Isle Royale moose-wolf investigations have conclusively demonstrated (Allen 1979). Also, areas that are hunted, even if the legal harvest is tightly regulated and light, provide questionable information unless estimates of actual offtake and the effects on distribution, population dynamics of the hunted species, and interactions with the native predator complex are understood. And even if fire is not a significant dynamic force, as it is not in maritime Canada, coastal rainforest, or some desert and tundra systems, variations in winter weather and drought may alone provide natural perturbations of sufficient magnitude to affect ungulate populations. Sinclair's (1977) comprehensive investigation of the buffalo in an unhunted system is a fine example of where a natural area provided ample opportunity to investigate issues of regulation of numbers.

I maintain that these issues cannot be adequately investigated unless the predator complex is basically intact. You can't conclude from evidence supporting the food limitation hypothesis that food limits in the natural condition if the predator component is absent or partially intact, simply because the alternative hypothesis cannot be investigated concurrently. Conversely, if the predator component is implicated in a system where human exploitation at some level is tacitly ignored, as is typically the case in studies of predator-ungulate relationships in northern North America, we do not learn much about how ungulates interact within an ecosystem. And finally, investigations of predator-prey relationships that ignore the ungulate-habitat interaction, or cursorily address it, will not be fruitful either. Even if ungulate populations fluctuate in a long-term cyclic manner as Peterson et al. (1984) suggest for moose on Isle Royale, we need more than one 30-year run of information for analysis, and certainly the entire complex must be reasonably intact.

So returning to the issue of what role native ungulate populations play in affecting biotic diversity, we should again address some of the old questions involving carrying capacity of a given area to support a certain number of animals. We need to develop a best approximation of what the natural relationship should be, and estimates of the ecological carrying capacity such as provided by Hobbs (1990) may well be the key. Perhaps it is natural for an ungulate winter range to have a low biological diversity in some habitats, as compared to an adjacent, comparable area where ungulates do not winter. Perhaps it is natural for native ungulates to retard plant succession, or conversely, to promote its advancement at a more rapid rate than where ungulates are absent or in low densities. Perhaps ungulates have no influence on succession and plant composition in the natural state. But these issues should be addressed across a broad range of habitats if we are to more fully understand these relationships, and place the native ungulate, whatever species, within the broader context of conservation for biotic diversity.

ROLE OF NATIONAL PARKS AND WILDERNESS AREAS

Houston (1971) recognized that few of the national parks are complete self-contained ecological units, that many have been extensively modified by man, and that management for ecosystem processes may be realistic in only a few of the larger parks. Nevertheless, he considered many of the ecosystems to be relatively intact. This is more true today than twenty years ago, given expansion of some parks, creation of additional wilderness adjacent to others, and coordinated attempts by the agencies to consider the entire ecosystem in management, as at Yellowstone. Efforts to reintroduce the gray wolf back into several of these larger ecosystems in the northern Rocky Mountains, if successful, will provide a major impetus toward this restoration process. Restoration of a more natural fire regime to these areas was a very major step toward restoration of major natural ecosystem processes, and restoration of the wolf, representing a major component of the vital process of predation, would be an equally important step.

The two restorative efforts involving fire and predators, if successful, will provide unique opportunities to investigate regulation of numbers of ungulates in ecosystems that are as closely representative of the natural conditions that affected these large mammals as is possible to obtain in the contiguous United States.

Ecosystem boundaries are often defined, however, on a basis of topographical, floristic, and political entities. If large mammals are to be included, there is a need to revise this approach to include the ranges of these species, or the land necessary to maintain a viable population of the indigenous mammal with the largest home range. When we deal with migratory deer populations, or with species made up of individuals with home ranges of over 2,600 square kilometers, like the grizzly bear (Craighead and Mitchell 1982), we need large land areas that encompass many ownerships and management priorities.

Problems with such investigations, however, are that they are case histories that are risky of extrapolation to other areas, and there is a question concerning whether a predator-prey system, once destroyed, can truly be restored. In the first instance, we have sufficient knowledge to know that the Yellowstone ecosystem, as an example, is a unique system that is considerably different from, as an example, the Glacier National Park area and the Northern Continental Divide ecosystem of which Glacier is a part. And there is strong reason to believe that large mammals adapt to these differences. These two ecosystems are far different from ecosystems further south, such as Yosemite and its surrounding area, or Rocky Mountain National Park and its surrounding area, or the Boundary Waters Canoe Area further east. In the case of Yellowstone, the ungulate-vegetation interaction that has gone on for 80 years in the absence of wolves may preclude restoration of a natural predator-ungulate-vegetation complex, even if we eventually understand what that might be.

Apparently wolves were not originally present west of the Sierra crest in California, meaning that they probably didn't occur in King's Canyon, Sequoia, and Yosemite (Hall and Kelson 1959). Restoration of the natural fire regime has more or less been implemented in these parks, so the dynamic processes that may have originally influenced mule deer in this region may be present in at least portions of the range of these deer populations. Restoration of natural regulatory processes for mule deer in this region would have to consider influence of timber harvest, and livestock grazing of the range of these deer when outside the parks, and of course hunter harvest. Residential developments may intervene to inhibit restoration of a true natural regulation process. However, there may be opportunities to approach that process if examined closely, and it is in these cases that Caughley's (1981) doubts about controlling mechanisms differing according to whether man perturbs the system or not deserve further attention.

Does all this matter? We have to make do with that we have to work with. Maybe there is insufficient biotic diversity modified by native ungulate grazing, either in the artificial or natural state, to make a difference. Maybe attempts to identify forces that naturally regulate ungulates are so compromised by man's all-pervasive influence that they are useless. Perhaps these are goals that we must strive towards – ideals that are never reachable. Considering the special significance of national parks and wilderness areas to society, maybe that is the way it should be. But then again, we might try to find out.

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REFERENCES

Allen, D. L. 1979. *Wolves of Minong – their vital role in a wildlife community.* Boston: Houghton Mifflin Company.

Bell, R.H.V. 1971. A grazing system in the Serengeti. *Scientific American* 225:86-93.

Caughley, G. 1970. Eruption of ungulate populations with emphasis on Himalayan tahr in New Zealand. *Ecology.* 51:53-72.

______. 1981. Comments on natural regulation of ungulates (What constitutes a real wilderness?). *Wildlife Society Bulletin.* 9:232-234.

Craighead, J.J. and J.A. Mitchell. 1981. Grizzly bear. In J.A. Chapman and G.A. Feldhamer, eds. *Wild Mammals of North America,* pp. 515-56. Baltimore, MD: Johns Hopkins Press.

Hall, E.R. and K.R. Kelson. 1959. *The mammals of North America, Vol. ii.* New York: The Ronald Press.

Hobbs, N.T. 1989. Linking energy balance to survival in mule deer: development and test of a simulation model. *Wildlife Monographs* 101.

Houston, D.B. 1971. Ecosystems of National Parks. *Science.* 172:648-651.

Klein, D.R. 1968. The introduction, increase and crash of reindeer on St. Matthew Island. *Journal of Wildlife Management.* 32:350-367.

Krefting, L.W. 1974. *The ecology of the Isle Royale moose with special reference to the habitat.* University of Minnesota Agricultural Experiment Station Technical Bulletin 197. Forest Series 15.

Leopold, A. 1941. Wilderness as a land laboratory. *The Living Wilderness* 6:3.

McNaughton, S.J. 1976. Serengeti migratory wildebeest: facilitation of energy flow by grazing. *Science* 191:92-96.

Messier, F. and M. Crete. 1985. Moose-wolf dynamics and the natural regulation of moose populations. *Oecologia* 65:503-512.

______. 1984. Body condition and population regulation by food resources in moose. *Oecologia* 65:44-50.

Parker, I.S.C. 1983. The Tsavo story: an ecological case history. In R. N. Owen-Smith, ed. *Management of large mammals in African conservation areas,* pp. 37-49. Pretoria, South Africa: Haum Educational Publishers.

Peek, J.M. 1980. Natural regulation of ungulates (What constitutes a real wilderness?). *Wildlife Society Bulletin* 8:217-227.

______. 1981. Comments on Caughley's comment. *Wildlife Society Bulletin* 9:234-237.

Peterson, R.O., R.E. Page, and K.M. Dodge. 1984. Wolves, moose, and the allometry of population cycles. *Science* 224:1350-1352.

Rolston III, H. 1990. Biology and philosophy in Yellowstone. *Biology and Philosophy* 5:241-258.

Ross, B.A., J.R. Bray, and W.H. Marshall. 1970. Effects of long-term deer exclusion on a Pinus resinosa forest in north-central Minnesota. *Ecology* 51:1088-1093.

Scott, J.M., et al. 1987. Species richness: a geographic approach to protecting future biological diversity. *BioScience* 37:782-788.

Scott, J.M., et al. 1990. Playing Noah while paying the devil. *Bulletin of the Ecological Society of America* 71:156-159.

Sinclair, A.R.E. 1977. *The African buffalo: a study in resource limitation of populations.* Chicago: University of Chicago Press.

FORCES OF CHANGE FOR WILDLIFE IN YOSEMITE NATIONAL PARK

Jeffrey A. Keay[1]

Several sources of human activities affect the natural integrity of wildlife populations in Yosemite National Park. They occurred 1) historically, 2) within the park, 3) across political boundaries, and 4) in distant locations. The park has four ongoing wildlife management programs that demonstrate the variety and types of those pressures and provide a perspective of the types of forces yet to affect the park. Hunting and domestic sheep grazing eliminated bighorn sheep from the central Sierra Nevada Mountains by the late 1800s, including what is now Yosemite National Park. Failure of remnant populations to expand naturally promulgated the reintroduction of bighorn sheep in 1986. Open-pit garbage dumps associated with human developments and increasing visitation within the park in the 1920s attracted bears, resulting in personal injuries and property damage to humans and altered food habits, habitat use patterns, movements, distribution, reproductive rates, and presumably abundance of bears. A comprehensive management program was implemented in 1975 to restore the natural integrity of the black bear population and protect visitors and their property. The park supports a large deer herd but contains essentially no winter range. Deer cross the park boundary in fall and are hunted, which alters herd sex and age ratios. Deer winter on public land where timber harvest, livestock grazing, mining, and recreation are among the important multiple-use activities. Habitat loss occurs on private land that is increasingly used for homesite development as foothill communities serve retirees and commuters to Central Valley and Bay Area cities. Peregrine falcons continue to suffer from pesticide poisoning that originates from agricultural practices in California and Central and South America. Managers must look beyond unit boundaries for opportunities to affect decisions that could have consequences to the integrity of natural area plant and animal communities. Building effective relationships with other governmental agencies through cooperative conservation and education programs will foster goodwill and allow opportunities for objective input. Wildlife management and research projects in Yosemite provide unique opportunities to gather information of value to animal population restoration efforts in other states, countries, and continents. Black bear research has provided important population dynamics information that will be valuable to conservation efforts for other bear species.

Wednesday, October 17, 3:30 pm

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THREATENED AND ENDANGERED ANIMALS: BACK FROM THE BRINK

PEREGRINE FALCON BIOLOGY AND MANAGEMENT IN YOSEMITE NATIONAL PARK

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Abstract

Peregrine falcons were discovered nesting in Yosemite National Park in 1978 after an absence of 37 years. Disappearance of peregrines from most of North America has been attributed to residues of the pesticide DDT causing reproductive failure. The rediscovery of nesting peregrines in Yosemite has been followed by management efforts by the Park Service aimed at protecting and augmenting peregrine reproduction. Known active peregrine nests now total three in the park, but only one other active site is known in the entire Sierra Nevada, emphasizing the importance of Yosemite as a nucleus for recovery of this species in the mountains of California. Reproductive success and longevity of peregrine falcons, however, continue to be affected in the park by pesticide residues from outside sources. This problem, despite the protection of park boundaries, argues for continued listing of peregrine falcons as an endangered species.

DISAPPEARANCE AND REDISCOVERY

In 1978, rock climbers scaling the face of El Capitan in Yosemite Valley found peregrine falcons *(Falco peregrinus)* nesting there; the first time in over 35 years that this species had been confirmed as breeding in the park. Their disappearance from Yosemite had occurred quickly, following the pattern of peregrine falcon populations over much of the world. The cause of this slide toward extinction was a mystery until researchers discovered that many falcons were suffering reproductive failure because the eggs they laid had abnormally thin shells. Eggs thus affected were often broken during incubation or poorly resisted dehydration, resulting in embryo death. Further research indicated that the use of organochlorine pesticides such as DDT was the cause of such large-scale problems (Hickey and Anderson 1968; Hickey 1969).

Organochlorine pesticides, developed during the technological flood of World War II, were hailed as miracle chemicals for eradicating disease vectors and helping to feed the world's population by controlling agricultural pests. As their use increased, however, serious troubles became apparent. Insects quickly developed resistant strains that required ever-increasing doses of pesticides to be killed. Even more disturbing, however, were the wide-ranging effects that introduction of such massive amounts of pesticides into the environment had on organisms and ecosystems even distant from the points of application. In organisms, DDT is metabolized into the residue DDE, which has proven to be an extremely stable compound that only slowly breaks down into nontoxic substances. Organochlorine pesticides residues are fat soluble, which means they are not quickly flushed from an animal's body but accumulate in its fat tissues. This leads to a process termed "biomagnification," in which the amounts and effects of pesticides are magnified as they move up an ecosystem's food chain. For example, insects exposed to a pesticide such as DDT carry a small amount of DDE in their bodies. A bird that eats many insects then acquires each insect's DDE load, and any predator that eats these contaminated birds accumulates the pesticide contained in each of their bodies. Thus, over time, predators can accumulate large and toxic concentrations of pesticides in their bodies.

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In birds, endogenous fat reserves are mobilized during egg formation, causing the release of the pesticides they contain. The pesticides affect the bird's metabolism in a variety of ways, but reproduction is affected by disrupting shell formation as the eggs pass through the oviduct. Eggs thus impaired may break while being incubated or could fail to hatch because embryos die from dehydration.

The position of the peregrine falcon in the food chain made it vulnerable to large accumulations of organochlorine pesticides. Peregrines feed almost exclusively on other birds that in turn have fed on many insects, or, in the case on seacoasts, on marine life. Pesticides, present in the habitat in even minute amounts, thus built up in the bodies of peregrine falcons in many parts of the world, leading to large-scale reproductive failure and plummeting populations.

Some researchers have presented data suggesting that DDT and its effect on reproduction were not the primary causes of peregrine falcon population declines. They pointed out that the patterns of the decline more closely followed the use of cyclodiene pesticides such as dieldrin (Newton 1974; Ratcliffe 1980; Nisbet 1988). These pesticides have more immediate toxic effects than DDT, killing adult falcons. Population models presented in support of this theory suggest that such mortality more adequately explains the crash. Few researchers, however, dispute that each type of pesticide pollution played its own role in decimating peregrine numbers.

The realization that peregrine falcons were slipping toward extinction, the discovery of its cause, and the publicity that followed were probably the most significant events in focusing public attention on the much larger overall pollution problem. Largely due to this attention, use of organochlorine pesticides in the United States was essentially banned in 1972. By this time, however, peregrine falcons had been on the federal endangered species list for two years, and California's population of peregrines was reduced an estimated 95 percent (Herman 1971).

Soon thereafter, numbers of peregrine falcons began to rebound slowly (Thelander 1976; Harlow 1977; Boyce 1979, 1980), helped along by active human efforts to protect and augment their reproduction. The Santa Cruz Predatory Bird Research Group (SCPBRG), an associate organization of The Peregrine Fund, was responsible for many of these efforts on the West Coast, including those in Yosemite that followed the rediscovery of peregrines in the park. At their facilities, located on the campus of the University of California, Santa Cruz, they have maintained a captive breeding population of falcons and safely incubated and hatched thin-shelled eggs collected from wild nests. More than 650 young falcons produced from these operations have been released into the wild to augment natural reproduction.

The return of peregrine falcons to Yosemite is seen as one manifestation of a rebounding population. Since the 1978 discovery on El Capitan, other breeding peregrines have been found in the park, further indicating that the species is recovering. In 1980, researchers found peregrines nesting at Hetch Hetchy Reservoir. This site has proven to be the most productive in the park; four young fledged from there in 1990. The suspected reason for this high success, compared to other nest sites in the park, is discussed later.

Half Dome, in Yosemite Valley, was the site of another discovery of breeding peregrine falcons in 1989. For unknown reasons, reproduction was unsuccessful in that year, but the pair moved to a different nearby site in 1990 and raised one young.

In 1990, a third pair of falcons was discovered in the southern region of the park near Wawona. Pair-bonding behavior was observed, but nesting did not occur. Observations suggested that the female of this pair was immature and thus would probably not initiate a nest until the following year.

This apparently growing population of peregrine falcons in Yosemite and the reoccupation of long-vacant nest sites across the country lends credence to the argument that the species has returned from the brink of extinction. But is the species indeed safely away from such a fate? Is it time, as some scientists and federal officials argue, for peregrine falcons to be the first federally endangered species to be removed from the list, and thus officially declared "saved"? Some answers may be found by examining the continuing threats to peregrine falcons, even those seemingly safe inside the boundaries of Yosemite National Park.

PESTICIDES

In 1981, eggshells collected from the El Capitan aerie were found to be critically thinned, prompting intensive manipulation of this site in following years to increase reproductive success (see section on assisting reproduction below). To the public, this was probably a shocking revelation; that peregrine falcons were continuing to be affected by pesticide residues even in a natural and governmental stronghold like Yosemite. To biologists working with the falcons, it was another familiar and discouraging example of the expanses of time and distance over which these toxins can be carried. Their research has identified several possible sources of this continuing contamination.

Although DDT has been almost completely banned in the United States and many other countries, its use remains widespread in developing nations. Significant to California's peregrine falcons is the heavy use of DDT and other organochlorine pesticides in Latin America. Many bird species that breed in California winter south of the U.S. border. There the birds accumulate pesticide residues, then return to California in the spring and are preyed upon by peregrines. Analyses for pesticide residues in the tissues of peregrine prey species in California showed at least a partial correlation between level of pesticide contamination and the degree of migratory behavior in a species (Monk et al. 1981).

However, the level of contamination in a species is also a function of its food habits. For example, both violet-green swallows and black-headed grosbeaks are migratory, but analysis of birds collected in Yosemite showed that swallows carried approximately 30 times the DDE load of the grosbeaks in parts per billion (Monk et al. 1981). Swallows are insectivorous and thus feed at a higher trophic level than the seed-eating grosbeaks and acquire greater pesticide residues.

These differences in pesticide levels among prey species are also thought to explain differences in nesting success between two of Yosemite's peregrine aeries. The eggshell thinning found at the El Capitan site is believed to come from the violet-green swallows and white-throated swifts that abound on the cliffs there and probably form a significant portion of the diet of the local peregrine falcons. Although white-throated swifts in Yosemite have not been tested for pesticide residues, they are also thought to be heavily contaminated because, like the violet-green swallows, they are insectivorous and migratory. In contrast, the continuing higher success of the falcons at Hetch Hetchy is attributed to their greater reliance on resident bird species such as Steller's jays, band-tailed pigeons, and several species of woodpeckers.

Levels of DDE contamination in peregrine falcon eggs in California declined little throughout the 1980's despite continuing severe restriction of organochlorine pesticide use in the United States (Monk and Walton 1988). This could be a reflection of foreign pesticide sources, but possible domestic sources must also be considered.

Some data suggest that DDE contamination found in peregrine prey species may simply be persistent residues from before DDT use in the United States was strictly controlled in 1972 (Risebrough et al.

1981). If this is true, the continuing high levels of contamination suggest unexpected persistence of DDE, or the existence of toxin "sinks" that constantly release contaminants into the environment.

Some research has implicated the dicofol pesticide Kelthane as a source of DDT (Hunt et al. 1986) that occurs as a contaminant during the manufacturing process. The Environmental Protection Agency has allowed continued use of Kelthane and other dicofol products under the provision that DDT and any other contaminants these products may contain remain less than 0.1 percent. This concentration is extremely low, but it may still contribute to continuing contamination of peregrine eggs, especially if Kelthane is used heavily.

Peregrine eggs that contain high levels of DDE also tend to be heavily contaminated with PCB (Monk et al. 1981), an industrial pollutant that has also proven to be highly persistent in organisms and ecosystems. Direct toxicity of DDE and PCB may explain high rates of infertility and embryo death among peregrine eggs in some areas. In 1990 SCPBRG collected 78 peregrine eggs from natural nests for captive hatching. Of these, 26 (34 percent) were either dead or infertile at the time of collection, and of the remaining 52 eggs, 36 (70 percent) hatched. Some of the eggs died from heavy contamination, while others showed developmental abnormalities that may have resulted from lower levels of toxins (Linthicum et al. 1990).

OTHER THREATS

Unquestionably, the wide-ranging effects of pesticides were the primary cause of the near-extinction of peregrine falcons, and today continue to be the largest barrier to complete recovery of the species. Other factors affecting peregrines on a smaller scale, however, cannot be ignored, especially considering the severely reduced populations.

Habitat Loss – U.S. populations of peregrine falcons had begun to slowly decline prior to World War II and the production of organochlorine pesticides, probably as a result of habitat destruction related to an increasing human population (Hickey 1969). In California, urban and agricultural development have destroyed nearly all central valley wetlands that once supported abundant avian prey, and coastal developments have affected peregrine nesting and feeding areas there. These habitat impacts have probably slowed the recovery of peregrine populations in some locations and may inhibit a return to natural numbers even if pesticides can be eliminated from the food chain.

Wintering areas of Yosemite peregrine falcons are unknown, but likely are at lower elevations of California where habitat degradation has occurred. This may limit the number of peregrines that can ultimately reoccupy the park.

Falconry – Peregrines are highly prized by falconers for their power and speed. When numbers of the falcons were precariously low in the late 1960s, collection of young peregrines from nests by falconers was a significant threat to those remnants, causing locations of aeries to be held in secrecy. Sympathy for the plight of peregrines and vigorous enforcement of laws protecting the birds have greatly reduced this threat, but the continuing high value of peregrines has prompted caution from people working for their recovery. In Yosemite, locations of aeries are not publicized and observers watch for human intruders.

Shooting and Collisions – When peregrines leave Yosemite, they increase their vulnerability to some forms of human-caused mortality. Peregrines that use wetlands in the central valley are putting themselves in the range of waterfowl hunters' guns. There, hunters may misidentify the falcons as gamebirds, or they may shoot peregrines, mistakenly thinking they are competitors for their quarry. Others are probably shot as just another unidentified target flying past or perched on a power pole.

A peregrine in full-speed pursuit of prey may not see the thin, tightly strung strands of a power line or fence. Collisions with these unnatural obstacles, which are much more common outside of Yosemite, have been known to cause the deaths of peregrines.

Neither shooting nor collisions are major influences on peregrine falcon populations compared to pesticide contamination. Given the reduced population, however, loss of individuals may slow the recovery of the species. No reproduction occurred at the El Capitan aerie in 1979 and 1983 because only one member of the pair was present; presumably the other member had died and the remaining peregrine did not find another mate in time for reproduction to occur.

MANAGEMENT

The Federal Endangered Species Act of 1973 charges all federal agencies with conserving endangered species. With this mandate in effect, the National Park Service initiated extensive management actions when peregrine falcons reappeared in Yosemite. These actions have continued through the present, with the goal of achieving a stable, self-sustaining population of peregrine falcons in the park.

Area Closures – Disturbance of nesting falcons may adversely affect their nesting success. Therefore, strict control of access to areas around nest sites is an important component of the recovery program.

Yosemite is world famous for its sheer granite faces, drawing thousands of rock climbers each year. This popularity makes it necessary to enforce closures of climbing routes near nest sites. Climbing is prohibited within approximately 400 feet on either side of an aerie, and from the base to the rim of the cliff within that distance. Peregrines may arrive in the nesting area and begin selection of a site months before eggs are laid. Climbing closures are, therefore, put into effect at the beginning of January each year to ensure that disturbance does not influence where or if the falcons nest, and are not opened again until the first of August, by which time the young should have dispersed from the nest. Signs are posted at the bases of closed areas and closures are announced in Park Service publications and fliers. During nesting, observers monitor activity at aeries and immediately report any violations of area closures to park rangers who take action to stop and cite trespassers.

Aircraft that fly too close to aeries can cause reproductive failure. An incubating parent, when startled, may flush from the nest, kicking the eggs from the ledge or damaging them in the nest. Also, young peregrines may fall from the aerie when frightened by the sudden close approach of aircraft. Park regulations mandate a minimum 2,000-foot altitude for aircraft flying over any part of Yosemite. Despite this restriction, low flights, especially by military aircraft, regularly occur. No reproductive failure has been attributed to this disturbance. Nonetheless, the potential for damage exists and personnel monitoring aeries report any airspace violations, recording the aircraft type and any identifying markings. The Federal Aviation Administration is notified of civilian aircraft violations, and appropriate military officials are contacted when their aircraft are identified buzzing too low.

Helicopters are often used by the Park Service for medical and rescue emergencies, but these aircraft can also be a threat to falcons. Pilots of Park Service-authorized aircraft are notified of aerie locations and are instructed to stay at least 1/2 mile from them. Landing is prohibited in nearby meadows. If human lives are at stake, these restrictions can be countermanded, but Wildlife Management personnel must be notified so they can help direct operations and minimize disturbance of the falcons. For example, a helicopter may be allowed to come close to an aerie during a rescue, but it must approach slowly from a distance to avoid startling the birds.

Monitoring – Long hours are spent in the field by observers providing almost continuous monitoring of peregrine nest sites in Yosemite. High-powered spotting scopes are used to closely follow activities of the falcons and detailed field notes are kept of observations. This considerable effort has several functions. First, it provides protection of the sites by detecting and reporting violations of the area closures around aeries noted above. Also, the monitoring yields valuable data about the chronology of courtship, nest initiation, incubation, hatching, and fledging. These data are necessary for managers to evaluate possible problems affecting reproduction and to successfully manipulate nests to improve reproduction (see below). Observations collected also provide important basic information on reproductive behavior of the species.

Hacking – Population models indicate that recovery of peregrine falcons to natural numbers can be greatly hastened by augmenting the local population through the release of captive-reared birds (Asay and Davis 1984). Recently, this has been pursued by "hacking" peregrines in Yosemite. This strategy, long practiced by falconers, involves confining young falcons that are near fledging to an enclosure ("hack box"). There they are regularly fed, bonding the young birds to the box as the location of a food source. Food is dropped through a chute in the box to minimize disturbance of the falcons and to keep them from associating humans with food. After approximately a week of confinement, the birds are released. Food continues to be provided at the box, but, in the meantime, the young falcons gradually acquire their natural hunting skills and become independent.

This technique, adding young falcons to the population without the presence of parents, has been used in Yosemite since 1987. The operation has required a source of captive-reared peregrines, supplied by the SCPBRG, which has also supplied personnel trained in falcon release procedures. These people, assisted by Park Service personnel, have operated hack boxes in two locations in the northern part of the park. Over the past 4 years, a total of 21 peregrine falcons have been released in this manner, with 12 (57 percent) confirmed as surviving to independence. Causes of release failure included predation by golden eagles *(Aquila crysaetos)* and great horned owls *(Bubo virginianus)*, and disappearance due to unknown causes. Some falcons apparently failed to bond adequately to the hack box, failing to return for food and probably starved.

Hack site attendants, however, monitor the progress of the falcons nearly 24 hours a day, enhancing success by protecting the birds. Eagles are hazed away by shotgun blasts, and the falcons, fitted with small, temporary radio transmitters, can sometimes be recaptured and returned to the box if they encounter difficulty.

Augmentation – As previously discussed, pesticide contamination of female peregrine falcons can adversely affect their reproductive success by causing them to lay eggs with abnormally thin shells. Research has shown that eggs with shells thinned 15 percent or more have little chance of hatching under natural incubation. To ensure the successful reproduction of a pair of peregrine falcons thus affected in Yosemite, biologists have intervened. In 1981, eggshells collected from the El Capitan aerie at the end of nesting season showed that they had become dangerously thin and the prospect of successful hatching under natural incubation in coming years was in doubt.

In 1982, observers carefully monitored this site, precisely determining when the falcons began incubation. At 10 days into incubation, climbers went to the nest, carrying two downy peregrine chicks hatched in captivity at SCPBRG. Once there, the climbers removed the eggs and replaced them with the chicks. The eggs were then quickly transported to Santa Cruz in a special portable incubator where they were hatched to be used in similar manipulations of nests. Allowing the eggs to be incubated

10 days before they were removed from the nest minimized the chance of them dying in transport as they were then most resistant to damage from chilling and movement. At the Santa Cruz facilities, the eggs were incubated under conditions that protected them from dehydration and breakage. Despite the abrupt transition from eggs to well-developed young, the peregrine parents immediately accepted the chicks and began bringing them prey.

This procedure of replacing eggs with young is called "augmentation," and has been used five times in the past 9 years at the El Capitan aerie. Augmentation has thus ensured that the pair of falcons at this site have consistently produced young when, otherwise, high levels of pesticide contamination in the female would have probably led to consistent failure.

Eggshell Collection – The concern over continued effects of pesticide residue accumulation in peregrine falcons has led park biologists to seek data on rates of eggshell thinning in the peregrines nesting in Yosemite. After the chicks have fledged and dispersed from the nest site, climbers sift through sand and dirt there to recover eggshell fragments, by then pulverized to less than 1 cm square by activity at the nest. These fragments are then sent to the Western Foundation of Vertebrate Zoology in Los Angeles where scientists measure their thicknesses and compare them to measurements known for peregrine falcon eggs laid before the development of organochlorine pesticides. These data guide park biologists in determining whether action, such as augmentation, may be necessary to increase the chance of reproductive success for pesticide-affected peregrine falcons.

CONCLUSION

The Pacific Coast American Peregrine Falcon Recovery Team, a coalition of state, federal, and private organizations, in a 1982 recovery plan set a goal for average production of 1.5 young fledging from at least 120 nests for five consecutive years in Washington, Oregon, California, and Nevada. When these goals were met, the recovery team would evaluate a recommendation to reconsider the listing of the peregrine falcon as an endangered species.

As these goals are approached, discussion of down-listing the peregrine from endangered to threatened, or removing it from the list altogether increases. But this judgment should be made as the result of evaluating all available information rather than just achievement of precise numbers. In 1990, nearly half of all north coast nests failed, and many historical sites remained unoccupied. Continuing high levels of pesticide contamination and nest failure must be considered significant circumstances calling for caution in reducing the amount of legislated protection given peregrine falcons.

For the recovery of peregrine falcons to be ensured, future research must concentrate on identifying sources of pesticides and other toxins that affect the species. Action must then be taken to reduce the flow of these contaminants, even if it means enlisting the cooperation of other nations. Intensive, hands-on management assisting the survival of peregrine falcons cannot be expected to continue indefinitely.

In the recovery picture, park service lands are important. All four known active aeries in the Sierra Nevada during 1990 were in national parks: the three in Yosemite plus another in Sequoia and Kings Canyon. These parks thus represent important nuclei for the recovery of peregrine falcons in eastern California. This potential, however, can be realized only when a stable, self-perpetuating population of peregrines is achieved. This goal seems unlikely as long as pesticides and other toxins continue to flow through the boundaries of parks and affect the reproduction and survival of peregrine falcons finding apparent refuge there.

REFERENCES

Asay, C. E. and W. E. Davis. 1984. *Management of an endangered species in a National Park: the peregrine falcon in Yosemite.* Technical Report Number 16. National Park Service. Yosemite National Park. Unpublished report.

Boyce, D. A. 1979. *California peregrine falcon reproductive success and protective effort in 1979.* U.S. Fish and Wildlife Service, unpublished report.

Boyce, D. A. 1980. *California peregrine falcon reproductive success and protective effort in 1980.* U.S. Fish and Wildlife Service, unpublished report.

Harlow, D. L. 1977. *The reproductive success and protective effort of peregrine falcons in California, 1977.* U.S. Fish and Wildlife Service, unpublished report.

Herman, S. G. 1971. The peregrine falcon decline in California. *American Birds* 25:818-820.

Hickey, J. J. (editor). 1969. *Peregrine falcon populations: their biology and decline.* Madison, WI: University of Wisconsin Press.

Hickey, J. J. and D. W. Anderson. 1968. Chlorinated hydrocarbons and eggshell changes in raptorial and fish-eating birds. *Science* 162: 271-273.

Hunt, G. W., B. S. Johnson, C. G. Thelander, B. J. Walton, W. M. Jarman, A. M. Springer, W. Walker II, R. W. Risebrough, and J. G. Monk. 1986. Environmental levels of p,p'-DDE indicate multiple sources. *Environmental Toxicology and Chemistry* 5:21-27.

Linthicum, J. 1990. *Peregrine falcon monitoring, nest management, hack site, and cross-fostering efforts-1989.* Santa Cruz Predatory Bird Research Group.

Monk, J. G., W. M. Jarman, B. J. Walton, and R. W. Risebrough. 1981. *Distribution of DDE residues in prey species of California peregrine falcons.* The Bodega Bay Institute, Berkeley, California. Unpublished manuscript.

Monk, J. G., and B. J. Walton. 1988. *California peregrine falcon implementation plan.* Santa Cruz Predatory Bird Research Group.

Newton, I. 1974. Changes attributed to pesticides in the nesting success of the sparrowhawk in Britain. *Journal of Applied Ecology* 11:95-101.

Nisbet, I. C. T. 1988. The relative importance of DDE and Dieldrin in the decline of peregrine falcon populations. In: *Peregrine Falcon Populations: Their Management and Recovery.* Cade, T. J., J. H. Enderson, C. G. Thelander, and C. M. White (editors).

Ratcliffe, D. A. 1980. *The peregrine falcon.* Vermillion, SD: Buteo Books.

Risebrough, R. W., J. G. Monk, and W. M. Jarman. 1981. *Origins of organochlorine pollutants accumulated by California peregrine falcons.* The Bodega Bay Institute, Berkeley, California. Unpublished manuscript.

Thelander, C. G. 1976. *Distribution and reproductive success of peregrine falcons* (Falco peregrinus anatum) *in California during 1975 and 1976*. State of California, Department of Fish and Game Administrative Report Number 76-3.

MOUNTAIN BEAVERS IN YOSEMITE: HABITAT USE AND MANAGEMENT IMPLICATIONS OF A RARE SPECIES

Paul A. Todd[1]

Abstract

Sierra Nevada mountain beavers (Aplodontia rufa californica) *were studied in Yosemite National Park, California to describe current and historic distribution, habitat use, and management implications. I surveyed 120 kilometers of randomly selected riparian areas in the park and found that distribution changed over the past 100 years in part from human impacts. Total abundance probably decreased minimally but development pressures impacted several active sites. Univariate analyses were used to identify habitat variables that distinguish used from unused areas, and to provide information for habitat management in the Yosemite National Park region. Out of 12 variables, shrub and herbaceous plant abundance, stream depth, and stream gradient were strongly associated with habitat use. Techniques used in this investigation may be applicable to species of concern in other natural areas.*

INTRODUCTION

Mountain beavers occur along the Pacific slope of western North America from lower British Columbia south to the Sierra Nevada of California. They are confined to well-vegetated, moist, cool environments – a function of their poor ability to concentrate urine and low tolerance for temperature extremes (Nungesser and Pfeiffer 1965). Compared to the humid environments of the Pacific Northwest, their preferred habitat is rare in the seasonally arid Sierra Nevada. Consequently, mountain beavers in this region have a scattered distribution and typically live in small, disjunct populations, some of which have become locally extinct or impacted by human activities (Wright 1969; Steele 1986; Todd 1990).

Three mountain beaver subspecies in California are now candidates for the federal Endangered Species List including a Mono Basin population (category 2) adjacent to Yosemite's east side (California Department of Fish and Game 1986, Federal Register 1989). Little quantified information was available on mountain beaver habitat use in the central Sierra Nevada and previous research reported that distribution in the area had been negatively affected by human impacts (Steele 1986).

The objectives of this study were to estimate mountain beaver distribution in Yosemite National Park, compare current distribution to the known, historic distribution, and identify environmental variables for characterizing potential habitat. The investigation was conducted during the summers of 1988-89.

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METHODS

The study area included 120 kilometers of randomly sampled perennial riparian habitat above 1,520 meters in Yosemite National Park. Areas below 1,520 meters elevation and with gradients >30 degrees were excluded to decrease the size of my sampling area and because mountain beavers rarely occur outside these limits in the park. (I obtained 30 historic accounts of mountain beavers in the park between 1915-88 and none were below 1,520 meters elevation.) However, occupancy below this elevation has occasionally been recorded in other central Sierra Nevada areas (Storer et al. 1944) and should not be ruled out.

The presence of mountain beavers is typically associated with moist meadows and riparian zones near small perennial springs and creeks within the montane zone. Sites have drained, sandy loam soils and are dominated by one or more of the following woody plants: dogwood *(Cornus* spp.), labrador tea *(Ledum glandulosum)*, willow *(Salix* spp.), alder *(Alnus* spp.), and aspen *(Populus tremuloides)*. Common herbaceous plants include cow parsnip *(Heracleum lanatum)*, corn lily *(Veratrum californicum)*, broad-leaved lupine *(Lupinus latifolius)*, fireweed *(Epilobium* spp.), and various grasses (Todd 1990).

Eight randomly selected, 15-kilometer long tracts (120 kilometers total) of riparian areas in Yosemite National Park were surveyed for the presence of mountain beavers. To obtain these tracts I generated eight random Universal Transverse Mercator (UTM) coordinates above the 1,520-meter contour. To facilitate surveying efficiency, the riparian habitat crossed by a road or trail nearest each random point was the center of each tract. I then surveyed 7.5 kilometers up and down the watershed along perennial rivers, creeks, and springs.

An active mountain beaver site was confirmed and plotted on 1:62,500 topographic maps when burrows were found with sign of activity (clippings and/or haystacks). I used breaks in burrow presence of at least 50 meters to distinguish between sites in densely populated areas. To estimate the number of active sites in the park, I extrapolated the frequency of sites found in the 120 kilometers of random survey tracts to all perennial riparian habitat above 1,520 meters elevation (2,018 kilometers estimated from Yosemite's Geographical Information System).

I defined "historic sites" as any reported location of mountain beaver sign in the park before 1988. Only those historic sites that could be relocated were inspected for mountain beavers; occupied historic sites were plotted on 1:62,500 topographic maps.

I analyzed habitat to identify environmental factors that might influence use. Seven physical and five vegetation variables were measured at 100-meter long sample reaches. One variable was categorical (susceptibility to flooding); all others were continuous. I measured stream gradient and aspect at the midpoint of each reach and determined elevation from 1:62,500 topographic maps. Stream depth and width were averaged from three measurements taken at 25-meter intervals along the reach. Percentages of cover were estimated visually when vegetation was fully leaved, and aspen abundance was the number of trees per reach. I defined trees as woody plants >15 centimeters diameter at 1.5 meters above ground. Categories for susceptibility to flooding were based on signs of seasonal flooding (high water marks and drift material).

To obtain samples of used versus unused reaches, I randomly selected sample reaches from the 120 kilometers of random survey tracts. Each sample reach was 100 meters long by 60 meters wide and placed lengthwise along perennial riparian areas. For occupied samples I randomly selected 33 reaches from confirmed mountain beaver habitat in the random survey tracts. Sample reaches unoccupied by mountain beavers in each 15-kilometer survey tract were allocated according to the area unoccupied per tract.

To evaluate variables, I explored distributions within and relationships between each variable with boxplots, dotplots, and two-sample Kolmogorov-Smirnov tests. Variables with strong differences between used and unused reaches were considered important or related to factors affecting mountain beaver presence. A Spearman correlation matrix was used to identify highly correlated variables. I then described habitat according to the easiest-to-measure and least correlated variables that showed strong differences between used and unused reaches.

RESULTS

Historic versus Current Distribution

Approximately half of the relocated historic sites contained active mountain beaver populations. Using 30 site descriptions from 1915-88 in Yosemite National Park, I positively relocated 11 sites, five of which had current mountain beaver activity.

More areas were currently occupied by mountain beavers than I expected based on previous records. I found 41 active sites in the park, 33 of which were in 7 of the 8 random survey tracts. Based on the surveys, I estimate that mountain beavers now occupy 200 to 550 sites in Yosemite National Park. In general, these sites were most concentrated and largest in red fir forests where small, perennial springs and creeks are common. Median elevation of 33 random occupied sites was 2,219 meters (inter-quartile range (IQR) = 935) and ranged from 1,585 to 3,262 meters, the highest elevation yet recorded for mountain beavers. Geographical extent and number of burrow systems in occupied areas varied greatly between sites, and appear to reflect the abundance of suitable habitat. Length and width of occupied areas (n = 41) had medians of 87 meters (IQR = 155) and 20 meters (IQR = 16), respectively. Burrow holes per site ranged from 4 to 175 (table 1).

Habitat Use

Mountain beaver habitat generally had more shrub cover, steeper stream gradients, narrower and shallower streams, more herbaceous growth, and more soil than unused sites. Nine of 12 variables showed strong differences between used and unused perennial riparian areas (table 2).

Of these nine variables, shrub cover, herbaceous cover, stream depth, and stream gradient were most associated with habitat. They showed strong differences ($P < 0.01$) between used and unused areas, were easy to measure, and were not highly correlated ($r^2 \leq 0.5$). Seventy-five percent of the used reaches were covered >60 percent by shrub species and >90 percent by herbaceous species. Stream depth on used reaches had a median of 2.7 centimeters (IQR = 2.5) versus 12.3 centimeters (IQR = 15) for unused reaches. In used reaches, stream gradient ranged from 6 to 27 degrees with a median of 10 degrees versus 5.5 degrees for unused reaches (table 2). I found running water at all sites, but in some cases it was only visible trickling through the bottom of burrow holes.

Mountain beavers harvested a wide variety of woody and herbaceous species that occurred within approximately 30 meters of burrow systems. I identified at least 48 plant species (six trees, 14 shrubs, and >28 herbs) clipped or stacked in the park. Red fir, dogwood, willow, and corn lily were harvested most frequently (≥20 percent occurrence at 41 sites) but all available plant material appeared to be utilized (Todd 1990).

Table 1. Geographical extent (meters) and number of burrow holes for active mountain beaver sites (n = 41) in Yosemite National Park, California, 1989

	Geographical Extent		
	Length	Width	#Burrow Holes
Median	87	20	25
Quartile 1	45	14	14
Quartile 3	200	30	60
Maximum	450	100	175
Minimum	15	5	4

Table 2. Median (MED), minimum (MIN), and maximum (MAX) values for 12 habitat variables on reaches used (n = 33) and unused (n = 34) by mountain beavers in Yosemite National Park, California, 1989. Significant differences between distributions are denoted by an asterisk (Kolmolgorov-Smirnov, P < 0.01)

	Mountain beavers					
	Present			Absent		
Variable	MED	MIN	MAX	MED	MIN	MAX
Stream Gradient (deg)	10	6	27 *	5	1	20
Elevation (m)	2,219	5,200	10,700	2,697 *	5,200	10,900
Aspect[1] (deg)	260	–	–	235	–	–
Flood Susceptibility[2]	1	1	2 *	2	1	4
Stream depth (cm)	2.7	0.2	7.7 *	12	0.7	75
Stream width (cm)	9.7	0.7	113.3 *	135	3.7	966.7
Soil cover (pct)	97	60	100 *	80	5	100
Shrub cover (pct)	70	35	96 *	25	5	80
Herbaceous cover (pct)	80	30	100 *	60	4	94
Willow cover (pct)	10	0	96	13	0	80
Dogwood cover (pct)	15	0	76 *	0	0	20
Aspen abundance	0	0	40	0	0	19

1. Reporting these values can be nonsensical if aspect distributions are bimodal. In this case, distributions were not bimodal and the contrast is valid.

2. Flood Susceptibility index: 1 = no sign of seasonal flooding, 2 = sign of occasional seasonal flooding, 3 = sign of major occasional seasonal flooding, 4 = sign of major and regular seasonal flooding.

DISCUSSION

Historic versus Current Distribution

The distribution of mountain beavers in Yosemite National Park has apparently changed over the past 100 years. Naturally occurring local extinctions and dispersal movements have probably caused most of these changes. I suggest that populations in the Yosemite National Park region have historically been unstable and scattered. The nonhuman induced distributional changes that have occurred, whether due to extinction, recolonization, or dispersal, are normal for a species such as the mountain beaver that is near the edge of its range (Wright 1969).

In Sequoia National Park, Wright (1969) found mountain beavers at three sites and signs of past activity in nine different areas. Other historic records in Sequoia National Park from 1928-68 indicate periodic disappearance (Wright 1969). Sumner (1953) suggested that populations may die out or move away as food supplies dwindle, but may sometimes reappear later in the same area. Beier (1989) reported no change in habitat use by mountain beavers over the past 50 years in the Truckee River basin. In particular, neither human activity nor the introduction of beavers *(Castor canadensis)* had forced mountain beavers out of their historically used habitat. My results agree with this and, except for two parking lot developments that caused local extinctions, abundance and distribution has been affected minimally by human activity in the park.

Current Distribution

The 200 to 550 mountain beaver sites estimated for Yosemite National Park assumes the random survey tracts were good representations of potential habitat. Areas in the park not included in this study (below 1,520 meters) may occasionally support mountain beaver populations (see Methods).

It was difficult to extrapolate from numbers of sites to numbers of animals. This is mostly because censusing within populations has relied on indirect methods such as burrow estimates (Steele 1986). P. Beier (personal communication) estimated population size per site in the Sierra Nevada to be <8 adults, Steele (1986) 6-12, and Camp (1918) only 2. Given estimates of 2 to 12 adults per site, from 400 to 6,600 adults might live in Yosemite National Park at this time.

Habitat Use

Mountain beavers in the Sierra Nevada require abundant riparian plants for harvesting but species composition is relatively unimportant. Grinnell and Storer (1924), Steele (1986), and Beier (1989) came to similar conclusions, and Beier (1989) felt that dense shrub cover may also provide thermal and escape cover. This might be especially important in Yosemite National Park at high elevations where extreme temperatures and deep snow are common.

Stream gradient consistently correlates with mountain beaver presence in the Sierra Nevada (Camp 1918; Wright 1969; Beier 1989). Beier (1989) suggested that steeper gradients may promote water drainage and prevent burrow flooding. In Yosemite National Park mountain beavers use relatively high gradient, high elevation, small perennial creeks and springs with an abundance of riparian plants. By doing so, they are selecting a specific microclimate and may be minimizing exposure to intolerable stochastic events such as flooding and high temperatures.

CONCLUSIONS

Mountain beaver populations in the central and southern Sierra Nevada are generally small, isolated, and near the edge of their species' range. They apparently have a history of frequent local extinction and recolonization. Therefore a reservoir of unoccupied but suitable sites may be necessary to ensure long-term survival of the species over a large geographic area. The habitat characteristics I found to be most associated with used areas can help identify potential habitat in the central Sierra Nevada. If left undisturbed, these sites can maintain natural corridors for dispersal and colonization.

Currently, mountain beavers in Yosemite National Park probably do not need special management. However, land managers in less pristine areas may want to consider mountain beaver habitat needs before undertaking maintenance, development, and agricultural activities. In such cases perennial seeps and creeks should be evaluated for their potential to support mountain beavers. Particular attention should be paid to seep areas where flowing water may be confined to burrows and not immediately obvious; these areas are prime mountain beaver habitat. To preserve foraging areas, I recommend a buffer of at least 25 meters from existing burrow entrances and centers of potential habitat.

Future studies should compare mountain beaver abundance and distribution in Yosemite National Park to other less protected areas. This is one way to effectively estimate the true status of mountain beavers in the Sierra Nevada and the level of protection necessary to ensure continued existence throughout historic ranges.

Associations between mountain beaver distributional changes and climate changes that may occur within the next century should also be investigated. With global warming and drying climates mountain beaver distribution in the Sierra Nevada may contract to areas where more desirable thermal regimes could be found (e.g., higher elevations and northern exposures). Mountain beaver distributional changes in the central and southern Sierra Nevada could be one of the first biological impacts of changing climates.

ACKNOWLEDGMENTS

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REFERENCES

Beier, P. 1989. "Use of habitat by mountain beaver in the Sierra Nevada." *Journal of Wildlife Management* 53(3):649-644.

California Department of Fish and Game, Wildlife Management Division. 1986. *Mammalian species of special concern in California*. Williams, D.F. Administrative report number 86-1.

Camp, C. L. 1918. "Excavations of burrows of the rodent *Aplodontia* with observations on the habits of the animal." *University of California Publications in Zoology* 17(18):517-535.

Federal Register. 1989. *Proposed Rules*. Drewry, G. 54(4):554-579.

Grinnell, J. and T. Storer. 1924. *Animal Life in the Yosemite.* Berkeley: University of California Press.

Nungesser, W. and E. Pfeiffer. 1965. Water balance and the maximum concentrating capacity in the primitive rodent, *Aplodontia rufa. Comparative Biochemical Physiology* 14:289-297.

Steele, D.T. 1986. *The mountain beaver (Aplodontia rufa) in California.* Masters thesis, University of California Davis.

Storer, T. I., F. C. Evans, and F. G. Palmer. 1944. Some rodent populations of the Sierra Nevada of California. *Ecological Monographs* 14(2):166-192.

Sumner, L. and J. Dixon. 1953. "Birds and mammals of the Sierra Nevada with records from Sequoia and Kings Canyon National Parks." University of California Press, Berkeley.

Todd, P. A. 1990. *The distribution, abundance, and habitat requirements of the Sierra mountain beaver in Yosemite National Park.* Masters thesis, University of Montana, Missoula.

U.S. Department of Agriculture, Forest Service. 1980. *California wildlife and their habits: western Sierra Nevada.* J. Verner and A. S. Boss. General technical report, PSW-37.

Wright, J. W. 1969. *Mountain beaver (Aplodontia rufa) behavior: extreme southern limits.* Masters thesis, California State University, Chico.

CHEVRON'S SAN JOAQUIN VALLEY ENDANGERED SPECIES PROGRAM

Patrick Y. O'Brien[1]

Facing large reductions in available habitat from competing land uses such as agricultural development, urbanization, water projects, grazing, and mineral development, many representatives of the biological communities endemic to the San Joaquin Valley are already considered threatened or endangered under state and federal laws, while other candidate species await listing actions. Listed species include the San Joaquin kit fox, blunt-nosed leopard lizard, giant kangaroo rat, Tipton kangaroo rat, San Joaquin antelope squirrel, Bakersfield cactus, Bakersfield saltbush, and the California jewel flower.

The best long-term solution to the problem of endangered species is to take the actions needed to secure their continued survival and eventual recovery. Chevron works on behalf of the private sector in the San Joaquin Valley Endangered Species Work Group that has the responsibility to develop realistic recovery plans for federally listed species. The company worked with The Nature Conservancy and government agencies to gain congressional approval for funding the acquisition of land on the Carrizo Plain to set up a reserve for endangered species and to provide staff for the U.S. Fish and Wildlife Service to carry out needed administrative tasks. Finally, Chevron represents the petroleum industry on the Kern County Endangered Species Task Force that is developing a Habitat Conservation Plan (HCP) to provide for the long-term protection of sensitive species in the unincorporated areas of Kern County.

Wednesday, October 17, 1:30 pm

1. Patrick Y. O'Brien, Chevron Corporation, P.O. Box 7924, San Francisco, CA 94120.

THE LEE VINING BIGHORN SHEEP REINTRODUCTION: WHAT HAVE WE LEARNED?

Leslie S. Chow[1]
David M. Graber[2]

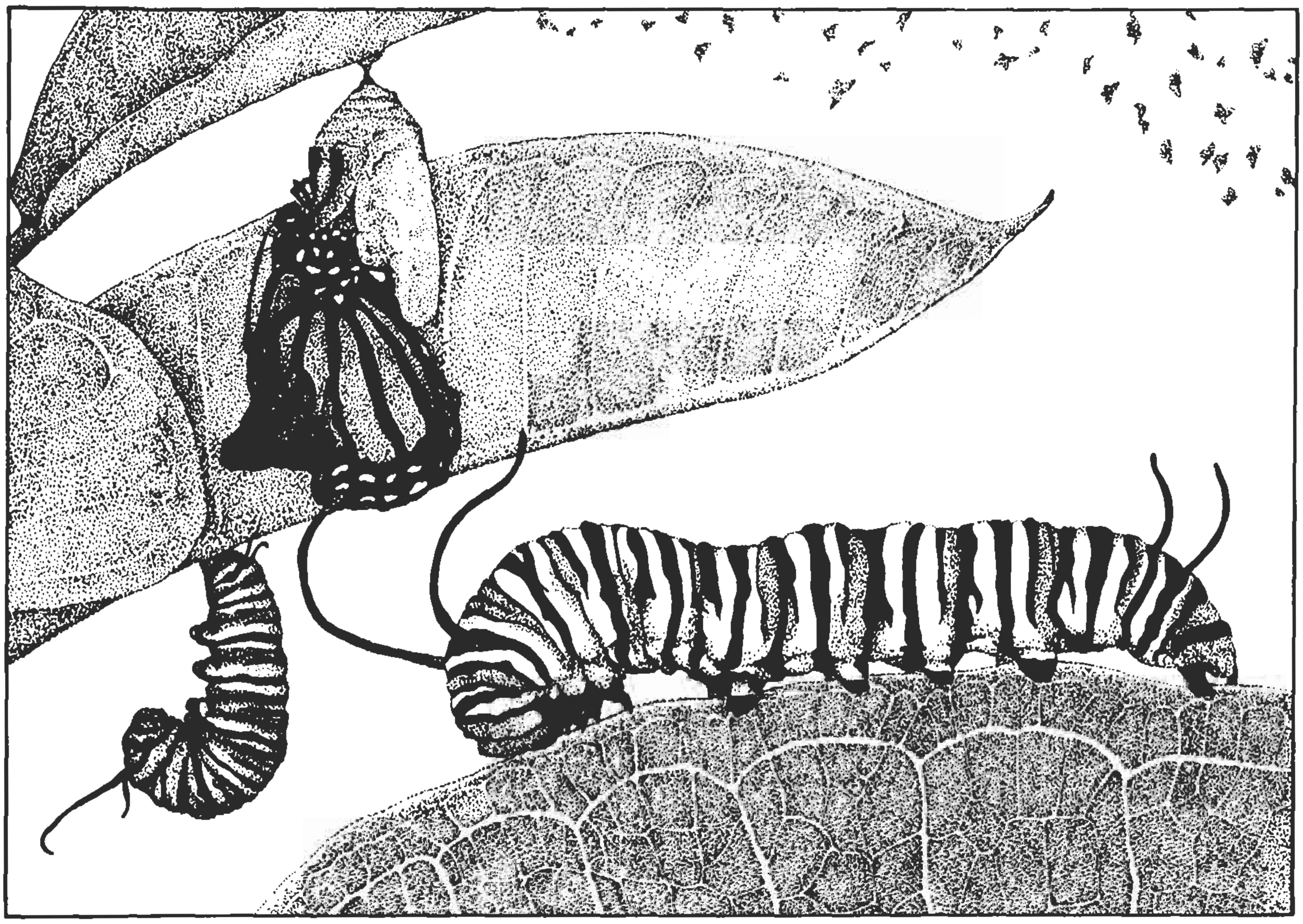
In March 1986, as part of an effort to restore bighorn sheep to historic ranges in the Sierra Nevada, 27 native Sierra bighorn were reintroduced to Lee Vining Canyon, Mono County, California. The herd was supplemented with 11 sheep in 1988. Intensive monitoring during the first five years following reintroduction enabled us to document herd growth and identify limiting factors. Herd growth averaged seven percent a year. A high reproductive rate was offset by mortality and dispersal. Primary sources of mortality were exposure and mountain lion predation. Five sheep migrated and established permanent residence in Bloody Canyon, 13 km south of Lee Vining Canyon. The effects of predation and dispersal on the growth of a small population are discussed.

Tuesday, October 16, 3:30 pm

1. Leslie S. Chow, National Park Service, Yosemite National Park, El Portal, CA 95318.

2. David M. Graber, National Park Service, Sequoia and Kings Canyon National Parks, Three Rivers, CA 93271.

VEGETATION



Feeding and Pupating Monarch Caterpillars, and Emerging Monarch Butterfly, *Danaus plexippus*
© 1983 Diana Dee Tyler

PALEOECOLOGY: GLIMPSES OF THE PAST

PALEOECOLOGY WITHIN CALIFORNIA'S SIERRA NEVADA NATIONAL PARKS: AN OVERVIEW OF THE PAST AND PROSPECTUS FOR THE FUTURE

R. Scott Anderson and Susan J. Smith[1]

Abstract

Paleoecological studies within and near Yosemite, Sequoia, and Kings Canyon national parks have been instrumental in determining the interaction between climate, disturbance, and vegetation, and have contributed to our knowledge of the relationship between environment and human adaptation in California. More studies have been undertaken in Yosemite than Sequoia or Kings Canyon national parks. The majority of data comes from sites within modern forested regions; little is known regarding the development of alpine tundra or chaparral vegetation. Future research will refine the vegetation chronology outlined here, concentrating on geographic areas and time periods where data are presently unavailable.

INTRODUCTION

The study of paleoecology is the study of ecosystems of the past. Paleoecologic investigations may encompass many aspects such as examination of vegetation change through time in response to changing climate, the history of forest disturbance by agents such as fire and humans, and conditions within the forests prior to introduction of exotic species. All of these investigations have been undertaken within the national parks of California's Sierra Nevada – Yosemite, Sequoia, and Kings Canyon. This article presents an overview of the history of paleoecological investigations within the central Sierra Nevada, concentrating on the region encompassing the national parks, and suggests a plan for additional studies necessary to complete a basic understanding of the vegetation history of the range.

Discussion of the paleoecology of the Sierra Nevada is an appropriate topic for the Yosemite Centennial Celebration and the 17th Annual Natural Areas Conference. Studies from Yosemite National Park have been instrumental in providing basic understanding of vegetation history in western North America. With myriad pressures on natural areas, outlined in numerous presentations in this conference, the study of natural conditions of the past within natural areas and reserves takes on a dimension of importance and even urgency. In times of rapidly changing environmental conditions due to impacts of humans, and climate change, studies within these relatively undisturbed areas can serve as yardsticks by which we measure environmental change in general.

In an article published just five years ago, Adam (1985) compiled what was known about the vegetation history of California. Although the earliest paper using modern techniques of fossil pollen analysis (Faegri and Iversen 1975) to deduce environmental change appeared in 1916 (von Post 1916), early work in North America (Osvald 1936), and specifically in California (Hansen 1942) lagged behind that of Europe. Most studies of vegetation change within the present interglacial, the Holocene (the last 10,000 years), have appeared since 1960 (Adam 1985). Of the 109 statewide sites listed in Adam's compilation, only 32 are published with only a handful detailing events within the Sierra Nevada. Since that time several additional sites have been investigated, and are summarized here.

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Paleoecological investigations within Yosemite, Sequoia, and Kings Canyon national parks have been undertaken for several reasons. Most of the studies have been instigated in order to determine the effect of climate change on post-glacial forest development. A second group includes the investigation of vegetation change near archeological sites. These projects seek to determine the relationship between aboriginal peoples and their environment. A third group includes the few studies concerned with biogeography of individual species.

STUDIES OF VEGETATION – CLIMATE INTERACTIONS

Work near Yosemite began in the mid-1960s with that of Adam (1967), whose pollen study from Osgood Swamp near Lake Tahoe established a postglacial vegetation chronology that rapidly became a standard reference for the Sierra Nevada, as well as the western United States at large. Adam interpreted late-glacial vegetation (prior to ca. 10,500 years before present yr BP) as an *Artemisia* (sagebrush) shrubland with "a few scattered pines and stunted junipers" (Adam 1967, p. 288). Moderating conditions during the early Holocene allowed the establishment of a mixed conifer forest (pines, *Pinus;* firs, *Abies*) with montane chaparral elements (manzanita, *Arctostaphylos*). After ca. 8000 yr BP, increasing oak (*Quercus*) signified intensification of the warming and drying trends in the middle Holocene. Cooler and/or wetter conditions followed after ca. 2900 yr BP, with a further expansion of fir.

Much of the work within Yosemite itself has been focused on sites near the Tioga Road, including three sites within the Adam (1967) study – Hodgdon Ranch, Crane Flat, and Soda Springs (fig. 1). Pollen studies here are not well dated, but comparison with nearby sites suggests a mid- to late Holocene age. At the Hodgdon Ranch and Soda Springs sites, the late Holocene witnessed a cooling of climates indicated by a lowering of the upper elevational range of fir (Soda Springs) and incense-cedar (*Calocedrus decurrens;* Hodgdon Ranch). Cores from the Ten Lakes region were studied by Anderson (1987). This record details the development of the subalpine forest, and the expansion of mountain hemlock (*Tsuga mertensiana*) over the past 3,500 years, suggesting increasing winter snowpack (e.g., cooler and/or wetter conditions) during that time.

Wood (1975, 1984) provided the first complete Holocene study of vegetation change within Yosemite National Park. His study of soil profiles and buried tree stumps near Aspen Valley suggested that forest soils developed in valley bottoms by ca. 10,200 to 9000 yr BP. Forested conditions persisted until 2500 to 1200 yr BP when wet meadow deposits formed over these soils, interpreted as a rise in the water table. Batch's (1977) study from the Polly Dome Lakes is consistent with the above, beginning with the establishment of a mixed conifer forest by ca. 9200 yr BP, and an expansion of fir within that mixed conifer forest after ca. 4,000 years ago.

One site along the Tioga Road has figured prominently in a comprehensive study of Holocene vegetation change on either side of the Sierran crest. A Holocene record from Tioga Pass Pond, situated along the Sierran crest at 3,018 m elevation, was combined with somewhat longer records from Barrett Lake (one of the Mammoth Lakes; east side of the crest at 2,816 m) and Starkweather Pond (near Devil's Postpile National Monument; west side of the crest at 2,438 m) to examine the synchroneity of change at different elevations (Anderson 1987, 1990a).

Prior to ca. 10,000 years ago trees were absent or sparsely established around Barrett Lake and Starkweather Pond, when ice was still present in the Tioga Pass Pond area. By 10,000 years ago lodgepole pines (*Pinus murrayana, P. flexilis*) became established at Barrett Lake, and lodgepole and western white pines (*P. monticola*) at Starkweather Pond, while the local area around Tioga Pass Pond remained treeless until ca. 6500 yr BP, instead supporting a dry, herb- and shrub-dominated plant assemblage. At the lower elevation sites montane chaparral shrubs and other open-ground plants were more abundant than today, indicating a more open forest at that time. These assemblages resulted from lowered effective precipitation during what was probably the warmest, driest portion of the Holocene in the Sierra.

By ca. 6000 yr BP, however, effective precipitation increased, allowing the expansion of subalpine conifers such as mountain hemlock and red fir (*Abies magnifica*), with greater closure of Sierran forests in general. These events probably reflect a cooling trend. Cooling intensified by ca. 2,500 years ago when mountain hemlock was extirpated from near Tioga Pass Pond, moving downslope and being replaced by the higher elevation conifer, whitebark pine (*P. albicaulis*) (Anderson 1990a).

Swamp Lake (1,554 m elevation) near Hetch Hetchy Reservoir has provided one of the most interesting and important records within the region (Smith 1989, 1990). The study is unsurpassed for its nearly 16,000-year record, documenting the establishment of vegetation within the western portion of Yosemite National Park during deglaciation. Continuous records of this antiquity are rare in the West outside of the Pacific Northwest. Smith's work documents the establishment of trees characteristic of the modern subalpine forest around Swamp Lake by ca. 13,500 yr BP. An oak-conifer forest dominated the area after ca. 10,400 BP; the modern Sierra montane vegetation was not established until later in the Holocene. Remarkably, prior to 10,400 yr BP, however, the forest consisted of a mixture of high- and mid-elevation conifers, such as mountain hemlock, lodgepole pine, sugar pine (*Pinus lambertiana*), and incense-cedar. This combination of conifers is not found today within Yosemite and suggests fundamentally different conditions during that time. It also suggests that several high-elevation conifers grew at least 700 m lower in elevation at that time.

Many additional studies are found at locations outside the national parks and contribute to our knowledge of vegetation history and climate change within the Sierra Nevada. These include Cole (1983), Davis et al. (1985), Anderson et al. (1985), Atwater et al. (1986), and Davis and Moratto (1988) on the west side of the crest, and Sercelj and Adam (1975), and McCarten and Van Devender (1988) on the east side.

STUDIES OF VEGETATION – HUMAN INTERACTION

Several pollen profiles from meadows near archaeological sites in Yosemite National Park have contributed to our understanding of prehistoric environmental change within the immediate vicinity of the sites. Initial studies were reported by Adam (1967; see above).

One recent study comes from Woski Pond (Anderson and Carpenter 1991) in Yosemite Valley (1,212 m elevation). The valley has been occupied by humans for at least the past 3000 years (Mundy and Hull 1987). The nearly 1,600-year long record documents a rapid shift from a closed conifer forest, dominated by ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), and Douglas-fir (*Psuedotsuga menziesii*) to a more open canopy forest, where oaks and shrubs (e.g., *Prunus* and *Sambucus*) were favored. This transition at ca. 650-700 yr BP is accompanied by abundant charcoal, indicating a major fire at that time. Contemporaneous changes in the archaeological record indicate a shift from the Tamarack cultural complex, indicative of seasonal hunting and gathering, to the more sedentary occupation characteristic of the Mariposa complex, with increased reliance on oak acorns for consumption and trade. Scenarios involving climatic change and change in the configuration of the nearby Merced River were considered. However, the coincidence of major vegetation and archaeological change, ethnographic evidence of protohistoric vegetation modification within Yosemite Valley itself (Ernst 1949; Lewis 1973; Wickstrom 1987), and similar stratigraphies for Wawona Meadow in the southern part of the park led Anderson and Carpenter (1991) to favor the explanation involving subsequent human modification.

Archaeological investigations within the Peregoy Meadow area of Yosemite National Park have suggested a long period of aboriginal habitation. Anderson and Smith (1989) investigated the stratigraphy of McGurk Meadow (1,260–2,210 m elevation), a small streamside meadow just north of the Peregoy sites, to place the archaeological record within a paleoenvironmental context. The 900-year record is consistent with interpretations presented elsewhere (Anderson 1990, Davis et al. 1985) of an open pine forest in the early to middle Holocene, with subsequent closure and expansion of fir trees in the late Holocene, dated here at ca. 4000 yr BP.

STUDIES RELATING TO PLANT BIOGEOGRAPHY

The biogeography and/or disturbance history of the giant sequoia (*Sequoiadendron giganteum*) has been the focus of two studies. Cole (1983) examined remains from packrat (*Neotoma* sp.) middens from a cave near Kings Canyon National Park. A mixed conifer pollen and plant macrofossil assemblage, including minor amounts of giant sequoia, was found in glacial-age middens. Vegetation there today is dominated by oak and chaparral elements, indicating a lowering of as much as 1,000 m in elevation during the glacial.

An ongoing study (Anderson 1990b), involving the history of the sequoia-mixed conifer forest, focuses primarily on the biogeography and disturbance history of the giant sequoia during the Holocene. Eight sites have been identified so far, both within and elevationally above modern giant sequoia groves. Sites within groves include JB Swale (near the Mariposa Grove in Yosemite National Park), Meadow of Honor (near Grant Grove in Kings Canyon National Park), and Log and Circle Meadows (the Giant Forest of Sequoia National Park). Sites outside of groves include Hightop and Weston Meadows (Sequoia National Forest), Long Meadow (Sequoia National Park), and Dogwood Meadow (Mountain Home State Forest). All include records of at least 10,000 years, except JB Swale.

Though results are preliminary, certain patterns have emerged from these initial analyses. Giant sequoia grew considerably lower in elevation during the last glaciation than it does today. Although its exact glacial refuge has not been determined, one location was probably within the Kings River Canyon. With climatic amelioration at the end of the Pleistocene, most conifers, including the giant sequoia, moved upslope to their modern ranges. Within modern groves, the giant sequoia appears to have been a very minor element during the early and middle Holocene. Only during the late Holocene did the tree reach its modern subdominance. Continued study will provide insight into the glacial-age distribution of the giant sequoia, the movement of the species into its modern elevational range, and the role of fire in the establishment and perpetuation of modern groves.

Similarly, the biogeography of ponderosa pine within and near Sequoia and Kings Canyon national parks has been addressed. Needles of the tree were found in packrat middens from elevations as low as 875 m in the Kings River Canyon, and dated to older than 45,000 yr BP (Cole 1983). Ponderosa pine reached its modern elevational range by 10,000–12,000 years ago (Anderson 1989), and has remained an important component of the mixed conifer forest since that time. The upslope movement exhibited by populations of ponderosa pine in the Sierra Nevada subsequent to the last glacial episode contrasts with the pattern in the American Southwest, where the tree apparently found an ice age refuge in the southern portion of its modern range, exploding northward after 10,000 years ago (Anderson 1989).

CONCLUSIONS AND PROSPECTUS

Our knowledge of forest development and vegetation change within the Sierra Nevada national parks has progressed considerably within the past few years. Although many details of the record remain obscure, an outline has become apparent.

Data from low elevations within the Central Valley of California during the last glacial episode are not available from near Yosemite. However, species characteristics of the modern Great Basin east of the Sierra Nevada were found at analogous elevations west of Sequoia and Kings Canyon National Parks (fig. 2). A xeric, mixed conifer woodland was found there at ca. 1000 m elevation. The transition to modern oak-chaparral vegetation at this elevation is not well dated.

The post-glacial record is better known from Yosemite than from the Sequoia–Kings Canyon area. Following deglaciation at Swamp Lake at ca. 15,800 yr BP, ice remained in the higher elevations for up to 6,000 years. Ice was gone from Exchequer Meadow (2,212 m) by ca. 13,500 yr BP and from Barrett Lake (2,816 m) by ca. 12,500 yr BP. Ice lingered longer in the Starkweather Pond (2,938 m) basin until ca. 11,000 years ago, and remained at higher elevations near Tioga Pass Pond (3,018 m) until after 10,000 yr BP. Melting of ice allowed for establishment of alpine or woodland conditions at all sites, although the occurrence was time transgressive, starting earlier at lower elevations (fig. 2). Trees characteristic of modern subalpine forests were found as low as 1,550 m elevation until ca. 10,400 yr BP, representing an elevational depression of 700–1,000 m over today for certain conifers in the Pleistocene.

For the early Holocene and into the mid-Holocene (to ca. 6000 yr BP), open woodland conditions prevailed at Tioga Pass Pond above 3,000 m, an open pine forest occurred in modern upper montane and subalpine forests, and oak–mixed conifers dominated near the lower forest boundary (fig. 2). Increases in effective precipitation during the late Holocene led to development of the modern closed forest conditions. In general, Holocene vegetation changes from Sequoia and Kings Canyon are similar, but differ slightly in timing and species involved.

Future paleoecological research within Yosemite, Sequoia, and Kings Canyon national parks could be directed in several areas. Most of the research in Yosemite National Park has been concentrated within an east-west corridor largely paralleling the Tioga Road and within the conifer forests of mid- to high-elevation on the west side of the park (fig. 1). Additional areas within the southeastern and northwestern portions of the Park should be investigated. In general, less is known regarding vegetation history of Sequoia and Kings Canyon parks than for Yosemite. For all areas, virtually nothing is known regarding the development of alpine tundra vegetation. Similarly, the development of chaparral vegetation within Sequoia is unknown.

While our knowledge of Holocene vegetation development has become clearer, glacial-age vegetation within the parks is still largely undeciphered. Other than the record from Swamp Lake (Smith 1989) and the midden study of Cole (1983), we do not have a good idea of the environments during and immediately subsequent to glaciation. Further research encompassing this time period is warranted.

Studies such as these are important in our understanding of the development of modern biological communities within our national parks. With the perspective provided by the paleoecological record it is clear that communities are not static entities. Vegetation change has occurred on several time scales, influenced by factors as diverse as climate and human intervention. While this information is interesting in itself for interpretive purposes, these observations also have management implications. Should we manage our natural areas in such a way as to maintain their pre-European contact characteristics? Considering the evidence, both paleoecological and archaeological, this clearly runs counter to trends established millennia ago.

ACKNOWLEDGMENTS

We wish to thank Jan Van Wagtendonk, Scott Carpenter, and the Yosemite Association for financial aid and logistical support of studies within Yosemite National Park. For work within Sequoia and Kings Canyon national parks, we thank David Parsons, David Graber, and Nate Stephenson. This study was supported, in part, by NPS Cooperative Agreement No. CA8000-7-0001, Laboratory of Palynology Contribution No. 21.

REFERENCES

Adam, D.P. 1967. Late Pleistocene and Recent Palynology in the Central Sierra Nevada, California. In *Quaternary Paleoecology*, E.J. Cushing and H. E. Wright, eds., pp. 275-302. New Haven: Yale University Press.

_______ 1985. "Quaternary Pollen Records from California." In *Pollen Records of Late-Quaternary North American Sediments*, V. M. Bryant, Jr. and R. G. Holloway, eds., pp. 125-140. Dallas: American Association of Statigraphic Palynologists.

Anderson, R.S. 1987. *Late Quaternary Environments of the Sierra Nevada, California*. Ph.D. dissertation, University of Arizona, Tucson.

_______ 1989. *Development of the Southwestern Ponderosa Pine Forest: What do We Really Know?* USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-185, pp. 15-22.

_______ 1990a. Holocene Forest Development and Paleoclimates Within the Central Sierra Nevada, California. *Journal of Ecology* 78:470-489.

_______ 1990b. *Holocene Vegetation Change in the Sequoia – Mixed Conifer Forests of California's Sierra Nevada*. Ecological Society of America, Abstracts with Program, p. 77.

Anderson, R.S. and S.L. Carpenter. 1991. Vegetation Change in Yosemite Valley, Yosemite National Park, California, During the Protohistoric Period. *Madroño* 38: in press.

Anderson, R.S., O.K. Davis and P. Fall. 1985. Late-Glacial and Holocene Vegetation Change in the Sierra Nevada of California with Particular Reference to the Balsam Meadow Site. In *Late Quaternary Vegetation and Climates of the American Southwest*, B.F. Jacobs, P.L. Fall, and O.K. Davis, Eds., pp. 127-140. Dallas: American Association of Stratigraphic Palynologists.

Anderson, R.S. and S.J. Smith. 1989. *Paleoenvironmental Research of the Peregoy Meadow Area, Yosemite National Park: Sediments from McGurk Meadow*. Unpublished report, Yosemite Association.

Atwater, B.F., D.P. Adam, J.P. Bradbury et al. 1986. A Fan Dam for Tulare Lake, California, and Implications for the Wisconsin Glacial History of the Sierra Nevada. *Geological Society of America Bulletin* 97:97-109.

Batch, J.R. 1977. *A Post-Glacial Pollen Record from a Subalpine Valley in Yosemite National Park*. M.A. thesis, San Francisco State University.

Cole, K.L. 1983. Late Pleistocene Vegetation of Kings Canyon, Sierra Nevada, California. *Quaternary Research* 19:117-129.

Davis, O.K., R.S. Anderson, P. Fall, M.K. O'Rourke, and R.S. Thompson. 1985. Palynological Evidence for Early Holocene Aridity in the Southern Sierra Nevada, California. *Quaternary Research* 24:322-332.

Davis, O.K. and M.J. Moratto. 1988. Evidence for a Warm Dry Early Holocene in the Western Sierra Nevada of California: Pollen and Plant Macrofossil Analysis of Dinkey and Exchequer Meadows. *Madroño* 35:132-149.

Ernst, E.F. 1949. Vanishing Meadows in Yosemite Valley. *Yosemite Nature Notes* 28:34-41.

Faegri, K. and J. Iversen. 1975. *Textbook of Pollen Analysis.* New York: Hafner.

Hansen, H.P. 1942. "A Pollen Study of Peat Profiles from Lower Klamath Lake of Oregon and California." In *Archaeological Researches in the Northern Great Basin,* L.S. Cressman, ed., pp. 103-114. Carnegie Institution of Washington Publication 538.

Lewis, H.T. 1973. "Patterns of Indian Burning in California: Ecology and Ethnohistory." *Ballena Press Anthropological Papers,* No. 1.

McCarten, N. and T.R. Van Devender. 1988. Late Wisconsin Vegetation of Robber's Roost in the Western Mojave Desert, California. *Madroño* 35:226-237.

Mundy, W.J. and K.L. Hull. 1987. The 1984 and 1985 Yosemite Valley Archeological Testing Projects. *Yosemite Research Center, Publications in Anthropology* No. 5. USDI, National Park Service, Yosemite National Park.

Osvald, H. 1936. Stratigraphy and Pollen Flora of Some Bogs of the North Pacific Coast of America. *Berichtungen des Schweizerisches Botanicshes Gesellschaft,* 46.

Sercelj, A. and D.P. Adam. 1975. A Late Holocene Pollen Diagram from Near Lake Tahoe, Eldorado County, California. *United States Geological Survey Journal of Research* 3:737-745.

Smith, S.J. 1989. *Pollen and Microscopic Charcoal Analysis of a Sediment Core from Swamp Lake, Yosemite National Park, California.* M.S. thesis, Northern Arizona University, Flagstaff.

_______ 1990. A 14,000 Year Pollen Record from the Central Sierra Nevada, Swamp Lake, Yosemite National Park, California. *Journal of the Arizona-Nevada Academy of Science* 25:29-30.

von Post, L. 1916. Om Skogstrandpollen i Sydsvenska Torfmosslagerfoljder. *Geologiska Foreningens i Stockholm Forhandlingar* 38:384-394.

Weeden, N.F. 1981. *A Sierra Nevada Flora.* Berkeley: Wilderness Press.

Wickstrom, C.K.R. 1987. "Issues Concerning Native American Use of Fire: A Literature Review." *Yosemite Research Center, Publications in Anthropology* No. 6. National Park Service, Yosemite National Park.

Wood, S.H. 1975. *Holocene Stratigraphy and Chronology of Mountain Meadows, Sierra Nevada, California.* Ph.D. dissertation, California Institute of Technology, Pasadena.

_______ 1984. "East Meadow of Aspen Valley, Western Yosemite National Park." In *Holocene Paleoclimatology and Tephrochronology East and West of the Central Sierra Crest.* S. Stine, S. Wood, K. Sieh, and C.D. Miller, eds., pp. 1-20. Guidebook, Friends of the Pleistocene, Pacific Cell.

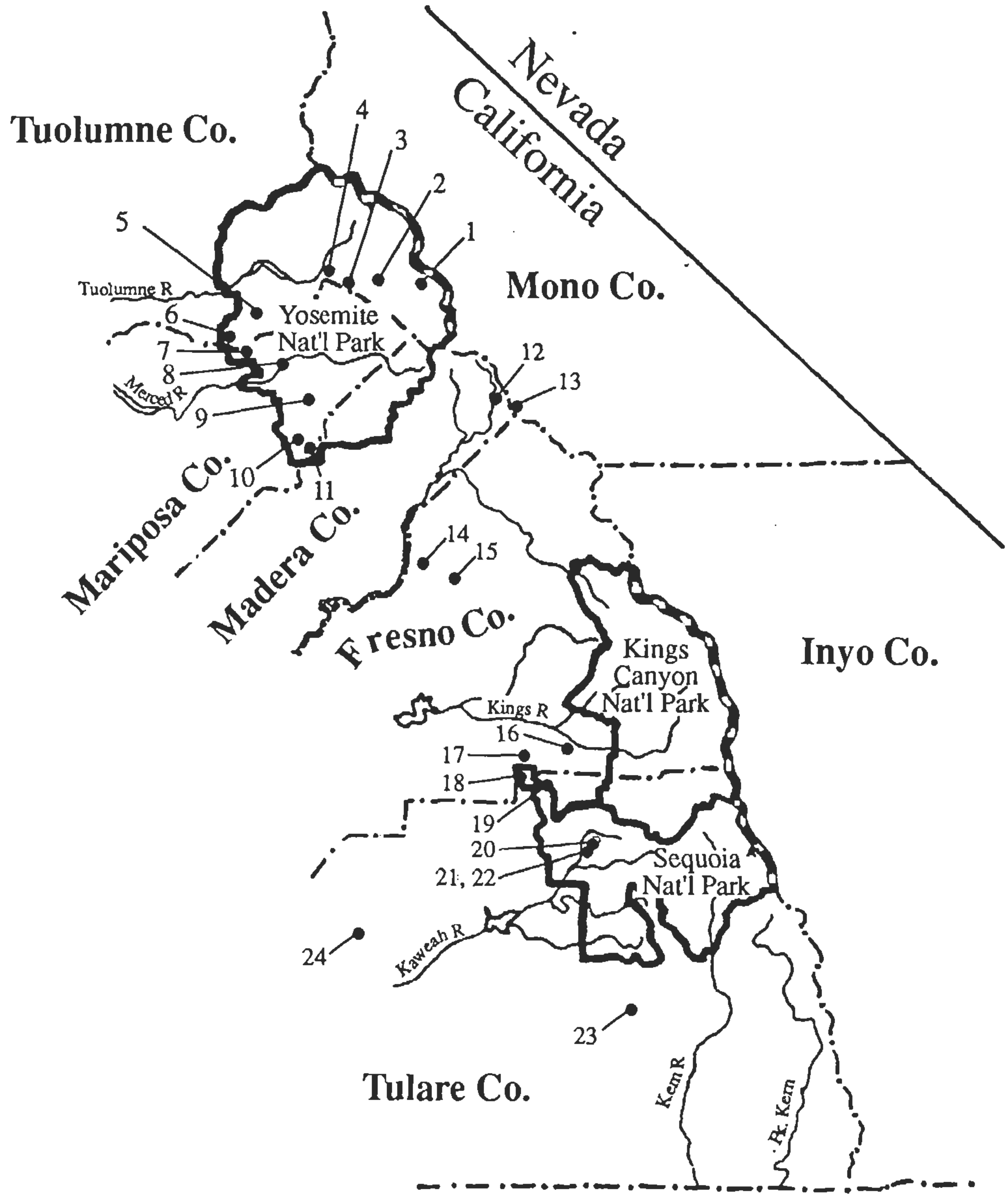

Figure 1. Location of sites mentioned in the text: 1= Tioga Pass Pond; 2= Soda Springs; 3= Polly Dome Lakes; 4= Ten Lakes; 5= Aspen Valley; 6= Hodgdon Ranch; 7= Crane Flat; 8= Woski Pond; 9= McGurk Meadow; 10= Wawona Meadow; 11= JB Swale (near Mariposa Grove); 12= Starkweather Pond; 13= Barrett Lake; 14= Balsam Meadow; 15= Exchequer Meadow; 16= Kings Canyon caves; 17= Hightop Meadow; 18= Meadow of Honor; 19= Weston Meadow; 20= Long Meadow; 21= Log Meadow; 22= Circle Meadow; 23= Dogwood Meadow; 24= Tulare Lake. Not shown are Osgood Swamp and Ralston Ridge Bog (base map after Weeden 1981).

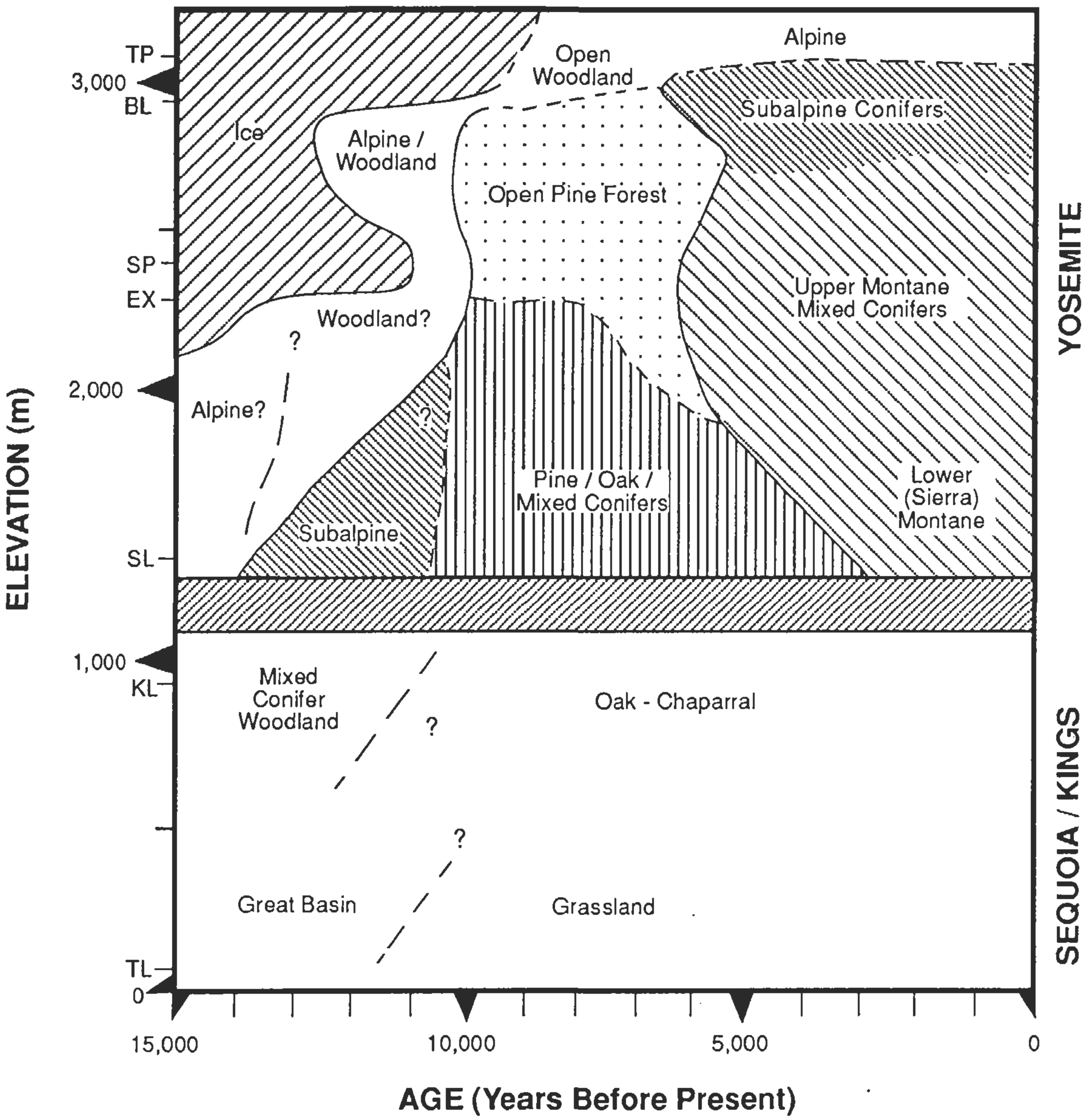

Figure 2. Generalized diagram of vegetation change on the west side of the Sierra Nevada and near the crest. Note that data from lower elevations are from the Sequoia – Kings Canyon National Parks area; data from higher elevations are from the Yosemite National Park area. The diagram is based on data from Tioga Pass Pond (TP), Barrett Lake (BL), Starkweather Pond (SP), Exchequer Meadow (EX), Swamp Lake (SL), Kings Canyon caves (KC), and Tulare Lake (TL).

ENVIRONMENTS NEAR SWAMP LAKE, YOSEMITE NATIONAL PARK, OVER THE PAST 16,000 YEARS

Susan J. Smith[1]

A 7.86-m sediment core, collected from Swamp Lake (1,554 m elevation), Yosemite National Park, California, has provided a continuous stratigraphic record of the past 16,000 years. The core documents Late Wisconsin, Tioga stage deglaciation at ca. 13,700 years before present, and also includes five volcanic ashes, chemically identified as four Mono Craters ashes and the Tsoyawata ash (Mt. Mazama, Oregon).

Macrofossil, pollen, and microscopic charcoal analyses of core subsamples allow reconstruction of vegetation near the lake from the Tioga glacial to the present. The fossil data indicate that herbs and sage dominated the late-glacial environment at Swamp Lake, while the post-glacial was characterized by upper montane conifers. Elements of the modern Sierra montane forest, are not discernible in the fossil record until ca. 10,400 years before present.

