

YELLOWSTONE CENTER FOR RESOURCES



ANNUAL REPORT
2001

YELLOWSTONE
CENTER FOR RESOURCES
2001 ANNUAL REPORT



*Hand-painted Limoges bowl,
Lower Falls of the Yellowstone, ca. 1910.
Part of the Davis Collection acquired in 2001.*

Yellowstone Center for Resources
National Park Service
Yellowstone National Park, Wyoming

YCR-AR-2001
2002

In memory of
Donay Hanson
1960–2001



Suggested Citation: Yellowstone Center for Resources. 2002. Yellowstone Center for Resources Annual Report, 2001. National Park Service, Mammoth Hot Springs, Wyoming, YCR–AR–2001.

Photographs not otherwise marked are courtesy of the National Park Service.

Front cover: clockwise from top right, Beatrice Miles of the Nez Perce Tribe; Yellowstone cutthroat trout; Golden Gate Bridge by W. Ingersoll, circa 1880s, from the Susan and Jack Davis Collection; low northern sedge (Carex concinna) by Jennifer Whipple; and center, Canada lynx. Back cover: mountain chickadee.

Contents

Introduction	<i>iv</i>
Part I. Resource Highlights	1
Part II. Cultural Resource Programs	7
Archeology	8
Ethnography	11
History	15
Museum Collections	20
Research Library and Archives	24
Part III. Natural Resource Programs	27
Air, Land, and Water	27
Aquatic Resources	29
Geology and Geothermal Resources	36
Vegetation	41
Wildlife Resources	43
Bears	44
Birds	48
Bison	50
Elk and Other Ungulates	55
Lynx	56
Wildlife Management and Monitoring	57
Wolves	58
Part IV. Yellowstone Center for Resources and Parkwide Support	61
Spatial Analysis Center	61
Resource Information	63
Research Support	66
Funding and Personnel	66
Appendix I. Personnel Roster for 2001	69
Appendix II. Publications, Reports, and Papers	73
Appendix III. Partnerships	75

Introduction

At the Yellowstone Center for Resources (YCR), it is time to celebrate our successes and evaluate our setbacks as we look back on the calendar year 2001. We hope that these annual reports continue to provide a useful record of natural and cultural resource management and science activities that occurred within the park. For some projects, additional information may be available in technical publications or special reports (*see Appendix II*).

This year, a new appendix highlights partnerships in which YCR staff were involved with other federal and state agencies, academia, and public organizations. Yellowstone National Park, the University of Utah, and the U.S. Geological Survey entered into an agreement to establish the Yellowstone Volcano Observatory to strengthen the long-term monitoring of volcanic and earthquake unrest in the region. Yellowstone also became a host site for the Greater Yellowstone Network biological inventory program, involving the staffs of Yellowstone and Grand Teton National Parks and Bighorn Canyon National Recreation Area. As Yellowstone's popularity as a place to do research increased in 2001, investigators from 47 states and 6 foreign countries were involved in 259 research projects, 40 of which were new.

Former Yellowstone district interpreter Roger Anderson came on board in July as chief of the Resource Information and Publications group. He got right to work coordinating the YCR's sixth biennial scientific conference on the Greater Yellowstone Ecosystem, "Yellowstone Lake: Hotbed of Chaos or Reservoir of Resilience?" The conference was noteworthy for its interdisciplinary nature, addressing management issues, natural features, and human history associated with Yellowstone Lake. Proceedings will be published in late 2002.

The Branch of Cultural Resources celebrated several important acquisitions in 2001, the Susan and Jack Davis Collection of Yellowstone memorabilia, and eight White Motor Company motor coaches used by the Yellowstone Park Company in the 1930s. The Branch of Natural Resources began a three-year survey to collect baseline information on the status of the threatened lynx in Yellowstone. The process of developing a field operations plan for bison management in and near the park was begun. With the hiring of a new aquatic resources team leader and a fisheries biologist, the aquatic resources program became fully staffed for the first time since the National Park Service assumed control of the program following the 1996 closure of the U.S. Fish and Wildlife Service office in the park.

Since the creation of the YCR in 1993, staff have been striving to learn more about the resources we are mandated to manage and protect, provide outreach, contribute to literature, and promote interpretation. We hope this report continues to help us attain these goals. For more information about specific topics of interest, readers may contact us at (307) 344-2203 or investigate the park's web site at www.nps.gov/yell.



John D. Varley
Director, Yellowstone Center for Resources



The Canada lynx, listed as a threatened species in 2000, is the subject of a new study in Yellowstone.

Part I. Resource Highlights

LYNX STUDY BEGINS

Historically reduced by persecution and habitat destruction, the Canada lynx (*Lynx canadensis*) in the conterminous U.S. was listed as a threatened species by the U.S. Fish and Wildlife Service during 2000. Despite evidence that lynx were still found in the park, no rigorous effort had been made to document their presence. In 2001, Wildlife Resources Team staff began a three-year survey to collect the baseline information needed to assess the status of the lynx in Yellowstone National Park (YNP). A GIS-based topographical analysis was used to identify prime lynx habitats. Intensive surveys will be conducted in these prime habitats through 2004 using ground- and aircraft-based snow tracking during the winter, and hair snares to obtain DNA samples in the summer.

From January to April 2001, 28 ground-based snow tracking surveys were completed on transects distributed widely throughout the park, ranging from 0.6 to 129 miles in length and totaling 286 miles. One probable and one possible lynx track were detected during snow tracking surveys. Tracks of red squirrels, weasels, and marten were abundant. Tracks of snowshoe hares were less abundant in habitats dominated by lodgepole pine compared to sites that principally supported Engelmann spruce and subalpine fir. Staff also identified tracks of wolves, red fox, coyote, grizzly bear, black bear, and river otter. The habitat model appeared to successfully predict the location and extent of lynx habitat in YNP.

Staff completed four air-based snow tracking surveys in northwest, southeast, and east central YNP on transects that totaled 488.4 miles in length. The aerial surveys enabled staff to effectively search large areas for lynx tracks. No lynx tracks were detected using this method, but staff saw individuals and tracks of grizzly bears, coyotes, and bobcats.

For the summer sampling, staff set up 160 hair-snare stations on 32 transects on the east side of the park, sampling a 200-square-mile area (14 × 14 miles). From July to October 2001, staff collected a total of 154

hair samples: 38 from the hair snares, 90 from the ground near the snares, and 26 from nearby trees. The sample sets (one per storage vial) each contained from 1 to more than 50 hairs and were sent to the Carnivore Conservation Genetics Laboratory (Dr. Scott Mills), University of Montana, Missoula. Results of species- and individual-level identification of hair are expected in April 2002.

THE DAVIS COLLECTION

In 2001, years of effort by park museum curator Susan Kraft and the Yellowstone Park Foundation came to fruition in the acquisition of the Susan and Jack Davis Collection to add to the park's museum. Kraft describes the Davis Collection as the foremost of its kind in the nation, encompassing images, artifacts, and documents dating from the earliest years of Yellowstone's history, continuing through the golden age of Yellowstone collectibles and into the modern era. The collection numbers some 20,000 items, including a 1905 Limoges china pitcher bearing pictures of Yellowstone scenery; hard-to-find Shaw and Powell blankets and dishes from the stagecoach days; pre-1917 ephemera and documents from the Wylie Camping Company; two rare 1890s pamphlet-guides written by the Wittich Brothers of Livingston, Montana; stereoviews, prints, lithographs, posters, historic postcards, maps, books of all kinds; and ephemera such as tickets, labels, stickers,

and menus, all representing various periods in Yellowstone's history.