Tuesday, October 16, 3:30 pm

1. Susan J. Smith, Bilby Research Center, Northern Arizona University, Box 6013 NAU, Flagstaff, AZ 86001.

LATE PLEISTOCENE-HOLOCENE VEGETATION CHANGE IN NORTHWESTERN CALIFORNIA: THE POLLEN RECORD

James G. West[1]

Changes in the region's vegetation were reconstructed based on the analysis of 14 pollen records ranging in age from <2000 to >10,000 years before present. These records are from five major vegetation associations: Redwood Forest, Mixed Evergreen, Coast Range Montane, Blue Oak-Digger Pine Forest, and Klamath Montane Forest with Yellow Pine. Varying pollen frequencies suggest significant vegetation changes have occurred at the local and regional scale.

Prior to about 8500 years before present, pine, and at some localities, pine and Taxodium, Cupressaceae, and Taxaceae pollen grains are the dominant types. After 8500 years before present the pollen records exhibit considerably more species and temporal diversity. At most localities, maximum oak values are reached at mid-Holocene times, peaking about 5000 years before present. After the peak oak values, Douglas-fir pollen increases. Modern pollen values were attained in the past 3,000 years.

Tuesday, October 16, 3:30 pm

1. James G. West, Bureau of Reclamation, Sacramento, CA 95825.

LATE-QUATERNARY VEGETATION CHANGE IN THE CENTRAL SIERRA NEVADA: POLLEN, CHARCOAL, AND MACROFOSSIL EVIDENCE FROM THE STANISLAUS DRAINAGE

Roger Byrne and Eric Edlund[1]

Until only recently the history of late-Quaternary vegetation change in the Sierra Nevada was poorly understood. Now there is general agreement on certain aspects of the record but the regional pattern for the whole of the postglacial is still far from clear. In this paper we report on pollen, charcoal, and macrofossil evidence from several lakes in the Stanislaus drainage of the central Sierra. The results indicate that postglacial vegetation changes in this area involved far more than a simple upslope migration of plants as the ice retreated. Of particular interest is the evidence for a late-glacial development of closed canopy lodgepole pine/fir/hemlock forest and extensive meadow sites at elevations as low as 2,000 meters. Charcoal evidence also indicates that this mesic forest was devastated by fires in the earliest part of the Holocene, and that a more xeric pine/oak woodland developed in its place. We suggest that these important changes in vegetation were a response to large-scale changes in climate during the late Pleistocene and early Holocene.

Tuesday, October 16, 3:30 pm

1. Roger Byrne and Eric Edlund, Department of Geography, University of California, Berkeley, CA 94720.

TESTING A MANAGEMENT STRATEGY FOR RESTORATION OF CALIFORNIA'S NATIVE GRASSLANDS

Daphne Hatch, J. W. Bartolome, Deborah Hillyard[1]

Abstract

California's grasslands were drastically altered by the invasion of Mediterranean weeds following European immigration. Pristine grasslands were believed to be perennial bunchgrass prairies with purple needlegrass (Stipa pulchra Hitchc.) *as a major component. In developing a restoration strategy for sites with remnant populations of* Stipa pulchra *we address two interrelated problems: 1) how to increase* Stipa *populations and 2) how to reduce competition with, and usurp the space occupied by, exotic annuals. Based on previous research results, we hypothesized that populations of* Stipa pulchra *would increase more rapidly in density and/or cover when managed under a combination of winter and summer seasonal livestock grazing and fall burning than through complete protection from grazing. A replicated randomized complete block experiment with two main effects, burning (after fall germination or unburned) and grazing (winter and summer or ungrazed), was conducted in two locations. This paper considers conceptualization of the experiment and 1989-90 pre- and post-burn* Stipa pulchra *seedling recruitment at Hopland and Sierra Field Stations. Within-treatment comparisons show significant increases in numbers of* Stipa *seedlings in 1990 in the grazed/unburned, ungrazed/burned, and grazed/burned treatments at Sierra, with no increase in seedling numbers in the ungrazed/unburned plots. There was no significant increase in seedling recruitment within any treatment combination at Hopland. Sierra has received near average rainfall while Hopland has experienced six years of drought.*

INTRODUCTION

The deterioration of California's pristine grasslands preceded any botanical descriptions. Domestic livestock and Mediterranean annual plant species were introduced along the coast beginning with the first Spanish settlement in San Diego in 1769. By the 1830s travelers noted herds of wild cattle and horses in the Central Valley. Recurrent extreme drought, coupled with rapid increases in cattle and sheep herds and local overstocking as an outgrowth of westward movement and the gold rush (Burcham 1957), produced excessive grazing pressure on native range.

Several stages of exotic plant invasions have been described. Hendry (1931) found at least six Mediterranean species in the earliest adobe bricks suggesting that they preceded Spanish settlement in California, possibly arriving as packing material or animal feed on earlier exploratory sailing vessels (Heady et al. in press). Wild oats (*Avena fatua*) and black mustard (*Brassica nigra*) already dominated the Central Valley prior to overgrazing by livestock (Burcham 1957). These Mediterranean species were pre-adapted to the state's climate and soils, grazing resistant, and highly competitive with the native perennial bunchgrasses by virtue of their greater fecundity and larger soil seed banks (Baker 1989). Cultivation was another significant factor in the destruction of native grasslands and their replacement by exotic annuals (Heady 1977).

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The pristine California prairie was probably an assemblage of perennial bunchgrasses interspersed with native annual grasses and forbs in the northern, central, and coastal portions of the state. The drier southern San Joaquin Valley probably supported fewer perennial and more annual species (Wester 1981). The more common bunchgrasses included purple needlegrass (*Stipa pulchra*), nodding needlegrass (*S. cernua*), pine bluegrass (*Poa scabrella*), coast range melic (*Melica imperfecta*), prairie junegrass (*Koelaria cristata*), blue wildrye (*Elymus glaucus*), and three-awn (*Aristida hamulosa*). The only common rhizomatous species was creeping wildrye (*E. triticoides*) (Heady et al. in press). Several other species commonly occur along the immediate coast.

Purple needlegrass is the most common native bunchgrass today. It has been suggested by some that it clearly dominated the California prairie in the past (Heady 1977) while others have argued it is the most common native grass now because it is favored by the types of disturbances that are common today (Bartolome and Gemmill 1981). While there is evidence suggesting it may have been dominant in one location (Bartolome et al. 1986), its past role in other locations remains unknown.

Native herbivores associated with the pristine California prairie included pronghorn antelope (*Antilocapra americana*), tule elk (*Cervus elaphus nannodes*), deer (*Odocoileus hemionus*), ground squirrels (*Citellus* species), black-tailed jack rabbits (*Lepus californicus*), pocket gophers (*Thomomys* species), the California vole (*Microtus californicus*), and kangaroo rats (*Dipodomys* species). Wagner (1989) states that with the exception of tule elk pressures, there were no concerted large mammal grazing pressures on California grasslands just prior to the arrival of the Spaniards. Deer are primarily browsers, pronghorn prefer forbs and browse, while tule elk are broad-spectrum feeders that spent much of their time in marshy vegetation. Tule elk and antelope were abundant along portions of the coast and in the Central Valley lowlands where they formed groups of up to 3,000 animals on a seasonal basis. In the foothills and coastal mountains deer banded into herds of 20 to 30 animals. Burcham (1957) concluded that "considered in its entirety the native animal community had a relatively small net effect on the plant cover." He also noted the "complete lack of evidence of general overgrazing of the range in the accounts of early travelers."

Fires, ignited by native Americans over the past 12,000 years, and by lightening, also influenced California's grasslands. Indian burning is too recent to have been a factor in the evolution of the native grasses. Infrequent lightening-caused fires most likely occurred in dry prairie vegetation in early autumn in the north and year round in the south (Heady 1972). Fog extends the period of green growth and severely inhibits both ignitions and the ability of fires to burn in coastal areas.

DEVELOPING A RESTORATION STRATEGY

In developing a restoration strategy for California's grasslands two interrelated problems must be addressed: 1) how to increase populations of native species, and 2) how to reduce competition with, and usurp the space occupied by, the exotic annuals. Only a few studies have addressed these problems.

Although livestock were a significant factor in the decline of the California prairie, whole landscapes now dominated by Mediterranean annuals only occasionally revert to native prairie when grazing is removed (Heady et al. in press).

Sampson and McCarty (1930) were interested in range restoration with *Stipa pulchra* because of its high palatability, its nine- to 10-month green forage period, and its high nutritional value when dry. In clipping studies they found that plants harvested prior to resumption of active growth in March produced abundant seed and herbage and came to maturity at the same time as untreated plants. Plants harvested after resumption of active growth (March 20 or later) produced few or no seeds. Late harvesting also produced much less growth in height than the controls. They concluded that moderately intense grazing in fall and winter would not cause irreparable injury to *Stipa* cover, and that maximum utilization should follow cessation of growth and the maturity of the herbage. They predicted that greatest injury would occur when increment growth is at a maximum (mid-April to mid-June).

Field clipping studies conducted by Dennis (1989) corroborate Sampson and McCarty's (1930) height growth results. *Stipa pulchra* plants clipped by Dennis on December 20 and February 19 showed an increase in mean relative tiller number over those clipped on March 30 and April 30. In weeding experiments Dennis found that *Stipa* plants in plots weeded on December 20 showed a threefold increase in tiller number relative to controls. This difference was maintained through the following year. Flowering was also enhanced slightly in the year of treatment.

Hervey (1949) looked at the effect of summer burning on the annual plant community while Ahmed (1983) and Fossum (1990) looked at effects of spring and/or summer burning on *Stipa* communities. While no data exist on the effects of fall burning on the number and composition of exotic annual plants, McClaran (1981) did note high mortality of germinated annuals following fall burning. Bartolome and Gemmil (1981) manipulated mulch levels in pot trials and found higher numbers of *Stipa* seeds germinating under 0 and 500 lbs/ac mulch than under 1,000 lbs/ac.

Based on this previous research we developed our central hypothesis that states that populations of *Stipa pulchra* will increase more rapidly in density and/or cover when managed under a combination of winter and summer seasonal livestock grazing and fall burning than through complete protection from grazing.

We predict that burning after germinating rains in the fall will kill annual seedlings, ensure survival of existing *Stipa* plants because of cooler fire temperatures, reduce accumulated litter, stimulate tillering and reproduction, and provide space for *Stipa* seedling establishment. The grazing treatment objective is to reduce litter accumulation in order to enhance seedling establishment and stimulate tillering.

METHODS

Field study sites are located at the University of California Hopland and Sierra Field Stations and were chosen for the presence of remnant *Stipa* populations, and for the ability to control grazing and conduct prescribed burns. Hopland is grazed by sheep and Sierra by cattle. Since exclosures were erected grazing has occurred in the months of December, January, February, June, July, and August.

Hopland Field Station is located in the North Coast Range in Mendocino County, 64 km inland from the Pacific Ocean. The study site ranges in elevation from 300 to 400 m. Mean annual precipitation is 89 cm. Hopland has experienced 6 consecutive years of drought with rainfall averaging 24 percent below the mean. Three exclosures were constructed in October 1986 and prescribed burns were conducted on October 13, 1986 and 1989.

Sierra Field Station is located in the Sierra foothills in Yuba County, 31 km east of Marysville. The study site is at an elevation of 150 to 200 m. Mean annual precipitation is 74 cm. Rainfall has been near average the past 2 years. Three exclosures were constructed in January 1989 and prescribed burns conducted on September 22, 1989.

A factorial experiment in a randomized complete block design with two main effects, burning crossed with grazing (by sheep or cattle), and three replications, was set up in open grassland at the two locations. The burning treatments are after fall germination of annual plants, or not burned. The two grazing treatments are in winter and summer, before the onset of rapid spring growth and after seedset and the onset of dormancy, or not grazed.

Two 10-m transects were located within *Stipa pulchra* stands in each experimental unit. Five permanent plots (.5 m^2 at Hopland and 1 m^2 at Sierra based on plant densities) were randomly located along each transect. Sampling occurred in winter and late spring. Individual plants were mapped by coordinates within the plots. Demographic variables measured include plant density, plant survivorship, number of vegetative tillers per individual plant, number of reproductive culms per individual plant, number of seeds per individual plant, and number of seedlings. Species cover and composition, peak standing crop, and fall residual dry matter were measured along transects.

The analysis of seedling recruitment in response to fall burning was by dependent T-test (2-tailed, a =.05). The difference in mean number of seedlings between 1989 (pre-burn) and 1990 (post-burn) was tested within treatment only. No between-treatment comparisons were made. Further analysis of treatment interaction and effect on demographic variables will be by repeated measures analysis of variance and covariance.

RESULTS AND DISCUSSION

Seedling recruitment in response to fall burning has been strikingly different at Hopland and Sierra Field Stations. At Sierra Field Station (fig. 1a) within-treatment comparisons show significant increases in the mean number of *Stipa* seedlings in 1990 over 1989 in the grazed/unburned (GU), ungrazed/burned (UB), and grazed/burned (GB) treatments. Increase in seedling number within the ungrazed/unburned (UU) treatment was not significant. Although no between-treatment analysis was conducted, it appears that conditions for seedling recruitment were generally more favorable in the burned treatments than in the unburned ones, and that cattle grazing alone may have offered some advantage over no treatment at Sierra. Further analysis may validate these conclusions.

No clear picture emerges from the results at Hopland (fig. 1b). Although seedlings increased in all treatments, none of the differences were significant. A partial explanation for the inconclusive results at Hopland is the loss of precision (N = 2) that resulted from discarding a replicate with an inadequate *Stipa* sample size. Additionally, drought conditions at Hopland may have precluded any response to treatment.

Preliminary analysis of pre- and post-burn seedling recruitment at Sierra lends support to our hypothesis that *Stipa* density will increase more rapidly when managed under a combination of seasonal livestock grazing and fall burning. The severity of drought conditions may be an important factor in the lack of a recruitment response at Hopland.

Although there were few seedlings in 1989 at Hopland or Sierra, observed survival over the summer was high, possibly because of unusually heavy rain in May 1989. Most mortality that did occur was caused by gopher and ground squirrel activity. No existing plants were killed by fall burning. Establishment of the post-burn seedling cohort will be followed in winter and spring of 1991.

California's Mediterranean landscape, permanently altered by past invasions and overgrazing, with its year-to-year unpredictability and extreme summer drought, is one to which the exotic annuals are better adapted than our native bunchgrass species (Jackson and Roy 1986). In essence we are attempting to establish a new set of ecological processes that will create and maintain a visual impression that mimics California's native prairie.

Our preliminary results indicate there is potential for the use of burning and prescriptive grazing to aid in enhancement of *Stipa pulchra* populations, but results are so far site specific and demonstrate the need to exercise caution in extrapolating results to other sites or sets of conditions.

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REFERENCES

Ahmed, E.O. 1983. *Fire Ecology of* Stipa pulchra *in California annual grassland.* Ph.D. Dissertation, University of California, Davis.

Baker, H.G. 1989. Sources of the naturalized grasses and herbs in California grasslands. In: L.F. Huenneke and H. Mooney, eds., *Grassland Structure and Function: California Annual Grassland,* pp 29-38. The Netherlands: Kluwer Academic Publishers.

Bartolome, J.W. and B. Gemmill. 1981. The ecological status of *Stipa pulchra* (Poaceae) in California. *Madroño* 28(3):172-184.

Bartolome, J.W., Klukkert, S.E., and W.J. Barry. 1986. Opal phytoliths as evidence for displacement of native Californian grassland. *Madroño* 33(3):217-222.

Burcham, L.T. 1957. *California Range Land.* California Division of Forestry, Sacramento.

Dennis, A. 1989. *Effects of defoliation on three native perennial grasses in the California annual grassland.* Ph.D. Dissertation. University of California, Berkeley.

Fossum, H.C. 1990. *Effects of prescribed burning and grazing on* Stipa pulchra (Hitchc.) *seedling emergence and survival.* M.S. Thesis, University of California, Davis.

Heady, H.F. 1972. Burning and the grasslands in California. *Proceedings Annual Tall Timbers Fire Ecology Conference* 12:97-107.

Heady, H.F. 1977. Valley grassland. In: M.G. Barbour and J. Major, eds., *Terrestrial Vegetation of California,* pp 491-514. New York: Wiley-Interscience.

Heady, H.F., Bartolome, J.W., Pitt, M.D., Savelle, G.D., and M.C. Stroud. In Press. California prairie. In: R.T. Coupland ed., *Ecosystems of the World: Natural Grasslands, Volume 8A.*

Hendry, G.W. 1931. The adobe brick as a historical source. *Agricultural History* 5(3):110-127.

Hervey, D.F. 1949. Reaction of a California annual-plant community to fire. *Journal of Range Management* 2:116-121.

Jackson, L.E. and J. Roy. 1986. Growth patterns of mediterranean annual and perennial grasses under simulated rainfall regimes of southern France and California. *Acta Oecologia, Oecologia Plantarum* 7:191-212.

McClaran, M.P. 1981. Propagating native perennial grasses. *Fremontia* 9(1):21-23.

Sampson, A.W. and E.C. McCarty. 1930. The carbohydrate metabolism of *Stipa pulchra*. *Hilgardia* 5(4):61-100.

Wagner, F.H. 1989. Grazers, past and present. In: L.F. Huenneke and H. Mooney, eds., *Grassland Structure and Function: California Annual Grassland*, pp 151-162. The Netherlands: Kluwer Academic Publishers.

Wester, L. 1981. Composition of native grasslands in the San Joaquin Valley, California. *Madroño* 28(4):231-241.

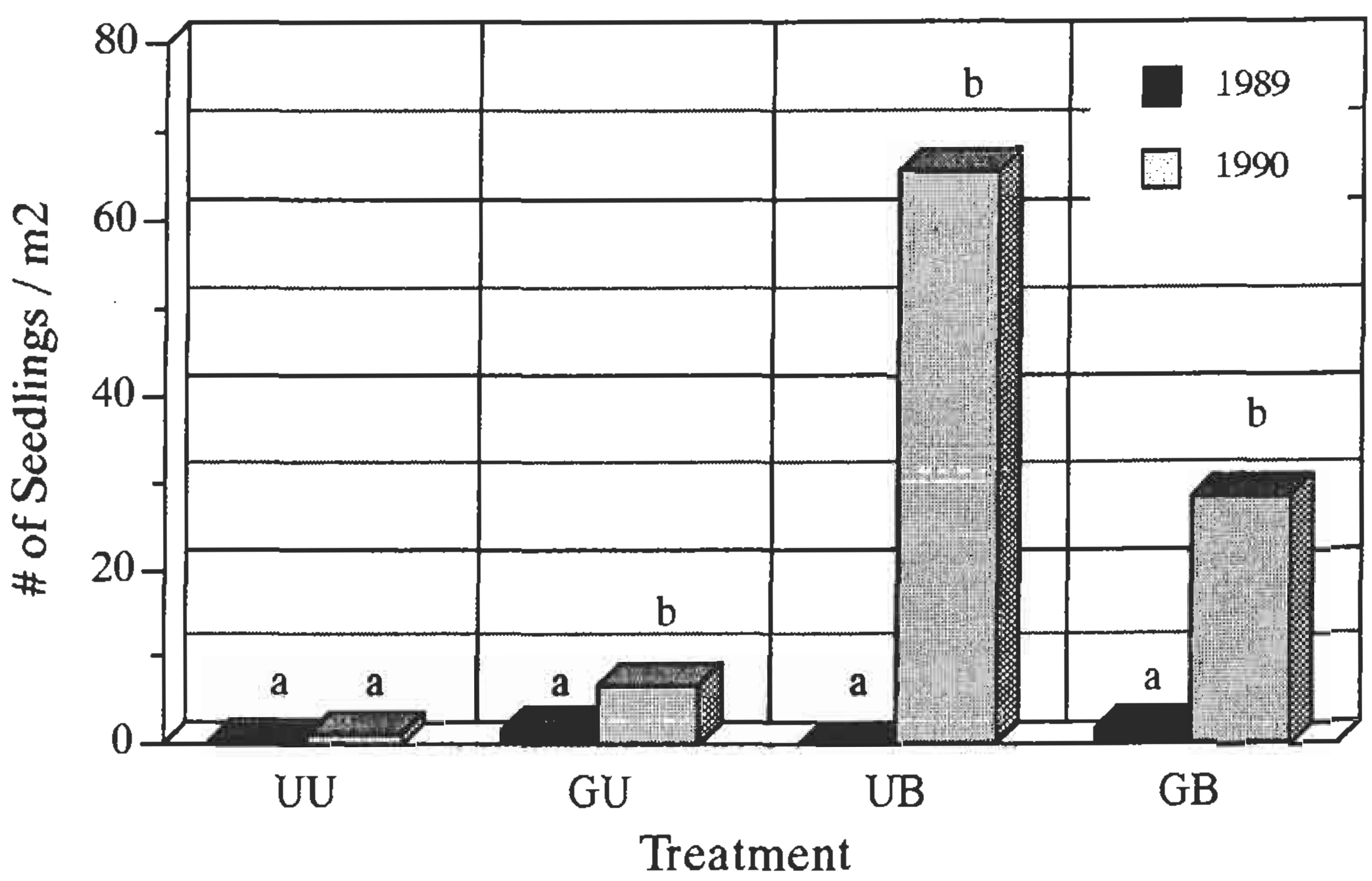

Figure 1a. *Stipa pulchra* seedling recruitment in response to fall burning on 9/22/89 at Sierra Field Station, Yuba County, CA. Mean number of *Stipa* seedlings/m^2. Treatments are UU=ungrazed/unburned, GU=grazed/unburned, UB=ungrazed/burned, and GB=grazed/burned. Different letters indicate significant year-to-year differences within treatment only, a =.05.

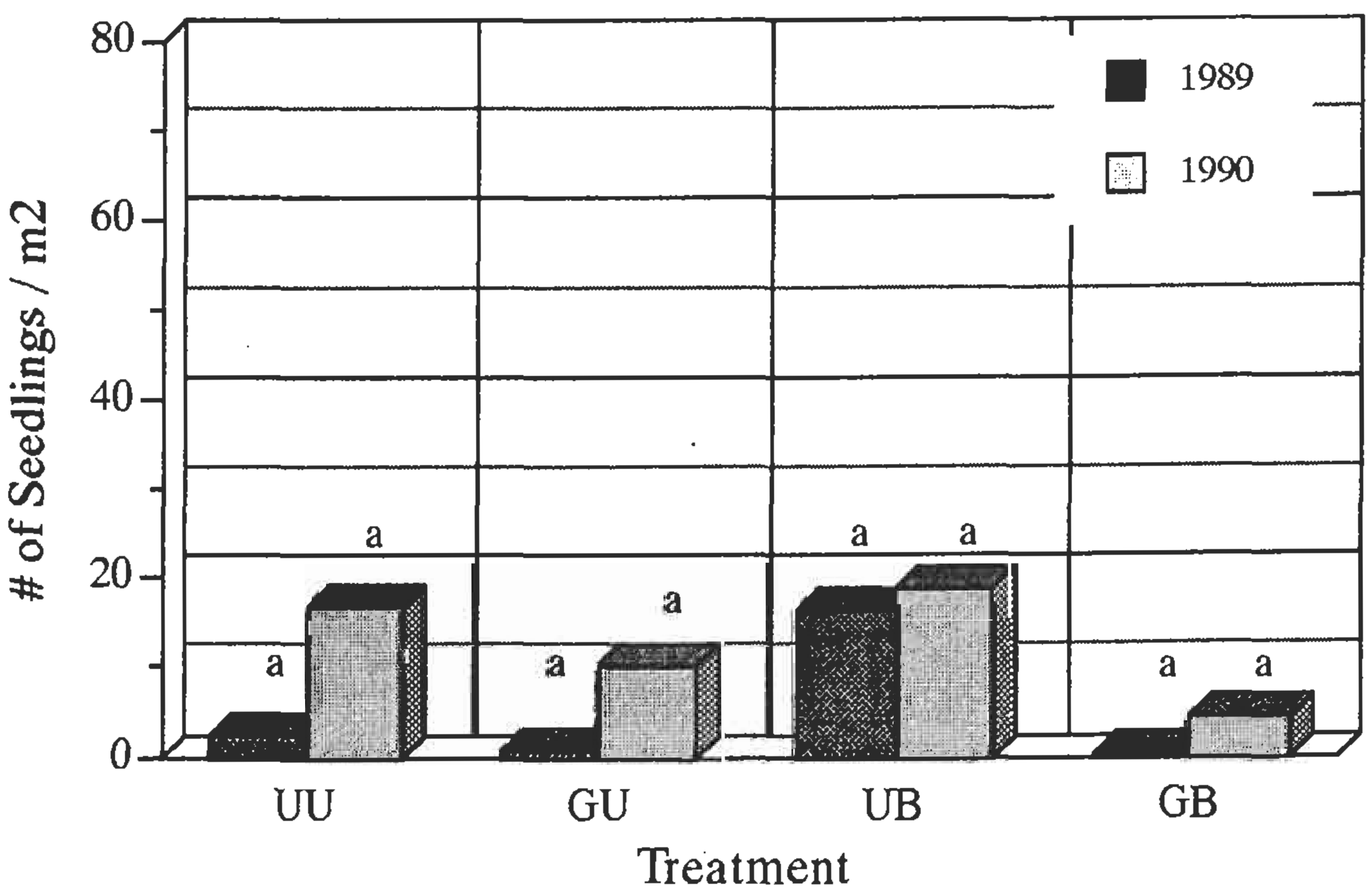

Figure 1b. *Stipa pulchra* seedling recruitment in response to fall burning on 10/13/89 at Hopland Field Station, Mendocino County, CA. Mean number of *Stipa* seedlings/m^2. Treatments are UU= ungrazed/unburned, GU=grazed/unburned, UB=ungrazed/burned, and GB=grazed/burned. There were no significant year-to-year differences within treatment, a =.05.

REVEGETATION AND THE NEED TO CONTROL EXOTIC PLANT SPECIES

Bertin W. Anderson and Early R. Miller[1]

Abstract

Sites selected for revegetation in arid land riparian areas are often vegetated with exotic plant species (e.g., salt cedar (Tamarix chinensis)*) that must be effectively controlled before there can be realistic hope of reestablishing the desired native species. Superficially this need may seem to be nothing more than a nuisance, albeit an expensive nuisance. In reality the presence of exotics may indicate something far more sinister – they become established because a habitat suitable for their establishment to populate an area has been created, often through man's activities (agriculture, grazing, dam construction). Ridding the area of an exotic may be far more complex than merely spraying them and planting the desirable species. If native species are to thrive in a revegetated area the autecological situation of the area must be appropriate for them. Preparing the area often means more than merely eliminating exotics, it may involve treatments that are drastic and expensive. For example, if the area is highly saline/alkaline even at deep levels in the soil, extensive leaching after tillage to the water table will be necessary if salt-sensitive native species are to be grown. Or, if saline conditions are restricted to the surface layer, removal of this layer may be necessary. Such action will also remove exotics. These options (needs) must be considered if we are to maximize the success associated with efforts to eliminate exotics and to replace them with native riparian species.*

INTRODUCTION

In this report we consider one means by which an undesirable exotic plant species, salt cedar *(Tamarix chinensis)* can be eliminated from riparian areas in the desert Southwest. However, another objective is to evaluate changes in riparian ecosystems and how these changes have favored invasion by salt cedar. We then compare these characteristics with abiotic characteristics associated with some native riparian species. This evaluation will indicate that many – perhaps most – of our desert riparian habitats have become so disturbed that expecting them to redevelop to a former state is unrealistic.

A widespread belief is that salt cedar is of little or no value to wildlife. Blind acceptance of this proposal is unwarranted; salt cedar does have value to wildlife in some situations and locations. Eliminating it under these conditions could do damage to riparian wildlife populations, especially if the autecological environment is not suitable for the reintroduction of native riparian habitats. We also discuss a method that we have found successful in controlling salt cedar in areas where native vegetation could be reintroduced.

METHODS

Data presented here were originally collected for other studies. Details concerning the sampling methods can be found in the original literature.

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We have conducted soil sampling along several rivers including the South Fork of the Kern River east of Bakersfield (Anderson 1988a), the lower Colorado River from Davis Dam (Bullhead City, AZ) to Yuma, Arizona (Anderson 1988b), the San Jacinto River (Anderson et al., unpublished data), and the Rio Grande in New Mexico and Texas. In addition we have sampled extensively on the Cibola National Wildlife Refuge (CNWR), along the Colorado River (Anderson 1989), and along the Bill Williams River near its confluence with the lower Colorado River. Soil type, pH, electroconductivity (EC) of the soil (in mmhos/cc), and depth to the water table were determined from random sampling. Where samples were taken in vegetated areas we recorded the species of vegetation present at the sampling point. In this way we obtained data concerning autecological conditions where various plant species were growing.

Bird censusing was done using the Emlen transect technique on transects located in a variety of habitats, three times per month for one year on the lower Rio Grande (Engel-Wilson and Ohmart 1978), for two years on the Pecos River in New Mexico and Texas (Hildebrandt and Ohmart 1980), for many years on the lower Colorado and Bill Williams Rivers (Anderson and Ohmart 1984, Ohmart et al. 1988), and for two years on the Gila River (Hunter 1988). More than 20 habitats were censused including those dominated by salt cedar, cottonwood/willow, and mesquite. For a discussion of the methods used for classifying habitats and a description of them see Anderson and Ohmart (1988).

RESULTS AND DISCUSSION

Autecological Factors and Annual Flooding

Prior to construction of irrigation diversion dams and hydroelectric dams, annual flooding occurred in most Southwest desert riparian ecosystems. This flooding served the native riparian flora well by flushing the area of debris thereby reducing the chances of fire in the floodplain. Many species of riparian plants are killed by fire. Flooding also leached salts from the soils. Finally, upon receding the moist soil permitted germination of riparian plants seeds. Cessation of flooding eliminates flushing, increases chances for fire, and decreases the probability of germination.

On the south fork of the Kern River, where flooding is an almost annual event, soil salinity levels are relatively low, and the soil has a very high sand content (table 1). On the Bill Williams where flooding occurs with some regularity, soil EC levels averaged 1.4 mmhos/cc (table 1). In both of these situations cottonwood and willow trees are numerically dominant and germinate regularly. Salt cedar is most abundant on the Bill Williams River.

Along the Colorado River agricultural fields are regularly irrigated by flooding. This, to some extent, simulates the annual flooding that occurred prior to the construction of dams that also serve as flood control agents. In these situations soil EC was higher than on the Kern River, but at a depth of about 1 foot it is only 36 percent of the level found in the adjacent riparian areas that are no longer flooded annually. For salt-sensitive species such as cottonwood and willow (e.g., Anderson et al. 1989), this level is too high to expect germination. In addition, the lack of flooding means that the soil surface is seldom wet; rainfall is not sufficient to stimulate natural germination. Historically, germination has relied upon annual flood flows. At soil levels to which the roots might penetrate (4-6 ft. below the surface) the EC level in flooded fields is 40 percent of that found in the adjacent riparian areas where salt cedar is the numerical dominant (Ohmart et al. 1988). The 5.8-EC level found in unflooded riparian areas is high enough to cause mortality for native salt-sensitive riparian species (Anderson 1989; table 4).

Table 1. Soil characteristics where annual flooding is common

EC=electroconductivity in mmhos/cc. For soil, sand = -3, clay, +3, 0 = even mixture of sand and clay, loamy. SE = 1 Standard Error; 4th QT= 4th quarter of soil profile.

		Soil EC		Soil Type	
Situation	N	1 ft. Mean (SE)	4th QT Mean (SE)	1 ft. Mean (SE)	4th QT Mean (SE)
Annual flooding common, So. Fork Kern River	391	1.2(.08)	0.9(.08)	-1.4(.08)	-1.2(.09)
Annual flooding common, Bill Williams River	42	1.4(.19)	1.4(.17)	-2.8(.09)	-2.3(.35)
Ag. fields flood irrigated, adjacent lower Colorado River	66	2.4(.30)	2.3(.34)	-1.3(.28)	-1.9(.25)
Overall conditions on lower Colorado River where flooding is highly irregular	693	6.6(.30)	5.8(.30)	-1.5(.08)	-2.0(.06)
Annual flooding for creation of waterfowl habitat in winter, CNWR, lower Colorado River	84	3.4(.42)	2.8(.38)	-0.1(.25)	-0.7(.27)
Adjacent areas where no flooding occurs, CNWR	756	8.2(.29)	6.2(.23)	0.1(.08)	0.1(.08)

An area of the CNWR flooded annually for creation of winter waterfowl habitat had EC levels near the surface 41 percent of that in the surrounding salt cedar-dominated riparian habitat. In the flooded areas there has been natural germination of mesquite *(Prosopis glandulosa, P. pubescens)*, wolfberry *(Lycium torreyana)*, seep willow *(Baccharis glandulosa)*, and quail bush *(Atriplex lentiformis)*, in addition to salt cedar. In the nonflooded portion only salt cedar and arrowweed are invading or redeveloping. There is virtually no seed source for cottonwood/willow in the area. At the level where roots might be expected to be found EC levels were 46 percent of that found in the nonflooded area (table 1). The "natural" area has EC levels too high for salt-sensitive species to germinate or even survive.

Even in flooded areas leaching may not be sufficient to reduce salinity to levels permitting germination of cottonwood/willow. Formerly much of the Colorado River floodplain was dominated by cottonwood/willow (Ohmart et al. 1977). From this we surmise that EC level in the Colorado River floodplain has gradually increased in recent decades.

Intermittent Flooding with Poor Drainage

Along arid land rivers if there is intermittent flooding into a basin with poor drainage a severe decline in the quality of the habitat can be expected. Occasional flooding results from runoff caused by summer storms or from runoff from agricultural areas. Either or both types of runoff are likely to be relatively high in salt content. If they flow into a poorly drained basin the salt is concentrated as evaporation occurs. As agriculture and associated irrigation increased in areas, runoff from the fields into rivers increased the salt load in the downstream direction, thus irrigation water used at downstream points has a higher salt load than that used in upper reaches. The lateral movement of water pushes this salt laterally to various distances from the river. In low places the water is drawn to the surface against the force of gravity by capillary action. In these places salts concentrate at the surface as the water evaporates. Inexorably, the potential for these areas to support native riparian species decreases.

Data from areas exemplifying this situation reveal that EC levels can climb to many times the levels suitable for cottonwood/willow (table 2). Soil in these areas is often dominated by silt or clay. Possibly such areas have always been saline, but the dead and decadent mesquite in the areas in table 4 testify to the degraded nature of the habitat. Salt cedar, though present, isn't thriving either, but it appears healthier than the mesquite. Such areas can be reclaimed only by establishing a drainage system followed by thorough leaching.

Table 2. Soil and salinity conditions in two areas lateral to the lower Colorado River where water is drawn to the surface by capillary action. As one goes from upstream to downstream the salt load carried in the river water increases. When capillary action draws this water to the surface, salt deposit on the soil increase as the water evaporates. There is decrease in the potential of these areas to support native salt-sensitive species. Standard error is in parentheses.

		Mean EC (mmhos/cc)		Mean Soil Type	
Water table (ft.)	N	Near surface	4-6 feet below surface	Near surface	4-6 feet below surface
3.6	14	28.4 (3.4)	28.4 (2.9)	2.4 (.3)	1.4 (.3)
5.2	14	25.9 (0.8)	23.1 (4.2)	1.9 (.3)	0.7 (.5)

When Riparian Lands Are Converted to Pastures

Along the South Fork of the Kern River there has been a tendency to use adjacent land as pasture for cattle. After decades of accumulation, the urine and fecal material add significant amounts of salt to the soil. Periodic flood irrigation ameliorates this situation to some extent, nonetheless there is significant salt accumulation (table 3). This is illustrated by comparison of a state-owned area that has not been pasture land for many years and that is leached annually by irrigation runoff water with an adjoining field that has frequently been used for pasture in recent years. The pastured area had surface soil EC levels more than 50 percent higher than in the nonpastured area (table 3). Soil lower in the profile had EC levels that were three times higher. This is probably because precipitation is never great enough to leach salts to lower soil levels. After rainfall, salt is moved from the surface downward a short distance but when drying begins capillary action brings it back to the surface. An EC level of 2.35 mmhos/cc is equivalent to about 10 tons of salt per hectare in the first 12 inches of soil. If this is removed the field can be relieved of nearly two-thirds of its salt load. This salt could be removed by leaching with large amounts of water, the precise amount varying with depth to the water table and soil type and other factors but at considerable expense.

Table 3. Comparison of soil electroconductivity levels in a piece of land that has been pasture for many years with an adjacent piece of land that has not been used for pasture for many years and that is leached annually by irrigation runoff water.

Situation	N	Soil EC 1 ft. Mean (SE)	4th QT Mean (SE)
Land used for pasture for many yrs	110	2.4 (.2)	0.8 (.1)
Land not pasture, leached annually	18	1.5 (.1)	0.7 (.1)

Among six species of native riparian plants for which we have collected data on the Colorado River, five were associated with EC levels in soil near the surface that were significantly ($P<0.05$) less than those that salt cedar was associated with; at deeper levels of the soil profile they were all associated with lower EC values lower than those of either salt cedar or bare ground (table 4). Only quail bush was associated with EC values approaching the average for salt cedar. The point at which 99 percent of all individuals of salt cedar were included encompassed the range 0-35 mmhos/cc near the surface and nearly that at deeper portions of the soil profile. For cottonwood and willow 99 percent of all observations, whether near the surface or deeper, were included in one-third of this range. Mule fat *(Baccharis glutinosa)* and honey mesquite were associated with higher salinity levels than cottonwood/willow. Clearly, high salt levels explain why bare ground is bare (table 4).

Table 4. Soil conditions associated with salt cedar, bare ground, and various species of native riparian plants. Data are from the lower Colorado River. 2SE = 2 Standard errors.

		EC (mmhos/cc)				Soil Type			
		Near surface		4-6 feet below surface		Near surface		4-6 feet below surface	
Species	N	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE
Salix exigua	6	1.14	0.25	1.32	0.62	-3.0	–	-3.0	–
Populus fremontii	41	3.28	1.34	2.22	0.78	-1.6	0.66	-2.3	0.46
Salix goodingii	32	3.61	1.48	2.30	0.92	-1.2	0.80	-2.1	0.58
Baccharis glutinosa	27	4.38	1.16	2.51	1.00	0.4	0.98	-1.7	0.80
Prosopis glandulosa	52	5.06	1.30	4.05	1.34	-1.6	0.46	-2.3	0.40
Atriplex lentiformis	14	8.39	1.36	5.46	1.84	-0.8	0.76	-1.9	0.60
Tamarix chinensis	382	9.18	0.84	7.80	0.78	-0.3	0.22	-0.5	0.24
Bare ground	90	17.49	2.52	14.82	1.94	-0.0	0.38	1.0	0.40

Observed associations between plant species and soil EC levels can be construed as indicating the level of salt tolerance for adult individuals but they do not indicate the level of tolerance for saplings, which is generally much lower. For sapling cottonwood/willow we have found that the threshold for productivity is 1 mmho/cc, above which productivity drops off at a rate of about 20 percent per increment of 1 mmho/cc (Anderson et al. 1989). Salt cedar is apparently more adapted than native species to the emerging saline ecosystems in many arid land riparian situations. This may, at least in part, explain their rapid spread to and numerical dominance in these ecosystems.

Salt Cedar and Wildlife

We found salt cedar to have less wildlife value than the majority of 23 habitat types studied on the Colorado River (Anderson and Ohmart 1984, Ohmart et al. 1988). However, on the Rio Grande near Presidio, Texas birds such as Summer Tanager, Yellow-billed Cuckoo, both absent in salt cedar on the Colorado, were commonly encountered in salt cedar stands in Texas (Engel-Wilson 1978, Hunter et al. 1988), and the Pecos River (Hildebrandt and Ohmart 1982, Hunter et al. 1988) in New Mexico and Texas (table 5).

Table 5. Percentage of summer birds that occurred in salt cedar in three arid land riparian situations. In each area there were at least six types of vegetation.

	River System		
Species	**Colorado**	**Pecos**	**Rio Grande**
Summer Visiting Insectivores			
Yellow-billed Cuckoo *(Coccyzus americanus)*	2.43	43.48	9.09
Ash-throated Flycatcher *(Myiarchus cinerascens)*	12.61	11.11	43.59
Western Kingbird *(Tyrannus verticalis)*	26.92	17.24	0.00
Northern Mockingbird *(Mimulus polyglottis)*	12.90	38.34	16.01
Yellow-breasted Chat *(Icteria virens)*	7.84	57.8	34.48
Summer Tanager *(Piranga rubra)*	0.00 *	12.8	39.47
Blue Grosbeak *(Guiraca caerulea)*	29.91	55.41	23.08
Painted Bunting *(Passerina ciris)*	–	81.82	27.88
Brown-headed Cowbird *(Molothrus ater)*	25.81	64.86	28.52
Northern Oriole *(Icterus galbula)*	12.59	25.93	20.00
Permanent Resident Insectivores			
Greater Roadrunner *(Geococcyzus californianus)*	26.19	75.00	12.00
Ladder-backed Woodpecker *(Picoides scalaris)*	6.75	13.33	30.77
Cactus Wren *(Campylorhynchus brunneicapillus)*	6.34	0.00	0.00
Crissal Thrasher *(Toxostoma dorsalis)*	17.72	64.29	12.50
Loggerhead Shrike *(Lanius ludovicianus)*	19.5	20.00	28.30
Pyrrhuloxia *(Cardinalis sinuatus)*	–	17.6	0.00

*Found in the evergreen species, *Tamarix aphyla*, but not in *Tamarix chinensis*.

We found that from west to east a greater proportion of the total insectivore populations used salt cedar habitats (table 5). Eleven of 14 species on the Pecos used salt cedar to a greater extent than on the Colorado and nine of these species used salt cedar more extensively on the Rio Grande (table 5). The yellow-billed cuckoo occurred in salt cedar habitats (8/100 acres) as extensively as in cottonwood/willow (7/100 acres) on the Pecos River (Hunter et al. 1988).

Explanation for this observation remained an enigma until detailed study (Hunter 1988) showed that habitat use of salt cedar increases along an elevational gradient. Apparently use of salt cedar by insectivorous birds is related to temperature with use increasing as average summer temperature decreases. In winter we see the reciprocal – bird use of salt cedar decreases from west to east, use again following a temperature (altitudinal) gradient, but greater use is associated with warmer temperatures (Hunter 1988).

A METHOD FOR ELIMINATING SALT CEDAR

We have been relatively successful in eliminating salt cedar by cutting the root crown 30-38 cm below the surface, using three modifications of the same basic methods. In all methods the first step is to clear the above ground vegetation with a dozer. With the first method we used a hydraulically controlled root-ripper with the blade set to cut roots at the desired depth. It was pulled with a D-7 Caterpillar, the power of which seemed to be sufficient to pull the ripper through the moderately silty soil. This area included 20 hectares with 345 salt cedar trees per hectare. A control plot with approximately the same number of trees per hectare was cleared but not root-ripped. This was done in July 1978. By October 1979 nearly all of the control site salt cedar had redeveloped from root stock, but only 59 per hectare on the root-ripped site. By October 1983 the control area was much the same as it had been before clearing; the root-ripped site had 80 trees per hectare. Thus after five years the clearing effort had been 77 percent successful with respect to the goal of eliminating salt cedar. However, many trees that redeveloped lacked vigor relative to the salt cedar present either before ripping or that had redeveloped in the control area. This lack of vigor may have been partly due to damage initially done by the ripper and partly to the competition that redeveloping salt cedar encountered. Preclearing data showed the area to have high EC levels, thus we revegetated using primarily salt-tolerant species such as quail bush and inkweed *(Suaeda torreyana)*. This vegetation developed into stands so dense that it may not have interfered with vigorous development of salt cedar not killed by the ripper.

The second modification of this general approach was done on moderately saline ground along the Rio Grande near Presidio, Texas. In the area salt cedar totaled about 585 individuals per hectare before clearing. After clearing, a roadgrader blade was welded to the tines of a D-8 caterpillar brush rake. This allowed for greater control because the cutting edge was pushed instead of pulled. It was highly effective in killing the salt cedar. One year after treatment, virtually none had regenerated on the treated area, but had regenerated on the untreated portion.

The third modification involved simply using a D-7 caterpillar blade to cut roots at the prescribed depth on a plot with sandy soils and salt cedar density of 375 trees per hectare. This site was located on the Colorado River near Blythe, California and the work was done in May 1988. Clearing was done after a fire on the area. The dozer worked at a rate of about 2 hectares per day in this area. In denser portions of the 20 hectares plot progress was much slower and success was much less. The D-7 had insufficient power to do an adequate job and maintain a rate of about 2-2.5 hectares per day. Overall success was high, although no tree counts were made. Salt cedar that did begin to regenerate were sprayed by hand with Arsenal. In September 1990, although no counts have been made, it is obvious that salt cedar is not a problem on the site.

This modification was tried on a 32-hectare plot on the CNWR. On this site clay was abundant and the D-7 Caterpillar struggled to get the blade to a lethal depth. As a consequence the effort was successful in reducing the number of trees by only about 50 percent. The D-7 didn't have sufficient power; progress was at a rate of less than 1.5 hectares/day; in many places the blade was obviously not deep enough to kill the salt cedar. A D-8 Caterpillar using a blade would have been successful.

The "blade" modification of the root cutting technique, with the proper sized machine, was successful. It progressed at about 1.2-2 hectares/day at a cost of $625-$750 per hectare. Since an area where salt cedar is killed will have to be cleared anyway the dozing method is perhaps the most feasible way of eliminating salt cedar. Another distinct advantage is that it can push the top 30 cm or so of salty soil into berms thus providing a net improvement in soil conditions and thereby increasing the chances of reestablishment by native species in the area.

CONCLUSIONS

Southwest arid land riparian habitats have been degraded badly in recent decades. The invasion of salt cedar is a sign, not the cause, of this degradation. The situation has been exacerbated by agricultural practices and dam construction for flood control and other purposes. The salt loads in riparian soils have increased making a significant portion of the riparian soils unsuitable for growth of native riparian plant species. Before eliminating salt cedar in an area the value of the existing salt cedar habitats to wildlife should be carefully evaluated. The soils in the area must also be evaluated so that a judgment can be made regarding the type of habitat that can be expected to develop if the salt cedar is eliminated. Once these determinations have been made a dozer with a blade can be used to simultaneously clear the salt cedar, and to kill it by cutting its roots about 30-38 cm below the surface. Salt cedar that regenerates after treatment can be treated with herbicide.

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REFERENCES

Anderson, B. W. 1988a. *Potential of the Kern River Preserve for Revegetation.* The Nature Conservancy and California Department of Fish and Game. San Francisco and Sacramento, CA.

_______. *Soil and Salinity Conditions in the Lower Colorado River Floodplain.* California Department of Fish and Game. Sacramento, CA.

Anderson, B. W., E. R. Miller, and J. Washington. 1989. *Revegetation on the Kern River Preserve 1986-1989.* The Nature Conservancy and California Department of Fish and Game. San Francisco and Sacramento, CA.

Anderson, B. W. and R. D. Ohmart. 1984. *Vegetation Management Study for the Enhancement of Wildlife along the Lower Colorado River,* U.S. Bureau of Reclamation, Boulder City, NV.

Engel-Wilson, R. W. and R. D. Ohmart. 1978. *Floral and Attendant Faunal Changes on the Lower Rio Grande between Fort Quitman and Presidio, TX.* USDA Forest Service General Technical Report. PSW-110473-475.

Hildebrandt, T. D. and R. D. Ohmart. 1982. *Biological Resource Inventory (Vegetation and Wildlife) – Pecos River Basin, New Mexico and Texas.* U.S. Bureau Reclamation. Amarillo, TX.

Hunter, W. C. 1988. *Community Dynamics of Desert Riparian Birds along a Climatic Gradient: a Grinnelian Nich approach.* Unpublished M.S. thesis, Arizona State University, Tempe, AZ.

Hunter, W. C., B. W. Anderson, and R. D. Ohmart. 1987. Avian Community Structure Changes in a Mature Floodplain Forest after Extensive Flooding. *Journal Wildlife Management* 51(2):495-502.

Ohmart, R. D., W. O. Deason, and C. Burke. 1977. "A Riparian Case History: The Colorado River." Pages 35-47 in R. R. Johnson and D. A. Jones, tech. coords. *Importance, Preservation and Management of Riparian Habitat: a Symposium.* USDA Forest Service General Technical Report. RM-43.

Ohmart, R. D., B. W. Anderson, and W. C. Hunter. 1988. *The Ecology of the Lower Colorado River from Davis Dam to the Mexico-United States International Boundary: A Community Profile.* U.S. Fish and Wildlife Service Report 85 (7.19). U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

THE NEED FOR FEDERAL ACTION TO CONTROL WEEDS OF NATURAL LANDS

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Abstract

Illinois natural areas and wildlands suffer from severe infestations of introduced exotic weeds. These weeds threaten the beauty, natural diversity, and habitat quality of these lands and therefore pose a major threat to Illinois' natural heritage. State, local and federal agencies and private organizations spend tens of thousands of dollars annually in control efforts on nature preserves, parks, and conservation areas in the state.

In spite of this effort, five nature preserves representing a public investment of over one million dollars have been totally overrun by weeds and are beyond known treatment. Many other preserves have severe infestations that defy eradication. Here, the managers are working to contain the problem until research finds an answer. Most forests and wildlands in Illinois are privately owned and go unmanaged as far as maintaining their natural quality is concerned. On this, our basic wildlife habitat support base, exotic weeds are beginning to convert significant areas of naturally diverse habitat into monocultures of alien weeds. The impact of these weeds on wildlife has not been researched, but the loss in beauty as our woodland wildflowers are replaced by weeds is obvious.

These weed problems are not unique to Illinois but cross state boundaries into our adjacent states. The problem weeds in the Midwest are somewhat different than other regions of the United States, but each region has its own suite of exotic weeds. Illinois' most serious weeds at present are purple loosestrife (Lythrum salicaria) *of wetlands and garlic mustard* (Alliaria petiolata) *in deciduous forests. Amur honeysuckle* (Lonicera mackii), *autumn olive* (Elaeagnus umbellata), *multiflora rose* (Rosa multiflora) *and Japanese honeysuckle* (Lonicera japonica) *are very severe problems as well. The latter two species along with purple loosestrife are illegal to sell or plant in Illinois under our state exotic weed act.*

The federal government has a responsibility for this problem because several of the most serious problem weeds in the midwest were imported and promoted by the U.S. Soil Conservation Service. The states have no authority or ability to restrict importation and distribution of noxious and potentially noxious weeds into the United States and the nation's only existing program to address development of biological controls of weeds is housed in the U.S. Department of Agriculture.

A federal program to address this national conservation problem should include the following elements:

1. John Schwegman, Botany Program Manager, Illinois Department of Conservation.

REGULATION OF NEW PLANT INTRODUCTIONS

No amount of effort to control the existing noxious weeds of wildlands will be meaningful if control is not instituted over the continuing introduction of new weeds. The U. S. Department of Agriculture's Plant Introduction Service and the Soil Conservation Service's Plant Materials Program and all other private and public plant introduction efforts should be required by law to evaluate weed potential of non-native plants they are considering for introduction. Plants that prove to have significant weed potential in parts of the United States should be prohibited by law from importation, sale and planting in all of, or the relevant portions of, the United States.

REGULATION OF INTERSTATE MOVEMENT OF DESIGNATED NOXIOUS WEEDS

Weeds of wildlands should qualify, along with agricultural weeds, as noxious weeds under a federal act designed to stop the interstate spread of noxious weeds. Such an act should allow for administrative listing of noxious weeds to provide the flexibility necessary to react in a timely manner to new outbreaks. It should allow some mechanism for input from the conservation community, especially natural area managers. The National Park Service, the Natural Areas Association, The Nature Conservancy, the Natural Resources Defense Council, and various states have such expertise. Listed noxious weeds should be prohibited from interstate commerce and personal transportation into areas of the country where they are suspected to have weed potential. The importation into the country to such areas from outside of the United States should also be prohibited. The selling, planting, discarding, and promoting of noxious weeds should be a federal offense in parts of the United States where they have weed potential.

FUNDING OF BIOLOGICAL CONTROL OF WILDLAND WEEDS

A program is needed at the federal level to fund biological control research and development for the most serious weeds of natural lands. This research involves carefully introducing insects and plant diseases that control these exotic weeds in their native land into their range in the United States. Because these problems regularly cross state boundaries and the cost of such research exceeds the ability of any one state to fund them, a federal program is required to meet this national need. A typical project costs about one million dollars over about nine years, but past experience with alligator weed, water hyacinth and Klamath weed biocontrol indicate a tremendous benefit over costs for such research. For our most serious wildland weeds here in Illinois, biological control is our only hope because of the scope of the infestations.

The U.S. Department of Agriculture currently has programs in biological control of agricultural weeds. This program is addressing some wildland weed problems, primarily range weeds of midwestern prairies because of their agricultural importance. The nonagricultural wildland weed project currently under way demonstrates the problem rather than indicating that the current program is beginning to address this problem. In spite of the fact that purple loosestrife is destroying critical waterfowl (game) habitat on a continent-wide basis, it took a decade of efforts to get the project funded. There is no dependable source of federal funding for problems unrelated to game species and funding for game problems is unreliable.

A national program is needed. This program (fund) should probably be regulated, if not administered, by the U.S. Department of Interior as opposed to Agriculture. A strong mechanism for meeting the needs of the states is imperative. While the needs of the national parks reflect some of the states' needs, many of the states' problems are not major problems within the parks. Those states wishing input into priorities for the program should have that opportunity along with other agencies of government and private organizations and individuals.

The funding level would depend on a national survey of needs, but a one million dollar appropriation in fiscal year 1991 would probably initiate a dozen or more of the most critical research projects. An effective program would depend on continuing funding in subsequent years. Illinois urges that garlic mustard and Amur honeysuckle be in any initial group.

RESEARCH FUNDS FOR CONTROL ON MANAGED AREAS

The protection and management of land for its natural heritage values is a rapidly growing activity in nearly all states. However, funding for research into controlling exotic weeds and other problems on nature reserves is very limited in the states. At present, federal funds can be obtained to study and determine proper management of single endangered species, while no funds are available to study control of a weed that is overrunning an entire natural community and threatens to make all of its species endangered! A program of federal funding, available to the state management agencies, is needed. The recent initiative of biodiversity research funds by the National Science Foundation is not adequate because these funds are granted to researchers who seldom address practical management problems. The funds need to go to managers who can then contract for the research they need.

ROLE OF PRESCRIBED BURNING AND GRAZING IN THE CONSERVATION OF NATIVE SPECIES IN CALIFORNIA GRASSLANDS

John W. Menke, Robert P. Langstroth, and Heather C. Fossum[1]

We hypothesize that prescribed burning and short-duration, time-controlled grazing of remnant purple needlegrass (*Stipa pulchra*) stands will increase the abundance of this native perennial bunchgrass. Two primary mechanisms will lead to this change: 1) increased tillering rates and seed output from clonal fragments through transformation of decadent tussock forms of mature plants, and 2) increased seedling establishment and survival of new plants. Three replications of two main effects, burning (burning each third year in late summer or not burning) crossed with grazing (one two- to four-day sheep grazing event per year in early spring or summer, or no grazing). Early-spring grazing with burning produced the greatest benefit in fragmentation and seedling regeneration. Summer grazing is more beneficial than no grazing. Burning without prior grazing reduced needlegrass abundance due to fire mortality, especially on mound sites where aboveground biomass is more abundant. Mechanisms causing these responses will be discussed. This research was supported by The Nature Conservancy, the Hewlett Foundation through the UCD Public Service Research and Dissemination Program, the California Agricultural Experiment Station, and rancher Burrows Hamilton by supplying sheep for grazing treatments.

Tuesday, October 16, 1:30 pm

1. John W. Menke, Robert P. Langstroth, and Heather C. Fossum, Department of Agronomy and Range Science, University of California, Davis, CA 95616.

ENDANGERED PLANTS IN NATIONAL PARKS: MANAGEMENT FOR THE 21ST CENTURY

ENDANGERED PLANTS IN NATIONAL PARKS: MANAGEMENT FOR THE 21ST CENTURY

Organized by Bruce M. Pavlik[1]

INTRODUCTION TO THE SESSION

Welcome to this session, which we have named "*Endangered Plants in National Parks: Management for the 21st Century.*" Besides assembling this collection of speakers, I function as a plant ecologist in the Biology Department at Mills College and serve as Vice President for Rare Plants in the California Native Plant Society (CNPS). For CNPS, I chair the Rare Plant Scientific Advisory Committee, the committee which oversees publication of the *Inventory of Rare and Endangered Vascular Plants of California* and which also maintains a working relationship with the Department of Fish and Game to provide valuable information on rare plants to the California Natural Diversity Data Base.

The committee, and the California Native Plant Society as a whole, have deep and long-standing commitments to the preservation of rare plants and their habitats. Those commitments are often focused on the activities of the U.S. Fish and Wildlife Service, the Forest Service, the Bureau of Land Management, and a wide variety of government agencies on state and local levels. We participate and often drive the endangered species listing process under state and federal law, examine issues of impact, mitigation and protection, and have recently begun to address restoration, recovery, and *ex situ* conservation. It is rather surprising then to realize how little interaction we have had with the National Park Service, especially since CNPS and NPS share similar objectives and large portions of the same, rich California flora.

To illustrate this lack of interaction, I asked Roxanne Bittman of the Natural Diversity Data Base to generate a map of all rare plant localities in the vicinity of Yosemite National Park. The map revealed that many populations of rare plants appear to come right to the park boundary and then abruptly stop. Such patterns of distribution are not likely to be natural. Instead, they either reflect a lack of data within the park or a lack of communication between the park and the Natural Diversity Data Base. I have since learned from Jan van Wagendonk, research scientist at Yosemite, that there is a considerable amount of recent data on rare plants stored in the park's computer data base. Therefore, in order to improve our efforts to preserve biodiversity, CNPS must forge a new, stronger link with the scientists of the National Park Service who are at the forefront of natural areas management. In turn, those scientists should increase their use of CNPS and the Natural Diversity Data Base as sources of expertise on the biology and management of rare plants. Such mutual efforts would certainly enhance the processes of data collection and exchange among parties that share the same overall goals.

Beyond the problems of data generation and exchange, there are major issues of policy and management that are now being debated within and beyond the national park system. Although we know something about the basic biology of many endangered species, we know much less about how such species can be managed in order to prevent extinction in the immediate future. The preservation of biodiversity within the nation's parks will be served best by exchanges of perspective and expertise, as well as data, between all concerned parties. Let this modest session be the start of improved communication and technical collaboration between the Park Service and other agencies, organizations, and individuals that share the common goal of preserving rare plants regardless of the political geography of their distributions.

1. Bruce M. Pavlik, Department of Biology, Mills College, Oakland, CA 94613.

This afternoon we are fortunate to have with us a panel of experts who work with rare and endangered plants both inside and outside of the national parks. Each member of the panel has been asked to present a short essay that attacks pieces of the major objective of our session. That objective is to explore how existing management policies/priorities/procedures either enhance or detract from the preservation of rare and endangered plants *(sensu lato)* in national parks.

The logical extension of that objective is the question: How can we develop a theoretically sound, yet practical set of management policies/priorities/procedures for the future?

The format we have chosen does not follow any standard rules. Each panel member was simply asked to address his topic by delivering a 10- to 12-minute essay. The essays contain relevant facts, opinions, and recommendations that will hopefully lead us into a new era of rare plant management and conservation in the National Park System.

SESSION PRESENTATIONS

Stephen D. Veirs, Jr. – NPS, UC Davis
Exogenous Threats to Sensitive Plants: Pollution, Climatic Change, Habitat Fragmentation and Alien Biota.

Steven DeBenedetti – NPS, Pinnacles National Monument
Implications of National Park Service Fire Management Policies for the Status of Sensitive Plant Species.

David Graber – NPS, Sequoia-Kings Canyon National Parks
Development of the Synecological Management Perspective in the National Parks and its Implications for Management of Endangered Plants.

Ken Berg – State of California, Rare Plant Program
Conflicts between National Parks Management and Endangered Plant Protection: Examples from California.

Stephen J. Botti – NPS, Boise, Idaho
Managing Beyond the Endangered Species Act: An Emerging Perspective on Sensitive Plant Protection.

Mark Skinner – California Native Plant Society, Sacramento, CA
Expectations of the Concerned Public Regarding the Management of Rare Plants by the National Park Service.

EXOGENOUS THREATS TO SENSITIVE PLANTS: POLLUTION, CLIMATIC CHANGE, HABITAT FRAGMENTATION, AND ALIEN BIOTA

Stephen D. Veirs Jr.[1]

How do plants, and animals for that matter, become sensitive, rare, threatened or endangered? What is the significance of this status? What does the foreseeable future hold for these species of concern?

Sensitive, rare, endangered and threatened are terms that we use today to loosely categorize our concerns about species represented by a small number of individuals. Usually we know little about them, except that they are small or diminishing populations, often in limited habitats. Usually they are exposed to pressure of various types that threaten to further diminish or destroy the taxon whether described as a population, variety, or species.

What makes a species rare? Some are remnants of human modification of whole ecosystems, especially in those regions easily converted to agriculture like the great plains or the central valley. Some are relics of past climatic conditions, quite resilient where adapted and evolving in limited but favorable habitats such as the margins of vernal pools, on serpentine soils or in acidic bogs. Others may be relatively recent evolved lines, successful in new habitats. Some may be merely the result of enthusiastic taxonomy. Some are organisms with limited options, truly at risk of extinction due to some random event of minor significance to the rest of the world.

What is the other side of rareness? The obverse of sensitivity? Some taxa are widespread, traditionally dominant and successful taxa – black spruce in the arctic, sagebrush in the arid west, cottonwoods in riverbottoms, etc. Some are adapting to new conditions of life associated with human influence – house sparrows, coyotes, Eurasian grasses, alien weeds. Many alien taxa have spread aggressively in the human disturbed landscape. These may be analogs of the natives they displace, radiating into living space yielded by less weedy natives of the same genus, family, or growth form.

But it is an oversight to think only of small populations of organisms as potentially at risk. We have seen the loss of large, widespread populations laid low by various agents. The fossil record includes vast assemblages of taxa now extinct for reasons unknown, arguable, or moot. The North American Pleistocene megafauna appears to have been decimated by the southward and eastward migration and radiation of bands of humans – humans with hunting skills and a taste for flesh. New world civilizations and societies based on the descendants of those same Pleistocene human groups were later lost. Lost to disease and predation visited upon them by their distant human relatives who moved westward, sailing to the New World in ships. Subsequent waves of "alien" diseases have more recently extirpated the vigorous large populations of American chestnut, American elm, leaving only scattered remnants. And new diseases continue to evolve with implications for humans, animals, and plants.

Habitat changes and human predatory activities long ago removed the passenger pigeon and the Carolina parakeet from their former extensive ranges. Many slower reproducing forms of animals, especially the larger predatory mammals, both terrestrial and marine, have been extirpated in many regions. Many insular forms of plants and animals, evolved in isolation, have been lost due to introduction of omnivore generalists like rats, pigs, and goats. Essential habitat for many migratory species is declining or disappearing throughout North America. New chemical compounds put whole food chains at risk.

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1. Stephen D. Veirs, Jr., National Park Service, Cooperative Park Studies Unit, Institute of Ecology, University of Davis, CA 95616 (916) 752-7119.

We have introduced many modern old world taxa for our own use, including cattle, sheep, honeybees, and crop plants, all of which have displaced natives or occupied habitat left vacant by earlier human activities. With these "good" taxa we have unwittingly or intentionally introduced the sugartramps and super weeds, the sparrows, rats, pasture grasses, and tree of heaven and other plain or showy weeds, too numerous to mention – the animals and plants that largely are successful invading and occupying native habitats disturbed by human activities. In some perverse way, you might say that we have increased the biotic diversity of the new world by some of our recent activity, but I'm not sure the gains exceed the losses, whatever scale is used.

In addition to direct reduction or augmentation of the biota, our own human population has grown and become increasingly industrialized. We have converted the landscape to agriculture, to city, and to highway. We are reducing the diversity of habitat once available to native species. We are making our world simpler, less heterogeneous.

As we increase the mass of fossil fuels converted to our use, we also bring whole bioregions under the oppressive influence of air pollution and acid precipitation. Not subtly, but insidiously, we are hammering into extinction great groups of plants, animals, and microorganisms about which we know little and which condition hardly concerns us at all. Only rarely can we document their passing. In the larger global climate, our effusion of man-made chemicals and our drawdown of the fossil carbon storehouse may move the average global temperature and ultraviolet radiation values to levels not tolerated by sensitive species under stress.

Our parks and wildernesses, our great biological reserves, both those deliberately established and those simply too remote as of yet to have been converted to saw logs and agriculture, are increasingly fragmented and modified. They serve only as minor reservoirs of genetic potential – isolates no longer part of their former biological realm. More and more our successful species travel by highway and airplane. They dwell with us. Our sensitive wildland species are reduced in number and threatened by our continued excesses of agriculture, industry, consumption, and population.

We are too much with the world. We lay waste to that which is not ours to destroy. A sonnet by William Wordsworth begins this way:

> The world is too much with us; late and soon,
> Getting and spending, we lay waste to our powers:
> Little we see in nature that is ours;
> We have given our hearts away, a sordid boon!

I am not here to give you answers – perhaps there are none. We are witness to and participants in the continuing earthly race of biological evolution, competition, and extinction. It is, more and more, the overbearing human presence that drives earth's biotic systems in new and surprising, though often predictable, directions. We are too much with the world. We lay waste to that which is ours. It is within our capacity to attempt to understand and moderate our excesses. It is also within our nature to rush pell mell into our brave new world. We can do it without heed to the limits of our natural world and without concern for our natural heritage. It is ours to squander. I hope that you and I can find the means within ourselves to do otherwise.

IMPLICATIONS OF NATIONAL PARK SERVICE FIRE MANAGEMENT POLICIES FOR THE STATUS OF SENSITIVE PLANT SPECIES

Steven DeBenedetti[1]

Fire is a multidimensional process affecting virtually all aspects of plant and community ecology. The frequency and timing of fire occurrence interact with elements of the fire environment (wind, temperature, humidity, available fuels, topography) and other environmental conditions (disease cycles, climatic history, other disturbance cycles/events) to directly and indirectly influence a plant's individual and/or population survivorship potential. Community-level fire effects (i.e., unleashing competitors, habitat changes that attract predators, microclimate change) also influence the survivorship potential of sensitive plants. A fire regime, unaltered in its range of intensities, frequencies, and timing is one of several process elements essential for maintaining the ecological integrity of wildland ecosystems. Any species may "acquire" a state of "endangeredness or threatenedness" if essential process elements are significantly altered.

Unlike many environmental processes (i.e., chemical weathering, nutrient cycling, decomposition, climate, successional trends), fire occurrence is neither incremental nor is its extent entirely uncontrollable. The perception of fires' apparent (and sometimes real) destructiveness, acuteness, and controllability has allowed wildland managers to separate this important ecological force from its less manipulable companion processes. This predisposition for managing fires, especially naturally ignited fires, may contribute to or create

A state of "threatenedness or endangeredness" may be derived from two distinct causal pathways:

1. The first pathway is process-driven extinction or natural selection. Individual species may be eliminated or endangered in a changing physical, community, and/or genetic environment. Fire management actions taken to preserve species threatened by such changes are incongruent with process-driven wildland resource protection and require special consideration (i.e., the emerging NPA biological diversity initiative). "Conscious" disruption of existing environmental conditions by a single species (humans) is excluded from this definition of process-driven extinction.

2. The second pathway is driven by the conscious activities of humans. Management of wildland fire is one of these activities. For the purpose of discussion, fire management policies potentially affecting (or creating) endangered plant species are divided into those specific to naturally occurring fire and those related to prescribed fire.

MANAGEMENT OF NATURAL FIRE

It is likely that the blanket fire suppression policy of past decades contributed to (or is responsible for) the scarcity of several plant species. One line of evidence supporting this hypothesis is the appearance of relatively large numbers of seedlings of rare species following fires. Examples include the tree anemone, *Carpenteria californica* (C1), the Carmel Valley Bush Mallow, *Malacothamnus palmeri* var. *involucratus* (C3), and the Pinnacles buckwheat, *Erigonum nortonii* (C3c).

1. Steven DeBenedetti, National Park Service, Pinnacles National Monument, Paicines, CA 95043 (408) 389-4485.

Current policy permits naturally ignited fires to run their course within ecosystems judged to be essentially unaltered by human activity under specific, prescribed conditions. These conditions have become increasingly restrictive and arbitrary from an ecological perspective. Driving the prescribed natural fire management perspective are considerations for the availability of suppression forces in the event of blow-up conditions, inside and outside park socio-economic and aesthetic concerns, and perceived and extant air quality regulations.

Examples of management protocols that may compromise the integrity of natural fire regimes (and potentially impact individual species) include those designed to control:

1. the number of fires permitted to burn simultaneously (locally, regionally, or nationally)
2. the number of acres or miles of perimeter allowed to burn at one time
3. the potential of fire to cross political boundaries to areas with nonconforming use
4. interference with visibility and/or aesthetic environments
5. criteria pollutant standards (PM10, CO)
6. threats that projected intensities may exceed controllability by resources on hand or immediately obtainable
7. the number of organized fire personnel not committed to ongoing fires
8. certification and monitoring procedures and frequencies.

Successful application of these protocols is likely to have its greatest effect upon the most significant fires from an ecological perspective: those with a potential to burn over a long period of time, burn intensively during a portion of that time, and burn over extensive areas. Stand-replacing fires will rarely be sanctioned. Given sufficient time, the integrity of the natural fire regime (its array of timing, intensity, extent, and periodicity) may be compromised. The status of individual species may be unwittingly jeopardized. The dubious notion that "any fire is better than no fire" emerges as the common denominator of the natural fire management perspective. The oxymoron "prescribed natural fire" becomes a literal description of the natural fire program.

PRESCRIBED FIRE MANAGEMENT

Prescribed fire is defined as the planned use of human-ignited fire to achieve specific, measurable objectives. Objectives may be ecological (i.e., reduce extent and amount of fuel buildup caused by fire suppression, alter nonnatural structure/composition of vegetation, mimic natural fire regime, maintain habitat of a sensitive species), administrative (i.e., reduce fire hazards near developed areas or political boundaries), or sociocultural (i.e., maintain historic landscape, mimic land management practices of previous cultures).

Superimposed on the specific objectives of a prescribed burn is the inherent liability associated with a management-ignited fire. Controllability is an essential and limiting element in any prescription. The notion of liability may also be projected to the aesthetic and economic environment of visitors, park and local residents, concessioners, and local business persons. Thus, the field of management objectives considered for prescribed fire is generally conservative.

Most prescribed burns are conducted under cool or moderate conditions, and in areas or at times where visitors and economic interests are least affected by such a fire. Ecological considerations are often secondary. The season in which prescribed fires are conducted often deviates from the seasonal array dictated by a natural fire regime. The timing of fires may affect the survivorship potential of individual plant species and/or affect community dynamics in such a way that the status of a species may be threatened. Prescribed fire programs may unwittingly create a state of "endangeredness" for individual species.

WILDFIRE

Wildfires are most simply defined as unwanted fires – fires that are incongruent with management objectives. Wildfires are frequently, but not necessarily, human caused. Timely and aggressive action is taken to suppress wildfires. The policy of suppressing unplanned, man-caused fires is consistent with process-oriented protection of sensitive plant species, provided that natural fires are permitted to burn or prescribed fire is applied in such a way that it mimics the natural fire regime. Threats to sensitive plant species in the management of wildfires are less likely to be derived from policy than from the physical impacts of suppression actions.

Wildfires threaten sensitive plants in several ways:

1. Physical disturbance of sensitive plant species during suppression activities (i.e., line construction).
2. Direct consumption by fire. Direct consumption of sensitive plant species is not generally problematic if wildfires are infrequent and vegetation is fire adapted. An exception might be species confined to duff layers such as *Pityopus californicus* (C3c). Consumption of sensitive plant species by wildfire in communities not adapted to fire or that have had their fuel or fire regimes altered by management practices or invading alien plant species is frequently deleterious. Numerous species of the Hawaiian Islands (i.e., *Kokia drynarioides, Colubrina oppositifolia, Alphitonia ponderosa, Pittostorum terminalioides)* have been negatively influenced by wildfire.
3. If wildfires occur with sufficient frequency to alter the natural fire regime, individual plant species may be threatened.

MITIGATING ACTIONS/RECOMMENDATIONS

The following recommendations attempt to minimize potential endangerment of individual species caused by fire management protocols. No attempt to address the role that national parks will play in protecting individual species from process-driven endangerment is presented.

Assertions/Predisposition

1. Acknowledge the important role that natural fire regimes play in determining the status of individual plant species. Acknowledge that intense, stand-replacing fires in altered ecosystems are positive ecological influences and are essential for maintaining the ecological integrity of wildland park resources.

2. Clearly state that smoke from naturally ignited fire is a natural phenomena in wildland ecosystems. A compromise of visual range and other aesthetic values by smoke from natural or prescribed fire is analogous to fog, rain, or clouds and should be periodically anticipated by visitors, employees, and concessioners as part of the natural environment that is to be preserved.

3. Clearly assert that removing human presence (visitor or employee) from health-threatening circumstances (elevated PM10 or carbon monoxide levels) is a viable and perhaps preferable management option when the alternative is to suppress an ecologically significant natural or prescribed fire.

4. Accept a greater degree of risk of fire spreading to adjacent areas.

Actions

1. Increase efforts to develop cooperative agreements with adjacent landowners to accept natural and prescribed fires from park areas. Increase NPS commitments to manage such fires on private/state/federal lands.

2. Where appropriate, develop in-park (or negotiate out-of-park) buffers where vegetation age, structure, density, or available fuel is managed to limit natural or prescribed fires from escaping core zones. It is important that buffers themselves do not impair ecological processes by acting as a barrier to the movement of animals or as a corridor for the influx of non-native species. Buffers may need to be established within wilderness boundaries.

3. Monitor the effects of prescribed fire regimes on vegetation. Implement long-term research and/or monitoring programs to assess the influence of management regimes on sensitive species.

4. Dedicate a portion of nationally available fire fighting forces for management of naturally occurring fires in wildland areas. Eliminate the need to classify natural fires as wildfires when resources aren't available to control them on a daily basis irrespective of local conditions, the location of the fire, or the behavior of the fire.

5. Establish a policy to make possible the reclassification of wildfires to prescribed natural fires when temporary resource shortages is the principal reason for classifying a naturally ignited fire in a wildland area as a wildfire.

6. Produce sensitive species maps that can be given to prescribed burn bosses and wildfire incident commanders. Emphasize through the superintendent's or manager's delegation of authority to an incident commander that the protection of sensitive plant populations is as important (if not more so) as protecting structures and other property. Resource advisors familiar with sensitive plant locations should be assigned to all incident management teams.

DEVELOPMENT OF THE SYNECOLOGICAL MANAGEMENT PERSPECTIVE IN THE NATIONAL PARKS AND ITS IMPLICATIONS FOR MANAGEMENT OF ENDANGERED PLANTS

David M. Graber[1]

From the inception of modern natural resources management in the late 1960s until the mid-1980s, the National Park Service was largely preoccupied with the autecological management of heroic and charismatic species. Notable examples include grizzly bears, giant sequoias, and Hawaiian silver-swords. Derived from an attempt to manage landscape "scenes" for the characteristics that originally led to their protection, this philosophy likewise led to efforts to extirpate alien species where – as in the Florida Everglades and the Hawaiian parks – they threatened the survival of key natives and often the very nature of the landscape itself.

The deeply held assumption that preservation of the aboriginal scene would automatically lead to the perpetuation of all of its elements ironically led to a relatively smug and ineffectual management strategy for the protection of legally threatened and endangered (T&E) species unless they were celebrated and visible. Even at the present time, the presence and locations of populations of listed species in national parks is poorly documented, especially in the large western wilderness parks. Despite numerous creditable examples of effective protection and restoration of T&E species, active management is the exception rather than the rule. The National Park Service today has the least effective threatened and endangered species management program of any of the federal land management agencies.

Over the past decade, the national parks have begun to recognize that they are profoundly threatened by systemic threats: insularization, pollution, climate change. This has led to a redirection of research and management concern from individual species-populations to ecosystems and a change in fundamental mission from the protection of a static landscape "scene" to the protection of ecosystem processes. Such a shift in philosophy fits well with the rejection of the equilibrium paradigm by mainstream ecology in favor of perennially disturbed and constantly re-equilibrating landscapes.

Such a change to a synecological management perspective is, in many ways, antithetical to conventional, aggressive management to perpetuate T&E species-populations. An ecosystem where disturbance is permitted to prevail may lead to the extinction of local populations and, if it is large enough, establishment of new ones. Although national parks such as those in the Sierra Nevada are quite large, management for natural processes may lead to the loss of some rare and marginal species. Moreover, systemic forces including insularization, pollution, and climate change can be expected to exacerbate local extinctions. The degree to which the Park Service should modify its basic management philosophy to protect populations of T&E species is a subject for debate.

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CONFLICTS BETWEEN NATIONAL PARKS MANAGEMENT AND ENDANGERED PLANT PROTECTION: EXAMPLES FROM CALIFORNIA

Ken Berg[1]

A common perception is that national parks are under protective management, therefore any endangered plants in national parks are safe. While National Park Service (NPS) management direction does place a greater emphasis on resource protection than extractive uses, particularly compared to multiple-use land management agencies, NPS emphasis on public access and recreational uses can result in conflicts between endangered plant protection and park management.

Experience in California illustrates that impacts to endangered plants do occur in national parks and that improvements in NPS programs are needed. This essay explores some of these conflicts and presents some recommendations for improvements.

PRIMARY CONFLICTS AND PROBLEMS

1. Siting of new facilities and maintenance and use of existing recreational facilities does impact endangered plant habitats. For example, siting of trails and campgrounds, road realignments and maintenance activities have impacted endangered plants in California national park units.

2. Land-use practices of private inholdings and concessions can impact park resources; for example, ranching, resorts, etc.

3. Park managers and resource specialists often view park units as isolate islands unto themselves, without consideration of broader ecological boundaries.

4. Endangered plants aren't a high priority relative to other sensitive resources in the view of some park managers.

5. Funding limitations have resulted in decreased staffing of resource specialists (botanists, ecologists, etc.) and an inappropriate consolidation of organizational divisions within park units.

RECOMMENDATIONS

1. Increase funding levels to allow:
   - more resource inventories
   - hiring more botanists and/or resource specialists
   - development of training for program professionals and park managers that addresses policy, program responsibilities, techniques and resource values.

2. Insulate park superintendents from political pressure to cater to private inholders or concessions. This would allow greater support for sound resource management decisions.

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1. Ken Berg, California Department of Fish and Game, Endangered Plant Program, 1416 9th St., Sacramento, CA 95814 (916) 324-3814.

3. Improve coordination between NPS research units and management units. Currently, coordination is not institutionalized and relies too heavily on personal initiative in either park or research unit staff.

4. Improve coordination between NPS botanists/resource specialists and botanists/resource specialists in other agencies (e.g., NPS staff should participate in the existing annual sensitive plant coordination meetings held between USFS/BLM/FWS/CDFG staff and other cooperators).

5. Continue NPS shift from a law enforcement/resource protection emphasis to a scientific/resource management emphasis.

6. Realign organizational divisions within park units along lines that encourage greater emphasis on ecologically based resource management. For example, interpretive staff and fire management staff should be aligned with resource management staff, not with law enforcement staff as is the case in some park units.

7. Improve program continuity within park units by changing the promotional process for park superintendents (and other park staff) which currently emphasizes mobility and results in ephemeral staff. Break the cycle of people leaving just when they become familiar with a park unit's resources and management needs. Provide opportunities for within unit promotions and advancement.

8. Require that park manager performance evaluations include successful completion of training programs on the sensitive natural resources within their park unit and their special management needs.

MANAGING BEYOND THE ENDANGERED SPECIES ACT: AN EMERGING PERSPECTIVE ON SENSITIVE PLANT PROTECTION

Stephen J. Botti[1]

From 1973 to the present, plants have been the stepchild of the Endangered Species Act. The act has been implemented with a double standard favoring animals, and its narrow focus has actually diverted park managers from some of the real crises in rare plant management.

Now is the time for parks to forge a new rare plant management program by combining the legal and philosophical mandates of the act with the National Park Service's own evolving sense of mission and leadership role in preserving natural resources.

Specifically, the National Park Service should take three actions:

1. Provide special protection to local populations of rare plant species commensurate with that given to animals (local populations of animals, such as the grizzly bear, have been afforded official protection under the Act even though the species is not globally threatened with extinction).

2. Provide special protection for all rare local variants within plant species even if these will never qualify for protection under the act. The status of species and subspecies is much more uncertain within the plant kingdom than the animal kingdom, and our understanding and classification of these variants may change along with our evolving knowledge of genetics and plant evolution.

3. Provide special protection to plant communities that are rare, even if they contain no threatened and endangered plants. By focusing at the species level, the act has diverted park managers from preventing or reversing the wholesale destruction of some natural plant communities.

By taking a broader view of its rare plant protection mandates, the National Park Service can develop a comprehensive protection program that more clearly defines the connection between the preservation of rare species and natural biological diversity.

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EXPECTATIONS OF THE CONCERNED PUBLIC REGARDING THE MANAGEMENT OF RARE PLANTS BY THE NATIONAL PARK SERVICE

Mark Skinner[1]

Will we have pretty parks or ecologically sound parks? This question really came to the attention of the public in the aftermath of the Yellowstone fires of 1989. The mandate of the National Park Service (NPS) clearly calls for both, but the concerned public, including the California Native Plant Society (CNPS), especially favors management for ecologically sound, biologically diverse parks. In the past, recreation has often triumphed over conservation during park management.

The NPS is insular in nature, as opposed to other federal land stewards such as the Bureau of Land Mangement (BLM) and the U.S. Forest Service (USFS). CNPS has relatively little involvement with NPS units in California. NPS employees often take the attitude that things are protected in the park simply because it is a park dedicated to preservation, but greater recognition of ecological processes is required to sustain biological diversity.

It is, therefore, the position of the California Native Plant Society that:

1. In addition to its own mandates, the NPS is mandated by the federal Endangered Species Act (ESA) to protect and conserve threatened and endangered (T&E) species on its lands. Also, NPS policy requires parks to comply with state legislation designed to protect rare species. The NPS has for too long been minimizing its commitment to this crucial part of its responsibilities.

2. The NPS should conduct resource inventories and identify priority taxa and communities for preservation within park boundaries. Results of these surveys should be communicated to others interested in natural resource protection, according to NPS objectives: "wherever possible, relying on state, local, and private alternatives to reduce the need for direct federal acquisition and management." According to the National Park service, currently only 20 percent of park units have conducted inventories. The map of rare plants in and around Yosemite National Park demonstrates this problem rather conclusively. Inventories are particularly necessary as an institutional memory for biological information in an agency that emphasizes advancement through mobility.

For example, Heritage Data Centers in Great Smoky Mountains National Park, established within the last three years, have already been used to prepare a priority list of sites and species in need of special management attention.

3. Threatened and endangered species must receive special management attention in NPS units. This would be facilitated through designation of T&E coordinators for each park, who would ensure that management needs for T & E species would be incorporated into general management plans for each unit. Monitoring and recovery efforts would be greatly improved, and are currently inadequate in most park units. Section 7 consultation with U.S. Fish and Wildlife Service (USFWS) needs to be institutionalized.

4. NPS needs to improve communication and coordination with other resource management agencies and private organizations. Current coordination and sharing of information is spotty and occurs primarily through the efforts of dedicated individuals. We have good knowledge of the

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endangered flora of Pt. Reyes National Seashore because of conscientious individuals willing to share information with CNPS and the Department of Fish and Game's Natural Diversity Data Base. Furthermore, CNPS has an excellent beneficent adversarial relationship with the USFS, through which data are shared routinely, and CNPS exercises its right to comment on USFS forest plans and proposed timber sales. CNPS members participate in rare plant surveys, monitoring, and protection efforts on National Forests. None of this occurs on NPS units.

In the NPS, the record on this is spotty, but the benefits of coordination are clear. In the NPS Midwest Region, a cooperative agreement between USFWS and NPS has resulted in development of comprehensive information on the status and distribution of T&E plant and animal species in NPS units. Already this has borne fruit by establishing priority management and research needs for more than a dozen rare plant species in the Midwest Region, and setting long-term species management goals. Similar coordination links need to be forged with other agencies and organizations.

5. The public should have ample opportunity for involvement and comment on NPS management plans to ensure that these plans address not only public access and maintenance for scenic beauty but preservation of biological diversity through active management. Because the emphasis of the parks has been on preservation of pristine habitat (keeping things the way they are), resource management conflicts have been few and not well publicized. Consequently, public involvement in management has been minimized, and park managers have assumed that rare plants have been adequately treated in parks. This is not so.

6. Rare plants should be accorded equal treatment to animals in national parks and other federal agencies. Currently, NPS spends 0.79 percent of its endangered species budget on plants, as opposed to these figures for other federal agencies: USFS = 1.2 percent; BLM = 12.2 percent; BIA = 0.057 percent; BR = 12.7 percent (BIA = Bureau of Indian Affairs, BR = Bureau of Reclamation). Overall expenditures for T&E species are much too low for all these agencies, including NPS (NPS = $2.4 million for 1989).

7. When recreation and conservation conflict, the NPS should adhere to their mandate and give preference to conservation. After all, the mission of the NPS is to "preserve scenery and the natural and historical objects and the wildlife therein . . . for the enjoyment of (present and) future generations." Therefore, rare plant conservation needs to figure more significantly in unit management plans. Public access needs to be restricted in many areas, and education as to the reasons will make this more palatable.

8. NPS needs to make rapid progress in identifying gaps in resource protection which can be met best through the NPS. These include timely designation of Protected Natural Areas, Research Natural Areas, and new park units. In California, for example, appropriate new National Park regions for preservation of scenic and natural diversity might include the Matthole River/King Range Mountains/Klamath/Trinity area.

9. NPS should designate Experimental Ecological Areas on a timely basis to better understand management options for park resources. In particular, the outmoded park service policy of fire suppression needs to be replaced by an attitude of using fire as an ecological managing tool. This must filter up to high-level managers and back down again as a policy to replace fire suppression in parks.

VEGETATION RESTORATION

REMOVAL OF EUCALYPTUS AND RESTORATION OF NATIVE BROADLEAVES IN BERKELEY HILLS

Sheauchi Cheng[1]

Abstract

A case study involving the removal of eucalyptus (Eucalyptus globulus) *stands to restore native oak/bay woodland, dominated by coast live oak* (Quercus agrifolia) *and California bay* (Umbellularia californica), *was conducted in Berkeley Hills, California. The interactions between eucalyptus and native tree species were examined, and a shelterwood tree removal system, which ensured the establishment and growth of native tree species was proposed. This study also indicated that the exotic tree elimination and vegetation restoration policy adopted in this region is creating oak/bay woodlands on sites where they would have not occurred naturally.*

INTRODUCTION

Berkeley Hills are part of the Central Coast Range, lying in a north-south direction, about 5 miles east of San Francisco Bay. Vegetation in this area has been heavily influenced by humans. Early settlers introduced livestock and annual grasses from Europe in the 1770s. Until the 1930s, grazing was the major land use activity in this area. Around the turn of the century, large areas were planted with eucalyptus trees (mainly *Eucalyptus globulus*) and conifers.

The chief original vegetation type before European settlement was perennial grassland, with some oak/bay woodland on the north-facing slopes and in hillside arroyos, and riparian growth along water courses (Harris 1927; Clarke 1959).

Currently, grasslands are dominated by annual grasses, such as wild oat (*Avena* species) and *Bromus* species. Because of the elimination of grazing and wild fire in 1930s, the grassland has been invaded by shrub species, mainly coyote brush *(Baccharis pilularis)* and poison oak *(Toxicodendron diversiloba)* (McBride 1974).