Susan Davis began collecting Yellowstone memorabilia in 1967. After her marriage to Jack, they continued to acquire treasures for more than 30 years. As they approached retirement, they wanted to divest themselves of the collection (which occupied most of their house!), but they preferred to see it go the park. The collection had already been partly catalogued, and had been well cared-for by its devoted collectors.

The Yellowstone Park Foundation, particularly board members Ron and Jane Lerner, had worked with the Davises to produce a color catalog and to help Susan Kraft prepare grant proposals for the estimated \$500,000 needed to purchase the collection. In 2001, the Lerner spearheaded a major burst of fundraising, which culminated in reaching the needed goal, and the transfer of the collection to the park occurred in September.

Acting Superintendent Frank Walker, Susan and Jack Davis, Yellowstone Park Foundation staff and board members, and other Yellowstone staff celebrated the acquisition at the historic Gallatin Gateway Inn on November 8, 2001. At the ceremony, the Davises also donated two Thomas Hine stereoviews of the park. Hine was a pioneer photographer based in Chicago, who traveled to Yellowstone in 1871 with Captain Barlow and the Hayden survey. Hine produced some 200 glass plates that summer,



Susan and Jack Davis in front of part of the Davis Collection. In 2001, the park acquired the majority of the Davis Collection through the hard work of Yellowstone museum curator Susan Kraft, the help of the Yellowstone Park Foundation, and the generosity of the Davises, who donated thousands of items. Photo by Thomas Lee of the Bozeman Chronicle.

but upon his return home, nearly all of his negatives were destroyed in the great Chicago fire. Historians think Hine had time to produce 16 Yellowstone stereoviews, but the whereabouts of the images were unknown for 120 years. In 2000, the Davises discovered that their collection contained two Hine stereoviews—some of the earliest photographs ever taken of what is now Yellowstone National Park.

The autumn 2001 issue of *Yellowstone Science* featured this important acquisition and an interview with the antique buffs. Items from the collection were featured in a 1995 exhibit at the Museum of the Rockies and again this summer at an exhibit at the new Museum of the Yellowstone in West Yellowstone, Montana. In the future, the park hopes to rotate items from the Davis Collection to display in the proposed Heritage Center or other visitor centers and museums across the ecosystem.

YELLOWSTONE VOLCANO OBSERVATORY ESTABLISHED

To strengthen the long-term monitoring of volcanic and earthquake unrest in the Yellowstone region, the U.S. Geological Survey (USGS), University of Utah, and Yellowstone National Park entered into an agreement in 2001 to establish the Yellowstone Volcano Observatory (YVO). This new partnership provides for improved collaborative study and monitoring of active geologic processes and hazards of the Yellowstone volcanic field and its caldera, site of the largest and most diverse collection of natural thermal features in the world. It will also allow for better interpretation of geologic events because park staff can access real-time data online.

The new observatory will improve the park's efforts to monitor the Yellowstone area's volcanic system. The agreement represents the evolution of collective work over the years to track and study Yellowstone's unrest.

The new observatory is modeled after the other USGS volcano observatories in Alaska, California, the Pacific Northwest, and Hawaii. Together, the five observatories monitor 43 of the 70 or so potentially hazardous volcanoes in the United States. The observatories are operated under the auspices of the U.S. Geological Survey's Volcano Hazards Program.

YVO operations will be based from existing facilities at the University of Utah and Yellowstone National Park. Ground-based instruments and satellite data are used for real-time monitoring of

active and restless volcanoes, including a modern digital seismic and GPS network operated for many years by the University of Utah Seismograph Stations under a cooperative funding agreement with the USGS and with additional support from the NPS. Campaign-style leveling stations and GPS techniques are also used to monitor deformation, and a newer, continuously recording GPS network has been established and carried out by scientists of both the University of Utah and the USGS.

For more information, visit the YVO web site at <http://volcanoes.usgs.gov/yvo/>.

“YELLOW BUSES” RETURN TO YELLOWSTONE

In the autumn of 2001, eight original White Motor Company model 706 motor coaches returned home to Yellowstone. The 14-passenger buses were part of a fleet used by the Yellowstone Park Company (YPC) to transport visitors around the park between 1936 and 1939. While Yellowstone's buses were yellow, similar model coaches were used in other western parks—Glacier has its famous “red jammers,” Rocky Mountain's were blue, and Mount Rainier's were green. Yellowstone's museum collection already includes two coaches, and AmFac Parks and Resorts has one used at the Lake Hotel for daily interpretive tours and special events.

Bruce Austin, a philanthropist from California and a member of the Motor Bus Society, and Robert Goss, of Gardiner, Montana, had researched the YPC records and found that 98 buses were listed on Yellowstone's insurance records until 1954, when they began to be sold off to private individuals. The Skagway Streetcar Company in Alaska had purchased eight of the buses, where they were still in use for public tours. The “Skagway Ladies” had undergone very little alteration—the original YNP license plates were on the vehicles—and they were in good operating condition. Austin found out that their owners had decided to sell them and encouraged the park to purchase and use these historic vehicles. However, no obvious government or private funding source was available.

In July, Austin arranged to take Acting Superintendent Frank Walker for a ride around West Yellowstone, Montana, in a Yellowstone-era White bus. Mr. Walker, persuaded that the buses would be popular with today's park visitors, decided to use donated funds to purchase the eight buses from Skagway. At



One of the "Skagway Ladies." Photo by Paul Schullery.

his request, the park's Business Management Office and concessioner sent mechanics to inspect the fleet and, finding them in good condition, arranged for their transfer to the park. The first two antique, canvas-roofed buses, "Mason City" and "Yellowstone," were delivered on October 8, 2001, and the rest shortly thereafter. They were covered with white protective fabric for the winter and soon will be on the road somewhere in Yellowstone, offering visitors a quality experience with the historic flavor of the park's past.

BISON FIELD OPERATIONS PLAN AND BRUCELLOSIS VACCINE DEVELOPMENT

Wild, free-ranging bison continue to thrive in the Yellowstone area, summering throughout the park and in some adjacent, high-elevation ranges, and migrating to winter range in geothermal areas and lower elevation grasslands both in and outside of the park. Controversy has grown for the last three decades over the management of bison leaving the park in winter. Bison moving from the park onto public or private land in Montana have been shipped to slaughter or shot because some of them may carry brucellosis. In December 2000, an interagency effort that lasted more than 10 years resulted in the signing of the *Record of Decision for Final Environmental Impact Statement and Bison Management Plan for the State of Montana and Yellowstone National Park*.

The Interagency Bison Management Plan (IBMP) employs an adaptive management approach, allowing the agencies to gain experience and knowledge before proceeding to the next management step,

particularly with regard to managing bison on winter range outside Yellowstone National Park. The IBMP employs nine areas of focus:

- a late winter/early spring population limit of 3,000 bison,
- bison vaccination,
- spatial and temporal separation of bison and cattle at the west management zone,
- spatial and temporal separation of bison and cattle at the north management zone,
- a contingency plan for handling a large migration of bison out of the park,
- vaccination of cattle in the area surrounding the park,
- protection from threats to Montana's brucellosis class-free status, and
- monitoring and testing of bison.

Development of field operating procedures. All of the agencies involved in the implementation of the Interagency Bison Management Plan gathered in January 2001 to begin the process of developing a field operations plan. A draft operating procedure document was agreed to in principle by all in attendance at a July meeting. The Montana Department of Livestock proposed a few edits in November. The document remains unfinished. Yellowstone's superintendent initiated a request for a solicitor's opinion to clarify the extent of the authority for NPS employees to take actions outside the boundaries of the park in the course of implementing the IBMP.

While the details of field operating procedures were being discussed and debated, field operations began. In June 2001 the winter bison management period ended with the hazing of the last animals back into the park. Hazing operations throughout the winter were successful in keeping bison from spending extended periods outside the park. Of 14 animals captured in the West Yellowstone, Montana, area during the winter, five tested positive for brucellosis and were transported to slaughter. An additional mortality resulted from implementation of the IBMP when one bull was killed in the West Yellowstone area on June 26 because personnel were unable to haze the animal away from private property and back into the park.

The operations were initiated again in October 2001 for the period that extends until June 2002. By the end of December the agencies had conducted numerous hazing operations. One bull was shot and killed on November 28, when repeated attempts to

haze the animal back into the park had failed. Four of six bison captured during December tested positive for brucellosis and were transported to slaughter. The remaining two animals were released in the vicinity of the trap facility.

The agencies have learned much from the first year of operations and should be able to complete the procedure agreement in 2002.

Development of a brucellosis vaccine. United States scientists continue to seek an improved brucellosis vaccine. A great deal of research was done in the former USSR on brucellosis during the Cold War, when *Brucella abortus* was identified as an important pathogen with potential use as a biological weapon. At the time, Soviet scientists were provided extensive resources to study the disease, as well as vaccines to prevent it.

In 2001, through an innovative partnership sponsored through the U.S. Defense Threat Reduction Agency (DTRA); the World Foundation for Environment and Development (WFED); and the Nuclear Threat Initiative, Yellowstone resource management staff participated in the development and implementation of new Russian research in brucellosis vaccine development. The progress made will supplement U.S. research geared toward use on Yellowstone's bison. These innovative investigations will be conducted primarily by three Russian research institutes: the Research Center of Toxicology and Hygienic Regulation of Biopreparations, the State Research Center for Applied Microbiology, and the All-Russian Research Veterinarian Institute. The Priosko-Tersny State Nature Preserve, the Russian home of the European bison (*Bison bonasus*), will be a collaborator in the development of vaccine delivery systems.

With support from the private sector and DTRA, NPS staff from Yellowstone and the USGS Biological Resource Management Division traveled to Russia to discuss the status of Russian brucellosis vaccine development and communicate the park's brucellosis risk management needs. These meetings will form a basis for developing collaborative scientific investigations of brucellosis. In September 2001, a Russian scientific delegation traveled to the U.S. to meet with cooperating experts from WFED, academia, and the U.S. Departments of Defense, Interior, Agriculture, and Energy, and visit Yellowstone to view America's wild bison in the field.

YELLOWSTONE LISTS PROPERTY ON THE NATIONAL REGISTER OF HISTORIC PLACES

Another proud accomplishment was the listing of the Queen's Laundry Bath House on the National Register of Historic Places, the first new Yellowstone listing to occur in 10 years. Historic architect Lon Johnson, who transferred to a similar position in Glacier National Park in October, prepared the nomination for the structure, located in the backcountry of the Firehole River valley. Park Superintendent Philetus Norris had this log structure built in 1881, and in his annual report he described the bath house as "a double-roomed, earth-roofed bath house, with wooden troughs for conveying the water to the building, for the free use of the public." The bath house was the first building constructed by the federal government for public use in a national park, and remains the oldest standing, federally-constructed building built in Yellowstone (or any national park) for public purposes. It is the only building that represents Yellowstone's early civilian administration from 1872 to 1886, and is the only structure that remains from the administration of Superintendent Norris. The building was apparently never finished, and former park historian Aubrey Haines, in his writings, described a proposal to remove the building in 1964—an idea which he himself undertook (successfully) to prevent. The bath house remains visible in its original location in Sentinel Meadows, where runoff encroaches from nearby thermal features.



Queen's Laundry bath house, 2001. Photo by Richard Collier.

LAKE TROUT REMOVAL

Since the 1994 confirmation of the presence of lake trout (*Salvelinus namaycush*) in Yellowstone Lake, the park's fisheries biologists have been seeking ways to minimize its threat to the native Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Bioenergetics modeling (estimates of how many cutthroat trout a lake trout may consume) suggests that a mature lake trout can eat between 50 to 90 cutthroat trout per year. Thus, the lake trout control project has saved a large number of cutthroat trout from predation by lake trout.

Since 1995, more than 43,000 lake trout have been removed from Yellowstone Lake via gill-netting. In 2000, refinements in netting techniques, combined with additional seasonal personnel dedicated to the netting program, enabled us to double the 1999 gillnetting effort and remove almost 13,000 lake trout from Yellowstone Lake. During 2001, the arrival in mid-June of a new boat designed specifically for gillnetting on Yellowstone Lake greatly improved working conditions for employees (running water, heat, adequate working space, and safety features) and the efficiency of gillnetting operations.

More than 15,000 lake trout were removed from Yellowstone Lake in 2001. The catch per unit effort was less than half that of 2000, indicating that the netting effort may be controlling the growth of the lake trout population. In August, personnel from the Idaho Department of Fish and Game donated time and equipment to repeat hydroacoustic surveys that had been done in 1997 and 1998. Density estimates in the West Thumb area of the lake, where the

highest densities of lake trout have been found, were 10 percent less than in previous years. The mean total length of lake trout caught near Carrington Island, in Solution Creek, and in Breeze Channel during spawning all decreased from previous years.

YCR ARCHIVIST AWARDED HONORARY DOCTORATE

Lee Whittlesey, a long-time park employee who has served as a seasonal patrol ranger, technical writer, museum technician, and has been the park's archivist since 1997, was awarded an honorary Doctor of Science and Humane Letters by Idaho State University, where he was also a keynote speaker at the spring commencement ceremony. Whittlesey received this honor for his writings in natural and historical research related to Yellowstone. His publications include several articles in *Montana The Magazine of Western History*; *Yellowstone Place Names* (Montana Historical Society, 1998); *Lost in the Yellowstone: Truman Everts's Thirty-Seven Days of Peril* (Univ. of Utah Press, 1995); *Death in Yellowstone: Accidents and Foolhardiness in the First National Park* (Roberts Rinehart, 1995); and a paper and a forthcoming book by the University of Nebraska Press on *Yellowstone's Creation Myth*, co-authored with Paul Schullery. Another book on *Yellowstone's Horse-and-Buggy Tour Guides: Interpreting the Grand Old Park, 1872–1920*, has been tentatively accepted for publication by the University of Oklahoma Press.



The new gillnetting boat, "Freedom."



Retired Yellowstone biologist and current archeology volunteer Dr. Mary Meagher stands at the Stradley site.

Part II. Cultural Resource Programs

The Branch of Cultural Resources experienced a year marked by several major accomplishments as well as significant setbacks caused by the absence of two program specialists. The skills of museum curator Susan Kraft were widely recognized as she left Yellowstone for a two-month detail to the National Park Service's System Support Office and Museum Services Center in Boston. Sadly, shortly after her return to the park in mid-summer, she was diagnosed with a life-threatening illness that kept her away from her professional duties for the remainder of 2001. During this period, the results of one of Susan's major initiatives came to fruition after years of effort—acquisition of the Susan and Jack Davis Collection for the park's museum. Another proud accomplishment was the listing of the Queen's Laundry Bath House on the National Register of Historic Places, the first new Yellowstone listing to occur in the past 10 years. For this, the park thanks historical architect Lon Johnson, who transferred to a similar position in Glacier National Park in October. The expertise of these and other branch employees resulted in an increasingly strong awareness of cultural resources in Yellowstone.