Eucalyptus and conifers grow well and have been spreading into adjacent areas, especially the eucalyptus. Most of the eucalyptus stands had been cut in early 1970s, due to the fire hazard they posed after the freeze in the winter of 1972. Many native hardwood tree species are found under the eucalyptus canopy.

The underlying policy of East Bay Regional Park District, which manages most of the land in this region, is to favor native vegetation. Its policies on new planting state that no planting should be undertaken on sites having naturally occurring native vegetation. Its guideline on the removal of eucalyptus stands is that every effort should be made to preserve the native hardwood tree species regenerated in the eucalyptus understory (East Bay Regional Park District 1978).

My ecological concerns on this policy are based on the following three facts: (1) the eucalyptus in Berkeley Hills were planted on grassland originally, (2) the native oaks and bays have become established because of the presence of eucalyptus, and (3) oak/bay woodland occurred naturally on north-facing slopes and hillside arroyos only, but the eucalyptus were planted on various sites.

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CASE STUDY

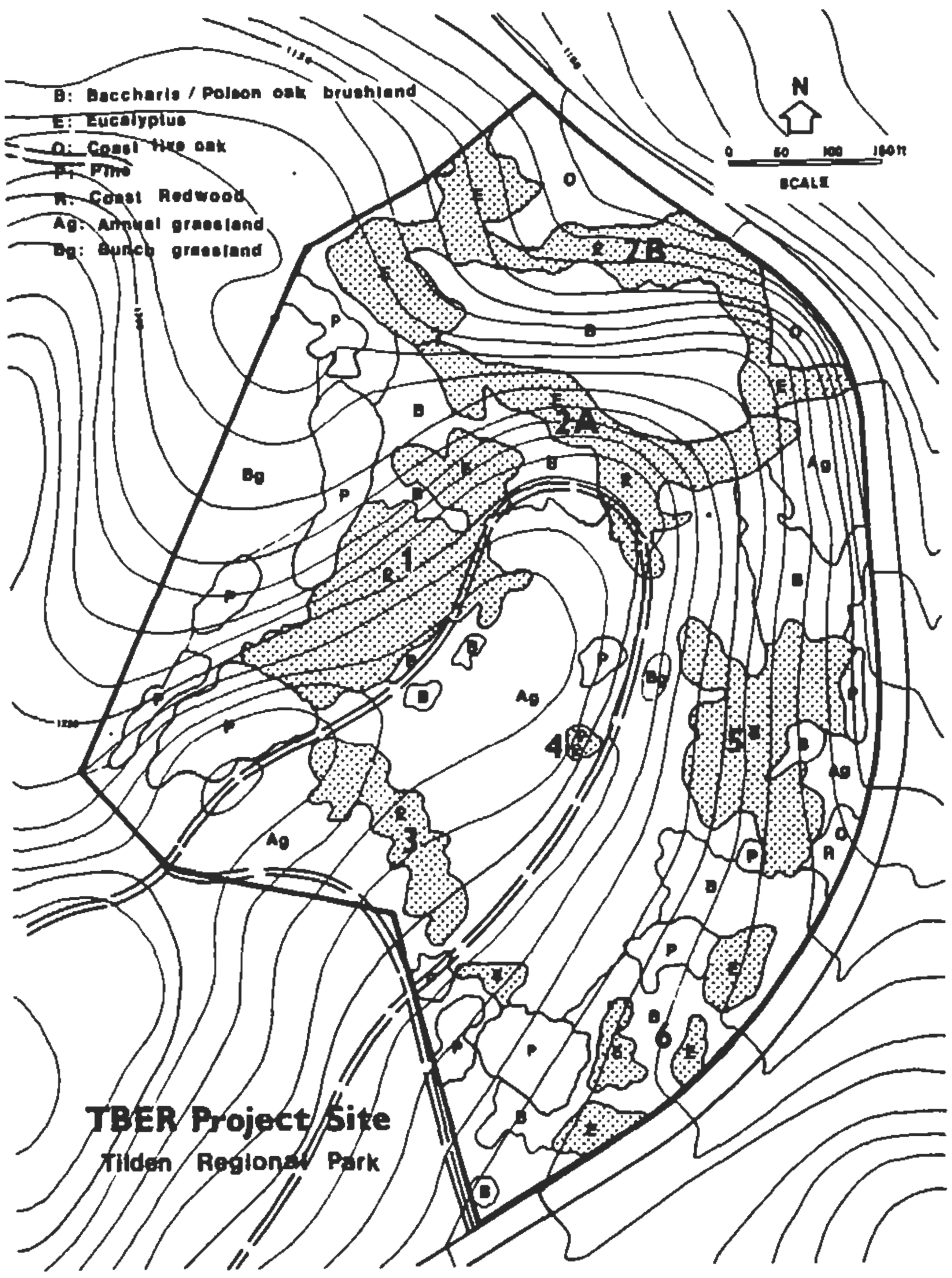
Background

A study was conducted last year on an 11-acre piece of land in the Berkeley Hills. East Bay Regional Park District wanted a plan for the removal of eucalyptus stands and replacement with the native oak/bay woodland on this site.

The major tasks were, first, to do a vegetation inventory before eucalyptus removal and, second, to make recommendations for vegetation management.

Site Description

Six vegetation types were delineated on the site (Map 1): annual grassland, bunch grassland, baccharis/poison oak brushland, eucalyptus plantation, pine plantation, and small areas of oak/bay woodland.



Map 1. Vegetation Map of Study Site

The annual grassland consists of many exotic species, such as wild oat (*Avena barbata, A. fatua*), and ripgut (*Bromus diandrus*).

The bunch grassland contains native perennial species, such as Idaho fescue (*Festuca idahoensis*), and foxtail barley (*Hordeum jubatum*).

Eucalyptus stands, planted around 1912, have been extending along their margins and have established satellite stands (Stand #4 and #6) on areas down slopes and along the road. The understories are abundant with poison oaks, seedlings and saplings of oak and bay, and herbaceous species.

Pine plantations are collections of many California natives, such as Monterey pine (*Pinus radiata*), Bishop pine (*Pinus muricata*), lodgepole pine (*Pinus murrayana*). The understory of the pine plantations, in contrast to those in the eucalyptus stands, are mainly annual grasses with few poison oaks, seedling and saplings of oak, bay, and pines.

Baccharis/poison oak brushland has been increasing its area on the site. Only one patch of brushland was found on an aerial photo taken in 1937. Gradually, more brushland appeared on aerial photos taken later.

There are small areas of native oak/bay woodland along the road. However, because of their proximity to the road and their small sizes, they are thought to be planted or volunteered after the construction of the road.

Method and Results

For eucalyptus stands, I did a 100-percent survey of each tree species. Tree diameter at breast height was measured for every eucalyptus tree. Height of 10 percent of the trees were taken to generate a regression of diameter and height, and timber volume was calculated. Only height was measured for native hardwood species. Eucalyptus trees are mainly small sprouts from the 1970s cut. The native hardwood undergrowth consists mainly of seedlings and saplings up to 7 feet high. Table 1 summarizes the tree species compositions of eucalyptus stands, and figures 1 and 2 show the size structure of eucalyptus, oaks, and bays in a typical stand.

Table 1. Tree Species Composition of Eucalyptus Stands

Stand Number	Area (Acres)	Number of: Eucalyptus	Oak	Bay	Pine	Redwood	Toyon
1	1.04	497	77	101	1	1	0
2A	0.60	318	25	20	0	0	1
2B*	0.70	371	29	23	0	0	1
3	0.31	216	7	40	0	2	0
4	0.05	11	0	0	0	0	0
5	0.85	394	9	10	0	0	0
6	0.29	100	0	0	0	0	0
Total	**3.84**	**1907**	**147**	**194**	**1**	**3**	**2**

*values prorated from stand 2A

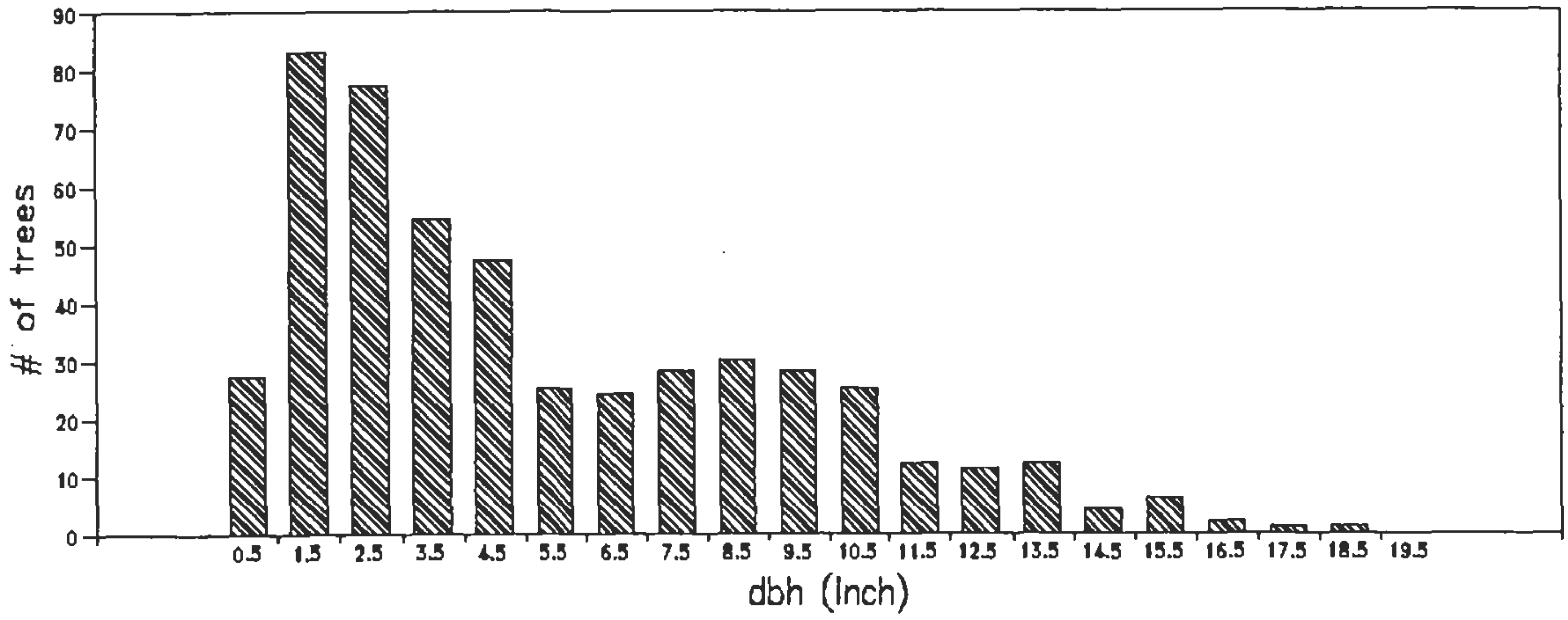


Figure 1. Size Structure of Eucalyptus in Stand #1

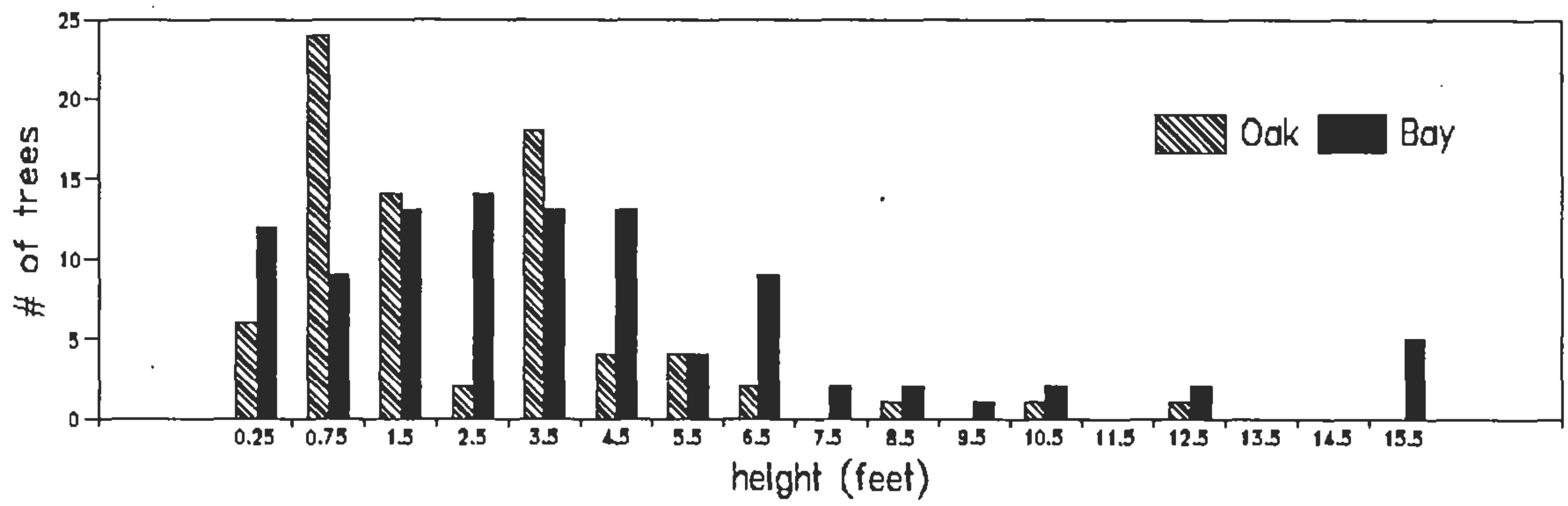


Figure 2. Size Structure of Oak and Bay in Stand #1

Discussion

Literature and on-site observation indicated that California bay and coast live oak are very tolerant of shade throughout their lives (USFS 1908, 1965; Jepson 1910). Tolerance is the forestry term to express the relative capacity of a tree to compete under low-light and high-root competition. Tolerant trees reproduce and form understories beneath canopies of less tolerant trees or even beneath their own shade (Daniel, Helms, and Baker 1979).

I have concluded that the native hardwood species started to establish themselves beneath the eucalyptus canopy mainly after the removal of eucalyptus during the 1970s. And the eucalyptus trees have been playing a role in providing shelter for the native hardwood species.

A similar situation was observed in Humboldt County in the early 1900s. Natural reproduction of native tolerant conifers including Douglas-fir *(Pseudotsuga menziesii)*, grand fir *(Abies grandis)*, western hemlock *(Tsuga heterophylla)*, and Bishop pine occurred in the understory of 20 years old eucalyptus plantation (Metcalf 1924). A lumber company near Fort Bragg used this relationship and planted eucalyptus to provide shade for second-growth redwood between 1900 and 1910 (U.C. Berkeley 1973).

I have concluded that the best way to ensure the successful restoration of oak/bay woodland would be a shelterwood method for the removal of the eucalyptus trees. The shelterwood system is characterized by a series of cuts instead of a one-shot operation. In contrast to the relatively unfavorable conditions created by clear-cutting, the essential purpose of the shelterwood method is to accomplish the regeneration of the site under the partial shade and protection of a thin tree canopy.

Other sites on Berkeley Hills where the eucalyptus trees had been removed previously were also studied to observe conditions following overstory removal. The vegetation covers nowadays are quite varied. Table 2 was compiled by McBride (1983) to report on development of vegetation following eucalyptus removal. It indicates that oak/bay woodlands are occupying "unnatural" sites, such as south- and west-facing slopes.

Recommendations

The following recommendations are proposed for the management of the project site:

(1) For the oak/bay woodland, all of the exotic species growing in this vegetation type should be removed.

Table 2. Observations of condition of trees and ground cover on sites where eucalyptus had been removed in the Berkeley Hills (From McBride 1983)

Site Num.	Aspect	Tree Species	Condition*	Ground Cover
1	SE	none		poison oak, coyote brush
2	NE	oak	+	poison oak, blackberry
3	N	oak	+	grass, some coyote brush
4	S	oak, bay	+	poison oak, coyote brush
5	N	oak, bay	+	poison oak, coyote brush blackberry
6	SW	none		grass
7	W	oak, bay	+	grass, poison oak
8	level	none		poison oak
9	W	oak, bay	+	grass, poison oak
10	W	none		poison oak, coyote brush
11	SW	bay	+	poison oak, coyote brush
12	NW	oak	+	grass, poison oak
		madrone	+	coyote brush
13	level	oak	+	grass, poison oak
		madrone	+	coyote brush
14	W	none		coyote brush, grass
15	SW	none		French broom
16	SW	none		Monkey flower coyote brush
17	SE	none		poison oak
18	W	oak, toyon	+	grass, coyote brush
		madrone	+	

*Condition: + = vigorous

(2) For the eucalyptus stands, shelterwood timber removal system should be applied on north-facing slopes (Stand #1 and #2), which are the only areas where oak/bay woodland might occur naturally. Under the system, I plan to remove half of the trees in the first operation and the rest five years later. The clear-cut method can be applied in other stands, where the restoration to oak/bay woodland is not appropriate because of the aspect.

(3) For baccharis/poison oak brushland, measures should be taken to prevent their further expansion. The large patches on north- facing slopes and at the base of the east-facing hillside will succeed to oak/bay woodland eventually.

(4) For pine plantations, all current and future seedlings, saplings, and poles should be removed and, as existing trees die, they should also be removed. The understories should be managed for grass with brush being removed and controlled. The eventual goal is to convert this vegetation type to grassland, which was the original vegetation type before the pines were planted.

(5) The existing mosaic of grassland, should be maintained, which means that the invasion of baccharis and poison oak needs to be controlled. Also purple needle grass *(Stipa pulchra)* and Idaho Fescue should be introduced to the annual grassland to convert it to bunch grassland.

Time Table for Vegetation Restoration

The areas covered by native vegetation currently are the bunch grassland and oak/bay woodland. Within five years, I expect that the annual grassland and part of the eucalyptus stands, those not on north-facing slopes, will be converted to bunch grassland. After about 30 years, oak/bay woodland should be well established on the north-facing eucalyptus stand sites. In the long run, some of the brushland will succeed into oak/bay woodland and the pine plantation will be replaced by bunch grassland.

CONCLUSIONS

In conclusion, two lessons learned from this study should be emphasized:

First, based on an understanding of the relationship of the eucalyptus trees and the native hardwood species, I propose that the shelterwood eucalyptus tree removal system is a better way to restore oak/bay woodland than the current practice of clear-cutting.

Second, the policy adopted in this area by the East Bay Regional Park District, concerning the preservation of the regenerated native hardwood species on the eucalyptus removal sites has resulted in the establishment of native oak/bay woodland on "unnatural" sites in the Berkeley Hills.

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REFERENCES

East Bay Regional Park District. 1978. *Vegetation Management Principles and Policies.*

Clarke, W. C. 1959. *The Vegetation Cover of the San Francisco Bay Region in the Early Spanish Period.* M.A. thesis, Department of Geology, University of California, Berkeley.

Daniel, T. J. Helms, and F. Baker. 1979. *Principles of Silviculture.* McGraw Hill Book Company.

Harris, M. R. 1927. *A Grazing Management Plan for the Berkeley Hills.* Master thesis, Department of Forestry, University of California, Berkeley.

Jepson, W. L. 1910. *The Silva of California.* The University Press, Berkeley.

McBride, J. R. 1974. Plant Succession in the Berkeley Hills, California. *Madroño* 22(7):317-329.

McBride, J. R. 1983. Unpublished Report to National Park Service.

Metcalf, Woodbridge. 1924. Growth of Eucalyptus in California Plantations. University of California Publications, Bulletin No. 380. University of California Printing Office, Berkeley, CA.

United States Forest Service. 1908. *Forest Trees of the Pacific Slope,* George B. Sudworth. U.S. Government Printing Office, Washington, DC.

United States Forest Service, 1965. Silvics of Forest Trees of the United States. *Agriculture Handbook,* 271.

University of California, Berkeley. 1973. *Crisis: Eucalyptus a Damaged Forest.*

SEAGRASSES OF SAN FRANCISCO BAY: STATUS, MANAGEMENT, AND CONSERVATION NEEDS

Christopher L. Kitting[1] and Sandy Wyllie-Echeverria[2]

Abstract

Data are rare on seagrass communities of Zostera marina L. *(eelgrass) in San Francisco Bay. Previously studied bays indicate numerous animals among these productive flowering plants. Eelgrass meadow animals such as amphipod crustaceans are important as food for many species of fish and waterfowl. Eelgrass communities provide a habitat for juvenile salmon and rockfish. Eelgrass also is an obligate food for black brandt along its flyway. In San Francisco Bay, this plant provides an important habitat where herring spawn.*

Early investigations indicate that substantial populations of eelgrass once existed in San Francisco Bay, but this grass now has declined. San Francisco Bay eelgrass currently totals about 1.28 km^2. This sparse amount does not approach the recently dense eelgrass in nearby bays.

San Francisco Bay eelgrass yields a higher density and diversity of animals than outside such patches. Sparse data available suggest much higher densities and diversities of animals in eelgrass at nearby bays. Research on limiting factors in such marine plant communities is previously unfunded and difficult, but necessary.

INTRODUCTION

Flowering plants living in the sea are called seagrasses. Although these plants are not true grasses, their buoyant leaves rise and fall with tidal and current activity, as Yosemite meadow grasses respond to gentle winds; hence the name "seagrass" (Phillips 1981). Twelve genera with 51 seagrass species inhabit shallow subtidal and intertidal regions of the sea (den Hartog 1970, Phillips, and Menez 1988).

Seagrass meadows rank as one of the most productive and important ecosystems on earth. Annual productivity ranges from 1300 to 2600 g C/m^2, depending on location and seagrass species (McRoy and McMillan 1977). The rich animal assemblages (above and below the bottom) associated with seagrasses are consumed by many species of fish and waterfowl (McRoy and Helfferich 1980; Kikuchi 1980).

Seagrasses are anchored in bay sediments by an extensive root and rhizome complex. This complex enables the plants to return nutrients and other compounds to the water (McRoy and McMillan 1977). In addition, this complex stabilizes sediment, providing protection and shelter for larval and juvenile fishes and invertebrates (Zieman 1982).

In San Francisco Bay, the predominant seagrass is eelgrass (*Zostera marina* L.). Small amounts of two other seagrasses, surfgrass (*Phyllospadix torreyi* and *P. scouleri* of more surfswept rocky areas) and widgeon grass (*Ruppia maritima* of brackish or freshwater areas) are present but unstudied in the bay. Eelgrass is a cold water plant and is discontinously distributed, found in bays throughout temperate regions of the western hemisphere (den Hartog 1970; Phillips and Menez 1988). On the west coast of

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North America, it is common from Alaska to Baja California (Phillips 1984). In spring, it produces 5-cm-long underwater flowers, and then develops 1-cm seeds which drift to the bottom. Successful reproduction usually results instead from runners (rhizomes) forming new shoots near the parent plant (den Hartog 1970; Phillips 1989).

EELGRASS DISTRIBUTION IN SAN FRANCISCO BAY

Early investigations (Setchel 1927;1929) indicated substantial populations of eelgrass in at least two sites in San Francisco Bay. Recent work, however, revealed that this eelgrass has declined (Wyllie Echeverria 1990). The only inventory of San Francisco Bay eelgrass documents the total acreage to be 1.28 k^2 (~316 acres; Wyllie Echeverria 1990). This sparse amount does not approach the dense eelgrass in other Northern California estuaries (table 1).

Seagrass in San Francisco Bay is sparse, the distribution is extremely patchy (fig. 1A), and it is not found deeper than 3m at mean high water (Wyllie-Echeverria 1986 and Zimmerman et al., in press). The patches may be the last remnants of a San Francisco Bay population vulnerable to extinction.

TABLE 1. Comparison of three Northern California estuaries in terms of total surface area of the water and amount of eelgrass (redrawn from Wyllie Echeverria 1990)

LOCATION	SIZE OF ESTUARY (km^2)	AERIAL COVERAGE (km^2) OF EELGRASS	REFERENCE
Humboldt Bay	62.4	12.2	Phillips 1984
Tomales Bay	30	3.9	Spratt 1989
San Francisco Bay	1140	1.28	Wyllie-Echeverria 1989

The waters of San Francisco Bay carry an enormous amount of particulate matter. Sources include sediment transported downstream, resuspension of the fine silts by waves and wind, and resuspension through the activity of dredging and filling, along with agricultural, industrial, and residential runoff. Furthermore, previous investigations forecast that a "sand wave" (a massive zone of sediment) up to 8m high moves across the bay bottom (Nichols and Patmatmat 1988). All of this results in a "scouring" of the vegetation with restricted light in the water column.

Several investigations have addressed the light-limited condition that exists in San Francisco Bay (Alpine and Cloern 1988; Fredette et al. 1988; Zimmerman et al. in press). To date, however, no long-term ecological studies relate the effects of increased sediment loading (the major factor in reduced water column light) to loss of bay biota.

WHY WORRY ABOUT SAN FRANCISCO BAY EELGRASS?

Previously studied bays in the Pacific Northwest show that dense populations of animals live among this productive eelgrass (Phillips 1984). Eelgrass has been shown to be an obligate food for the black brandt (*Brandta bernicla*) during its coastal migration from Baja California (Einarsen 1965). Other eelgrass meadow animals such as amphipod crustaceans are important as food resources for many species of fish and waterfowl. Eelgrass communities provide a habitat for juvenile salmon (*Oncorhynchus* spp.) and rockfish (*Sebastes* spp.) (Phillips 1984). A variety of marine animals, including dungeness crabs (*Cancer magister*), appear to grow up most successfully in this underwater nursery area (fig. 1BC).

Data are virtually absent on animals in eelgrass from San Francisco Bay. The California Department of Fish and Game has monitored the most valuable fishery in California, the Pacific herring (*Clupea harengus*), showing the importance of San Francisco Bay eelgrass as a preferred substrate for herring to lay their eggs (Spratt 1981).

We have encountered the species most rapidly increasing its use of eelgrass regions in California, and it is us, *Homo sapiens*! But other animals continue to use eelgrass areas too, as shelter and a source of food.

With other volunteers as assistants, Kitting seasonally has been sweeping one-square-meter areas of eelgrass and adjacent areas non-destructively, using push nets at low tide (after Huh and Kitting 1985). Compared with animals in the densest eelgrass meadow in San Francisco Bay, animals are less common and represent fewer species outside the eelgrass. Presently available data represent relatively high animal densities characteristic of late summer or early fall in San Francisco Bay (Kitting 1990). During the same season, analogous preliminary sampling of eelgrass in bays away from severe human influences, including Elkhorn Slough and Morro Bay, suggests 10-100X higher animal densities and much higher species diversity in their eelgrass, meadows, with common amphipods, shrimp, and snails (fig 2BC). Elkhorn Slough on Monterey Bay had extensive eelgrass 10 years ago, but most of it has disappeared (Kitting, personal observation). The animal community in the eelgrass remaining there suggests very high densities of invertebrates, with ~1000 amphipods / m^2 (fig. 2C). San Francisco Bay eelgrass often yields about 10 macroscopic animals (mostly amphipods) above the bottom, per square meter (fig. 2A).

CONCLUSIONS

Our investigations show that eelgrass in San Francisco Bay is extremely sparse and very patchy when compared to other bays. But other than the effects of prolonged murky water on deep eelgrass plants, data are lacking to explain the current distribution. Efforts to restore populations through transplantation were unsuccessful (Fredette et al. 1988). More basic research is needed to understand limitations on these eelgrass communities.

More of the earth is being managed each day. Environments in the sea are no exception. If managers do not understand the relationship between species declines and environmental disturbance, they will not be able to manage effectively.

San Francisco Bay is a system that must be managed. Most of the shoreline has been or is being developed. The water column receives runoff and residue from a number of human sources. There is really no wildness left, and it is difficult to escape the presence of humanity. We need to be realistic. The bay will not return to a pristine system. It will remain a system under the influence of human activity and management. It is important, therefore, to do the best job we can as environmental managers.

In 1979 the American Society for the Advancement of Science published a two-volume set on San Francisco Bay. The second volume, *San Francisco Bay: Use and Protection*, concludes with some excerpts from the "San Francisco Bay Plan" that pertain to biological systems. Eelgrass is not mentioned in the section entitled "Marshes and Mudflats" (Kockelman et al. 1979) nor is seagrass mentioned anywhere in the two-volume set. It is amazing that this valuable habitat has so little information available from California bays, particularly San Francisco Bay. Research on such vulnerable populations of marine plants and their animal communities is previously unfunded, but necessary.

Managed systems must function as the natural systems they replace (Woodell 1983). We contend that loss of eelgrass signals the breakdown of the structure and function of San Francisco Bay. Eventually, it will no longer be a viable estuary in the biological sense. This will be a tragedy, not only for estuarine plants and animals, but for all those who live near the shores of the Bay. Management can encourage research on habitat of this productive seagrass resource and reverse the trend of this depleted bay habitat loss if action is taken soon.

ACKNOWLEDGMENTS

We thank R. Phillips and the Wyllie Echeverria Family for encouragement and assistance during all phases of the eelgrass distributional work. M. Pamatmat and J. Spratt provided much further assistance. The California Native Plants Society, M. Rea, and H. Allen provided partial grant support for the botanical work. East Bay Regional Parks, Mrs. R. Keil, and U.S. Coast Guard helicopters helped provide access to our study sites. Numerous volunteers at California State University Hayward also assisted in the seagrass animal sampling, especially N. Franceschini, C. Miller, L. Lica, D. Baron, C. Duncan, and T. Palmer. To these people and others we are grateful.

REFERENCES

Alpine, A.E. and J.E. Cloern. 1988. Phytoplankton growth rates in a light-limited environment, San Francisco Bay. *Marine Ecology Progress Series*, 44(1):167-173.

den Hartog, C. 1970. *The Seagrasses of the World.* Amsterdam and London: North Holland Publishing Company.

Einarsen, A. R. 1965. *Black Brandt: Sea Goose of the Pacific Coast.* Seattle: University of Washington Press.

Fredette, T., M. Fonseca, J. Kenworthy, and S. Wyllie Echeverria. 1988. *Sandy Wyllie Echeverria, Institute of Marine Science, University of Alaska, Fairbanks, Alaska, Sandy Wyllie Echeverria, Institute of Marine Science, University of Alaska, Fairbanks, Alaska, An Investigation of Eelgrass* (Zoster marina) *Transplanting Feasibility in San Francisco Bay, Ca.* Internal Working Document El-88-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Huh, S.H. and C.L. Kitting. 1985. "Trophic relationships among concentrated populations of small fishes in seagrass meadows." *Journal of Experimental Marine Biology and Ecology* 92:29-43.

Kikuchi, T. 1980. Faunal relationships in temperate seagrass beds. In: Phillips, R.C. and C.P. McRoy eds., *Handbook of Seagrass Biology: An Ecosystem Perspective.* New York and London: STPM Press.

Kitting, C.L. 1984. "Selectivity by dense populations of small invertebrates foraging among seagrass blade surfaces." *Estuaries* 7(4A):276-288.

Kitting, C.L. 1990. "Comparisons of small fish and invertebrate densities among central California eelgrass meadows." Western Society of Naturalists Annual Meeting. Abstracts (in press).

Kockelman, W.J., T.J. Conomos, and A.E. Leviton. 1979. *San Francisco Bay: Use and Protection.* San Francisco: Pacific Division, American Association for the Advancement of Science.

McRoy, C. P. and C. McMillan. 1977. "Production ecology and physiology of seagrasses." Chapter 3 *in* C.P. McRoy and C. Helfferich, eds. *Seagrass ecosystems: a scientific perspective.* New York: M. Dekker.

McRoy, C.P. and C. Helfferich. 1980. "Applied aspects of seagrasses." Pages 297-343 *in* R.C. Phillips and C.P. McRoy, eds. *Handbook of seagrass biology: an ecosystem perspective.* New York: Garland STPM Press.

Nichols, F.H. and M.M. Patmatmat. 1988. *The ecology of the soft-bottom benthos of San Francisco Bay: a community profile.* U.S. Fish Wildlife Service Biological Report 85(7.19).

Phillips, R.C. 1981. "Eelgrass, the wheat of the sea." *Oceans* 14(4):18-24.

Phillips R.C. 1984. *The Ecology of Eelgrass Meadows in the Pacific Northwest: A Community Profile.* U.S. Fish and Wildlife Service FWS/OBS-84/24.

Phillips, R.C. and E.G. Menez. 1988. Seagrasses. *Smithsonian Contributions to the Marine Sciences,* number 34.

Setchell, W.A. 1927. "*Zostera marina Latifolia*: ecad or ecotype?" *Bulletin of the Torrey Botanical Club* 54:1-6.

Setchell, W.A. 1929. "Morphological and phenological notes on *Zostera marina.*" *University California Publications in Botany* 14:185-201.

Spratt, J.D. 1981. Status of the Pacific herring, *Clupea harengus pallasii,* resource in California 1972 to 1980. *Fish Bulletin* 171. California Department of Fish and Game.

Spratt, J.D. 1989. The distribution and density of eelgrass (*Zostera marina*) in Tomales Bay, California. *California Fish and Game* 75(4): 204-212.

Woodwell, G.M. 1983. The Blue Planet: of Wholes and Parts an Man. In: H.A. Mooney and M. Gordon (eds.), *Disturbance and Ecosystems,* Berlin, Heidelberg, New York, Tokyo: Springer-Verlag.

Wyllie Echeverria, S. and P. Rutten. 1989. *Resource Inventory Eelgrass in San Francisco Bay.* Administrative Report, Southwest Regional NOAA, National Marine Fisheries Service, Terminal Island, CA.

Wyllie Echeverria, S. 1986. Biomass data, rhizome maps and overall bed size regarding Eelgrass, *Zostera marina* at two sites on the San Francisco Bay. Report prepared for Waterways Experiment Station, Vicksburg, MS.

Wyllie Echeverria, S. 1990. Geographic range and distribution of *Zostera marina*, eelgrass in San Francisco Bay, California. In: K. Merkel and R. Hoffman (eds.). *Proceedings of California Eelgrass Symposium.* Sweetwater Press, San Diego.

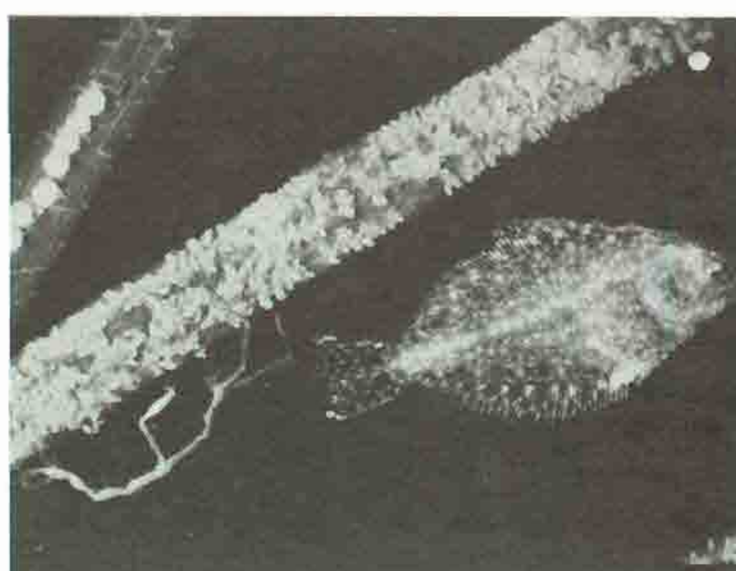
Zimmerman, R., J.R. Reguzzoni, S. Wyllie Echeverria, R.A. Alberte, and M.N. Josselyn (in press). "Assessment of Environmental Suitability for Growth of *Zostera marina* in San Francisco Bay." *Marine Biology.*

Zieman, J. C. 1982. The ecology of the seagrasses of south Florida: community profile. U.S. Fish and Wildlife Service Biological Services Program. FWS/OBS- 82/85.

Figure 1. Illustrations of the San Francisco Bay Eelgrass Community.

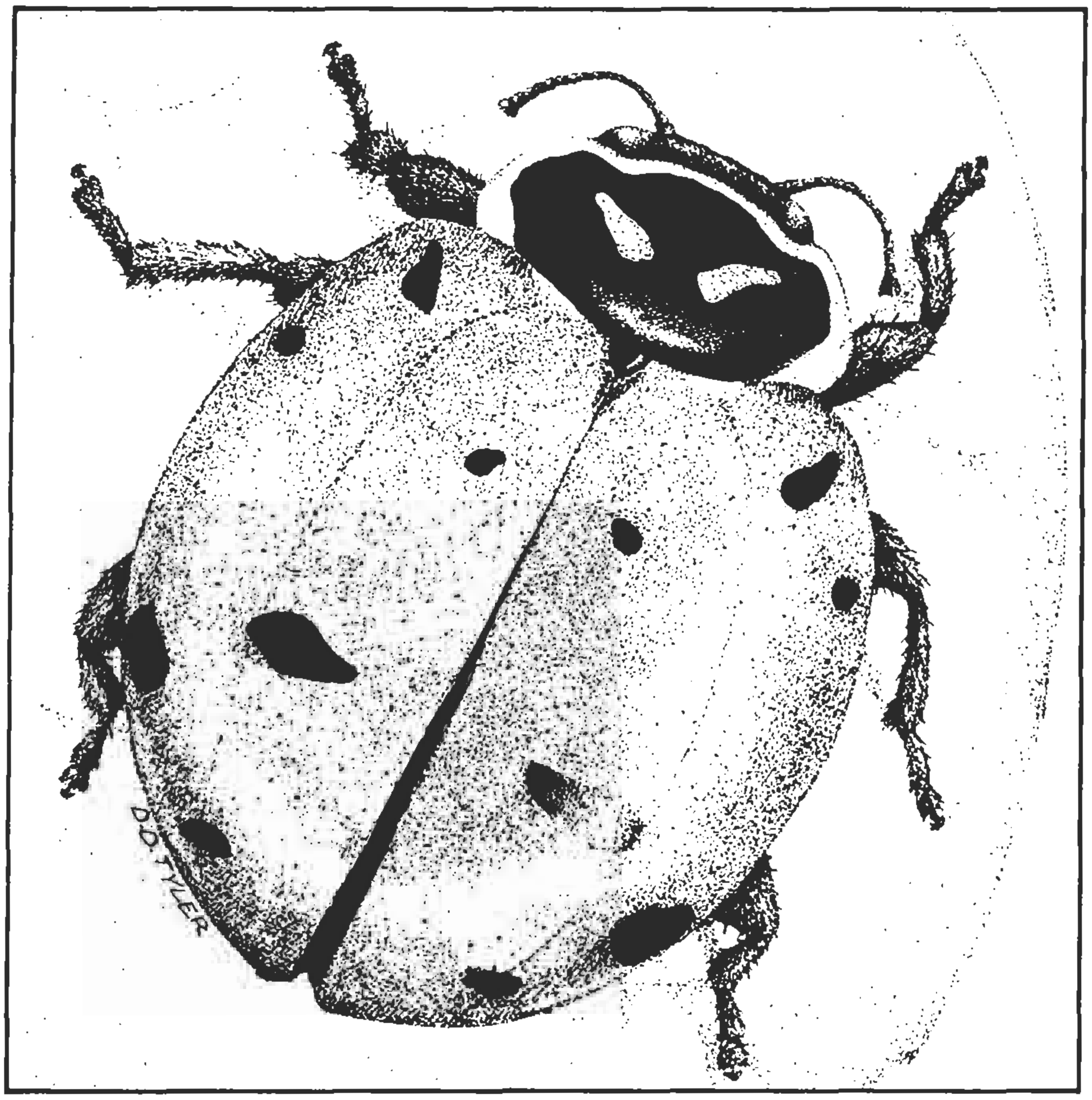
A. Shoreline eelgrass meadow near the Golden Gate, near Keil Cov.

B. Underwater view of eelgrass plants (1 cm wide) with crab moult near the base.



C. Juvenile flatfish, *caprellid amphipod* on eelgrass blade with many small gammarid amphipod tubes, and egg masses on a second eelgrass blade. The photographic field width is 10 cm.

AQUATIC AND RIPARIAN SYSTEMS



Ladybird Beetle
Illustration by Diana Dee Tyler, © 1978 by Dell Publishing Co., Inc.

PRESERVING AQUATIC, RIPARIAN, AND WETLAND RESOURCES

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
SAVE OUR RIVERS PROGRAM

William M. Helfferich[1]

Abstract

Florida's Water Management Lands Trust Fund, commonly known as the Save Our Rivers (SOR) Fund, provides monies to the state's five water management districts for the acquisition and management of lands necessary for water management, water supply, and conservation and protection of water resources. Formed by the Legislature in 1981, the SOR program is funded by documentary tax stamps levied on all real estate transactions. The South Florida Water Management District (SFWMD), has targeted more than 500,000 acres for acquisition. Since the inception of the program, more than 125,000 acres have been purchased. The Save Our Rivers program has a variety of objectives, and these are reflected in the diversity of lands which have been acquired or targeted for future purchase. The Kissimmee River restoration is the largest undertaking of its kind. Before backfilling of the dredged channel and reflooding of the historic flood plain can occur, the land must be in state ownership. Protection and acquisition of a 50,000-acre watershed, known as the Corkscrew Regional Ecosystem, and home range to many of the last remaining Florida panthers, is being accomplished through a land trust, comprised of state and local government, private land owners, and national conservation organizations. While most of the protection effort is devoted to large ecosystems, SFWMD is also working with The Nature Conservancy to acquire 600 acres of Caribbean slash pine forest and freshwater marshes in the Florida Keys, adjacent to the Key Deer National Wildlife Refuge, and the only year-round source of surface freshwater in the Keys.

INTRODUCTION

In 1981, the Florida legislature enacted a bill to provide funding for the acquisition and management of water resource and environmentally sensitive lands. Formally known as the Florida Resource Rivers Act, this legislation is commonly called the Save Our Rivers program. It is funded through documentary tax stamps, which are levied on all real estate transactions. In 1990, Florida's five water management districts shared more than $39 million. Due to the varying tax base size within the five districts, funding is proportional to the size of the tax base. The South Florida Water Management District (SFWMD or District) received approximately $13 million for its program in 1990.

The South Florida Water Management District is responsible for acquiring and managing critical water resource related lands under the state's SOR program. The major purposes of the program are water management, water supply, and the conservation and protection of water resources. As steward of these vital resources, it is the charge of the District to provide for their protection, enhancement, restoration, and preservation for the beneficial use and enjoyment of existing and future generations.

Resource manageability, surface and groundwater systems, and the formation of corridors for the critical interaction of wildlife are major considerations in the land acquisition process. Prime requisites in managing these public lands are to ensure that the water resources, fish and wildlife populations, and native plant communities are maintained in an environmentally acceptable manner, and made available for appropriate outdoor recreational activities consistent with their environmental sensitivity.

1. William M. Helfferich, South Florida Water Management District, Box 24680, West Palm Beach, FL 33416.

LAND EVALUATION MATRIX

An evaluation matrix was developed which addresses the water and other natural resource values of each parcel. The matrix consists of ten parameters:

PARAMETER	WEIGHTING FACTOR
The primary factors are:	
* Water Management	5
* Water Supply	5
* Conservation and Protection of Water Resources	5
There are seven secondary factors:	
* Manageability	2
* Habitat Diversity	2
* Species Diversity	1
* Connectedness	2
* Rarity	2
* Vulnerability	1
* Recreation	1

A scoring system applies values of 1 to 5 for each parameter, with weighting factors, or multipliers, applied to the various parameters, which reflect their importance in the overall selection process. Assigning numerical scores to natural resource values brings visions of "applied voodoo biology," but it was the only means we could develop to apply some objectivity to a very subjective process.

PRIORITY ACQUISITION PLAN

The evaluation matrix creates a priority listing based on water resource and environmental values. Four additional parameters are considered when making the actual decision to acquire land:

- **Strategic Plan** – District-wide plan for resource management
- **Potential for Resource Loss** – Threat from agricultural and urban development
- **Cooperative Acquisition** – Cost sharing with other state/local programs
- **Willing Seller** – SOR program does not have condemnation power. Cannot force people to sell.

FIVE-YEAR PLAN

Florida's five water management districts each prepare a SOR five-year plan, which summarizes that district's acquisition and management efforts for the past year. The plans also highlight proposed acquisitions and stewardship activities for the coming year. Although they are called five-year plans, the state legislature requires annual updates.

SFWMD PRIORITY SOR PROJECTS

The district includes most of the southern peninsula of the state, extending from Orlando to Key West. The SOR program has a variety of objectives, and these are reflected in the diversity of lands which have been acquired and are targeted for future purchase. The District has targeted more than 500,000 acres for acquisition; since the inception of the program in 1981, more than 125,000 acres have been purchased.

KISSIMMEE RIVER

The Kissimmee River once meandered for 105 miles, from Lake Kissimmee to Lake Okeechobee, in south-central Florida. In its natural state, the Kissimmee was a flowing river/flood plain ecosystem. In 1962, the U.S. Army Corps of Engineers began a flood control project which transformed the river into a 30-foot-deep, 56-mile-long canal. Approximately 34,000 acres of wetlands were drained, while 13,000 acres were converted to impounded wetlands. By the time the channelization was complete in 1971, the ecological damage was apparent, and environmentalists began a campaign to restore the river. Their simplistic, emotionally charged statement has been "put the dirt back in the ditch." A river/flood plain restoration model has been developed by an interdisciplinary team of water management district engineers and biologists and Dr. H.W. Shen, from the University of California, Berkeley.

The restoration plan alternative that has been selected by the SFWMD Governing Board calls for a series of earthen plugs, as well as refilling portions of the canal between the plugs. A critical part of the design requires the maintenance of flood protection in the upper basins – the reason the river was channelized in the first place. If the proposed backfilling plan is completed, it still will not restore total pre-channelization ecological function. It is estimated that prechannelization hydrologic characteristics would be restored along 52 contiguous miles of river channel and 24,000 acres of floodplain. The total cost of the project, including land acquisition, is estimated at $291 million.

While a total commitment to restore the river has not yet been made at the state and federal level, land acquisition efforts through the SOR program are proceeding. Approximately 57,000 acres are needed to complete the project. As of 1990, nearly 20,000 acres have been purchased, at an average cost of $1,000 per acre.

As land acquisition is completed in individual river reaches, "mini" restoration projects, involving the reflooding of individual sloughs and swamps, is proceeding. It may be many years before the total project is complete, but the district has made a commitment to do as much as possible, as quickly as possible.

The Kissimmee River restoration has received national attention, but the political and bureaucratic hurdles have made it a nearly insurmountable task. The SOR program is enjoying much greater successes on other projects.

DuPUIS RESERVE

In 1986, the district, in conjunction with The Nature Conservancy, acquired a 22,000-acre piece of rural south Florida, known as the DuPuis Reserve. The property was threatened by agricultural development, and its owners accepted $22 million, which was far less than market value, to prevent it from being cleared for orange groves and sugar cane fields. The DuPuis family operated it as a cattle, sheep, and goat ranch, but without the intense clearing and draining associated with most Florida ranching operations. It contains a variety of habitat types, including pine flatwoods interspersed with broadleaf marshes, cypress sloughs, and 2,500 acres of remnant Everglades sawgrass marsh. Most of the original wetlands, particularly the Everglades marsh, have been drained by a series of shallow swales and ditches, and planted with pasture grasses. A simple, cost-effective program of restoring the historic hydrologic condition has begun through the placement of earthen plugs in the ditches and swales. With the exception of the extreme western edge of the property, where land elevations drop five feet in one-half mile, the tract is very flat. With the ditches and swales blocked, wetlands fill up and overflow onto the surrounding pinelands. Isolated wetlands that produce populations of invertebrates and forage fishes during the June through October wet season are critical feeding areas to most of south Florida's wading bird population. An intensive hydrologic study and engineering design is underway to develop a containment dike and water control structure which will allow us to reflood the 2,500 acres of drained Everglades.

The DuPuis Reserve is the site of some of the most intensive management efforts of the SOR program. Florida pinelands are a fire-dependent community. Prior to the district's prescribed burning program in 1988, the property had not been burned in nearly 15 years. Heavy fuel loads had developed in the saw palmetto understory. Palmetto "roughs" 10 feet high were not uncommon. With no prior burning experience, the newly trained SOR burn crew is extremely cautious. Our intent is to reduce hazardous fuel loads, minimize the loss of overstory trees, and improve foraging habitat for native wildlife species. In heavy fuel areas, burn blocks are usually kept to less than 200 acres.

The DuPuis Reserve is only 45 minutes from major urban centers of the Florida Gold Coast. A low-intensity, high-quality hunting program has been developed in conjunction with the Florida Game and Freshwater Fish Commission. Selected by lottery, only 50 hunters are allowed on the 22,000-acre tract per weekend. Archery, blackpowder, and modern weapons are allowed on separate weekends, to take deer and feral hogs. In 1989, nearly 9,000 applications were submitted for the limited number of hunting permits.

The Florida Trail Association and local horsemen's groups have developed a series of separate hiking and equestrian trails. The SFWMD has recently entered into a management agreement with the Florida Division of Forestry, to operate the tract as a state forest. The Division of Forestry will be responsible for management and public recreation, and the water management district will retain responsibility for restoration and management of the water resources.

LOXAHATCHEE RIVER

South of Lake Okeechobee, the average elevation change is approximately 1/10 foot per mile. Most of south Florida's "rivers" are broad areas of sheet flow, such as the Everglades. South Florida does, however, contain Florida's only national wild and scenic river – the Loxahatchee. Most of the river corridor has been purchased with SOR moneys. It provides a wilderness canoe run of approximately seven miles, through a rapidly developing urban area.

BIG PINE KEY

Twenty-five miles east of the southernmost point in the United States, Key West, the district is in a joint acquisition program with The Nature Conservancy to purchase 600 acres of globally threatened Caribbean slash pine forest and tropical hardwood hammock on Big Pine Key. Big Pine Key is quite unique, in that it is underlain by a lens of freshwater. The freshwater lens floats on top of the underlying seawater. The island has a series of freshwater sloughs which are critical to the survival of the Key deer, an endangered species, as well as 37 other threatened or endangered plants and animals. Unlike other SOR projects, where thousands of acres are being acquired, the tracts on Big Pine

Key are mostly one-acre lots, and scattered among existing homesites. Illegal potable use and irrigation wells are threatening the freshwater lens. Potable water to all of the islands in the Keys is provided through a pipeline from the mainland. Septic tank drainfields discharge contaminated water directly into the water table, which rises and falls with the tide. Protection of the freshwater lens and the adjacent coastal waters, which have been designated as outstanding Florida waters, are the major reasons for acquisition. The district is entering into a management agreement with The Nature Conservancy that will promote a specialized prescribed burning program designed to perpetuate the pine rockland community as well as specific habitat needs of the Key deer.

CORKSCREW REGIONAL ECOSYSTEM WATERSHED (CREW)

On the southwest coast, the district has been instrumental in the formation of a land trust to protect more than 50,000 acres. These include a mix of uplands and wetlands critical to the future water supply of the region as well as the protection of critical habitat for the endangered Florida panther. The Corkscrew Regional Ecosystem Watershed Trust – known as the CREW Trust – consists of members of state and local government, private land owners, and local and national conservation organizations – including National Audubon, the Trust for Public Land, and The Nature Conservancy. National Audubon's Corkscrew Swamp Sanctuary is a 10,500-acre preserve containing the last remaining virgin bald cypress stand in the United States, and the largest wood stork rookery in North America. The CREW project surrounds Corkscrew Sanctuary on the east, south, and west. An agreement has just been reached to acquire nearly 7,000 acres of Corkscrew Marsh, the eastern neighbor to Corkscrew Sanctuary and the headwaters of the entire system. One of the two county governments involved recently acquired 4,000 acres of dense cypress forest to the west of Corkscrew Sanctuary, as well. County residents voted to increase local sales tax to raise $10 million for acquisition of nearly 13,000 acres in their county. Agreements have been made that will put title to all the land, no matter who pays for it, in the name of the SFWMD. Water supply sources in the rapidly developing area of southwest Florida are in great demand. By putting title in the District's name, the demands for use of the resource for public water supply can be balanced with the need to maintain the wetland ecosystem.

MANAGEMENT

Acquisition of land is the easy part. It is simply a matter of reaching an agreement on price. When the original SOR legislation was enacted, no funds were provided for post-acquisition management. In 1985, the Resource Rivers Act was amended to allow the use of up to 10 percent of the total revenues to be used for management. Proper stewardship and environmental restoration of these lands will be the challenge of the 21st century, for if we cannot manage them as well or better in public ownership as they were in private ownership, we have no business owning them at all.

WILD AND SCENIC RIVER STATUS OF THE LOWER MERCED RIVER

Deane K. Swickard[1]

The Bureau of Land Mangement has aggressively pursued management of the lower Merced River. Wild and scenic river status is under study, illegal and unauthorized uses have been prosecuted, Briceburg historic building is under renovation, land has been acquired to protect the river and the public future management options and new and progressive approaches are being used with recreational mining and other river uses. Whitewater recreational activities will be discussed.

Wednesday, October 17, 1:30 pm

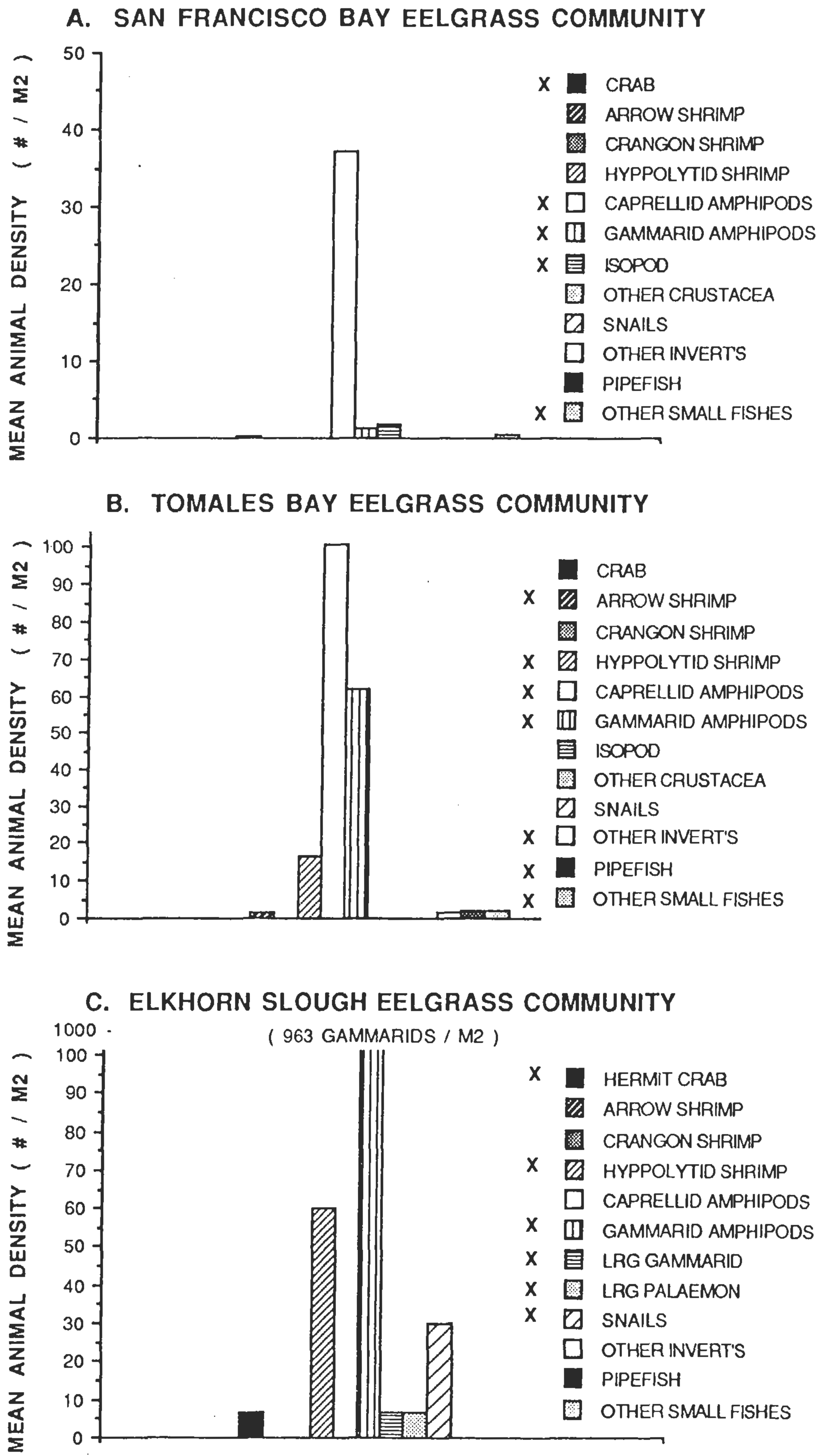
1. Deane K. Swickard, Bureau of Land Management, 63 Natoma Street, Folsom, CA 95630.

Figure 2. Preliminary data on population densities of major animals in eelgrass meadows of central California, sampled during early fall, 1990. N = 12 push net samples. Checkmarks denote presence of each taxon. The sequence in the list matches the sequence along the axis.

A. San Francisco Bay near Oakland.

B. Tomales Bay east of Inverness

C. Southern shore of Elkhorn Slough (Monterey Bay) near Highway 1 bridge. Note: 50 percent scale for San Francisco Bay data, and amphipod data off scale at Elkhorn Slough.



VEGETATION RESTORATION AS A TOOL FOR THE PRESERVATION OF BIOLOGICAL DIVERSITY

Tom Griggs[1]

The preservation of biological diversity has often been referred to as "saving the pieces." Unfortunately, for many of California's native habitats the "pieces" that are left are too small, too degraded, or too fragmented to function properly even if we managed to save all that is left. Therefore, to effectively preserve the diversity of California, we must restore some habitats to their natural or potential biological diversity. The most important among these have either a high degree of rare and endangered species present or an intrinsically high species diversity. The California Nature Conservancy is currently restoring riparian vegetation along three rivers in the Great Valley, has active research and development projects underway for the coastal dunes, bunchgrass prairie, and saltbush scrub vegetation types, and will be initiating in the near future the restoration of a desert palm oasis.

Thursday, October 18, 1:30 pm

1. Tom Griggs, The Nature Conservancy, 11010 Foothill Road, Los Molinos, CA 96055.

AQUATIC SYSTEMS RESTORATION

YOSEMITE VALLEY'S FORGOTTEN NATURAL PROCESS: THE STREAM SYSTEM

James F. Milestone[1]

Abstract

The stream system of Yosemite Valley does not represent a natural flowing channel that one would expect to find in our national parks. The changes caused by man began in 1879, when park guardian Galen Clark blasted the El Capitan Moraine in order to lower the base-level of erosion, drain the valley's lower meadows, and increase channel degradation. This was followed by a 100-year campaign to regulate the Merced River and its tributaries. The campaign sought to increase stream efficiency, reduce flooding, remove hundreds of natural log-jams, dredge tons of in-channel gravel for road construction, and install over 14,500 feet of rip-rap revetment to stop stream bank erosion. Early park guardians failed to recognize the natural resource value of natural processes such as stream bank erosion and in-channel organic debris. The Merced River has been historically viewed as an evil force, and if allowed to continue, would destroy the valley's forest and lush meadows, leaving behind a gravel wasteland. Modern perspectives view the Merced River and its tributaries as a natural resource that deserves restoration and protection. This paper documents 111 years of influence by modern man on the stream system of Yosemite Valley. The paper also provides a strategy for restoring the Valley's stream system, so visitors can one day enjoy a natural riverscape in Yosemite Valley.

INTRODUCTION

The Merced River has flowed through Yosemite Valley since before the time of glacial advances. The stream system's erosional processes were responsible for creating the gorges and pinnacles and exposing the world famous domes that surround the valley walls today. The glacial advances followed the stream system's path down through the Tenaya and Merced Canyons and into Yosemite Valley carving the final details on the massive landforms. The pristine aboriginal streams of Yosemite Valley had the appearance of a dynamic stream system. Rapidly eroding stream banks sloughed off into the shallow stream channel. The Merced River transported sand and gravel alluvium between the numerous mid-channel islands, depositing layers of sediment on point bars or against any one of hundreds of timber debris jams. Huge black oaks, alders, and pines were perched precariously over the steep river banks, providing cool shade for the river's aquatic life. Oxbows and low-lying meadowlands were seasonally flooded with backwater, held up behind the El Capitan Moraine. Recently deposited point bars along the Merced River provided footings for sprouting willows and alders which would snag branches, logs, and more sediment. This process would eventually revegetate the barren gravel point bars, returning the area to meadowland. Annual floods would inundate the flood plain leaving a fresh veneer of soil and localized channel changes. Periodically, huge mid-winter floods would cover the entire central portion of the valley floor creating a new generation of stream channel. Ancient logjams would be moved down stream, while dozens of newly undermined trees would lodge mid-channel causing the river to shift in one direction or another. All these features of the river environment contributed to the creation of the valley floor as it was seen during the time of white discovery in 1851.

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1. James F. Milestone, National Park Service, P. O. Box 146, Crater Lake, OR 97604.

BLASTING OF THE EL CAPITAN MORAINE

Between 1851 and 1879, the river system of Yosemite Valley was maintained in a natural riverscape appearance. One of the most noticeable conditions were swampy meadowlands that existed in the lower end of the central valley floor. The combination of a permanent rock dam formed by a glacial moraine and numerous logjams found throughout the riverscape was largely responsible for the swampy meadows that the early pioneers frequently described. The most important feature and cause of the swampy meadowland on the valley floor was the El Capitan Moraine. The moraine left by glacial advances, controlled the base-level of erosion in the central portion of the valley and influenced surface water drainage. The periodic winter floods in Yosemite Valley are a result of the El Capitan Moraine's landform bottlenecking the river channel.

It was not until 1879 that the stream system was seriously disturbed by modern man. Galen Clark, an early guardian of Yosemite Valley, succeeded in lowering the elevation of base-level, lowered the water table, and increased surface drainage causing channel degradation. Galen Clark realized the influence of the El Capitan Moraine on the hydrology of the central portion of Yosemite Valley. In an effort to open potential grazing land and provide drier roads for access to the upper valley, Clark blasted the moraines bottleneck channel. The following letter written by Clark in 1907, titled "Cause of Swift Erosion" describes the incident:

> It may be interesting to the public to know the cause of there being in recent years so much more activity in the river currents cutting away the river banks than during the earlier known history of Yosemite. When the El Capitan bridge was built in 1879, it was located across the narrow channel of the river between the two points of what remains of an old glacial moraine. The river channel at this place was filled with large boulders, which greatly obstructed the free outflow of the flood waters in the spring, causing extensive overflows of the low meadow land above, greatly interfering with travel, especially to Yosemite Falls and Mirror Lake. In order to remedy this matter, the large boulders in the river channel were blasted and the fragments leveled down so as to give a free outflow of the flood waters. This increased the flow of the river currents, which now commenced greater eroding work on the river banks, and as the winding turns became more abrupt the destructive force annually increases. Some thorough system of protection should be promptly used to save the banks from further damage.

A detailed study of the El Capitan Moraine was completed during the fall of 1977. Taking advantage of the drought's low water, observations revealed the location where Galen Clark blasted the moraine boulders in order to lower the river channel and reduce surface water behind the moraine. The study determined the width, length, and depth of the blasted area. By measuring boulder fragments, tributary stream terrace levels and surveying six cross sections of the valley floor, the original height of the moraine prior to blasting was determined. Since 1879, tributary stream channels immediately above the moraine appear to have down cut an average depth of 4.5 feet. The number of stream terrace formations in tributary channels decreases as one moves further upstream from the moraine. This indicates that adjustment to the moraine has occurred, the most rapid changes being near the source of change. Since the moraine controls the base-level of erosion, the present river gap in the moraine must be 4.5 feet lower than what existed in 1879. This is significant since the valley floor is relatively level with only a 12-foot rise in elevation between the moraine and the Old Village foot bridge, 3.5 miles upstream.

LATERAL EROSION: A DYNAMIC STREAM CHANNEL

Photographs taken of Yosemite Valley by Watkins and Fiske in 1866, fifteen years before the El Capitan Moraine was blasted, show photo after photo of heavily eroded stream banks 5- to 6-feet high. Undermined trees with exposed roots lean out precariously over the river channel. Large in-channel logjams are frequently seen with mid-channel islands forming downstream. The scenes described above indicate an actively eroding stream channel, constantly shifting across the floodplain of the valley. Oxbow bends, abandoned stream channels, and sloughs scar the floors of every large meadow in Yosemite Valley. Stream bank erosion was as much a part of the aboriginal landscape in Yosemite Valley as was the waterfalls.

Despite the fact that the process of lateral erosion was normal, early guardians and the managing Board of Commissioners for Yosemite saw this natural phenomenon as destructive. In all actuality, no one noticed the river's dynamic character until it began to undermine landmark trees, roads, bridges, and artists' cabins all constructed within the floodplain. Galen Clark began the campaign of altering the pristine aboriginal riverscape by rejuvenating stream degradation, while the Board of Commissioners sought methods to halt lateral erosion.

In 1882, State Engineer William Hall visited Yosemite Valley and inspected the river system to suggest improvements at the commissioner's request. The following quotations are from his pamphlet, "To Preserve From Defacement and Promote Use of the Yosemite Valley" (1882). The following quotations document that braided reaches of channel existed and that numerous amounts of logs and unchecked lateral erosion were natural features in the riverscape.

> . . . several notable obstructions lay in the river channel. Waters must be brought into one channel.
>
> . . . above the Upper Iron Bridge, I found the river channel to be in especially bad condition, in fact, it divided up, spread out, obstructed and torturous in its course . . . result in unregulated overflow of large portions of available meadowlands in the Valley.
>
> . . . the streams of the valley must be cleared and regulated.
>
> Rivers are constantly demolishing their banks at some points and building up in others.

From these quotations one can get a good physical description of the river's behavior. Lateral erosion was very evident and was augmented by natural debris in the stream channel.

STREAM BANK STABILIZATION

Beginning in the early 1880s, modern man installed the first physical armor to protect stream banks from eroding. Large granite boulders called rip-rap revetment were strategically placed on the riverbank to stop erosion of the soft loamy soils. This type of armor required thousands of cubic yards of granite rock to be hauled in from the valley's talus slopes. The first reach of eroding bank armored in Yosemite Valley was done to protect a landmark sugar pine tree. The tree is found on the Merced River immediately downstream from the confluence of Tenaya Creek. The tree still survives today on the right bank just below "Sugar Pine Bridge." Installation of rip-rap revetment throughout the valley floor continued through the 1960s.

In the fall of 1977, the first complete comprehensive inventory of all artificial structures found in Yosemite Valley's stream system was completed. The total length of every rip-rap revetment site found throughout Yosemite Valley's stream system totals 14,518 feet. To understand the magnitude of this figure, imagine turning the length vertically with the base at sea level. Comparing such a column of revetment to the height of Mount Whitney leaves a tower of rip-rap revetment some 22 feet above the mountain's summit.

Having installed this mammoth amount of granite boulders along the eroding riverbanks of the stream system, the source of alluvium required to maintain the original braided channels was significantly reduced. The combination of Galen Clark's blasting of the El Capitan Moraine's river channel, the installation of thousands of feet of rock revetment and the removal of hundreds of logjams resulted in the present down cutting of the Merced River channel in the lower end of the valley's central portion.

DAMS

Mirror Lake in the upper portion of Yosemite Valley has been dredged and dammed since 1882. This work was done to prevent the shallow lake from filling in with sediments washing downstream from Tenaya Canyon. The first dam constructed at Mirror Lake in 1882 allegedly increased its size six times. Inspections of the dam site today, indicate the dam is 9 feet above the original overflow channel. Since 1882, the dam was increased in size and height several times.

REMOVAL OF LARGE WOODY DEBRIS

Throughout the Depression of the 1930s, federal public work crews such as the Civilian Conservation Corps did extensive misguided improvements to the stream system. Removal of large woody debris from the stream system was one project that took years to complete and likely had an adverse affect on the aquatic health of the river system. Hundreds of logjams were removed and steep riverbanks were machine sloped and armored with rip-rap revetment. This program was continued throughout the 1970s.

FLOODS

Large scale flooding occurs from time to time in Yosemite Valley. Historically, large winter floods occur between November and February when large snowpacks are suddenly melted by warm tropical rain storms. Yosemite Valley has recorded several 100-year and 50-year floods within the last century. There exist a possibility that residents have yet to experience the largest recorded flooding in Yosemite Valley.

Following the big 1937 flood, few people believed they would ever see a comparable flood within the next 100 years. The 1937, 1950, 1955, and 1964 floods each came as a shock to the residents because of their power, extent of inundation, and damage to man-made structures. Floods are significant sediment events. River channels are sometimes abandoned and totally new channels are formed during floods. Floods in Yosemite Valley typically limit their damage to man-made structures. Nearly all of the damage occurs to structures constructed within the low-lying floodplain. Following the next flood, park management will decide on whether or not to restore damaged structures, roadways, bridges, and utilities. Following a flood, management can use the event to remove damaged structures and let nature take back complete control of the floodplain. Every future flood will be an opportunity to restore the floodplain to a natural state.

RESTORATION

Restoration of Yosemite Valley's stream system is a realistic goal. Restoration efforts should not be limited to individual reaches of stream channel, but instead, focus on restoring the ecology of the valley's floodplain. The goal should be to restore all the natural processes of the primitive floodplain, including lateral erosion, large woody debris accumulation and restoration of wetlands in the vicinity of the El Capitan Moraine.

In order to restore Yosemite Valley's stream system, the following four steps should be implemented:

a. Restore the El Capitan Moraine's natural base-line of erosion. Gradually increase the moraines river channel elevation 4.5 feet. This would cause the stream channel upstream of the moraine to fill in with sediments. Spring and early summer runoff would cause limited flooding of lower valley meadows. Numerous trees that have invaded the meadows as a result of 1879 blasting would die from elevated ground water. Seasonal flooding of the low-lying meadows would be restricted to the lower portion of the central valley and would not extend above Liedig Meadow. Raising the moraine's channel to its original height would not significantly change the extent of flooding during the large 100-year floods. Galen Clark's alteration to the moraine's river channel influences low-water flows and groundwater. Clark's misguided improvements have little influence during large floods in comparison to the moraine's massive landform rising up from the valley floor as a natural dam. The El Capitan Moraine still serves as an effective bottleneck during large-scale floods.

b. Restore the stream channel's natural process of lateral erosion. This could be achieved by removing sections of rip-rap revetment from various reaches of the stream channel. Revetment that has failed and not been maintained should be removed first. Revetment that remains sound and may be presently protecting a bridge, roadway, or utility should be left until plans or conditions allow the structures to be removed altogether from the floodplain. Rip-pap revetment that is removed from the river channel could be moved to the El Capitan Moraine and used as fill to restore the moraine's original channel height.

c. Allow large woody debris to accumulate within the stream channel. Logjams should be allowed to form unless visitor safety is threatened. Individual large woody debris accumulations should be evaluated in regard to safety considerations, such as their proximity to popular campground swimming holes and potential conflicts with river rafting in the upper valley.

Bridges should be considered in relation to the location of upstream logjams. During flood periods, logjams can break free and drift into the constricted channel of a bridge. Large woody debris can plug a constricted bridge channel during floods causing the river to seek a new course or undermine bridge abutments. Existing bridges that have a reduced channel width should be removed to allow logjams to develop. Large woody debris accumulations are important for aquatic habitat and encourage the natural process of lateral erosion.

d. Remove all dams from Yosemite Valley. This includes dismantling Mirror Lake's dam, the old abandoned powerhouse dam, and any of the nine existing pipe dams found throughout the valley's stream system. Where pipe crossings are important for utility purposes, the pipe should be reset at a depth well below the bed of the stream channel.

CONCLUSION

As seen by the evidence presented here, there have been many changes to the natural stream system of Yosemite Valley in the past 100 years. Unfortunately, most of these changes occurred as a result of modern man's manipulation of the natural stream system. Had the early guardians not viewed the river's natural processes as destructive, visitors today would still be able to view a pristine stream system in Yosemite Valley.

Today we are left with a river in which many reaches are artificially controlled, with sections of riverbank sloped by machine, armored with tons of rip-rap revetment, and with a channel choked by constricting bridges and pipe dams. The irony of such a dilemma is that this situation exists in the heart of one of America's great national parks. This paper recommends restoring the valley's stream system by: 1) rebuilding the El Capitan Moraine's channel; 2) removing all rip-rap revetment wherever practical; 3) allowing large woody debris to accumulate in stream; and 4) removing all dams from the stream system. Such efforts will be necessary to begin restoring the stream system to a natural condition.

The National Park Service has recently proposed a river restoration plan that is an exciting step towards restoring the valley's stream system. The restoration plan incorporates recent research by Danny Hagans, Mary Madej, and William Weaver. Their research suggests that human trampling and the resulting destruction of riparian vegetation are the overriding causes of accelerated bank erosion in developed areas of upper Yosemite Valley. Replanting riparian vegetation and managing visitor use in trampled areas of the riverscape will restore the natural beauty and preserve the aquatic resources of the valley's streams.

After 100 years of managing Yosemite Valley as a national park, the park guardians are coming to appreciate the importance of restoring a significant natural process in Yosemite Valley. The restoration work proposed by park management, if implemented, would provide visitors an opportunity to view a more natural and scenic stream system that has not been experienced in Yosemite Valley since the late 1800s.

REFERENCES

Clark, G. 1907. Cause of Swift Erosion. *Yosemite Nature Notes*, Vol. VI. No. 2-2-27.

Commissioners. 1877-1904. Commissioners to Manage Yosemite Valley and the Mariposa Big Tree Grove. Biennial Report, California State Printing Office.

Hall, W. 1882. *To Preserve from defacement and promote use of the Yosemite Valley.* Report of State Engineer. California State Printing Office.

Hagans, D., M. Madej, W. Weaver. 1989. *Channel Changes in the Merced River, Yosemite Valley.* Redwood National Park, Arcata, CA.

Matthes, F. E. 1930. *Geologic History of the Yosemite Valley.* U.S. Geologic Survey, Professional Paper, p. 160.

Milestone, J. F. 1978. *Influence of Modern Man on the Stream System of Yosemite Valley.* San Francisco State University, Master Thesis, Geography Dept. San Francisco, CA.

STREAM BANK PROTECTION AND RIPARIAN VEGETATION RESTORATION UTILIZING BIOENGINEERING TECHNIQUES IN THE SACRAMENTO VALLEY

Roger W. Cole[1]

Three bank protection and revegetation projects with ages varying from days to four years (totaling 267 meters of bank) are examined. These projects have a primary function of bank protection and a secondary function of riparian revegetation. We used the bioengineering technique of brushlayer construction and the creation of a small floodplain and terrace niches. All plants utilized were native species.

INTRODUCTION

The three projects are located in Northern California in Chico at the base of the southernmost extent of the Cascade foothills. Project 1 is located on Big Chico Creek, which runs through Bidwell Park, 1,700 acres in the canyon formed by the stream. Big Chico Creek has a drainage area of 72.4 square miles. Maximum annual flows average 541 cubic meters (5,818 cubic feet per second, USGS figures 1965-70). It is unique in that it has no diversions above project 2. Project 1 is 4.3 km downstream of the Lindo Channel Diversion (U.S. Army Corps of Engineers project). Project 2 is located 2.8 km upstream of said diversion. Project 3 is 2.0 km downstream of said diversion. The Lindo Channel Diversion receives approximately 80 percent of peak flows (my estimate) and is designed with a peak flow of 6,000 cubic feet per second (558 cubic meters).

PALMITER STYLE BANK PROTECTION AND REVEGETATION

The palmiter style bank protection and revegetation project was installed by Streaminders in October 1986. (Mary E. Meyer was project coordinator from 1986-1988.)

Construction, Phase 1 (see also Meyer 1988)

A palmiter system of brush deflectors was constructed at the site of an eroding 69-meter-long and 3-meter-high vertical bank. As shown in diagram 1, a 0.6-meter-wide by 1-meter-deep trench was excavated as close to the toe of slope as feasible with a backhoe. Vertical 3-meter cuttings were anchored in the trench together with steel fenceposts and dormant riparian cuttings (cottonwood, [*populus fremontii*], willow [*Salix goodingii*]; and [*Baccharis viminea*] 3-meter brush was wired horizontally to the fenceposts.

Deflectors A and B were installed just upstream of the eroding bank for initial deflection of the current. These deflectors differ from the others in that they are constructed at a 30-degree angle to the bank for initial deflection of the current. From that point on, 14 deflectors approximately 4-meters long were built perpendicular to the bank. To increase capacity and reduce the amount of water flowing against

1. Roger W. Cole, P.O. Box 68, Forest Ranch, CA 95942, (916) 895-0866, principal Streaminders (environmental nonprofit) and Interactive Design (consultant firm). Streaminders is a private nonprofit organization that has been involved in stream protection and restoration since 1986. We have received four grants from the California Department of Water Resources Urban Stream Restoration Program to do work as well as money from other sources. Monitoring and planting on our sites continues.

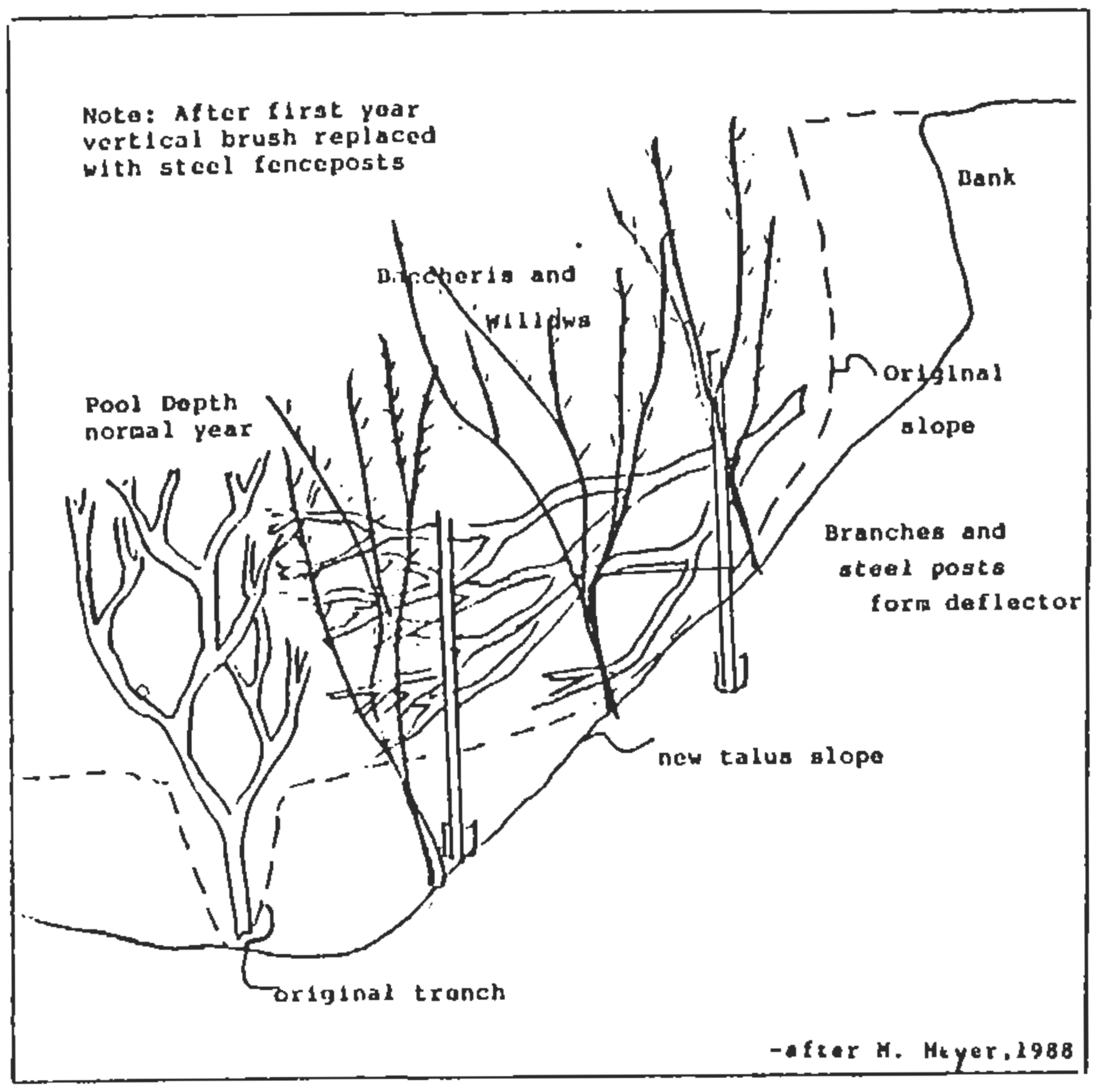

Figure 1 – Project 1 cross section

the bank 180 M^3 of alluvial gravels were shaved off the opposite point bar and pushed against the toe of the bank. Dormant cuttings were also placed in the talus slope below the vertical bank. (A dripline placed at the base of the bank was irrigated for 12 to 18 hours every seven days during California's dry season May through October 1986-88.)

PHASE 1 RESULTS

Deflectors accumulated large amounts of organic debris after storm events. Initially we were pleased at this deposition, thinking it would hasten revegetation efforts. We have since discovered that this organic debris substantially decreases the permeability of the brush deflectors so that very large storm events will sometimes collapse them. It has therefore become a maintenance task to periodically remove this debris and cast it up on the upper terrace. Other maintenance includes the annual replenishment of the brush deflectors with new material.

The initial cuttings placed in the trench drowned and were eroded out as the pool deepened. *Baccheris* cuttings placed above the toe were successful in rooting and growing. Additional plantings included box elder, (*Acer negundo*), black walnut (*Juglans hindsii*), digger pine (*Pinus sabiniana*), live oak (*Quercus agrifolia*). The box elder lacked drought tolerance. In the talus slope black walnut performed well, growing to a height of 3 meters after 3 years. *Baccheris* and willows were some 2 meters in height.

PHASE 2 RESULTS

I assumed project management in spring of 1989. In early fall, the project was reviewed to determine needed maintenance.

During high winter flows in succeeding rainy seasons the stream eroded away substantial amounts of bed material to create a 1-meter-deep pool (at active channel discharge) just beyond the end of the brush deflectors. This pool has improved fish habitat if one can judge by the number of large fish seen holding in this pool. Adding bank roughness forced stream energy to downcut instead of eroding the bank. One of the deflectors in the center of the curve had collapsed. We determined that deflectors were spaced too far apart at this area and planned to add a deflector at this point.

Another fluvial effect was the changing of the angle of flow coming off the riffle downstream of the project. This angle steepened by approximately 10 to 15 degrees and tended to deflect the flow more directly into the opposite bank, causing a small amount of bank erosion below the project area at the toe of the opposite bank. We determined that deflectors intruded too far into the active channel and therefore shortened four of the deflectors towards the bank and also added a small parallel deflector at the erosion point across the creek and cuttings of *baccharis* to reinforce the area. Deflectors are now spaced an average of 3.5 meters (11.6 feet).

PLANT CONDITION IN FALL 1990

Cottonwood, (*Populus fremontia*) cuttings (0.6 meter) were added 0.7 meter above winter water level. Twenty percent of these survived and were watered every 2 weeks (summer 1989) by a "porous pipe" buried 0.15 meter below the soil in the upper part of the talus slope. 1990 was the first summer the project went without supplemental water. Watering was carried on for this length of time due to new plantings each fall and California's prolonged drought; this area received from 40 to 75 percent of normal rainfall for the past three years.

In the talus slope black walnut performed well and grew to a height of 3 meters.

3 years. Some 21 *baccheris* and willows average 2.3 meters in height, ranging from 3.7 meters (12 feet) to 1.2 meters (4 feet). Six cottonwoods average 2.3 meters.

HEDGEBRUSH LAYER USED AS REVEGETATION/BANK PROTECTION (Streaminders, Cole 1989)

History

This project was initiated after the City of Chico attempted to protect an unpaved road to the upper park portion of Bidwell Park. The road passes within 10 meters of the stream. In 1987 following a historic flood event (variously estimated as a 50 to 500 year event). Consequently the city used flood damage funds and employed a bulldozer to remove stream gravels (820+ cubic meters) from the stream and push it up on the stream bank at a 2:1 slope (horizontal:vertical).

The bank had eroded away primarily due to human use. The city asked Streaminders to help with the problem. We applied to the Department of Water Resources, Urban Stream Restoration program for funding. In the spring of 1988, we received $6,900. Circumstances beyond our control prevented our work from beginning that year.

Our first workshop took place April 1, 1989 with 21 volunteers including students and parents from a fifth-grade class. Volunteers excavated discontinuous trenches 0.4 meter above the water level down to significant moisture and placed 200+ cuttings (0.5 meter in length) of *bacceris viminea* and *salix* sp. Due to the lateness of planting we obtained dormant cuttings by traveling some 33 kilometers (20 miles) upstream (we assumed genetic uniformity along the stream), to an altitude of 1,000 meters where we acquired cuttings of willows, alder, (*Alnus rhombifolia*), and big leaf maple (*Acer bignoides*). Fully 70 percent of the cuttings sprouted including the maple, which was strictly an experiment.

Our watering system consisted of tossing bucketfulls of water up on to the bank over and above the cuttings once a week; thus both watering and washing fines down into voids. Unfortunately, California was entering a drought, and combined with early spring heat, the majority of our willow and all *Acer bignoides* and *alnus rhombifolia* cuttings perished. The response of the *baccharis viminea* cuttings was staggering. In three months, the *baccharis* had grown to a height of 1.4 meters with multiple stems.

Planning began for the next major workshop. A survey of the stream unit to determine stream parameters such as active channel width, depth, substrate, and floodplain width was conducted in accordance with D. Rosgens (1985) stream typing system to determine stream type and probable stream response to protecting the fill slope.

We determined the following: the stream was a type C-3, moderately confined by its stream valley with moderate- to fine-textured alluvial terraces, unstable banks, and unconsolidated noncohesive soils.

We discovered that the active channel was wider at the site (27 m) than above (21 m) or below (23 m) the site. We decided to protect the fill slope and allow the streambed to adjust. The design for 50 meters of bank utilizes hedgebrush layer construction (Schleitl 1980) as shown in figure 2.