Working with staff from the Maintenance Division, cultural resources personnel continued to plan for the construction of a \$6.1-million dollar Heritage and Research Center to house the park archives, library, and most of the museum objects. In July, Yellowstone received approval from the NPS Development Advisory Board to proceed with the project using NPS line-item construction funds to be allocated in FY2002.

The branch was authorized to spend approximately \$342,200 in FY2001. Additional funds to support specific projects included \$235,000 from the Federal Lands Highway Program, \$6,500 from Hill Air Force Base to pay Yellowstone's cultural anthropologist to work on an ethnographic assessment, an additional \$124,000 obtained from special emphasis project funding sources, and \$114,000 from the park's Recreation Fee Demonstration program. The Yellowstone Association provided about \$32,800 in support of cultural resource programs, particularly in the operations of and new acquisitions for the museum, library, and archives. The Yellowstone Foundation facilitated more than \$500,000 worth of donations to acquire the Davis

Collection and other smaller but vital pieces to add to the park's collections.

ARCHEOLOGY

In 2001, park archeologist Dr. Ann Johnson, cooperators, temporary staff, and volunteers conducted inventories of 1,200 acres and 40 new sites. Volunteer John Reynolds entered catalog data on 1,800 archeological specimens or lots.

New Acquisitions

In July 2000, a large artifact collection made by a park ranger in the 1930s–1950s was returned to the park, and the accompanying descriptions will make it possible to identify many of the items to sites. Perhaps the most interesting is the southwestern pottery found in a drainage ditch in the Lake area. It could be part of the rim of a bowl identified in 2001 by NPS curator Barbara Stanislawski as a 1930s ceramic vessel made by the Hopis for the tourist trade using a design borrowed from prehistoric pottery. Such a bowl may have been sold by a concessioner in the park during the 1930s along with other Southwestern Indian artifacts.

An Exciting Discovery

For park archeologist Ann Johnson, the most interesting find of the year was the recognition of a pattern of human-caused pits in talus slopes. While conducting an aerial count of bighorn sheep in the park 30 years ago, wildlife biologist Doug Houston was looking down on a talus slope north of Tower Junction. There had been a little snow, and it perfectly outlined a round pit in the rocks. Houston told Mary Meagher, now a retired bison biologist and archeology volunteer, who told Johnson about it in 1999. In September 2001, Johnson and Meagher rode into this area on horseback and verified that the pit had a cultural origin.

The Stradley site (named for the pilot who flew Drs. Houston and Meagher on wildlife surveys) consists of one exceptionally preserved round pit about three feet high and six feet across. There are at least two other pits that are less obvious. As the investigators did not do a complete inventory, there may be other pits in the area. They identified no diagnostic artifacts, but observed a number of red quartzite cores and flakes, suggesting that flint-knapping may have occurred while the people waited for the sheep.

The park archeologist realized that the talus slope pits at the Stradley site and at locations northwest of Gardiner, Montana, and east of Lava Creek in the park, represent a pattern. Each site is in an area where bighorn sheep are known to cross, with a grassy, level, or nearly level area above a rocky talus outcrop, and a nearly vertical cliff leading to a rocky area with one or more pits. One of the pits northwest of Gardiner has some wooden poles, suggesting that at least some of the users may have built cover as an ambush site to hunt the sheep. Armed with this information, archeologists will be looking at similar locations in the future.

Field Inventories

Fieldwork was again accomplished by crews of professional and student archeologists, particularly those from the Museum of the Rockies (MOR) in Bozeman, Montana, and the Office of the Wyoming State Archaeologist (OWSA). Work was done to record and test sites to determine their eligibility for listing on the National Register of Historic Places.

Osprey Beach. Under the guidance of Dr. Donald Blakeslee, volunteers from Wichita State University were in the park again for a week. They returned to the Osprey Beach site on Yellowstone Lake, carried out a surface collection, and excavated several test units whose primary purpose was to determine if intact cultural deposits were located back from the eroding bank. Osprey Beach is the oldest archeological site that has been recorded in the park. The test units verified that the Cody component extends back some distance (at least 20 meters in this one location) from the bank. Several more Cody Complex artifacts were recovered.

Evidence of at least two components, Cody Complex and Pelican Lake, has been found on the S-4 shoreline or lake beach that was extant 9,350 years ago. Of particular interest is an obsidian Plainview point found by Wichita State during the terrace inventory in 2001. This identification suggests that a prehistoric group approximately 500 years older than the Cody Complex used the same location. Plainview artifacts at Medicine Lodge Creek on the west side of the Bighorn Mountains in northeastern Wyoming have been dated at 9,700 before present (BP). It is possible that an older, low landform located back from the lakeshore has not been recognized.

The site continues to erode (and is probably being illegally collected), and bank stabilization is

not possible. In response to a proposal made by the park archeologist, the Yellowstone Park Foundation agreed to seek funds for data recovery efforts.

Marshall Hotel. One of the park's early tourist hotels, the Marshall Hotel, was located on Fountain Flats in the northern portion of the Firehole River valley. When it was torn down in 1891, materials were disposed of by throwing them in the Firehole River. The underwater portion of the Marshall Hotel was documented this year through a Challenge Cost Share project by park staff working with Dr. William Hunt, Jr., of the NPS Midwest Archeological Center, Dr. Annalies Corbin of the P.A.S.T. Foundation, and 15 high school students and their teachers from Lincoln, Nebraska. The objectives of the project were to identify the range of archeological resources at the site and document their physical locations; identify site elements affected by past and present human activities and natural actions; recommend protection and interpretation alternatives; and provide an educational opportunity for a group of high school students and their teachers. The group established a grid and documented artifacts in the river, provided on-site interpretation for visitors, and recommended treatment and curation of artifacts retrieved from a thermal environment. A Master's thesis will result from the fieldwork and analysis.

Lake Hotel dump. During backhoe excavations to install a grease trap behind the Lake Hotel in November 2000, workers uncovered an historic dump. The dump has been assigned as an archeological component of the hotel, which was built in 1891. At the time of discovery, the ground was frozen to a depth greater than one foot. In the obsidian-sandy



Archeologists and students investigating the underwater portion of the Marshall Hotel site (48YE773). Photo courtesy William J. Hunt, Jr.

soil below that were found china plates, cups, and serving platters to the west half of the excavation, and bottles to the east. Some glass objects had been deformed from exposure to fire. The entire feature appears to have been removed either by previous excavations or by this most recent one. The odor and the confined distribution of the artifacts suggested that they had been dumped into a cesspool. Miscellaneous metal objects were also found, including a crank for a Model T Ford and a Lake Hotel key fob that is close but not identical to one already in the park's museum collection.

Seasonal employee Megan McCullen cataloged the artifacts and prepared a draft report that briefly summarizes the discovery and collection procedures and categorizes the artifacts. Based on time-sensitive artifacts, the dump is estimated to date to around 1916 or a few years later.

In March 2001, during excavation closer to the Lake Hotel, a concentration of bricks, lath, and plaster were found just beyond the location of the previous discovery. This material was interpreted to have come from a remodeling of the Lake Hotel many years ago, unrelated to the historic dump. The plaster was very well preserved and remnants of paint were visible.

Backcountry investigations. This was a field season in which the Museum of the Rockies (MOR) crew cleaned up loose ends, inventorying roughly between the park road from Blacktail Ponds and Mammoth and the south/southwestern toe of Mt. Everts. Due to steep slopes and erosion, few archeological sites were identified west of Undine Falls.

The MOR crew completed National Register testing for sites on both sides of the Yellowstone River at the Bannock Trail ford at Tower Fall. The data does not meet archeological standards for a traditional ford, which should have evidence of many groups camping and staging, usually on both sides of the river as people were getting ready to cross or drying out afterwards. The terraces on both sides of the river at this location would be suitable for this purpose, but they contain limited evidence of prehistoric use. There was no evidence of use during early historic or late Late Prehistoric times.

There are physical reasons why this site may not have been favored for fording the river. The Yellowstone River roars through a steep, relatively narrow canyon that would be difficult to ford until high water was over. Also, the path on the eastern bank is steep, sandy, and very difficult to navigate.

Aubrey Haines documented use of the Bannock Trail near Tower by various explorers in *The Yellowstone Story*, and Wayne Replegle, writing in the early 1950s for his book on *Yellowstone's Bannock Indian Trails*, reported that he could see evidence of the trail in this area. Archeologists regard both of these sources as reliable. The absence of any present trace of the trail may suggest limited use and that this area was not a traditional ford. The evidence seen by Replegle may represent use of this route during a later period as American Indians tried to avoid identification by the U.S. Cavalry or other Euro-Americans. Testing of the archeological sites did not find evidence of historic or protohistoric use.

MOR also tested three sites on Hellroaring Creek, including one at the ford of that stream where archeological materials are plentiful on both sides and indicate long use, both temporally and intensively, of this locality. All traffic in this area is channeled to this ford, as this is the best place to cross when the creek earns its name during spring and summer. The sites up the creek from the ford, which are smaller and have fewer archeological components, probably represent groups traveling along Hellroaring Creek with shorter stays due to more limited resources. Testing has enabled archeologists to put the two sites at the ford into perspective and gauge their relative importance.

Roadside investigations. Pedestrian inventories were conducted to identify historic and prehistoric archeological sites located within areas that may be affected by the Wyoming Abandoned Mine Lands reclamation projects at the Lone Star Geyser, Sedge Creek, and Natural Bridge/Bridge Bay gravel pits.

The Office of the Wyoming State Archaeologist (OWSA) carried out several projects in support of the Federal Highway Administration's reconstruction programs in the park. The OWSA crew inventoried one mile of the South Entrance road, beginning at the south gate, but did not locate any significant archeological resources. They investigated a portion of the power line corridor from Mammoth Hot Springs north to Swan Lake Flats as part of a multi-year effort to inventory power line corridors throughout the park. OWSA also investigated a prehistoric site bisected by the West Entrance road to determine National Register (NR) eligibility. Inventory of prehistoric and historic archeological sites on the old alignment of the East Entrance road indicated that several old road camps along this abandoned road segment may retain a sufficient degree of integrity to

warrant documentation in anticipation of wetland mitigation. The crew took photographs and recorded UTM locations for three road camp locations and a historic dump, and will return to complete site documentation and National Register testing in summer 2002.

Cultural resource technician Elaine Hale and the archeologist worked with fire management staff to assess potential effects of hazard fuels removal and other fire-related activities on historic and prehistoric archeological resources in frontcountry and backcountry cabin locations. Park staff also monitored road reconstruction activity in several areas.

Calcite Springs.—In anticipation of the widening of the Canyon-to-Tower road near the Calcite Springs Overlook, OWSA crews completed data recovery at the Tower Falls Soldier Station site in September 2001. Based on a plan developed by Paul Sanders, project director, the researchers focused their efforts on the excavation of a small depression in the borrow ditch and a possible foundation at the former officers' quarters. Although the small depression was initially regarded as a possible trash pit, excavation revealed only a tin can and a few pieces of broken glass. The investigators concluded that the depression is the remains of a small tree well into which the trash fell.

Few artifacts were found in excavations of the officers' quarters, which were located much farther away from the current road alignment. The investigators determined that the site would not be affected by the proposed road construction and that it was eligible for nomination to the National Register.

Canyon area.—OWSA staff also conducted National Register testing of eight prehistoric sites along the Canyon-to-Lake Junction road, and researched and documented the remains of the Canyon incinerator and the bus complex. Road construction presents an ongoing challenge as the park needs to provide some housing for contractors' road crews, so YNP and FHWA began exploring the possibility of adding trailer sites or other housing units to the east and west ends of the existing Canyon contractor camp. The Wyoming State Historic Preservation Office and the Advisory Council on Historic Preservation concurred with YNP's assessment that no historic properties would be adversely affected.

The OWSA archeologists conducted archival research and archeological testing and took Historic American Engineering Record large-format photographs for the historic Otter Creek bear-feeding

station. This site, which has long been used for minor administrative purposes, has been proposed for reclamation to offset habitat loss caused by newer construction activities in the park.

Major reports. *Fountain Soldier Station (48YE727): Report of Research and Mitigation* documents the archival research and data recovery carried out by Kenneth Karsmizki, Carolyn Karsmizki, and Viktoria Magnis at this historic site in the Firehole Valley as part of the parkwide road improvement project. Copies are available from the Yellowstone Research Library.

Eligibility for the National Register. Archeological sites associated with the Federal Highways improvement program are evaluated for their eligibility to be included on the National Register of Historic Places. Those evaluated in 2001 include:

- **17 prehistoric sites, of which:**
 - 7 were determined eligible,
 - 7 were determined ineligible, and
 - 3 remain unevaluated.
- **8 historic sites, of which:**
 - 1 was determined eligible, and
 - 7 were determined ineligible.
- **3 multi-component sites, of which:**
 - 2 had prehistoric components eligible and historic components non-contributing, and
 - 1 had prehistoric components eligible, and historic components unevaluated.

ETHNOGRAPHY

Activities conducted within the park have the potential to affect places and resources of significance to the 26 American Indian tribes that are affiliated with Yellowstone. Their traditional subsistence and ceremonial practices involved the use of what are now considered resources of the park. Park policy recognizes that Indians' continuing access or use of these resources is often essential to the survival of tribal families, communities, and identities. Various laws, presidential executive orders and memoranda, as well as National Park Service policies and guidelines require consultation regarding native heritage at the park and thoughtful consideration of the needs of affiliated tribes.

In 2001, the YNP cultural anthropologist continued working with tribes and park staff on behalf of these mandates. Yellowstone routinely consults with tribes in a broad range of venues to learn about their histories in the area, identify resources of traditional



Visiting delegation of Lower Brule Sioux Tribe, June 2001.

importance, and solicit suggestions for how best to manage them. The anthropologist also works with various park divisions to ensure that ethnographic resources are considered in planning and managed in a culturally informed manner, and that American Indian histories and the significance of indigenous places and resources is sensitively conveyed to the public.