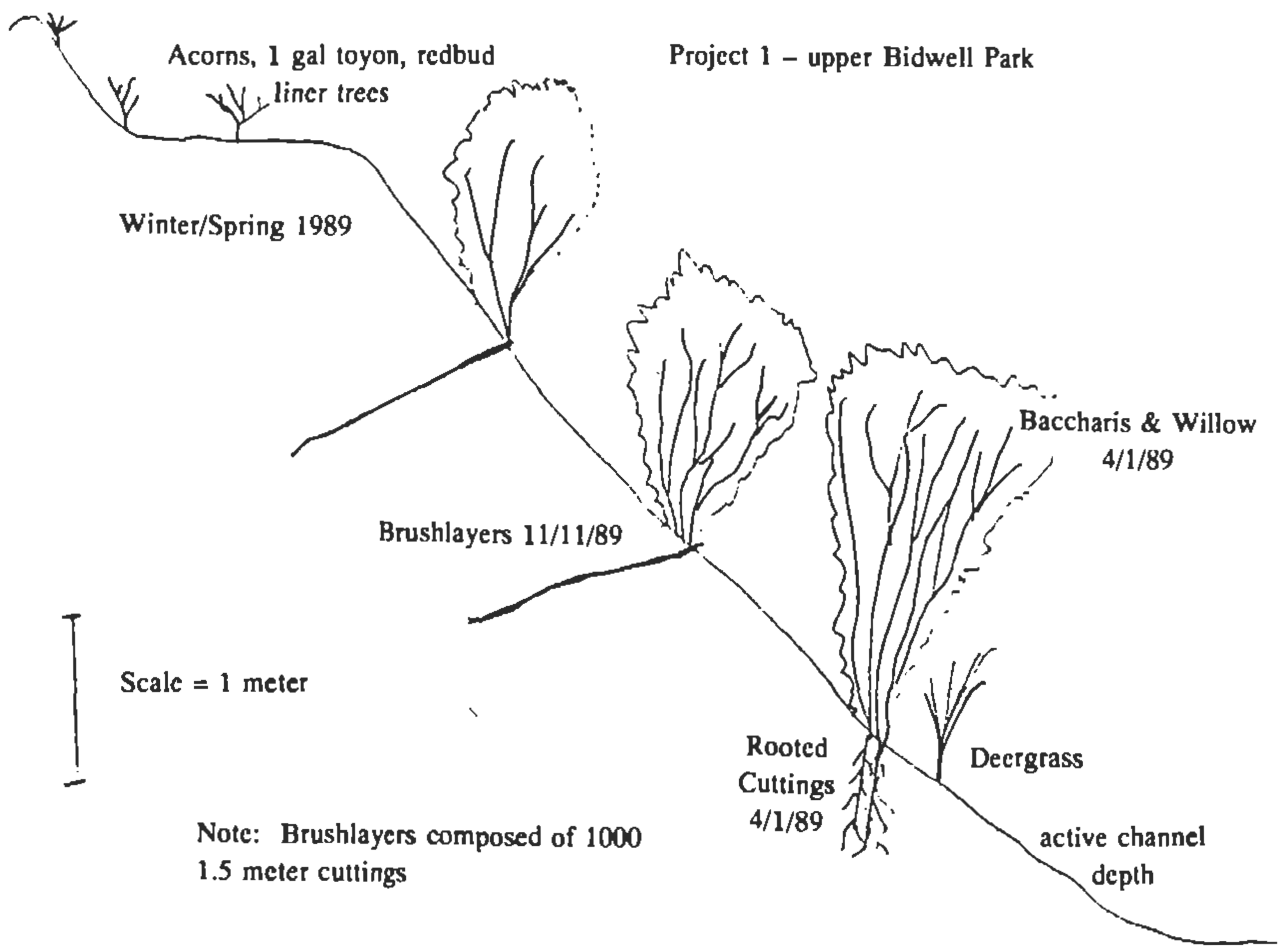

Figure 2. Planting Design for upper Bidwell Park Project Streaminders (Cole 1988)

Prior to construction publicity was arranged food and drink was procured (both essential for volunteers), and 1,200 1.5 meters *willow* sp. and *baccharis viminea* cuttings were obtained from within 1 kilometer downstream.

Some 20 volunteers and the smallest and newest bulldozer (new bulldozers do not leak) we could locate commenced work the next morning. A crew went off to obtain an additional 2,000 cuttings and the bulldozer cut a 1.5-meter terrace with a slight backslope (to assure rooting) as close as possible to the water (1.3 meters) and the existing *baccharis viminea* as possible. Cuttings were laid every 10 centimeters. A second terrace was created when the first was covered.

Utilizing soil from the corner of the site, we created an upper terrace at the level of the remnant of an existing terrace. One hundred valley oak acorns were planted in this terrace, and it was mulched with wood chips (juniper) provided by the city. The site was watered with a gas-powered pump.

Other workshops took place throughout the winter and spring. One hundred additional willow and *baccharis* cuttings were placed at the toe. A December workshop constructed a "rough channel" from the culvert outfall to the stream with a settling pond at the upper terrace level. Although vandalized, it has largely held together.

Any restoration in an urban park must take into account human use and abuse. The first summer after initial plantings, I observed that tons of cobbles (approximately 14 cubic meters) were thrown into the creek and pushed down the bank by people walking on the fill slope. I constructed and installed educational signage which helped; the city dug a ditch and created a berm to prevent parking. In January 1990 the city installed 1.3 meters of wire fence. These have substantially decreased foot traffic and vandalism.

Streaminders Adopt a Creek program[2] (with schoolchildren as volunteers) planted 34 liner trees (0.36-meter liner) valley oak, *quercus lobata;* live oak *quercus agrifolia; populus fremontii;* and *cercis occidentalis;* (provided by the U.S. Forest Service Chico Tree Improvement Center); also 1 gallon toyon, *heteromeles arbutifolia*, and *lupinis* sp. were planted on the upper terrace and berm. 16 deergrass (*Muhlebergia rigens*) divisions were planted 0.3 to 0.5 meter above the spring water level (comparable to nearby naturally occurring specimens).

Plant Performance

The last four years in California have been drought years. In spite of watering this site every 2 weeks, planting losses have been substantial. From an initial 85 valley oak sprouts from acorns we have 72. A sampling of the dead oak seedlings found that 90 percent were due to gopher predation. Liner stock died (in decreasing order) due to foot traffic, drought, and unknown causes. The diagram shows a triangular berm above the terrace. Plants near and on the top of the berm are most vulnerable to heat, dryness, and dust from the road. Losses at this location were almost total. Only *lupinus* sp.and *Pinus sabiniana* survived in this area. Their loss indicates the importance of selecting appropriate niches for each species of plant. Also, *muhlenbergia rigens* were quite successful when planted at the edge of the active channel.

Fluvial Effects

Common drought effects on fluvial channels include vegetation encroaching into the active channels due to a lack of flushing flows. At this site encroachment has primarily occurred on a gravel bar located at the downstream end of the project. This bar has been heavily colonized by *baccharis viminea*, sedges, sycamore, and alder. There is concern that this vegetated bar has created an obstacle to stream flows that will split flood flows into the bank downstream of the project-causing major erosion. Thus far such erosion has been minimal due to the presence of a downed oregon ash and the lack of flood flows.

HEDGEBRUSH LAYER, RIPRAP TOESLOPE, AND SMALL FLOODPLAIN CONSTRUCTION USED AS BANK PROTECTION/RESTORATION (Interactive Design, 1990)

Drake homes applied to subdivide a parcel adjacent to Bidwell River Park and the north bank of Lindo Channel, an old stream channel, and part of a flood control project of Chico Creek as previously mentioned.

The City of Chico, having previously had experience with the creek eroding homeowners' yards on older projects located too close to the streambank, required the developer to riprap the entire 390 meters of bank adjacent to the project. Local environmentalists including Streaminders objected to the destruction of the riparian zone and called for a study of the potential for erosion by the Department of Water Resources Environmental Branch. The study concluded that there was erosion, but that it was

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2. Streaminders Adopt a Creek program had two teachers and a creek technician (myself). The students were instructed in stream ecology and then participated in actual riparian revegetation.

controllable. The city was convinced to require a bioengineered instead of riprap solution. We were contacted by Geoff Lane of Drake Homes to design the project.

Interactive Design conducted an extensive survey: stream typing, vegetation, fluvial geomorphology, erosion sites, etc.

Part of the design program was saving an 0.5-meter DBH sycamore *(platinus racemosa)*. This presented a difficult design challenge as it was at the top of a steep vertical bank, and was already undermined. At the other end of the project, the problem was caused by an improperly built concrete bikepath placed across the active channel at an oblique angle. The bikepath directed streamflow into the bank 50 meters downstream, at the upstream end of the Drake subdivision.

The streambank was composed of alluvial fill with cobbles and a small percentage of nutrient-deficient clay soil, underlain by a ancient agglomerated Pleistocene deposit. This deposit was providing resistance to the stream power.

Our survey determined that the creek was a type C-2 (Rosgen, 1985) or overfit channel created by historic flood events with a slope of two percent and low stream power.

A large portion of the adjacent area within the park was floodplain. Peak flows in the channel are regulated to 557 cubic meters.

We concluded that a cost-effective design would include riprap (one-eighth of what was formerly required) up to a small (1.3 meters) floodplain (see fig. 3).

The floodplain would contain three of our brushlayers. They would grow into a thick hedge. Floodwaters would be substantially slowed by the hedge and the bank protected. The fourth brushlayer would be located behind the riprap to slow flows, mask it, and provide additional habitat.

The project was scheduled to be constructed in spring of this year, but delays in the permit process pushed the work into the summer, which is impractical for planting due to valley heat and dryness (July average temperature is 89°F and relative humidity is 30 percent or less).

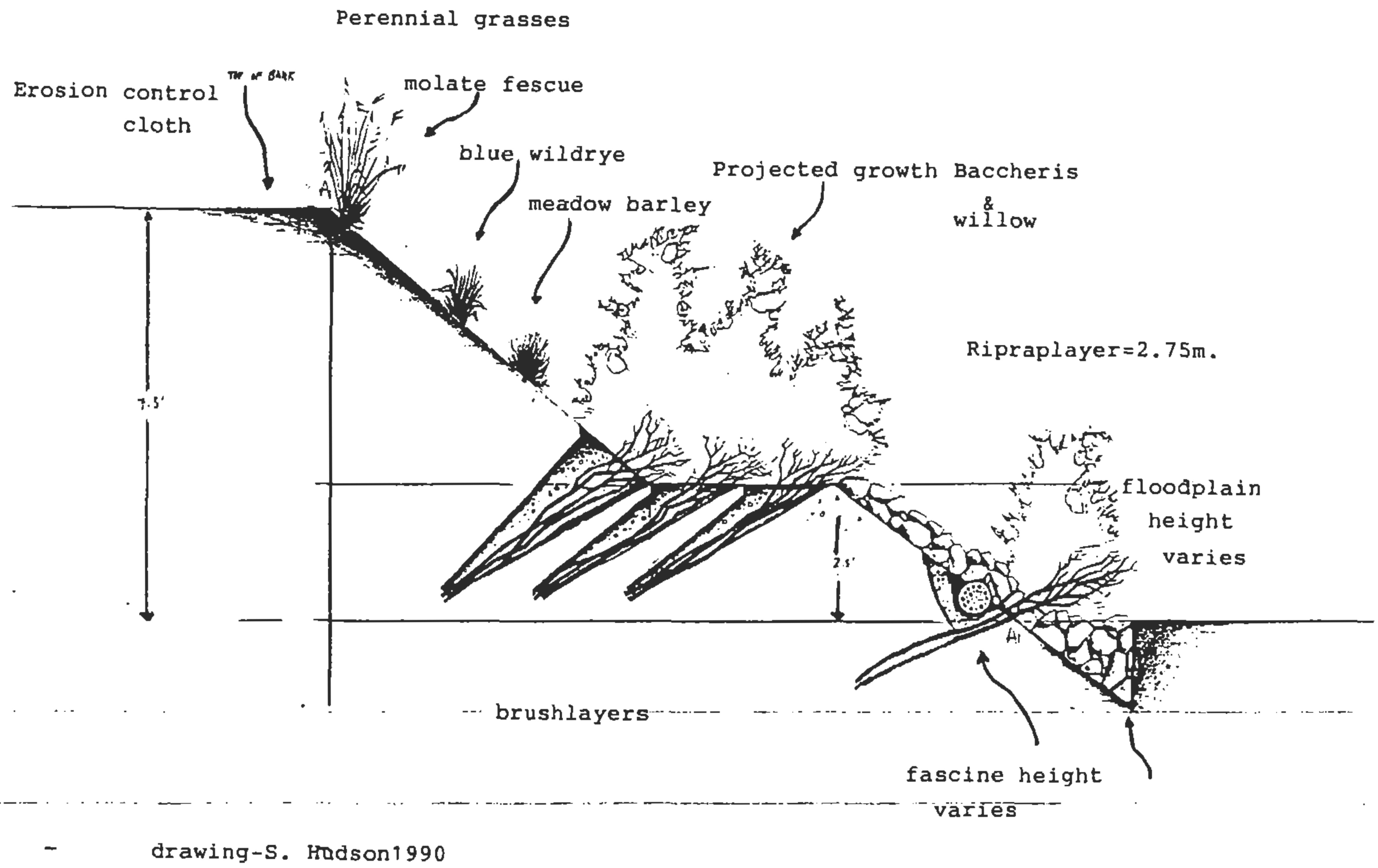

Figure 3. Hedgebrush layer, riprap, toeslope, and small floodplain design for bank protection and restoration Interactive Design (Cole and Owen 1990)

Thus delayed, work started Monday, October 8th. All cuttings were placed by October 18th. Unlike previous projects, leaves were not stripped from cuttings. But cuttings were kept moist from project inception. Plant response has been excellent. An estimated one-third of the cuttings showed 3-centimeter growth from all exposed buds by November 18th. Costs came to approximately $38,000 or $95 per lineal foot.

BRUSHLAYER/FLOODPLAIN CONSTRUCTION

We first cut the bank to rough contour and removed fill from the bank. We then dug a toe trench and created the average water level mound with an excavator. Concurrently 2,000 cuttings (< 19¢ ea.) were obtained by a three-person crew. We then placed the first brushlayer and fascine on top of the mound, staking the fascine in place. We then built a mound to floodplain level, and excavated a notch behind for brushlayers. (The notch enables the cuttings to reach down to the water table.)

Concurrently, the crew obtained 4,000 additional cuttings. We then placed and buried second, third, and fourth brushlayers, being careful to maintain floodplain elevation.

Before burying the last brushlayer, we installed a porous pipe watering system and covered it with 6 inches of soil.

The next step was the placement of riprap from the toe trench up to the side dump; polish with excavator and hand labor. We then sloped the top of bank to 2:1 with an excavator. We soaked the site down (ongoing from placement of first cuttings).

We prepared for native perennial grass seeding by irrigating to germinate the seed bank, followed by an herbicide treatment with glyphosphate, Roundup. A slow-release fertilizer, 14-14-14, was then applied at the rate of 156 grams per square meter. The seed was then applied at the rate of 47 grams per square meter, and consisted of the following Conservaseed-brand native grasses: Meadow Barley (*herdeum brachyantherum*) 50 percent (designed to perform as a nurse crop); Molate Fescue (*Fescue Rubra*) 25 percent; and Blue Wildrye (*Elymus glaucus*) Stanislaus 2000 variety 25 percent.

An excelsior erosion control blanket (to provide erosion resistance and mulch), Xcel Regular, was installed.

Project performance evaluations will await the return of Northern California's normal rainfall pattern.

ACKNOWLEDGMENTS

I wish to thank Orene Owen, codesigner of project three as well as Streaminders' most faithful volunteer; John Ost, one of the original Streaminders, as well as Chuck Lundgren, Helen Ost, the rest of the Streaminder volunteers, and Geoff Lane of Drake Homes; California Department of Water Resources, Urban Stream Restoration Program for grant monies; and Stacey Cepello of the Department of Water Resources for valuable technical advice.

REFERENCES

Alderon Laird, *Draft-Basin Level Inventory Approach to Stream Classification.* Trinity Fisheries Consulting. 1990.

Meyer, E. "A Low Cost Brush Deflection System for Bank Stabilization." In *Proceedings of the California Riparian Systems Conference.* Protection, management, and restoration for the 1990s, Abell, Dana technical coordinator 1989; Sept. 22-24, 1988; Davis, Ca. Gen. Tech. Rep. PSW-110. Pacific Southwest Forest and Range Experiment Station, U.S. Dept. of Agriculture, Forest Service, Berkeley, CA.

Institute of Environmental Sciences, Miami University. 1982. *A Guide to the George Palmiter River Restoration Techniques.* Contributing Report 82-CRI. U.S. Army Engineer, Institute for Water Resources.

Rosgen, D. L. 1985. "A stream classification system." In: *Riparian Ecosystems and their management: reconciling conflicting uses.* April 16-18; Tucson Az. Gen. Tech.

U.S. Dept. of Agriculture. Rept. RM-120. Fort Collins, Co. Rocky Mtn. Forest and Experiment Station, Forest Service, 91-95.

Schiechtl, H. 1980. *Bioengineering for Land Reclamation and Conservation.* University of Alberta Press.

CHANNEL CHANGES IN THE MERCED RIVER, YOSEMITE VALLEY

Danny Hagans, Mary Ann Madej, and William Weaver*[1]

Streambank erosion on the Merced River is a serious problem threatening riparian vegetation, aquatic resources, channel stability and human developments. Channel changes, with an emphasis on channel widening, were quantified in two study reaches in the Merced River, one in the most heavily developed area between Happy Isles and Sentinel Bridges, and the second with relatively little human impact near El Capitan Meadow. A comparison of 1988-1989 surveys with a 1919 topographic map showed the channel width increased 25 to 110 percent in most areas. The following potential causes of channel widening were investigated, but eliminated: upstream land use alterations, changes in rain and snowfall patterns, water and sediment discharge trends, and changes in channel bed elevation. Human trampling and the resulting destruction of riparian vegetation are the overriding causes of bank erosion in the upper reach. Human modifications in the form of riprap, groins, bridge constrictions, and the removal of large woody debris have caused further problems.

Thursday, October 18, 3:30 pm

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ENCROACHMENT OF WOODY RIPARIAN VEGETATION ONTO THE PLATTE RIVER CHANNEL IN NEBRASKA

Michael Duever[1]

During the mid 1800s, the Platte River in Nebraska was a broad shallow prairie river with only small areas of woody vegetation confined primarily to islands in the river and wide expanses of wet meadows along its banks. Since then the river channel width has been reduced by 60 to 90 percent, and extensive riparian forests have colonized the islands and banks along the active river channel. A variety of explanations have been proposed for this massive expansion of woody vegetation, including elimination of: 1) grazing by buffalo and other large herbivores, 2) prairie fires, 3) wood-cutting, 4) late summer droughts because of increased irrigation return flows, and 5) high-scouring flows during the normal late-spring period of woody vegetation seed germination. Higher nutrient loads and greater seed availability may have further increased the rate of establishment of woody vegetation. Efforts are underway to minimize further encroachment and to restore the broad open prairie character of portions of the river.

Thursday, October 18, 3:30 pm

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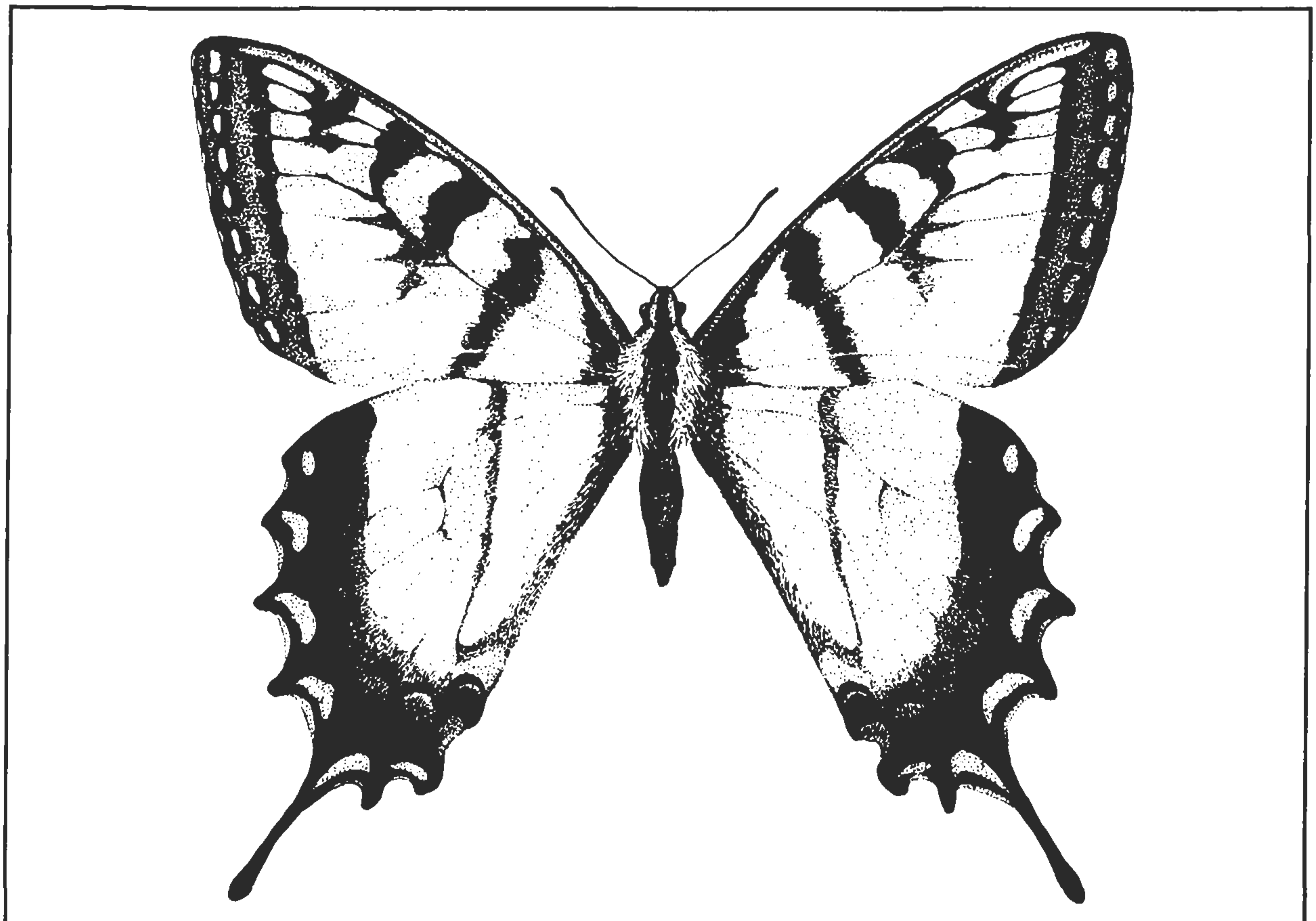
1. Michael Duever, National Audubon Society, Naples, FL.

BIODIVERSITY



Tiger Swallowtail, *Papilio glaucus*
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POPULATION VIABILITY ANALYSIS AND THE DESIGN OF NATURAL AREAS

POPULATION VIABILITY THEORY AND ITS UTILITY IN THE DESIGN OF NATURE RESERVES: AN OVERVIEW

Peggy L. Fiedler[1]

Abstract

Population viability theory is reviewed to provide background into its potential and general applicability for determining the longevity of populations of sensitive plant and animal species. In addition, population viability theory is placed in the context of our current knowledge of nature preserve design to suggest several areas for the integration of population viability analysis and nature preserve design.

INTRODUCTION

The science of conservation in the United States has a distinguished history, as evidenced by the Natural Area Association's joint meeting with Yosemite National Park's Centennial Celebration in 1990. Of course, concern for the conservation and preservation of our nation's resources dates back scores before the dedication of Yosemite on October 1, 1890, as one of the nation's first national parks.

However, what makes conservation science so exciting now, a century later, is the infusion into the discipline of the study of the biology of small populations. The concern for understanding the life history, genetics, and demography of small populations of rare or captive species has rejuvenated the science and has brought a new cadre of biologists into the fold. One of their most significant contributions has been to codify the concept of **minimum viable population** (MVP), a minimum population size limit first mandated by the National Forest Management Act (NFMA) of 1976 (16 U.S.C. §1600 *et seq.*) and its implementing regulations (36 C.F.R. §219). The NFMA requires that ". . . fish and wildlife habitat shall be managed to maintain minimum viable populations of existing native and desired nonnative vertebrate species in the planning area." The immediate question for research biologists and natural area managers alike, of course, is what constitutes a "minimum viable population?" Following this, we must ask, "how do we manage for minimum viable populations?"

WHAT CONSTITUTES A MINIMUM VIABLE POPULATION?

In 1981, Mark Shaffer offered the following as a definition of a minimum viable population:

> A minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite foreseeable effects of demographic, environmental, and genetic stochasticity and natural catastrophes" (Shaffer 1981:132).

Estimates of population viability subsequently have been revised downward to a 95-percent chance of survival over several centuries (Soulé 1987), although as many authors recognize, in reality there are no magic numbers (Soulé 1987; Simberloff 1988).

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Shaffer offered four limits to population viability: 1) demographic uncertainty, 2) environmental uncertainty, 3) natural catastrophes, and 4) genetic uncertainty. **Demographic stochasticity** is defined as chance reproductive failures among individuals within a population. These failures, in turn, are determined by a) the resilience of the population, b) individual fitness, and c) the species adaptability, i.e., the species ability to maintain enough genetic diversity to adjust to changes as a result of pressures by natural selection. **Environmental stochasticity** occurs as a result of random or unpredictable changes in food supply, the weather conditions, populations of predators, parasites, etc. **Natural catastrophes** are random catastrophic events, such as floods, fires, droughts, and earthquakes. The oft-cited demise of the heath hen is, of course, our most sobering example of extinction due to the proximate causes of both environmental stochasticity and natural catastrophes (see Simberloff 1986). Finally, **genetic uncertainty** is a fourth limit to population viability and is considered to be random changes in the genetic make-up of a population due to founder effects, genetic drift, or inbreeding. All result in the altered survival and reproduction of the individuals. Although these four stochastic limits are more intrinsically interesting than the systemic type of limiting factor, such as hunting, they are infinitely more intractable (Shaffer 1981).

POPULATION VIABILITY ANALYSIS

Getting back to the first question of what constitutes a viable population, a technique was developed to analyze the environmental, autecological, and demographic factors influencing small populations. This technique is called "Population Viability Analysis." The history of Population Viability Analysis (PVA) is remarkably recent and dates from the earliest efforts to describe the demographic and environmental stochasticities affecting such charismatic creatures as the grizzly bear (*Ursus arctos*) (Shaffer 1978, 1983), desert bighorn sheep (*Ovis canadensis mexicana*) (Watts and Conley 1981), the northern spotted owl (*Strix occidentalis caurina*) (Marcot and Holthausen 1987; Gilpin personal communication), the red-cockaded woodpecker (U.S. Fish and Wildlife Service 1985), and the black-footed ferret (*Mustela nigripes*) (Seal et al. 1989). But PVA is a technique first put forth formally in 1986 by Michael Gilpin and Michael Soulé, two luminaries in this new subdiscipline of conservation biology (Gilpin and Soulé 1986).

As originally conceived, PVA examined not the four stochasticities as explicitly delimited by Shaffer (1981, 1986), but a similar web of interacting factors: **population phenotype, environmental quantity and quality**, and the **population structure and fitness** (Gilpin and Soulé 1986). Factors shaping the population phenotype include the size, shape, and patterns of morphological variation, physiological constraints, the intra- and interspecific behavior (if appropriate), and the behavioral components of dispersal, migration, and habitat selection. The environmental component of PVA circumscribes the overall quantity of habitat available to individuals of the population as well as the habitat quality as determined, in general, by resource abundance and the patterns of habitat disturbance. Finally, the population structure and fitness component of PVA involves life history parameters such as age and/or size structure, sex ratio, population growth rates (r), variance of r, etc. Also of importance to this final component are the metapopulation structure and degree of fragmentation of the population.

What happens to a population when a major shock, be it genetic, environmental, demographic, or catastrophic, strikes, is that the population responds with reduced growth and increased fragmentation, and perhaps succumbs to immediate extinction. Or, the population will devolve to feedback loops involving fragmentation and demographic fluctuations, inbreeding, and loss of adaptability. These may interact to exacerbate the problems of population survival. The population likely flounders, and indirectly, these events have resulted in population or species extinction.

The overall process of PVA is that of quantifying or at least estimating the probability of the feedback processes that lead to one of four extinction vortices (Gilpin and Soulé 1986). These vortices have been identified as the **R** vortex (increased variance in the population growth rates, resulting in population vulnerability to other disturbances), the **D** vortex (fragmentation), **F** vortex (decreased N_e, resulting in inbreeding depression and loss of heterozygosity, thus leading to decreased fitness), and the **A** vortex (consequences of drift and loss of genetic variance resulting in the disruption of stabilizing selection) (Gilpin and Soulé 1986). Thus the ultimate goal of PVA is to establish a minimum viable population that will reduce the risk of extinction by any means to an acceptable level.

But because PVA is a recent and still emerging algorithm for the analysis of interacting factors that put a population or species at risk of extinction, and because the theoretical complexities of the interacting facts inhibit the development of a reliable model (Grumbine 1990), PVA does not have a universally accepted method of analysis. There have been very few population viability analyses performed to date (but see Murphy et al. 1990), and certainly plants present somewhat different considerations than animals, as so elegantly demonstrated by Menges (1990).

PRINCIPLES OF PRESERVE DESIGN

Gilpin (1987) has pointed out that spatial structure of populations plays a "ubiquitous" role in the dynamics of the PVA feedback loops. This is clearly true, as evidenced by the patchy distribution of the black-footed ferret's restriction to prairie dog (*Cynomys leucurus*) towns or the spotted owl's restriction to forest patches of old growth Douglas-fir (*Pseudotsuga menziesii*) in the Pacific Northwest. The grizzly bear, too, shows distribution isolates in the Cabinet-Yaak region of Idaho and in the Yellowstone ecosystem, away from the main population within the Glacier ecosystem in the United States and Canada.

Gilpin also stated that many preserve design principles as developed by Diamond, May, Wilcove and his colleagues, among others (Diamond 1975, 1986; Diamond and May 1976; Wilcove et al. 1986) are general geometric configurations that provide universal guidelines in the consideration of absolute area, edges, and corridors for maintaining minimum viable populations. Diamond has also developed a simple list of biological considerations relevant to the design of a reserve system. The identification of the most probable causes of extinction is far and away the most relevant to population vulnerability analysis, yet it is most intractable of all.

However, rarely do we have the opportunity to design preserves and other natural areas in the temperate zone, particularly in areas where the vast majority of land is in private ownership, such as the eastern United States. The most obvious exception may be the development of research natural areas and wilderness areas within the national forest system, and it is with great expectations that these areas be designed properly, as discussed below.

For the purpose of this discussion, let us review just one aspect of parks and preserves design, and that is size. In a recent compelling article on the federal land management system, Grumbine argues that studies by Schonewald-Cox (1983), Newmark (1985), and Salwasser et al. (1987) demonstrate that, based on absolute area alone, current U.S. reserves are sadly inadequate to protect most large vertebrate species. Given an MVP of 500, a figure agreed upon only as the right order of magnitude, even the largest federal reserve is six times too small (Grumbine 1990). In fact, the conservation community has become resigned to the fact that most MVPs for large mammals and sensitive species will be so large that it will not be possible to maintain minimum viable populations within existing parks and preserves (Shaffer 1987). We must assume that concern for many smaller vertebrates, invertebrates, and plants echoes similar grim possibilities.

What makes the situation even more bleak is the degree of habitat fragmentation that exists within existing parks and preserves. The most obvious example is the extensive public road system that greatly dissects U.S. parks and national monuments (Schonewald-Cox and Buechner in press). Also, the seemingly endless miles of logging roads built by the U.S. Forest Service within our national forests are unacceptable at best when viewed in the context of multiple use. Again, Grumbine (1990) suggests that, based on generalized predictive results of population viability analysis and studies of wildlife based on reserve size alone, most of our natural areas will, in the long term, be incapable of supporting minimum viable populations of large vertebrates. Such conclusions have sobering implications for most of our society that does not understand that our natural areas at present do not *de facto* protect many of the species found within (Grumbine 1990). The glimmer of hope in all of this is the move to adopt an ecosystem approach, or perhaps a landscape level approach to natural areas management. Thus we have come to the second question, i.e., how do we manage for minimum viable populations?

HOW DO WE MANAGE FOR MINIMUM VIABLE POPULATIONS?

Ecosystem approaches to preservation require a number of difficult and sometimes delicate arrangements in order for them to work. These include:

1) a change in point of view, from freeze-frame containment to dynamic, process-oriented management;
2) federal, state, and local policy changes that provide buffer zones for the most critical of natural areas;
3) compromise of jurisdictional conflicts among private, state, and federal organizations;
4) legislation for an Endangered Ecosystem Act (Hunt 1989; Grumbine 1990);
5) restoration of degraded or abandoned areas that could serve as part of an ecosystem reserve;
6) the design of natural areas taking the present and future climatic change into account; and finally,
7) the design not of new nature reserves per se, but the design of corridors and connectors that would double or treble the area, increase habitat diversity, decrease the probability of environmental, genetic and demographic stochasticities, and increase population sizes.

It is in the design of natural areas that takes global climate change into account (#6) and the connecting and networking of current natural areas (#7) that the two, PVA and reserve design will intersect. Setting aside new nature reserves for a long-term goal (e.g., [future] habitat preservation) not immediately realizable is a controversial idea, especially in the western United States with private property, and individual and states rights an inviolate tradition. It is possible, however, that we will see an enlightened populace in the near future as the data on increased global warming and sea level rising accumulate. To this end, we must work toward the education of our nation so that our citizenry becomes both sympathetic and active in the analysis of population viability and the design of natural areas.

The notion of corridors has been around from sometime, but remains a controversial topic because of the conflicting views on the spread of, for example, disease, predators and weeds within a corridor systems (Simberloff and Cox 1987). However, efforts to save the Florida panther (*Felis concolor coryei*) for example, by connecting existing habitat to the north and south of the Ocala National Forest are dependent on establishing such a corridor system (see Maehr 1990; Harris and Silva-Lopez in press). This is a special case, however, and some may question the enormous amount of funding and publicity surrounding the saving of this species from extinction. But the fanfare does not negate that landscape connectivity might save the Florida panther from extinction and might save others in similar situations as well.

CONCLUSIONS

What should one remember from this discussion? Population viability analysis is an exhaustive technique for identifying the potential causes of extinction of species of special concern, and it is gaining a following among conservation biologists and wildlife managers to assist in immediate management decisions. However, PVA must be grounded in extensive, long-term, incontrovertible data that document a species' habitat requirements and its population dynamics. A *complete* PVA is not possible for every threatened species, or perhaps for *any* species. But it is possible that PVA can be used in conjunction with the basics of preserve design to build a landscape-level system of natural areas, one that would increase the probability of persistence of the population of our threatened and endangered plants and animals for the future as well as for the present. Thus it is in the immediate adoption of a new scale of resource management in both time and space that we can hope for the long-term preservation of our native flora and fauna.

REFERENCES

Diamond, J.M. 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural reserves. *Biological Conservation* 7:129-146.

_______. 1986. The design of a nature reserve system for Indonesian New Guinea. In *Conservation Biology: The Science of Scarcity and Diversity*, ed. M. Soulé, pp. 485-503. Sunderland, MA: Sinauer.

Diamond, J.M., and R.M. May, 1976. Island biogeography and the design of natural reserves. In *Theoretical Ecology: Principles and Applications*, ed. R.M. May, pp. 163-186. Philadelphia: W.B. Saunders.

Gilpin, M.E. 1987. Metapopulation structure and population vulnerability. In *Viable Populations for Conservation*, ed. M. Soulé, pp. 125-139. Cambridge: Cambridge University Press.

Gilpin, M.E. and M.E. Soulé, 1986. Minimum viable populations: processes of species extinction. *Conservation biology: The science of scarcity and diversity*, ed. M. Soulé, pp. 19-34. Sunderland, MA: Sinauer.

Grumbine, R.E. 1990. Viable populations, reserve size, and federal lands management: A critique. *Journal of Conservation Biology* 4:127-134.

Harris, L.D., and G.Silva-Lopez. In press. Forest fragmentation and the conservation of biological diversity. In *Conservation Biology: The Theory and Practice of Nature Conservation, Preservation and Management*, eds. P.L. Fiedler and Jain, S.K. New York: Chapman and Hall.

Hunt, C.E. 1989. Creating an endangered ecosystem act. *Endangered Species UPDATE* 6:1-5.

Maehr, D.S. 1990. The florida panther and private lands. *Journal of Conservation Biology* 4(2):167-170.

Marcot, B.G., and R. Holthausen. 1987. Analyzing population viability of the Spotted Owl in the Pacific Northwest. *Transactions of the North American Wildlife and Natural Resources Conference* 52:333-347.

Menges, E.S. 1990. Population viability analysis for an endangered plant. *Journal of Conservation Biology* 4(1):52-62.

Murphy, D.D., K.E. Freas, and S.B. Weiss. 1990. An environment-metapopulation approach to population viability analysis for a threatened invertebrate. *Journal of Conservation Biology* 4(1):41-51.

Newmark, W.D. 1985. Legal and biotic boundaries of western North American national parks: a problem of congruence. *Biological Conservation* 33:197-208.

Salwasser, H., C.M. Schonewald-Cox, and R. Baker. 1987. The role of interagency cooperation in managing for viable populations. In *Viable Populations for Conservation*, ed. M. Soulé, pp. 147-173. Cambridge: Cambridge University Press.

Schonewald-Cox, C.M. 1983. Conclusions: guidelines to management: a beginning attempt. *Genetics and Conservation: A Reference for Managing Wild Plant and Animal Populations*, eds. Schonewald-Cox, C.M., Chambers, S.M., MacBryde, B., and Thomas, W.L., pp. 141-145. Menlo Park: Benjamin-Cummings.

Schonewald-Cox, C.M., and M. Buechner. In press. Park protection and public roads. *Conservation Biology: The Theory and Management of Nature Conservation, Preservation and Management*, eds. P.L. Fiedler and Jain, S.K. New York: Chapman and Hall.

Seal, U.S., E.T. Thorne, M.A. Bogan, and S.H. Anderson. 1989. *Conservation Biology and the Black-Footed Ferret*. New Haven: Yale University Press.

Shaffer, M.L. 1978. Determining minimum viable population sizes: a case study of the grizzly bear (*Ursus arctos* L.). Ph.D. dissertation, Duke University, Durham, NC.

_______. 1981. Minimum population sizes for species conservation. *BioScience* 31:131-134.

_______. 1983. Determining minimum viable population sizes for the grizzly bear. *International Conference Bear Research and Management* 5:133-139.

_______. 1987. Minimum viable populations: coping with uncertainty. In *Viable Populations for Conservation*, ed. M. Soulé, pp. 69-86. Cambridge: Cambridge University Press.

Simberloff, D. 1986. The proximate causes of extinction. In *Patterns and Processes in the History of Life*, eds. Raup, D.M., and Jablonski, J., pp. 259-276. Berlin: Springer-Verlag.

Simberloff, D. 1988. The proximate causes of extinction. *Annual Review of Ecology and Systematics* 19:473-511.

_______., and J. Cox. Consequences and costs of conservation corridors. *Journal of Conservation Biology* 1(1):63-71.

Soulé, M. 1987. *Viable Populations for Conservation*. Cambridge: Cambridge University Press.

U.S. Fish and Wildlife Service. 1985. *Red-cockaded woodpecker recovery plan*. U.S. Fish and Wildlife Service, Atlanta, GA.

Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. In *Conservation Biology: The Science of Scarcity and Diversity*, ed. Soulé, M., pp. 237-256. Sunderland, MA: Sinauer.

Watts, T. and W. Conley. 1981. Extinction probabilities in a remnant population of *Ovis canadensis mexicana*. *Acta Theriologia* 26:393-405.

CONSIDERATIONS IN THE VIABILITY ASSESSMENT OF RARE PLANT POPULATIONS

Eric S. Menges[1]

Population viability analysis is used to predict extinction probabilities for populations and metapopulations and to understand factors threatening populations. Assessments of population viability for plants are just beginning and may require different approaches than have been used for animals. Several traits found in plants will affect population viability and its measurement. Environmental stochasticity may be buffered by phenotypic plasticity in growth and life history, utilization of alternate microsites, and adaptations to disturbance. Plant species are often subdivided with metapopulation structure, which may buffer environmental variation while increasing genetic erosion within populations. Because plants have life histories incorporating selfing and because they often exist in small genetic neighborhoods with histories of inbreeding, inbreeding depression may not be a great threat to viability of wild populations. Both general models and empirical studies of plants suggest minimum viable population sizes necessary to counter environmental stochasticity (often 10-10) will be more than adequate to safeguard *in situ* populations from genetic stochasticity.

Wednesday, October 17, 1:30 pm

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PROTECTION OF NATURAL RESOURCES, ECONOMY AND CULTURE: RESOLVING CONFLICTS

Christine Schonewald-Cox, M. Buechner, R. Sauvajot, B. Wilcox

We have reviewed the literature offering numerous strategies as tools for the resolution of conflicts between parks and surrounding lands. Our focus is on strategies that are potentially useful for U.S. national parks. Our review emphasizes literature concerning park design and management published between 1980 and 1990 and consists of over 75 sources (books, reports, and articles).

In describing our results, we begin with a brief historical perspective, and then review suggested strategies for conflict resolution and obstacles to strategy implementation obtained from our published sources. We compare these results to our observations derived from interviews and conclude by making some recommendations on how conflict management can be improved systemwide.

Wednesday, October 17, 1:30 pm

CONSERVATION OF BIOLOGICAL DIVERSITY ON PUBLIC LANDS

NATIONAL CONSERVATION AREAS: A NEW APPROACH FROM THE BUREAU OF LAND MANAGEMENT[1]

James Colby, Gwen Goodman, and David Williams[2]

Abstract

Congress has designated seven[3] National Conservation Areas (NCA) on lands managed by the Bureau of Land Management (BLM): California Desert, King Range (CA), Steese (AK), El Malpais (NM), San Pedro Riparian (AZ), Red Rocks (NV), and Gila Box (AZ), for the protection of biological and other resources within a multiple use mandate. Except for the 12.5 million acre desert, NCAs range in size from 20,000 to 1.2 million acres. They may contain areas of critical environmental concern, wilderness, and wild/scenic rivers. Congress establishes the management emphasis for each NCA, such as protection of a riparian zone in the San Pedro, and requires more detailed planning by BLM. No disposal of lands is allowed. The concept is working so well that BLM is proposing that Congress consider several additional NCAs, many of them with large wilderness at their core.

The purpose of this paper is to explore the potentials for NCAs to protect biological values on a larger scale and with more permanence than existing management tools.[4]

INTRODUCTION

Across the arid desert lands of Arizona, the San Pedro River flows year-round providing precious streamside sanctuary for wildlife. In Alaska, the historic Fortymile caribou herd calves along the Birch Creek National Wild River. Majestic California redwoods reach down to sandy dunes and rugged coastline along the great expanse of the Pacific.

These important natural areas are located on lands managed by the BLM as NCAs. They are among the seven NCAs established by federal statute (see table 1). An NCA is an area of the public lands statutorily protected to conserve resources of outstanding or exceptional national value. National Conservation Areas are managed under a philosophy of resource conservation along with carefully planned compatible uses.

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1. This paper presents the views of the authors only. It is not an official representation of the position of the U.S. Bureau of Land Management.

2. James Colby–U.S. Bureau of Land Management
Gwen Goodman–Planning and Environmental Analyst, Cooperative Education student at the University of Pennsylvania receiving masters in government administration in May 1991
David Williams–Chief, Division of Planning and Environmental Coordination, U.S. Bureau of Land Management

3. At the time this paper was delivered on October 17, 1990, there were five existing NCAs. Two additional areas were designated during the final days of the congressional session.

4. Readers of this paper may well make important contributions to future development and use of the NCA concept. Feedback and comments on this paper are welcome. They may be sent to the authors at the BLM (760) in Washington, DC 20240.

Table 1. Existing National Conservation Areas

Name	State	Acres	Public Law	Year
King Range	California	60,000	91-476	1970
California Desert	California	12,500,000	94-579	1976
Steese	Alaska	1,220,000	96-487	1980
El Malpais	New Mexico	262,000	100-225	1987
San Pedro Riparian	Arizona	56,000	100-487	1988
Red Rock Canyon	Nevada	62,000	101-621	1990
Gila Box Riparian	Arizona	20,000	101-628	1990

The resource values in these NCAs that have been designated by Congress are diverse, as are the management guidelines. An overview of the protected resources and management prescriptions for each NCA is shown in table 2.

The objectives of this paper are to introduce the reader to the NCAs and to explain how they may relate to the protection of natural area values and biodiversity.

THE BUREAU OF LAND MANAGEMENT

The BLM was created in 1946 through the merger of the General Land Office and the Grazing Service. The General Land Office's mission had been the disposal and sale of public domain lands. These lands were an important resource of the federal government. National parks, wildlife refuges, homesteads, national forests, railroad grants, Indian reservations all came from the public domain. This land helped to finance early military operations as well as to foster and shape the development of the United States.

Over 1.8 billion acres were sold, given away or transferred. What remained were the most hostile, most undevelopable lands—lands that have been referred to as the lands that no one wanted.

More than 3,000 species of plants, trees, fish, birds, and wildlife make their home on the 272 million acres of public lands currently managed by the BLM. Some studies have documented a greater diversity of biological representation on these lands than exists in the national forest system or the national park system. These lands are primarily located in Alaska and the western states of Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming.

There is also a great diversity of uses occurring on the public lands: the original grazing, mining and timber production, along with coal, oil and gas, power plants and pipelines. These lands also contain cultural sites (e.g., 250,000 Anasazi sites alone), native claims, wild horse and burro range, geothermal and wind machines, solar power, and ghost towns. A broad range of recreation activities takes place including camping, hiking, driving for pleasure, photography, hunting and fishing, mountain biking, off-highway vehicle use, river running, soaring, mountain climbing, and skiing.

Table 2. Comparison of Resource Values and Management Prescriptions of Existing NCAs

National Conservation Area/Location	Principal Resource Values Protected by Law and/or Plan	Selected Management Prescriptions in Law and/or Plan
California Desert Southern California	Historical, scenic, archeological, environmental, biological, cultural, scientific, educational, recreational, and economic.	Public lands placed into four classes: controlled (wilderness) limited, moderate and intensive use with appropriate management guidelines for each. See CDCA resource management plan for details.
El Malpais Western New Mexico	La Ventana Natural Arch, unique and nationally important geological, archeological, ecological, cultural, scenic, scientific, and wilderness resources surrounding the Grants Lava Flow.	· Cebolla Wilderness, 60,000 acres & West Malpais Wilderness, 38,210 acres added to National Wilderness Preservation System. · Grazing permitted. · Withdrawn from mining. · Hunting and trapping permitted.
Gila Box Riparian Southern Arizona	Riparian, aquatic, wildlife, archeological, paleontological, scientific, cultural, recreational, educational, and scenic.	· Restricts motorized vehicles to designated roads. · Withdrawn from mining. · Reserves water for NCA. · No buffer zones.
King Range Northern California	Beach, forests, scenic values.	· Divides NCA into seven zones with dominant and compatible uses established for each.
Red Rock Canyon Southern Nevada	Geological, archeological, cultural, scenic, scientific, and recreational resources of Red Rock Canyon.	· Withdrawn from mining. · Reserves water for NCA. · 46,500 acres in wilderness study area.
San Pedro Riparian SE Arizona	Riparian area and the aquatic, wildlife, archeological, paleontological, scientific, cultural, educational, and recreational resources of the San Pedro River.	· ORV limited to designated roads. · Gravel extraction in the riparian area prohibited.
Steese Central Alaska	Caribou range and Birch Creek National Wild River.	· Mineral development allowed to proceed in environmentally sound manner. Some areas such as caribou calving ground and Dall Sheep habitat withdrawn from mining. · ORV allowed subject to restrictions and monitoring.

THE FEDERAL LAND POLICY AND MANAGEMENT ACT PROVIDES A MANDATE

For 30 years the BLM managed the public lands under a confusing, sometimes conflicting, maze of laws. With the passage of the Federal Land Policy and Management Act (FLPMA) in 1976, Congress resolved the confusion and provided the BLM with a charter for managing the public lands. The BLM is to:

- Retain the public lands.
- Manage the lands in the national public interest in accordance with the principles of multiple use and sustained yield.
- Prepare land use plans for the use and protection of the lands and resources and manage them in accordance with those plans.

Under the FLPMA, all BLM planning and management is to be for the long-term needs of future generations. The BLM is to "protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resources and archeological values" and, where appropriate, "preserve and protect certain public lands in their natural condition" and "provide food and habitat for fish and wildlife and domestic animals."

BLM'S ACTIONS TO PROTECT NATURAL SYSTEMS AND PROCESSES

In the spirit of the FLPMA, the BLM is engaged in a number of efforts to protect natural systems and processes. Major (but not the only) undertakings that protect natural systems/values include:

- The BLM is now submitting wilderness proposals to Congress on more than 25 million acres of lands which have been intensively studied over the past 15 years. These proposals are being acted upon. The Arizona Wilderness Act (P.L. 101-628) establishing 1.3 million acres of wilderness was signed by the president on November 28, 1990.
- The BLM is involved in substantial activity enforcing the Endangered Species Act. Recovery actions are being implemented for 152 species listed as endangered or threatened that occur on BLM-managed lands. Notable examples include the desert tortoise (*Gopherus agassizii*) in the American Southwest, the American peregrine falcon (*Falco peregrinus anatum*), the loach minnow (*Tiaroga cobitis*), and the spikedace fish (*Meda fulgida*).
- In recent years, the BLM has designated more than 430 areas of critical environmental concern (ACECs) on 6.6 million acres of lands. In each case, special management measures have been adopted to protect important and relevant resource values, including natural systems.[5]

But these are not enough. The need to do more is readily apparent. The above efforts generally focus on individual species. The protection of entire ecosystems is a growing concern. The BLM manages public lands which include significant ecoregions such as the Columbia Basin, Great Basin, and the Wyoming Plateau that are not yet well represented in natural area systems.

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5. For more information on ACECs, see "How the Bureau of Land Management Designates and Protects Areas of Critical Environmental Concern: A Status Report, with a Critical Review by the Natural Resources Defense Council" by David Williams and Faith Campbell published in the *Natural Areas Journal*, v.8, n.4, 1988.

AN OPPORTUNITY – NATIONAL CONSERVATION AREAS

One way to protect such ecosystems is to make use of the NCA concept. There is no overall law or regulation governing the designation and management of NCAs. The seven existing NCAs were the result of separate statutory actions by the Congress between 1970 and 1990, and appear to be based on a variety of motivations. Some were included as a section of more comprehensive legislation. Examples include the California Desert NCA in the FLPMA, the Steese NCA created in the 1980 Alaska National Interest Lands Conservation Act, and the Gila Box NCA, which was a provision of the 1990 Arizona Wilderness Act. Others were established by single-purpose statutes. Examples of these are the King Range and the San Pedro acts. Some were proposed by the BLM. Although characterized by an apparent *ad hoc* history, the seven NCAs share common features that collectively suggest their potential for preserving natural areas and values and fostering the conservation of biological diversity.

- The public purpose of establishing NCAs is to conserve resources.
- The legislative establishment of NCAs assures that resources will be permanently protected.
- All existing NCA statutes direct the BLM to prepare a plan for the protection and management of each NCA.
- Generally, the appropriate management of an NCA is determined by the BLM using resource management planning procedures, including analysis of alternatives, public participation, and intergovernmental coordination.
- The area of an NCA can be large enough to conserve a diversity of values – to cover an entire ecosystem.
- The NCA designation serves to give identity, definition, and focus to the area due to its status as an area of important national interest for conservation purposes.
- Each NCA is unique but all have special management prescriptions governing the appropriate compatible uses.
- The designation process has required the cooperation and partnership of affected groups, local communities, and the public.

These features provide guidance for the establishment of future NCAs. It is interesting to note that Congress explicitly recognized the ecosystem concept in establishing the California Desert Conservation Area as a "total ecosystem that is extremely fragile, easily scarred and slowly healed." The protection of riparian areas, noted for their biological diversity, has been the public purpose behind the establishment of two of the most recent NCAs: the San Pedro Riparian NCA and the Gila Box NCA.

RELATIONSHIP OF NCAs TO OTHER DESIGNATIONS

Statutory designations applied to public land administered by the BLM include wilderness, trails, wild and scenic rivers, national recreation areas, national scenic areas, and national conservation areas. Understanding the relationship of an NCA to other federal land designations is helpful in appreciating the NCA concept.

ACECs are designated by BLM managers during resource management planning. Since 1976, the use of ACECs has become well established—more than 430 ACECs covering 6.6 million acres have been designated. ACECs are managed under multiple use principles to protect or conserve a wide variety of resource values. Research natural areas and outstanding natural areas are incorporated under the ACEC umbrella. An NCA may have several ACECs located within its boundaries; for example, the San Pedro Riparian NCA has three ACECs.

National Conservation Areas are not and should not become a surrogate for wilderness. A wilderness area, or wilderness study area, may be included as part of an NCA when the wilderness values are of national significance. For example, in the El Malpais NCA, 98,000 acres out of 263,000 are designated and managed as wilderness. (In fact, this example illustrates one way to provide special management attention to areas surrounding a wilderness while allowing compatible uses.)

While National Scenic Areas (NSAs), National Recreation Areas (NRAs) and NCAs each designate an area of national significance, there are important differences among the three. The NSAs are managed primarily to protect scenic values, and NRAs for recreation values, most often urban- or water-based. An NCA can be thought of as a broader conservation umbrella protecting resource values of national importance that may vary depending on the specific area under designation. National scenic areas have been designated (by the secretary of the interior) in the California Desert Conservation Area.

The NCAs are nationally significant multiple use areas. But they are not the only, or necessarily the most important, nationally significant areas on the public lands. BLM will continue to propose wilderness, wild and scenic rivers, and national recreation areas for Congress to designate, and itself designate ACECs and NSAs.

THE FUTURE OF NCAs

The NCA concept appears to have a promising future. The establishment of El Malpais NCA in 1987 and San Pedro NCA in 1988 revived the concept of the NCA as a pragmatic means to conserve public land areas with natural resources of national interest. Congress and agency officials began to see more clearly the benefits of this unique designation and its compatibility with agency missions and management systems. With growing public interest in and support for more careful conservation of important public natural resources, the need for statutory designations such as NCA made sound political sense.

By 1989, top management officials in the BLM were hearing with increased frequency discussion of potential new NCAs. In the 1989-1990 congressional session, six proposals for NCAs were introduced. In the waning hours of the session, Congress enacted legislation to establish two new NCAs. Red Rock Canyon NCA in southern Nevada will protect the magnificent scenic and recreational lands of the Red Rock Canyon only minutes from Las Vegas. As part of the Arizona wilderness legislation, the Gila Box NCA was established to conserve and enhance the riparian area of the Gila River.

While seven NCAs have been designated by Congress, at the present time there is no policy, standards, or guidance on the identification, evaluation, and designation of NCAs. Unlike the National Park Service, which has standard guidelines for establishment of National Parks, designation of NCAs has proceeded on an *ad hoc* basis. Some proposals have been developed in concert with BLM field and Washington staff. Others may emerge at the initiative of a member of Congress.

Future NCA proposals need to be assessed to assure they fulfill a national interest and are appropriate. And existing NCAs need to be carefully monitored to ensure they are meeting their objectives.

With seven NCAs and the potential of more, two important questions are raised:

1. Is a national system of NCAs desirable?

2. What standards and criteria should guide the establishment of future NCAs?

The answers to these questions are presently being discussed both within the BLM and outside the agency.

SUMMARY

A critical examination of the seven existing NCAs provides substantial evidence to conclude that a new system of national interest natural areas has been established. The precedents presented by these examples present a powerful model for future NCAs. Certainly it is likely that additional NCAs will be established. BLM-managed lands will always be a mosaic of resources, uses, values, and designations.

THE FOREST SERVICE RESEARCH NATURAL AREA PROGRAM IN CALIFORNIA: GOALS AND STUMBLING BLOCKS

Todd Keeler-Wolf[1]

Abstract

The Forest Service Research Natural Area Program in California has the potential of preserving a large sample of the remaining natural biological diversity in the state. About 42 percent of all communities known from the state occur on Forest Service land. RNAs are chosen based on target element (community) representation in each physiographic province of the state. Currently about 90 candidate and established RNAs exist with about 75 percent of the elements represented on at least one RNA. The ultimate goal of the system is to fully represent all communities on Forest Service lands in each of the physiographic provinces in which they occur. RNAs serve as important rare plant and animal habitat with 10 percent of California Native Plant Society listed taxa represented, 15 percent of the threatened and endangered animals, and 25 percent of the animals of special concern listed by the State Department of Fish and Game known from RNAs.

Despite the great diversity represented on the series of candidate and established RNAs there is much work yet to be done to insure the goals of the program. Slow rates of establishment hampered by lethargic bureaucracies and a lack of prioritizing and identifying needs in the program, have largely been rectified by recent innovations and renewed enthusiasm from within and outside the Forest Service. A lack of publicity for the program has hurt its image and dissuaded use, but recent positive steps have been taken. Progress is just now being made in the many and varied issues of management and monitoring of these areas.

INTRODUCTION

The Forest Service Research Natural Area (RNA) system encompasses the only program specifically designated for the maintenance of biological diversity on Forest Service lands in California. To quote from the Forest Service manual:

"The primary objective of RNAs is to preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geological, and similar natural situations that have special or unique characteristics of scientific interest and importance that, in combination form a national network of ecological areas for research, education, and maintenance of biological diversity (FSM 4063.02)."

Although the concept of the RNA has not changed appreciably since its beginnings about 60 years ago, the value of these areas has greatly increased. As the alteration of natural communities during these recent decades has proceeded at unprecedented rates, RNAs represent rare examples of pristine habitat, repositories of rare and endangered species, gene reservoirs of economically valuable timber species, as well as many other natural values now in short supply.

The Forest Service in California (formally known as the Pacific Southwest Region, or PSW) is responsible for managing about one-fifth of the total area of the state or about 19,768,000 acres. These lands contain a large portion of California's remaining unaltered natural ecosystems.

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RNAs are required to be large enough to provide essentially unmodified conditions within their interiors. Generally, 300 acres is the minimum size. The average size of established and candidate RNAs in California is 1,140 acres (range: 70-6439). These cover about 102,000 acres or about 0.5 percent of the total Forest Service land in the state.

RNAs in the PSW are chosen through a gap analysis process whereby representatives of each community type existing on Forest Service land in each of the physiographic provinces of the state are selected. Therefore, widespread vegetation types should have at least one representative RNA in each province in which they occur. This multiple representation takes into account the natural variation with relation to climate, species composition, and population characteristics occurring within these wide-ranging types.

BODY

Representation of Diversity

California, with its large size and vast array of habitat types contains a great diversity of potential RNAs. About 42 percent (152) of all the terrestrial communities recognized in the state by the California Natural Diversity Data Base (California Department of Fish and Game 1986) occur on Forest Service land (U.S. Department of Agriculture Forest Service 1990a). Currently, the PSW recognizes 106 target elements with 80 of these (75 percent) represented in the approximately 90 established or recommended RNAs (U.S. Department of Agriculture Forest Service 1990b).

Another important value of the Forest Service RNAs is as a reserve for rare, threatened, or endangered plant and animal habitat. About 10 percent of the 1,548 plant taxa considered rare, threatened, or of limited distribution by the California Native Plant Society (Smith and Berg 1988) are known from RNAs (U.S. Department of Agriculture Forest Service, in press). This number will undoubtedly increase when more of the areas are surveyed. Fifteen animal species currently considered threatened and endangered by the State Fish and Game (Steinhart 1990) and 40 species of special concern are known from California RNAs. About 53 of the 152 natural communities (34 percent) recognized by The Natural Diversity Data Base (California Department of Fish and Game 1986) known to occur on Forest Service land and are considered rare communities. This number constitutes about 42 percent of all the currently considered rare communities in the state.

Several RNAs have been selected to represent unique ecosystems or ecological situations which otherwise would not be included within the currently recognized list of target communities. These include limestone ecosystems with paleontological and archaeological values, habitats enriched with relict species, and soil-vegetation chronosequences resulting from periodic volcanic mudflows.

Difficulties and Conflicts

Despite the marvelous diversity apparent on the established or recommended RNAs, the RNA program has not been without its problems. Although the program has been in existence in California since 1931 (first RNA established in 1932), only 19 RNAs have been established, a rate of about 0.3 per year (table 1). This is in contrast to the over 90 candidate areas which have been selected as potential RNAs and in great contrast to the PSW (Oregon and Washington), which has established over 40 Forest Service RNAs in the same amount of time (U.S. Department of Agriculture, Forest Service 1986). A series of challenges have arisen for the program since its inception in 1931. Some of these have been met while others remain to be addressed. A review of the history of the Forest Service RNA system in California will help explain the languor of the program and point to future needs.

Prior to 1970 there was no regional RNA committee and there were few habitat classification schemes upon which to base selection of RNAs. Thus, there was no systematic analysis of what priorities should be set for RNA selection in the region and no definitive way to decide where they were needed and what they should represent. There was also no established method of determining the value of a potential RNA based on its biological and ecological characteristics.

Suggestions for RNA targets came from the chief forester's Washington office with little guidance regarding prioritizing and identification of potential sites. These suggestions were based on a broad view of forest cover types known from the state (e.g., Eyre 1980 and previous editions) with little attention paid to the intricate diversity of these and additional non-forest habitats. The four RNAs that were established before 1971 included a random assortment of habitats with little evidence of cohesive planning (see table 1).

Early Innovations

In the early 1970s an RNA committee was formed. Since this time, it has met regularly to specifically discuss the direction and establishment of priorities within the region. This committee was made up of research foresters, geneticists, silviculturists, administrators, and forest ecologists. It included several members from outside the Forest Service (University of California).[2] For a few years there was an employee working full-time on RNA-related issues and in 1971-1972 five RNAs were established.

In 1977 the committee formalized a set of goals for habitat representation based on Society of American Foresters (SAF, Eyre 1980) and other classification systems (U.S. Department of the Interior 1966; Munz and Keck 1959; Barbour and Major 1977) for California vegetation. The state was then divided into geomorphic provinces and, based on the distribution of the habitat types, target elements were set for each province. These targets were divided into major and minor types. The major types represented extensive and characteristic vegetation types for the region, while the minor types represented localized habitat types or single tree species. Major types included 20 forest, eight woodland, six scrub and chaparral, four grassland and meadow, and two marsh and bog elements. Minor types included 15 "special" elements (typically represented by tree species unique to the region). The system remained open-ended by the inclusion of a unique ecosystems category, which could be determined on a case-by-case basis.

The appropriate personnel on each national forest were advised of the target elements occurring within their area and were expected to nominate a series of potential RNAs. These nominees would be further reviewed by the committee, and if approved, would be surveyed by an ecologist contracted by the committee.

Ecological surveys began in 1975 as a means of evaluating each candidate area and as a method of obtaining baseline data for existing RNAs. The surveys are detailed reports describing the geology, soils, vegetation, and other natural values. They discuss rare plants and animals present, and include botanical and vertebrate lists. Between 1975 and the present, over 75 ecological surveys have been completed.

2. Recently, the RNA committee has added representatives from the California Native Plant Society, the State Department of Fish and Game Heritage Division, and The Nature Conservancy as "cooperators," while membership is about equally shared between the Pacific Southwest Research Station and the regional office.

Difficulties with Establishment

Despite the advances in the program in the 1970s only five more RNAs were established from 1975 to 1986. This was a time of greatly increased timber output throughout much of the state. Many timber producing forests were slow to select potential candidates. Some forests reneged on areas that were previously approved by the RNA committee as a result of timber-related conflicts. Financial and logistical support dwindled. In spite of efforts by some Forest Service personnel to establish certain areas, there was often little motivation by the district rangers and forest supervisors to follow through with establishment.

The completion and signature of an establishment record, the formal document used to officially designate the RNA and set forth management guidelines, is a slow and tedious process. These reports follow a detailed, prescribed format and often require considerable preparation effort and bureaucratic jockeying. Close tracking of these documents is often necessary, as approval and agreement is required from the Washington office, the regional forester, research station director, forest supervisor, and district ranger. Turnaround of the few established from 1975 to 1986 was usually on the order of several months.

In 1987 the California field office of The Nature Conservancy signed a cooperative agreement with the regional office of the Forest Service to assist in the preparation of a number of establishment records for RNAs. The Nature Conservancy (TNC) hired contractors to write draft and final reports, and have employees track their progress through the bureaucracy, thus lifting much of the financial and logistical responsibility from the Forest Service. The agreement has initiated the production of 26 establishment records in the past three years, with four new areas established, five areas only needing final approval from the Washington office and several others awaiting revision by the contractor. The momentum initiated by the TNC agreement was transferred to the RNA program, with the Forest Service producing nine establishment records of its own in less than six months in late 1989 and early 1990. All of these are in the final stages of establishment. Many of the remaining TNC establishment records are awaiting final forest land and resource management plans before they can be processed further.

Revised Target System and Gap Analysis

The recent rapidity of selection of RNAs for establishment has depleted the remaining series of originally proposed targets and candidate areas. This prompted the RNA committee to reconsider its existing target element classification and the gaps in the system. The original classification had been strongly based on Society of American Foresters forest cover types (Eyre 1980), which only include tree-dominated vegetation. Although a few additional targets had been added since 1977, a number of non-tree communities with substantial representation on Forest Service lands were not included within the original classification. With much new information available in the past decade on community classification and endangerment of habitats and/or species it became clear that the RNA target system needed revision.

A new gap analysis and target element classification system was performed recently (U.S. Department of Agriculture Forest Service 1990 a and b). This system is based on the most recent natural community classification system for the state (California Department of Fish and Game 1986) and designates a number of new non-forest habitat types as target elements (including 12 new terrestrial types and 39 riparian and aquatic targets). Currently, only 24 out of the 106 total elements (23 percent) are represented within each physiographic province from which they are known, and only 67 elements (63 percent) are represented in half or more of their physiographic provinces. Thus, this gap analysis will initiate a number of new RNA candidates. However, it also reevaluates the existing candidate and established RNAs and identifies multiple targets on the same RNA. These additional targets, depending on their extent and diversity of representation within an RNA, can potentially fill gaps without the need of selecting additional RNAs.

The new target system promotes the establishment of RNAs containing a broad range of the target and associated vegetation within a physically (not politically) defined area. This approach has advantages for ecosystem-wide studies, maintaining natural integrity, and hedging against future climatic change. The system remains open-ended, with provision for adding new elements as seen fit by the RNA committee.

Publicity

Once established, an RNA acts first and foremost as a nature reserve. That, in itself, is its greatest value. However, one of the deficiencies of the PSW RNA program is that the existence, purpose, and values of regional RNAs are not well known. This lack of publicity has hurt the program not only from the standpoint of lack of scientific use of these areas but also in its support and understanding both within and outside of the Forest Service. With just a few exceptions, scientific use of the California established and candidate RNAs has been virtually nonexistent. This is in contrast to the Pacific Northwest Region, which since 1972 has had a detailed account published for each of its RNAs (U.S. Department of Agriculture Forest Service 1972) and hundreds of additional projects and publications associated with their RNAs (U.S. Department of Agriculture Forest Service 1986).

In an effort to remedy this situation the RNA committee has recently begun a multi-faceted approach to publicizing the California RNA program. In the past year, a poster and brochure have been produced describing the system and a detailed summary of all the ecological surveys conducted on established and candidate RNAs will be published by the region this winter (U.S. Department of Agriculture Forest Service in press). Additional publicity includes several Forest Service and inter-agency conferences on RNAs within the state and funding student grants for research within RNAs. Other publicity measures are planned for the future.

Monitoring and Management

Perhaps the greatest issue yet to be addressed by the Forest Service RNA system regionally (as well as nationally), has to do with monitoring and management. RNAs are far from exempt for any past or ongoing impacts. Many of these are complex ecologically and politically. Management issues were, up until recently, considered part of the establishment record (ER). However, the procedure has changed. As the Forest Service takes a more active role in managing these lands for their natural values, it has become clear that the detail of the management implications for many RNAs goes beyond the considerations of an ER. From a logistical view, an increasing number of conflicts ensued as a result of management direction set forth in ERs that was not supported by the ranger districts, forest supervisors, or forest land and resource management plans. As a means of streamlining the establishment process, most specific management direction has been removed from ERs. Instead, following establishment, a separate management plan designed specifically for each RNA is to be written, addressing general and intrinsic issues.

Despite the clear need for these plans, to date none have been written. Typical questions raised during establishment of RNAs include:

1. How are we to deal with conflicting grazing use, which has in some cases been a permanent fixture for over 100 years?

2. What are we to do about lethal introduced diseases such as Port Orford-cedar root rot or white pine blister rust (already on sugar pine on several RNAs and spreading rapidly on whitebark pine, and western white pine in California)?
3. How do we determine when an area with fire-adapted vegetation should be burned with prescribed fire or conversely, how long do we wait for a natural fire to do the job?
4. During a major fire how do we insure that an RNA is treated naturally when surrounding lands are to have a policy of active suppression?
5. How do we best measure the long-term effects of such things as recreational use and climatic change upon the target vegetation of an RNA?
6. Who will be responsible for the regular monitoring of RNAs?

Help answering some of these questions can be obtained from work on Bureau of Land Management Areas of Critical Environmental Concern (Hastey 1987). Several of these ACECs have had successful management plans developed for sensitive plants and habitats. Also other national forests such as the Shawnee in Region Nine have developed successful management plans for their RNAs (Stritch, this Symposium). However, many PSW RNAs contain habitats never before managed for their natural values. A flexible policy of RNA management and monitoring will be needed due to highly variable situations unique to each area. Therefore, although certain criteria should be considered in each area's management plan, methodologies and focuses will undoubtedly differ for each area.

In an effort to get the management planning of RNAs off the ground, the RNA committee has recently begun to develop pilot management plans for the soon to be established Station Creek RNA on the El Dorado National Forest and the long-established Harvey Monroe Hall RNA on the Inyo National Forest. Station Creek is an area with blister-rust infected sugar pine and drought-stressed white fir. The Harvey Monroe Hall RNA has a long history of scientific use and due to its scenic nature, sustains heavy recreational use. Thus, a number of typical management questions for PSW RNAs will be addressed in these two prototypes. These plans are projected to be completed by March 1991.

CONCLUSIONS

Although the Forest Service RNA program in California has been slow to start, there is clear momentum in recent years to make up for lost time. The regional RNA committee is developing a comprehensive 10-year plan for establishing, managing, and promoting RNAs in the Pacific Southwest Region. In a recent letter to all regional foresters and research station directors, the chief forester has clearly stated his belief in the importance of the RNA program and his hope that all concerned give the program their full support. It appears that with this and similar positions taken by other important members of the Forest Service hierarchy, the path has been cleared for rapid and regular improvement of the program.

The relatively late start of this program in the PSW region has been detrimental to the preservation of prime examples of some habitats, particularly certain highly productive forest types. These include coast redwood, western hemlock, and related forests of the humid northwestern part of the state, as well as Pacific ponderosa pine, and sugar pine-white fir forests of the Sierra Nevada. However, unlike many other areas in the state, the comparatively low impact of western civilization on California Forest Service lands still affords many possibilities for the preservation of excellent examples of natural ecosystems.

ACKNOWLEDGMENTS

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REFERENCES

Barbour, M. G. and J. Major (eds.) 1977. *Terrestrial Vegetation of California.* New York: Wiley-Interscience.

Eyre, F. H. (ed.) 1980. *Forest Cover Types of the United States and Canada.* Washington D.C.: Society of American Foresters.

California Department of Fish and Game. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* R. Holland. Unpublished report Sacramento.

Hastey, E. 1987. *Conservation of Rare Plants on Public Lands in California.* In Elias, T. (ed.) Conservation and management of rare and endangered plants. Sacramento, CA: California Native Plant Society.

Munz, P.A. and D.D. Keck. 1959. California Plant Communities. In P.A. Munz. *A California Flora.* Berkeley and Los Angeles: University of California Press.

Smith, J. P. and K. Berg. 1988. *Inventory of Rare and Endangered Vascular Plants of California.* Fourth Edition. Sacramento, California: California Native Plant Society.

Steinhart, P. 1990. *California's Wild Heritage: Threatened and Endangered Animals in the Golden State.* Sierra Club Books in association with California Department of Fish and Game and the California Academy of Sciences.

U.S. Department of Agriculture, Forest Service. 1972. *Federal Research Natural Areas in Oregon and Washington: A Guidebook for Scientists and Educators.* Franklin, J., F. Hall, C. Dyrness, and C. Maser. Portland, Oregon: Pacific Northwest Forest and Range Experiment Station.

_______. 1986. *Research Natural Areas in Oregon and Washington: Past and Current Research and Related Literature.* Greene, S., T. Blinn, and J. Franklin. Pacific Northwest Research Station General Technical Report PNW-197.

_______. 1990a. *Gap Analysis and Revision of Research Natural Area Target Elements on Forest Service Lands, Pacific Southwest Region.* Wolf, T. Keeler. Unpublished report on file at Pacific Southwest Experiment Station, Berkeley, California.

_______. 1990b. *Refined Target System for the Region Five Research Natural Area Program.* Martin, A. Unpublished report available from Pacific Southwest Experiment Station, Berkeley, California.

_______. In press. *Ecological Surveys of Forest Service Research Natural Areas in California.* Keeler-Wolf, T. Pacific Southwest Experiment Station. General Technical Report.

U.S. Department of the Interior Geological Survey. 1966. *Potential Natural Vegetation.* Kuchler, A. W. Bulletin 1969. Washington, DC.

Table 1: Established Research Natural Areas in the Pacific Southwest Region, U.S. Forest Service

Name	National Forest	Establishment Date	Target Acreage	Vegetation
Backbone Creek	Sierra	3/71	430	*Carpenteria californica* (endemic chaparral shrub)
Blacks Mtn.	Lassen	2/76	521	Eastside ponderosa pine
Cahuilla Mtn.	San Bernardino	7/89	960	Coulter pine – California black oak
Cone Peak Gradient	Los Padres	7/87	2955	Coast live oak, mixed evergreen, chaparral, coast redwood
Cub Creek	Lassen	10/81	3922	Mixed conifer forest
Devil's Garden	Modoc	2/33	800	Western juniper
Fern Canyon	Angeles	7/72	1460	Chamise chaparral, canyon live oak
Frenzel Creek	Mendocino	1/71	935	Serpentine chaparral, Sargent cypress, McNab cypress
Hall Canyon	San Bernardino	3/90	735	Mixed conifer forest
Harvey Monroe Hall	Inyo	1/33	4000	Subalpine forest, meadow, fell-field
Indiana Summit	Inyo	6/32	1310	Jeffrey pine
Last Chance Meadow	Inyo	7/82	660	Foxtail pine
Moses Mtn.	Sequoia	2/90	960	Giant sequoia
Mud Lake	Plumas	7/89	335	Baker cypress
San Joaquin Experimental Range	Sierra	8/71	70	Blue oak-digger pine
Sentinel Meadow	Inyo	3/83	2041	Lodgepole and limber pine
Shasta Mudflow	Shasta-Trinity	10/71	3115	Pacific ponderosa pine, successional mudflow
White Mtn.	Inyo	11/53	2110	Bristlecone pine
Yurok	Six Rivers	5/76	150	Coast redwood

THE SHAWNEE NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN: A MODEL FOR MANAGEMENT FOR BIODIVERSITY ON PUBLIC LANDS

Rodney K. Sallee[1]

This paper examines the effects on biodiversity of the various standards and guidelines and management prescriptions developed to ensure the perpetuation of natural ecological processes inherent in the landscape encompassed on the Shawnee National Forest; the transition from even-age timber management to uneven-age timber management that incorporates current research concerning gap-phase dynamics, the creation of a riparian area management prescription and forest-wide standards and guidelines that provide for the preservation and management of filter strips to ensure linkages and corridors for the migration and movement of species, threatened and endangered species habitat management and recovery, the creation of a management prescription to mitigate the effects of forest fragmentation which has led to the creation of 20 Forest-Interior Management Units for the breeding enhancement of neotropical migrant species of birds and the incorporation of landscape and ecosystem analysis when implementing projects. Additionally, this paper will examine the integration of preservation-oriented land management prescriptions with utilization-oriented land management prescriptions to provide for the perpetuation of the components of biodiversity.

Wednesday, October 17, 1:30 pm

1. Rodney K. Sallee, Shawnee National Forest, 901 S. Commercial Street, Harrisburg, IL 62946.

THE ROLE OF FEDERAL LANDS IN PROTECTING BIODIVERSITY: AN OVERVIEW

David S. Wilcove[1]

By virtue of its size and geographical breadth, the U.S. federal land system sustains a large proportion of the native species, wildlands, and natural communities of the United States. As more of the private landbase is developed, the value of the federal lands as reservoirs of biological diversity will increase. The survival of a growing number of species, ranging from red-cockaded woodpeckers to grizzly bears, will hinge on the ways in which federal lands are managed. The long-term protection of biological diversity on federal lands will require significant reductions in logging, mining, grazing, and other extractive uses, coupled with coordinated management and planning of adjacent units and greater investments in inventory, monitoring, and management of biological resources.

Wednesday, October 17, 1:30 pm

1. David S. Wilcove, The Wilderness Society, 900 17th Street, N.W., Washington, DC 20006.

BIOLOGICAL DIVERSITY: PRESERVING GENETIC BALANCE

ANIMAL DIVERSITY: GENETIC CONSIDERATIONS WITHIN POPULATIONS AND SPECIES ASSEMBLAGES

Michael H. Smith[1]

Species and genetic diversity are correlated in species assemblages. Levels of genetic variability in populations vary widely among species of different taxonomic groups even within a single species. Differences in genetic variability have been correlated with reproductive rates, density, aggressiveness, and asymmetry at the populational level, and with body condition, metabolism, growth rate, body size, number of offspring, aggressive behavior, and size of body parts and appendages. These correlations are suggestive of different strategies of energy partitioning between secondary productivity (growth, reproduction, and energy storage) and maintenance metabolism or different access to resources by animals with different levels of genetic variability. Those with high genetic variability are better able than those with less variability to use medium- or low-quality food to maintain body weight. Thus, the level of genetic variability is related to many characteristics that have important influences on population dynamics and habitat utilization. Maintenance or enhancement of genetic diversity and variability should be a goal of any good management program that deals with our natural biological resources.

Wednesday, October 17, 1:30 pm

1. Michael H. Smith, University of Georgia's Savannah River Ecology Laboratory, Drawer E, Aikan, SC 20802.

PREDICTING THE DISTRIBUTION OF GENETIC DIVERSITY FROM THE CHARACTERISTICS OF PLANT SPECIES

J.L. Hamrick, M.J.W. Godt, and S.L. Sherman-Broyles[1]

Conservation programs have as one of their primary objectives the preservation of natural patterns of genetic diversity. However, the amount and distribution of genetic diversity varies greatly among species. Thus, information is needed in order to formulate effective strategies for the preservation of genetic diversity. Most often, however, there is not time to genetically analyze each species of interest. The question then becomes, "Can information about the range, ecology and life history characteristics of species of interest be used to predict the amount and distribution of genetic diversity?" Reviews of the plant allozyme literature indicate that crude predictions of the levels and distribution of genetic diversity can be made from the characteristics of the species. Traits used to classify plant species explained approximately 30 percent of the interspecific variation in the amount of allozyme diversity at the species and population levels. These same traits explain nearly 50 percent of the interspecific variation in the distribution of genetic diversity within and among populations. Fortunately, this last parameter is the most critical for the development of effective conservation programs.

Tuesday, October 16, 1:30 pm

1. J.L. Hamrick, M.J.W. Godt, and S.L. Sherman-Broyles, Departments of Botany and Genetics, University of Georgia, Athens, GA.

SAMPLING FOR GENETIC CONSERVATION: THEORY AND PRACTICE

Constance I. Millar[1]

Conservation biologists have a responsibility not only to provide information on basic biological parameters, but to assist resource managers in adapting this information to be useful in practice. This perspective is needed in conservation of genetic diversity in non-rare species. Whereas most recent attention has focused on rare and endangered species, the plight of species with wider distributions is less well known. In addition to their intrinsic values, many widespread species have special conservation concerns. For instance, the natural genetic structure of species that have commercial or recreation value, such as forest trees and fishes, is being drastically altered by direct human manipulations. Other widespread species serve keystone ecological roles or as index species of diverse associated communities, for example, old growth forest species. Disease, often caused by non-native pathogens, threatens many widespread species (sugar pine, Port-Orford-cedar, chestnut, elm).

These species often have complex patterns of intraspecific genetic diversity that reflect ecological adaptations. Maintaining these genetic mosaics provides species with the evolutionary potential to survive in constantly changing environments. Neglecting the importance of these mosaics may be the first step in creating threatened and endangered species. In some cases, naturally occurring genetic diversity may be essential to the survival of the species (e.g., in disease situations).

Wednesday, October 17, 1:30 pm

1. Constance I. Millar, USDA Forest Service, PSW Forest and Range Experiment Station, Box 245, Berkeley, CA 94709.

WHERE WILL WE CONTAIN THE VIABLE POPULATIONS?

Christine Schonewald-Cox[1]

Planning for effective protection of threatened species requires that information on behavior and population be available at the scales of area required for localized individuals and larger geographic scales of area required for populations. But this information, as well as population viability estimates for species will not suffice to make protection effective. Information is needed also on how protection of such species is likely to be affected by policy and management of land. In an ideal scenario, the requirements of declining species would already be described in detail years in advance of the species' decline towards probable extinction. Unfortunately, for most species we have neither the requisite time nor funds for such efforts. In some critical cases, we simply do not have enough animals or habitat left for such studies. In this increasing number of cases affecting conservation of declining species, we can learn to make effective use of reviews of available census data. These data can help us decipher how spatial requirements likely range statistically for organisms, making it possible to lay down provisional plans for their conservation. Even for species for which data are scarce and perhaps marginally reliable, we can use reviews to examine phylogenetic, socioecological, and geographic-scale effects that affect space requirements, population trends, and probable effects of habitat fragmentation on survival. This "detective work" is less than attractive to a classic statistical review but may shift the reliability of our planning. Estimates might be generated on the range of space requirements likely to be exhibited by a focal species, sufficient as conservative stop-gap tools for planning. We examine the possibilities of developing such an information base with mammalian carnivores and ungulates and propose that the investment is useful and deserving of continued attention.

Tuesday, October 16, 1:30 pm

1. Christine Schonewald-Cox, National Park Service-CPSU, University of California, Davis.

CULTURAL HISTORY AND NATIVE AMERICANS

Grizzly Bear, *Ursus arctos*, in Huckleberry Bushes
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ARCHAEOLOGY, HISTORY, ETHNOHISTORY

THE CULTURAL HERITAGE OF NATURAL AREAS: THE YOSEMITE PERSPECTIVE

Scott L. Carpenter[1]

Abstract

Yosemite was preserved as a natural area years before its establishment as a national park in 1890. As with many other natural areas throughout the world, Yosemite's natural setting has been the home of many different human cultures over at least the past 4,000 years. The prehistoric and historic interactions of humans and the natural environment cannot be separated when studying the patterns of the past, conditions of the present, and management strategies for the future. The rich cultural heritage of natural areas is presented through a centennial view of Yosemite and its cultures. An integrated perspective combining natural and cultural resources research and management is illustrated. Recommendations are provided for the establishment of a permanent link between the management and preservation of natural and cultural resources.

A PREFACE TO THE PRESENTATIONS

The creation of Yosemite as a national park occurred 100 years ago. Prior to that, in 1864, the Yosemite Valley and Mariposa Grove of Big Trees was set aside by federal action under the pen of President Lincoln "in trust to the State of California, to preserve inalienable for all time."

In fact, Yosemite was created at the beginning of time, a time immeasurable in spirit, a time millions of years ago in the rocks of the Sierra Nevada and the land forms and oceans that existed before the present remnant granitic batholith.

It is important to realize that Yosemite was not first "discovered" by humans in 1851, as chronicled by the Mariposa Battalion, nor in 1833 by Joseph Walker and his band of hearty explorers. During their "discoveries," both of these groups encountered, through rather relentless efforts, the native peoples of Yosemite. Native peoples with their own language, culture, and relationship with the land. Native peoples who, according to the available archeological record, inhabited the area for at least 4,000 years. And, according to various myths and spiritual beliefs, since time itself began.

Within the Yosemite region, we have a unique geographical area – unique throughout the world for its singular geologic grandeur, exhibition of animal and plant life, and scenic wonder. These are the natural resource elements that were considered at the time of drafting the legislation to establish Yosemite National Park 100 years ago.

It was not until the 1920s that the first prehistoric archeological site was formally recorded within the park. Similarly, it was not until the same early days of the twentieth century that recognition was made of the native, yet almost curio, lives of the Yosemite Indians.

The creation of Yosemite National Park was a collection of events that truly "made history." Yet those same events were not fully recognized as "history" until the past few years. It seems that only with our vantage over the events of the past century, do we realize the complex cultural heritage that Yosemite holds. A cultural heritage that is intricately entwined with the land and its natural resources. The

1. Scott L. Carpenter, Park Archeologist, Yosemite National Park.

heritage of a millennia of native American populations who procured plant and animal products for food, tools, and shelter. The historic period sheep herders, ranchers, miners, and loggers, who extracted their resource discoveries. The natural historians, conservation practitioners, and early natural area managers who set policies and implemented programs to establish and operate national parks and forests.

We have within Yosemite and other natural areas, a vast record of many cultures who have interacted with the natural environment to procure resources, alter natural productions and ecosystems, and implement methods to enhance and preserve animal and plant populations, water sources, viewsheds, and spiritual and recreational locations. Just as these elements of cultural activities are woven with the natural environment, it is impossible to view one completely without the other. As example, natural resource ecologists seeking to model the "natural" role of fire in previously established "natural" ecosystems, a view must be made of the possible effects of anthropogenic burning by prehistoric human populations.

This concurrent topic session will examine the disciplines of archaeology, history, and ethnohistory. The presenters will report on information and research focusing on Yosemite National Park and its complex of prehistoric and historic cultures. The information to be presented provides an integrated perspective that combines both natural and cultural resources research and management, ranging from the history of the creation of Yosemite as a preserved natural area, to research of ethnobotanical data, stone tool production and procurement, and a special view of the dynamic culture of the present native inhabitants of the Yosemite area. Robert C. Pavlik will present a paper entitled, "Yosemite History: An Overview," Kat Anderson will present, "Plant Gathering as a Conservation Strategy: Learning from California's Earliest Resource Managers," Robert Jackson will follow with, "A Prehistoric 'Blade Runner': The Glen Aulin Obsidian Biface Cache, Yosemite National Park, California," and Ken Swartz will follow with a special video documentary entitled, "Yosemite: The First People."

YOSEMITE HISTORY: AN OVERVIEW

Robert C. Pavlik[1]

The study of history in a great natural national park, such as Yosemite, is more than academic. Clio's craft can find application in many disciplines: interpretation, planning, policy analysis, and cultural and natural resources management. History, the study of change over time, is used in compiling administrative histories, tracing the physical development of parks, and chronicling changes in our attitudes and philosophies regarding the natural environment, as well as human impacts to the landscape and ecosystems. An understanding of a park's history and evolution is a useful tool for any park manager or scientist. A brief overview of Yosemite's many histories is presented here to illustrate this point.

Scott L. Carpenter has already touched on the region's prehistory and its human occupation for nearly 5,000 years. My story begins in the mid-nineteenth century, when sweeping changes were taking place in California. The discovery of gold on the American River began a deluge of immigrants that became one of the most remarkable migrations in recorded human history. It resulted in the displacement of native inhabitants and the disruption of the Hispanic population which had lived in California for almost 100 years. Argonauts eager to "see the elephant" discovered some remarkable natural features instead. Yosemite Valley, spied in 1849 by two lost miners, and entered by the Mariposa Battalion in 1851, and the Calaveras Grove of Giant Sequoia, stumbled upon by a wayward bear hunter in 1852 are just two examples. The discoveries of these natural areas and the subsequent excitement generated by the news of their existence generated a strange and competing mix of reactions. Some were opportunists who saw only dollar signs and get-rich-quick schemes; others (fewer in number) recognized the inherent value of the areas and agitated for their protection from exploitation. Within a few years, however, the floor of Yosemite Valley had been plowed and sown with grain and apple seeds, and some of the greatest specimens of giant sequoia in the Calaveras Grove had been felled or stripped of their bark for transport to eastern U.S. cities, and even to London, for display.

With the first tourist party arriving in Yosemite Valley in 1855, the great chasm became a place to marvel at and worship, a destination for a growing number of nature lovers inspired by the writings of Emerson and Thoreau. These early tourists made the difficult pilgrimage to bathe in scenic grandeur and to describe the sublime views in drippy Victorian prose. The "Gilded Age" of tourist travel lasted about 40 years, during which time a series of trails, and later three roads, were blazed into the valley. It was also about this time that a hotel and dance platform were being built in the Calaveras Grove, the latter on the stump of a fallen giant. This was an era of elite visitors who came to enjoy the scenery from the veranda of a deluxe hotel. Most of them are gone now: The Sentinel, the Stoneman House, Glacier Point Mountain House, but their offspring still survive and continue to cater to an elite clientele.

In 1864, during the height of the Civil War, President Abraham Lincoln forever assured his place in environmental history by signing into law a bill setting aside the Yosemite Valley and the Mariposa Grove of Giant Sequoia as a state grant, to be "held for public use, resort and recreation...and shall be held inalienable for all times." The significance of this piece of legislation, not fully recognized nor understood at the time, has become a landmark since the protection of a tract of wild land for public use had never before occurred in all of human history.

1. Robert C. Pavlik, State Historian II, San Simeon Region, California Department of Parks and Recreation.

For two reasons 1890 is a watershed year. One is that the federal census would reveal that the frontier had ceased to exist, and the other is the creation of Yosemite National Park on October 1 of that year. The corresponding change in management of federal lands (now to be known as Yosemite National Park) also reflected a change in the governing philosophy. No longer would the government allow sheepherders, timber men, and miners to roam the public lands surrounding the Yosemite grant, placing claims, driving sheep and cattle, and abusing the resource as they once did when the land seemed to be endless and inexhaustible. The land and its resources were imbued with a new set of values, the emphasis being on preservation rather than exploitation. The new values were not widely nor readily accepted, and when it was determined that certain portions of valuable land had been locked up, they were removed from the park's boundary in 1905 and allowed to revert to some of their former uses. These so-called "mineral lands," "timber reserves," and prime grazing districts comprised approximately 450 square miles of the original park, and the boundaries were readjusted to follow somewhat more natural contours of the landscape. Within the park, the early exploiters of Yosemite's high country were forced out, leaving behind their artistic blazes on trees, derelict mining sites, rugged wagon roads, and weathered log cabins. Certainly, those resources can be found outside the park's boundary, but the protection granted these historic remnants within the park allowed them to remain somewhat intact even until this day.

Corresponding with the creation of a new national park came a new national consciousness regarding the importance of largely open, unspoiled areas, more highly valued by those in the burgeoning urban areas than by those who weathered the outdoor's ordeals on a daily basis. Organizations like the Sierra Club, formed in 1892 under the leadership of John Muir, made annual treks to the high Sierra to revel in the magnificence of the great outdoors. During this period, the U.S. Army Cavalry was responsible for patrolling the national park, and while they were rousting sheepherders from the remote high country, they were also mapping the large portion of parkland that very few people knew anything about. Many of the trails that traverse the backcountry were explored, blazed, and mapped during this period. Adventuresome visitors who gloried in this form of wilderness immersion, differing from their Victorian counterparts who enjoyed the scenery from a comfortable vantage, followed the new routes or forged courageously on their own, delighting in the sense of excitement and accomplishment. It was during this period that the pictographs of Pate Valley were discovered, and the first set of cables were placed on Half Dome's east-facing slope in 1908.

The creation of the National Park Service in 1916 came 3 years after the first horseless carriages legally wheezed into Yosemite, resulting in a tremendous surge in visitation spawned by the increasingly easier access provided by the automobile. The numbers of people visiting the park went from approximately 33,000 in 1916 to ½ million by the Depression, a staggering increase of 1,500 percent in a little more than 10 years. The Park Service's first director, Stephen T. Mather, and Yosemite's first superintendents, W.B. Lewis and C.G. Thomson are credited with virtually remaking the face of Yosemite National Park in a 20-year period. Yosemite evolved from an isolated and rugged tourist attraction to a major travel destination made easier every year with the improvement of roads, concession facilities, and the dynamic and forward thinking management of a unified governing body.

Many improvements can be attributed to Mather's effective job of selling the American public on the national parks, and they in turn pressured their elected officials to support appropriations for improvements in roads, trails, campgrounds, and other park service facilities. Later, what was a demoralizing and debilitating era in American history, the Great Depression, turned out to be a boon for the Park Service, who benefitted from a number of alphabet agencies created by then-President Franklin D. Roosevelt. The Civilian Conservation Corps, originally charged with performing unskilled projects involving manual labor, such as blister rust control, insect control, and landscaping, eventually became involved in the construction of a number of buildings within the park. The Public Works Administration, also created in 1933 and charged with the granting of funds to federal agencies who contracted with private developers, was responsible for the construction of buildings in Yosemite during the period 1933 to 1940.

World War II slowed visitation to the national park because of gas rationing, the need to conserve rubber and other commodities necessary for the war effort, and the booming economy that was developing in California that provided ample employment, but little free time for a work-starved population. Yosemite once again became a military outpost, occupying the Ahwahnee as a special naval hospital for sick and injured military personnel who found the surroundings rather boring.

The changes that World War II wrought on the western states, and California in particular, were nothing less than revolutionary. The population of the state increased dramatically, and after the war, thousands of new Californians flocked to the park in record numbers, overtaxing the facilities and overrunning the resource. Director Conrad Wirth responded with a call for a 10-year appropriations package for the park service, with the terminal date of 1966 coinciding with the 50-year anniversary of the Park Service. This brought a new era of development to Yosemite, resulting in a frenzy of building activity designed to accommodate the burgeoning numbers of visitors without regard for the impact on the natural or cultural resources. The last section of the Tioga road, a new section of the Big Oak Flat road, employee housing in El Portal and Yosemite Valley, and new, modern (by 1950's standards) concession facilities sprang up in the park. Whereas, before World War II, developments were created in harmony with the natural landscape, these improvements in some instances did a great deal of harm to the land, and aesthetically were not very pleasing.

Scientists and naturalists have long made Yosemite their laboratory, beginning with John Muir and J.D. Whitney debating the geologic origins of the region, to Emil Ernst's studies of Yosemite Valley's meadows in the 1940s and Jan Van Wagtendonk's scientific application of fire in the 1970s. Animal and plant species have been both selectively reduced and reintroduced, extirpated, relocated, and reinvigorated. And the idea of wilderness has gone from de facto status, as when Joseph Walker and his party made the first east-west crossing of the Sierra Nevada by Euroamericans in 1833, to a legal mandate, when Congress approved the Wilderness Act of 1984 and set aside 94.5 percent of the park under this special management designation.

CONCLUSION

Yosemite National Park is recognized worldwide as a great natural national park. What is not realized is that the very concept and the creation of the national park idea is, in itself, a human fabrication – an arbitrary designation that is designed to protect what are widely regarded as outstanding natural and cultural features. Until Yosemite Valley and the Mariposa Grove were set aside as public reserves in 1864, there had been no such precedent in all of human history.

The emphasis on the conservation and management of Yosemite's natural features has at times given rise to the de-emphasis of the human history of the park. Whereas native American features have been duly and rightfully recognized as important elements in the landscape, there has been much debate as to what constitutes historic resources in Yosemite worthy of preservation. In an attempt to come to a greater understanding and appreciation of Yosemite's history, there have been misguided attempts to segregate the "historic" from the "natural." The Pioneer History Center in Wawona is a case in point. I contend that, with careful study and cooperation between the different disciplines that manage Yosemite's diverse resources, that cultural and natural resources can coexist, resulting in a benefit to the park and the visitors that come to it to enjoy its deep forests, glacier-carved canyons, and sweeping vistas.

PLANT GATHERING AS A CONSERVATION STRATEGY: LEARNING FROM CALIFORNIA'S EARLIEST RESOURCE MANAGERS

Kat Anderson[1]

Abstract

The vegetative reproductive mechanisms of California native plants (corms, sprouts, rhizomes, bulbs, etc.) were manipulated by California Indians through a variety of horticultural techniques. Methods such as tillage, burning, pruning, and coppicing were designed to enhance native plant populations while simultaneously meeting Indian cultural needs. Some of these techniques may have applications for wildland management of Yosemite and other national parks. Recent experiments in the Gil Tract, Albany, and Sierra National Forest designed to "mimic" indigenous practices may reveal an ecological and cultural rationale to plant manipulations. These preliminary findings offer further evidence to support the changing image of California Indians from hunter-gatherers to horticulturalists.

INTRODUCTION

George Catlin, as early as 1832, envisioned a national park extending for hundreds of miles along the Rocky Mountains protecting not only the buffalo and the wilderness, but the Indian (Nash 1974). John Muir and Galen Clark even suggested that conservationists might learn from Indian practices (Commissioners 1889-90). Despite these early considerations of the Indians, in the establishment of Yosemite and other national parks, the native peoples were systematically displaced, and the national park model evolved without provisions to honor the larger land claims of indigenous populations (Hecht and Cockburn 1990).

Additionally, as a rule, indigenous knowledge of areas designated as a national parks has not been valued. Yet ironically, Yosemite as well as other national parks were deemed worthy of protection because they were maintained for centuries by native peoples in ways that left them "pristine" (Clay 1985). Park managers are just beginning to understand that the traditional indigenous systems of resource management that undergirded our national parks at the point of Anglo contact, were as rare and priceless resources as the plants, animals, and rocks that these systems of knowledge were designed to protect and enhance.

As early conservationists pointed out, conservation goals can be furthered by linking them to the land rights and subsistence traditions of indigenous cultures (Clay 1985). For example, in the Amazon, it is now well established that there are no other land use models for the tropical rain forest that preserve ecological stability or biological diversity as efficiently as those of the indigenous groups presently encountered there (Houseal et al. 1985). For this reason, park planners and rural developers are incorporating indigenous knowledge as a main strategy for the preservation of tropical rain forests.

Contrary to conventional belief, the Southern Sierra Miwok in the Yosemite region and other California Indian tribes practiced a variety of horticultural techniques which enabled them to directly influence the diversity, quantity, and quality of plant resources (Reynolds 1959; Anderson 1990; Heady and Zinke 1978; Lewis 1973). In fact, plant manipulations of the California landscape were extensive, varied, and were conducted in a manner which allowed certain plants to regenerate so completely that

1. Kat Anderson, Forestry and Resource Management, University of California, Berkeley.

virtually every settler, gold miner, ethnographer, and missionary was fooled into thinking that the land they saw was "virgin."

In this paper I am using the ethnobotany and ecology of specific California native plants to highlight the role of California Indians in vegetation management. First, I will demonstrate that the California Indians managed a variety of lifeforms to meet their cultural needs and second, through their gathering strategies and management, the California Indians were not only able to maintain but also enhance populations of plants of interest.

TAPPING VEGETATIVE REPRODUCTION: A RENEWABLE RESOURCE

The California Indians in order to obtain enough food, basketry material, and other items, augmented natural systems to make them productive enough to sustain their populations without relying extensively on labor-intensive methods. Plant species were purposefully selected which exhibited strong asexual plant reproductive mechanisms. Many of the most widely used plant species by California Indians have excellent regeneration capability by sprouts, corms, bulbs, stolons, tubers, rhizomes, or from rootstock fragments that have separated from the parent (Anderson 1989).

Indians understood that advantage is gained by harvesting from plants which have a dual reproductive system consolidating the local plant population and at the same time extending the range (Frenkel 1970). Certain patterns of harvesting and management could trigger vegetative reproduction repeatedly. Vegetative reproduction enables the plant to survive and reestablish itself in place after human disturbance (Spurr and Barnes 1980).

Forms of vegetative reproduction most exploited by California Indians included: shrubs or trees that sprout after harvesting favored for baskets, arrows, and many cultural products and underground swollen vegetative stems such as rhizomes, bulbs, or tubers utilized for basketry material and as a starch and protein source in the diet. Indians used a variety of horticultural techniques to take advantage of asexual reproduction such as weeding, tillage, coppicing, burning, and pruning.

ABOVE-GROUND PRUNING, COPPICING, AND BURNING

Populations of many different species of plants were burned, pruned, or coppiced by California Indians, but since the ethnohistoric record is lacking, one must examine finished cultural products made from plants to elucidate past management. The Lowie Museum and other museums house California Indian material cultural items for domestic use such as pump drills, fire-making kits, arrows, musical instruments, game sticks, mush paddles, fishing gear, etc. Upon examining these finished cultural items, the morphological characteristics of the raw plant material are clearly apparent; all of these items required special types of straight branches for their manufacture (Anderson 1989).

Straight-stemmed plants demonstrate a type of plant architecture that has been valued by peoples for centuries. For example, straight branches of such shrubs and grasses as mock orange (*Philadelphus lewisii* ssp. *californicus*), arrowreed (*Phragmites* sp.) and rosewood (*Rosa californica*) were selected in the manufacture of arrows (Heizer 1978). A straight arrow shaft will make an arrow more aerodynamic, affecting the accuracy of hitting wild game in the hunt. Branches of elderberry (*Sambucus caerulea*) suitable for the making of musical instruments, such as flutes and clapper sticks, were straight in order to achieve the proper tones and sounds. The burned bases of oaks (*Quercus* spp.) and maples (*Acer macrophyllum*) were harvested for their long straight sprouts, which were pliable, to make fish traps and looped stirring sticks (Merriam 1955; Barrett and Gifford 1933).

Alfred Kroeber, in evaluating the various types of California Indian material culture, concluded that basketry was the most advanced of all the material arts (Kroeber 1976). The variety of California baskets in the various museums that show exacting qualities and fine detail were due not only to the tedious preparation of the materials. The basketmaker selected for certain characteristics in the gathering of basketry branches (Anderson 1988-89).

Bundles of rods of various plant species (i.e. willow *Salix* spp., redbud *Cercis occidentalis*, maple, and deerbrush *Ceanothus integerrimus*) in museums, also exhibit special qualities: the branches are long, straight, slender switches with inconspicuous leaf scars, clear unmottled bark, and no lateral branching. These are the characteristics most valued by California Indian tribes for basketry material. The California Indians selectively harvested only straight shoots of various plant species to make all kinds of twined and coiled baskets. Neatly wrapped coils of basketry material, which are split branches, are housed in museums and their morphological characteristics also reflect the selective harvesting of straight branches (Anderson 1990).

The value of a straight-growing branch is fairly obvious. Straight branches will make longer rods in foundations, split more easily and evenly, create longer sewing strands when split, and make stronger, more uniform baskets. These withes are more flexible, free of disease and insect activity, and have no lateral branch scars, which would form weak spots in a basket (McMinn 1939). Old branches on the other hand, are often gnarly, crooked with mottled and cracked bark, and many lateral branches. Old growth is often insect or disease damaged and has lost flexibility and will snap when bent (Anderson 1988).

Shrubs that occur on wildlands, growing "naturally," display very crooked branch architectures. For example, a wild, mature redbud shrub may contain 400-500 branches, only a handful of which would be straight enough to select as suitable basketry material by a weaver. Yet a large Miwok feasting basket would require perhaps a thousand straight rods of redbud (Peg Matthewson pers. comm. 1990). In order to gather branches for basketry in sufficient quantity of the type suitable for the making of many kinds of baskets by the adolescent and adult females in various villages, the California Indians had to manage and maintain abundant populations of certain plants at the level of a small- or medium-sized industry.

All of the most important basketry and arrow-making shrubs selected by California Indian tribes are "sprouters." This means that if the branches are damaged or broken in some way through herbivory, a lightning fire, or flooding, the plant responds to the disturbance by vigorously sprouting branches and ground stems (U.S. Dept. of Agriculture 1972). California Indians took advantage of this plant adaptation using man-made disturbances such as human-set fires, pruning, and coppicing to induce "sprouting" of shrubs (Anderson 1990).

Thus, the California Indians were active horticultural ecologists, a feature that was rarely pointed out in early ethnographic reports. Infrequently, citations such as the following appear further verifying horticultural management of shrubs useful for domestic items:

"To get good materials the bushes (redbud) were burned and the green and pliable shoots that grew after the burning were used" (Potts 1977).

"And the hazel bushes, when they burn them off for hazel sticks, they pick them two years later, then they are good hazel sticks, they get so hard" (Harrington 1932).

"Small bird arrows were made from the long shoots of the snowberry (*Symphoricarpus racemosus*). This was cut down in the fall, so that it would send up shoots the following spring and be straight and smooth by autumn" (Murphy 1959).

Furthermore, many ethnohistoric reports hint of horticultural management by labeling branches suitable for basketry or arrows as "withes," "sprouts," or "suckers," implying that young or new growth was required (Chestnut 1902; Aginsky 1943).

These citations, together with early photographs displaying the straight stems harvested by weavers, and the material culture in museums, verify the prevalence of pruning, coppicing, and burning among California Indian tribes. Further support of this type of vegetation management is from personal observation of Indian weavers in the field and through interviews. Today the Miwok as well as other tribes continue horticultural practices although, due to fire restrictions and the advent of modern tools, they have switched from burning to pruning and coppicing. Indian-managed plants are easily spotted in the landscape and are good evidence this management continues. Several elders remember relatives, formerly piling brush in individual shrubs of willow, sourberry (*Rhus trilobata*), and redbud, lighting them on fire in the fall of the year to induce sprouting (Anderson 1989).

In order to scientifically quantify the impact of these indigenous practices, I mimicked the coppicing practices of the Indians in an experiment conducted on Sierra National Forest in California. Plants subjected to coppicing, produced significantly greater numbers of redbud shoots for basketry than noncoppiced plants.

In horticultural texts it is often recommended to prune or burn redbud branches to control certain diseases such as die-back, wilt, and canker (Everett 1981) or to improve the shape of the shrub if it becomes too tall and lanky. Other possible beneficial effects of Indian pruning and coppicing on the productivity of redbud are greater numbers of ground stems and above-ground branches. More branches increase the leaf area, which may be accompanied by enlarging the root surface area to accommodate the additional water loss in the leaves (Wilson 1970).

BELOW-GROUND PRUNING/WEEDING

The major underground plant parts, harvested historically and presently by California Indian tribes for basketry material, are generally called "roots" by Indians, but technically these are both roots and underground stems called rhizomes. Some of the plant species harvested for roots and rhizomes included: black cottonwood (*Populus trichocarpa*), bracken fern (*Pteridium aquilinum var pubescens*), sawgrass (*Cladium mariscus* var. *californicum*), sedge (*Carex* spp.), and bull pine (*Pinus sabiniana*), among others (Latta 1977; Hudson n.d.).

One of the most important plants still utilized by weavers for their rhizomes is sedge. The plant grows in open or brushy slopes and valley flats that are wet in the spring, from sea level to 3,000 ft. Different desirable species of sedge occur in the valley grassland, foothill woodland, mixed evergreen forest, and yellow pine forest plant communities (Munz and Keck 1968).

The rhizomes of sedge were historically used for basketry starts, sewing strands, and foundations of baskets among certain tribes. Earlier photographs that show large burden baskets filled with coils of sedge rhizomes suggest a sizable operation of harvesting and management occurred among various villages of different tribes.

Different species of sedge are still highly valued by gatherers from various tribes today. The rhizomes are generally dug in the fall or winter after sufficient rain, but can be collected any time of year except spring (Bev Ortiz pers. comm. 1987). Native Americans dig down until they hit the rhizome and then delicately follow it along, moving back the dirt with their hands. Today a digging stick, metal fork, or trowel is used to harvest rhizomes (Allen 1972).

Accompanying gatherers in the field reveals the necessity of intensive management of sedge "beds" if the proper quality and quantity of rhizomes are to be obtained. Sedge rhizomes are very much affected by the types and conditions of the soil in which they grow. In the selection of rhizomes, Indian basketweavers select for long straight rhizomes (2 to 3 feet long), free of branchings, with few or no kinks, unimpeded by rock soils or weed competition. These split more easily and evenly and make strong baskets. These valued characteristics do not occur naturally on wild plants and thus, areas are carefully selected and managed to create suitable growing conditions to promote desirable qualities. Patches that are not regularly weeded and pruned become overgrown, and often the sedge is outcompeted by other plant species.

Rhizomes like other underground stems are an important means of propagation among perennial plants. Native Americans today often assert that the digging and pruning of rhizomes causes rapid elongation of new rhizomes to grow out of the "spur" of the parent plant. Digging with a digging stick may also have increased the moisture-holding capacity of the soil by aerating it to aid root gas exchange and oxidize allelopaths in the soil (Peri and Patterson 1976; Anderson 1989).

Evidence of rhizome and root management in the literature for basketry material is scanty. Latta (1977) reported that:

"Slowly I was educated in root *(Cladium mariscus)* digging. It was a scientific farming operation. They (Yokuts Indians) farmed a strip about six feet wide. The roots grew into the strip from the bordering bed of old, undisturbed roots."

TILLAGE

Tillage has been studied mainly among the indigenous groups that practiced the earliest forms of agriculture with wooden digging sticks. Yet the oldest form of tillage was the digging of underground plant parts of wild plants for food (Sauer 1956).

Underground swollen stems harvested from "wild" plants included bulbs, corms, tubers, tuberous roots, and rhizomes, and they formed a very important starch and protein component in the diet, second in importance to seeds. Called "Indian potatoes" by California Indians, this plant part was often recorded as an emergency back-up food during lean acorn years; and numerous tribes stored bulbs and corms, further supporting the assumption that they were a major food source (Powers 1976; Heizer and Whipple 1971).

Plant species with edible bulbs, corms, and tubers grow from sea level to subalpine elevations of 14,000 ft. and in every vegetation type in California, being least frequent in the desert and the salt marshes (Roger Raiche pers. comm. 1988). Corms and bulbs come in various shapes, sizes, and colors. Wild onions such as *Allium fimbriatum* probably have some of the smallest bulbs (less than the size of a pea), while soaproot *(Chlorgalum pomeridianum)* have some of the largest edible underground stems.

Major genera commonly harvested for their edible corms and bulbs include: *Balsamorhiza, Chlorogalum, Brodiaea, Calochortus, Perideridia, Dichelostemma, Allium, Lilium,* and *Camassia.* Some of these genera are still highly valued by gatherers from various tribes (i.e., Western Mono, Miwok, Pomo) for their edible bulbs and corms. The most important of these species, reputed to be the most widespread, sweetest, and recorded by the greatest number of tribes, was *Brodiaea* throughout California (Anderson 1989).

The preferred digging implement was the digging stick, made of mountain mahogany, buckbrush, or some other wood. Early photographs show prolific populations of bulbous plants. Places such as the Ketten Chow Valley on the western slope of Mount Shasta and Gualala Creek were called "camass valley" and the "potato place" respectively by the Indians in former times because of the abundance of bulbous plants (Powers 1976).

Early reports suggest that Indian potatoes were much more prevalent in precontact times and within a short time after contact. In fact, Chestnut and Manning documented such abundance in their writings. For example, Chestnut reported in the late 1800s that in one clump there were over 200 plants of *Tritelea laxa* in 1 square foot of ground.

Mrs. M.H. Manning observed at Fort Bidwell in 1903, "edible tubers of *Perideridia* (yampa) highly esteemed by the Indians were dug by the sackfuls before the blossoms come and kept on hand for winter use. They were commonly occurring as plentifully as if planted in favorable localities."

How could these favored gathering spots contain such an abundant supply of Indian potatoes, if they were being dug from yearly? It is possible that the digging of certain bulbs, corms, and tubers actually is a form of "tilling" and "thinning" which results in enhancement of certain plants, both in quality and numbers. Underground storage organs are an important means of propagation among perennial plants. Removal of tubers, bulbs, corms, and rhizomes can activate new vegetative reproduction in the form of offsets or stimulate growth in fragments left after harvesting. Digging bulbs may also increase the size of the tract, aerating the soil, lowering weed competition, and preparing the seedbed to increase seed germination rates (Anderson 1990; Peri 1985).

Digging tubers, bulbs, and corms may have exerted selective pressure in favor of the plants most useful to humans. Hints of practices bordering on a knowledge of tillage are sometimes found in the ethnohistoric literature. For example, John P. Harrington (1932) recorded:

"But they knew indeed that where they dig cacomites all the time, with their digging sticks, many of them grow up, the following year many grow up where they dig them. They claim that by digging Indian potatoes, more grow up the next year again. There are tiny ones growing under the ground, close to the Indian potatoes."

Also, early reports mention Indian potatoes growing in beds as if cultivated:

"The flowers *(Brodiaea)* were beautifully marked and colored, and as the bulbs grew in beds, they were easily harvested" (Murphy 1959).

Indian potatoes are still gathered by some California Indian tribes today. For example, one Miwok woman gathers *Sanicula* sp. under the ponderosa pines on her property with a crowbar and she eats the tuber raw. She has told me that whenever she gathers in the same spot, it is more plentiful the next year.

Interviews with contemporary Indian gatherers verify knowledge of tillage. For example, two such quotes follow:

"When I gather Homogi (with a long carrot-like root) I only gather the large ones, I leave the little ones behind " (Yokuts Elder).

"We harvest the large bulbs of Panowe (*Brodiaea* spp.) and leave the small bulbs behind so they will grow larger" (Northfork Mono Elder).

An experiment is underway in the Gil Tract (U.C. Berkeley) in Albany, California. Twelve hundred blue dicks *(Dichelostema puchellum)* plants arranged in 60 plots will be dug spring and summer 1991 with a digging stick at different harvesting regimes designed to mimic Indian harvesting. The study will measure the effects of this harvesting on the productivity of the species and specifically, the quality and quantity of corm and cormlet production.

PLANT GATHERING AS A CONSERVATION STRATEGY

The idea of "conservation" is a Western perspective, but resource management and ecological impacts can also be viewed from an ethnoecological sense that accounts for relative availability of plant resources in a particular culture's terms (Ford 1978). Whether or not California Indians had any sense of resource conservation is particularly interesting because certain gathering techniques, under certain intensities of harvesting, could have been beneficial to plant species populations, purely as a result of harvesting rather than as a deliberate management technique.

In working with native plants, particularly rare and endangered plants, it is essential not to underestimate the importance of the indigenous groups in manipulating the range, distribution, and abundance of certain species. For example, *Wilcoxia*, used to be more abundant in Arizona in prehistoric times, even though indigenous groups ate the tubers. Is it possible to underexploit a plant whereby if the human influence is removed, the plant decreases in numbers?

Often contemporary Indian gatherers mention that deliberate disturbance of the habitat is not only nondetrimental to certain plant species, but actually maintains or enhances the availability of certain plants. Today among the Indian families there is a feeling that using the plants and interacting with them is regenerative. When they are not used, they deteriorate in quality, and become senescent, depleted, or even eliminated (Anderson 1989; Heffner 1984).

Some of the basic elements of modern range and forestry management plans and practices may be similar to indigenous management schemes. The California Indians evolved a set of management principles from tradition and experience to effectively obtain resources over the long term. For example, the concept of "sustained yield" which figures prominently in modern range and forestry management literature, also may apply to gathering strategies developed by native peoples.

I am proposing that wild plant gathering is a conservation strategy, whereby the continual harvesting and manipulation of certain, selected plants is in a way that maintains and enhances wild plant resources while simultaneously obtaining a sustained yield of the plant parts valued to meet cultural needs. Human disturbance is at the proper level, time of year, and pattern to perpetuate particular plant populations of interest, and a symbiotic balance is created.

The plants selected are "renewable" in the sense that harvesting does not deplete the plant populations and the plant response is two-fold: (1) the plant part grows anew and/or (2) the plant creates totally new "spur" plants, spreading the population.

More studies are needed to verify the sustainability of these methods of horticulture. It is possible that in precontact times, indigenous peoples chose certain plants with asexual reproductive capabilities, because they could be divided and multiplied indefinitely through low levels of human disturbance, offsetting the impetus to develop agriculture in California.

Historians, ethnobotanists, and anthropologists have tended to view indigenous wild plant gathering and agriculture as two opposite poles of human intervention systems, without looking at them as part of a continuum of cultivation systems involving differences in scale of operation, plant diversity, management techniques, human impacts, etc. (Farrington and Urry 1985). It is the middle of the continuum which constitutes a complex and sophisticated set of plant-human interactions practiced by indigenous groups which has been neglected as a research topic by scientists and resource managers.

These types of interactions are less severe forms of human disturbance which do not significantly alter the habitat to the point beyond the biological capacity of species for natural regeneration (Richardson 1977). Diversity and abundance of plant species useful to humans heightens with this intermediate set of interactions. It is the understanding of the middle of this continuum that may provide an ecological basis for alternative management strategies for Yosemite National Park and other wildlands.

ACKNOWLEDGMENTS

The Yosemite Association, Yosemite National Park, the Hardman Foundation and the California Native Plant Society provided generous financial support for this research. I am deeply grateful to the Indian families that shared themselves – their memories, crafts, knowledge, gathering places – all that makes their cultural heritage so rich. Special thanks goes to Scott Carpenter and Jan van Wagtendonk, Co-Directors of the Yosemite Research Center.

REFERENCES

Aginsky, B.W. 1943. Culture Element Distributions: XXIV Central Sierra. *Anthropological Records* Vol. 8:4.

Allen, E. 1972. Pomo Basketmaking: A Supreme Art for the Weaver. Naturegraph Publisher, Inc., Happy Camp. p. 67.

Anderson, M.K. 1990. California Indian horticulture. *Fremontia: A Journal of the California Native Plant Society.* pp. 7-14.

1989. Unpublished Western Mono, Chuckchansi Yokuts, Southern Sierra Miwok and Central Sierra Miwok field notes.

1988. Southern Sierra Miwok Plant Resource Use and Management of the Yosemite Region. Master's Thesis. Department of Forestry and Resource Management. U.C. Berkeley.

Barrett, S.A., and E.W. Gifford. 1933. Miwok Material Culture. *Bulletin of the Public Museum of the City of Milwaukee* 2(4):117-376.

Clay, J.W. 1985. Parks and people. *Cultural Survival Quarterly.* Vol. 9(1).

Chesnut, V.K. 1974. *Plants Used by the Indians of Mendocino County, California.* Mendocino County Historical Society.

Commissioners' Report, 1889-1890. *Biennial Report of the Commissioners to Manage Yosemite Valley and the Mariposa Big Tree Grove.* Sacramento.

Everett, T.H. 1981. *The New York Botanical Garden Illustrated Encyclopedia of Horticulture. Volume 2.* New York: Garland Publishing.

Farrington, I.S. and J. Urry. 1985. Food and the early history of cultivation. *Journal of Ethnobiology.* 5(2):143-157.

Frenkel, R.E. 1970. *Ruderal Vegetation Along Some California Roadsides.* Berkeley: University of California Press.

Harrington, J.P. 1932. *Tobacco Among the Karuk Indians of California.* Smithsonian Institution Bureau of American Ethnology Bulletin 94. Washington DC: United States Government Printing Office.

Heady, H.F. and P.J. Zinke. 1978. *Vegetational Changes in Yosemite Valley.* National Park Service. Occasional Paper #5.

Hecht, S. and A. Cockburn. 1990. *The Fate of the Forest.* New York: Harper Perennial.

Heffner, K. 1984. *Following the Smoke: Contemporary Plant Procurement by the Indians of Northwest California.* Six Rivers National Forest. Eureka.

Heizer, Robert F. (ed.) 1978. *Handbook of North American Indians, Volume 8: California.* Washington: Smithsonian Institution.

Heizer, R.F. and M.A. Whipple. 1971. *The California Indians.* Berkeley and Los Angeles: University of California Press.

Houseal, B., C. MacFarland, G. Archibold and A. Chiari. 1985. Indigenous cultures and protected areas in Central America. *Cultural Survival Quarterly.* Vol. 9(1).

Hudson, J.W. n.d. Chicago, Field Museum of Natural History. Unpublished manuscript of ethnographic field notes made while collecting material circa 1899-1906.

Kroeber, A.L. 1976. Handbook of the Indians of California. *Bureau of American Ethnology Bulletin 78.*

Latta, F.F. 1977. *Handbook of the Yokuts Indians.* Kern County Museum.

Lewis, H.T. 1973. Patterns of Indian Burning in California: Ecology and Ethnohistory. *Ballena Press Anthropological Paper No. 1.*

McMinn, H.E. 1939. *An Illustrated Manual of California Shrubs.* Berkeley and Los Angeles: University of California Press.

Merriam, C.H. 1955. *Studies of California Indians.* Berkeley: University of California Press.

Munz, P.A. and D.D. Keck. 1968. *A California Flora and Supplement.* Berkeley.

Murphy, E. V. 1959. *Indian Uses of Native Plants.* Mendocino County Historical Society . Fort Bragg, CA.

Nash, R. 1974. *The American conservation movement.* Forums in History. St. Charles, MO: Forum Press.

Peri, D.W. 1985. Pomoan plant resource management. *Ridge Review,* Mendocino. 4:4.

Peri, D.W. and S. M. Patterson. 1976. The basket is in the roots, that's were it begins. *Journal of California Anthropology* Vol 3:2.

Potts, M. 1977. *The Northern Maidu.* Happy Camp, CA: Naturegraph Publishers, Inc.

Powers, S. 1976. *Tribes of California.* Berkeley: University of California Press.

Reynolds, R.D. 1959. Effect of Natural Fires and Aboriginal Burning Upon the Forests of the Central Sierra Nevada. M.A. Thesis, Department of Geography, University of California, Berkeley.

Richardson, D. 1977. A Faustian dilemma. *Unasylva* 29:12-14.

Sauer, C.O. 1956. *The Agency of Man on the Earth.* In the Proceedings of the International Symposium: Man's Role in Changing the Face of the Earth. W.L. Thomas, Jr. (Ed.). Chicago: University of Chicago Press.

Spurr, S.H. and B.V. Barnes. 1980. *Forest Ecology.* Third Edition. New York: John Wiley and Sons.

U.S. Dept. of Agriculture. Intermountain Forest and Range Experiment Station Forest Service. 1972. *Wildland Shrubs – their Biology and Utilization.* Proceedings of an International Symposium. C.M. McKell et. al (editors). Ogden, UT.

Wilson, B.F. 1970. *The Growing Tree.* Amherst: The University of Massachusetts Press.

A PREHISTORIC 'BLADE RUNNER': THE GLEN AULIN OBSIDIAN BIFACE CACHE, YOSEMITE NATIONAL PARK, CALIFORNIA

Robert J. Jackson[1]

In 1971 two hikers encountered over 100 obsidian artifacts near Glen Aulin campground in the Tuolumne River drainage in Yosemite National Park. The bifacial artifacts were carried over the crest of the Sierra Nevada at least 600 years ago by a prehistoric traveller and hidden, for a reason that we will never fully understand. This paper describes the artifacts, their age, point of origin, and process of manufacture. It concludes with a consideration of prehistoric trans-Sierran exchange and population movement and its implications for social and subsistence change in the Sierra Nevada.

Wednesday, October 17, 1:30 pm

1. Robert J. Jackson, Yosemite National Park, CA. 95389.

YOSEMITE: THE FIRST PEOPLE

Ken Swartz[1]

During 1990 a documentary program was produced to present the information about the Yosemite Indians, their history, contemporary lives, and spiritual beliefs. Highlights of the documentary program will be presented with discussion about this modern ethnographic record.

Wednesday, October 17, 1:30 pm

1. Ken Swartz, KRON, News Center 4, 1001 Van Ness Avenue, San Francisco, CA 94109.

NATIVE AMERICAN PERSPECTIVES ON NATURAL AREAS AND THEIR MANAGEMENT

CULTURAL PERSISTENCE AND NATURAL RESOURCES FOR CONTEMPORARY CALIFORNIA INDIAN COMMUNITIES

Jay Johnson[1]

Good afternoon ladies and gentlemen:

My name is Jay Johnson, I am of the Miwok and Paiute tribes. I was born and raised in Yosemite Valley and my ancestry goes directly back to my great-grandmother who was also born in Yosemite Valley in the early 1830s. Therefore, I am a descendent of the Yosemite Indian tribe, which existed long before the white man set foot in the valley and long before any land was set aside for the people of this country.

We all know the history of the California Indians, what happened to them, why it happened, and the final outcome of the California Indian population during the 1800s. We all know of the treaties the U.S. commissioners had made with the California Indian tribes, bands, or groups during 1851-1852 and that these eighteen treaties were never ratified by the U.S. Senate in Washington, D.C. upon receiving them from the U.S. commissioners.

I would like to share with you today some of the experiences and struggles that we, as Indian people were faced with during these recent years, specifically, from the year the Mariposa Indian Council was organized as an Indian organization. Like the majority of California Indians, we are a non-federally recognized tribe.

In January of 1971, the American Indian Council of Mariposa County was formed. Since that year the council started getting involved with various programs that would assist the council in achieving its goals for the betterment of the Indian communities of Mariposa County. During these years, we have been involved with county, state, and federal agencies; with health programs, mental health programs, cultural programs, and other projects.

Within our council we have an education program which assists, on a small scale, with available funds to help Indian students with college or vocational training.

One of the primary reasons for organizing the council was to revive and continue our tribal traditions and to keep in balance with our culture and heritage. We have made excellent progress toward achieving this goal. For the past 16 years, we have been having a celebration that is called "Yosemite Indian Days," in Yosemite National Park. This is an annual event and is a weekend for the Indian communities to join together in performing their tribal dances and ceremonies.

We appreciate the cooperation of Yosemite National Park management during these years and we hope this will continue in the future, for our children and their children to have a chance to preserve their culture.

Today we still use many of the native plants for medicinal purposes, food, and use in our ceremonies. We still gather acorns, berries, and mushrooms for food for our families. It is very important and it is a part of our tradition that when we go to gather the plants, nuts, and berries that we make an offering and say a prayer before we take anything. We take or gather only enough for our family's needs. This is what we have learned from our parents and grandparents, and this is what we will pass on to our children.

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1. Jay Johnson, Council Member, American Indian Council of Mariposa County.

Our council has been involved and is still active with the Yosemite General Management Plan and other issues concerning native Americans.

Economic development has always been another main goal for us. This has been tough for us in this area because of several factors. A big factor is that we are not a federally recognized tribe and do not have a land base, such as trust land or reservation. Therefore, we are not eligible for any grants or funds set aside for the federally recognized tribes.

In 1982, we were able to obtain a grant from the ANA Indian Desk in Washington, DC. We used the grant monies to hire a firm to do tribal research for our council, which is one of the first steps in submitting a petition for federal acknowledgement to Washington, DC. All criteria for the federal acknowledgment petition was completed in 1984 and sent to the Washington, DC, Office of the Bureau of Indian Affairs. Today, 1990, we are still waiting for our federal recognition status as an Indian tribe.

As we look to the future, we know there will be obstacles in our paths and challenges to face. For we, too, are very concerned about what happens to Yosemite – today, tomorrow, and for the next 100 years.

Thank you very much.

CHANGING PERCEPTIONS: IS IT REALLY A CHANGE?

Dwight A. Dutschke[1]

Since 1966, with the establishment of the National Historic Preservation Act, the National Register of Historic Places has been used by federal agencies to determine which historic resources should be conserved. Over the years, the definition of what constitutes a historic resource has changed.

In recent years, native Americans have been more vocal about how the environment should be perceived and managed. These efforts by native Americans have resulted in, what some perceive as, an expanded definition of what constitutes a historic resource. This paper will explore the changes that have occurred over the last fifteen years. A period when native Americans, for the first time, described for land managers how resources affecting their cultural existence should be defined and considered.

Wednesday, October 17, 3:30 pm

1. Dwight A. Dutschke, California Office of Historic Preservation.

YOSEMITE INDIANS – A HISTORICAL REVIEW

Lowell John Bean and Sylvia Brakke Vane

This paper will review the history of the peoples traditionally associated with Yosemite Valley and its environs. We will describe the relationship that they have had with other Indians, non-Indians, and, especially, federal agencies throughout their history culminating in a description of the current activities of the Mariposa Indian Council and its goals and efforts to manage Indian concerns in relationship to the Yosemite Park, the federal Indian recognition project, and other contemporary concerns.

Wednesday, October 17, 3:30

HISTORIC PRESERVATION

A LANDSCAPE METHODOLOGY FOR PLANNING AND DESIGN

Robert W. Allen Jr.[1]

Abstract

The landscape is extremely complex. It consists of perceptual, abiotic, biotic, cultural, behavioral, social and economic components. One must look for simple patterns in the landscape in order to understand its complexities. One pattern is "the stage setting," which forms the physical portion, and consists of abiotic, biotic, and cultural components. Another pattern is "the actors," which forms the human portion. This consists of people carrying out behavior, social, and economic activities. Unifying "the whole" is process, which consists of material, energy, species, and visual flow between the components and through time. This landscape ecology methodology allows one to summarize, simplify, and reduce landscape description to a minimum. This is accomplished while retaining the unique characteristics of the "whole" landscape. Thus, this procedure provides for the simple integration of landscape process with human purpose. It includes planning and design applications. Also, it can be applied universally. (See the Landscape Ecology Methodology flow chart.)

INTRODUCTION

The total landscape is incredibly complex. It is a mosaic of vegetation communities. It contains pockets of human activities and facilities, which are connected by corridors and paths. These occur on landforms over a large surface area. Over time the landscape is the resultant of the interaction of living organisms, including human beings, with other organisms. All of these are contained within their environmental surroundings. It is an ecological system consisting of homogeneous components. Its complexities are studied by looking for similarities within it or within individual populations. One must look for simple visual patterns in the large-scale landscape. This allows one to study its incredible intricacy and to understand its processes, which are causing the mosaic of patterns to occur. Can landscape ecology provide a basis for the better integration of human purpose with landscape process?

THE LANDSCAPE UNIT

A landscape unit consists of abiotic (non-living), biotic (living), and cultural (thinking) components. These components are united by process (flows of energy, materials, and species). The physical component serves as the basis for the human activity component. These activities include behavioral, social and economic endeavors. This landscape ecology procedure allows for the simple integration of human purpose with landscape process. These purposes include planning and design activities.

The landscape unit (ecosystem) is the primary element of the total landscape complex. It's physical component (subsystem) provides the landscape with its foundation and form. Its boundaries are based in the biotic component (subsystem), which are identified visually. The physical component and the biotic component are modified by human activities of the cultural component (subsystem). These respond to landscape process and the result is an overall mosaic pattern on the large-scale land surface.

1. Robert W. Allen, Jr., Landscape Planner/Architect, National Park Service, Denver Service Center, P. O. Box 25287, Denver, CO 80225-0287.

The physical, biotic, and cultural components provide the basis for the mosaic patterns of the total landscape. These components are described in text and mapped separately. The Physical Properties map, shows the general distribution of nonliving materials or the substrate. Its boundaries are based on similar properties for geology, soil, and hydrology formations. The Biotic Communities map shows the patterns formed by living plants and animals in the total landscape. Its boundaries are based on common inhabitants of plant communities on land, and benthic communities in water. The Cultural Features map illustrates man-affected or man-built characteristics. Its boundaries are based on unique properties for archaeological, historical, and contemporary land uses.

The Landscape Units map and table combine these three major components into a Composite or Ecosystem map. (See Daingerfield Island Ecosystem Map & Table). The mapping units include the following topics: the make-up and distribution of physical materials, the characteristic plants and animals, the human activities and/or facilities, and the accompanying landscape processes. Each landscape unit has characteristic properties that are homogeneous and that are adapted for human use and/or development.

Thus, a landscape capability map can be produced. A panel of experts determines each landscape unit's capabilities for preservation, use, or development. (See Daingerfield Island Resource Capability and Concern map and table.) The ability of each landscape unit to support a specific human activity and/or facility is judged. The characteristics of the proposed use and/or development are compared with the attributes of each landscape unit. Then high, medium or low capability rankings for use and development can be assigned.

This evaluation and assessment of landscape units must then be adjusted or "fine-tuned" to address other more site-specific concerns. These are vital, sensitive or critical factors that cross landscape units or zone boundaries. For example, they include flood-prone areas, or areas containing rare, threatened, and endangered species. These areas are important in estimating the overall landscape capability for use and/or development.

THE HUMAN ACTIVITY COMPONENT

Human purpose is combined with landscape process. There is a planned interrelationship of human activities with the landscape. The specific activity and its immediate setting are a distinct unit. This unit has spatial, social and economic characteristics. It is the primary unit of the behavioral component. Human needs, desires, and expectations are identified and analyzed for a specific site. The existing and/or proposed activities are compared with the attributes of each landscape unit. The specifics needed to support each given activity is addressed. The spaces are united by channels that contain flows of materials, energy, and individuals.

THE SITE PROGRAM

The landscape and human activity components are combined to form "the whole." This is accomplished by developing a ranked series of human values. These are based on purposes, goals, and objectives, and they provide a framework for judging planning and design programs for specific landscape sites. The purpose is to enable individuals to find, to know, and to do something on that site in relationship to their values, as well as those of the landscape.

Now alternative site programs can be developed. (See Daingerfield Island Site Program map and table.) Each program map and table show the specific spaces (volumes), their functions (activities), and their circulation linkages (channels) in their desired locations on the project site. The Site Program table includes the following items: the specific human activities, the setting, the necessary land management controls, the characteristics of the visual space, the approximate area needed for each activity, the support facility and/or prop needed for each activity, the density of use allowed, the internal and external circulation linkages, and the construction costs for the proposed facilities.

A landscape impact chart can be prepared that compares landscape units with human activities. This chart shows the elements arranged by land and/or water categories. The human activity units include the following categories: built facilities, user activities, and/or circulation. Also, the landscape table shows the approximate area and the type of support facility committed to each human activity. The possible degree of impact includes high, moderate, and low categories.

LANDSCAPE SITE EVALUATION AND ASSESSMENT

Alternative site use and/or development models are evaluated and assessed. Perceptual, physical, behavioral, social and economic criteria, and performance standards provide the basis for making judgments. These are derived from the purposes, goals, and objectives that were determined previously. Each alternative has spaces, corridors, and a setting that affect the various human activities in different ways. A panel of experts evaluates and/or assesses the environmental consequences of an alternative by addressing each set of criteria and/or performance standard.

These are organized into a table showing capacities, qualities, and costs. (See Daingerfield Island Capacities, Qualities, and Costs tables.) A rating is assigned for each criteria and/or performance standard. Also, the table is weighted according to the relative importance of each part to the "whole." An index number of "one" is assigned to any one of the alternatives. This number provides the basis for comparing the capacities and qualities for each alternative. Also, it helps determine the relative effectiveness. Then construction, operation, and maintenance costs are determined for each alternative.

The Summary Value table compares the relative index numbers for qualities, capacities, and costs for each alternative. (See the Daingerfield Island Summary Value table.) The qualities and the capacities are added. Then they are divided by the costs. The resulting number provides a cost-effectiveness comparison of the alternatives.

Thus, this landscape ecology procedure results in a numerical ranking of the alternatives. This includes land and water categories. Also, comprehensive human purposes are integrated with complex landscape process, including planning and/or design activities.

CONCLUSION

This landscape ecology procedure is useful for inventory, assessment, and modeling purposes. Also, it is useful for Planning and Design applications. In the future, the procedure can be applied to various categories of landscape, including wild, rural, suburban, and urban and their various degrees of mixture in the landscape. It can be used to study, monitor, or manage small, medium, and large scale landscapes. Also, the consideration of short, moderate, or long-term time periods is integrated into the procedure.

This methodology recognizes that the landscape unit provides "the stage setting." This is perceived as allowing, or not allowing, various human activities to occur, or not to occur. These activities are carried out by human "actors" in response to their various purposes. This procedure focuses on the ongoing system of interrelationships between the two. Here is a procedure for the positive, long-term, integration of complex human purpose with broad scale landscape process that can be applied universally.

REFERENCES

Allen, Jr., R., G. Nez, F. Nicholson, and L. Sutphin. General Technical Report PSW-35. "Enviroplan – A Summary Methodology for Comprehensive Environmental Planning and Design." Proceedings of Our National Landscape – A Conference on Applied Techniques for Analysis and Management of the Visual Resource. U.S. Department of Agriculture. April 1979. Incline Village, Nevada. Dansereau, Pierre. 1975. Inscape and Landscape – The Human Perception of Environment. New York and London: Columbia University Press.

Deasy, C.M. In Collaboration with T.E. Lasswell. 1985. *Designing Places with People – A Handbook on Human Behavior for Architects, Designers and Facility Managers.* New York: Watson-Guptill Publications.

Dickinson, R.E. 1970. *Regional Ecology.* New York: John Wiley and Sons, Inc.

Fisher, W.F., J.H. McGowen, L.F. Brown, and C.G. Groat. 1972. *Environmental Geologic Atlas of the Texas Coastal Zone.* Bureau of Economic Geology, Austin, Texas.

Forman, R.T.T. and M. Gorden. 1986. *Landscape Ecology.* New York, Chichester, Brisbane, Toronto, and Singapore: John Wiley & Sons.

Hester, Jr., R.T. 1975. *Neighborhood Space.* Stroudsburg, PA: Dowden, Hutchinson and Ross, Inc.

Isachenko, A.G. The First English Language Edition 1973. *Principles of Landscape Science and Physical-Geographic Regionalization.* Clayton, Victoria, Australia; Portland, Oregon, USA; Victoria, Canada; and London, England: Melbourne University Press.

Perin, C. 1970. *With Man in Mind – An Interdisciplinary Prospectus for Environmental Design.* Cambridge, MA: The MIT Press.

McAllister, D.M. 1982. *Evaluation in Environmental Planning – Assessing Environmental, Social, Economic and Political Tradeoffs.* Cambridge, MA and London, England: The MIT Press.

LEGEND

RIVER ESTUARY
Freshwater tidal river,moderate flow rate,
phytoplankton,zooplankton,benthic invertebrates
fish and waterfowl

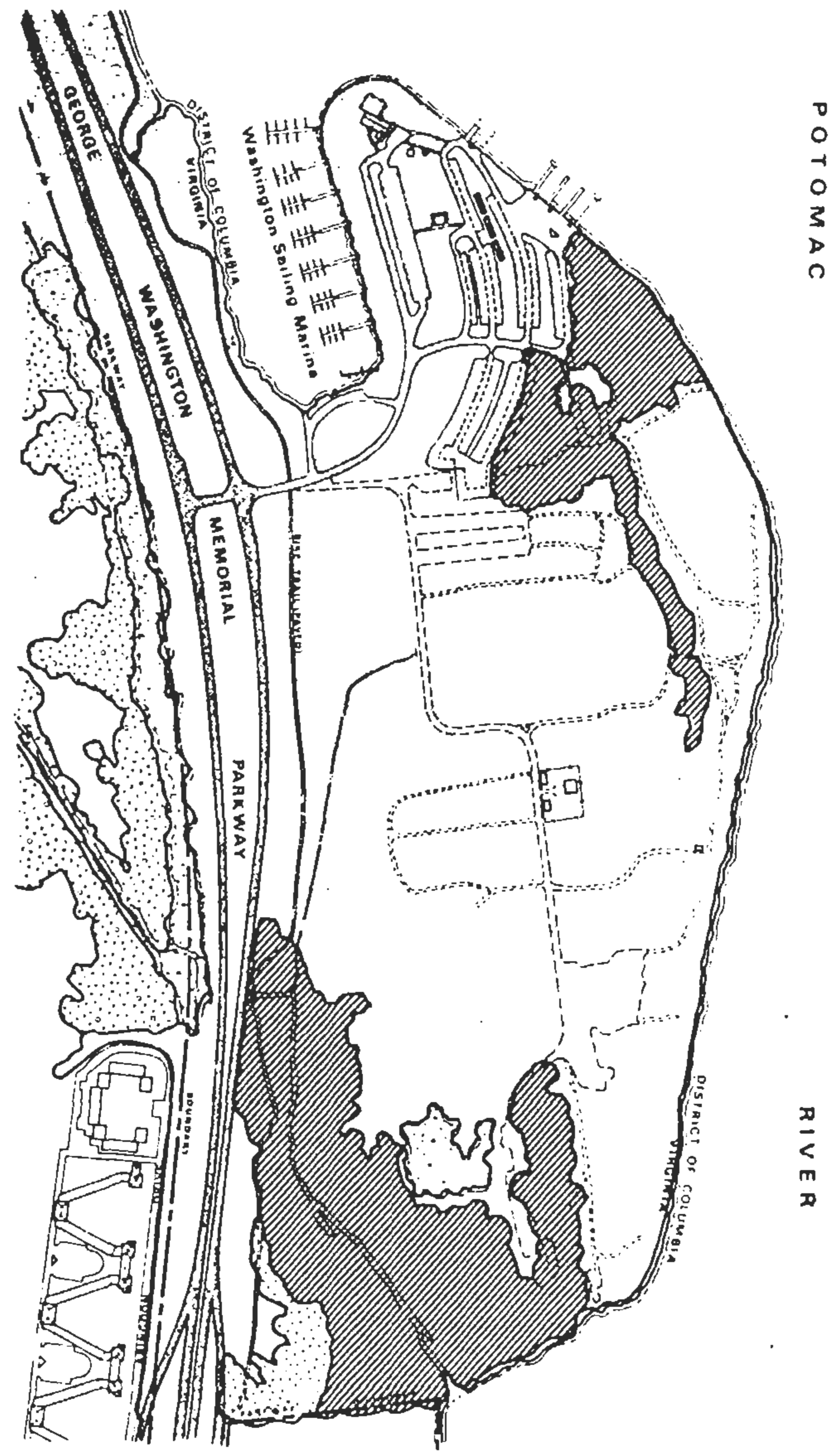
WETLAND
Inland fresh marshes permanent high water table,
relatively impermeable organic deposits,
emergent grasses,bulrushes and rushes,
reptiles,waterfowl and mammals

PARKLAND
Dredged,sandy fill subject to infrequent flooding
moderately high water table;
deciduous trees,ornamental trees and shrubs,
grasses, herbaceous plants,
reptiles,amphibians,birds and mammals

BOTTOMLAND HARDWOOD FOREST
Dredged,sandy fill subject to infrequent flooding,
moderately high water table,
deciduous trees,
reptiles, amphibians,birds and mammals

UPLAND HARDWOOD FOREST
Well-drained,fine,sandy loam,
deciduous trees;
reptiles,amphibians,birds and mammals

HUMAN SYSTEM
Man-made sites and structures, dredged sandy fill subject to infrequent flooding, exotic and ornamental trees and shrubs



PARKWAY BOUNDARY
STATE BOUNDARY
PRIMARY ROAD
PAVED PARK ROAD/AREA
UNPAVED ROAD/TRAIL
BUILDING
STREAM
WETLAND

N

ECOLOGICAL SYSTEMS
DAINGERFIELD ISLAND
GEORGE WASHINGTON MEMORIAL PARKWAY
VIRGINIA

0 1000 2000 FEET
100 0 500 METERS

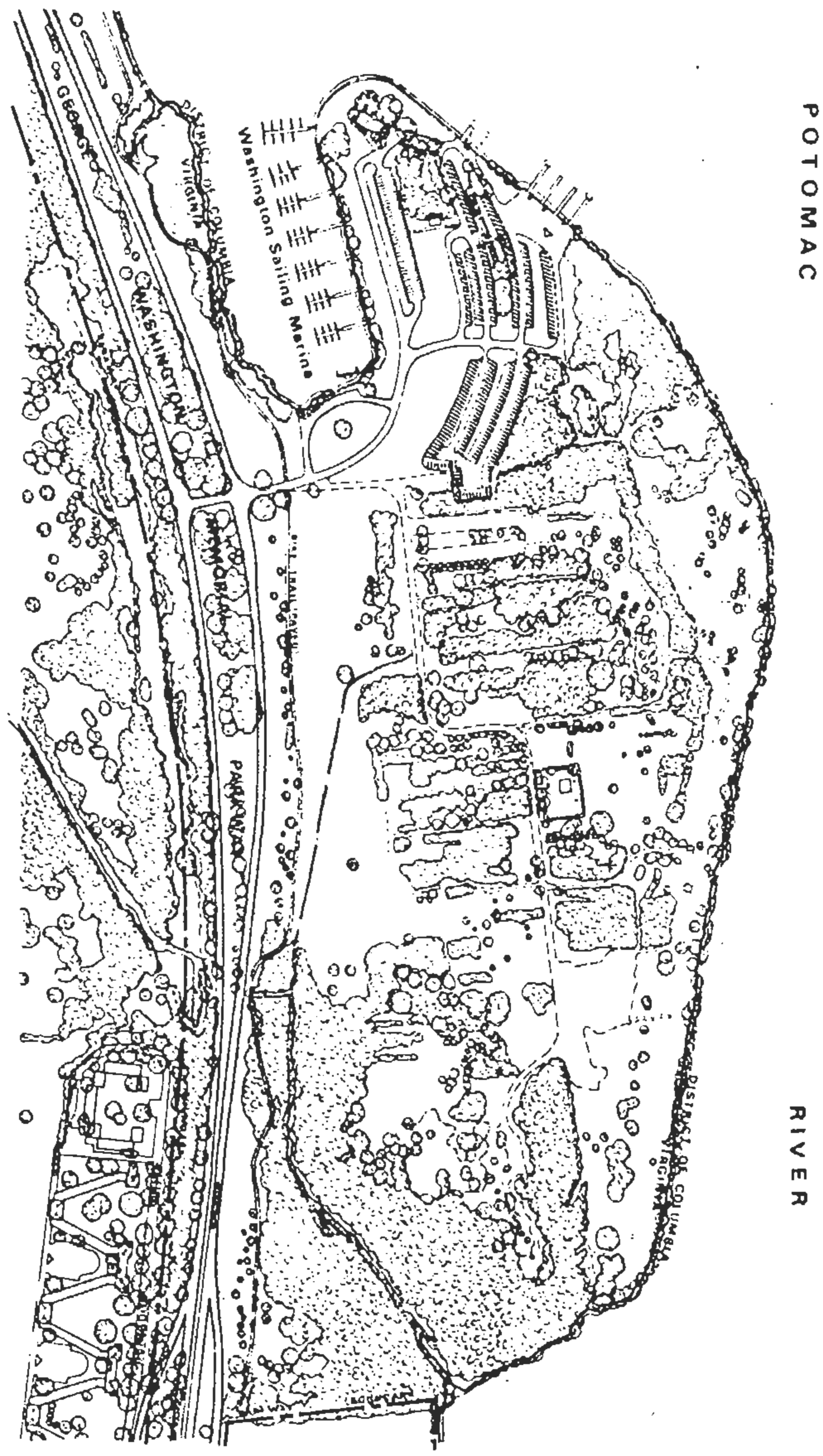
UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

850 | 40,024
DSC | MAY '80

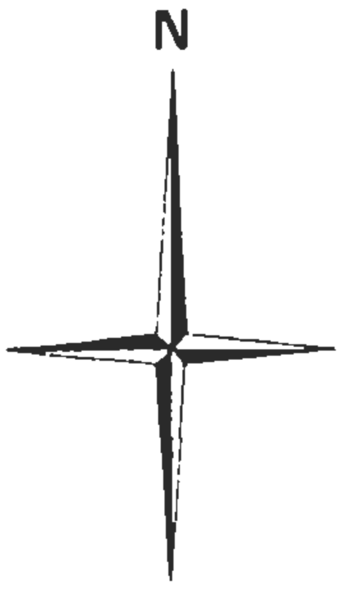
ECOSYSTEM SUMMARY TABLE	ECOSYSTEM				
	River Estuary	Wetland	Parkland	Bottomland hardwood forest	Upland hardwood forest
Landform	Broad, shallow basin except where channelized.	Low depressed areas.	Low-lying, relatively flat relief.	Low-lying, relatively flat relief.	Moderate slope; 0-8%
Physical	River bottom mud deposits, overlying silt and clay, rubble, and larger rocks .	Generally impermeable organic deposits.	Dredged, sandy fill with some clay and silt.	Dredged, sandy fill with some clay and silt.	Fine sandy loam overlying silty clay loam.
Microclimate	Generally cooler in the summer; warmer in the winter.	Humid and cooler in the summer; warmer and more moist in the winter.	Generally warmer and drier in summer; colder and drier in winter.	Cooler and more moist in summer; warmer and more moist in winter.	Cooler and more moist in summer; warmer and more moist in winter.
Water	Tidal freshwater; moderate flow rate.	Permanently high water table.	Moderately high water table ; subject to infrequent flooding.	Moderately high water table ; subject to infrequent flooding.	Well drained, not subject to fluvial flooding.
Biotic	Phytoplankton, zooplankton, benthic invertebrates, freshwater and anadromous fish; and waterfowl.	Emergent grasses, bulrushes and rushes; reptiles, waterfowl, and mammals.	Deciduous trees, ornamental trees and shrubs, grasses, herbaceous plants, reptiles, amphibians, birds, and mammals.	Deciduous trees; reptiles, amphibians, birds, and mammals.	Deciduous trees; reptiles, amphibians, birds, and mammals.
Cultural	Dredging necessary to maintain channel.	Man-made alterations to topography.	Recreational facilities and roads.	Relatively undisturbed.	Relatively undisturbed.
Environmental Process	Freshwater river; first major bend below the fall line; beginning of silt deposition.	A permanently high water table; poor drainage; depression.	Man maintained.	Succession controlled by infrequent flooding.	Normal upland succession.

LEGEND

- NPS building/facility
- NPS maintained area
- Concession building/facility
- Concession maintained area
- Concession parking
- Wooded area
- Open grassland
- Wetland



PARKWAY BOUNDARY
STATE BOUNDARY
PRIMARY ROAD
PAVED PARK ROAD/AREA
UNPAVED ROAD/TRAIL
BUILDING
STREAM
WETLAND



EXISTING CONDITIONS

DAINGERFIELD ISLAND

GEORGE WASHINGTON MEMORIAL PARKWAY

VIRGINIA

0 1000 2000 FEET

100 0 500 METERS

850 | 40020
DSC | MAY '80

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

LEGEND

RESOURCE ZONE

Parkland	A
Nursery	B
Transitional bottomland forest	C
Upland hardwood forest	D
River estuary	E
Bottomland hardwood forest	F
Wetland	G

RESOURCE CAPABILITY

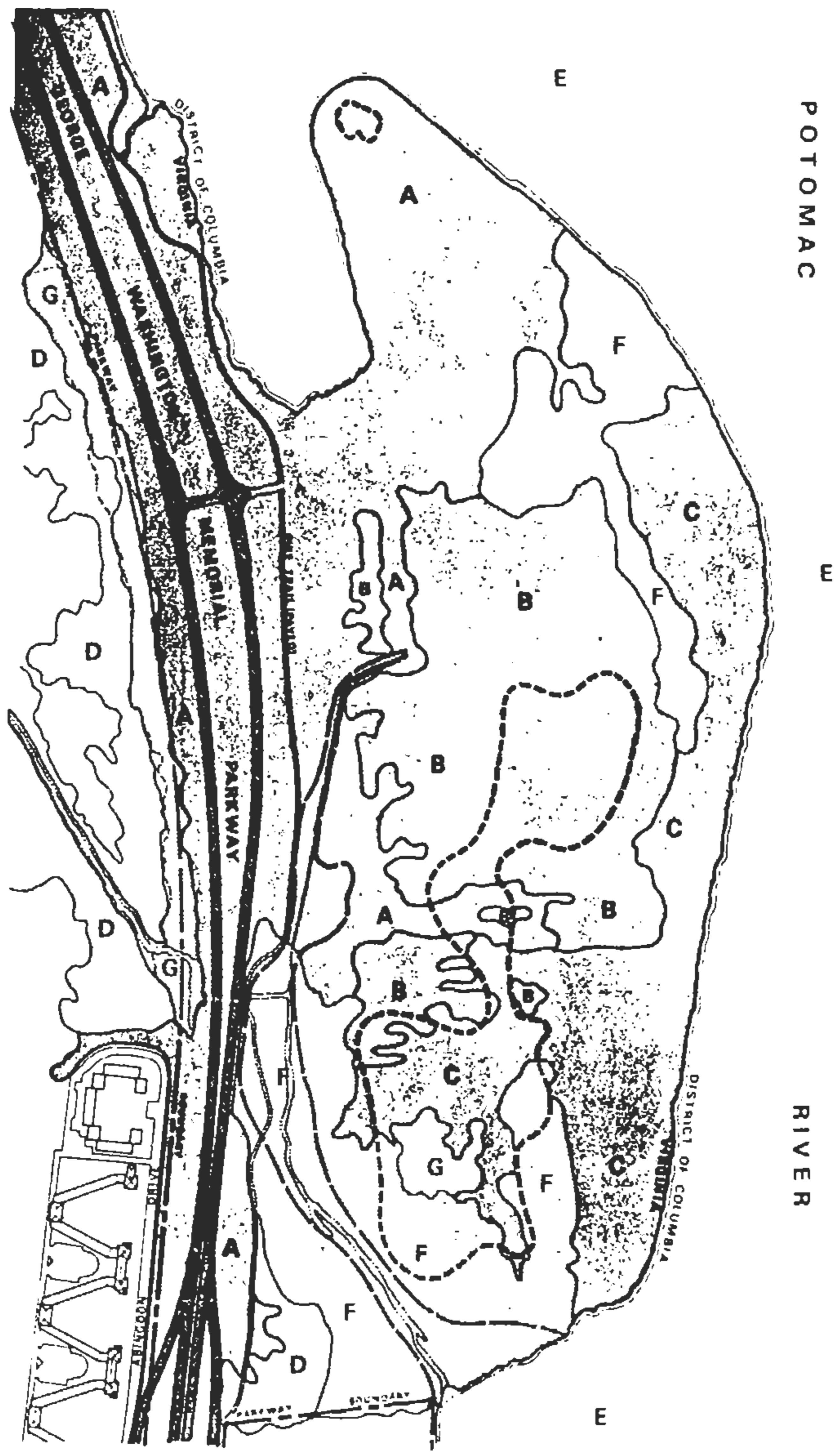
Medium to High	A,B,C
Medium to Low	D
Low	F,G
Very Low	E

RESOURCE CONCERN

High flood line (100 year) - - - - - -

Low flood line (Semi-Diurnal) — — —

PARKWAY BOUNDARY
STATE BOUNDARY
PRIMARY ROAD



N

RESOURCE CAPABILITY AND CONCERN

DAINGERFIELD ISLAND

GEORGE WASHINGTON MEMORIAL PARKWAY

VIRGINIA

0 1000 2000 FEET

100 0 500 METERS

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

850 | 40.033
DSC | MAY '80

Resource Capability Table

DAINGERFIELD ISLAND

PROPOSED USE AND DEVELOPMENT

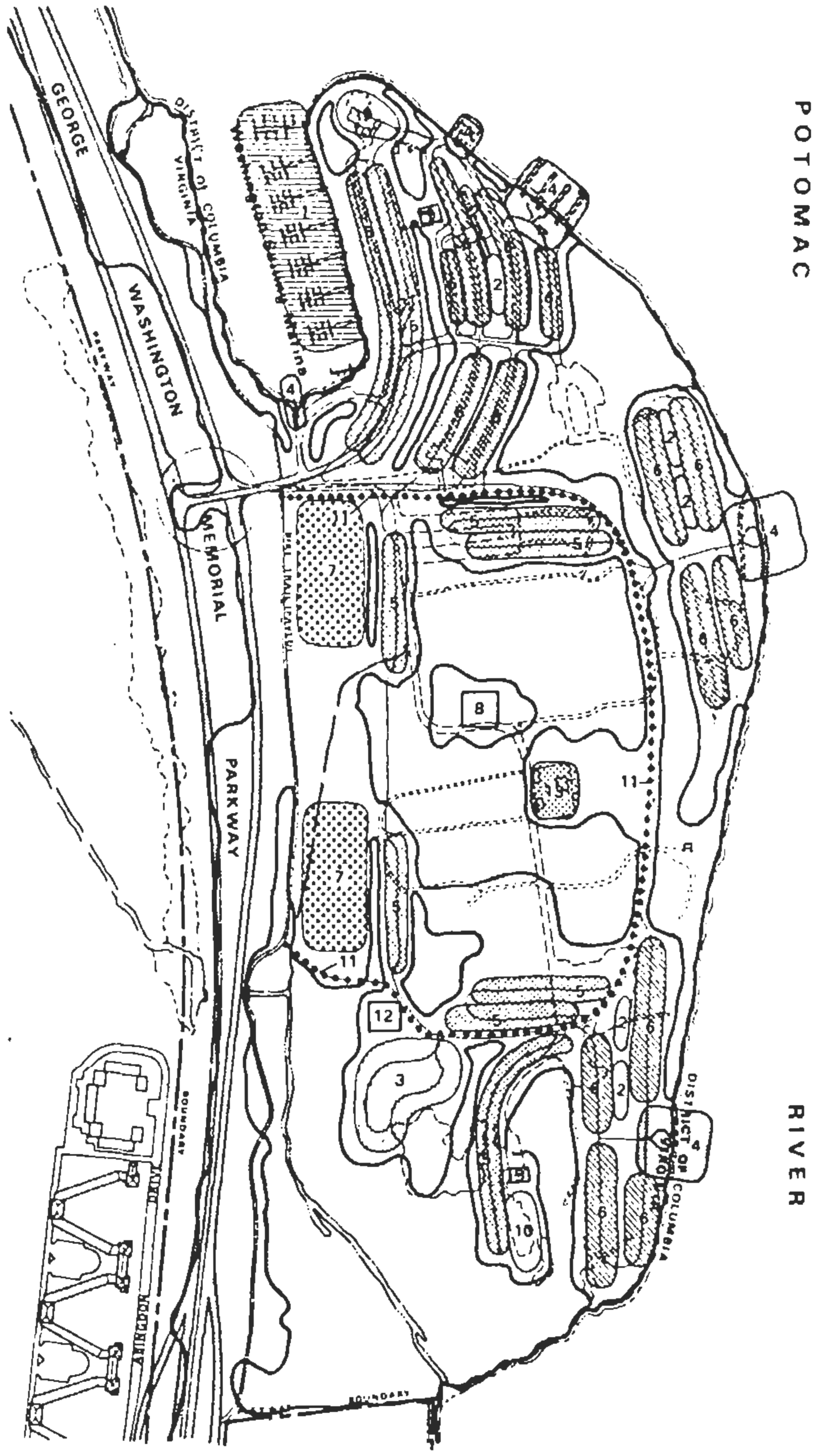
Resource Zone	Dry Boat Slips	Rack Storage	Boat Launch	Wet Boat Slips	Boat Harbor	Dredging	Comfort Station	Food Concession	Viewing Area	Sports Field	Sports Concession	Maintenance Facility	Boat Repair Yard	Parking	Road	Bicycle Trail
Parkland	□	○	▲		▲		○	□	○	○	○	□	□	□	□	○
Nursery	□	○					○	□	○	○	○	▲	▲	□	□	○
Upland Hardwood	▲	□					□	▲	□	▲	□	▲	▲	▲	▲	□
Transitional Bottomland	▲	□	▲	▲	▲		□	▲	□	▲	□	▲	▲	▲	▲	□
Bottomland Hardwood	▲	□	▲	▲	▲		□	▲	□	▲	□	▲	▲	▲	▲	□
Wetland	▲	□		▲	▲		▲	▲		▲	▲	▲	▲	▲	▲	▲
River Estuary			▲	▲	▲	□										

CAPABILITY: HIGH ○ MEDIUM □ LOW ▲

LEGEND

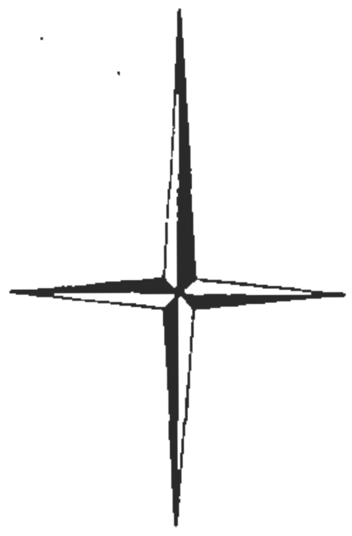
ACTIVITY

Activity	
Mooring boat	1
Storing small boat	2
Repairing boat	3
Launching boat	4
Parking automobile	5
Parking boat trailer	6
Playing field sport	7
Eating	8
Toileting and showering	9
Viewing	10
Walking, jogging, biking	11
Storing sports equipment	12
Storing maintenance equipment	13



PARKWAY BOUNDARY
STATE BOUNDARY
PRIMARY ROAD
PAVED PARK ROAD/AREA
UNPAVED ROAD/TRAIL
BUILDING
STREAM
WETLAND

N



Site Program

ALTERNATIVE 3

DAINGERFIELD ISLAND

GEORGE WASHINGTON MEMORIAL PARKWAY

VIRGINIA

0 1000 2000 FEET

100 0 500 METERS

UNITED STATES DEPARTMENT OF THE INTERIOR / NATIONAL PARK SERVICE

850 | 40,030
DSC | MAY '80

SITE PROGRAM

ALTERNATIVE 3

ACTIVITY ZONE	Characteristics of the visual space	Approximate area in square feet	Support facilities	Allowable density	Circulation linkages	Construction cost
Mooring boat	Shore microclimate, open	7,900	Slips and decks	3 X 185 = 555 people	Parking, launch, dry boat slips	Existing $ 0 . 00
Parking boat trailer	Screened, flat, linear	373,875	Roads & pull-offs	3 X 924 = 2,772 people	Road, launch, wet boat slips	$ 150,200
Storing small boat	Covered, screened	11,325	Structure	288 boats	Parking, launch	$ 506,700
Repairing boat	Enclosed, flat	6,670	Hard surfacing	100 boats	Road	$ 35,300
Launching boat	Shore microclimate, props necessary, open	107,160	Wood decks, ramp, and 7 cranes	8 launches	Wet boat slips, dry boat slips, rack storage, parking	$ 96,800
Parking automobile	Screened, flat	281,835	Surfacing	2.5 X 940 cars= 2,350 people	Boat slips, road, concession, sports field	$ 344,800
Eating	Open, flat	12,200	Structure	468 people	Central location	$ 937,300
Toileting and showering	Enclosed	1,800	Structure	48 people	Sports field, boat slips, concession	$ 155,900
Playing field sport	Screened, open	156,815	Grass	44 people	Comfort station, concession, parking	Existing $ 0 . 00
Storing sport equipment	Enclosed	8,000	Structure	60 people	Sports field, bike trail	$ 623,700
Storing maintenance equipment	Enclosed	30,500	Surfacing		Road	Existing $ 0 . 00
Riding bike	Partly enclosed, linear	4,000	Hard surfacing		Sports concession	$ 3,000
Driving car	Open, linear		Hard surfacing			$ 185,400
Viewing	Open	40,000	Surfacing	700 people	Concession, river	$ 24,300
Dredging channel		111,110(cu.yd.)	Dredging equipment			$ 1,559,200
TOTALS		1,305,190 sq. ft.		6,997 people		$ 4,622,600

The Site Program charts for each alternative deal with cost figures obtained from the National Park Service Class C procedures. They are current year (1979) estimates and are the initial construction costs only. These costs include only those activities that are described in each alternative. Related costs for support actions are not included here, but will be identified prior to construction when detailed cost estimates are necessary.

CAPACITIES (facility sizes converted into equiv. no. of persons in simultaneous use, existing at <u>end</u> of 20 year period of net change in facility conditions)

FACILITIES	ALLOWABLE DENSITY	ALT. I		ALT. II		ALT. III		ALT. IV		ALT. V	
		QUANT. OF FACILITY	PERSON	QUANT. OF FACILITY	PERSON	QUANT. OF FACILITY	PERSON	QUANT. OF FACILITY	PERSON	QUANT. OF FACILITY	PERSON
Parking boat trailers	1 space -3 person equiv.	100	300	364	1092	924	2772	772	2316	922	2766
Storing boats	1 boat -2 person equiv.	50	100	72	144	288	576	192	384	288	576
Mooring boats	1 slip -3 person equiv.	50	150	185	555	185	555	185	555	398	1194
Auto parking	1 car -3 person equiv.	75	225	226	678	940	2820	1230	3690	1270	3810
Toilets	1 unit -1 person equiv.	16	16	16	16	48	48	48	48	48	48
Sports	1 field -40 person equiv.	1	40	1	40	2	80	5	200	2	80
Picnicking	1 acre -50 person equiv.	1/2	25	10	500	6	300	6	300	6	300
Biking	1 mile -40 person equiv.	1	40	1	40	1.7	68	1.7	68	1.7	68
Walking-Jogging	1 mile -50 person equiv.	1	50	1	50	1.7	85	1.7	85	1.7	85
Viewing	various sites		50		50		100		100		100
Eating	concession building		60		114		400		600		800
SUM OF CAPACITIES			1056		3279		7804		8346		9.27
REL. INDEX NO. BASED ON ALT. I			1.00		3.11		7.33		7.84		9.23

QUALITIES (comparative rating range 1-10, see footnote[1/])

CRITERIA	RELATIVE IMPORTANCE WEIGHT[2/]	ALTERN. I		ALTERN. II		ALTERN. III		ALTERN. IV		ALTERN. V	
		Rating[3/]	Weighted Rating	Rating[3/]	Weighted Rating	Rating[3/]	Weighted Rating	Rating[3/]	Weighted Rating	Rating[3/]	Weighted Rating
Convenience and minimal congestion of boat launching and mooring	.14	1	.14	4	.56	8	1.12	6	.84	10	1.40
Convenience of separate launching of small boats	.02	1	.02	2	.04	10	.20	6	.12	10	.20
Convenience of boat repair	.07	1	.07	3	.21	8	.56	10	.70	10	.70
Quality of meeting space and supporting facilities for sportsman	.09	1	.09	2	.18	8	.72	10	.90	10	.90
Efficiency of pedestrian circulation	.07	1	.07	1	.07	6	.42	6	.42	6	.42
Maintain: Diversity of ecology on land & water	.14	8	1.12	10	1.40	4	.56	6	.84	2	.28
Interesting shoreline access	.07	1	.07	1	.07	8	.56	6	.42	10	.70
Interesting viewing stations	.06	1	.06	2	.12	7	.42	7	.42	7	.42
Efficiency and safety of bicycling	.08	1	.08	1	.08	6	.48	6	.48	6	.48
Interesting and convenient picnicking	.06	1	.06	5	.30	4	.24	4	.24	4	.24
Convenience and quality of food facilities	.10	1	.10	3	.30	8	.80	10	1.00	10	1.00
Efficiency of vehicle circulation/parking	.10	1	.10	3	.30	8	.80	6	.60	10	1.00
SUM OF QUALITIES	1.00		1.98		3.63		6.88		6.98		7.74
REL. INDEX NO. BASED ON ALT. I			1.00		1.83		3.47		3.52		3.90

1/ These qualities cannot be indicated by capacities alone. These criteria are defined and applied by planners and managers familiar with these resources and activities. Each Alternative is rated between 1 and 10 on each criterion. See text.

2/ These relative importance factors total 1.00. They are interpreted from the park mandate and management policy. They are predetermined before qualitative ratings are applied to Alternatives.

3/ The Alternatives are rated between 1 and 10 on each criterion by a multi-discipline professional group.

COSTS (of development, maintenance and operations, selective, where differing substantially among alternatives in $000, in terms of annual averages)

FACILITIES	ALT. I		ALT. II		ALT. III		ALT. IV		ALT. V	
	Constru(a)	O&M(b)	Constru	O&M	Constru	O&M	Constru	O&M	Constru	O&M
Storing small boats		12.50		18.00	14.62	72.00	9.75	48.00	14.62	72.00
Parking boat trailers	1.00		2.00		4.33		4.03		4.41	
Launching boats					2.80		2.80		5.90	
Boat repair area					1.00		2.00			
Mooring boats	4.30		8.60		8.60		8.60		14.50	
South boat slip									54.80	
Silt dredging(c)		30.00		90.00		90.00		90.00		100.00
Turf for field sports		2.16	4.4	2.16	4.5	3.78	5.00	3.24	4.40	3.78
Viewing platforms/sites					.07		.07		.07	
Jogging, biking		.72		.72	1.70	1.44	3.50	1.20	2.80	1.92
Picnicking			.30		.20		.15		.20	
Eating in buildings	3.25	.50	6.55	1.00	27.00	2.70	57.65	5.76	57.65	5.76
Toilets and showers	1.00	5.11	2.00	10.22	4.50	20.44	4.50	30.66	4.50	30.66
Water, sewer, electricity	1.00	2.00	2.00	3.00	4.50	4.00	4.50	4.00	4.50	7.00
Auto roads	1.00	.72	1.35	.72	9.95	1.44	13.00	1.20	13.43	1.92
Auto parking	1.00		1.35	.72	9.95	.72	13.00	.72	13.43	.72
Signing/paint striping		7.72		7.74		13.25		11.40		13.25
Maintenance equipment		1.20		1.20		3.00		3.00		3.00
Storage of sports equipment					18.00	30.90	22.00	1.1	22.00	1.1
Supplies and materials		4.54		4.54		8.76		9.80		11.00
	12.55	67.17	28.55	140.02	98.72	221.62	150.55	210.08	217.21	252.11
SUM OF COSTS	79.72		168.57		315.34		360.63		469.32	
REL. INDEX NOS. BASED ON ALT. I	1.0		2.11		3.95		4.52		5.88	

Footnotes

(a) Although construction occurs mainly at beginning of 20-year period it is annualy averaged here. No interest or present valuation computation is made, because it would not change comparisons.

(b) Operations and maintenance will increase over 20 years but are annually averaged, for this chart.

(c) Silt dredging estimates as follows: Alt. I: area 2000' x 100', av. ann. siltation .5'/yr. @ $8/cu.yd or 15¢ per 1/2 cu. ft. per year=$30,000 per year annual average.

Alt. II, III, IV: 2000' x 300' is 3 times wider dredged area = $90,000.

Alt. V: The added south boat slip would have much less siltation than north slip, estimating both slips at $100,000.

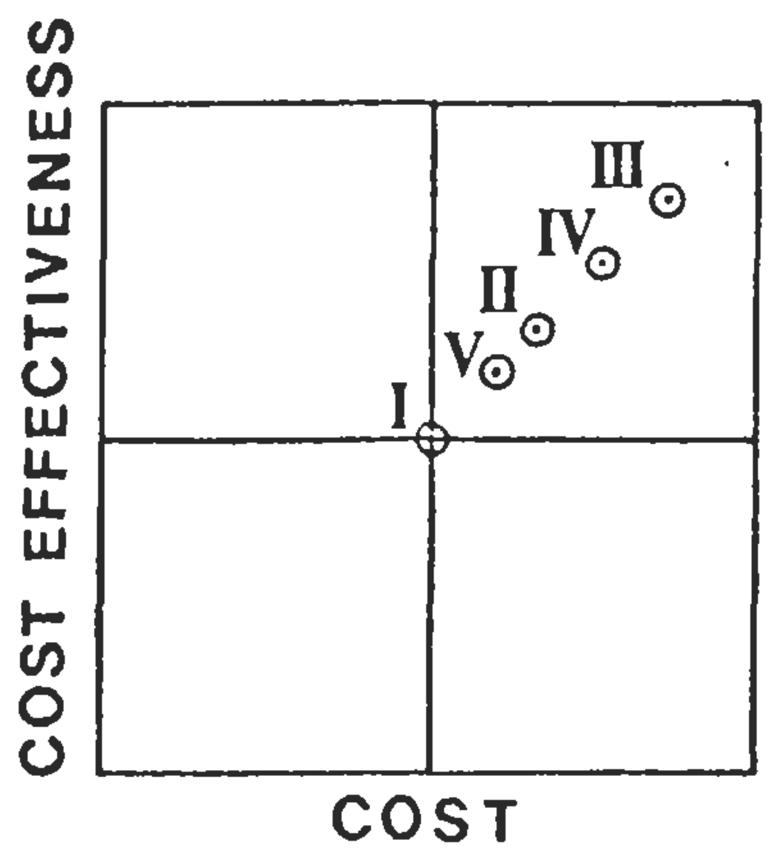
Summary Values (relative index numbers)

	Capacity	Quality	Cost
Alternative I	1.00	1.00	1.00
Alt. II	3.11	1.83	2.11
Alt. III	7.33	3.47	3.95
Alt. IV	7.84	3.52	4.52
Alt. V	9.23	3.90	5.88

TABLE 5

Cost-Effectiveness Comparisons

It is now possible to use these summary values in the cost-effectiveness relationship: $\frac{V + Q}{C}$.



The highest quotient indicates the best cost-effectiveness. Environmental, social, and political factors must be considered as well as economic to determine the preferred alternative. This comprehensive evaluation will occur after this document has been submitted for public hearing during the Environmental Review period.

THE HISTORIC LANDSCAPE ARCHITECTURE OF NATIONAL PARKS

Linda Flint McClelland[1]

Abstract

From 1916 to 1942, the National Park Service (NPS) established a landscape design ethic for the development of public parks that harmonized roads, trails, and buildings, with scenery and natural features. The origins of NPS landscape architecture lay in the English landscape gardening tradition promoted in the United States by Alexander Jackson Downing and practiced in the private pleasure grounds and urban parks in the 19th century. In the late 1920s, NPS developed both a program of master planning on which to base annual requests for funding for the construction of roads, trails, and buildings, and practices of rustic design and naturalistic planting that blended construction into the natural surroundings. In these ways, NPS provided facilities for public access, use, and comfort and upheld its role of stewardship. During the New Deal, NPS policy and practices influenced the development of state parks nationwide.

An understanding of the landscape architecture of national parks provides a basis for evaluating the historic significance of park landscapes. These areas are historic districts containing roads, trails, overlooks, bridges, buildings, parking areas, vistas, landscape plantings, and small elements such as signs and water fountains. Because these places reflect the commonplace and manifold contributions of a generation of creative NPS designers who were committed to the use and preservation of national parks, many of these areas are eligible for listing in the National Register of Historic Places and, therefore, merit protection through the management of cultural resources.

INTRODUCTION

The Organic Act of 1916, creating the National Park Service, charged the Service with promoting and regulating the use of national parks in ways that would:

> conserve the scenery and the natural and historic objects and wildlife therein by such means as shall leave them unimpaired for the enjoyment of future generations.

This purpose has been attributed to Frederick Law Olmsted, Jr., a preeminent landscape architect and the son of Frederick Law Olmsted, who had authored a pivotal report that led to the preservation of Yosemite half a century earlier. The involvement of the Olmsteds in park conservation is indicative of the advocacy of the landscape architecture profession for the preservation of natural areas. The profession also played an important role in the development of parklands for public use, enjoyment, and appreciation.

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1. Linda Flint McClelland is an architectural historian for the National Register program of the National Park Service.

ORIGINS OF PARK LANDSCAPE DESIGN

The landscape design of national and state parks evolved from the 18th- and early 19th-century English landscape gardening tradition of William Kent, Capability Brown, and Humphrey Repton. This tradition came to America at the beginning of the 19th century and was first manifested in the "pleasure grounds" of the wealthy along the Hudson River in New York. Estates, such as Montgomery Place, were celebrated in the writings of Alexander Jackson Downing in the *Horticulturalist* (Downing 1894), whose *Treatise on the Theory and Practice of Landscape Gardening,* first published in 1841, would become the standard text for the landscape profession.

Apart from a fashionable manor house and formal gardens, the pleasure grounds contained serpentine circuit drives, open meadows, winding paths, picturesque rockwork, rustic bridges, and wooded glades. Rustic summerhouses and pavilions of unpeeled logs and branches, provided shade and seating for rest and contemplation. Picturesque elements – groves of hemlocks and pines, bubbling streams, rock outcrops, waterfalls, and scenic riverviews – defined a "wilderness," as the wild, untamed natural areas of these places were called (Haley 1988; Downing 1859).

The components of the 19th-century pleasure grounds would find counterparts in national and state parks in the 20th century. The gatehouse would become the entrance station. Summerhouses would become overlooks and picnic shelters. Rustic seats would become sturdy benches and picnic tables. Rockwork would become natural outcrops and be incorporated into the foundations and walls of park structures. Woodland paths would become rugged hiking and bridle trails through which visitors experienced the natural beauty of the parks. The circuit drive would become the loop roads that facilitated the flow of traffic in campgrounds and picnic areas or that circled parks to provide access and scenic views from many points.

The transition from the pleasure ground to the public park occurred in the second half of the 19th century through the work of Olmsted, Sr., Calvert Vaux, and others. These parks were urban and often created through earthmoving and extensive planting. Natural features, such as meadows, streams, lakes, waterfalls, and wooded glens, were improved upon or completely assimilated to provide picturesque effects.

Of Olmsted's greatest parks, Franklin Park in Boston, designed in the 1880s, established the precedent for the landscape design of natural areas. The park was envisioned as a "country park" from the start and preserved natural wooded areas and picturesque outcrops of Roxbury puddingstone, a local conglomerate. Open meadows were carved out of previous farms and fields; natural vegetation was retained and enhanced by new plantings, many of which were native to the region.