Intergovernmental Consultations

General consultation meetings. YNP conducted two general consultation meetings in 2001. The meeting on April 24–25 was attended by 16 representatives of eight tribes and American Indian organizations: the Blackfeet Tribe, Crow Tribe, Eastern Shoshone Tribe, Intertribal Bison Cooperative, Nez Perce Tribe, Northern Cheyenne Tribe, Oglala Sioux Tribe, and the Shoshone-Bannock Tribes. The following issues were discussed:

- what constitutes government-to-government consultation;
- an explanation and discussion of the Record of Decision for the *Final Environmental Impact Statement and Bison Management Plan for the State of Montana and Yellowstone National Park*;
- protocol for communicating about smaller scale development activities in the park;
- opportunities for future participation of tribes in bison management;
- entrance fee exemption for American Indian tribes;
- report from the USDA Animal Plant and Health Inspection Service (APHIS) on brucellosis; and
- benefits-sharing environmental assessment.

The government-to-government consultation meeting on October 2–3 was attended by eight members of three tribes: the Crow Tribe, the Gros Ventre and Assiniboine Tribes, and the Oglala Sioux Tribe. The meeting was originally co-sponsored by APHIS, which sent a letter to all affiliated and bison-interested tribes announcing that the director of their agency was unable to attend. Unfortunately, many tribes interpreted the letter to mean the meeting was cancelled and turnout was less than usual. At the meeting, the following issues were discussed:

- overview of research on brucellosis and eradication efforts;
- summary of and update on the Interagency Bison Management Plan for the Yellowstone herd;
- winter management of bison exiting the park at West Yellowstone and the North Entrance; and
- update on entrance fee exemption.

Transcripts of the meetings are available upon request.

To enable park staff, community members, and affiliated tribes to become better acquainted, YNP and the Bear Creek Council co-sponsored a potluck dinner on the first night of each consultation meeting. The program for the April meeting was so successful that it was repeated again in October. Those who attended the event were asked to bring a story about their experiences with wolves and other Yellowstone wildlife. Tribal guests were enthusiastic participants in this event, as they shared their oral traditions about animals their ancestors would have interacted with in the Yellowstone ecosystem.

Visit by Lower Brule Sioux. In what was likely an historic event for the NPS, the park hosted an official delegation of 20 representatives from the Lower Brule Sioux Tribe of South Dakota from June 19 to 22. The full contingent of the Lower Brule, including the chairperson, tribal council, and the elder resource advisory committee, visited the park to see wolves, tour geyser basins, and meet with park managers. Acting Superintendent Frank Walker, most division chiefs, and other staff met with the group. They discussed the Bison Management Plan, the reintroduction of wolves, sacred sites, fee waivers for religious and other traditional purposes, and employment opportunities. An end-of-the-week dinner honored the guests. Among the attendees were park staff and external partners, including representatives from the Greater Yellowstone Coalition and Bear Creek Council. Chairperson Michael Jandreau told

dinner guests that this was the first time that the Lower Brule Sioux Tribe had “met with such responsive and caring federal employees” in his 30 years of working with federal representatives. Jandreau has been chairman of the tribe for 21 years.

Fee exemption policy. The National Park Service has the authority to exempt entrance fees for tribes for religious or other traditional purposes, and affiliated tribes have requested this exemption at each of the last four consultation meetings. Effective at the October meeting, members of affiliated tribes who present their tribal enrollment card will be admitted to YNP without charge when making a non-recreational visit for religious or other traditional purposes. (Yellowstone National Park is the aboriginal territory for affiliated tribes where traditional activities would have transpired.)

Native American Graves Protection and Repatriation Act (NAGPRA). Affiliated tribes must be consulted about items in park museum collections that fall under the purview of NAGPRA, including human remains, funerary objects, sacred objects, and objects of cultural patrimony. Yellowstone’s collection contains all of these types of items. Tribal representatives who visited the park museum during the summer and fall provided information about their historical relationship with the park, viewed relevant NAGPRA objects, and made a field trip to the location where human remains were exhumed in the 1940s and 1950s. Their collective traditional knowledge has enlarged our understanding of the diverse ways in which indigenous peoples related to this massive landscape. Consultation promises not only to enrich our insight into the historical process of the Yellowstone ecosystem, but promotes the interest of



Curator Susan Kraft with representatives of the Gros Ventre and Assiniboine Tribes, May 2001, NAGPRA consultations.

affiliated tribes in ensuring that their unique cultural heritage survives and is conveyed to visitors. Based on consultation with the tribes as well as archeological, anthropological, linguistic, historical, and other evidence, YNP will make determinations of cultural affiliation on objects covered by NAGPRA in 2002.

Shoshone-Bannock Tribes survey the Mammoth-to-Norris road segment. When development is planned within the park, consultation with affiliated tribes provides an opportunity for them to identify resources of historic and cultural importance and to determine impacts to these resources. The information is used as data for an environmental assessment, to fulfill our legal and administrative mandates for consultation, and to use for management purposes. On September 27, 22 elders from the Shoshone-Bannock Tribes surveyed the Mammoth-to-Norris road corridor, scheduled for reconstruction. Many elders did not speak English, and three were in their 90s. All are descendants of various bands, including the Sheep Eaters, Salmon Eaters, the Bannock, and the Lemhi. En route, elders identified Liberty Cap, Mammoth Terraces, "Lemhi Campground" (what we know as "Sheepeater Cliff"), the Bannock Trail, Obsidian Cliff, plants, buffalo, and the Norris Geyser Basin as places and resources that played a role in their histories here. Names exist for these, and stories were relayed about them. A copy of their report will be provided to the park.

Ethnographic Research

Ethnographic assessment. *American Indians and Yellowstone National Park: A Documentary Overview* was ready for printing by the end of the year. Primarily through documentary sources and limited interviews, the report identifies nine tribes historically associated with what is now Yellowstone National Park. When printed, the report will be distributed parkwide, to affiliated tribes, to regional and national repositories, and to interested members of the public.

Affiliated tribes. Two more tribes came forward in 2001 with evidence that their ancestors used the Yellowstone country. From generalized accounts of elders within and outside their community, as well as a limited exploration of other sources, the Comanche Tribe of Oklahoma reported that some of their ancestors, as Shoshonean speakers, have their "earliest roots in the great territory of Yellowstone." The implication is that at least some Shoshonean ancestors lived in the region far longer than most

anthropologists have speculated. According to the Comanche, small bands began to migrate out of the area between A.D. 1500 and 1700, precipitated by other *indigene* moving into the area.

Originating in the Northeast, the Turtle Mountain Band of Chippewa Indians, a band of the Ojibwa, became equestrians in the 1700s and adopted the lifestyle of the Plains Indians. They began their migratory hunt of buffalo across the northern Plains. Ancestors of this tribe would follow the movement of herds into Montana and northern Wyoming, including Yellowstone country.

With the addition of two tribes, the list of affiliates now stands at 26: the Assiniboine and Sioux Tribes of Fort Peck; Blackfeet Tribe; Cheyenne River Sioux Tribe; Coeur d'Alene Tribe; Comanche Tribe; Confederated Tribes of the Colville Indian Reservation; Confederated Tribes of the Umatilla Reservation; Confederated Salish and Kootenai Tribes; Crow Creek Sioux Tribe; Crow Tribe; Eastern Shoshone Tribe; Flandreau Santee Sioux Tribe; Gros Ventre and Assiniboine Tribes; Kiowa Tribe; Lower Brule Sioux Tribe; Nez Perce Tribe; Northern Arapaho Tribe; Northern Cheyenne Tribe; Oglala Sioux Tribe; Rosebud Sioux Tribe; Shoshone-Bannock Tribes; Sisseton-Wahpeton Tribe; Spirit Lake Sioux Tribe; Turtle Mountain Band of Chippewa Indians; and Yankton Sioux Tribe.