Sturdy Shingle-style shelters atop Schoolmaster Hill and on a 600-foot boulder terrace in the Playsted were built of rusticated stone and boulders. Rockwork provided rustic accents in an overgrown curving stairway of 99 steps and in the edging of overlooks, paths, and roads. A circuit or loop road and system of meandering paths was installed and grades for strolling and driving were separated by stone bridges and the vine-covered Ellicotdale arch, a rustic foot tunnel (Zaitzevsky 1982).

Franklin Park established both a precedent and a standard for the design of rustic park structures, use of rockwork and native vegetation, and the arrangement of the country park in relationship to natural features and transportation needs. The Olmsted legacy established a design ethic for the public use of natural areas that would be carried into the 20th century by the landscape architecture profession. This influence would appear in the great camps of the Adirondack region in the late 19th century and would be practiced in the many park and parkway projects of the Olmsted firm and others into the 20th century. It combined with the West Coast influences of Bungalow architecture and Japanese landscape design in the Craftsman architecture of the early 20th century. Naturalistic gardening techniques as well as comments on the preservation of natural areas appeared in period writings, and wild gardens were included in the most formal estate designs. Through these influences and the growing natural history programs of the national parks, this design ethic was adopted and developed by NPS designers (Hubbard 1924; Stickley 1909; Waugh 1917).

EARLY DEVELOPMENT OF NATIONAL PARKS

When NPS took charge of the parks in 1916, visitation was hampered by poor roads and lack of facilities. NPS inherited the development of former keepers – the U.S. Army, the railroads and concessioners, and, in the case of Yosemite, the state of California. Entrance arches, patrol cabins, and rudimentary ranger stations existed. By far the grandest of park architecture were the hotels that concessioners had built. The most popular and dramatic of scenic viewpoints were accessible by wooden planks, stairways, and railings.

Director Steven Mather hired landscape architect Charles Punchard in 1919. Punchard was followed in 1920 by Daniel Hull, who served as the NPS's principal planner and designer until 1927, when Thomas Vint, his assistant, took charge. The chief responsibility of these individuals was to harmonize construction, new and old, with the unique natural and scenic qualities of each park.

Poor roads and dangerous conditions were a constant concern in the western parks. In 1924, Congress enacted legislation that allowed annual appropriations for the construction and improvement of park roads and trails (43 Stat. 90). In 1925, NPS entered into a cooperative agreement with the Bureau of Public Roads to construct park roads. Existing park roads were improved and new roads created through this agreement. This collaboration ensured that park roads would reflect a high standard of construction and state-of-the-art technology. NPS engineers and landscape architects participated directly in locating roadways, setting standards for the work that would have minimal impact on the surrounding parkland, and designing walls, bridges, tunnels, culverts, and overlooks. Contracts for each job prohibited destructive blasting procedures and specified practices that would minimize the scarring of natural outcrops and destruction of natural vegetation. The most enduring landscape features developed in the mid-1920s were the concrete bridges and culverts veneered with roughly cut local stone to harmonize construction with natural rock and soil. Standard plans for log and stone guardrails were developed; of these, the "mountain" type would become the hallmark of national park roads in western parks. Featuring an irregular pattern of cut stone with crenulations at regular intervals, the wall blended harmoniously in color and texture with its setting. Although designed initially for the Cascades and northern Rocky Mountains in open alpine terrain with crenulations inspired by the jagged glacial peaks, the walls became suitable for parks throughout the West. In 1929, NPS designers introduced an innovative method for flattening and rounding the slopes of earth cuts that was to become a major characteristic of park roads and parkways (USDI, NPS, General Provisions 1929; USDI, NPS, Albright to Vint, informal correspondence 16 June 1929; USDI, NPS, c1930 Davidson; Vint to Albright, official correspondence 20 March 1931).

The earliest trails in the parks were patrol routes used by park rangers to control fires and discourage poaching; many of these were old roads previously used for mining, logging, or farming. Recreational trails in many parks were developed by local hiking clubs. With annual funding during the 1920s and 1930s, trails were improved and new trails developed to create an intersecting network of sturdy and safe trails in each park. Heavily used trails, such as the Bright Angel Trail in the Grand Canyon and the Moro Rock Trail in Sequoia, received special attention and became laboratories for improving methods of trail construction. In 1934, the Engineering Division issued standards that combined both engineer and landscape concerns, such as drainage, maximum grade (15 percent), construction of switchbacks, and use of local stone to reinforce the outer edge of bridle trails and to construct culverts, steps, water breaks, retaining walls, and guardrails (USDI, NPS, Kittredge 1934).

Increased visitation put pressure on the NPS to develop new kinds of facilities, such as museums, observation stations, checking stations, comfort stations, and administration buildings. Plans made in the early 1920s to move the old village in Yosemite Valley out of the open meadows to a new site under the trees and against the valley walls established the concept of the "plaza" as the center of park business and of locating development under a screen of vegetation. Overcrowding in many parks led to the identification of additional developed areas and separate areas for park housing and maintenance. The influx of automobiles into parks necessitated parking areas, campgrounds, gasoline stations, and watering stops. Concessioners wishing to expand accommodations or develop new ones worked closely with NPS designers to reach solutions that were appropriate for park use and harmonious with park scenery.

A PROCESS OF PARK PLANNING

In 1928, Vint hired a staff of landscape architects, who resided in the parks during the summer and completed drawings and plans at the headquarters in San Francisco during the winter. With increasing appropriations during the Hoover administration, general development plans for each park took on new importance. Park superintendents and the Landscape Division had developed these plans beginning in the mid-1920s as a basis for requesting appropriations for park improvements (1925 General Development Plan for Mt. Rainier; Vint to Mather, memorandum 1 September 1926).

The term "master plan" was applied to these general development plans in 1932. At this time they took the form of series of large drawings and a narrative, called the development outline. Plans were developed for each park; they were organized in several sections: major roads, trail systems, major development areas, such as the valley floor at Yosemite, and minor development areas, such as entrance stations, road intersections, parking areas, or ranger stations. Master plans were six-year plans, revised annually. They plotted existing construction and recommended changes in the form of new construction and removal of existing features. They also noted important vistas, areas of vegetation, and individual trees or rock formations that merited preservation. The plans reflected an integrated approach to park planning and management. To a large extent, they addressed issues of interpretation, forestry, fire control, engineering, scenery preservation, automobile traffic, and pedestrian circulation, and concessioner operations. During the 1930s, the development plans, in addition to site plans, would include sheets on vegetation, fire control, utility layouts, geological formations, and wildlife areas, and provide housing and road inventories and interpretative statements.

Plans identified "sacred" and "wilderness" zones, as well as "research areas" that had special preservation values. These designations were viewed to be equally important to park management as development plans. As early as 1928 at Mt. Rainier, Mather had designated the glacial zone and particular areas of outstanding natural beauty as wilderness areas accessible only by foot or on horseback and to remain undeveloped. During the 1930s, any area of the park not targeted as a developed area was considered a "wilderness area"; research areas were reserved for special studies of plants, animals, or other natural features; "sacred" zones were areas or special features that were to remain unimpaired. (Mather, official correspondence, July 1928; USDI, NPS 1940; Cammerer to Washington and Field Offices, official memorandum 3 April 1936.)

The development of Yakima Park on the eastern side of Mt. Rainier illustrates the evolution of these plans. In the late 1920s, plans began to open Mt. Rainier to automobiles from the East and develop visitor facilities at Yakima Park, also called Sunrise, a subalpine plateau overlooking the moraine of Emmons Glacier, the mountain's largest glacier, and the White River Valley. Mather, himself, was enthusiastic about this project, seeing it as a way to relieve crowding at Paradise on the mountain's southern flanks and to encourage greater visitation by connecting the park by a new state highway with cities east of the Cascades. By 1931, the road was complete, including an extensive scenic overlook at Sunrise Point, which afforded views east to the mountain, north to Canada, and south to the Oregon Cascades. The concessioner's development and the park administrative building, in the design of a pioneer blockhouse, were in place. Innovations were several, indicating the extent to which NPS's planning process had evolved. The concessioner's lodge and cabin court were built away from the rim of the canyon overlooking the Emmons Glacier and the White River outflow and the ridge to the north. The plaza was defined by a large parking area bounded on two sides by space for park buildings and visitor services to be built in phases. Telephone lines were placed underground. A modern power plant was located away from the village screened by trees. Camping was spread over three areas, one adjoining the village, and two others a mile away along spur and loop roads. A network of foot and horse trails with scenic overlooks connected the village with the canyon rim to the south and the ridge to the north (1931 General Development Plan for Mt. Rainier; USDI, NPS, Davidson c1930; 1933 Master Plan for Mt. Rainier).

More successful in harmonizing development with nature was the plan for the newly-acquired east entrance at Tipsoo Lake. Here the scars of hunting and fishing camps were removed by restoring native vegetation. The winding serpentine highway had turnouts for scenic views on alternating sides of the road. An entrance arch at Chinook Pass was simultaneously a sign, boundary marker, and bridge carrying the Cascade Crest Trail over the highway into the adjoining national forest. Groves of subalpine firs near the pass were plotted and slated to remain untouched by development (1933 Master Plan for Mt. Rainier).

NATURALISTIC GARDENING AND LANDSCAPE NATURALIZATION

A style of naturalistic gardening emerged in the late 1920s as one of the principal methods for harmonizing construction with nature. It involved the siting of facilities in respect to the natural topography, the character of nearby natural features, and the preservation of scenic views. Native vegetation and rockwork became the principal materials. These practices complemented and followed the rustic architectural design of buildings, which was incorporated in small landscape features such as water fountains and shelters. Rustic design was characterized by horizontal buildings with overhanging eaves, use of indigenous materials, battered stone foundations that appeared to spring from the earth, avoidance of right angles and straight lines, the irregular shaping of log and stone components by freehand lines to retain naturalistic qualities, and the overscaling of components to blend proportionately with the surrounding trees and outcrops (USDI, NPS Tweed *et al.* 1977; USDI, NPS Harrison 1986; USDI, NPS Maier c1934; USDI, NPS Good 1935; USDI, NPS Good 1938; Steely 1985).

Naturalism required that roads and trails follow the natural contours in curving lines and that overlooks be sited to take best advantage of scenic views and provide access to outstanding natural features without impairing them. Atop Mt. Cadillac at Acadia, an extensive system of paths radiated out to various scenic viewpoints following the natural contours of the natural granite peak. The shelters along the Bright Angel Trail blended into the setting through materials that matched the coloration and texture of the canyon walls. Scenic overlooks followed the natural undulating topography of the Blue Ridge. The local rock formation was preserved and integrated into the design of the portals of Mary's Rock Tunnel on Skyline Drive. At Acadia, a causeway and triple arched bridge followed a naturalistic curve imitating the shoreline of coastal inlets and allowed for the passage of tides and currents.

In 1929, Director Albright asked Vint to draw up a budget for naturalization work in national parks. He had been greatly impressed by the planting and transplanting of trees and shrubs in the late 1920s at Mount Rainier and was interested in making "naturalization" work a definite feature of NPS activity. (Albright to Vint, official correspondence, 21 May 1929). Landscape naturalization included:

> grading around buildings or elsewhere for better topographical effects; filling and fertilizing of soils; transplanting or planting of trees, shrubs, lawns, flowers, to make artificial work harmonize with its surroundings; erection of outdoor furniture such as stone seats, drinking fountains, flagstone walks, etc.; vista clearing and screen planting and cleanup in areas not included as Roadside Cleanup (Vint, 1930 Fieldwork on Naturalization Data Requested).

Roadside cleanup, which was funded under annual appropriations for roads and trails included:

> restoration of natural conditions along highways by cleanup and repair of construction damage; covering by plantings of cut slopes; screening undesirable views and vista clearing for good ones; planting out old roadways and borrow pits; and may include various roadside structures as fountains, parking area development, etc. (*op cit.*).

In 1930, NPS established a policy for the exclusion of all exotic seeds and plants from the national parks and issued a "set of ideals" for the use of native flora. These ideals called for the elimination of exotics already planted around hotels, lodges, and private dwellings, and their replacement with native species. There were several reasons for these ideals based on NPS's stewardship role:

> It is the consensus of opinion that national parks should stress the protection and conservation of native plants and animals, and . . . the introduction of exotic species endangers the native forms through competition and destroys the normal flora and fauna, and . . . it is the duty of the National Park Service to protect nature unchanged for the benefit of this and future generations . . . ." (Albright to all superintendents and concessioners, 11 November 1930).

Naturalistic gardening practices became standards for naturalization work. After the slopes of park roads were flattened and rounded, they were planted with grasses, shrubbery, and young trees; new vegetation was skillfully blended into the irregular line of mature growth beyond the cut; natural rock exposed during blasting was blended with native plantings to create natural effects (USDI, NPS Maier c1934). During building construction, existing trees were protected; afterwards they became the screens to hide development or blended with new plantings in naturalistic groupings. Construction scars were erased as native grasses, ferns, and shrubs embraced battered stone foundations. Tall trees were planted individually or in small clusters at the ends of bridges and corners of buildings to blend the construction into the scale and character of the natural setting. Native plantings and curving paths edged with rock became an important aspect of the design of the museums, amphitheaters, wayside exhibits, and nature shrines at Yellowstone in the late 1920s. Upon the completion of the Yavapai Observation Station at Grand Canyon, a system of curving rock-edged paths was laid out and a "life-zone" garden of native species was planted, enhancing the interpretation of the park's natural history.

One of the most extensive programs of naturalization began in 1930 at Crater Lake, where decades of use, poor soil (ash and pumice), and a harsh winter climate had caused severe loss of natural grasses and trees in the Rim Area. A promenade marked by the standardized parapet wall with observation bays was constructed half-a-mile along the rim, following the natural undulations of the caldera and connecting various points of visitor use including the information center, a memorial and observation building, parking areas, and the lodge. Water fountains were fashioned out of the crenulations of the wall and ghost trees were retained along the slopes of the caldera. Experiments with native grasses were made to determine the most appropriate cover for the area before a sod mixture of wild flowers was selected. Mature large tress of several native specimens – white fir (*Abies concolor*), subalpine fir (*Abies lasciocarpa*), noble fir (*Abies nobilis*), and mountain hemlocks (*Tsuga mertensiana*) – were transplanted from construction sites in other parts of the park. The density and arrangement of the trees followed the natural distribution and clustering found in similar areas of the park and framed vistas of the lake from many points (USDI, NPS, Gilbert and Luxenberg 1990).

EMERGENCY CONSERVATION WORK IN NATIONAL AND STATE PARKS

In 1933, Emergency Conservation Work brought funding and labor to carry out master plans and to move ahead with naturalization programs. The supervision of Civilian Conservation Corps (CCC) jobs initially was entrusted to the Branch of Forestry. It focused on projects for fire control, tree protection against disease, road clearing and planting, and "beautification" projects (many of which would now be considered ecologically harmful) such as the clearing of dead trees from Jackson Lake in the Grand Tetons (left by damming prior to park acquisition) and the sites of destructive forest fires in Glacier. Rapid progress was made on many master plans. Within two years the impact of the CCC was felt in all NPS programs, leading to the formation of regional offices. By 1936, regional landscape architects and architects in each office took charge of work in both state and national parks.

The development of the Hazel Mountain Overlook in 1935 on the east side of Skyline Drive along the Blue Ridge in Shenandoah National Park illustrates the extent to which naturalistic practices became integrated in the work of the CCC. The overlook was sited along natural contours of the ridge centered on a picturesque outcrop of granite gneiss having a dramatic pattern of jointing. Curvilinear stone walls sprung from each side of the outcrop to provide a barrier for cars and a guardrail for visitors. Stone steps built into the outcrop led to the top from which one could view the dark hollows and farmlands below. The parking area was separated from the drive by an island, edged in stone and densely planted with native pines, oaks, and an understory of mountain laurel (*Kalmia latifolia)* to screen the sight and noise of traffic on the drive and to blend the overlook with the natural slopes beyond the drive.

In the 1930s, NPS programs for master planning, rustic design, and landscape naturalization extended to the development and improvement of state parks. NPS approved and supervised CCC and WPA work in state parks and provided technical assistance in the form of site inspections, critiques, designs, and approval of master plans. Designs and ideas for every aspect of park development were circulated in publications; these included the portfolios on comfort stations, cabins, and other park structures (1934), bound volumes of photographs and plans of some of the best park structures and facilities built in state and national parks (USDI, NPS, Good 1935; USDI, NPS, Good 1938). Techniques for siting and constructing facilities, such as roads, trails, campgrounds, were left to a less-known volume on landscape conservation (USDI, NPS, Waugh 1935) and manuals in the CCC project training series. CCC work followed the naturalistic precedent set by NPS designers. However, because of the recreational and reclamation purposes of many parks, there was less emphasis on natural area preservation and greater freedom in manipulating the park landscape. Practices considered inappropriate for national parks were commonplace and encouraged, including the damming and channelization of streams, draining of swamps, and creation of artificial lakes and picturesque features, such as waterfalls, lagoons, and meandering streams.

Advances were made in the design of picnic areas, campgrounds, and waysides. Following the approach recommended by E.P. Meinecke, a plant pathologist for the U.S. Forest Service, campgrounds incorporated defined roads, paths, and campsites; and provided barriers of stone and log to control traffic and parking so that heavy use of the grounds would not damage the root systems of surrounding shrubbery and trees (USDA, Forest Service 1932). NPS designers devised and published a number of plans to accommodate tent and trailer camping (USDI, NPS, Good 1938). Design for picnic areas emerged that featured loop roads with adjoining parking areas, circulations paths, access to scenic points and nearby trails, stone fireplaces and water fountains, log and stone tables and benches, picnic shelters and overlooks, and comfort stations; these areas were embellished with native plantings and picturesque rockwork.

CONCLUSION

When the United States entered World War II in 1942, the CCC era ended and with it an important period of park development marked by creative designs as well as functional solutions. Master plans and construction projects were halted for over a decade in many parks. When activity resumed in the 1950s with the fervor and vision of Mission 66, new theories of design, materials, and methods of construction, took over. The lessons of naturalization and harmonization were cast aside and forgotten.

The design principles and practices of the 1920s and 1930s have relevance today. As historic landscapes are identified, these practices can be revived to restore and maintain these areas in ways consistent with their historic character. Furthermore, it is time to recapture the spirit and commitment of the early park designers and combine their practices with our increasing environmental concerns so that future developments may be both scenically harmonious and ecologically sound. In this way, we can become better stewards and ensure that the national parks remain unimpaired for the enjoyment and use of future generations.

ACKNOWLEDGMENTS

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REFERENCES

Albright, H. M. 1985. *The Birth of the National Park Service.* Salt Lake City: Howes Brothers.

Cutler. P. 1985. *Public Landscape of the New Deal.* New Haven: Yale University Press.

Downing, A. J. 1859. *A Treatise on the Theory and Practice of Landscape Gardening adapted to North America.* New York: A. O. Moore & Company.

_______. 1894. *Rural Essays.* New York: Hagemann Publishing Company.

Haley, J. M., ed. 1988. *Pleasure Grounds: Andrew Jackson Downing and Montgomery Place.* Tarrytown, NY: Sleepy Hollow Press.

Hubbard, H. and T. Kimball. 1924. *Introduction to the Study of Landscape Design.* New York: MacMillian.

Ise, J. 1961. *Our National Park Policy: A Critical History.* Baltimore: Johns Hopkins Press.

National Archives and Records Service (NARS). Record Group (RG) 79. Entry 7: Central Classified Files, 1907-49. Washington, DC.

_______. RG 79. Entry 29: Records of the Field Headquarters in San Francisco, Classified Files, 1925-36.

_______. RG 79. Entry 32 : Records of the Field Headquarters in San Francisco, Master Plans, 1931-41.

United States Department of Agriculture, Forest Service. 1932. *A Campground Policy,* by E.P. Meinecke.

United States Department of the Interior. 1917. *Proceedings of the National Parks Conference.* U.S. Government Printing Office.

United States Department of the Interior, National Park Service. 1986. *Architecture in the Parks National Historic Landmark Theme Study,* by L. S. Harrison.

_______. 1985. *The Civilian Conservation Corps and the National Park Service, 1933-1942: An Administrative History,* by J.C. Paige.

_______. c1934. *Inspector's Photographic Handbook,* Region 7, by H. Maier.

_______. 1935. *Landscape Conservation,* by F. A. Waugh.

_______. c1930. *Landscape Work in Connection with the Development of the Yakima Park Area, including the Approach Highway within Mt. Rainier National Park,* by E.A. Davidson.

_______. 1977. *National Park Service Rustic Architecture: 1916-1942,* by W. Tweed, L. E. Soulliere, and H. G. Law.

_______. 1940. *Master Plans: A Manual of Standard Practice for Use in the National Park Service.*

_______. 1935. *Park Structures and Facilities,* by A. H. Good.

_______. 1938. *Park and Recreation Structures,* by A. H. Good.

_______. 1990. *The Rustic Landscape of Rim Village, 1927-1941, Crater Lake National Park,* by C. Gilbert and G. Luxenberg.

_______. 1934. *Standards for Trail Construction,* by Frank Kittredge, Office of Chief Engineer

Newton, N. 1971. *Design on the Land.* Cambridge: Harvard University Press.

Runte, A. 1979. *National Parks: The American Experience.* Lincoln: University of Nebraska Press.

Shankland, R. 1954. *Steve Mather of the National Parks.* New York: Alfred Knopf.

Steely, J. W. 1985. *Rustic Style in Depression Texas: Federal Architecture in the State Parks, 1933-1941* Austin: University of Texas (unpublished M.S. thesis).

Stickley, G. 1909. *Craftsman Homes.* New York: Craftsman Publishing Company.

Wirth, C. 1980. *Park, Politics and the People.* Norman: University of Oklahoma.

Zaitzevsky, C. 1982. *Frederick Law Olmsted and the Boston Park System.* Cambridge, MA: Harvard University Press.

MAKING TIME STAND STILL: PRESERVATION AND PHYSICAL REALITY

Allan Temko[1]

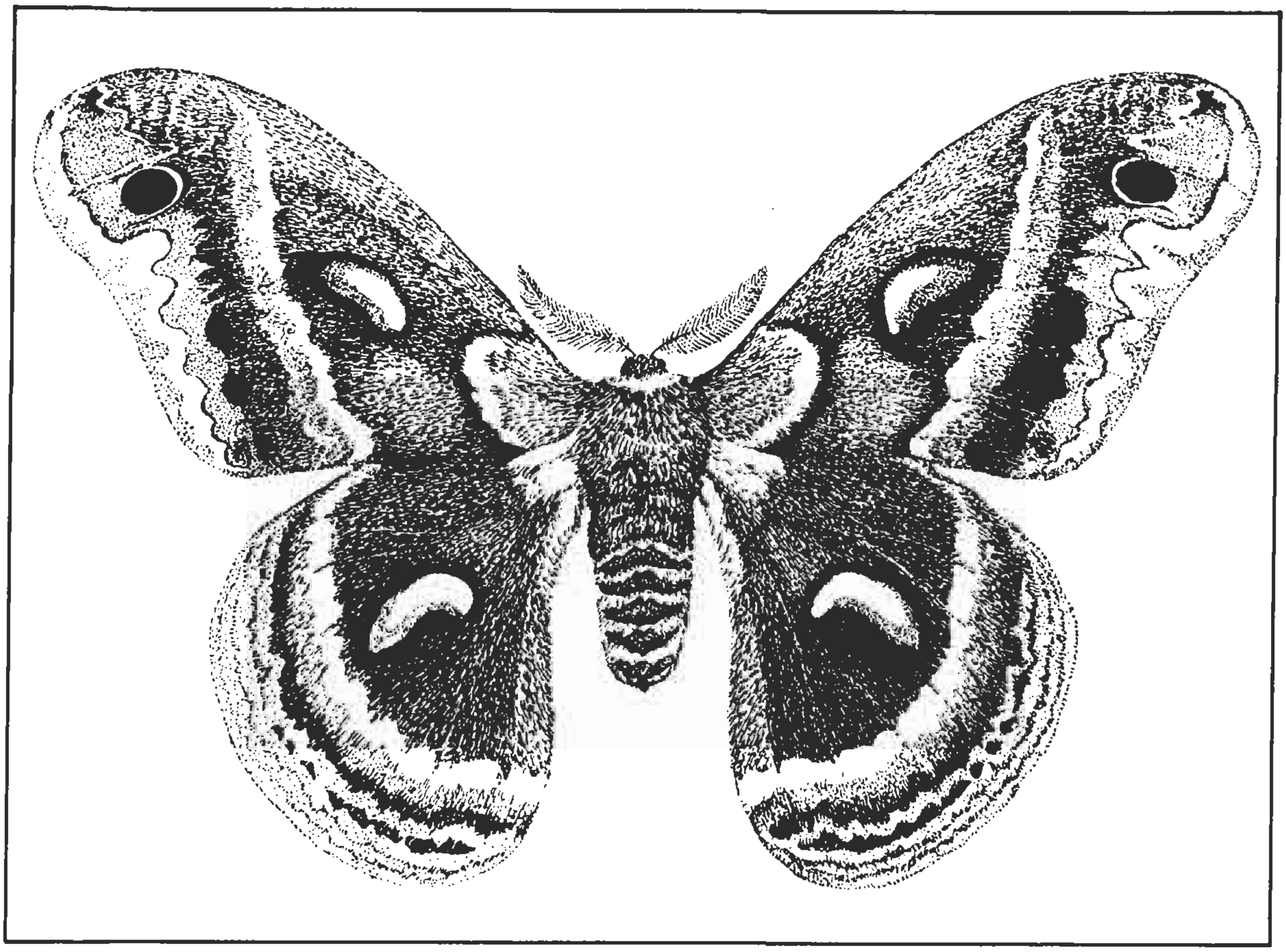
Nature, except for wilderness, may coexist with buildings and other fixed and longlasting man-made "improvements" such as roads. But nature changes incessantly, and is constantly affected by people and machines. A philosophic argument could be made that there is no such thing as historic landscape, and there are photographs to prove it, for instance views of Yosemite Valley and the meadows (kept open by burn-offs by indigenous tribes), which since the 1850s have gradually filled with trees and, of course, with buildings that rarely qualify as fine architecture.

For landscapes and buildings, even when they are modest vernacular structures, must be treated as ongoing works of art, respecting the past, but limitlessly open to the future. It is time to reevaluate the attitudes and organization of the National Park Service and even the National Trust for Historic Preservation, to say nothing of the Sierra Club and the Wilderness Society, as they strive to protect history, even though time itself – like Andrew Marvell's running sun – will not stand still.

Tuesday, October 16, 1:30 pm

1. Allan Temko, *San Francisco Chronicle.*

GEOLOGY



Cecropia Moth, *Samia cecropia*
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INTERPRETING YOSEMITE GEOLOGY – THE ROLE OF THE UNITED STATES GEOLOGICAL SURVEY

N. King Huber[1]

Abstract

During the years since the U.S. Geological Survey was established in 1879, its members have made major contributions to the understanding of Yosemite's geology. Highlights noted here extend from Clarence King's observations, while a member of the earlier California Geological Survey, up to the publication of a new geologic map of the park in time for Yosemite's Centennial.

HIGHLIGHTS OF U.S. GEOLOGICAL SURVEY CONTRIBUTIONS

The U.S. Geological Survey (USGS) has played a significant role in the evolution of our understanding of the geology and geologic history of Yosemite National Park, which celebrates its centennial this year. The USGS celebrated its own centennial 11 years ago, and its members were active in Yosemite even before it became a national park.

In 1863, the California Geological Survey, under the direction of State Geologist Josiah D. Whitney, mounted the first geological expedition to Yosemite. They explored from Yosemite Valley to Tuolumne Meadows and the High Sierra crest, in the process, naming many prominent features, such as Mounts Hoffmann, Conness, Dana, Gibbs, Maclure, and Lyell (California Geological Survey 1865b; Brewer 1930). Clarence King, later to become the first director of the USGS, was in Yosemite in 1864 as a member of the California Geological Survey.

Clarence King was an excellent observer and was the first to conclude that a glacier had once occupied Yosemite Valley (fig. 1). He recognized that a series of ridges, which crossed the valley between Bridalveil Meadow and El Capitan Meadow, were actually moraines that marked the maximum downstream extent of a former glacier (California Geological Survey 1865b, 422). In 1864 President Lincoln signed the bill that granted Yosemite Valley to the state of California and during that year King and James Gardner surveyed the boundaries of the Yosemite Grant and made the first topographic map of Yosemite Valley (California Geological Survey 1865a) (fig. 2). The United States Geological Survey was created in 1879, and King became its first director.

In its infancy, the USGS began studies in California; one such study included part of the Yosemite region. In 1881 Israel C. Russell extended his work on the Mono basin into the Yosemite High Sierra to study glacial phenomena and provided the first descriptions of the glaciers and moraines along this part of the Sierran crest. A highlight of his report is a physiographic map depicting the configuration of the Lyell Glacier more than 100 years ago (USDI, GS 1889) (fig. 3). From that map we can see that the Lyell Glacier once occupied more than twice its present area.

The year 1886 saw Henry W. Turner and Waldemar Lindgren begin geologic mapping of the California gold belt on the west slope of the Sierra Nevada. When Yosemite National Park was established in 1890, these studies were well along, and Turner turned his attention to Yosemite. He recognized compositional and textural differences among the many varieties of granitic rock in Yosemite, and applied local names, some of which, like El Capitan Granite, are still in use today for the variety of

1. N. King Huber, U.S. Geological Survey, Menlo Park, CA.

rock that makes up that monolith (Turner 1900). Turner was also the first to conclude that there had been more than one period of glaciation in Yosemite Valley and established the maximum downstream limit of an early glaciation as being near El Portal (Turner 1900). He was able to trace an ancient, Tertiary channel of the Tuolumne River, that became abandoned when it was buried beneath volcanic mudflows (Turner 1902). Turner's reconstruction of a stream profile for about 30 miles along the length of this ancient channel allowed him to speculate on the late Cenozoic uplift and westward tilt of the Sierra Nevada; his conclusions have been substantiated by later work (Huber 1990).

Granite domes, hallmarks of Yosemite, were interpreted by Turner (1900) as derived from a process of exfoliation, or the peeling off of rock shells. He believed this to result from temperature-related expansion and contraction of the rock mass. His colleague, G. K. Gilbert (1904), noted that the rock sheets paralleled the topographic surface, whether on a dome (convex upward) or in a valley (concave upward). He concluded that expansion toward the exposed surface was due to release of confining pressure in otherwise massive, unjointed or unfractured granite by removal of overlying material – a process he referred to as unloading, and an explanation generally accepted today.

Over the years a wide discordance developed among various theories for the origin of Yosemite Valley (USDI, GS 1930). Some views were extreme, such as Josiah Whitney's hypothesis of the catastrophic downdropping of a block of the Earth's crust, and John Muir's belief that Yosemite Valley was gouged out entirely by glaciers. By the turn of the century, disagreement as to the valley's origin narrowed down to the relative amount of excavational work accomplished by preglacial streams versus glaciers. Turner, for example, favored predominant stream erosion, while Henry Gannett, chief geographer of the USGS, favored predominant glacial erosion. Finally, at the specific request of the Sierra Club, the USGS agreed to undertake a study to resolve the issue, and in 1913 the task fell to Francois E. Matthes (USDI, GS 1930).

Matthes turned out to be the ideal person to undertake this task. He was a topographer by vocation, but a geomorphologist by avocation (Fryxell 1962). His masterful rendering of the topographic map of Yosemite Valley, published in 1907 (fig. 4), led him to ponder the valley's landforms, thereby uniquely equipping himself to carry out the USGS project on the origin of Yosemite Valley. His meticulous research resulted in a monumental treatise on the *Geologic History of Yosemite Valley*, published in 1930 as a USGS Professional Paper, that one of the foremost geomorphologists of the time described as a "newborn classic" (Bryan 1932).

Matthes concluded that during at least three glaciations, glaciers advanced down preexisting, V-shaped canyons cut by streams into the flank of the rising Sierra Nevada. The glaciers deepened and rounded the canyons into U-shapes as they slowly descended, a process still considered valid (USDI, GS 1930). Thus, both stream and glacial erosion were involved, along with the important role of local rock structure – whether the rock is massive or fractured. In Yosemite Valley itself, however, Matthes greatly underestimated the amount of glacial excavation, for later geophysical studies revealed that the depth of alluvium is as much as 2,000 feet beneath the present valley floor (fig. 5). Although recent work has forced the abandonment of some of Matthes's concepts, such as that of episodic uplift of the Sierra Nevada with distinct cycles of erosion, his pioneering studies nevertheless laid the groundwork for all later geomorphic studies of Yosemite.

While Matthes was studying the evolution of Yosemite's geomorphology, his colleague Frank Calkins was unraveling the bedrock geology (Calkins, in USDI, GS 1930). Taking up where Turner left off, Calkins mapped Yosemite's mosaic of discrete bodies of granitic rock, recognizing compositional and textural differences among them and identifying the subtle natural boundaries that separate them. These observations allowed him to establish relative ages for the sequential emplacement of the granitic bodies that together comprise what today we call the Sierra Nevada batholith – the granitic backbone of the range. His geologic map of Yosemite Valley remains a classic (USDI, GS 1985).

In 1946 the USGS, under the leadership of Paul C. Bateman, began geologic studies in the Bishop tungsten district in the eastern Sierra Nevada. Over the next four decades, this work evolved into a broader regional study of the geology across the central Sierra Nevada, involving Bateman and more than a dozen of his USGS colleagues, including myself. Together with some work sponsored by the California Division of Mines and Geology, this resulted in the preparation of modern detailed geologic quadrangle maps covering a large area, including Yosemite, at a scale of 1 inch to the mile.

The availability of all the excellent new mapping, supported by the wealth of equally new geophysical, geochemical, and isotopic age data, prompted the chief geologist of the USGS to support the compilation of the first geologic map to cover the entire national park. The map was to accompany a descriptive text suitable for use as a geologic guide by park visitors. That chief geologist, Dallas L. Peck, currently the survey's director, had previously mapped the geology for two key quadrangles in the park himself and had long nourished the hope that he could some day personally carry out this project. Full-time administrative duties thwarted that dream, however, and I became the fortunate recipient of that assignment. Experience in carrying out a similar assignment at Isle Royale National Park in Lake Superior helped immensely in taking on this much larger task. The subsequent proposal to the Park Service received a positive and enthusiastic response, and the Yosemite project was launched. One of the first products to come out of this new Yosemite project was an *Oblique Map of Yosemite National Park* (USDI, GS 1986) (fig. 6), prepared by cartographer Tau Rho Alpha, whose graphic skills were a great asset to the project. The view is directly up Yosemite Valley from an angle of 30 degrees above the horizon. The map uses an orthographic projection, without a vanishing point, so as to show as much detail in the back part of the map as in the front. This map has a geodetic accuracy not reflected in some artistic, but schematic, renditions, and provides a dramatic overview of the Yosemite landscape.

Clyde Wahrhaftig, of the USGS and University of California, Berkeley, was enlisted to help unravel the glacial geology of the entire park, inasmuch as Matthes had worked out the extent of Pleistocene glaciers for only a limited area (USDI, GS 1930). With the aid of modern aerial photographs, unavailable to Matthes, Wahrhaftig was able to improve on Matthes's mapping and also to extend map coverage to the entire park for the Tioga glaciation. Tioga is the youngest major glacial stage, which peaked about 15,000 to 20,000 years ago. This information was then superimposed on the oblique map of Yosemite to provide a three-dimensional rendition of what Yosemite might have looked like when partially buried under the Tioga icefield and with valley glaciers extending down the major canyons (USDI, GS 1987a) (fig. 7). The longest valley glacier of Tioga age was in the Tuolumne canyon, where it extended about 10 miles below Hetch Hetchy Valley. In contrast, the Tioga-age glacier in Yosemite Valley reached only to Bridalveil Meadow, although earlier glaciers did extend beyond. Glacial Lake Russell in the Mono basin was much larger than today's Mono Lake, even before diversion of Mono water to Los Angeles caused the modern Mono Lake to shrink in area.

Although geologic concepts have advanced significantly since Matthes's time, there has been little modern material on Yosemite suitable for developing a well-balanced geologic interpretive program for the park visitor. As mentioned earlier, filling this void was a major goal of the Yosemite project, and the vehicle settled on was a book titled, appropriately enough, *The Geologic Story of Yosemite National Park* (USDI, GS 1987). This book synthesizes the geology of Yosemite with a minimum of technical jargon and is the first to treat all major aspects of the park's geology and geologic history. It is also the first to apply modern plate-tectonic concepts to the origin of Yosemite's granitic terrane. The book is both descriptive and interpretive. It describes the rock formations and their origins and fits them into the context of a geologic history. The text is complemented by abundant photographs and diagrams that provide a visual impact to the geologic story. The final product from the USGS Yosemite project is a *Geologic Map of Yosemite National Park and Vicinity* (USDI, GS 1989). I saved this item for last because it was just released this year, in time for the Yosemite Centennial. The map synthesizes the geology of more than 2,000 square miles of the central Sierra Nevada, centered on

Yosemite. This multicolor map depicts the park's geology with 70 individual geologic map units, including surficial deposits, and volcanic, sedimentary, granitic, and metamorphic rocks. The map explanation provides a brief description of each geologic unit and supplies an index to the more detailed information available on individual geologic-quadrangle source maps. A brief summary highlights some key features of the park's geology.

Granitic rocks of many varieties dominate the Yosemite landscape and together they are part of the Sierra Nevada batholith, a composite body of granitic rock stretching the length of the Sierra Nevada. Such rocks are shown on the geologic map in shades of pink, red, and purple. Metamorphic rocks bounding Yosemite on both the west and east are shown in shades of green and blue. Yellows and light browns reflect surficial deposits, mostly of glacial origin. This map, useful by itself, is a good companion to the *Geologic Story*, which contains only a much generalized, small-scale geologic map.

One of the great advantages in carrying out the Yosemite project as a member of the USGS was the security of knowing that a fact or a concept could be verified, an idea checked, or a map or other unpublished data borrowed by just walking down the hall to consult with this or that knowledgeable colleague. This availability of expert consultation and generous sharing of painstakingly collected data, much of which was unpublished, made the work not only pleasant, but possible! It allowed me to build productively upon my own experience of nearly 30 years in the Sierra Nevada, most of it on the fringes of Yosemite. The frosting on the cake was the good fortune to spend two pleasant summers in the park becoming familiar with local details of Yosemite's geology.

During my sojourn in the park there developed a mutually productive relationship with the Park Service scientific and interpretive staff, an essential ingredient to the success of the project, and one that helped determine the direction our descriptive and interpretive products would take. This was truly a cooperative effort between the U.S. Geological Survey and the National Park Service, without whose logistic support the necessary field work would have been impossible.

Although we can claim something close to state-of-the-art quality for these most recent published products dealing with the geology of Yosemite, we also know the final word will never be written. Theories evolve, new tools will be invented, and yes, even field discoveries, heretofore overlooked, will be made. It is our hope and belief that the United States Geological Survey will be as responsible for advancing these new frontiers as it has been since the days of Clarence King.

REFERENCES

Brewer, W. H. (F. P. Farquhar editor). 1930. *Up and Down California in 1860-1864, the Journal of William H. Brewer, Professor of Agriculture in the Sheffield Scientific School from 1864 to 1903*. New Haven: Yale University Press. Third Edition, 1966, University of California Press.

Bryan, K. 1932. (Review of) "Geologic History of the Yosemite Valley" by F.E. Matthes. *Journal of Geology* 40:84-87.

California Geological Survey. 1865a. *Map of Yosemite Valley, from Surveys made by Order of the Commissioners to Manage the Yosemite Valley and Mariposa Big Tree Grove,* C. King and J. T. Gardner. Attached to J. D. Whitney's *The Yosemite Book* (1868), and *The Yosemite Guide-Book* (1869). Map reprinted 1989 by Great West Books, P. O. Box 1028, Lafayette, CA 94549.

_______. 1865b. *Geology, Volume 1, Report of Progress and Synopsis of the Field Work from 1880 to 1884,* by J.D. Whitney.

Fryxell, F. (ed.). 1962. *Francois Matthes and the Marks of Time, Yosemite and the High Sierra.* San Francisco, Sierra Club.

Huber, N. K. 1990. "The Late Cenozoic Evolution of the Tuolumne River, Central Sierra Nevada, California." *Geological Society of America Bulletin* 102: 102-115.

Gilbert, G. K. 1904. "Domes and Dome Structure of the High Sierra." *Geological Society of America Bulletin* 15: 29-36.

Turner, H. W. 1900. "The Pleistocene Geology of the South-Central Sierra Nevada, with Especial Reference to the Origin of the Yosemite Valley." *California Academy of Sciences Proceedings, 3rd series, Geology* 1: 261-321.

_______. 1902. "Post-Tertiary Elevation of the Sierra Nevada." *Geological Society of America Bulletin* 13: 540-541.

U.S. Department of the Interior, Geological Survey. 1889. *Quaternary History of Mono Valley, California,* I. C. Russell. Annual Report 8: 261-394. Reprinted 1984 by Artemisia Press, Lee Vining, CA.

_______. 1930. *Geologic History of the Yosemite Valley,* F. E. Matthes, with an Appendix on "The Granitic Rocks of the Yosemite Region," by F. C. Calkins. Professional Paper 160.

_______. 1985. *Bedrock Geologic Map of Yosemite Valley, Yosemite National Park, California,* F. C. Calkins, with Accompanying Pamphlet by N. K. Huber and J. A. Roller. Miscellaneous Investigations Series Map I-1639.

_______. 1986. *Oblique Map of Yosemite National Park, Central Sierra Nevada, California,* T. R. Alpha, N. K. Huber, and C. Wahrhaftig. Miscellaneous Investigations Series Map I-1776.

_______. 1987a. *Oblique Map Showing Maximum Extent of 20,000-year-old (Tioga) Glaciers, Yosemite National Park, California,* T. R. Alpha, C. Wahrhaftig, and N.K. Huber. Miscellaneous Investigations Series Map I-1885.

_______. 1987b. *The Geologic Story of Yosemite National Park,* N. K. Huber. Bulletin 1595.

_______. 1989. *Geologic Map of Yosemite National Park and Vicinity, California,* N. K. Huber, P. C. Bateman, and C. Wahrhaftig. Miscellaneous Investigations Series Map I-1874.

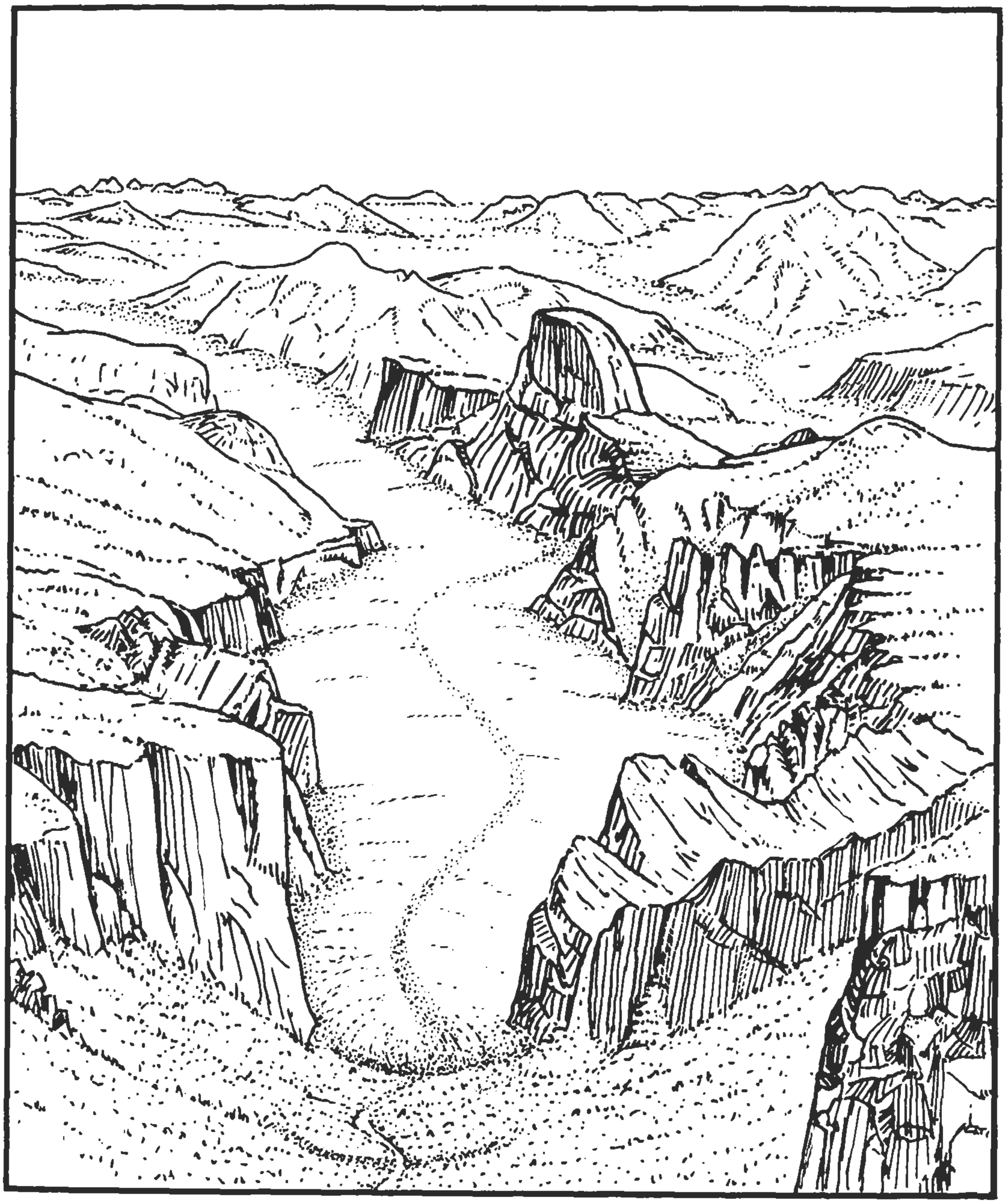


Figure 1. Tioga-age glacier in Yosemite Valley reaches as far as Bridalveil Meadow.

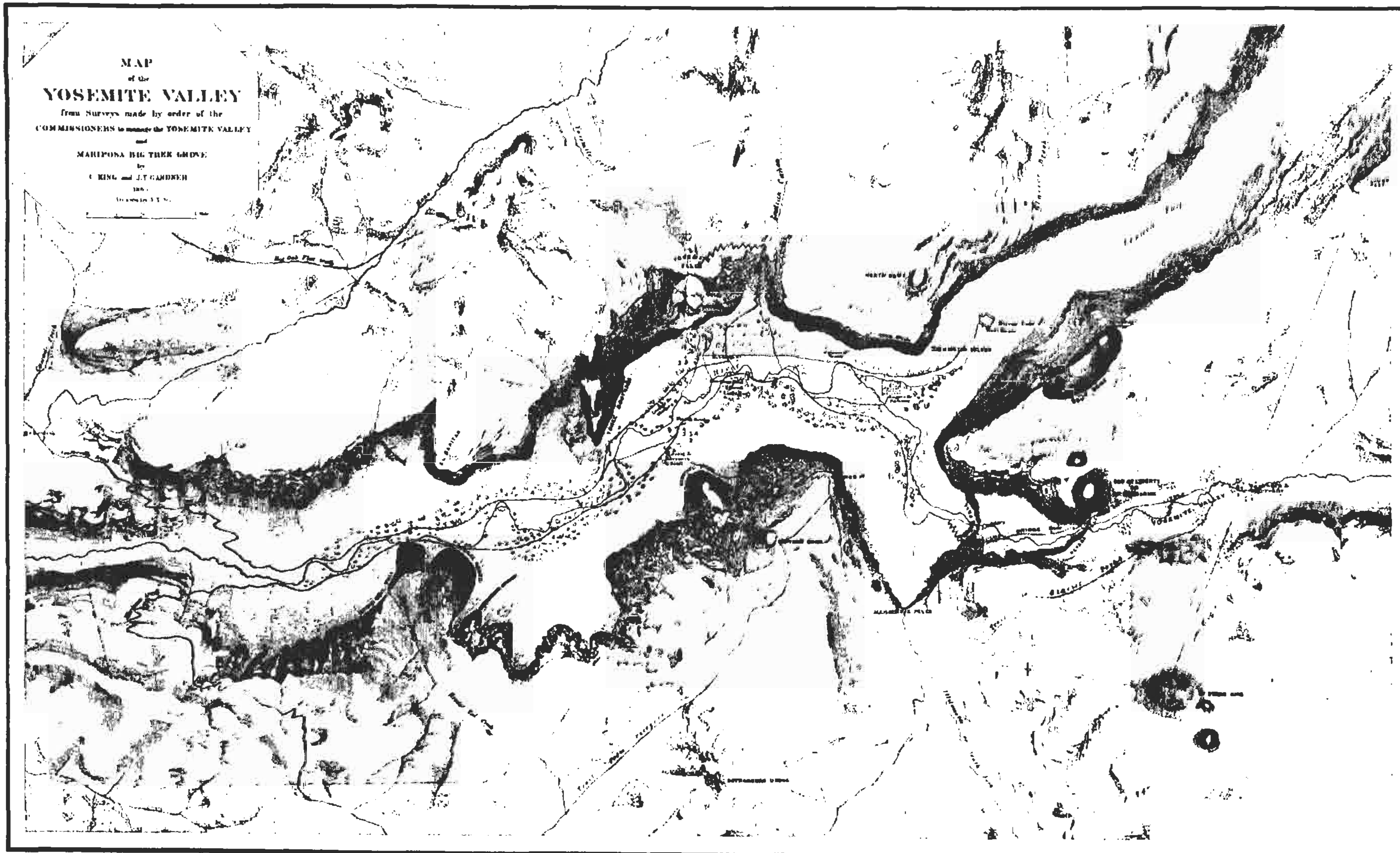


Figure 2. Physiographic map of Yosemite Valley by Clarence King and James T. Gardner, showing boundary of the Yosemite Grant.

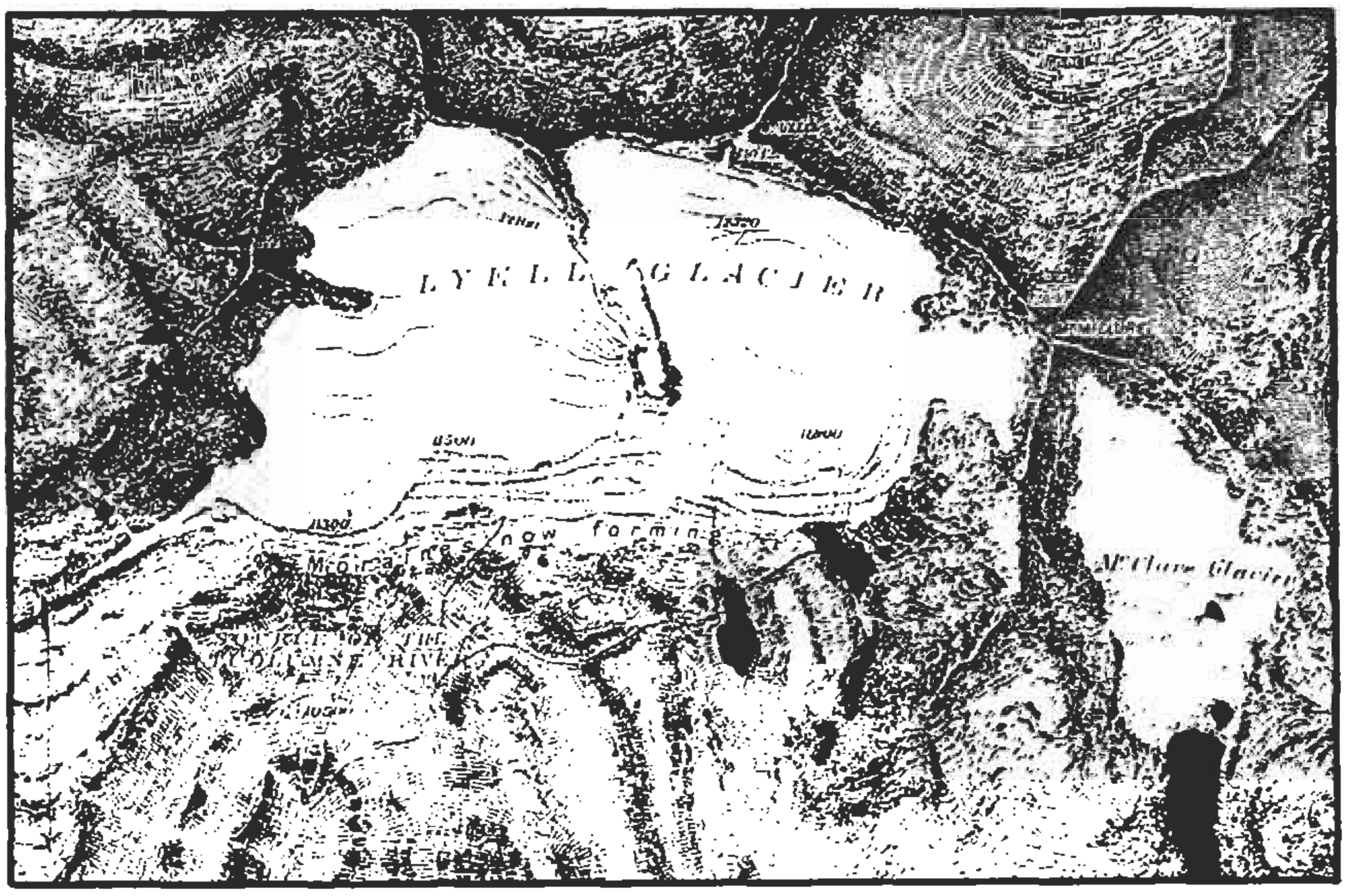


Figure 3. Physiographic map of Lyell and Maclure Glaciers by W. D. Johnson.

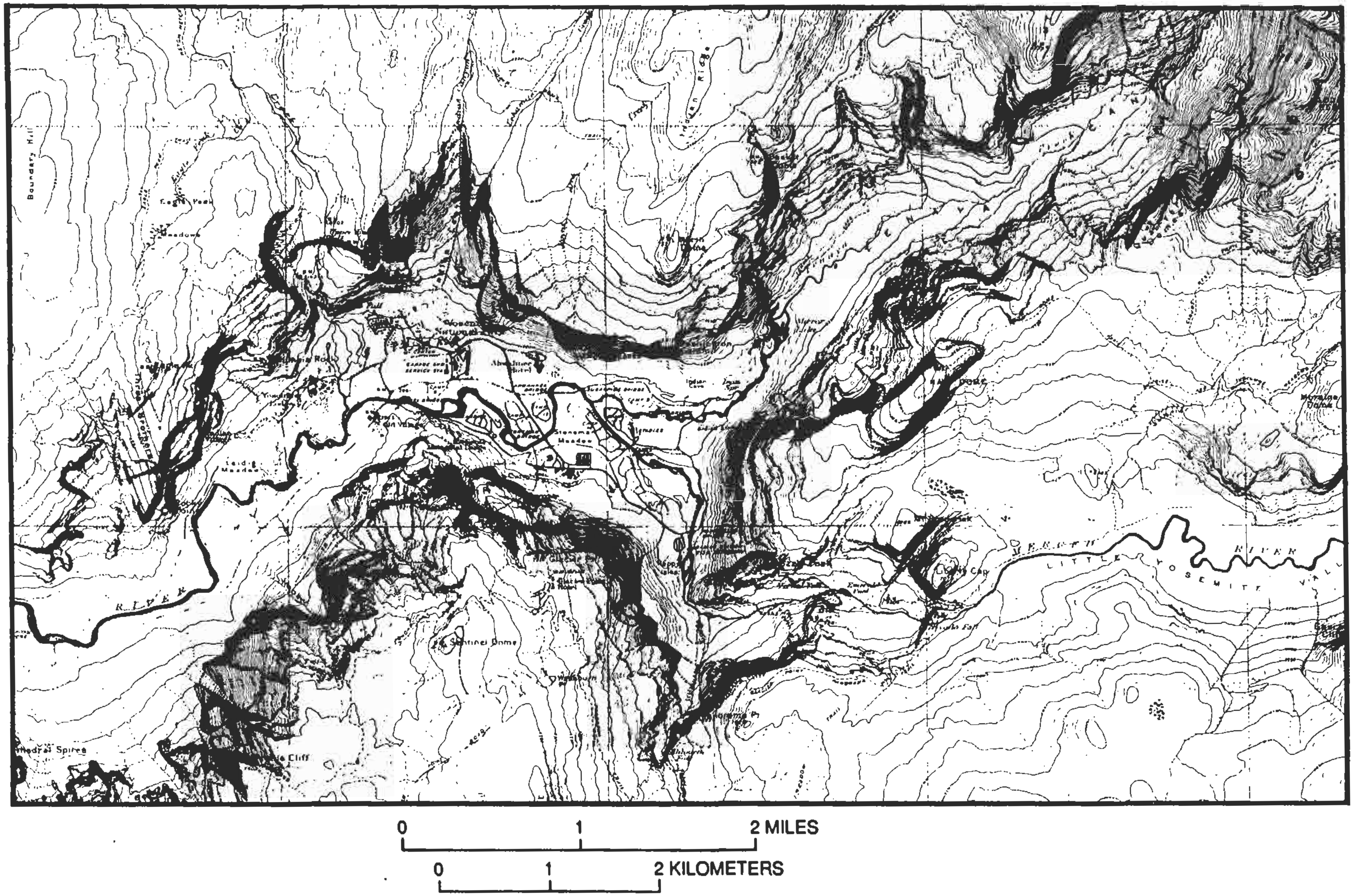
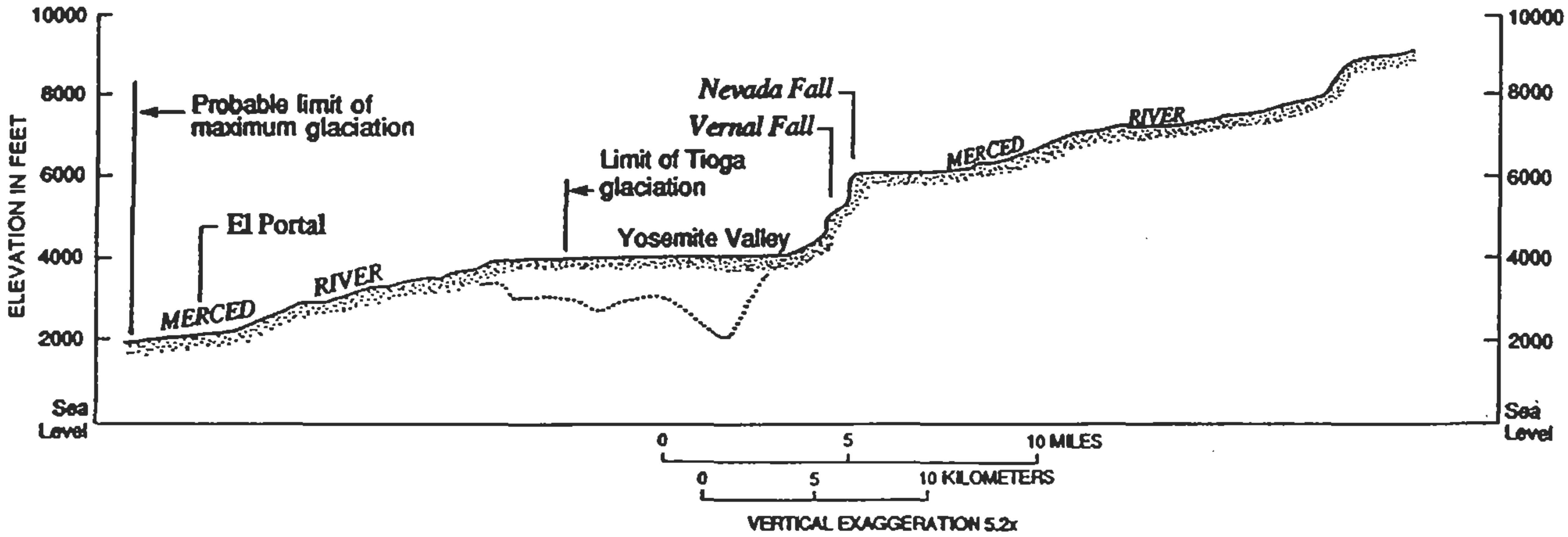


Figure 4. Part of 1907 topographic map of Yosemite Valley by Francois E. Matthes.



Longitudinal profile of Merced River

Figure 5. Longitudinal stream profile of Merced River. Dotted line indicates the bedrock basin in Yosemite Valley, as interpreted from seismic data.

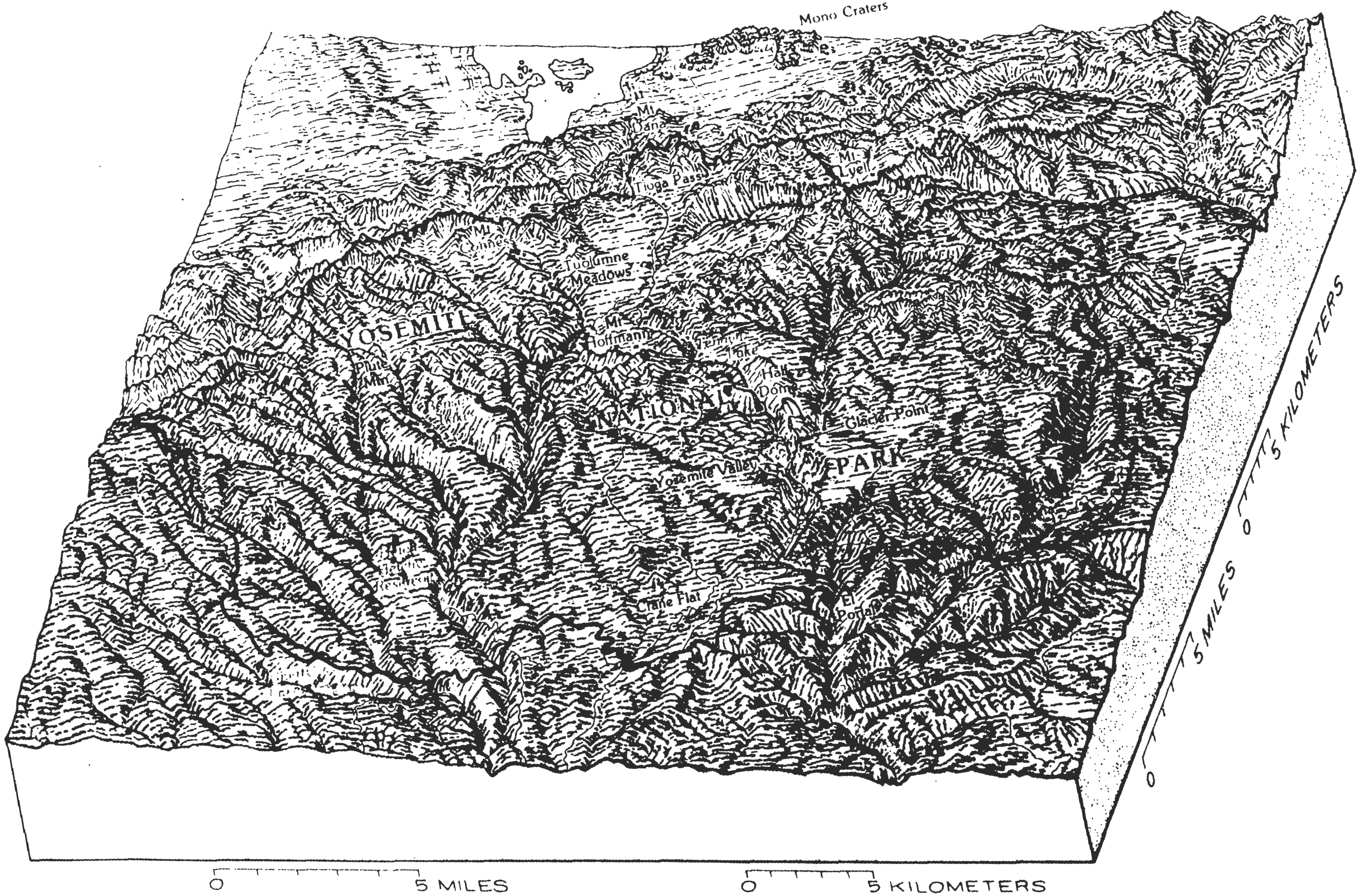


Figure 6. Oblique physiographic diagram of Yosemite National Park.

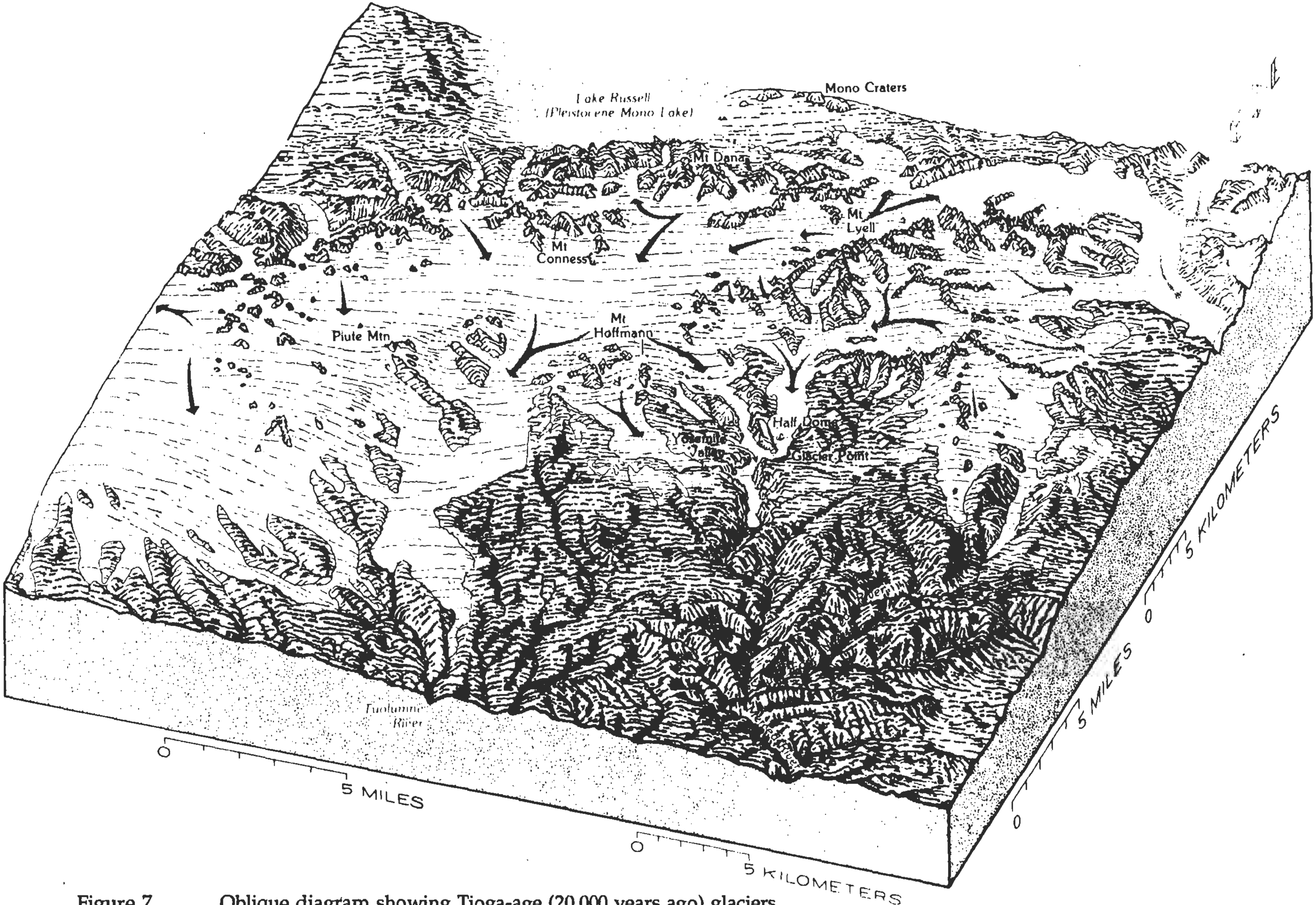


Figure 7. Oblique diagram showing Tioga-age (20,000 years ago) glaciers.

AN OVERVIEW OF THE EFFECTS OF VOLCANIC AND TECTONIC ACTIVITY IN THE LONG VALLEY CALDERA-MONO CRATERS AREA, EASTERN CALIFORNIA

David P. Hill[1]

The eastern escarpment of the Sierra Nevada is part of a geologically active zone that extends from the Salton Trough in southern California northward into west-central Nevada. The region southeast of Yosemite that includes Long Valley caldera and the Inyo-Mono craters volcanic chain stands out in this zone as having produced both the largest (700,000 years ago) and most recent (500 years ago) volcanic eruptions as well as having maintained an exceptionally high level of seismic activity in historic time. The occurrence of five magnitude-6 earthquakes in the region since 1980 together with recurring swarms of smaller earthquakes in the Long Valley caldera accompanied by inflation of the central section of the caldera by more than 50 cm emphasize that this region is still active and capable of modifying the eastern Sierra Nevada landscape as it has many times in the past.

Tuesday, October 16, 1:30 pm

1. David P. Hill, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025.

LATE PLEISTOCENE GLACIATION OF YOSEMITE NATIONAL PARK AND ITS IMPACTS

Clyde Wahrhaftig[1]

Numerous peaks, aretes, and nunataks stood above the late Pleistocene ice sheet of Yosemite Park. Using their well-defined trim-lines, and moraines and other glacial landforms, ice-sheet limits and upper-surface contours have been reconstructed. Glacial striae, boulder trains, etc., defined ice-flow directions.

The late Pleistocene climatic firn limit rose northeastward from 8,500 feet near Yosemite and White Wolf to 11,000-12,000 feet along the range crest. In preexisting canyons, streams of thick, hence vigorous ice-deepened the canyons and excavated deep lake basins. Intervening areas of thin sluggish ice did not completely remove mid-Tertiary sandy soil from the plateaus. A preglacial topography of plateaus, bluffs, and benches on granitic rocks already had domes and waterfalls, and nonaccordant stream junctions cannot be used to measure glacial erosion.

Moraines of Tioga and Tahoe age are present, as well as till and erractics of one or more slightly more extensive earlier advances. In Yosemite Valley only the Tioga advance, with terminal moraines at Bridalveil Meadow, was greater than the Tahoe.

Tuesday, October 16, 1:30 p.m.

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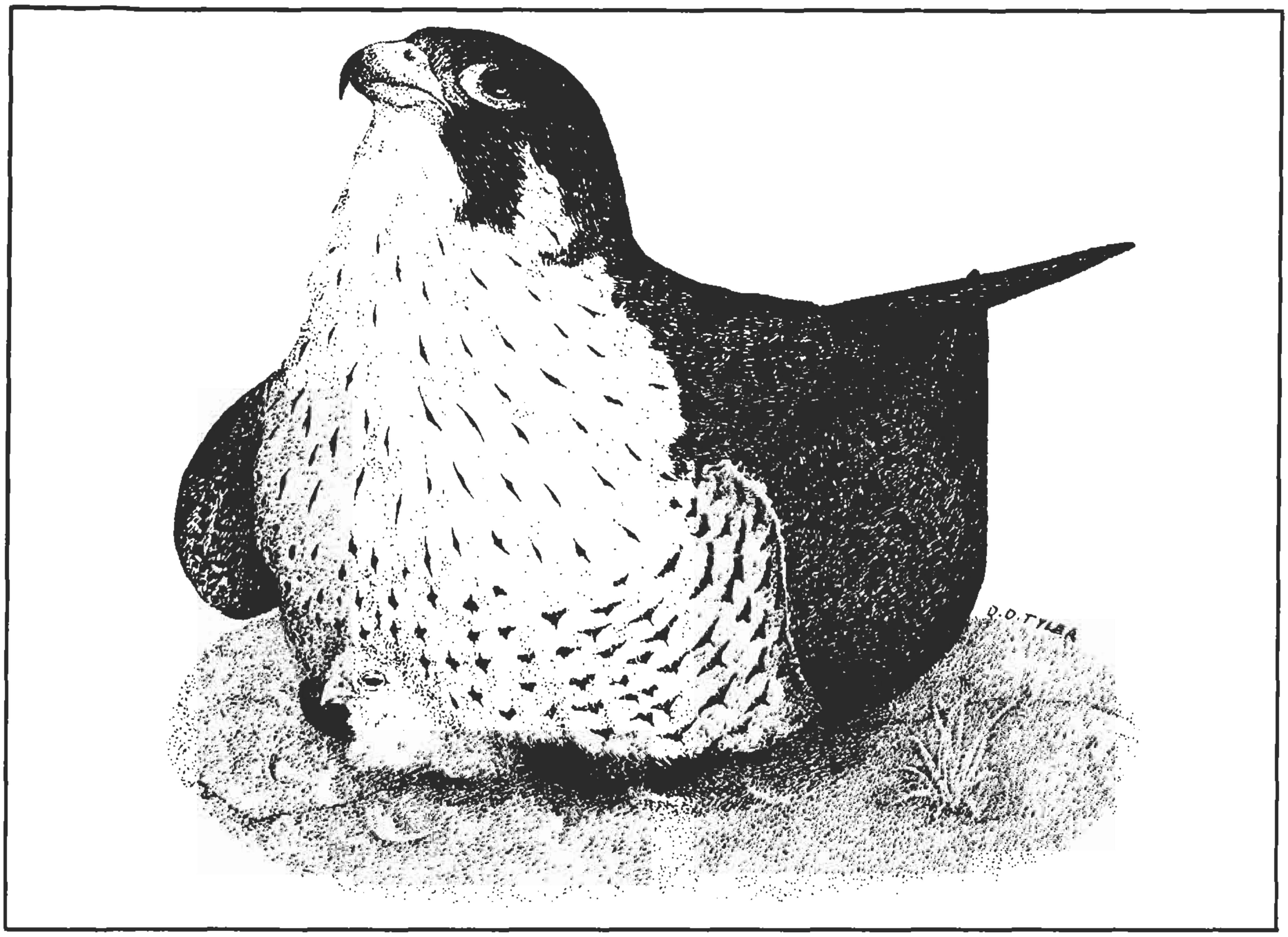
VISITOR USE, VOLUNTEERS, AND EDUCATION



Peregrine Falcon, *Falco Peregrinus*, and Chick
Illustration by Diana Dee Tyler, © 1978 by Dell Publishings Co., Inc.

VISITOR USE AND RESOURCE PROTECTION

ACCOMMODATING VISITORS IN NATURAL AREAS: A BALANCE OR A PARADOX?

Kerry B. Gates[1]

Abstract

This paper offers a philosophical look at the inherent paradox that exists between the American notion of "natural" and our desire to make natural areas available for public use. Since the advent of the conservation movement as represented by the thinking of John Muir, our society has grappled with the dilemma of finding the right "balance" between preserving wild areas and making them available for public enjoyment. If the "natural condition" is defined as the pre-European landscape, to what degree are people compatible with nature? What factors must be considered in making this judgment of balance? The factors are 1) the physical tolerances of the resources themselves, 2) the integrity of the "spirit of place" of a natural area, and 3) the cultural expectations we seek to satisfy in any given natural area. Our decision regarding our cultural expectations for a natural area will define the "degree of naturalness" of that area. In order to set the criteria for judging whether a "proper balance" has been achieved, we must first establish a clarity of purpose for each natural area so that cultural expectations are intelligently chosen in response to the limits of resource tolerance and spirit of place.

INTRODUCTION

The balance of nature, a time-honored concept of the web of life, provides the metaphor for the dilemma we have been discussing today. To consider the implications of balance, visualize the robed figure of Justice, blindfolded and holding her scale. To reach a just decision, she blindly (to assure objectivity) measures facts to determine in which direction the scales tip. Any tiny incremental fact can be enough to tip the scales in one direction or the other. The balance of nature is viewed a little differently, but the concept of the sensitivity and fragility of balance is even more pronounced. Here it is implied that a myriad of interrelated factors in the ecosystem are arranged in a delicate configuration that is in equilibrium or in balance. The implication is that this equilibrium is at once self-regulating and fragile; that, left to its own processes, although delicate, it is enduring and in harmony.

Cast awkwardly alongside the beauty and complexity of such a natural system is mankind.

For millennia, Western civilization has regarded humanity as apart from our environment. In fact, at an ever-accelerating rate, our history has reinforced this notion. Our economic capacities and our technologies have led us to an ever-widening separation from our environmental context. So, the paradox has deepened, and people have become at once farther removed from the land and its fundamental processes and a greater threat to the balance, or sustainability of those same natural processes.

So it is within this conflicting view of nature and its processes and the traditional cultural philosophy of domination over the natural world, that we now examine the notion of "Visitor Use and Resource Protection: Striking a Balance." Will a change in cultural perspective allow us to factor human use into

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the balance so that people are in harmony with natural systems? Or is the notion of harmony a paradox?

THE PARADOX

The paradox of man in nature is a most familiar one in Western history. Its roots extend to the Garden of Eden and the Biblical imperative to fill the earth and subdue it. The wilderness was viewed as a hostile place, an environment to be overcome. However, since the Industrial Revolution and the advent of modern medicine, survival has been considerably easier in the West than it was 2,000 years ago and the cultural view of wild lands has begun to change. Ironically, as our environment has become less of a threat to our survival, we have become a threat to the survival of our environment. As we have become increasingly aware of the damage that industrial man inflicts upon the ecological systems and the species of the world, there is an increasing alarm over the fouling of the nest and an increasing call to preserve the vestiges of truly natural areas. There is a growing recognition of the finite limits of the earth and momentum is building to convert our economies forever to sustainable agriculture and to renewable sources of energy.

So, the traditional cultural alienation Westerners feel towards our relationship to nature, born out of a drive for domination and control, is now compounded by the reality and the guilt of the global damage we are inflicting on our environment. The factor of guilt is a significant one. In our Judeo-Christian and Puritan traditions, we have long been a society that acknowledges and responds to guilt. We feel guilty that we are not a supportive strand in the web of life. It is with both guilt and admiration that we have to look to preindustrial societies, such as those of native American peoples, to find models of humanity that exist in harmony with the natural environment. The cultural message we are feeling now is that not only are we *not* genuinely a part of the great balance of nature, but we are also failing in our adopted role of responsible stewards of the planet. This strong sense of guilt is manifest, too, in what is actually the religious zeal of the most ardent environmental activists who have turned to civil disobedience to pursue their goals.

Suffice it to say that we in the West have grown so far away from living in harmony with our environment that we now are reacting with some alarm to attempt to restore even a sense of stability with our habitat.

The cultural basis for our paradoxical view of man's relationship to the environment can also be seen in the history of conservation in this country. The earliest debate over natural areas management appeared in the clash between John Muir's preservationist philosophy and Gifford Pinchot's utilitarian philosophy. On the one hand, Muir's philosophy stressed the importance of preserving wild lands for their inherent spiritual values to individuals. His approach is reverential in nature and acknowledges civilization as antithetical to the intrinsic values of natural areas. Pinchot, on the other hand, stressed the real value of natural resources as being derived from their economic use by society (the Biblical imperative). Pinchot championed carefully managed multiple use that derived direct economic benefits to society at large. Proponents of Muir generally seek to minimize disturbance and public use and to isolate the presence of man, while proponents of Pinchot generally seek to maximize uses to generate the greatest good for the most people.

Interestingly, federal lands were managed in accordance with the Muir/Pinchot philosophical split, the more sublime park system essentially embracing Muir, and the other public lands being managed for multiple use (the U.S. Forest Service and the Bureau of Land Management).

THE QUESTION OF BALANCE

For the past 100 years, this clash between an economically based value system for managing resources (producing dollars as a social benefit) versus a spiritually based value system for managing natural areas (preserving intrinsic values of wild places) has been the central issue. The disparate management approaches to Hetch Hetchy and Yosemite clearly represent this split. Of course, John Muir was a central figure in this debate as well. He argued in favor of preserving the Hetch Hetchy Valley for the same reasons as he fought, successfully, to preserve Yosemite. It is with some irony that, though Hetch Hetchy was inside the very Yosemite Park the Muir was largely responsible for creating, Muir lost this battle and the City of San Francisco dammed the Hetch Hetchy Valley to provide a water supply.

But the issue we are facing today, the issue of an appropriate balance between preservation and use of natural areas, is a further evolution of the Muir/Pinchot debate. We are no longer considering economic exploitation of resources in this question; we have already opted in favor of resource preservation and spiritual values.

So what are the factors in the equation for determining an appropriate balance between resource preservation and visitor use? There are two essential factors and a third complicating factor:

1. **Factor #1** is, to the degree possible, an *objective* determination of the physical capacity of a given resource to sustain visitor use without significant loss to natural processes. Factor #1 sets outside physical limits on visitor uses.

2. **Factor #2** is a *subjective* evaluation of the spirit of place necessary to establish the criteria for assuring the essence and natural identity of an area. Factor #2 is the "John Muir" factor.

3. **Factor #3** is a potential modifier of Factor #2 and is the wild card in considering balance. Factor #3 is *subjective* and includes social and cultural expectations that could alter the findings of Factor #2 and increase the presence of man's influence in a natural area (but not beyond the physical limits defined by Factor #1). For example, in the European tradition, Factor #3 may judge that the Ahwahnee Hotel, as a sensitive example of well-designed and well-sited architecture that provides for the comfort of less hardy visitors, is a compatible element of the natural landscape. In other words, Factor #3 includes the notion that there can be acceptable degrees of naturalness; that the pre-European condition of our landscape is not the only accepted definition of natural.

In addition to the idea that there are varying acceptable degrees of naturalness, Factor #3 addresses other cultural and political considerations. For example, in our society we cherish a strong democratic ideal that celebrates individual freedom and equal access of all citizens to public lands. In fact, our national park and California state park movements were largely based upon the belief that parks were good for people and that all citizens had an inherent right to enjoy them.

In considering these three factors in determining the balance between use and preservation of natural areas, the implications for the future are both demographic and political. It is important to recognize that the history of the conservation and preservation movements in this country has essentially been a history guided by the values and sensibilities of well-educated, affluent, white culture. Similarly, until the last decade or two, the constituent users of natural areas and natural parks were predominantly this same segment of society. In recent years, however, particularly in parks and natural areas near population centers, open-space users predominantly come from different socioeconomic backgrounds and come to natural areas with a different set of expectations. Many of these visitors are seeking primarily social and recreational opportunities rather than the more solitary and contemplative opportunities as promoted by Muir. This disparity is apparent in Yosemite Valley on a summer holiday weekend, where great numbers of people seeking a plethora of different experiences collide in a tangle of cars, bikes, buses, campers, vans, and radios.

The management of Yosemite Valley itself offers a clear example of the dilemma of balance, of the clash between social values (which are the various benefits of natural areas to people) and the intrinsic values of the natural areas themselves.

Certainly each visitor to Yosemite is seeking a legitimate and positive experience that is heightened by one of the most beautiful and inspiring natural areas in the world. But what about balance? What spirit of place have we emphasized in Yosemite Valley?

On the physical, or objective, side of the ledger (Factor #1), much has been written about how the floral and faunal fabric of Yosemite Valley has been dramatically altered by our management over the last 140 years. And certainly there have been many plans proposed, and a number of them implemented by the Park Service, to restore many of the natural processes that have been disrupted, primarily through the introduction of fire and other proactive vegetation management ideas. I believe we possess the knowledge and the capabilities to restore and properly manage the natural environment of Yosemite Valley to its natural condition.

But what of the subjective component of balance (Factors #2 and #3)? What of our judgment about the proper spirit of place for Yosemite Valley? How close are we to defining this ultimate determinant of whether visitor use is in balance with this place?

Here, perhaps, is where our traditions, our methods, and our societal values have failed to provide us with a satisfactory answer to this most subjective question. Clearly, we are not managing the Yosemite Valley championed by John Muir. Almost as clearly, we are not milking the multiple benefits espoused by Gifford Pinchot. We have landed somewhere in between.

In our desire to preserve this most magnificent of natural places, I suggest that we have defined Yosemite's sense of place in terms of a public pleasure garden that brings the most good to the most people. In our spirit of democracy, we have determined that we want *everyone* who wishes to see Yosemite Valley to be able to do so. We have found a way to accommodate three million such visitors each year. We have provided them with a democratic array of accommodations that range from the most humble walk-in tent site, to the family campground, to tent cabins with and without running water, to motel rooms, to the magnificent and luxurious Ahwahnee Hotel. We have a supermarket, restaurants, cafes, cafeterias, and boutiques. We have provided the amenities of a town to meet the needs of a town full of visitors. But what *is* this place? At what point did it assume a life of its own? At what point did we disrupt the balance?

It is clear that we have not preserved John Muir's Yosemite. It is also clear that we feel it is important that people who are not as vigorous as John Muir should have the opportunity to see and feel such a powerful place. If we react strongly to restore the Valley to its natural integrity, and if that implies elimination of automobiles, how will our aged and infirm Aunt Minnie get in to see Half Dome?

CONCLUSION

Answers to the questions of balance are not easily agreed upon. We can call upon no blind Justice, standing with her calibrated scale to settle these questions. Certainly, the National Park Service is fully aware of this, as its own master plan, in the making for years, sits idly on the shelf. The plan, it seems, moved too far, too fast from what Yosemite has become.

We must consciously and forthrightly focus on the three factors that must be weighed together in making wise judgments about how to include people in natural areas. First, and always, we need to be conscious of the physical sensitivities of natural systems so that we do not compromise their stability and integrity. Second, we must be aware of the spirit of place of natural areas so as to understand, to feel, and to protect these vital spiritual values. And third, we must be clear on the cultural expectations we choose to overlay upon our natural places. For, surely, it is the application of these external values that can alter the spirit of a wild place or the integrity of a natural process. We have an obligation to make these choices with care, with insight, and with sensitivity to the balance we propose to make. Because, if we choose poorly, we may lose the essence of a natural place and forfeit the values we are seeking to perpetuate.

The lesson for Yosemite Valley, and for all our natural areas, should be that we are in peril of our own ambivalence toward things natural and toward our notions of what is fair and equitable under our laws. We must recognize this ambivalence and try not to make our natural areas become all things to all people. In weighing Factor #2, the spirit of place, against Factor #3, our social values and expectations, we must acknowledge that there will be times when, by the very purpose for which we set aside natural areas, the spirit and the place win out and their preservation, intact, may preclude use and some broader public benefit.

We must encourage the agencies that manage our natural areas to develop defensible processes for determining, in detail, the express *purposes* for which natural areas have been set aside. We need to learn all we can about the physical working of these natural systems and we need to distill the essence of place that they represent. Further, we need to plan for people to visit these places within this framework.

This approach needs to embrace natural areas as well as parks and recreation areas. We need to consciously recognize the different needs for accommodating natural values as opposed to accommodating human or social values, so that we can formulate a sensible notion of balance in any given place. *Both* values are real and both values need to be accommodated, but not necessarily in the same location.

As the population burgeons in California and as global pressures on the environment mount, it is increasingly important that our most important natural areas, for their protection, be treated as single-purpose places. Few places are large enough, diverse enough, or resilient enough to be all things to all people. The question of balance may lead to some difficult and unpopular answers; we need to exercise the courage and the foresight to articulate them.

FOR ALL TIME: VISITOR USE AND LONG-TERM MANAGEMENT AT RED ROCK CANYON STATE PARK (CALIFORNIA)

Mark R. Faull[1]

Abstract

The majority of state and national park systems are founded upon dual opposing mandates that create an inherent conflict between satisfying current (single generation) recreational needs and accomplishing prolonged unimpaired maintenance of resources. Park managers refer to an elusive balance between these contradictory mandates. The balance is imperfectly understood and no single accepted methodology exists. The best model for discussion probably revolves around the resolution of the cumulative variety of issues faced at a single park unit.

Through the examination of multiple resource-related problems encountered, and the questions subsequently formulated, it is possible to intricately examine our short- and long-term goals and the fabric of our management understanding. A review of current management projects and programs at Red Rock Canyon State Park, from archeology, paleontology, exotic species control, sensitive species management, and new species discoveries, illustrates how we are continually enlightened and tested by our creative abilities to properly steward these precious landscapes.

INTRODUCTION

The wording was created. The language was set on congressional paper, signed by the president in the midst of a divisive civil war. And so in 1864, the signature of Abraham Lincoln initiated and formalized the dilemma.

The land concerned was a place the native Americans called Yosemite, in honor of the "great full-grown grizzly bear" (Ise 1961, 51). While the California grizzly would fall prey to extinction, this landscape was saved. In the wording of the legislation of the Yosemite Grant, this landscape was presented to the state of California "upon the express conditions that the premises shall be held for public use, resort, and recreation; shall be inalienable for all time . . ." (Brockman and Merriam 1959, 36). These sentiments were further defined as an "interest in the preservation both of Yosemite Valley and the Big Trees Grove" and that these landscapes had been committed to the state of California "for their constant preservation, that they may be exposed to public view, and that they may be used and preserved for the benefit of mankind . . ." (Brockman and Merriam 1959, 37).

"Used and preserved" – the basic tenets of our natural parks had been written, the inherent conflict, the dilemma recorded. No more succinctly could it be written than in these three words. These guidelines, this concept was echoed eight years later, for another landscape only recently explored, a place named Yellowstone. Here the Congress expressed the preservation in different language, but the meaning was identical. Yellowstone was set aside for the benefit of mankind forever (Albright and Taylor 1928, 182). Within the language of the first true national park, borrowed from the Yosemite Grant, the concept would be reworded but remain constant. And it would be retained as the basis for both national and state park land preservation across the continent. The concept of withdrawal of landscapes for public appreciation to be transmitted unimpaired to future generations was formulated.

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Here was the birth of stewardship, or what today natural area managers refer to as resource management. Here also was the inherent conflict in our mandate, the struggle for balance between public recreation and landscape preservation. Again, "used and preserved" – this is the essence of the struggle. All public uses carry with them an impact. Public recreation and landscape preservation are opposed. Each entity erodes the other. It is impossible to maximize either and be true to our mandates. If we increase our preference toward one the other diminishes. And thus we speak of balance.

Balance, however, is elusive. Its perception varies. It is more a collection of individual instances than a blanket approach. The particular details of each individual case are essential. The timeless decisions must be based on our imperfect knowledge of nature. But, moreover, these collections of individual decisions must also adhere to the broad interaction of ecological detail.

In striving for a balance there is no one answer, no one pathway. Perhaps the best, the only, discussion can be about the cumulative variety of issues faced at any one park unit. The realities and the subtle difficulties of on-site resource management are confronted most acutely at this level. It is here that the inherent struggle between recreation and preservation occurs. This is the location where the visitor engages the landscape. This is also the site where the complexities of nature are most revealed, complicating and sometimes foiling the efforts of even the best resource managers. Therefore, a study of the intricate details and subtleties revealed by one unit can be enlightening, illustrating the challenge of today and shaping the policy of tomorrow. Red Rock Canyon State Park, an amazingly diverse desert unit within the California State Park System, represents an attractive exemplar to study the conflict inherent between satisfying current (single generation) recreational needs and prolonged unimpaired management of natural resources.

MANAGEMENT AT RED ROCK CANYON STATE PARK

Red Rock Canyon State Park, located in the northwestern corner of California's Mojave Desert, is a visually stunning badlands topography. This sensitive landscape, with an active resource management program, encounters a variety of public-use demands, from filming of motion pictures and television commercials to the use of off-highway vehicles. Of those uses we manage, I have selected to relay those that challenge (and occasionally outright baffle) our creative abilities to properly steward this precious landscape.

Geology and Paleontology

As its name implies, the initially striking factor about Red Rock Canyon is the "painted" nature of its canyon walls. The geology consists of colorful tilted sedimentary and volcanic strata of Miocene age (Loomis and Burbank 1988). Not only is the canyon's geology stunning, it is also significant in its context and content. Nearly 25 colleges and universities use Red Rock Canyon as an outdoor geologic classroom. But beyond the geology, Red Rock Canyon is an extremely significant paleontological resource. Encased within our sedimentary geology, exposed by erosion are the fossil remains of two distinct time frames. A paleontologist, with park permits, produces new specimens and nearly new extinct taxa annually. Occasionally, fossils are discovered and stolen by park visitors or commercial profiteers.

The parkland produces mostly a Miocene paleofauna, but a significant Pleistocene fossil assemblage was recently discovered. Paleontologist Dr. David P. Whistler of the Los Angeles County Museum of Natural History discovered individual remains of horse, camel, several Columbian Mammoths (*Mammuthus columbi*), and almost 20 percent of a single bison skeleton (*Bison antiquus*), roughly dated at 10,700 yr BP. The find warranted publicity, both because the recovery of 20 percent of one animal is extremely uncommon and because the late Pleistocene fauna dramatically illustrated the youth of the Mojave Desert (less than 10,000 years old). Dr. Whistler and the State Park System staff discussed the options. The risk of increased fossil theft due to promotion was weighed against the significance of the find, the public's interest in such knowledge, and the public's increased appreciation for their preserved parks. A "media day" was planned after designs were discussed to minimize impacts. The fossil story was released to the media during the park's lowest visitor use season (due to the extremes of heat) and the exact location of the discoveries was not released to the public. The story received excellent local and regional coverage and was distributed nationally by the Associated Press (AP). Dr. Whistler was interviewed for an AP International release.

Faunal Resources

Nesting Birds of Prey. The intricate canyon land of Red Rock Canyon displays many varying habitats for flora and fauna. The impressive cliffs contain numerous ledges of resistant rock strata that provide excellent habitat for nesting birds of prey. Of particular interest are two birds of prey – the golden eagle (*Aquila chrysaetos*) and the prairie falcon (*Falco mexicanus*) – which annually nest on the protective ledges and are of concern to both the federal and state governments. Both species are sensitive and susceptible to human disturbance. In 1986, after documentation of general visitor use causing nesting agitation (Lehman 1986), an annual seasonal closure was implemented, surrounding and buffering the canyon displaying the most known aeries. Approximately 1,200 acres are closed to human entry from February 1 to July 1 to provide for nesting solitude. Since the closure's implementation, prairie falcon nest sites have been documented annually in the protected terrain (normally more than one). However, both prairie falcons and golden eagles have attempted annually to nest outside the protective closure zone on unprotected cliff faces. While prairie falcons normally display multiple nest sites within the canyon, in recent years only one golden eagle aerie per year has been attempted. The unprotected golden eagle nests appear to have been unsuccessful.

When sensitive birds of prey fail to use acreage set aside for breeding solitude, and instead experience nesting failure, do we create mobile seasonal breeding closures? The realities of further restricting visitor use and posting and enforcing temporary migrating seasonal closures must be addressed. If no further action is attempted, will the golden eagle disappear from the Red Rock Canyon theater, or will the current nesting pair eventually reestablish in the solitude of the protected closure? For now, these questions are unanswered.

Mohave Ground Squirrel. Ricardo Campground within Red Rock Canyon State Park was created in 1974. Planning led this intensive recreation facility to be intentionally placed at a location previously impacted by human activity. The planning process functioned properly, and then new data became available. Suddenly the park staff and visitors began documenting the presence of the now state-listed "threatened" Mohave ground squirrel (*Spermophilus mohavensis*). At the time of the site determination for the campground, Mohave ground squirrel occurrences were not well documented. As of the present, the majority of Mohave ground squirrel sightings are reported from the Joshua Tree Woodland (*Yucca brevifolia* var. *herbertii*) of the campground. The subsequent documentation of Mohave ground squirrel presence within the camping impact zone has led to concern for the preservation of this species within the park. It remains uncertain if Ricardo Campground truly represents the largest colony or whether the concentration of human activity could account for the number of sightings.

Do we consider reducing the size of our only campground if it appears that a state-listed squirrel's largest local colony may be adversely effected? At present, resource management funds have been allocated to study both the distribution of the Mohave ground squirrel throughout the unit and to attempt to discern if the Ricardo population is negatively impacted by the campground activity. Difficult decisions will be dependent on the study results.

CULTURAL RESOURCES

Native Americans

As one would suspect, the spiritual value and resources available in Red Rock Canyon are not limited to modern discovery. Native Americans, in particular the Kawaiisu, liberally used these scenic halls, and their past use is evidenced in the landscape.

Red Rock Canyon contains a rich cultural heritage. Native American prehistoric sites are continually discovered and documented. Two important prehistoric localities receive special attention and concern from the Red Rock Canyon staff. A native American rock shelter (CA-KER-147) displays pictographs, mortars, milling slicks, and a significant cultural midden (Sampson 1990). In the early years of Red Rock Canyon State Park, this rock shelter was interpreted on nature walks. Vandalism of the cultural midden and deterioration of the pictographs led to suspending interpretation of the site and contracting for excavation of the damaged midden in 1973 (Robinson no date).

Does current vandalism to important native American rock shelters and art sites warrant their closure to all current users to allow preservation for future generations? In this instance, we said yes. This non-renewable resource is treated with secrecy, withheld for future generations.

On a remote, dissected canyon land mesa, an intaglio or aboriginal ground effigy remains from the local native American culture (Davis and Winslow 1965). Although this feature (CA-KER-244) is remote, a limited number of private citizens have knowledge of and visit the site. A few additional visitors accidentally hike across the figure. From photographs of the intaglio taken 20 years ago, it appears that the margins are less distinct. There is also evidence that a rock alignment in the interior of the ground figure was altered (Faull 1987b). This deterioration has disturbed the park's resource managers. A protective fence has been proposed to enclose the ground figure. However, it is feared that this measure will attract visitors, curious about the fence, who otherwise would be ignorant of its existence. Therefore, continued monitoring and a policy of withholding site information from the public are the current management methods.

Historic Mining

A century ago, in 1893, Red Rock Canyon experienced a historically brief but significant attempt to mine placer gold (Faull 1989a). To recover the gold, a surge of miners dug almost two hundred adits, tunnels, and shafts into gold-bearing Pleistocene sedimentary deposits. Lacking water, the miners attempted to separate the gold from the encasing gravel by a process known as dry washing. Within two years, the majority of mining operations had ceased.

Today, limited sections of the state park display the concentrated activities of the miners. The open adits and tunnels in the landscape are nonrenewable, archeological features depicting past human usage, but they are also potential visitor hazards (and departmental liabilities). For the protection of current park users, a Mine Safety Program has been implemented (Faull 1989b).

Individual site examination by a mine safety engineer identified hazardous openings that require modification. In certain instances, the modifications will be complete after the installation of a cable netting rock-bolted in place. In this instance, entry is prohibited, yet history is protected and visible. Other exposures will require total concealment by rock walls backfilled with earth. While the entrance to the historic mine will be completely concealed, monuments set nearby with recorded angles and distances will enable future archeologists to relocate the entrances (and the enclosed and preserved historic mine cavity).

While approximately one-third of the historic mine resources will be altered to allow for public recreation (and safety), the majority of the historic landscape will remain open and unmodified with the exception of signs warning of mine hazards.

Nearly 200 miners poured into Red Rock Canyon in 1893. Within 4 months the number plunged to 60, and dwindled to 18 by 1896. The park staff has discovered at least one significant mining camp or residence site from this time frame. No structures remain from what appears to have been a tent community. Leveled tent pads, tent stakes, and a collection of artifacts discarded by the resident miners depict and allow scientific interpretation of the life of the placer gold miner. Archeological work is underway at this site.

Current park users, not knowledgeable of the site's antiquity, have complained that the historic "trash" is unsightly. One visitor even started to clean up the site, inadvertently removing some artifacts from their context in the landscape.

How do we treat areas of historic trash that are important for archeological study, but are viewed as unsightly by our public? Park managers are left with three imperfect options. First, remove the remaining surface artifacts after archeological study to present a clean park appearance. This option sanitizes the site and diminishes or destroys future archeological reexamination (which might involve improved technology or techniques). The second option is to interpret the site, informing the public about the importance and historic nature of the trash. The result might be resource destruction by theft and vandalous excavation. The third option retains the historic trash on-site once archeological investigation concludes. This option, while perpetuating the unsightly appearance of the trash, retains the historic fabric for future archeological investigation. The importance of this nonrenewable resource warrants its retention despite unfavorable public perceptions.

VEGETATIVE RESOURCES

Non-native Species Removal

In 1985, the park staff realized that non-native tamarisk species (*Tamarix parviflora* and *T. ramosissima*) had significantly invaded critical park habitats (Faull 1985). In particular, tamarisk had invaded Sodium Spring in the main wash channel in Red Rock Canyon. Notorious water transpires the tamarisk had literally lowered the water table, reducing the above-ground flow of the spring. A program of tamarisk removal resulted in a dramatic increase in the surface flow of Sodium Spring. While the initial removal of a large green thicket of tamarisk had an impact upon the visitors' visual perception, the increased surface flow of Sodium Spring produced compensating changes. Initially, the increase in Sodium Spring produced massive germination of tamarisk seeds. Following the manual removal of tens of thousands of tamarisk seedlings, native seed germination created an important emerging riparian habitat.

In 1982, the main Red Rock Canyon wash channel, which contains Sodium Spring, had been approved as an acceptable vehicle-use corridor or "designated road." After the tamarisk removal restored the spring, conflicts between the emerging riparian growth and vehicle use became evident. As a result, a new vehicle route was created adjacent to Sodium Spring atop a washside bench to reroute public vehicle use. For one quarter mile, vehicle use is diverted around the emerging riparian zone, allowing tranquility for plant emergence and wildlife use. This scenario retained public use while preserving the primary riparian resource.

Rare Plant Management

Red Rock Canyon State Park contains a number of sensitive species of flora and fauna. One species of flora, *Hemizonia arida* (the Red Rock Tarweed), is endemic to the western El Paso Mountains of Kern County and is listed by the California Department of Fish and Game as "rare." Red Rock Canyon State Park contains all but one of the known occurrences of this extremely restricted annual. Unrestricted public use in the canyon prior to park ownership threatened the survival of this species (Twisselmann 1967). Studies by the park staff indicate that this species displays strong geologic preferences and has apparently increased under the park's protective management (Faull 1987a).

Within the state park, two parcels of land have been classified as "natural preserves" that contain 95 percent of the specimens located on state-owned land. Within natural preserves, only foot traffic is allowed.

At the Red Cliffs Day Use parking area, the rocks outlining the dirt park perimeter was reduced by 25,000 square feet to provide additional habitat for the Red Rock Tarweed in 1986. By 1988, 26 tarweed plants had naturally expanded into the new habitat. The past two extreme drought years have hampered further rehabilitation.

New Species Discovery

In the spring of 1988, fieldwork and investigative research discovered a subspecies of poppy new to science in Red Rock Canyon (Clark and Faull in press). Studies continue on the "Red Rock Poppy," which have discovered an apparent geologic preference for granitic and rhyolitic rocks. The population numbers found to date indicate a small total population that could be considered for proposed state protective listing.

In addition, the state park staff, through ties with the Los Angeles County Museum of Natural History, has become aware of two day-flying moths (*Eremanthe chemsaki* and *Plumipalpia martini*) and one subterranean snail (*Mohavelix micrometallus*) that have their type localities in or adjacent to Red Rock Canyon and have never been redocumented beyond their initial scientific collection.

These discoveries of new species or subspecies illustrate the necessity for land stewards to continue research on their landscapes, to foster new and greater understanding of proper long-term management.

CONCLUSIONS

Red Rock Canyon State Park effectively illustrates the diversity of resource management interactions that occur between visitor use and resource preservation at a single park unit. The variety of individual resource concerns discussed is integrated into an interrelated management strategy for Red Rock Canyon.

Within the profession as a whole, the fabric of our management understanding is constantly evolving, constantly in flux. The balance we seek is elusive and remains dependent on realities such as renewable versus nonrenewable resources and on abstract concepts such as the carrying capacity of our landscapes.

Management of our park resources is an imperfect science. Each generation of natural-area stewards submit new concepts to the profession, new theories to be tested, new practices to be monitored. And so we progress, fully realizing that many of our own practices will fall prey to change, to better understanding and greater expertise . . . and for this we long. The struggle, the balance between our dual mandates – use and preserve – is endless. It cannot be resolved, only mitigated by each generation. Park stewards must establish a foundation of preservation, based upon sound data, overlain by a framework of public recreation, reduced to renewable and sustainable impacts.

The evolution of our management practices must parallel the advances in scientific enlightenment, if we are to successfully sustain our mandates and effectively manage these precious landscapes . . . for all time.

REFERENCES

Albright, H.M. and F.J. Taylor. 1928. *Oh, Ranger!* New York: Dodd, Mead and Company.

Brockman, C.F. and L.C. Merriam, Jr. 1959. *Recreational Use of Wildlands.* New York: McGraw-Hill Book Company.

Clark, C. and M. Faull. In press. A New Subspecies and a New Combination in *Eschscholzia minutiflora* (Papaveraceae). Submitted to *Madrono* for publication.

Davis, E.L. and S. Winslow. 1965. Giant Ground Figures of the Prehistoric Deserts. *Proceedings of the American Philosophical Society.* 109(1):8-21.

Faull, M.R. 1985. *A Survey of Tamarisk Populations: Red Rock Canyon State Park.* On file at Red Rock Canyon State Park.

_______. 1987a. Management of *Hemizonia arida* (Asteraceae) by the California Department of Parks and Recreation. In *Conservation and Management of Rare and Endangered Plants,* Proceedings of a California Conference on the Management of Rare and Endangered Plants, edited by Thomas S. Elias. Sacramento: The California Native Plants Society. p. 429-439.

_______. 1987b. *A Preliminary Survey of Native American Sites, Cultural Resource Inventory, Red Rock Canyon State Park.* On file at Red Rock Canyon State Park.

_______. 1989a. Cultural Resource Management at a Natural History Park. Submitted for publication in *Proceedings of the Historic Mining Workshop,* held January 23-27, 1989. Death Valley National Monument.

_______. 1989b. *Initiation of Mine Safety Program.* On file at Red Rock Canyon State Park.

Ise, John. 1961. *Our National Park Policy: A Critical History.* Baltimore: Johns Hopkin Press.

Lehman, Robert N. 1986. *Public Use of BLM Lands Near the Scenic Cliffs, California Desert District, and Potential Impacts to Breeding Raptors.* On file at Red Rock Canyon State Park.

Loomis, D.P. and D.W. Burbank. 1988. The Stratigraphic Evolution of the El Paso Bas, Southern California: Implications for the Miocene Development of the Garlock Fault and Uplift of the Sierra Nevada. *Geological Society of America Bulletin.* 100:12-28.

Robinson, R.W. No date. *Excavations at KER-147: Red Rock Canyon State Park, California.* On file at Antelope Valley College, Lancaster.

Sampson, M.P. 1990. Studies of Rock Art and Earthen Art in Red Rock Canyon State Park, Kern County, California. *Proceedings of the Society for California Archeology, Volume 3.*

Twisselmann, E.C. 1967. A Flora of Kern County, California. *Wasmann Journal of Biology.* 25:365-366.

THE ROLE OF RECREATION IN THE EXTIRPATION OF ALPINE PLANT SPECIES IN THE NORTHEASTERN UNITED STATES

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Abstract

Comparison of the extant alpine flora with historical records showed some rare disjunct populations were declining or extirpated in New York, Vermont, and New Hampshire. Trampling of vegetation, soil compaction, and erosion along a hiking trail apparently extirpated Gnaphalim supinum from Tuckermans Ravine, New Hampshire. Similarly, foot traffic resulted in the reduction of populations of Carex scirpoidea *on Mt. Marcy, New York, and* Carex atratiformis *on Mt. Mansfield, Vermont. They are vulnerable to extirpation because their diminished populations are disjunct and restricted to small eroding areas disturbed by hikers. A management response to reduce hiker impact in New York was the hiring of summit stewards to patrol two Adirondack peaks in 1990.*

INTRODUCTION

Dozens of state-protected rare plant species are disjunct on alpine mountaintops in northern Maine (Dibble et al. 1989, 1990), New Hampshire (Storks and Crow 1978; Crow 1982), Vermont (Countryman 1978; Thompson 1989) and New York (Mitchell et al. 1980; Zika 1990a), at elevations of ca. 1,200-1,900 m. This glaciated terrain is among the most rugged and remote in the region. Most alpine zones are protected by designation as wilderness, state park, national forest, natural area, or biosphere reserve.

Despite the protected status and public ownership, there are a number of potential threats to rare alpine species and plant communities. The threats include trampling, compaction, and erosion of thin soils and vegetation mats caused by recreational visitors (Willard and Marr 1970; Bell and Bliss 1973; Ketchledge 1982; Ketchledge and Leonard 1970, 1982; Marchand and Roach 1980; Price 1985). Natural recovery rates are slow, sometimes requiring centuries, in the harsh environment (Willard and Marr 1971; Billings 1973; Bliss 1966).

Recreational use of northeastern alpine areas has increased dramatically since 1950 (Waterman and Waterman 1989). An estimated 10,000-20,000 people climb New York's Mt. March each year. Up to 40,000 people per year have been recorded on Mt. Mansfield in Vermont (Peet 1979) and Mt. Katahdin in Maine (*NY Times* 1990). The Appalachian Mountain Club estimates 60,000 hikers, campers, and skiers visit Tuckermans Ravine, Mt. Washington, New Hampshire, per annum.

Climatic warming since the close of the Little Ice Age ca. 1850 (Hamburg and Cogbill 1988; Dansgaard et al. 1975) may have exacerbated other stresses on small and vulnerable northern plant populations disjunct in alpine areas. Competition from exotic species has become a problem on some mountains. Future threats to alpine ecology may include chronic pollution; forest decline is already a significant problem on lower slopes of the alpine mountains (Siccama et al. 1982; Johnson and Siccama 1983; Klein and Perkins 1988; Vogelmann et al. 1988).

In this study, a comparison was made between pre-1950 botanical records and the extant alpine flora. The reduction or extirpation of a number of populations was detected. Cases presumably caused by

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recreation are discussed here. Documentation of extirpations related to overcollection, development, and stochastic and/or climatic events are presented elsewhere (Zika in press).

METHODS

Historical data were assembled from literature and herbarium records, Natural Heritage Program databases, and interviews with regional botanists. Extensive fieldwork produced a list of species apparently extirpated from historical alpine localities in New Hampshire, Vermont, and New York, as was essentially done at Mt. Katahdin, Maine, by Fernald (1901), Hudson (1988), and Dibble et al. (1990). Circumstantial evidence from the historical record provided plausible explanations for extirpations.

RESULTS

The rarest alpine species are often restricted to small areas. An example is *Carex scirpoidea,* Scirpus-like sedge, on Mt. March in the Adirondack Mountains of New York. The station was documented with herbarium collections from 1862-1888. It was relocated in 1990 during this study. The population of ca. 20 shoots was restricted to a 2-meter square segment of eroding turf, surrounded by a wide devegetated zone in the middle of the main hiking trail, a few meters from the summit. The lack of recent records, despite many botanical studies on the peak (Peck 1891, 1900; Adams et al. 1920; Woodin 1959; Ketchledge and Leonard 1984; DiNunzio 1971; Riebesell 1982), implies the species was always rare and overlooked on Mt. Marcy. The eroding surroundings strongly suggest the *Carex scirpoidea* population is declining as the intact meadow habitat decreases in size.

Carex scirpoidea is vulnerable to extirpation on Mt. March for five reasons: 1) the population is small, 2) the population is concentrated, 3) the site is rapidly eroding and is frequently disturbed by large numbers of hikers, 4) the population is disjunct and near the southern limit of its range, and 5) the taxon is inconspicuous.

Carex atratiformis, black sedge, is very local on the ridgeline of Mt. Mansfield, Lamoille Co., Vermont. The small colony at 1,170 m is confined to a square meter near a parking area, where it is subjected to trampling. Observations of black sedge since 1979 have shown sharp declines in vigor, aboveground biomass, reproductive output, and percent ground cover. Similar untrampled colonies in Smugglers Notch, Vermont remained stable over this time period. *Carex atratiformis,* like *Carex scirpoidea,* is vulnerable to extirpation by trampling, for the same reasons.

Gnaphalium supinum, mountain cudweed, is known from only two mountains in the United States (Dibble 1990; Fernald 1950). Pease (1964) lists collections of *Gnaphalium supinum* (1850-1900) from Tuckermans Ravine, Mt. Washington, Coos Co., in the Presidential Range of the White Mountains of New Hampshire. The colony was restricted to a small area at the base of cirque's headwall, where snow lies late in the growing season. Fred Steele (pers. comm.), an active botanist in the area for most of this century, remembers seeing the station persist until ca. 40 years ago, along the margin of the Tuckermans Ravine Trail. Since then, visitor use of the trail has mushroomed (Waterman and Waterman 1989), and the trail corridor has widened. At present, the trail is confined to a constructed stone staircase, surrounded by a wide strip of trampled rubble denuded of vegetation.

Is the *Gnaphalium supinum* population extirpated from the site? The evidence is compelling. There is a 40-year history of unsuccessful searches by botanists in the area, including Steele. The area in question is small and accessible and thus easily searched. Repeated searches by the author and others led to the presumption the population was extirpated.

Was recreation the reason for the extirpation? The data strongly suggest it. Cogbill (1984) and Fitzgerald et al. (1990) noted a similar increase in hiker traffic through Monroe Flats and the ultimate extirpation of a subpopulation of *Potentilla robbinsiana* west of the trail. Destruction of vegetation along alpine trails is commonly observed (Willard and Marr 1970, 1971; Bell and Bliss 1973; Brown et al. 1978; Ketchledge 1982). The snowbank and snow arch at the *Gnaphalium supinum* site contribute to off-trail trampling of cudweed habitat. Many visitors are attracted to the midsummer snow, which lies a short distance from the stone path (Willard and Marr 1971).

Alternative explanations for the extirpation of *Gnaphalium supinum* lack strength. Herbarium collecting is a poor explanation; there are no recent specimens. Air pollution and allied factors do not seem responsible. A second historical locality is extant in a similar habitat in Huntingtons Ravine, 1.6 km to the north (Pease 1962). Observations of both sites suggest the only significant difference between the Tuckerman and Huntington Ravine environments is that there is no summer trail through the Huntington population.

Although *Osmorhiza depauperata* Phil., blunt-fruited sweet-cicely, is not an alpine species; it is another mountain plant, probably extirpated by heavy recreational use of its habitat. A colony documented in 1926 at Bingham Falls, at the base of Mt. Mansfield (Pease 1974 NEBC) was not seen recently, despite repeated searches since 1977 (Jenkins and Zika 1987). Much of the site was essentially denuded of herbaceous vegetation by sightseers and swimmers at the falls.

DISCUSSION

The immediate threats to *Carex scirpoidea* on Mt. March also exist for other rare and local alpine species in the Adirondacks, such as *Poa fernaldiana, Prenanthes boottii,* and *Empetrum eamesii* ssp. *atropurpurea* (Zika 1990b). Severe alpine soil erosion caused by trampling in the Adirondacks resulted in emergency measures to establish exotic grasses, with the goal of preserving the organic matter, nutrients, and seed bank from irreversible loss (Ketchledge and Leonard 1970; Ketchledge et al. 1985). *Poa pratensis,* a rhizomatous European species, was seeded and fertilized on destabilized sites. This species dies back at some sites after a few years (Runolfsson 1987). However, it is now a pernicious weed displacing native sod-forming species on Mt. March and Whiteface Mt. in New York, and on Camels Hump and Mt. Mansfield in Vermont (Zika in press). It is preferable to use seed from native alpine species such as *Calamagrostis canadensis, Agrostis mertensii, Juncus trifidus, Arenaria groenlandica, Empetrum nigrum,* and *Vaccinium uliginosum* to stabilize eroding soils (Cargill and Chapin 1987; Kershaw and Kershaw 1987; Marchand and Roach 1980).

New York instigated a more proactive management program in 1990. Summit stewards patrolled the alpine areas on Algonquin Peak and Mt. March (NY *Times* 1990). Through low-key education of visitors, travel corridors were limited to well-defined paths and exposed ledges. The program was modeled after the successful system of alpine ranger-naturalists on Mt. Mansfield and Camels Hump in Vermont, established in the 1970s. Cooperative funding for the New York effort came from the New York Department of Environmental Conservation, Adirondack Nature Conservancy and Land Trust, Adirondack Mountain Club, and the Forty-Sixers.

Even the vigilance and public education afforded by patrolling rangers does not guarantee rare species will survive near intensely travelled areas. The short-term survival of both *Carex scirpoidea* and *C. atratiformis* is likely to require additional steps, including erosion control, as well as completely rerouting hiker traffic by using barricades and clearly marked alternative trails. This type of integrated approach apparently stabilized a declining *Potentilla robbinsiana* population along the Appalachian Trail (Fitzgerald et al. 1990).

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REFERENCES

Adams, C. C., G. P. Burns, T. L. Hankinson, B. Moore, and N. Taylor. 1920. Plants and animals of Mount Marcy, New York. *Ecology* 1:71-94, 204-233, 274-288.

Bell, K. L., and L. C. Bliss. 1973. Alpine disturbance studies: Olympic National Park, USA. *Biol. Conserv.* 5:25-32.

Billings, W. D. 1973. Arctic and alpine vegetations: similarities, differences, and susceptibility to disturbance. *Bio Science* 23:697-704.

Bliss, L. C. 1966. Plant productivity in alpine microenvironments on Mt. Washington, New Hampshire. *Ecol. Monogr.* 36:125-155.

Brown, R. W., R. S. Johnson, and D. A. Johnson. 1978. Rehabilitation of alpine tundra disturbances. *J. Soil Water Conserv.* 33:154-160.

Cargill, S. M., and F. S. Chapin III. 1987. Application of successional theory to tundra restoration: a review. *Arct. Alp. Res.* 19:366-372.

Cogbill, C. V. 1984. Historic changes in the distribution of Potentilla robbinsiana and its habitat. *Progress report to Appalachian Mountain Club.*

Countryman, W. D. 1978. *Rare and Endangered Vascular Plant Species in Vermont.* The New England Bot. Club in cooperation with the U.S. Fish and Wildlife Service, Newton Corner, MA.

Crow, G. E. 1982. *New England's Rare, Threatened, and Endangered Plants.* U.S. Fish and Wildlife Service in cooperation with New Hampshire Agric. Exp. Sta., Univ. of New Hampshire, Durham.

Dansgaard, W., S. J. Johnson, N. Reeh, N. Gundestrup, H. B. Clausen, and C. U. Hammer. 1975. Climatic changes, Norsemen and modern man. *Nature* 255:24-28.

Dibble, A. C., C. S. Campbell, H. R. Tyler, Jr., and B. S. J. Vickery. 1989. Maine's official list of endangered and threatened plants. *Rhodora* 91:244-269.

_______, S. C. Rooney, H. Hinds, W. D. Hudson, Jr., and B. A. Sorrie. 1990. Rediscovery of some rare plants on Mt. Katahdin. *Rhodora* 92:38-41.

Dinunzio, M. G. 1972. *A Vegetational Survey of the Alpine Zone of the Adirondack Mountains, New York.* M.S. thesis. State University of New York, College of Environmental Sci. and For., Syracuse.

Fernald, M. L. 1901. The vascular plants of Mt. Katahdin. *Rhodora* 3:166-177.

______. 1950. *Gray's Manual of Botany*. 8th ed. American Book Co., New York.

Fitzgerald, B. T., K. D. Kimball, C. V. Cogbill, and T. D. Lee. 1990. *The biology and management of potentilla robbinsiana*, an endemic from New Hampshire's White Mountains.

Hamburg, S. P., and C. V. Cogbill. 1988. Historical decline of red spruce populations and climatic warming. *Nature* 331:428-431.

Hudson, W. D., Jr. 1988. *The Preliminary Vascular Flora of Baxter State Park.* Misc. Pub. #37. Maine State Planning Office, Augusta.

Jenkins, J., and P. Zika. 1987. *The Waterfalls, Cascades and Gorges of Vermont.* Vermont Agency of Environmental Conservation, Waterbury.

Johnson, A. H., and T. G. Siccama. 1983. Acid deposition and forest decline. *Environ. Sci. Technol.* 17:294A-305A.

Kershaw, G. P., and L. J. Kershaw. 1987. Successful plant colonizers on disturbances in tundra areas of northwestern Canada. *Arct. Alp. Res.* 19:451-460.

Ketchledge, E. H. 1982. Adirondack insights 2: The sensitive summits. *Adirondac* 46:20-21.

______ and R. E. Leonard. 1970. The impact of man on the Adirondack high country. *Conservationist* 25:14-18.

______ and ______. 1982. Adirondack insights 6: Summit stability. *Adirondac* 46:22-23.

______ and ______. 1984. A 24-year comparison of the vegetation of an Adirondack mountain summit. *Rhodora* 86:439-444.

______, ______, N. A. Richards, P. F. Craul, and A. R. Eschner. 1985. *Rehabilitation of Alpine Vegetation in the Adirondack Mountains of New York State.* Res. Paper NE-553, USDA Forest Service, Northeastern For. Exper. Sta., Broomall, PA.

Klein, R. M., and T. D. Perkins. 1988. Primary and secondary causes and consequences of contemporary forest decline. *Bot. Rev.* 54:1-43.

Marchand, P. J., and D. A. Roach. 1980. Reproductive strategies of pioneering alpine species: seed production, dispersal, and germination. *Arct. Alp. Res.* 12:137-146.

Mitchell, R. S., C. S. Sheviak, and J. K. Dean. 1980. *Rare and Endangered Vascular Plant Species in New York State.* New York State Mus. in cooperation with the U.S. Fish and Wildlife Service, Albany.

New York Times. 1990. State stewards guard Adirondacks' alpine flora. Sunday *New York Times.* 139(Aug. 26):40.

Pease, A. S. 1964. *A Flora of Northern New Hampshire.* New England Bot. Club, Cambridge, MA.

Peck, C. H. 1891. Plants of the summit of Mt. March, pp. 177-187. In: Colvin, V. *Report on the Progress of the State Land Survey*, J. B. Lyon, Albany.

______. 1900. *Report of the State Botanist,* 1898. New York State Mus. Bull. 5(25):618-688.

Peet, H. T., Jr. 1979. Long Trail use figures are useful. *Long Trail News* 39:8-9, 11.

Price, M. F. 1985. Impacts of recreational activities on alpine vegetation in western North America. *Mt. Res. & Dev.* 5:263-277.

Riebesell, J. F. 1982. Arctic-alpine plants on mountaintops: agreement with island biogeography theory. *Am. Nat.* 119:657-674.

Runolfsson, S. 1987. Land reclamation in Iceland. *Arct. Alp. Res.* 19:514-517.

Siccama, T. G., M. Bliss, and H. W. Vogelmann. 1982. Decline of red spruce in the Green Mountains of Vermont. *Bull. Torrey Bot. Club* 109:162-168.

Storks, I. M., and G. E. Crow. 1978. *Rare and Endangered Vascular Plant Species in New Hampshire.* The New England Bot. Club in cooperation with the U.S. Fish and Wildlife Service, Newton Corner, MA.

Thompson, E. 1989. *Vermont's Rare, Threatened and Endangered Plant Species.* Vermont Natural Heritage Program, Agency of Natural Resources, Waterbury.

Vogelmann, H. W., T. D. Perkins, G. D. Badger, and R. M. Klein. 1988. A 21-year record of forest decline on Camels Hump, Vermont, USA. *Eur. J. For. Path.* 18:240-249.

Waterman, L., and G. Waterman. 1989. *Forest and Crag.* Appalachian Mountain Club, Boston.

Willard, B. E., and J. W. Marr. 1970. Effects of human activities on alpine tundra ecosystems in Rocky Mountain National Park, Colorado. *Biol. Conserv.* 2:257-265.

______. 1971. Recovery of alpine tundra under protection after damage by human activities in the Rocky Mountains of Colorado. *Biol. Conserv.* 3:181-190.

Woodin, H. E. 1959. Establishment of a permanent vegetational transect above timberline on Mt. March, New York. *Ecology* 40:320-322.

Zika, P. F. 1990a. *New York Rare Plant Status List.* N.Y. Natural Heritage Program and N.Y. State Dept. of Environmental Conservation, Latham.

______. 1990b. The first records of *Gnaphalium sylvaticum (Asteraceae)* and *Empetrum eamesii* ssp. *atropurpureum (Empetraceae)* in New York State. *Rhodora* 92:120-125.

______. In press. Historical species loss in the alpine zone of Camels Hump, Vermont. *Bull. Torrey Bot. Club.*

THE VOLUNTEER IN NATURAL AREA PRESERVATION

VOLUNTEERS IN ECOLOGICAL RESTORATION: THEY ARE NOT JUST FOR PICKING UP TRASH ANYMORE

T. Destry Jarvis[1]

Abstract

The thousands of volunteers recruited, trained, and placed in public land conservation service projects by the Student Conservation Association (SCA) over the past three decades have become increasingly sophisticated in the quality of work that they are able and requested to perform on the public lands.

At one time, public officials had the opinion that most volunteers were capable of only the most menial tasks and that the more sophisticated projects had to be left for "professionals." Such is no longer the case. Increasingly, volunteers are being sought by public land agencies to undertake the most complex of tasks. Work carried out in recent years by SCA program participants has included disturbed site restoration, revegetation with native plant materials, erosion control, and soil stabilization, in addition to numerous wood and rock craft projects, including construction in remote locations of timber bridges and rock stairs.

INTRODUCTION

For more than thirty years, the Student Conservation Association has recruited, trained, and placed student volunteers, under the supervision of SCA adult personnel, in extended public service programs in cooperation with a number of federal, state, and local land managing agencies in a program called the High School Work Group (HSWG).

Additionally, for over 25 years, the SCA has carried out a program using college undergraduate and graduate students, working in their field of academic major, in even longer term and more professional internships, alongside agency professionals, the Resource Assistant program (RA).

In more recent years, this RA program has grown to encompass not only young adults but retirees as well. SCA's Resource Assistant program is a participating agency in the American Association of Retired Persons (AARP) Volunteer Talent Bank. At present, we are placing over 1,000 RAs in over 250 natural resource sites in 49 states and the territories of the Virgin Islands and Puerto Rico, annually.

Together, the SCA high school work group (HSWG) and RA programs have utilized the sweat energy and brain power of nearly 20,000 volunteers in furtherance of conservation programs in virtually every state in the United States.

Operating on the theory that all segments of the population can and will volunteer their energy in public service, SCA has for a number of years conducted a number of volunteer programs for recruits from special populations. These include High School Work Groups for inner-city, underprivileged, and/or minority teenagers; HSWG for hearing impaired teens, with sign language-capable leaders; RA positions for blind and wheelchair-bound young adults; and a special program, the Campground Administration and Maintenance Program (CAMP), in which SCA contracts with the U.S. Forest

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Service to operate public campgrounds using developmentally disabled teenagers and special education leaders.

With the current and likely future shortfall in financial and personnel allocated to the federal public land managing agencies, the role of volunteers takes on an increasing significance. The agencies will have to move aggressively to take advantage of the opportunity currently available to them as a result of the vast and growing public concern for the environment, by developing even more outlets on the public lands for the energies of the thousands of potential volunteers available to them.

Existing programs, with track records of successful performance like SCA and newer, more localized ones, will become increasingly important to these land-managing agencies if they are to carry out their missions effectively.

THE ROLE OF PUBLIC LAND VOLUNTEERS

Federal land managing agencies currently use volunteers to varying degrees and in a variety of field program areas, but it is safe to generalize that their role is increasing, both in numbers and sophistication.

For over three decades, SCA has carried out volunteer programs with the National Park Service, using both our High School Work Group program and our Resource Assistant Program. Twenty years ago, the program expanded to the U.S. Forest Service, and ten years ago, programs were established with the U.S. Fish and Wildlife Service and the Bureau of Land Management. In 1990, SCA developed its first programs with the U.S. Navy Department on their natural resource lands in the Chesapeake Bay and the Channel Islands of California. In addition, programs are conducted in cooperation with state agencies in California, Wyoming, Colorado, Utah, New Hampshire, and Maine.

The normal format for the SCA HSWG is that selected groups of six to ten teenagers, with one or two adult SCA leaders/supervisors, will spent four to five weeks in a field program located in a backcountry site on the public lands. Unlike some other volunteer programs also being used on the public lands, SCA volunteers are full time, working 40 or more hours per week under direct SCA leadership. One of the unique aspects of the SCA program is that our supervisors, rather than agency personnel, lead the work, so that burden on the agency is substantially reduced.

With the SCA Resource Assistant Program, volunteer applicants are carefully screened and matched by academic discipline and course work to the job specifications of the agency. Typically, the RA spends 12 weeks, at any time of the year, in their volunteer internship. Because of the match of academic discipline to the job at hand, these volunteers, mostly recruited from the natural sciences, will be assigned tasks of a professional or semiprofessional nature and will be treated like virtually any other seasonal employee of the agency.

In the early days, SCA's high school work group field programs focused primarily on trail construction and repair. However, over the years, a number of programs were added in the areas of disturbed site restoration and revegetation. Most recently, in 1989, SCA was asked to develop the Greater Yellowstone Recovery Corps, to undertake large-scale fire-recovery projects in the Yellowstone ecosystem following the fires in the summer of 1988. This has been SCA's largest single project to date, thus far using over 700 volunteers devoting over 85,000 hours of service to the recovery effort.

Today, more often than not, virtually all of the SCA HSWG programs include disturbed site restoration work. Ecological restoration/revegetation work has also been integrated into our ongoing adult training program, Wilderness Work Skills, a routine field training experience required for all SCA leaders.

Five years ago, SCA decided that a formal training program in the work skills necessary to public service work in the backcountry of the public lands was needed and was not available through any of the agencies with which we were working. For this reason, SCA developed the Wilderness Workskills Training Program, a five-day, hands-on field course, which is taken not only by SCA leaders, but by agency personnel, who also find it difficult to obtain this training elsewhere.

The work skills training program, for which SCA has developed a technical manual, includes a full day of training in each of these areas – revegetation/restoration; trail design and construction; trail construction and maintenance; and rustic timber and rock construction. In addition, several specialized training courses are offered, including a full three-day course in revegetation and restoration and a five-day program entitled Wilderness Management School, which not only includes many of the work skills, but several more scientific aspects involving impact assessment and mitigation in wilderness settings.

We are currently preparing a technical manual, under contract to the Forest Service's Intermountain Research station, on high elevation revegetation in the Northwest, and have plans underway to expand this manual to cover the full range of bioregions where restoration techniques are needed.

In the summer of 1990, SCA volunteers, both HSWG and Ras, went to work in Yosemite National Park as elements of the parkwide effort to implement the Wilderness Restoration Plan, carrying out projects in the high Sierra. The primary focus in 1990 was restoration of trampled high Sierra lakeshores and removal of braided trail corridors through revegetation. This work in Yosemite is expected to continue and to expand in the coming years, until the task is complete.

Through all of this work by SCA volunteers, and that of other individuals and organizations, it is apparent to me that the role of the volunteer in the conservation of our public lands is one of increasing sophistication, complexity, and growing demand. In fact, it may well be that the agencies could not adequately carry out their mission without the continued infusion of time and talent from volunteers.

RESTORING A REGION'S NATURAL AREAS WITH VOLUNTEERS

George Johnson[1] and Gillian Moreland[2]

Abstract

The dominant natural communities of presettlement Illinois were tallgrass prairie and oak savanna. In 1978, a state inventory found 2,352 acres of prairie remaining; savanna totaled only 1,296 acres. Inventory biologists identified encroachment by woody and exotic weed species as a significant hazard to these remaining sites. Professional staffs responsible for natural areas were sufficient to carry out restoration and burn management on only a portion of these acreages. In 1984, The Nature Conservancy organized the Illinois Volunteer Stewardship Network, and today, 196 key natural areas are under intensive management and restoration programs in Illinois. Over 2,000 volunteer stewards coordinate an expanding list of activities under the direction of professional personnel from the owning agencies. The condition of Illinois natural areas is being dramatically improved.

INTRODUCTION

The tallgrass prairie was the dominant presettlement natural community of Illinois. Tallgrass prairie is composed of 250 grasses and flowering plants. Ascending the prairie food chain are about 10,000 insect species, 50 or so reptiles and amphibians, and an equal number of birds and mammals.

Tallgrass prairie is composed mostly of perennial species that require full sunlight and die back to the ground each winter. Prior to settlement, the tallgrass prairie burned or was torched by Indians every year.

It has been established that there was a closely associated ecosystem occupying much of Illinois. It was the tallgrass savanna. The savanna's signature is the oak tree, particularly the bur oak. Its understory flora is a hundred or so species, most of them unique to the savanna and with shade preferences ranging from open shade (10 to 30 percent canopy) through mesic (30 to 70 percent) and closed shade (70 to 90 percent). Only now are we beginning to understand the uniqueness of this system and the narrow range of habitat requirements of many of its species.

And again, it has been proven that an absolute requirement for maintenance of the savanna is fire. Without fire to kill the seedlings of the trees and exotics, one soon has a 100 percent closed canopy – another plant community entirely. Oaks, especially bur oaks, resist fire in the seedling stage, hence the association with shade-tolerant, understory plants.

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THE ILLINOIS NATURAL AREAS INVENTORY

In 1976 and 1977, the Illinois Department of Conservation commissioned a survey of the state of Illinois to locate all remaining natural areas. The surveying biologists found 689 parcels containing high-quality natural communities. Adding up every pioneer cemetery and abandoned railroad right-of-way remnant, they could find only 2,352 acres of all types of tallgrass prairie. That's in a state with 36 million land acres, often called "the prairie state" and only settled in the 1830s.

Worse yet, savanna had declined to a mere 1,296 acres, and the inventory used a broader designation than it would be given today. In fact, there remained only *six* acres of mesic tallgrass savanna, so rare that today it carries a G-1 (most endangered) designation by The Nature Conservancy.

Of the minuscule acreages of prairie and savanna discovered in the natural areas survey, over half were in private hands and disappearing with each passing day – not only from the plow and the builder, but, more importantly, from the steady encroachment of woody species. "Control of woody vegetation and exotic species" was cited by the surveyors as the *leading* management problem in Illinois natural areas. Uncontrolled alien and native trees and brush were shading out the prairie – and savanna understory plants – with consequences throughout all dependent life forms.

In 1977, at the completion of the natural areas survey, it was clear that this historic and splendid tallgrass ecosystem would become essentially extinct in Illinois *within our lifetimes.* The tiny remaining acreage would be lost under a smothering blanket of European buckthorn, gray dogwood, sumac, black cherry, boxelder, poplar, and species of similar aggressive habits.

As often happens, it takes the imminent loss of something we care about to muster the means to save it. Northeastern Illinois has a number of exceptional botanists and ecologists. William Beecher, Ray Schulenberg, Robert Betz, Floyd Swink, Gerould Wilhelm, Steve Packard, and others began calling for more active steps to "save the prairies." They focused especially on

- The need for bringing the quality acreage under protection.
- The risk from woody plant degradation.
- The need for more information about management to maintain the presettlement condition, particularly the place of the prescribed burn.

The job was enormous. The staff manpower, just to hold the brush in check, was not available. Time was short and the patient was terminal.

THE VOLUNTEER STEWARDSHIP PROJECT

In 1977, Steve Packard of The Nature Conservancy personally began recruiting volunteers to work with him to stem the changes in certain choice natural areas on Cook County Forest Preserve land along the north branch of the Chicago River. Packard and his North Branch Prairie Project group began using prescribed burns in the fall or spring, wherever there was sufficient plant residue to support fire.

Where brush had overgrown the prairie and savanna, the group began, under Forest Preserve staff supervision, a carefully planned system of brush cutting, herbiciding the stumps to prevent regrowth, scattering of seed, and general nurturing of the residual seed bank until fire could again be used to maintain the presettlement complex. Today, the North Branch Project group alone manages almost 500 acres in 10 sites, and their volunteer structure involves hundreds of people.

This same activity is going on today at 196 natural areas in Illinois. In cooperation with the professional staffers, the group is reclaiming, replanting, and restoring the native vegetation and the fauna that lived there.

This volunteer network was developed by The Nature Conservancy and has been supervised from its beginning by Steve Packard. The day-to-day direction of the Illinois Volunteer Network is carried on by Gillian Moreland, also of The Nature Conservancy.

The Volunteer Stewardship Network began in 1983 as a joint project with The Nature Conservancy in Illinois and the Illinois Nature Preserves Commission to surveil and assist with management on the many high-quality natural areas in the six-county region around Chicago. In line with The Nature Conservancy's mandate to preserve biotic diversity, they looked at the full spectrum of natural areas, irrespective of ownership, and targeted 65 high-quality areas listed on the Illinois Natural Areas Inventory.

Initially, volunteer stewards were asked to surveil their sites, watching out for damage, such as broken fences, missing signs, dumping, and misuse like that of off-road vehicle trails. Then, beginning in a tentative way, each steward was encouraged to embark on carefully planned brush and alien plant removal programs. Controlled burns were organized and conducted with the approval of the site owners.

Co-stewards were recruited as work increased. The West Chicago Prairie stewardship group was organized in 1984 by Melvern Hoff, a retired Amoco chemist. Today, he and about 50 co-stewards are involved in restoration and monitoring work on this fine 160 acre prairie-savanna-wetland complex. All activities are approved by Wayne Lampa, biologist for the owner, the Du Page County Forest Preserve District. Their primary activities include

- cutting and herbiciding areas of gray dogwood and other species too dense to permit formation of burnable surface residue.
- collecting seed of over 50 plant species.
- reseeding and plant propagation in restored areas.
- conducting adult and student tours.
- monitoring plants, birds, and insects.

Volunteers working together and supporting the owners provide an important constituency, adding a powerful voice in saving and expanding critical areas. By 1987, there were 55 stewards on as many sites. Since then, the six-county network has more than doubled to over 130 steward-assigned sites. From records at the end of 1989, there are now at least 2,000 volunteers working there.

The network is now expanding. In central Illinois, 30 new sites with stewards were added during a 12-month period by Michael Reuter, working as a regional volunteer steward. In August 1989, The Nature Conservancy hired Reuter full time to coordinate stewardship in downstate Illinois.

Monitoring programs have been developed parallel to restoration efforts. A volunteer field coordinator of plant monitors is assisted by John Schwegman of the Illinois Department of Conservation and Marlin Bowles of the Morton Arboretum.

Plant monitors may be the site steward or a co-steward recruited especially for this work. Activities concentrate on state endangered species and the G-1s, 2s, or 3s on The Nature Conservancy list. Procedures, training, tabulation, and reporting are a joint function of all involved. Formal plant monitoring has been conducted on 35 sites for up to four years.

Insect monitoring is organized along these same lines. The project mentor is Ron Panzer of Northeastern Illinois University. Sixteen monitors concentrate primarily on butterflies. So little is known about specific insect/plant relationships that a volunteer is currently being recruited, for example, to concentrate solely on the insects associating with the prominent prairie species, leadplant (*Amorpha canescens*).

Early in the growth of the Volunteer Network, it was recognized that stewards would need a high level of training. In 1990, the network held five burn workshops. Summer field seminars included management and restoration of wetlands, savannas, woodlands, and prairies, and another on glacial topography.

In the spring of 1989, the Ninth Northern Illinois Prairie Workshop was organized by the volunteers of the North Branch Prairie Project. Over 1,000 people attended.

A looseleaf *Handbook for Stewards* is presently in progress, being written and pulled together from material already available by a volunteer editor/writer. Instructions on how to girdle trees, collect and store seed, "make it happen" on volunteer workdays, and prepare management schedules will be some of the subjects covered.

Management plans and schedules are a crucial part of any natural area program. Originally prepared by the owner, these are increasingly being written by the stewards and have proved helpful in setting goals and priorities for the site. They also encourage cooperation between the owner agency's professional and the steward. Assistance in writing these is often given by the regional steward.

The regional steward was added to the network organizational structure in 1987. Fifteen experienced stewards were asked to assist and train the half dozen or so stewards in their immediate areas. This addition has been so successful that regional activities are being reorganized into four subdivisions: administration, stewardship, ecology, and public relations. These regional volunteers may be responsible for all the natural areas in a county, as many as 35 sites. This reorganization is, in part, the result of a study made by Nicolaas Kist, a board member of the Illinois chapter of The Nature Conservancy.

The Nature Conservancy publishes a network newsletter three times a year. The Grove and Prairie Calendar, produced twice a year, lists workdays, walks, and other events taking place in the next several months at each natural area in the network. Regional newsletters report on more local news.

Another expansion for both the conservancy and the network in Illinois is an agreement with the Cook County Forest Preserve District to restore larger areas within their 66,000 acres of preserves. In late August 1989, The Nature Conservancy members and the public were invited to attend an introductory meeting at Cook County's Poplar Creek Forest Preserve where the first major restoration project of this new program was to take place. Almost 100 people attended. The plan is to restore 600 acres at that site. About 50 or 60 people gathered seed all fall, and strips were prepared to receive this seed in the spring. Through the winter, an average of 30 people were out cutting brush every weekend. Today, over 250 volunteers are involved in some way at Poplar Creek.

A frequent question among stewards is, "How do we attract new volunteers?" For the last three years, the network has sponsored one or more natural areas recruiting workshops a year. The most recent workshop was held in Will County, where the numbers of volunteers are low and sixteen sites are without stewards. A total of 136 people came on a Saturday afternoon to learn more about local natural areas – and perhaps be induced to become more involved as stewards.

A widely publicized event was the salvage of the Healy Road Prairie in July 1990. Here was a rare, two-acre hill prairie, threatened by gravel mining and priced above any agency's ability to purchase. The Illinois Nature Preserves Commission agreed to permit construction of a new gravel hill in a mined-out area in their Bluff Spring Fen preserve. Almost everything was donated – bulldozers to scoop up foot-thick sods of prairie, trucks to haul them, and tree spades to remove and transport deep plugs of the choicest plant combinations. At Bluff Spring Fen, 400 volunteers manhandled and molded the thick blocks of the prairie over its new home. Ahead of the move, special task forces collected over 10,000 insects and a small number of snakes and rodents from Healy Road and brought them to the new site.

Today, with the enormous potential for restoration, and with what has already been achieved with agencies and volunteers working together, we envision the people of Illinois living within a network of preserves where the prairie will also live and flourish. As columnist John Husar wrote in the *Chicago Tribune* after attending a natural areas workshop, "When you come across a natural area, you'll enter a rare world of Ice Age remnants. You'll see combinations of plants and animals that cannot be found anywhere else. And, now and then, you'll have the bonus of meeting a very high-grade human, some of the best that you'll find in chance encounters. These are stewards. . . ."

ACKNOWLEDGMENTS

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REFERENCES AND ADDITIONAL READING

The Forest Preserve District of Cook County. 1990. *Twelfth Year Report, North Branch Prairie Project 1985-1989.*

Illinois Department of Conservation. 1978. *Technical Report, Illinois Natural Areas Inventory.*

Illinois Department of Conservation and Natural Land Institute. 1981. *Endangered and Threatened Vertebrate Animals and Vascular Plants of Illinois.*

Henderson, R. 1982. "Vegetation-Fire Ecology of Tallgrass Prairie." *Natural Areas Journal* 2(3):17-26.

Jordan, W. R. 1987. "'Something We Were Always Looking For.' The Origins of the Chicago Prairie Movement." *Restoration and Management Notes* 5(2):68-71

Nelson, H. 1987. "Prairie Restoration in the Chicago Area." *Restoration and Management Notes.* 5(2):60-67.

Packard, S. 1988. "Just a Few Oddball Species: Restoration and the Rediscovery of the Tallgrass Savanna." *Restoration and Management Notes.* 6(1):13-22.

Wilhelm, G. 1988. "The Arboretum's East Woods: Are They Forever?" *The Morton Arboretum Quarterly.* 23(4):54-62.

THE ROLE OF VOLUNTEERS IN YOSEMITE'S FUTURE

Mark A. Landon[1]

Many positive accomplishments are being reflected upon during Yosemite's Centennial Celebration. Unfortunately, due to a dwindling budget, the Centennial also marks the end of an era in which the Park Service can single-handedly maintain and preserve the ecological integrity of Yosemite. Today, the most promising and least recognized potential for preserving the park is the use of volunteers. From revegetation work to construction, the volunteers are proving their ability to accomplish a wide array of projects.

To maximize the volunteer effort, the Park Service will need to explore the following areas with volunteer agencies:

1) Planning projects so that volunteers with specific skills can be recruited.

2) Interfacing with volunteers.

3) Meeting the volunteers' logistical needs.

4) Recognizing, motivating, and retaining volunteers.

5) Using volunteerism on a national scale.

The accrued benefits of volunteerism are just beginning to unfold. It will be exciting to review the volunteers' role and accomplishments at Yosemite's Bicentennial Celebration.

Tuesday, October 16, 3:30 pm

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INTERPRETATION AND EDUCATION: BUILDING A CONSTITUENCY FOR THE FUTURE

ENVIRONMENTAL EDUCATION BY A NONPROFIT IN A NATIONAL PARK: THE WORK OF YOSEMITE INSTITUTE

Pete Devine[1]

Abstract

The biggest asset in the future management of natural areas will be a public that is informed and appreciative of the value of places like national parks, preserves, wilderness areas, etc. Of the various ways of elevating the environmental literacy of our taxpayers, park visitors, and outdoor recreationists, few are more effective than the residential, outdoor science programs that work with our school systems. The Yosemite Institute is a private, nonprofit educational organization that has operated in Yosemite National Park since 1971. While the National Park Service Division of Interpretation works to inform the contemporary park visitor about resource issues affecting Yosemite, the Yosemite Institute works to prepare the next generation of citizens for informed decision making, sensible resource use, and appropriate attitudes with regard to the healthy management of Yosemite National Park and sustainable development of the earth as a whole.

INTRODUCTION

"Education . . . is preservation's strongest ally." (Runte 1990)

Imagine this: take your average American kid, remove him from his home environment, and put him in the Sierra. Toss him into a bag with waterfalls, Giant Sequoia trees, lots of granite, and a Yosemite Institute instructor, and shake the bag for five days. At the end of this period, you can pull out the instructor, trees, rocks, and waterfalls relatively unchanged, but these things will have catalyzed a change in this young person. Where Bart Simpson went in on Sunday, the Lorax goes home on Friday.

The function of Yosemite Institute is to encourage the development of the informed voter, the thoughtful consumer, and the sensitive park visitor – the environmentally literate citizen.

INTRODUCING YOSEMITE INSTITUTE

Yosemite Institute was formed in 1971. The organization's mission is to provide environmental education opportunities that inspire people to understand and appreciate the interdependence of life on earth and empower them to think critically and act as responsible stewards of the planet. About 7,000 students a year come through programs at the Institute, most for five days/five nights at a time. Most of the students are with school groups, fifth through 12th grades, but participants also include much younger students, a couple of college groups, various family and adult groups, and several hundred senior citizens with the Elderhostel program. Students come from public and private schools throughout California, especially the Los Angeles region and the Bay Area, but also from Colorado, Texas, New York, and the Soviet Union. Capacity is around 250 students per week, except during the summer when Yosemite National Park gets busy and the Institute scales back to a quarter of its school year size.

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1. Pete Devine, Education Director, Yosemite Institute, P.O. Box 487, Yosemite National Park, CA 95389.

All of the Institute's programs are educational, but with a diverse clientele, foci vary. In terms of academic content the emphasis is on environmental science and cultural history. Some groups seek to experience the physical challenges of the mountains, and many teachers seek personal and social growth experiences for their students outside the context of the classroom. Yosemite Institute has its own formula for environmental education but strives to integrate the Yosemite field experience with the schools' curricula. Specially tailored programs are the rule.

Yosemite Institute bases its field teaching out of three areas in the park: Yosemite Valley, Wawona, and Crane Flat. These sites offer a diversity of natural and cultural features to explore.

YOSEMITE INSTITUTE ORGANIZATION

In 1977, the National Park Service at Golden Gate National Recreation Area invited the Yosemite Institute to open a campus at the Marin Headlands, just north of San Francisco. Since then, the Headlands Institute and the Yosemite Institute have further given rise, with Park Service invitation, to the Olympic Park Institute in Washington State. The three outdoor environmental education programs are governed by a parent organization called Yosemite National Institutes, which is based in Sausalito.

Yosemite National Institutes has a full time CEO: R. Garrett Mitchell, president of the organization. The board of directors includes individuals from various parts of American business, academic, and scientific communities, and has always involved Yosemite luminaries such as Ansel Adams's son Michael, photographer Galen Rowell, and former Valley rockclimber Robert Redford.

Yosemite Institute operations rely on five managers and seven support personnel, but the heart of the organization is a bright, talented, and dedicated faculty. There are 26 instructors who do all the teaching in the field. They are required to have at least a Bachelor's degree, certification in Advanced First Aid as well as a professional background in education and the natural sciences. Instructors are enthusiastic and motivated not by large paychecks, but by sincere concerns that what they do is important.

YOSEMITE INSTITUTE FINANCES

Unlike most nonprofit organizations, Yosemite Institute does not rely on grants and donations for operating revenue, but is self-sustaining with tuitions paid by participants. Tuitions average $200 per student for a 5-day residential program and are variously generated from students' parents, school and district budgets, and fund raisers. Yosemite Institute has a scholarship fund that disbursed $18,000 last year to individuals and groups that needed assistance. Although Yosemite Institute operates under a 20-year cooperative agreement with Yosemite National Park, its budget is independent of the federal government. The park concessioner, Yosemite Park and Curry Company, generously lowers its rates for services provided to the Institute but has no other financial connection to the nonprofit's operation. Each campus of Yosemite National Institutes functions within its own operating budget but all have strong support from the parent organization.

YOSEMITE INSTITUTE PROGRAMMING

Because the Institute is an independent organization, not strictly tied to a particular school, county, or district, it's been free to develop its own pedagogy and curriculum. Above all else, any program presented will be designed for an individual group. A given school or class may have certain needs or expectations pertaining to a residential outdoor science program, and those requirements will be met by Yosemite Institute to the extent possible. Different student ages, varied social backgrounds, and diverse school philosophies dictate that no two programs will be exactly alike. For example, a fifth grade class from an agricultural community may want an emphasis on native Americans, natural cycles, and geologic processes during their visit, while at the same time, an eleventh grade group from a wealthy suburban area may be focused on studies of predator-prey relationships, the evolution of flowering plants, and the abiotic elements of Sierran ecosystems.

Some classroom teachers bringing groups put less emphasis on academic content and more importance on group development and self-discovery. Being away from home and the traditional school setting facilitates the appreciation of new perspectives. Many teachers have found that learning outdoors nurtures the growth of the whole student in ways that the classroom cannot, and they look to the Institute to foster this development.

That the wide-ranging demands of a variety of groups have been successfully met over the years is attested to by the fact that 85 percent of Yosemite Institute's business comes from regular, repeat customers. The flexible program foci are complemented by a pedagogical approach stressing hands-on, interactive learning, discovery, and teamwork. A 12 to one student-to-instructor ratio assures individual participation in learning, such that the educational experience is an emotional experience. The emotional connection to the natural world will be a powerful and lasting kind of understanding.

Yosemite National Institutes has developed a thorough, yet adaptable, core education framework based on the core themes of a sense of place, interconnections, and stewardship. These three themes flow through the week to structure it into a cohesive, comprehensive whole. The graph below is one illustration of the way the themes work together for informational content and for group dynamics during a 5-day program (fig. 1).

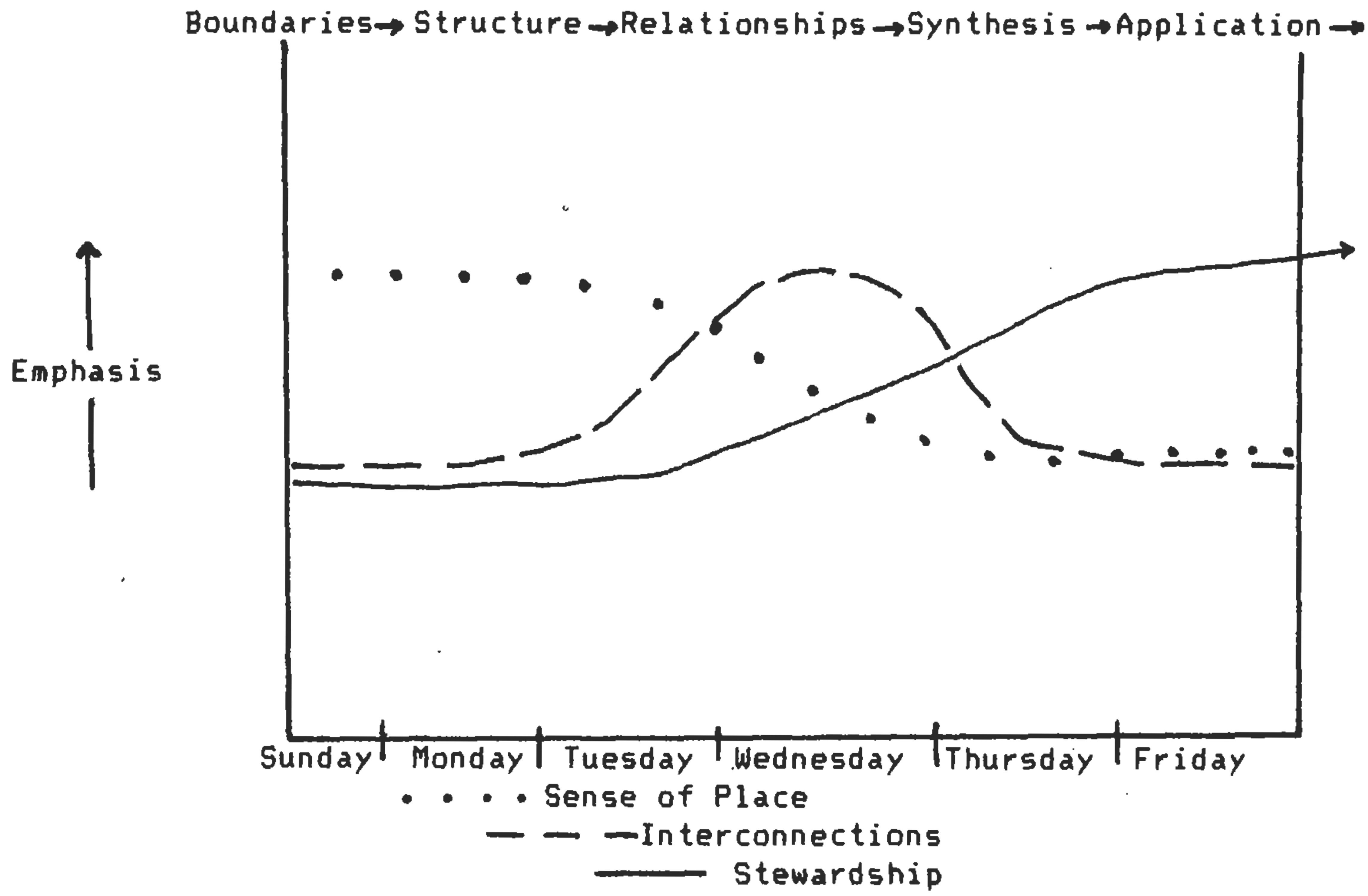


Figure 1. YNI Core themes for five-day program. Note changing emphasis through the week, with stewardship concept carrying beyond program dates. Top line refers to group development.

RESULTS: THE FUTURE

Superintendent Michael V. Finley accurately states that the biggest threats to Yosemite National Park are not from inside, but from outside, in the form of acid rain, global warming, air pollution, ozone depletion, etc. The same can be said for many other areas, such as Kesterson National Wildlife Refuge in California, Grand Canyon or Everglades National Parks, and Antarctica. There is very little that a park superintendent or a natural area manager can do to directly protect the resource within their jurisdiction from such regional or global problems. For those threats that are internal, serious problems require the allocation of funds for their mitigation. In these times of government and societal austerity such resources can be scarce indeed.

In the case of both internal and external threats to the sustained integrity of natural areas like Yosemite National Park, the greatest long-term need is a public constituency. An individual who knows and loves Yosemite is a person who will avoid peak visitation periods in the park and treat the place gently when he/she does visit. This individual will understand that a fuel-efficient automobile and less driving means cleaner air for the park in the Sierra. This person will vote for those political candidates who pay attention to the needs of park managers and the environment in general. An environmentally literate public will be the best ally of a conscientious natural area management agency. Yosemite National Park is somewhat unique in having had Yosemite Institute to build allegiances for the past 19 years. It is to be hoped that environmental education efforts will be supported in all their forms. In addition to residential outdoor science schools, public school curriculum, the local nature center, and a government bureau are all areas where environmental education can grow and build a constituency for a sustainable future.

REFERENCES

Runte, A. 1990. *Yosemite: The Embattled Wilderness.* Lincoln: University of Nebraska Press.

USING THE "GAIA" (GLOBAL AWARENESS TO INDIVIDUAL ACTION) FRAMEWORK TECHNIQUES FOR INTERPRETING GLOBAL ISSUES AT YOUR PARK SITE

Robyn Lee Myers[1]

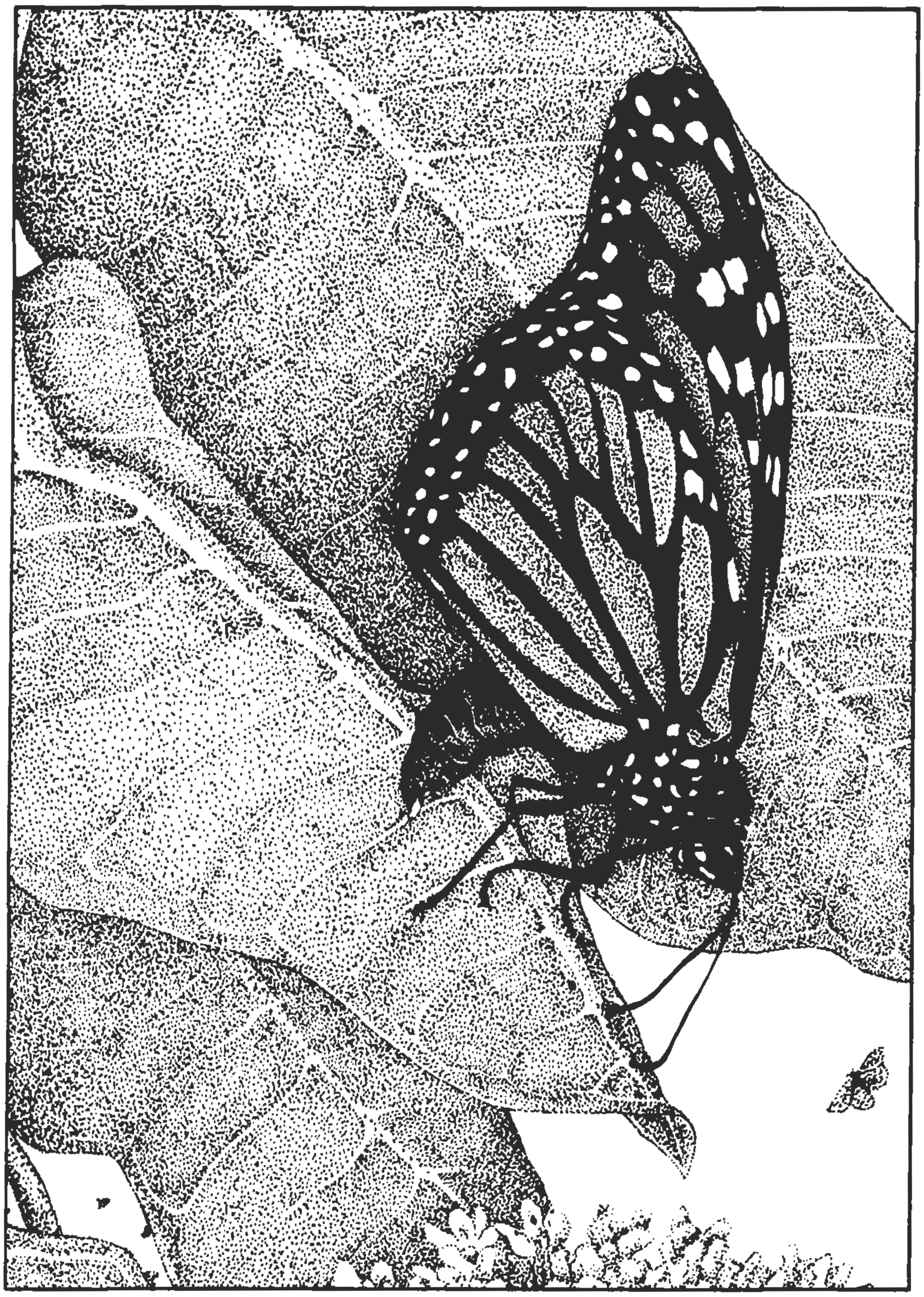
The modern scientific hypothesis that life itself controls the physical and chemical condition of the earth's surface, the atmosphere, and the oceans, to make and keep them fit for living, is called the Gaia hypothesis. This hypothesis has led to the development of a new systems-science, which studies all the interrelations of the ecosphere. The name "Gaia" was chosen after the ancient Greek concept of Mother Earth, or Gaia, as the deity was known.

We all believe in the concept of "think globally, act locally." But when planning a short program for adults or students it is challenging to try and tie their interests to both the park (or other site) themes *and* current global issues. The GAIA Planning Framework is a method for organizing short programs or lessons that look at local issues from a global perspective, while following a teaching framework that moves people from awareness, through knowledge, understanding, and personal valuing to action. It also provides a step-by-step planning process for defining themes and goals, identifying and then researching global issues appropriate to an area, applying these concepts to local environment, and finally organizing a program for students or park visitors. Examples of ongoing programs throughout the NPS and other agencies will be used throughout.

Thursday, October 18, 1:30 pm

1. Robyn Lee Myers, Interpretive Specialist, National Park Service.

ARTS AND LITERATURE



Monarch Butterfy, *Danaus plexippus,* Laying Eggs on a Milkweed Leaf
© 1983 Diana Dee Tyler

ANSEL ADAMS IN YOSEMITE

Jeanne Adams[1]

Welcome! We are delighted that you are here, participating in the Yosemite National Park Centennial and Natural Areas Symposium. The Symposium was conceived and developed as an opportunity to urgently explore and develop new concepts and actions that will be of considerable import during the next 100 years. How can Ansel Adams's accomplishments inspire constructive action that meets needs now and in the next 100 years? Will the psychic commitment to wilderness perceived in Ansel's photographs endure?

Wherever they are in the world, people have a memory/an image of Yosemite that, over time, will transcend Ansel Adams. For nearly 70 years of his life, Ansel photographed Yosemite. For many, he and his photographs became synonymous with Yosemite. "Inevitably, some of Ansel's pictures have become more deeply embedded in the American consciousness than the actual rocks they depict," Because of his work, far more than any other place, this extraordinary natural wonder symbolizes the image of wilderness. Wilderness was for Ansel "a mystique: a valid, intangible, nonmaterialistic experience." Ansel Adams profoundly captured the spirit of Yosemite and the Sierra in his photographs. His work, more than any other, has inspired that almost sacred wilderness image and the recognition of the need to protect our environment.

I will consider the man, the body of his work, and the impact.

ANSEL ADAMS

Ansel was born in San Francisco in 1902. He lived in the open sand dunes in the Sea Cliff area, overlooking the Golden Gate. During the 1906 earthquake, his nose was broken after a fall. He never had it repaired. His family was told to wait until he grew up to fix it. Ansel always said that he never grew up!!! For those of you who knew him, you know that he had a great sense of humor and joy.

Education/Ethic/Character: A precocious, gifted, curious, only child. He graduated from the eighth grade but did not like school. His family took him out of school, had him tutored in the usual subjects, but also in Greek, astronomy, and advanced math. Ansel was reared with a great sense of service and decency. In 1915, Ansel was given a pass to the Panama-Pacific International Exposition. The year was spent watching, listening to music, working with adding machines and typewriters, and enjoying the varied exhibits. Did this spark his lifelong fascination with science and technology?

Music: At age 13, he began formal piano lessons. Ansel progressed rapidly through several teachers who felt he had absorbed all they could offer. By 1923, he was a professional pianist, teaching and performing occasionally.

Yosemite, 1916: While recuperating from an illness, Ansel, an avid reader, was captivated by *In the Heart of the Sierra,* by J. M. Hutchings. He persuaded his parents to vacation in Yosemite. He arrived by way of the old Yosemite Valley Railroad to El Portal. They stayed overnight at the old hotel. The next day, they rode in an open bus to Camp Curry. You will see a slide of the "upside down image of Half Dome," snapped with his father's Box Brownie as he tumbled off a rock. At the age of 14 Ansel recognized that Yosemite was to be a primary influence of his future. The mountains, stars, the granite,

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1. Jeanne Adams, The Ansel Adams Gallery, Yosemite National Park.

the light, its purity, the experience, inspired him. For the remainder of his life, he spent some time every year in Yosemite.

Back in San Francisco, his interest in photography was whetted while he worked with a local photofinisher.

In 1920 he became custodian of the LeConte Memorial Lodge for the Sierra Club, which he did several summers. Longer burro trips into the back country began in 1920. A love of this high country began. He hiked, photographed, became at one with his beloved High Sierra. More than an observer, Ansel captured the power of nature. Very early, Ansel consciously composed his photographs and tried to convey his feeling of the experience in his photograph. His training as a pianist disciplined him. I believe that in these early years Ansel understood the connectedness of all life. He spent summers in Yosemite and Sequoia, and in what is now Kings Canyon National Park. (His photographs aided that achievement!)

On April 17, 1927, Ansel photographed "Monolith, The Face of Half Dome." Using his last 8x10 glass plate negative, Ansel carefully composed and exposed. He used a red filter (rather than the expected yellow) to achieve the image he visualized. The breakthrough was that for the first time he previsualized precisely the image he would make. I see a consistency of love and intensity that Ansel was feeling when he made some of his finest photographs. "Bridalveil Fall" was also exposed in 1927.

About this time, Ansel was torn between his two loves – piano and photography. "He was advised that the camera could not possibly express the human soul and that he should remain with music. He was told that the intimate details of nature were of minor importance compared with the grand landscapes. It was pointed out that if he wished to make a living in photography, he should get down to earth to the more lucrative jungles of concrete and technical affairs."

I think his body of work shows his view of the harmony of all nature – the grand symphonies of landscapes to the minute detail of forest and rock.

In 1923 Ansel met Virginia Best, the daughter of Harry Cassie Best, a landscape painter in Yosemite since 1902. Ansel practiced on the piano in Best's studio. Ansel and Virginia were married in January, 1928 in Yosemite. Ansel selected photography as his life's work.

Both Virginia and Ansel continued trips into the Sierra backcountry in summers, living and working in San Francisco in the winters. Virginia provided Ansel with a steady love and friendly home environment, a comfortable base from which he pursued his photography. Michael was born in Yosemite in 1933. Anne was born in San Francisco in 1935. In 1936, Harry Cassie Best died suddenly, leaving the studio to Virginia. They moved to Yosemite. In 1937, Virginia and Ansel opened the shop with emphasis on photography, quality books, and fine American Indian crafts. Best's studio has been known as the Ansel Adams Gallery since 1972. The Gallery is the oldest concession operated in the national parks continuously by the same family. The Ansel Adams Yosemite special edition photographs are an example of Ansel's effort to provide an affordable, quality memento for the visitor.

ANSEL ADAMS PROFESSIONAL WORK

Ansel took an active role in establishing photography as an appreciated fine art. He helped to create the Photography Department at the Museum of Modern Art in New York. As a sharing person, he was an educator, developing the zone system of measuring light (a monumental technical advance), writing, viewing portfolios, and teaching. The Annual Photography Workshops he pioneered in Yosemite in 1940 celebrated their 50th anniversary this June in Yosemite with "The Artist and the Environment" Workshop Ansel's numerous published works began in 1922 and continued until his death in 1984. Publications include books and articles illustrated with his photographs, original photographs in portfolios, his writings, technical books, articles, films. Exhibitions of his photographs began in New York in 1933 and continue throughout the world. In 1960 this is the american earth popularized the idea that we need to respect and tenderly care for the earth, The American wilderness, with unpublished images and Ansel's writing was just published last week. I shall share some quotations about his concerns for the wilderness and clear thinking regarding policy to protect the environment.

"The National Parks are, indeed, phenomena of an advanced society; James Bryce once said that the concept of the National Parks was America's unique contribution to the democratic idea. In fact, it is difficult to conceive of America without them. They represent those intangible values which cannot be turned directly to profit or material advantage, and it requires integrity of vision and purpose to consider such impalpable qualities on the same effective level as material resources. Yet everyone must realize that the continued existence of the National Parks and all they represent depends upon awareness of the importance of these basic values. The pressures of a growing population, self interest, and shortness of vision are now the greatest enemies of the National Park idea. The perspectives of history are discounted and the wilderness coveted and invaded to provide more water, more grazing land, more minerals, and more inappropriate recreation. These invasions are rationalized on the basis of necessity.' And this necessity may appear quite plausible on casual examination. People must have land, and land must have water. Cattle and sheep must have forage. With the establishment of reservoirs – great man-made lakes often reaching far into the wilderness domain – come diverse human enterprises, roads, resorts, settlements. The wilderness is pushed back; man is everywhere. Solitude, so vital to the individual man, is almost nowhere. Certain values are realized, others destroyed. The dragons of demand have been kept at snarling distance by the St. Georges of conservation, but the menace remains. Only education can enlighten our People – education, and its accompanying Interpretation, and the seeking of resonances of understanding in the contemplation of Nature.

From the foreword to *My Camera in the National Parks*, 1950.

". . . while it is as essential as ever to protect the National Parks and Wilderness Areas, it is also essential that we protect the forests, the crops, the minerals and the oceans, and it is essential that we preserve the purity of the air we breathe and the water we drink."

From "Give Nature Time!" commencement address, Occidental College, June 11, 1967.

"After many years' experience with Park and Forest people, with conservationists, with the kind of 'do-gooder' who tempers his principles to the wind of advantage and 'financial necessity,' I have come ruefully to the conclusion that very few know what they are talking about, I am distressed that so many academic people fall back on the conventional security of terms such as 'management,' or spice their arguments with references to 'population increases, economic travel pressures,' etc. It seems to me that the whole business of wilderness preservation; National Park principles, etc, is in a desperately dangerous mess.

"We either have wild places or we don't. We admit the spiritual-emotional validity of wild beautiful places or we don't. We have a philosophy of simplicity of experience in these wild places or we don't. We admit an almost religious devotion to the clean exposition of the wild, natural earth, or we don't." From a letter to Or. Henry J. Vaux, 10/7/60.

"I wish I had gotten into environmental work earlier because I think that's a citizen's fundamental responsibility. The channeling of creative arts in that direction has been very difficult. As I said, I never made a picture with a direct environmental objective, but if they can be used for that, that's fine."

"You must have certain noble areas of the world left in as close to primal condition as possible. You must have quietness and a certain amount of solitude. You must be able to touch the living rock, drink the pure waters, scan the great vistas, sleep under the stars, and awaken to the cool dawn wind. Such experiences are the heritage of all people.

INSIGHT INTO THIS CRAFT

Approaches: Contrived or Straight

You come across a phenomenon in nature that you can visualize as an image. Then, if you have the craft, you proceed to make it. Without failure. In theory, I have no excuse for ever making a mistake. I might not have an expressive picture, but at least I should capture everything I want – providing I don't make some stupid arithmetic error. . . .

From the Artnews, Summer 1984 issue "The Last Interview," by Milton Esterow, Editor and Publishers

Recently, in a large transcontinental plane at 41,000 feet, I crossed the Sierra Nevada in less than 10 minutes. I tried to locate the mountains of my youth; they were mostly confused in the remote geologic patterns. The entire Sierra appeared as if God had just ruffled a rug! I was thoroughly aloof from any contact with the earth. In a few seconds I crossed areas equivalent, fifty years ago, to a traverse requiring weeks afoot with a couple of pack burros as companions. While this airplane experience was spectacular, the earlier experience was far more memorable. Not only was I in contact with natural things and prospects – I was also allowed to contemplate and dream. I never considered any of this as time wasted!" From a Wilderness Society address, 5/9/80

"The clear realities of Nature seen with the inner eye of the spirit reveal the ultimate echo of God."

From "The Meaning of the National Parks," in *My Camera in the National Parks, 1950.*

"A great work of art emits more energy than a lesser one." Audrey Flack

In 1932, Ansel said that "with all art expression, when something is seen it's a vivid experience – sudden, compelling, inevitable. The visualization is complete the seemingly instant review of all the mental and imaginative resources called forth by some miracle of the mind computer that we do not comprehend. For me, this resource is not of things consciously seen or transcriptions of musical recollections. It is perhaps a summation of total experience and instinct. Nothing modifies or replaces it."

CONCLUSION

Ansel Adams has made a lasting image of the magnificence and grandeur of nature in our minds. He has taught us reverence for the wild and natural places. His photographs and writings will, in the future, give reference to the past.

"Today, the artist has an inescapable obligation. The world has been good to him; it has provided great beauty and deep experience. Now, both the natural and the human world are imperiled. (After all, 'what is so unnatural about man?'). This peril lies in over-population, pollution, depletion of resources, and the destruction of natural and cultural beauty. The power of art to counteract this destruction, not merely to veil it, is – I am sure – tremendous. I believe photography has both a challenge and an obligation: to help us see more clearly and more deeply, and to reveal to others the grandeurs and the potentials of the one and only world we inhabit." "A Photographer Talks about His Art," Occidental College, January 22, 1969.

THE PERFORMING ARTS AS AN INTERPRETIVE TOOL

Lee Stetson[1]

Actor Lee Stetson, creator of the John Muir shows in Yosemite National Park, puppeteer Jo Diotalcvi, co-founder of Puppets on the Path in Hawaii Volcanoes National Park, singer/songwriter/storyteller Rita Cantu, currently public affairs specialist for the U.S. Forest Service in Prescott, Arizona, and actor Earll Kingston, performing the role of John Wesley Powell at the Grand Canyon National Park, will bring from their combined experience considerable insight into the advantages that performing artists offer to interpretation.

Discussion will include the problems of locating appropriate talent and the creation of suitable materials, factors determining the suitability of specific parks to host similar productions, inherently shared values of artist and interpreter, and the economics of fee-based interpretive programs.

Wednesday, October 17, 1:30 pm

1. Lee Stetson, Wild Productions, P.O. Box 811, Yosemite, CA 95389.

LITERATURE

WRITING THE LAND: LEARNING IN THE WILDERNESS CLASSROOM

Mark T. Hoyer[1]

INTRODUCTION

Arguing that our old minds are ill-equipped to deal with the new world we now find ourselves inhabiting – one characterized by depletions in the ozone layer, in old-growth forests, in the diversity of plant and animal species – Robert Ornstein and Paul Ehrlich suggest that "to retain ourselves requires a radical shift in our normal way of perceiving ourselves and our environment" (Ornstein and Ehrlich 1989, 11). In David Orr's fine phrase, we need to develop "ecological literacy" (Orr 1989). Assuming that these thinkers are right in their prescriptions, we all, but especially our educators, face an important question: How do we go about such a retraining; how do we promote such literacy?

In this paper I would like to suggest part of a possible answer. Any answer, it seems to me, must share two qualities: responsiveness to the needs of the earth and its inhabitants and creativity in envisioning and implementing solutions. These two characteristics are integral to what I call "writing the land." Writing the land is more elemental than simply reading or listening to nature, in traditional Emersonian fashion, more elemental than any metaphor can suggest. I want to argue that it is in the act of writing in nature's presence that nature, and I mean this next phrase quite literally, writes through us – writes us into its language – using processes remarkably akin to the processes that current pedagogical research has shown are most productive for writers. If, furthermore, writing is a mode of knowing, as Janet Emig (1977) has suggested, then writing in natural areas – and especially in wilderness areas – possesses obvious potential as a pedagogical technique, not just for writing teachers but for instructors in all disciplines.