Oral history of the Confederated Salish and Kootenai. YNP received a \$7,750 grant through the Challenge Cost Share Program for documentation of the oral histories of the Confederated Salish and Kootenai Tribes with Yellowstone National Park. Funds were conveyed to the tribes to produce a video documentary synthesizing information from the interviews, others from the tribes' oral history archives, and documentary evidence. On September 25–26, three Salish elders (Felicity McDonald, Mike Durglo Sr., and Josephine Quequesah) traveled to Fishing Bridge, Obsidian Cliff Plateau, and Mammoth Terraces where they were interviewed by Tony Incashola, the director of the Salish-Pend d'Oreille Culture Committee in the Salishan language and English. Sam Sandoval, the videographer for the tribes, recorded the interviews and took footage of these and other park features. The documentary will be completed in 2002. Material from the work will be integrated into exhibits and other educational activities at Yellowstone. Information gleaned from the oral history work also will be used to help in planning and resource management.



Felicity McDonald at Fishing Bridge, September 26, 2001, for Salish oral history project. Sandra Nykerk photo.

Nez Perce (Nee-Me-Poo) National Historic Trail. YNP received a \$20,000 grant to enhance interpretation of the Congressionally-designated trail through the creation of a 30-minute CD to depict the arduous trek of more than 800 Nez Perce with 2,000 horses through the park in 1877. Representatives from the Nez Perce tribe at Lapwai, Idaho, also visited trail sites in the park where they were interviewed. From the master CD, three five-minute sound extracts will be produced for the park's web site. An interpretive brochure will be printed, and two new wayside exhibit signs will be installed.

The YCR sponsored a series of educational events in August 2001 to increase our knowledge about this aspect of the park's history. Nez Perce Tribe elders (Allen Pinkham, Beatrice Miles, and Clifford Allen) and Jerry Greene, NPS historian who recently wrote the book *Nez Perce Summer 1877: The U.S. Army and the Nee-Me-Poo Crisis*, were invited to the park for a series of public presentations, a round-table discussion, and site visits. Greene chronicled the Nez Perce flight from their traditional homelands with a focus on the events that transpired in the park. Also present were elders from Lapwai, Idaho, who relayed accounts from ancestors who participated in that trek.

A roundtable discussion that also included park archivist Lee Whittlesey and district ranger John Lounsbury addressed some of the historical questions about the trek, such as the exact route taken through the park, why rugged terrain was chosen, why a few Radersburg tourists were killed, why an elderly woman was left to die at Indian Pond, and the

significance of the trail for Nez Perce descendants. This discussion was videotaped and is available upon request. A brief summary of the discussion appears in *Yellowstone Science* 9(4), Fall 2001.

Oglala Sioux Tribe elders relay accounts about wolves. Elaine Quiver and Joe Swift Bird of the Grey Eagle Society of Pine Ridge, South Dakota, came to the park for the April consultation meeting. They stayed an additional day to view the wolves in Lamar Valley, meet with wildlife biologist and Wolf Project leader Doug Smith, and relay accounts about the Teton Sioux's historical relationship with wolves. One account reveals that it was the wolves of the Greater Yellowstone Ecosystem that led some of the Teton Sioux to the thermal fields. The Oglala elders also spoke extensively about their ancestors' relationship with these canids, a very different one than we have today. Wolves acted as guides to places and food, forecast weather and hunts by their calls, provided transportation for goods and people, and acted as companions. Prior to relaying stories about the ecosystem's historical ecology, Elaine and Joe took a field trip to see the Druid Peak pack. Thanks to the help of Rick McIntyre, they witnessed several wolves take down a bull elk. Before the kill, Elaine observed certain wolf behavior, relayed to her by her grandfather, which led her to predict the hunt. Thanks to the fieldtrip, she rekindled memories she thought she had forgotten about the wolves, including information about their behavior, other Teton stories, as well as songs. Elaine carried that information back and relayed it to the members of the Oglala Sioux Tribe. The reintroduction of the wolves in Yellowstone has added a previously unknown value. It has enabled the preservation of cultural traditions, as well as biodiversity.

The Kiowa Tribe returns to Yellowstone. From the early 1500s A.D. through the 1700s A.D., ancestors to contemporary Kiowa lived in the Greater Yellowstone Ecosystem. Both the Salish and the Crow have accounts about them. In October 2001, representatives from the Kiowa Tribe, including elders Billy Evans Horse, chairman; Louise Hall; Marjorie and George Tahbone, Jr.; Modina Waters; and NAGPRA representative George Daingkau, returned to their homeland after a 500-year hiatus. During their three days at the park, they visited sites, discussed items in the collection pertaining to NAGPRA, and spent at least two days doing oral history interviews that were videorecorded. In the course of the interviews, they provided information

about the historical ecology of the area, how certain animals gave them dances and songs, chronicled their collective history, talked about traditional Kiowa culture, and relayed an account about Dragon's Mouth, the site at which, according to oral accounts, their creator, *Doh Ki*, transformed the landscape into the abundance we see today and gave it to the Kiowa as their homeland.

Educational Opportunities for Park Staff and Visiting Public

Native cultures of the greater Yellowstone area. For the second year, Larry Loendorf, co-author of the ethnographic overview and assessment, taught a week-long seminar for park employees. Loendorf provided an overview of early archeological history of the Yellowstone area and discussed some of the tribes with a historic presence in the park. Dr. Loendorf focused particularly upon the mountain Shoshone, who are often referred to as Sheepeaters. Copies of the seminar on videotape are available upon request.

Yellowstone's sacred places. In July, film producer Toby McLeod previewed at Old Faithful and at Mammoth Hot Springs a nationally broadcast documentary, "In Light of Reverence," that explores concepts of nature at three places considered sacred by American Indians. Co-presenter Rosemary Sucec, YCR cultural anthropologist, spoke briefly about the sacred sites of Yellowstone that have been identified by affiliated tribes.

HISTORY

As the park continued to function without a full-time historian in 2001, the park archivist performed part-time duties for this program.

Historic Buildings

Old Faithful Inn. The historic clock mounted on the inn's central fireplace, designed by the inn's architect, Robert Reamer, and constructed in 1903 with the building itself, had ceased to function many years ago. After being retrofitted by Livingston historian Dick Dysert; Anaconda, Montana, machinist Mike Kovachich; and Bozeman clock expert Mike Berghold, the newly reticking timepiece was unveiled in 2001. The restoration work was featured in the winter 2001 issue of *Yellowstone Science* magazine.

An interdisciplinary team of park staff began working with partners and contractors to plan a

major restoration of the "Old House," the original section of the inn. Nearly \$15 million dollars of NPS line-item construction funds have been approved for a multi-phased restoration effort to begin in FY2003. Goals include making the structure more earthquake-resistant, replacing worn elements such as electrical and mechanical systems, and restoring architectural features that have been lost or modified over the life of the nearly 100-year-old inn. The inn, which brings in about 20 percent of the hotel concessioner's total revenue, will remain open while work is done. In 2001, A&E Architects prepared a historic structures report assessing the state of the landmark building and presenting a number of restoration options for the park to consider. Planning and design work will continue in 2002.

Norris Geyser Basin Trailside Museum.