Before any of you teachers or administrators begin to cringe as you anticipate the daunting logistical task of conducting classes in wilderness areas, let me expand on what I've just said. Any area where nature is apparent, working either above or in congruence with human processes would provide a sense of a human relationship to the land and thus serve well as a classroom venue. A fishing town on Cape Cod or along the Oregon coast, an Amish farm in Pennsylvania, a Hopi mesa town – all would have their own unique process-produce and human-nature relationships that would influence writing and learning outcomes positively, especially as these are places where humans are residents rather than visitors. Even closer to home, an arboretum, for instance, could provide a suitable environment on the grounds of one's home campus. The essential factor in choosing an appropriate educational venue is that its processes be observable, and more importantly, that one can participate in them. In wilderness areas, nature's cycles go on largely unimpeded by the presence of humankind, and, if one spends any length of time there, one is forced to participate in those cycles. These natural processes, furthermore, bear a marked similarity to both the creative ones employed in writing and the responsive ones employed in learning. This is why wilderness stands out as a unique educational venue.

1. Mark T. Hoyer, University of California, Davis and Santa Cruz Extension (Sierra Institute).

BODY

The goal of writing in the wilderness classroom is to help students bring together the "interior" landscapes of their minds with the "exterior" landscapes in which they find themselves. As Barry Lopez points out, "The interior landscape responds to the character and subtlety of an exterior landscape; the shape of the individual mind is affected by land as it is by genes" (Lopez 1989, 65). Why is this so? James J. Gibson's "ecological approach to visual perception" tells us that "proprioception," or the reception of information about the self, occurs simultaneously with "exteroception," the reception of information about the environment. Thus, "to perceive the world is to co-perceive oneself . . . The awareness of the world and of one's complementary relations to the world are not separable" (Gibson 1979, 141). Educators have long realized the importance of the connection. Dewey went so far as to claim that "[w]e never educate directly, but indirectly by means of the environment" (1916, 22). The questions this raises for educators are then: What characteristics are possessed by the landscapes in which we usually teach, and how do these compare to what we find in the wilderness classroom? What qualities are these characteristics fostering within our students' interior landscapes? More precisely, are these qualities hindering or helping us develop educated and caring people?

Most traditional classrooms, reflecting the institutional environments in which they are situated, embody what Robert Sommer calls the principles of "hard architecture," the characteristic appearance of which is "impervious, impersonal, and inorganic . . . [with] a lack of permeability between inside and out" (Sommer 1974, 188-9). Catherine Howett goes even farther, charging that "[t]he landscapes we design and manage are most often meant to obliterate any real or symbolic suggestions of disorder, decay or death, any hint of risk, vulnerability, or of mysteries beyond our understanding" (1987, 8). Reading such environments, students often become rigidly entrapped in rules that they have learned, rather than truly exploring their subject matter. In writing, this tendency manifests itself in a dependence on such artificial structures as the five-paragraph essay, which unequivocally reduces even the most complex of topics to a thesis and three supporting points. That risk and disorder are essential to the processes of successful writing and learning, to the surprise upon which they depend, is now a tenet of the writing-as-process philosophy. As Donald Murray describes it:

> The writer sits down intending to say one thing and hears the writing saying something more, or less, or completely different. The writing surprises, instructs, receives, questions, tells its own story, and the writer becomes the reader wondering what will happen next. . . . All writing is experimental in the beginning. It is an attempt to solve a problem, to find a meaning, to discover its own way toward meaning (1985, 7-9).

The importance of such "messiness" is underscored by research that suggests that both nature and the human mind work by a parallel stochastic process – that is, by "a sequence of events . . . [in which] a random component [is combined] with a selective process so that only certain outcomes of the random are allowed to endure" (Bateson 1979, 230; Calvin 1990). Such findings again highlight the importance of outdoor classrooms, for such environments possess those characteristics which directly and physically foster independence with interdependence, originality, and creativity with harmony.

How does the wilderness classroom help to create an optimum learning environment? Before I go on to answer that question, let me give some background about the wilderness classroom as I have experienced it. In UC Santa Cruz's Sierra Institute, for which I have taught over the past several summers, class size is generally from eight to 14 students, a size large enough to encourage individual participation on the one hand and small enough to promote group cooperation, cohesion, and individual responsibility to that group on the other. The format of the Sierra Institute course depends on several factors, among them the length of the course, the number of subjects being taught, and the style of the individual instructor. My course, which this past summer took place in Yosemite's backcountry, consists of a three-week excursion during which we explore one subject – nature writing – by both reading literature and writing our own. My groups take two to three backpacking trips during the three weeks, each lasting five to nine days, between which there is time to resupply, get a hot shower and fresh food, do laundry, etc. A trip might cover anywhere from 15 to 45 miles, depending on the group; I generally prefer to hike to a series of locations, where we set up camps as bases for further exploration, rather than to hike every day to a new destination. This format allows students to spend more time reading, writing, and discussing than would be possible otherwise. Students do lots of writing on the trip – most have no trouble filling an entire journal with their daily entries, class exercises, and initial attempts at both nonfiction and poetry – but also have time to polish and prepare their final assignments after they return from the backcountry. Both the "classroom" and my "office" bring students together with me at the level of the writer. Our dress does not mark us in any way as expert and novice but unites us as part of a community. Not surprisingly, the metaphors between teacher and student seem to change. I find it easier to take on new roles such as mentor, counselor, advisor, or to play traditional roles in a new way as a co-learner, or master learner (Gamson and Hill 1984); students, too, seem to more readily accept and respond to these new roles, rather than resisting them and depending on me as an expert whose will they are merely to implement in their own writing, a state of affairs more common in the institutional environment. Conferences in the wilderness classroom are marked less by questions like, "What do you think I should do?," and more by ones like, "I'm going to try this in my next draft because such-and-such. What do you think?"

The differences extend beyond attitudes. The wilderness classroom makes obvious the importance that writers be in contact with their subject matter. Thus students begin to form relationships in which they find a closer integration of the concrete and the abstract, of "reality" and their ideas about it, of theory and practice. As their interior minds begin to adapt to the external environment, writing processes change.

Let me trace in some detail how this happens. Most researchers break the writing process into three stages: prewriting, drafting, and revising. These stages are not distinct but loop back on each other, providing feedback in ways similar to those found in self-regulating systems. Indeed, the three stages together form their own system which operates on the stochastic process. The prewriting stage is the random phase of that process. During this stage, students record impressions, jot notes and ideas, respond to readings, and free write in their journals. I also guide them through several exercises designed to get them to observe and describe their surroundings. This is the time when ideas are spawned and connections made. This stage, then, depends mostly on perception, which however, is only the first stage to knowledge. Gibson goes on to state that "To perceive the environment and to conceive it are different in degree, but not in kind. . . . Knowing is an extension of perceiving" (1979, 258). Thus to know one's environment is to know oneself and vice versa. The culmination of this stage is that the writer begins to sense what he/she wants to say.

As we live and learn and write and discuss in the backcountry, we must deal not only with our beliefs about nature and our relationship to it, but with the physical reality that shoves us around. We must abide by the rules that the land itself imposes on our visit there. In this way we truly begin to find our "niche," which is crucial to the successful organization of both our group and our writing.

An obvious example of finding our niche would be that in the wilderness classroom, we are forced to choose a living environment based on some rather elemental factors within the environment as opposed to merely social ones – the availability of water, for instance, or the exposure to climatic conditions. One doesn't, after all, choose to camp on an exposed ridge or a granite dome, or under the tallest trees during an electrical storm. Discovering our niche is contemporaneous with learning about our place and occurs not only from traveling but from class activities as well. In an informal lesson on Sierran forest communities, for example, we learn not only about the trees and plants but also about rhetorical modes that reflect the thought processes underlying our understanding of not only plant communities but writing as well. In identifying, classifying, describing, and narrating stories about the life forms they observe, students learn that the thinking that underlies rhetorical modes is relational, a discovery reinforced by the visual clues the environment gives – how the boundaries between the ranges of the white fir in the mixed coniferous forest and the red fir are not strict but dependent on a variety of conditions. This affects our writing as well: "When we perceive objects and events, we don't merely isolate or identify them; we relate them to other objects and events, to our own past experiences. If thought processes relate perceptions, organizing them into patterns, then it follows that paragraphs will express those relationships. Not only paragraphs, but also sentences and whole discourse" (Lindemann 1982, 154).

Not only does the nonhuman environment provide such a graphic reminder of processes that are basic to writing, so too does our community of writers. As we organize ourselves and then modify both the relationships between members and the logistics of our trips as we go along, we begin to discover form. This discovery is the main goal of the drafting stage. "A subject probed thoroughly enough begins to organize itself, begins to suggest possibilities for arranging its presentation" (Lindemann 1982, 167).

As this sentence suggests, discovering form is a matter that is augmented in the wilderness not only by our constant direct contact with our subject matter, but by the very activities we undergo living within it: traveling and writing and living together themselves result in changes that are reflected in what we produce individually and as a community. Process and product become one. And it is this relationship between ourselves as writers and this combination of subject and process that makes the wilderness classroom such a powerful and informing learning venue.

The very elements within the students' environment that help them discover form – the natural and human communities – are what also assist them in rewriting, the third stage of the process. Peter Elbow (1982), among others, has identified feedback as one of the crucial elements in this stage. And feedback is, of course, a central component of the stochastic process; not all outcomes of the random can be allowed to endure. In the wilderness classroom, not only do the writers have peers and teacher to comment on their writing – the same resources they would have in the appropriately managed traditional classroom – but they also have the almost constant feedback from their own subject matter, the natural environment itself.

Physically finding a niche, as a relational activity, thus becomes a key to finding form in our writing. Because our environments and what they afford differ vastly within the wilderness and the traditional classrooms, the niches we fill within the two environments likewise differ. In the traditional classroom, students are asked to "grapple with" the subject matter, the goal being, of course, to "master" it, and eventually, to have "control" over it. We have traditionally treated the natural world in the same way. But learning in the wilderness allows students to – indeed, demands that they – be mastered by their environment and their subject matter. Affording them experience directly through the medium of their senses, such learning opportunities provide an experiential basis that reinforces or helps to modify any strictly intellectual bases for their understanding of not just nature, but the processes of writing and learning as well. Because of the mutually reinforcing nature of the relationship among thought, language, and behavior described by linguists like Benjamin Lee Whorf (e.g., Whorf 1956), their new-found understanding begins to affect the ways they talk or write about a place which in turn affects the way they act in respect to that place, each stage reinforcing the next. Ecological literacy, the necessary responsiveness I mentioned at the beginning, begins to manifest itself in a creative interaction with the world.

The result is an expanded sense of community. Perceiving ourselves within both the environment and a human community, we begin to realize what Mitchell Thomashow of the Antioch/New England Graduate School calls our "environmental identity:" ". . . [M]ore than personal introspection . . . it is . . .

a gift, an opportunity, the potential to integrate theory and practice for the purpose of environmental awareness" (1989). Arne Naess goes even further: The self is as comprehensive as the totality of our identification, it and such identification, he maintains, is the source of ecological values, which also depend on "a synthesis of theory and practice" (Naess 1988, 258-261). By its very nature, the wilderness classroom provides the synthesis of theory and practice, and likewise, of intellect and experience, by which we learn and through which our consciousness is touched in such a way that we begin to identify with and learn from our surroundings. As one student remarked after this summer's class, "I feel that these pieces came from a place inside of me that didn't exist before this summer." Such identification has also been the hallmark of some of our greatest environmental thinkers. The basis of John Muir's success in discovering the glacial origins of Yosemite, for instance, was his ability to "l[ie] upon [the rocks] for years as the ice did, [in order to] arrive at the truths which are graven so lavishly upon them" (1938). I said earlier that any answer to the question of how we were to go about developing "ecological literacy" would depend on two characteristics: responsiveness and creativity. Gibson's theories of ecological perception show how, even unconsciously at times, we are responding to our environments. What happens in the wilderness classroom is that students develop familiarity with the world in which they live and with their beliefs about that world. This familiarity is "the outcome of exploration . . . [and] also the starting point for play . . . essential to the playful rearrangement and recombination of the elements of thought that we tend to associate with insight and creativity" (Kaplan and Kaplan 1983, 93). This, I would argue, should be the goal of the educational enterprise.

To provide a graphic illustration of where such exploration and familiarity can lead, let me turn to the work of two faculty members at the University of California at Davis – photographer David Robertson and poet Gary Snyder – whose works provide wonderful examples of the power and the play, the power of the play, that can result when the natural process is integrated into one's art. In David Robertson's "environmental self-portraits," play has an enormous role in the taking and creating of the photograph (Robertson 1990). All of Robertson's photographs are characterized by two elements integral to both the process and the product: he is in the photo (in some more obviously than in others), and the photos are in various states of physical degeneration from the work of the chemicals that coat the film and that Robertson allows to remain rather than removing them immediately. Robertson overcomes his own visual preconceptions of what a scene should look like by integrating accident and random event into the processing of film. He will smash the positive or the negative, allow dust to collect on it, or simply set the photo aside for up to a year while the chemicals slowly eat away at the image. He does these things in play, to see what will happen rather than to achieve a certain preplanned effect. Once he even asked a student to dip a photo he had just taken into the ocean. Such techniques allow what would be more purely representational scenes to become scenes that capture the sense of natural process and decay that photos do not – indeed, cannot – otherwise capture. One result of this process is that Robertson's photographs, as they integrate the human into the natural, show the transience of human control over the natural and integrate the randomness inherent in natural processes into both the artist's image and his message. Gary Snyder, too, employs a sort of natural randomness in his craft. One of Snyder's gifts to poetry is his part in reawakening the sense of sound, of song, and of rhythm, that poetry has historically expressed. In an interview published in *The Real Work* Snyder explains how the rhythm of his poems can come from the "good old rural life work rhythms." But rhythm also comes from the "whole of the landscape of the Sierra Nevada . . . [from] the periodicity of ridge, gorge, ridge, gorge, ridge, gorge at the spur ridge and tributary gorges that makes an interlacing network of, oh, 115-million year old geological formation rhythms." One way to tune into this rhythm is by "singing a range of mountains," whereby "you sit down somewhere where you're looking at a long mountain horizon . . . [and] [t]hen you sing it up and down all the way along like that." The result is that, through trial and error– through this form of play – "you begin to feel it . . . so that it's a kind of a source of form" (1980, 48-49). One can imagine that it was such play that wrote many of Snyder's poems. "On San Gabriel Ridge," for instance, or "By Frazier Creek Falls," the first part of which follows:

Standing up on lifted, folded rock
looking out and down –

The creek falls to a far valley. Hills beyond that
facing, half-forested, dry
– clear sky
strong wind in the
stiff glittering needle clusters
of the pine – their brown
round trunk bodies
straight, still;
rustling trembling limbs and twigs

listen . . .

(Snyder 1974, 41)

CONCLUSION

Noting the effect that the landscape has on Snyder's writing lets us see the implications of studying literature within the wilderness classroom. Many of our greatest authors have of course dealt with nature as subject matter. Indeed, some critics – Leo Marx (1964) and Annette Kolodny (1975), for instance – view the attempt to reconcile ourselves to nature as the fundamental creative force behind our American literature. Such an approach can also inform our study of authors who do not fit into the nature-writer category. The reason is simple. As Barry Lopez points out, "the shape and character of . . . a person's thinking . . . are deeply influenced by where on this earth one goes, what one touches, the patterns one observes...the intricate history of one's life in the land, even a life in the city, where wind, the chirp of birds, the line of a falling leaf, are known" (1989, 65). Experiencing an author's environment as best we can will, therefore, help us in understanding the author.

I have been talking in this paper about the processes of writing-as-art in the wilderness classroom. But if I am right in suggesting that the stochastic process employed in nature reinforces the one used in writing and learning, then there is no reason that functional as well as artistic writing cannot be adapted to the needs of other disciplines. Lewis Thomas has already called attention to the critical need for revising our educational methods in the sciences, which have been treated as if they were nothing more than "unambiguous, unalterable and endlessly useful display[s] of data that only need to be packaged and installed somewhere in one's temporal lobe in order to achieve a full understanding of the natural world" (Thomas 1984, 560). Incorporating the mystery and uncertainty and sense of exploration fundamental to the scientific endeavor and readily apparent in the wilderness classroom would be a start. As for the social sciences, Mary Austin's "re-expressions" of traditional Indian dances and songs in *The American Rhythm* (1930) show how an understanding of the landscape contributes to one's understanding of a culture and its practices within that landscape. Lawrence Halprin, a landscape architect, sees the potential of the wilderness classroom for the teaching of design:

> Nature has many lessons for us, but to me, as a designer, these two are most important. The first of these is that order, natural order, is overwhelmingly clear and that I relate to it easily and organically and my own sense of order derives from it . . . Second is process. Here is clearly seen the way in which our sense of nature arises. Process and product becomes synonymous . . . (1969, 104).

The implication of all of this is not that all students must take writing classes in the wilderness, but rather that we should consider integrating a component of both wilderness and writing in tandem – what we might call "writing in place" – into the curricula for a broad spectrum of classes across all disciplines. Perhaps such a plan can even help us to more effectively teach within our traditional institutional environments as well. Words, like wilderness landscapes, are largely alien territory to a generation of students conditioned by the rapid-fire unrelatedness of images produced by electronic media. This observation again brings us back around to the connection between landscape and language. Both have an organic unity that, at first, may be difficult for students to detect. But because of the connection, when one has ventured into the alien landscape of the wilderness, perhaps one can return to the landscape of words in the traditional institutional environment with a better understanding, a better sense of where to look, of how to look, for meaning.

The effects might also be felt beyond the classroom. Coming to know and identify with particular places in our world is of course a prerequisite to participating in the environmental health of our wilderness area as well as in the social health of our communities. But personal awareness is only the starting point. As Thomashow (1989) explains: "It is a gift to have an environmental identity. But it is a greater gift to pass this awareness on. How we translate our environmental identity is the real work; it is the mission of the practitioner." This is where the real power of the wilderness-writing classroom will be felt, for writing the land not only helps students in developing an environmental identity, but, more importantly, it helps them in finding ways to translate that identity into words, into well-formulated ideas and on into actions, which can, like gifts, be given, shared, and passed.

As Lewis Hyde points out in his wonderful essay, "The Gift Must Always Move" (1982), the defining characteristic of the gift is that, rather than being simply exchanged back and forth between giver and receiver in an exclusive relationship, it is put into wider circulation within the society or between societies. As an educator who finds the qualities of both nature and community worth preserving and sharing, teaching in the wilderness classroom gives me an opportunity to pass along to my students a gift that, through them, finds its way into wider circulation. The ultimate beneficiary is not humankind only – "not man apart" – but the larger realm of nature within which we are inextricably bound.

REFERENCES

Austin, M. 1930. *The American Rhythm: Studies and Reexpressions of American Songs.* New and enlarged edition. Boston and New York: Houghton Mifflin Company.

Bateson, G. 1979. *Mind and Nature: A Necessary Unity.* First edition. New York: Dutton.

Calvin, W. 1990. *The Cerebral Symphony: Seashore Reflections on the Structure of Consciousness.* New York: Bantam Books.

Dewey, J. 1916. *Democracy and Education: An Introduction to the Philosophy of Education.* New York: The Macmillan Company.

Elbow, P. 1985. *Writing with Power.* New York: Oxford University Press.

Emig, J. 1977. "Writing as a Mode of Learning." *College Composition and Communication* 28 (May): 69-78.

Gamson, Z., and Hill, P. 1984. "Creating a Lively Academic Community." *Liberating Education,* by Z. Gamson et al. San Francisco: Jossey Bass.

Gibson, J. 1979. *The Ecological Approach to Visual Perception.* Boston: Houghton Mifflin Company.

Halprin, L. 1969. *The RSVP Cycles: Creative Processes in the Human Environment.* New York: George Braziller.

Howett, C. 1987. "Systems, Signs, Sensibilities: Sources for a New Landscape Aesthetic." *Landscape Journal* 6 (1): 1-12.

Hyde, L. 1982. "The Gift Must Always Move." *Coevolution Quarterly* 35 (Fall): 10-31.

Kaplan, S., and Kaplan, R. 1983. *Cognition and Environment: Functioning in an Uncertain World.* New York: Praeger.

Kolodny, A. 1975. *The Lay of the Land: Metaphor as Experience and History in American Life and Letters.* Chapel Hill: University of North Carolina Press.

Lindemann, E. 1982. *A Rhetoric for Writing Teachers.* New York: Oxford University Press.

Lopez, B. 1989. "Landscape and Narrative, Crossing Open Ground." New York: Vintage Books.

Marx, L. 1964. *The Machine in the Garden: Technology and the Pastoral Idea in America.* New York: Oxford University Press.

Muir, J. 1938. *John of the Mountains.* L. W. Marsh, Editor. Boston: Houghton Mifflin Company.

Murray, D. 1985. *A Writer Teaches Writing.* Second Edition. Boston: Houghton Mifflin Company.

Naess, A. 1988. "Identification as a Source of Deep Ecological Attitudes." *Deep Ecology.* M. Tobias, Editor. San Marcos, California: Avant Books.

Ornstein, R., and Ehrlich, P. 1989. *New World New Mind: Moving Toward Conscious Evolution.* First Edition. New York: Doubleday.

Orr, D. 1990. "Ecological Literacy." *Meadowcreek Notes* (Spring): 1 ff.

Robertson, D. 1990. *Places on Earth.* Colloquium at UC Davis (May).

Sommer, R. 1989. "Hard Architecture." *The Little, Brown Reader.* Fifth Edition. M. Stubbs and S. Barnet, Editors. Glenview, Illinois: Scott, Foresman and Company.

Snyder, G. 1974. *Turtle Island.* New York: New Directions.

_______. 1980. *The Real Work: Interviews and Talks, 1964-1979.* New York: New Directions.

Thomas, L. 1984. "The Art of Teaching Science." *Fields of Writing: Readings Across the Disciplines.* N. Comley et al., Editors. New York: St. Martin's Press.

Thomashow, M. 1989. "The Reflective Environmentalist: Educating for Environmental Identity." Unpublished essay.

Whorf, B. L. 1956. *Language, Thought, and Reality: Selected Writings.* J. Carroll, Editor. Cambridge: Technology Press of the Massachusetts Institute of Technology.

TRAVELOGUES TO TRANSCENDENCE: THE "POPULAR SUBLIME" IN EARLY ACCOUNTS OF YOSEMITE

John A. Stenzel[1]

Abstract

For an eager magazine readership of the 19th century, Yosemite provided a prime locus of sublime scenery, an American version of the Alps that had simultaneously terrified and enlightened European travelers. By examining early (pre-1872) accounts of Yosemite Valley I show how the philosophical and aesthetic theory of the Sublime (passed down from Longinus through Kant and Burke) takes on a popular resonance and becomes a sub-genre of its own. The Valley cliffs staggered the mind with their size, depth, and sheer verticality, as did the waterfalls with their breathtaking leaps and thunderous power; the Big Trees gave a time sense, a living reminder of history and age, while the exfoliating cliff walls evoked geological time on a scale almost impossible to fathom.

Trying to find words to match their experiences, the early writers responded to the physical, emotional, intellectual, and religious challenges in highly entertaining, moving, and sometimes hilarious ways. This essay shows this range of styles, from straightforward exposition to the rhetoric of transcendent religious experience, from hardheaded Yankee pragmatism ("the Falls could drive four or five mills") to blatant plagiarism; there's also a wonderfully cynical account that satirizes the conventions and clichés of previous Yosemite chronicles. Besides being a window onto 19th-century American popular culture, my study offers a valuable perspective on what Yosemite meant in an age before motorhomes had replaced stagecoaches, before camcorders supplanted sketchbooks.

The scenery of Yosemite has always defied description, but people keep writing about it. Travel writers of the mid-19th century had certain advantages over us, including a vocabulary of aesthetic response ranging from "beautiful" to "picturesque" to "sublime" – terms that seem almost interchangeable today. In contrast to well-ordered "beautiful" landscapes or slightly less harmonious "picturesque" art in which scenic disruptions were interesting but minor, sublime painting overwhelmed with its images of disorder and danger; similarly, sublime music overpowered the listener, and sublime literature broke classical rules of order and convention. The present essay explores one path by which ideas of the Sublime – the capital "S" denoting a movement – emerged from the world of aesthetic philosophy, literature, and art and entered the "mass media" of the day.

In the early periodical accounts of Yosemite Valley, we can see how the Sublime not only takes on a popular resonance but becomes a sub-genre of its own, transmuting and adapting the elements of Burke's or Emerson's aesthetic theory into the entertaining fare of travel literature. The practitioners of this mode of writing were, I believe, aware of the intellectual roots of the Sublime (whether or not they had read widely in the primary sources) and calculatedly used its vocabulary to capture and move readers. Availing themselves of what became a formulaic style, even playing off the expectations and conventions of that mode, the writers of the genre combined seriousness with humor, dry fact and anecdote, to describe physical, emotional, intellectual, and religious challenges that the incomparable Valley posed for its early visitors.

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Yosemite is an important locus of the American Sublime for historical as well as aesthetic reasons, since it was the first body of land set aside by Congress as a park for recreational purposes. President Lincoln deeded the grant to the state of California in 1864, after the area had been known to outsiders for only thirteen years. In fact it was this very power of the unknown, and its concomitant ability to terrify, which contributed to its allure and concentrated force as a sublime landscape; even the first explorers had heard from released captives awe-inspiring tales of a hellishly deep dark gorge, a fortress protected by sheer overhanging cliffs – and this predisposition shaped response to this landscape in important ways. After all, fear – or at least the illusion of overwhelming power or danger – was a key ingredient in the aesthetics of the Sublime.[2]

Yosemite rapidly became a part of the tourist itinerary; within a few years of the Mariposa Battalion's visit, entrepreneurs like James Hutchings and Charles Leidig had established primitive hotels in the Valley, and Galen Clark was operating his way station near the Mariposa Grove of Giant Sequoias. Despite these developments, the route remained rugged and demanding well into the latter part of the century; this meant that many travel accounts had a built-in dramatic structure, as the ordeal of dusty roads, hard stagecoach seats, and spine-wrenching horse trails gave way to the climactic views of the great valley. The three-day journey from Stockton thus provided early sightseers with plenty of opportunity to savor the anticipated pleasures (gleaned from previous rhapsodic accounts) against the grimy prelude of mid-nineteenth-century California travel.

One of the earliest of eastern tourists to publish in a periodical was the Reverend Thomas Starr King, whose six articles for the *Boston Evening Transcript* in 1860-61 helped inspire artists, writers, and even legislators to make the trip. Among them were the painter Albert Bierstadt and Speaker of the House Schuyler Colfax, whose 1863 tour helped bring about the original Yosemite Grant. Starr King wrote lyrical and lush descriptions of the valley and the big trees, imbuing the scenery as others did with religious significance but also making connections to the worlds of art and music; many later writers would also choose these means, since words, no matter how descriptive, seem inadequate for the size and overwhelming depth of this landscape.

This process of analogy forms a key to any comprehension of the Valley, since the answer to the question "How was it?" implies a simile in response (as big as x, as loud as y, as old as z). The very indescribability provided the challenge to literary and religious approaches, as writers resorted to metaphorical or even allegorical structures to infuse words with a sense of the place. When Starr King searches for a summation, he refers to another higher authority, an acknowledged measure of the literary sublime, "The sublime poetry of Habbakuk is needed to describe the impression and perhaps the geology . . . Thou didst cleave the earth with rivers" (Starr King, 1).

In a particularly beautiful passage from the sixth installment, Starr King combines several ingredients of the Sublime to connect the river with recognizably "sublime" music: he sees the "patches of luxuriant meadow with their dazzling green" and the "superb firs . . . and graceful oaks" as "delightful rests of sweetness and beauty amid the threatening awfulness – like the threads and flashes of melody that relieve the towering masses of Beethoven's harmony." With a fascinating metaphorical inversion he concludes, "The Ninth Symphony is the Yo-Semite of music."

Recalling Burke's theory of the sublime, with its emphasis on terror (whether combined with real danger or not) and overpowering impressiveness, we note that Starr King emphasizes the mixture that is Yosemite, the power of contrast – between light and dark, meadows and cliffs, roaring, plunging waterfalls and calm rivers – which shapes our reactions to its many splendors. Yosemite is, after all,

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2. For a good overview of the Sublime, see the standard works by Monk (especially Chapter 5), and Hipple, among others.

a paradox of geology: it is a U-shaped glacial valley, with rich parkland surrounded by towering sculptured granite; its entrance is protected by steep gorges, but it is not a place of unrelenting intimidation. Even today, visitors can wander peacefully beneath the trees and suddenly step into a scene that mocks the human scale. The varying tones of the periodical accounts also reflect this pattern of rising and falling intensity of landscape and reaction.

Starr King used music as an analogue, but other travelogue writers used the visual arts to scale down Yosemite. The paintings of Salvator and Claude had provided 18th-century travelers with ideas of what to expect from the Alps or Apennines, and Yosemite was the American version of the Alps. A painter or photographer could bring back the experience of the scenery, or at least a concrete representation of it; since paintings were a legitimate source of vicarious sublimity, audiences could more easily apprehend the qualities that the print media sought to describe. As illustrated magazines gained in technical sophistication and fidelity, engravings and drawings could supplement the verbal descriptions; text, evocations of painterly analogues, and actual illustrations all worked together to communicate the sense of the landscape to an eager Eastern public.

Carleton Watkins's 1861 photographs of the valley and big trees had created a sensation on the East Coast, prompting an admiring editorial by Oliver Wendell Holmes in an 1863 *Atlantic Monthly;* in particular the stereoscopic views (taken with no little skill on Watkins's large-format apparatus) whetted tourists' appetites for the real thing. In the first long article on Yosemite in a national magazine, Fitz Hugh Ludlow gives Watkins partial credit for enticing his party (which included Bierstadt, two other artists, and several gentleman-scientists) to visit the Sierra. Ludlow later published a book describing several trips in the West, but the original "Seven Weeks in the Great Yo-Semite" appeared in *Atlantic* for June 1864. It is one of the best-written and most entertaining of the articles I have found, filled with literary and biographical allusion as well as humorous anecdote – and its appeal may have led one rival editor to plagiarism.[3]

Ludlow's account, which begins in San Francisco, is more than a travelogue; it attempts to convey to an educated readership the myths and realities of post-Gold Rush California life. He refers explicitly to Watkins's photographs and Starr King's articles as inspiration for his expedition; Starr King would have been Ludlow and Bierstadt's tour guide if he had not tragically died. As in so many other cases, the travelers have heard much about their destination, and Ludlow exploits these preconceptions with wryly humorous allusions to other, specifically literary, loci of the Sublime:

> If report was true, we were going to the original site of the Garden of Eden – into a region which out-Bendemered Bendemere, out-valleyed the valley of Rasselas, surpassed the Alps in waterfalls, and the Himmal'yeh in its precipices. Now we were going to test her reported largess for ourselves. (Ludlow, 740).

The Ludlow-Bierstadt party enters via the Giant Sequoias, and these trees provide the first chance for reflections on the Sublime, lending a new, *temporal,* dimension to the American Sublime. Previous accounts of the sequoias actually seem to work against transmission of the experience, since "I find no one on this side of the continent who believes the literal truth which travelers tell about these marvelous giants" (Ludlow, 744). Ludlow approaches the task by giving the "dry statistics of the

3. An unusual example of Ludlow's influence is an article in *Scribner's Monthly* for August 1871, "A Visit to the 'Great Yosemite,'" attributed in the Contents to "J.S." The publisher must have been hard pressed for copy early in the magazine's history (1871 was its second year), because the entire article, with the exception of two paragraphs and a few transpositions, is stolen directly from Ludlow's *Atlantic* account of seven years before. Into just four pages "J.S." (and I find no one on the masthead to blame with those initials) manages to fit a sliced-up and discontinuous pastiche of Ludlow's descriptions and anecdotes, containing no significant detail, only the vaguest of geographical fact, and the thinnest rhetorical skin of the sublime.

matter"; a paragraph of impressive but ultimately bewildering measurements follows. But he realizes this is far from adequate, choosing instead to retreat from the exotic or scientific to a comparison literally closer to home, he likens a fallen trunk to "an ordinary two-story house." "You propose to cross by a plank laid from your roof to the upper side of the tree. That plank would perceptibly slope *up* from your roof-peak" (Ludlow, 745).

While he attempts, through these and other analogies, to convey a sense of size and bulk, what really impresses Ludlow is the *age* of these monarchs, saplings in 1200 B.C., as old as the Hartford Charter Oak even in Solomon's day:

> We cannot realize time-images as we can those of space, by a reference to dimensions within experience, so that the age of these marvelous trees remains to me an incomprehensible fact, though with my mind's eye I continue to see how mountain-massy they look, and how dwarfed is the man who leans against them (Ludlow, 745).

This overwhelming sense of passed time leads Ludlow toward a concept of the Sublime that incorporates intellective size – the extent of time – as well as the more conventional spatial ingredients of Sublime size and scope. If the trees' grandeur is difficult to describe in words, Ludlow notes, it is all but impossible to convey on canvas: "You paint a Big Tree, and it only looks like a common tree in a cramped coffin." Instead, the artists resign themselves to capturing the gnarled branches and cinnamon-colored bark.

A day later the party completes the final leg of the journey, traveling past "hillsides gorgeous beyond human gardening" to "the Valley's tremendous battlement," and the abrupt overlook at Inspiration Point:

> That name had appeared pedantic, but we found it only the spontaneous expression of our own feelings on the spot. We did not so much seem to be seeing from that crag a vision of a new scene of the old familiar globe as a new heaven and a new earth into which the creative spirit had just been breathed. I hesitate now, as I did then, at the attempt to give my vision utterance. Never were words so beggared for an abridged translation of any Scripture of Nature (Ludlow, 746).

He speaks from atop a "sheer granite wall, whose terrible perpendicular distance baffled all computation," and this promontory stimulates in him (and in his successors) religious revelation: the landscape not only manifests a Creator's handiwork – "a new heaven and a new earth" – it is *alive* and raw, untamed in ways European and eastern landscapes no longer are.

This sort of language teeters on the brink of hyperbole and bathos, as it becomes part of the rhetorical genre of magnificent inflation. Even the protestations of verbal inadequacy become formulaic, though with a writer like Ludlow, we can count on a certain self-awareness that further complicates our evaluation: "when Nature's lightning hits a man fair and square, it splits his yardstick. On recovering from this stroke, mathematicians have ascertained the width of the valley to vary between half a mile and five miles" (Ludlow, 746). Furthermore, where Starr King had confined his religious associations to Christian sources, Ludlow is more eclectic: one cliff-face he compares to "the serene radiance of a snow-white granite Boodh," whereas Sentinel Rock becomes a "square stupendous tower that might have been hewn by the diamond adzes of the Genii for a second Babel-experiment, in expectation of the wrath of Allah."

This studied overstatement has the ring of a western "tall tale," as when he asserts that one of the vertical rock faces would cover "one of our smaller Eastern counties, though its exquisite proportions make it seem a thing to hold in the hollow of the hand" (Ludlow, 747), there is every indication that Ludlow expected that these jokes would help convert his audience. His description of Half Dome, or Tis-sa-ack as the Ahwahnee knew it, embodies both these qualities of extreme exaggeration and the prose of the Sublime's transcendent landscape:

> Not living was it? Who knew but the debris at its foot was merely the cast-off sweat and *exuviae* of a stone life's great work day? Who knew but the vital changes which were going on within its gritty cellular tissue were only imperceptible to us because silent and vastly secular? What was he who stood up before Tis-sa-ack and said, "Thou art dead rock!" save a momentary sojourner in the bosom of a cyclic period whose clock his race had never yet lived long enough to hear strike? What, too, if Tis-sa-ack himself were but one of the atoms in a grand organism where we could see only by monads at a time, – if he and the sun and the sea were but cells or organs of some one small being in the fenceless *vivarium* of the Universe? Let not the ephemeron that lights on a baby's hand generalize too rashly upon the non-growing of organisms! As we thought on these things, we bared our heads to the barer forehead of Tis-sa-ack (Ludlow, 747).

In this passage we find an explicit illustration of Yosemite's appeal as an organic part of the landscape and a further illustration of a rhetoric of sublime time: the sequoia trees he places in human history, and the rocks extend that scale backward before mankind. Ironically enough, the fact that Yosemite is relatively "young" in geological terms is what makes it seem such a "living" geological being, its huge piles of talus not yet covered by greenery.

As Ludlow extends his conception of a living landscape, the valley begins to take on a life of its own, the Sublime jolting Ludlow's sense of cosmic order and stimulating deep reflections: "the mighty pines . . . which grew all along its edge seemed like mere cilia on the granite lid of the Great Valley's upgazing eye" (Ludlow, 746). Where Emerson, at his moment of sublime revelation crossing Boston Common on a gray day, found himself "become a transparent eyeball," Ludlow anthropomorphizes the landscape, creating an optic sense for the superhuman valley itself.

It is important to keep in mind the literary context out of which these descriptions arose; in the gothic novels of Mrs. Radcliffe (and in Jane Austen's satire of the genre) we find the exact same rhetoric of fear, awe, and enlightenment, with the same speculations on a quasi-organic inhabited landscape that brings humans to full awareness of their own fragility. What the Alps were to the Old World, the Sierra and Rockies were to the New; each meditation affords a glimpse of the Infinite and of the insignificance of man, and both have been set in motion by the interplay between scenery and reason – or the defeat of reason by sublime scenery. A century earlier, Addison had seen this as a key ingredient in our taste for the Sublime: "Our Imagination loves to be filled with an object, or to grasp at any Thing that is too big for its capacity. We are flung into a pleasing Astonishment at such unbounded Views, and feel a delightful Stillness and Amazement in the Soul at the Approaches of them" (Addison, 540). In both spatial and temporal terms, Yosemite forces the visitor's imagination to contend with things "too big for its capacity," though writers treated the "Stillness and Amazement" in different ways.

The public's appetite for accounts of Yosemite and the Sublime was, of course, not easily satisfied: within a year *Harper's Monthly* ran a piece by J. L. Wiseley describing another trip to the region. Wiseley does not have Ludlow's descriptive prowess, but then he has the benefit of something Ludlow did not: the *Harper's* article features well-executed engravings made from C. L. Weed's photographs, thus removing some of the pictorial burden from the text. This is not to say that Wiseley avoids description or floods of purple prose, nor does he hesitate to allegorize the landscape: his religion, however, often has a Sunday-school savor to it, appearing more as footnotes to his text than as images to be pursued. He describes his approach from Coulterville in some detail, emphasizing the grim reality of California's summer drought, with cattle dying by the thousands before they could make it to the cooler foothill meadows: "I was often reminded of Ezekiel's valley of dry bones, and of the valley of the shadow of death" (Wiseley, 698). Later, his faith seems more practical, centered on a sturdy trust in human ingenuity and human scale.

Wiseley's account stresses the *architectural* aspect of the valley, constantly referring it not merely to the human scale but to human achievement: he observes that in the rich soil of the valley floor "a number of farms might be made," and that "we could not help remarking what an eligible place was here for the enterprising Blondin" – the celebrated tightrope acrobat who had thrilled thousand with his crossing of Niagara Falls, the preeminent eastern locus of the Sublime (Wiseley, 700, 702). Wiseley continues his musings on human technology with a speculation on bridge-building:

> In all soberness we wondered if human ingenuity, in its progressive course of development, would ever contemplate throwing a suspension bridge across a chasm as wide and deep as that. A short debate decided that many works that actually exist would at one time have been deemed as impossible as this would be now (Wiseley, 702).

In this equivocal tone Wiseley perpetually relates natural features to more prosaic details of engineering and public works, reminding us in subtle and not-so-subtle ways that this is the era of the transcontinental railroad, of vast acreage coming under the dominion of American ingenuity, of a cult of progress defined in terms of economics and engineering. The question for us is still relevant: could sublime scenery survive such pragmatism?

As it had been with Ludlow, the timelessness of the place is as important as the physical size, from the granite blocks "suggestive of the ruins of a mighty mountain" to the vast face of El Capitan, which "almost overwhelms the beholder"; "solid and seamless, it defies the action of time and the elements; and one is impressed with the conviction that it stands as entire as it did on the day when the morning stars sang together." The waterfalls, particularly Yosemite Falls, which "must ever be regarded by the sober critic as one of the most sublime of Nature's wonders," move Wiseley even more, despite a somewhat utilitarian preface – "there was water enough to turn three or four mills" (Wiseley, 703, 705).

After a lengthy comparison of Niagara and Yosemite (with the conclusion that everyone should attempt to see both of them), Wiseley moves up the canyon to Half Dome, "unquestionably the most sublime object around the valley." In his flights of fancy he "could not help associating it with 'heavenly palaces,' and in my excited imagination I peopled it with supernatural beings . . . ," but concludes with the oddly anticlimactic, "Efforts were made to scale it some years ago, but it was found utterly impracticable" (Wiseley, 706).

Beginning in 1870 several more articles appeared; one of the most interesting is a skeptical piece by Olive Logan entitled, "Does it Pay to Visit Yosemite?" Whereas earlier writers had mentioned that the journey to Yosemite was rough and taxing, especially for women, Logan makes the discomforts of the trip and the primitiveness of the accommodations the main themes of her account. Her aim, she avers, is to correct the too rosy picture painted by so many previous authors: "I think it not unwise to tell a plain unvarnished tale of what awaits the Yo Semite pilgrim; for of the dozens of persons who have written about Yo Semite, I have never known one who gave anything like an accurate description of the perils and tortures attendant upon the journey thither" (Logan, 498). One of her chief complaints is that the trip is, as Ludlow bragged, "no Saratoga affair"; the travelers are allowed only a minimum of spare clothing, and the ethnic heterogeneity of her fellow passengers seems to be a source of genteel dismay for her.

Her account is full of wry comment, beginning with her description of Stockton, whose main claim to fame seemed to be that it was a jumping-off point for Yosemite: "I was stricken with the Yo Semite fever. . . . A short walk in the town revealed that there was an Insane Asylum there. Can this have any connection with its being the returning point for Yo Semite tourists?" (Logan, 500). She lingers over her fellow sojourners (singling out for continuing treatment a newlywed from Chicago whose hairpiece becomes a casualty to the road) and on the hardships of the journey, always keeping us aware of the tradition of Yosemite travelogues she is setting out to debunk:

> We try our best to enjoy life. . . . The scenery is wild and grand; the air is pure and sweet; the fruit we buy is so ripe and juicy that it fairly melts in the mouth. Isn't this a delightful picture? This is what all tourists write about. Now the truth is, that the possession of these things is scarcely noticed. . . . At present you are coated with dust, your eyes are smarting, your tongue is clogged, your flesh inflamed, you want to go home, and this is only the first day, over the best part of the road, and in the stage (Logan, 501).

Through hours on hard jolting seats, the brave tourists remind themselves, as if repeating an incantation, that "we have not seen the Valley yet. The Valley will repay us for all, the stage driver says. . ." (Logan, 502); this inverts the usual thrust of the Yosemite accounts, since the anticipation in this case actually intensifies the suffering and leads to anticlimax.

After a litany of depredations – "execrable dinner at Hogden's," "sorry brutes" of horses, and "dangerous and unendurable roads" – the descent into the valley brings no raptures like those of Ludlow; she does not even mention the view, only that they arrive at Hutchings's primitive hotel, and "our sufferings are at an end now. And tomorrow shall burst upon our enchanted eyes the glorious sight whose beauty is to atone for all" (Logan, 505). The "atonement" presented sarcastically here is a far cry from the customary religious and quasi-religious meditations, and Logan's version of the incomparable valley the next morning explicitly sets out to undercut her predecessors' high-flown prose and transcendent poses:

> Here is the great prize to obtain a view of which we have come so many weary miles. Now we are to be repaid for all. We make a hurried toilet, and as quickly as our weary limbs will permit, we drag out to see the view which shall awe us, shall make us lose our identity, shall cause us to feel as though we were in the spirit land.
>
> And what do we see? Tall rocks, a few tall trees, a high and narrow waterfall, a pretty little river! No more. A lovely natural scene, I grant you; but oh! where in this broad and beautiful land of ours are not lovely natural scenes the rule? Words cannot tell the feeling of cold despair that came over me and all our party as we looked about us. Was it for this we had so suffered!
>
> We never rallied from that first impression.
>
> "But that stone wall is nearly a mile high."
>
> It may be so, but it does not look it; and if it did, the stars are higher, and, thank God, the stars shine at home!
>
> "That waterfall is eleven times higher than Niagara."
>
> Indeed! It looks like a fireman's hose playing over the top of Stewart's store (Logan, 506).

Unlike the others whose invocations and hymns weave in and out of humorous anecdote, Logan can maintain a consistent tone, an unabashed catechism of deflation. Unimpressed by the size of the features – the very proportions praised by Ludlow lead to Logan's disappointment ("It may be so [a mile high], but it does not look it"), and the domestic imagery used by others to describe the huge size of trees becomes, in Logan's hands, the stuff of Lilliputian shrinkage ("like a fireman's hose playing over the top of Stewart's store"). Although the party attempts to "find Beauty" elsewhere in the valley, they encounter only sun-dazed rattlesnakes and impoverished Ahwahnee Indians.

While these parodic descriptions by themselves would paint an interesting and contrasting picture of Yosemite, Logan fascinatingly analyzes the psychology of what I have come to call the "Travelogue Sublime." Rather than lovingly describing the objects themselves, she retraces Kant's steps, directing her attention to the *subjects* or participants in the Sublime transaction; her descriptions of her fellow sojourners – "Yo Semite pilgrims" in search of enlightenment--force us to look at the ways predisposition, not landscape, affects reaction. Travel writers (and aestheticists) attempt to mediate experiences for their readers, to prime them for enjoyable experiences and warn them away from the unenjoyable; Logan avails herself of these expectations for humorous and dramatic effect.

Her fellow pilgrims are "in no condition to enjoy it," and even if the valley were ten times as grand, "the sight of it would not repay one for the suffering involved. . . . [T]he plain truth is that nine out of ten who visit Yo Semite think this but they will not say what they think." The problem is that some people . . . never have an opinion of their own, but parrot-like repeat the refrain which has been set them to sing" (Logan, 507). She continues with an exhortation: "O travelled monkey! Dare to tell the truth, why do you not? Because you are afraid some other traveled monkey will say you can't appreciate the scenery which makes your head ache to look at, and your bones ache to get at." Thus, according to Logan, not only is the valley overrated, but the people who praise it are part of a colossal conspiracy to dupe the gullible. She also casts doubt on all of the valley's propaganda, exposing as she does this conspiracy of unfounded praise that seduces the unwary and flatters the pretentious.

This critique taps a vein of serious questions we must ask about the Sublime, especially in its travelogue form: if fear or Burke's "pleasing terror" is a necessary requirement (with discomfort magnifying the experience), and if the effect of fear is to overwhelm the understanding and open up the soul to Higher Things, we should acknowledge that fear and discomfort also tend to suspend our *aesthetic* sense as well, at least until after our pulses have had a chance to return to normal. The roller-coaster syndrome epitomizes an extreme kinesthetic form of this: people wait in a line for half an hour so they can shriek and quake for a minute and a half, only to return to the line to talk about how much they enjoyed it. While this is not what we might like to consider the Sublime, it is similar, at least to the travelogue variety, in several key respects: it is a retrospective enjoyment, it is an enjoyment grounded in anticipation and predisposition, and it has an unacknowledged social dimension – a vital ingredient is the shared sense of danger and exaltation. If, as Burke avers, the danger or threat to life must be potential and not real for us to experience the Sublime, we usually have to wait until we sit down to write or talk to be sure it was truly safe – and sublime.

Another more general aesthetic consideration emerges from this discussion: do we appreciate something genuinely or do we modify our response at the direction of arbiters of taste? For Logan there is no middle ground – the purveyors of a Yosemite sublime are simply "travelled monkeys" spouting the inflated rhetoric of transcendence to keep from thinking about the all-too-present privations and disappointment. For Logan the landscape cannot bring on spiritual elevation or universalization, the observer must remain fixed in physical context; at every opportunity she reminds herself and her readers of how "down to earth" she is (as opposed to head in the clouds, we suppose) and how ridiculous and, more importantly, *dishonest* everyone else looks. Yet in some basic way skepticism and sarcasm become for her the means of a kind of transcendence – both of physical reality and of literary genre: Yosemite becomes a source of ironic self-aggrandizement as *she* becomes the purveyor of the "plain unvarnished truth," the heroic debunker of myth. Ironically, in her encounter with the sublime valley she *has* "gained an identity" despite herself, by playing off and situating herself above the powerful aesthetic and cultural forces collected in this landscape.

The "travelogue sublime" might be a rhetoric of expansiveness and grandeur, verging into empty hyperbole (as painterly expressions and hack writers often clearly demonstrated), but it achieves an entertaining and moving character when energized with genuine feeling. Yosemite deeply affected its early visitors and the readers who partook vicariously of its charms: the mountains staggered the mind with their size, height, and sheer verticality, as did the waterfalls with their breathtaking leaps and thundering power; in counterpoint to both was the pastorally inviting valley bottom. Setting Yosemite apart from other loci of the Sublime for these writers, however, was the time sense: the Big Trees were a living reminder of history and age, whereas the exfoliating, eroding cliff walls evoked geological time on a scale almost impossible to fathom and set otherwise blase tourists to thinking beyond the human and geological past to the Hereafter.

REFERENCES

Addison, J. 1965. *Spectator*, 412. Ed. Donald Bond. 4 Vols. Oxford: Clarendon Press.

Burke, E. 1958. *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and the Beautiful.* Editor J. T. Boulton. London: Routledge & Kegan Paul.

Hipple, W. J. 1957. *The Beautiful, The Sublime, and The Picturesque in Eighteenth-Century British Aesthetic Theory.* Carbondale: Southern Illinois University Press.

Holmes, O.W. *Atlantic,* XII (1863), 8.

King, Thomas Starr. In *Boston Evening Transcript.* 26 Jan 1861.

Logan, O. S. "Does it Pay to Visit Yo Semite?" *Galaxy,* X (1870), 498-509.

Ludlow, F. H. "Seven Weeks in the Great Yo-Semite." *Atlantic,* XII (1863), 738-750.

Monk, S. H. 1960. *The Sublime: A Study of Critical Theories in Eighteenth-Century England.* Ann Arbor: University of Michigan Press.

"J. S." "A Visit to the Great Yosemite." *Scribner's,* III (1872), 261-277.

Wiseley, J. L. "The Yosemite Valley." *Harper's,* XII (1865), 697-708.

HONOR THY MOTHER: URSULA K. LE GUIN'S ECOFEMINIST INHABITORY ETHIC

Amy Clarke[1]

In *Always Coming Home,* Ursula K. Le Guin posits an alternative to the traditional Western view of humans as above and outside nature, nature's masters rather than its children. She depicts a Napa Valley of the distant future that is still recovering from the devastations of the 20th century. In a conscious effort not to repeat the mistakes of the past, the people who live there see themselves as an integral part of nature, coequal members of the valley ecosystem. Fundamental to their way of life is the belief in the valley as life source, as Mother, and in the necessity of maintaining a thoughtful, reverent relationship with that life source. In many ways, *Always Coming Home* incorporates the tenets of ecological feminism. In this paper I shall outline the principles of ecofeminism, discuss its place in Le Guin's novel, and consider its effectiveness as a tool for reshaping our understanding of the relationship between humans and the natural world.

Wednesday, October 17, 3:30 pm

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PAINTERS AND THE CALIFORNIA LANDSCAPE

PAINTERS AT YOSEMITE: IN THE WAKE OF GOD'S GREAT PLOW

Kate Nearpass Ogden[1]

Abstract

This paper and the slide presentation on which it was based deal with geology and geologists as they influenced the painters who worked at Yosemite Valley in the 1860s and 1870s. On a general level, geology was of interest to all the artists who depicted the valley's unique granite formations. In addition, some painters were hired by scientists as illustrators, while other artists and geologists made social contact in the small world of the valley. Particular attention is given to early theories of the valley's geologic creation and their influence on artists: specifically, J.D. Whitney's belief in a general subsidence of the valley floor, and John Muir's greater emphasis on "God's great plow," the glacier.

BODY

In his book, *Americans and the California Dream,* Kevin Starr wrote that in the nineteenth century, "Yosemite began to assume a primary significance in the minds of Californians. Here was the one adequate symbol for all that California promised: beauty, grandeur, expansiveness, a sense of power, and a sense – this in the geological history – of titanic preparation for an assured and magnificent future. . . . In 1864 Americans set the Yosemite aside [as a park] because it was so unutterably beautiful and because it expressed their own best hopes" (Starr 1973, 193).

Yosemite was among the most celebrated of all American landscape sites during the nineteenth century and it was painted by an impressive number of resident and visiting artists of varying levels of talent (Ogden 1990; Robertson 1984). The view from Inspiration Point, to name a single, highly popular subject, was painted by Thomas Hill, John Henry Hill, Samuel Colman, Virgil Williams, Charles D. Robinson, George W. King, and others. As intimated by Kevin Starr, the valley supported a variety of symbolic associations which gave depth and resonance to the paintings and photographs it inspired. National and state pride, religion, tourism, and geology all influenced Yosemite image-making.

As an Edenic site, fresh and green in the spring and summer, yet hidden and protected by steep gray granite walls, the valley seemed at once virgin and ancient, an American Garden of Eden kept pristine since the day of its creation. Paintings of Yosemite, as the crowning glory of the California landscape, embodied the state pride of those who lived here. Yosemite landscapes were collected by many whose fortunes had been founded on California products and transportation.

Yosemite also served the cause of nationalism, since it was considered bigger and better than anything like it in Europe. California was constantly compared with Italy and the Mediterranean – and the Sierra Nevada was compared with Switzerland – by those who promoted the state to tourists and potential immigrants. Tourism was another inspiration to artists painting the valley, providing subject matter as well as an important market. Geology was also an influence, providing inspiration and occasional employment.

In the context of the Natural Areas and Yosemite Conference, with its focus on ecology and environmental issues, I would like to concentrate on the last influence mentioned – geology – as it

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affected painters working in Yosemite Valley. On a general level, geologic issues were of inescapable interest to *all* the artists who explored the valley's unique physiography. The many waterfalls and unusual rock formations found in and around the valley were the *raison d'etre* for numerous Yosemite landscapes. Half Dome, for example, served as the subject of paintings by Thomas Moran, Albert Bierstadt, Thomas Hill, John Henry Hill, Gilbert Munger, George and James D. Smillie, and Herman Herzog; Cathedral Rocks inspired Bierstadt, Herzog, Enoch Wood Perry, William Keith, Edwin Deakin, and William Hahn; Sentinel Rock served as a focal point for Keith, Perry, James D. Smillie, Virgil Williams, and Frederick Butman; and the Royal Arches inspired Bierstadt, Gilbert Munger, and Ransom G. Holdredge. In some works, more specific geologic issues were explored in greater depth.

Two of the first geologists who focused their attention on Yosemite were Josiah D. Whitney and Clarence King. Whitney came to the valley after his appointment as state geologist while beginning a survey of California. After a superficial reconnaissance of the entire state executed between 1860 and 1863, detailed studies were initiated at some of the more spectacular sites: the Kings and Kern river canyons, Lake Tahoe, Mono Lake, the Big Trees, and Yosemite (Goetzmann 1966).

Between 1864 and 1867, Whitney's field crews worked in and around Yosemite, surveying the valley and its surroundings, preparing a detailed map, and studying its geology. One of those performing the Yosemite field work was the talented young geologist Clarence King, who had joined the survey team as a volunteer in 1863. Whitney and King found themselves wondering how such an unusual valley had formed. Theories regarding Yosemite's creation were a subject of intense debate during the late 1860s and the 1870s, a debate followed by the general public, including artists, as well as by the scientific community.

J.D. Whitney, as state geologist, was the first to publish his views on the subject. Confronted with a valley resembling nothing in his prior experience, he more or less invented a theory to explain its creation. "We conceive," he wrote, "that, during the process of upheaval of the Sierra or, possibly, at some time after that had taken place, there was . . . a subsidence of a limited area, marked by lines of 'fault' or fissures . . . In other and more simple language, the bottom of the Valley sank down to an unknown depth, owing to its support being withdrawn from underneath . . ." (Whitney 1868, 77). According to Whitney, the valley floor was then filled in by erosion and sedimentation, resulting in the level meadows which are there today.

Whitney's view, called the "subsidence theory," was first published in his 1865 book on the findings of the survey and was later refined in his 1868 publication, *The Yosemite Book.* The earlier book, entitled *Geology of California, Volume 1,* also included several engravings based on photographs by Carleton Watkins. Most of the illustrations in the section on Yosemite are images of individual rock formations: North Dome, Half Dome, Sentinel Rock, Cathedral Rock, El Capitan, and so forth. The illustrations, like Watkins's original photographs, present the rock formations of Yosemite as curiosities rather than as objects of intense scientific scrutiny. Composed in standard picturesque fashion, with the formations near the center, trees framing the sides, and frequently, a reflective pool of water in the foreground, they are landscapes of scenic rather than strictly scientific interest.

The only Yosemite image in Whitney's book which relates directly to his geologic theory is an engraving after Carleton Watkins's photograph, *El Capitan and the Cathedral Group,* and a section line drawing of the same subject. This pair of images accompanies and illustrates Whitney's remark that "the peculiar features of the Yosemite are; first, the near approach to verticality of its walls; next, their great height, not only absolutely, but as compared with the width of the valley itself; and, finally, the very small amount of debris, or talus, at the bottom of these gigantic cliffs . . ." (Whitney 1865, 409-10).

The young Clarence King, who first entered Yosemite in 1864 with Whitney's field crew, considered the glacier a more important factor in the valley's creation. Unlike his supervisor, King noticed glacial striations and polishing on the valley walls, and a series of glacial moraines on the floor (King 1864, 15-20; Whitney 1865, 422). King may have been more up-to-the-minute than Whitney in his knowledge of glaciers, since only a year earlier he had attended lectures given at Yale by the eminent scientist Louis Agassiz. It was Agassiz, in fact, who referred to the glacier as "God's great plow," a juxtaposition of theology and science typical of the time (Shuck 1869, 216-7).

John Muir, a third Yosemite naturalist, was more voluble than King in objecting to Whitney's subsidence theory. Because Muir placed more importance on the glacier, he was called by some the "genial advocate of the glacial theory." Muir visited Yosemite soon after arriving in California in 1868 and afterwards lived in the valley for several years. It seems that Muir, like King, was aware of glacial evidence at Yosemite from the beginning of his stay. Although the controversy involving Muir and Whitney has been discussed elsewhere (Fahy 1985; Smith 1987, 100-3), the highlights bear repeating here. Whitney categorically denied Muir's discoveries, writing that "there is no reason to suppose, or at least no proof, that glaciers have ever occupied the Valley or any portion of it . . ." (Whitney 1870, 84). Muir in turn negated Whitney's subsidence theory, remarking that "The bottom never fell out of anything God made." (Teale 1954, xix)

Although Clarence King himself had noted signs of an ancient glacier in the valley, he generally took Whitney's side against Muir and he refused to credit Muir's next discovery: that "living" glaciers still existed in the Sierra Nevada. King caustically remarked that Muir, the "ambitious amateur," should "divert his evident enthusiastic love of nature into a channel, if there is one, in which his attainments would save him from hopeless floundering." (King 1878, 477-8) In the 1870s, Joseph LeConte of the University of California at Berkeley raised his voice in support of Muir's work. Twentieth-century geologists have likewise considered Muir's theory closer than Whitney's to what probably occurred.

The argument between Whitney, King, and Muir sounds a latter-day echo of the debate held by the so-called "catastrophists" and "uniformitarians" earlier in the century. The catastrophists essentially tried to include miracles in their world cosmogeny – miracles in the form of unusual, catastrophic events, which accounted for radical changes – while the uniformitarians argued that the processes now in existence must have caused earlier changes as well (Gillispie 1951). Whitney's subsidence theory was basically catastrophist, since it accepted a unique, previously unrecognized catastrophic event as the primary instrument of change. Muir's glacial theory, on the other hand, was solidly based on ongoing natural processes, including glaciation and erosion, and argued for a more gradual process of change.

At Yosemite, geology was of interest to nearly everyone, tourists and scientists alike. Upon arrival, visitors were immediately intrigued with the valley's depth, its steep vertical walls, its granite domes and other formations. As Clarence King wrote, "I believe no one can study . . . these great Sierra can[y]ons without asking himself some profound geological question.s" (King 1872, 32) Religion and science were still closely linked during these years, and despite the publication of Darwin's *Origin of Species* in 1859, Americans still hoped that science would find ways of "proving" the lessons in the Bible. The granite walls of the valley were seen by many as a kind of hieroglyphic text awaiting translation by geologists. In such a climate of interest, it is hardly surprising that geology was an influence on artists, providing them with inspiration and ideas in addition to projects and employment.

A number of the artists who came to Yosemite were hired by or volunteered to work for scientists exploring the area. The photographers Carleton Watkins and W. Harris, for example, were commissioned by the State Geological Survey in the mid-1860s. Watercolorist John Henry Hill traveled west in 1868 with Clarence King's survey of the fortieth parallel. Gilbert Munger occasionally worked for King's survey in California, and his western paintings were reproduced as chromolithographs in King's book *Systematic Geology* (1878). Albert Bierstadt likewise accompanied some of King's field excursions. The painter William Keith was introduced to the Sierra landscape by his fellow Scotsman John Muir, and the photographer John J. Reilly also trekked the Sierra Mountains with Muir. Thomas

Hill occasionally worked on commission for Muir after William Keith's paintings became too subjective to suit the Scottish naturalist.

These artists, and others working independently at Yosemite, would have been aware of the geologists' debate regarding the formation of the valley. Guidebooks and other popular literature frequently quoted the theories predominant at the time, and the scientists themselves were often there in person to argue their ideas. Muir, in particular, was something of a fixture at Yosemite during the 1870s. Although the *commissioned* work of the painters just mentioned often took place outside the valley, the artists would have been aware of current geologic thinking when they *did* paint Yosemite.

The geology of the recently discovered valley was thus of widespread interest, and this interest was manifested in a multitude of paintings of individual monuments. Among the many examples not yet mentioned are paintings of Sentinel Rock by William Keith, Enoch Wood Perry, James D. Smillie, Virgil Williams, and Frederick Butman, and paintings of the Royal Arches by Albert Bierstadt, Gilbert Munger, and Ransom G. Holdredge. Other granite formations of the Sierra were also considered fit subjects: George Tirrell sketched the Cap of Liberty as early as 1858, James D. Smillie painted the domes of Little Yosemite Valley in 1871, and Thomas Moran painted a dome on the Tuolumne River in 1890.

At times, the same artists created images of more specific geologic interest. The polished base of Glacier Point cliff, easily accessible near the center of the valley, was a favorite subject in the 1870s, when Muir's glacier theory was becoming more widely known. James D. Smillie painted the polished lower surface of this rocky promontory in 1871, and Thomas Hill did the same from a different angle somewhat later. William Keith and Gilbert Munger painted views of this cliff face in 1869 and the early 1870s, respectively, creating images in which geologic interests mingle with artistic explorations of the sublime and the romantic. Herman Herzog's oil sketches from the early 1870s occasionally show a similar interest in cliffs and polished granite, just as some of James D. Smillie's drawings and oil sketches demonstrate that painter's fascination with the domes and other rock formations of the area.

Artists' on-site, *plein air* sketches often show their interest in geology more clearly than their finished paintings. Many of the small watercolors in James D. Smillie's sketchbooks, for example, are more concerned with empirical honesty than with picturesque organization. The change which occurred between on-site studies and finished easel paintings is especially clear in a comparison of two works by the well-known eastern painter Albert Bierstadt: an apparently truthful oil sketch of Hetch-Hetchy Valley (now in a private collection) and the more subjective, elaborate, and stylized easel painting based on the sketch (Wadsworth Athenaeum, Hartford, CT). Another pair by Bierstadt which further illustrates the conceptual chasm between sketch and final painting is his *plein air* study of Half Dome (Joslyn Museum, Omaha, NE) and the 15-foot *Domes of the Yosemite,* the largest Yosemite painting now in existence (St. Johnsbury Athenaeum, VT). In his sketch of Half Dome, Bierstadt aimed at a scientifically accurate level of visual note-taking. In *The Domes of the Yosemite,* on the other hand, he combined and synthesized a number of on-site sketches, resulting in a composition which is geographically false. Although I myself took the wrong trail and never did reach the vantage point shown in Bierstadt's painting, I'm told that the entirety of the scene is *not* visible from any one spot.

At least two photographs made by Eadweard Muybridge in 1872 document the polishing effects of "God's great plow." One, titled *Ancient Glacier Channel, Lake Tenaya (No. 47),* was brought to public attention by Weston Naef, who chaired Tuesday's conference session on photography. Mr. Naef has noted that Muybridge photographed these polished rocks and glacial boulders at the suggestion of the geologist Clarence King, who was then visiting the valley (Naef 1975, 174). King would certainly have pointed out such glacial evidence to those around him. A second image by Muybridge, titled *Glacier Channel, Valley of the Yosemite (No. 41),* shows a similar interest in the polished surfaces of the Sierra Nevada Mountains. The photographer's purpose in taking these photographs was clearly not limited to aesthetic interest. They show few if any of the characteristics which make his other Yosemite landscapes picturesque or dramatic. Muybridge's photographs of Yosemite Falls in the dry season likewise exhibit intense interest in the rocks of the area, as do some of John J. Reilly's High Sierra photographs.

One of the most intriguing parallels between art and science is found in Albert Bierstadt's Yosemite paintings and their relationship to contemporaneous theories of the valley's creation. Although the painter's first Yosemite trip occurred in 1863, before any detailed scientific work had been performed at the valley, many of his early paintings were created between 1865 and 1868 – immediately after the publication of Whitney's subsidence theory.

There can hardly be a better illustration for the catastrophist sensibility than Bierstadt's apocalyptic painting *Sunset in Yosemite Valley* (1868), now at the Haggin Museum in Stockton, or the sketch on which it was based, now at the Museum of Fine Arts in Boston (1864). Certainly, nothing more suggestive of seething geological process can be imagined unless one looks at actual images of earthquakes and volcanoes. Bierstadt made several similar paintings for patrons who requested them: these are now at the Oakland Museum, the Yale University Gallery of Art, and the Birmingham Museum in Alabama. These paintings evoke a sense of mystery and tumultuous change appropriate to the catastrophist belief in upheaval and miracles. Their depiction of divine light pouring over God's handiwork would also have met with catastrophist approval.

By the early 1870s, when Muir's glacial theory was beginning to win acceptance, Bierstadt's pictorial interpretation of Yosemite had also begun to change. Bierstadt returned to Yosemite several times in 1872 and 1873. Several of the landscapes which resulted from these trips are more brightly lighted and placid rather than tumultuous. Examples include *Looking Up Yosemite Valley* (n.d.) and *Lake in Yosemite Valley* (1868-70), both at the Haggin Museum in Stockton. Where Bierstadt's landscapes of 1865 to 1868 presented Yosemite as a place of mystery and change, his paintings of the late 1860s and 1870s depict the valley as a place of solid, everyday reality and very slow change. These are the uniformitarian's "rocks of ages," not the potentially mutable, molten rocks of the catastrophist. Change, when it occurred to these rocks, would be induced by erosion and glaciers, slow-moving agents still at work today.

Other interactions between science and art are more obvious. In 1871, Clarence King and John Muir independently discovered living glaciers in California and published articles announcing their accomplishments. King found his glaciers at Mount Shasta; Muir found his in the High Sierra. In the aftermath of their discoveries, a number of California artists began painting landscapes with glacial themes.

Hiram Bloomer, for example, began a painting called *The Glaciers of Mount Shasta* in the fall of 1873. Shasta would become quite a popular subject in the 1870s. In 1874, William Keith painted the ice-covered top of *Mount Lyell, California Sierra,* which John Muir had been first to climb in 1871 and which Muir also sketched around that time. Within a few years Keith began *Glacial Meadow and Lake, High Sierra* (c.1870s-80s), *Mount Shasta* (c.1878-9), and *Headwaters of the San Joaquin* (1878). (The last had also been sketched by John Muir.) Muir himself pronounced Keith's work "so full of plain truth . . . as to be fit for scientific illustrations . . . "(Muir 1875, 482). James D. Smillie began a similar glacial landscape in the 1870s, entitled *High Sierra, California,* which his brother George finished years later. Gilbert Munger painted *Glacier Lake, Kings Canyon* in 1876, and Charles Dorman Robinson rendered the Lyell Glacier in pictorial form for John Muir's book *Picturesque California* (1888).

Having made a case for the influence of geology on California landscape painting, I must now admit that tourism ultimately surpassed science as an influence on the art of Yosemite. Of the many Yosemite paintings focusing on single granite formations, most contain more curiosity than scientific value. The appeal of most of these paintings is aimed more at the general public than at the scientist. The rock formations are depicted from their most characteristic angle – the side most famous, and therefore most desirable in a tourist's souvenir.

These images were, nevertheless, entirely appropriate for the scientific publications of the day. The engravings after Watkins's photographs which were used in Whitney's book *Geology of California* were scarcely less scientific than Whitney's text. In fact, the illustrations seem tailor-made for Whitney's use when we consider the similarities in their approach to the material. Whitney's early writings on Yosemite (1865, 1868) did indeed cover scientific issues like the origin of the valley, and the climate, botany, and topography of the Sierra Nevada. In addition, however, Whitney promoted Yosemite as a tourist attraction; he discussed the best means of travel and the best routes to Yosemite; he enumerated and described the waterfalls and natural monuments as one encounters them in the valley; and he even suggested specific day-by-day itineraries for visitors. In other words, Whitney treated the valley's unusual geologic features as stops on a tourist program, essentially the same approach taken by Watkins and the painters.

Other early books on Yosemite by reputable writers were equally "pseudo-scientific." These include publications by John S. Hittell, a journalist and historian known for his 1863 book *The Resources of California*, and Samuel Kneeland, a professor of zoology and physiology in Boston. Despite the intellectual ambitions of the authors, their publications are essentially tourist guidebooks like Whitney's, and the illustrations are suitably scenic.

In conclusion, geology was one of several discourses enriching the art of Yosemite in the 1860s and 1870s. The valley was then a newly discovered wonder, and it inspired a host of artists to sing its praises in paint. Artists were also exposed to the debate then in progress regarding the valley's creation: Josiah D. Whitney and his subsidence theory; John Muir, the advocate of the glacial theory; and Clarence King, who recognized signs of glaciers but initially deferred to his supervisor, J.D. Whitney. Albert Bierstadt's paintings offer one of the most intriguing pictorial expressions of this debate. At Yosemite, geology was as glamorous as it gets, and painters were quick to capitalize on its spectacular impact.

ACKNOWLEDGMENTS

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REFERENCES

Fahy, N.E. 1985. Josiah D. Whitney, The California State Geological Survey, and Yosemite Valley. *California Geology* 38(6):129-33.

Gillispie, C. 1951, 1959. *Genesis and Geology: A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain, 1790-1850.* New York: Harper & Bros.

Goetzmann, W.H. 1966, 1978. *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West.* New York: W.W. Norton & Co.

Hittell, J.S. 1868. *Yosemite: Its Wonders and Its Beauties.* San Francisco: H.H. Bancroft & Co.

King, C. 1864. "Field Notes and Observations on The Yosemite Valley and Surrounding Country." Unpublished notebook, Huntington Library, San Marino.

King, C. 1872. *Mountaineering in the Sierra Nevada.* Boston: James R. Osgood & Co.

King, C. 1878. *Report of the Geological Exploration of the Fortieth Parallel, Volume 1, Systematic Geology.* Washington, D.C.: U.S. Government Printing Office.

Kneeland, S. 1871. *The Wonders of the Yosemite Valley, and of California.* Boston: Alexander Moore.

Muir, J. 1875. "Art Notes." *Overland Monthly* 14(5):481-2.

Naef, W. 1975. *Era of Exploration: The Rise of Landscape Photography in the American West, 1860-1885.* Boston: New York Graphic Society.

Ogden, K. 1990. "Sublime Vistas and Scenic Backdrops: Nineteenth-Century Painters and Photographers at Yosemite." *California History* 69(2):134-53.

Robertson, D. 1984. *West of Eden: A History of the Art and Literature of Yosemite.* Yosemite Natural History Association and Wilderness Press.

Shuck, O. 1869. *The California Scrap-Book: A Repository of Useful Information and Select Reading.* San Francisco: H.H. Bancroft & Co.

Smith, M.L. 1987. *Pacific Visions: California Scientists and the Environment, 1850-1915.* New Haven: Yale University Press.

Starr, K. 1973. *Americans and the California Dream, 1850-1915.* New York: Oxford University Press.

Teale, E. *The Wilderness World of John Muir.* Boston: Houghton Mifflin Co.

Whitney, J.D. 1865. *Geology of California, Volume 1, Report of Progress and Synopsis of the Field-Work, from 1860 to 1864.* Philadelphia: Caxton Press.

Whitney, J.D. 1868. *The Yosemite Book.* New York: J. Bien.

Whitney, J.D. 1870. *The Yosemite Guide-Book.* Cambridge, MA: University Press.

TAMING THE LANDSCAPE: PAINTINGS FROM 1860 TO 1930

Harvey L. Jones

California landscape paintings of the 1860s and 1870s differed considerably from those of the late nineteenth and early twentieth centuries. The earlier painters, faced with an untamed, generally uncharted wilderness, often tried to delineate every detail of their surroundings, as if trying to understand and thereby "tame" the land. Later in the nineteenth century, as the California landscape itself became better known, artists like William Keith felt free to add an overlay of their own personal style and subjective response. By the twentieth century, painters began to choose entirely different aspects of the landscape for their artistic studies. Although they depicted more settled, less rugged scenery, their experiments in color and brushwork were more daring than those of their predecessors. Illustrated with slides, this talk will draw from a variety of sources including the collection of the Oakland Museum, one of the strongest museum collections focusing on California painting.

Thursday, October 18, 1:30 pm

VITAL VIEWS: NATURE IN CONTEMPORARY CALIFORNIA PAINTING

Margaret Thomas

The work of three contemporary painters, Pegan Brooke, Ev Thomas, and Maggie Thomas, will be illustrated with slides and discussed from the perspective of one of the artists. All three painters live near the ocean in Marin County, where nature has exerted a strong influence on their work. Although on the surface their paintings differ considerably, they share an underlying philosophical approach which seems almost Emersonian in its response to nature.

Thursday, October 18, 1:30 pm

CALIFORNIA LANDSCAPE: THE VERBAL AND VISUAL LEGACY

MYTHS AND REALITIES: CALIFORNIA LANDSCAPE PAINTINGS OF THE 1880s AND 1890s

Janice T. Driesbach[1]

Abstract

The monumental landscapes created by such artists as Albert Bierstadt and Thomas Hill in the 1860s and 1870s have become identified as iconic images of Yosemite. These works, which often embody the transcendental ideals enunciated in 19th-century American literature, served to establish California as a Promised Land. In contrast, by the late 1870s, due to a number of factors, California landscape painting became smaller in scale and often presented more intimate scenes. Paintings of Yosemite continued to proliferate, however, and, although their intentions may have often appeared more realistic, these compositions continued to create visual myths for the audience they served.

INTRODUCTION

Our interpretation of our artistic heritage is necessarily influenced by an historical overlay, which in regard to Yosemite landscape painting has identified as supreme achievements the monumental canvases of the 1860s and 1870s by such artists as Albert Bierstadt, Thomas Hill, and William Keith (Albert Bierstadt, *Yosemite Valley*, 1868, the Oakland Museum).

Painted on a grand scale deemed appropriate to capture the awesome western landscape, these paintings (Thomas Hill, *Great Canyon of the Sierra,Yosemite*, 1871, Crocker Art Museum, Sacramento) commanded princely sums from major art collectors of the period, many of whom were Californians who had realized fortunes in the construction of the transcontinental railroad or in silver mining ventures. *The Great Canyon of the Sierras* by Thomas Hill, which, like many of the great Yosemite landscape paintings, was created in the East after the artist's prolonged absence from California, was acquired by E. B. Crocker for either $5,000 or $10,000.

These compositions, which used new tools to address a new subject, symbolized the magnificence of the American West – and California as a Promised Land. (William Smith Jewett, *The Promised Land*, 1850, Berry-Hill Galleries.) In today's terminology – they were "cutting edge" and demonstrated innovative qualities that have traditionally used as criteria to judge artistic achievement. However, as the fortunes of Andrew Jackson Grayson and his family, depicted in William Smith Jewett's 1850 group portrait *The Promised Land*, faltered in the decades following this commission (Grayson, at the time a businessman, was to become the great illustrator of birds of the Pacific, a vocation that cost him his fortune; his son, dressed in ermine in the depiction to suggest the riches the younger generation would reap, was to be murdered in Mexico shortly after his release as a Civil War prisoner), so social and economic changes in California and beyond would fundamentally alter the visual interpretation of Yosemite in the 1880s and 1890s.

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1. Janice T. Driesbach, Curator of Art, Crocker Art Museum, Sacramento, California.

THESIS

The sea change in the approach to painting Yosemite and Northern California appears to have occurred several years prior to 1880 and was influenced by a number of factors, among them the construction of wagon roads into Yosemite Valley in 1874-75 (William Hahn, *Yosemite Valley from Glacier Point*, 1874, California Historical Society), allowing easier tourist access, and the protracted economic depression that occurred in California beginning in 1877. The impact of the latter is suggested by an editorial in the May 1880 issue of *The Californian*, where the author noted that loans on mortgages had fallen from $24 million to 9.5 million in two years" and continued that "rich men are fleeing to the East and to Europe . . . real estate is everywhere unsalable or will bring a fraction of its recent value. Building has almost ceased." In an effort to adjust to the devastating effects on the art market, artists turned toward painting smaller canvases, which often showed more intimate and less specific views (Julian Walbridge Rix, *Foggy Morning Near San Rafael*, 1881, Crocker Art Museum); decided to depart California; or, in the case of Rix – both.

However, if artists explored less dramatic scenery offered in Central California (Gideon Jacques Denny, *The "City of Lakeport" on Clear Lake*, 1876, Crocker Art Museum) and along its coast (Raymond Dabb Yelland, *Point Bonita from Point Lobos, San Francisco*, 1883, The Fine Arts Museums of San Francisco) – scenes that are frequently referred to in discussions of California painting after the mid-1870s – Yosemite nevertheless remained a popular subject (Jules Tavernier, *Yosemite, Sentinel Rock*, 1886, Private Collection). It was depicted by both younger and more established artists, by those who came as visitors and, by 1880, by painters making regular, extended stays in Yosemite (Charles Dormon Robinson, *Bridal Veil Falls*, n.d., Crocker Art Museum).

The fact that these were not the earliest paintings of Yosemite and often were created to serve a tourist market (on order, in many cases) should not interfere with the appreciation of the best of these works. And, although many pedestrian canvases were created at the same time, these compromise neither the quality of finer paintings, nor their ability to serve as visual documents of the period (Thomas Hill, *Mist in Tenaya Canyon*, n.d., Crocker Art Museum).

That Yosemite did not decline as a subject for painters is reflected in an account book Thomas Hill used between 1884 and 1887, which is in the Crocker Art Museum collection. The volume notes the sale of some 165 drawings and paintings, of which the overwhelming majority are comprised of Yosemite subjects. From the notes, it appears that generic "general views," "early mornings," and "Inspiration Points" were ordered in more or less standard sizes, primarily by residents of the East Coast, Midwest, and British Empire (only 10 percent of the sales are recorded to northern California patrons). These figures at once suggest the demography of the tourists who visited Hill's Yosemite studio and the areas where the myth of the American West had its strongest impact. That both Hill and C. D. Robinson had large numbers of clients in England, where Buffalo Bill's Wild West Show was to play to enthusiastic audiences suggests the power that this myth held for the British.

The spectacular canvases of the 1860s and 1870s are widely recognized as often having been composite views, developed in faraway studios from field sketches or photographs (Albert Bierstadt, *Looking Up Yosemite Village*, The Haggin Museum; Thomas Hill, *Great Canyon of the Sierras, Yosemite*, 1871, Crocker Art Museum) and are acknowledged for their role as symbols of transcendentalism and God's beneficence. The paintings that followed are often less formal, and therefore seemingly more realistic; however, they likewise project myths not dissimilar from those conveyed by their predecessors (Thomas Hill, *Figures in Yosemite Valley*, 1894, sold by Butterfield and Butterfield, October 1990). Among the characteristics – and these are generalizations – of California paintings of the 1880s and 1890s, including depictions of Yosemite, is indeed a preponderance of smaller scale works. And, with the exception of the mammoth ill-fated panorama attempted by Charles Dormon Robinson near the end of the century, few monumental works are recorded. Major geologic features of the valley, often shown in combination, remain prominent in Yosemite paintings – although High Sierra views are also shown (William Keith, *High Sierra Canyon*, 1890s, Hearst Art Gallery, Saint Mary's College). These describe areas that a writer, referring to Robinson's work in 1886, stated that "artists have hitherto failed to penetrate." Both kinds of views are shown under clear or lightly overcast skies – it never rains in paintings of Yosemite from the 1880s and 90s.

In addition, at a time when visitors to Yosemite and facilities to accommodate them were increasing rapidly, evidence of human presence in the area – haystacks, structures (other than tents), or cattle – are notably absent, even though they appear in photographs of the time (William Keith, *Yosemite Falls*, 1870s or early 1880s, Hearst Art Gallery, Saint Mary's College).

Although a figure or an animal may be present to establish scale, they are usually generalized and appear in isolation. This is again in contrast to contemporary photographs, which document specific individuals and often show parties of visitors. Tourists may have posed for photographers to prove *they* had been to Yosemite, but the paintings they acquired seemed designed to suggest that *no one else* had intruded on the landscape. The figures that are employed are often native Americans, perhaps seen by then as romantic types or in greater sympathy with nature than European man (Charles Dorman Robinson, *Panorama of Yosemite*, n.d., Crocker Art Museum).

For if paintings no longer attempted to convey the transcendental qualities of nature (William Keith, *Headwaters of the Tuolumne River*, the Oakland Museum), they nonetheless suggested that contact with nature enhanced man's well-being and avoided references to commercial intrusions on Yosemite scenery (C. D. Robinson's *Composite Picture Used on Barnard's Hotel Stationery*, Yosemite Museum, aside).

By the 1880s changes in style are evident in California painting and can be understood by comparing Yosemite landscapes of the period with earlier examples. Representations of the 1860s, such as Virgil Williams's *Along the Mariposa Trail*, tended to be highly detailed; and Hudson River school pictorial devices were commonly applied to the vastly differing landscape of the West in other paintings (Thomas Hill, *Sugar Loaf Peak, El dorado County*, 1865, Crocker Art Museum). Although broader foreground treatments of the 1870s allowed for more successful organization of magnificent views (Thomas Hill, *The Great Canyon of the Sierras*, 1871), in later years the treatment of forms became even more generalized (Thomas Hill, *Yosemite Valley*, c. 1900, the Anschutz Collection). This more schematic approach reflected the impact of Barbizon realism in this country, and may, in certain cases, also have represented a response to the demands of fulfilling outstanding commissions. A variety of personal stylistic elements also coexisted; for instance, Thomas Hill was noted for his predilection for a palette dominated by browns and yellows; C. D. Robinson preferred blues and grays; and William Keith was noted for his poetic interpretations (William Keith, *Glacial Meadow and Lake, High Sierra*, 1870s-early 1880s, Hearst Art Gallery, Saint Mary's College).

Whereas earlier compositions often isolated or prohibited the viewer access by such devices as foreground promontories (Thomas Hill, *Yosemite Valley*, 1876, the Oakland Museum) or, in the case of Bierstadt, intense sunlight effects (Albert Bierstadt, *Sunset in Yosemite Valley*, 1876, The Haggin Museum), by the 1880s, the spectator is more frequently invited to participate in the pictorial space (Thomas Hill, *Mist in Tenaya Canyon*, Crocker Art Museum).

CONCLUSION

If California landscape scenes of the 1880s and 1890s – and Yosemite views, in particular – have not been perceived as representing the artistic forefront of their time, as compared with the contemporary explorations of French Post-Impressionist and Symbolist painters or even American Impressionist artists, they nonetheless document continued artistic vitality in California and the presence of an audience interested in California painting throughout the end of the 19th century. That these works do not fit the paradigm that equates innovation with quality lessens neither the quality of the works themselves nor their ability to serve as historical and cultural statements.

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Grizzly Bear (top), Polar Bear (Center), Black Bear (bottom)
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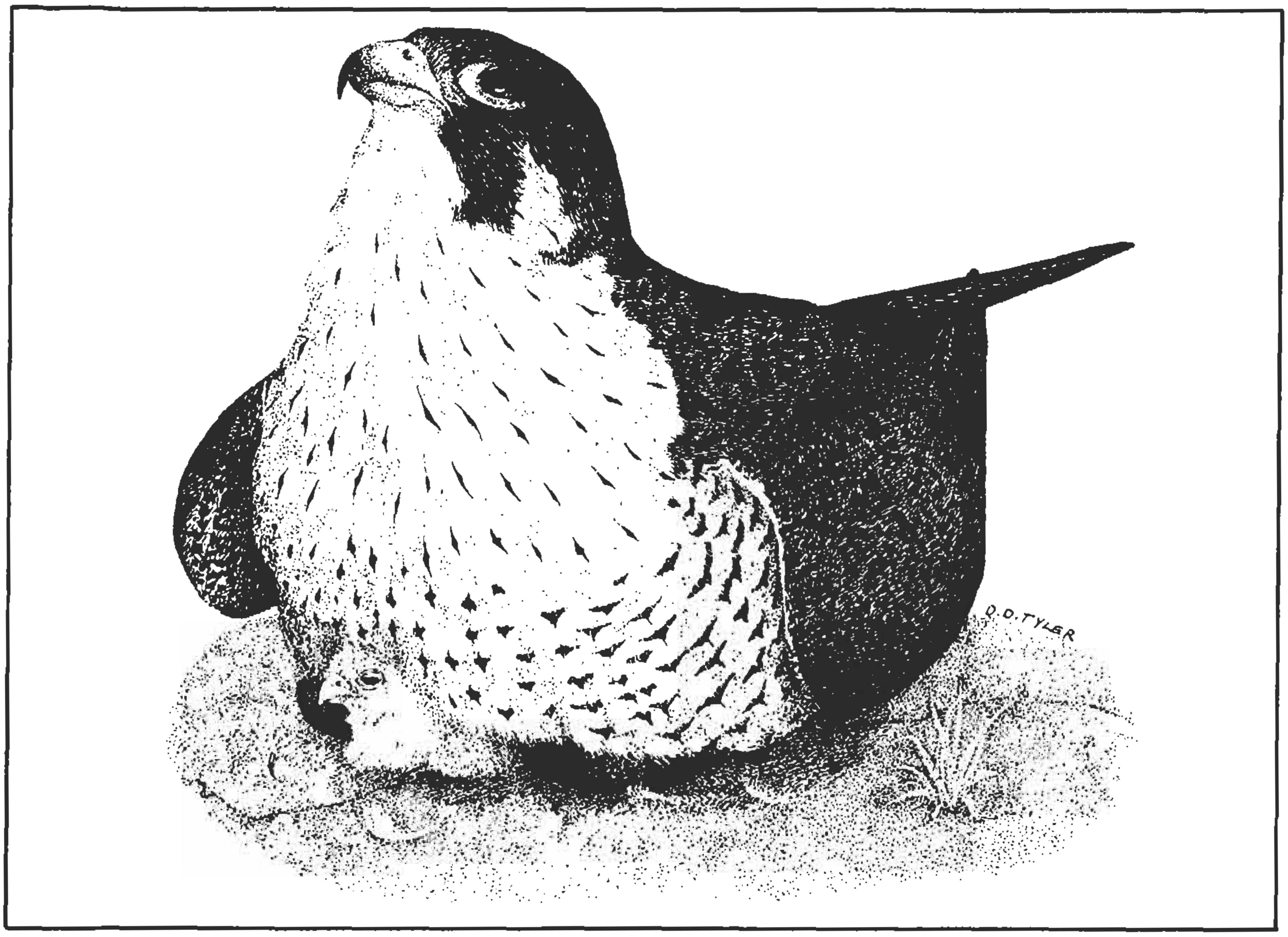

Peregrine Falcon, *Falco Peregrinus*, and Chick
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