Among Yellowstone's six National Historic Landmarks are the three "trailside" museums at the Norris Geyser Basin, Madison, and Fishing Bridge. Special funding received in 2001 enabled the park to begin exterior maintenance work and pest management at the Norris Geyser Basin museum, which was completed in 1930. The building was designed by Herbert Meier, who later joined the NPS and exerted enormous influence over the architecture of park museums and other structures. Lon Johnson worked with interpretive specialist Carolyn Duckworth on a site bulletin to describe the historic trailside museums in text and photographs.

Mammoth Hotel. This historic structure contributes to the significance of the Mammoth Hot Springs historic district. The existing building is the result of remodeling and alterations done in 1913 to the National Hotel, which was built in 1882, and from subsequent changes made between 1936 and 1938. The historic structure report describes the hotel lobby as "sparsely decorated at the time of its construction" due to funding constraints. Considerable alterations have been made to the lobby during the ensuing years, and the report's author, historical architect James McDonald, made various recommendations to renovate the lobby in keeping with the original character of the 1938 construction. In late 2000, the park hotel concessioner contracted with McDonald to design a fireplace for the lobby in keeping with the Secretary of the Interior's Standards for the Treatment of Historic Properties. Although the original hotel was used only during summers, the fireplace will likely be a popular gathering place for present-day visitors who come in the colder seasons of



The Mammoth Hotel lobby got a new fireplace in 2001.

spring, autumn, and winter. This year, the park and the Wyoming SHPO determined that this project would not adversely affect the historic structure, and the fireplace was finished. Park officials expect to undertake additional historically appropriate renovations to the Mammoth Hotel using some \$11 million in line-item construction funds anticipated in fiscal year 2005.

National Register of Historic Places

The National Historic Preservation Act and NPS management guidelines require YNP to identify, evaluate, and nominate to the National Register historic properties that are under its stewardship, including archeological sites, individual structures, roads, cultural landscapes, natural or cultural landmarks, and historic districts. Properties that are listed in or determined eligible for listing are managed and maintained in a way that considers the preservation of their National Register qualities. The actual number of properties officially listed for Yellowstone is small. Many additional sites or districts have been determined eligible for listing, but the process of placing them on the register is not complete.

The Queen's Laundry Bath House was added to the National Register list in 2001 after the acceptance of documentation submitted by the historical architect. Park Superintendent Philetus Norris's annual report for 1881, described the log structure built that year as "a double-roomed, earth-roofed bath house, with wooden troughs for conveying the water to the building, for the free use of the public." The bath house is significant because it was the first building constructed by the federal government for public use

in a national park, and remains the oldest standing, federally-constructed building built in any national park for public purposes. It is the only structure that remains from the administration of Superintendent Norris, and the only building that represents Yellowstone's early civilian administration from 1872 to 1886. The building was apparently never finished, and historian Aubrey Haines was able to avert a proposal to remove it in 1964. The bath house remains visible in its original location in Sentinel Meadows, where runoff encroaches from nearby thermal features. This was YNP's first addition to the National Register in 10 years.

The following park properties are officially listed in the National Register of Historic Places:

- **National Historic Landmarks**

- Old Faithful Inn
- Madison Junction Trailside Museum
- Norris Geyser Basin Museum/Comfort Station
- Obsidian Cliff
- Fishing Bridge Trailside Museum
- Northeast Entrance Station

- **Historic Districts**

- Old Faithful
- Roosevelt Lodge
- Lake Fish Hatchery

- **Sites**

- Obsidian Cliff (Nature Shrine) Kiosk
- Lamar Buffalo Ranch
- U.S. Post Office, Yellowstone Main
- Lake Hotel
- Queen's Laundry Bath House

Nominations to the Register.

Fort Yellowstone National Historic Landmark.—The park's original headquarters, built by the U.S. Army after arriving in 1886 to become the park's first guardians of Yellowstone, is a physical representation of the Army's role in the history of our national parks. By 1918, the cavalry had constructed a military post that included about 35 buildings, dating from three main construction periods (1891, 1897, and 1908). In 1999, the National Trust for Historic Preservation contracted with Front Range Research Associates, Inc., to prepare a National Historic Landmark nomination for the fort and associated buildings throughout the park, including the Bechler River and Norris Soldier Stations, the Buffalo Lake Snowshoe Cabin, and the Roosevelt Arch. After completing their review of the contractor's nomination, park staff submitted it to the

Keeper of the Register in the summer of 2001, who reviewed the document and forwarded it to the National Park System Advisory Board for consideration. The Secretary of the Interior designates landmarks based on the board's recommendations.

Mammoth Hot Springs Historic District.—

Front Range Research Associates, Inc., also prepared a National Register nomination for the Mammoth Hot Springs Historic District, which overlays the landmark district. In addition to the U.S. Army buildings, it includes the historic concessioner buildings, National Park Service administrative and residential buildings, and the Mammoth Campground—one of the first designed auto campgrounds in a national park. The historic district is eligible for listing because of its architecture and its association with the development of administrative and concession policies in the national park system. In 2001, the historical architect edited and submitted the nomination for consideration by the Keeper of the Register.

Determinations of eligibility. Cultural resources staff evaluated several properties for the National Register of Historic Places, and received consensus determinations of eligibility (DOE) from the Wyoming State Historic Preservation Officer for the following properties.

The Haynes Photo Finishing Laboratory and Warehouse.—These buildings associated with the park's concessioner operation are separated from the Old Faithful Historic District by roads and new construction, and were determined to be eligible for listing as non-contiguous resources contributing to the historic district. F. Jay Haynes first photographed the park in 1881, and two years later was appointed the official photographer for the Yellowstone National Park Improvement Company. In 1887, Haynes constructed a log cabin studio on leased land in the Upper Geyser Basin where he sold postcards and photographs. The building was described by the superintendent as "the most beautiful and most appropriate in the park . . . rustic in appearance throughout. . . ." Although the Old Faithful Inn is generally credited with establishing the rustic style in Yellowstone, this log cabin predated it by six years.

The building was abandoned as a place of business in 1930, and park officials wanted it removed because of its location in front of the Old Faithful Inn, and between Hamilton's original store and the Old Faithful geyser baths. In 1932, Haynes proposed relocating the log cabin, and the park's landscape architect approved moving it to the south

of the Old Faithful Inn, near the government utility area. The building became an overnight photo finishing shop and dormitory, and Haynes constructed an adjacent warehouse in 1939. The warehouse was probably used to store flammable and explosive materials. The photo finishing laboratory and warehouse retain integrity, and the design, materials, and workmanship of the buildings have not been modified since the 1930s.

The Yellowstone Park Transportation Company Historic District.—

In 1906, the Department of the Interior granted the Yellowstone Park Transportation Company (YPTC) authority to occupy an acre of land near Gardiner, Montana, where the company built a stable, coach house, and combination mess house and bunkhouse. These sophisticated, rustic-style buildings were designed by Robert Reamer, architect of the Old Faithful Inn. After Yellowstone opened its roads to motor vehicles in 1915, NPS Director Stephen Mather met with park officials and determined that the YPTC would motorize and conduct transportation through the park. In 1922, YPTC had 125 eleven-passenger cars, 29 touring cars, and numerous freight and gasoline trucks. A 41 percent increase in park visitation in 1923 stretched the company's resources and, to meet transportation needs, it purchased 20 more 11-passenger cars, two new 25-passenger cars, one two-ton truck, and nine touring cars from the Yosemite Park Company.

With a 20-year renewal of its lease in hand, the YPTC retained the Montana architectural firm of Link and Haire, and in 1924 construction began on three new buildings on its leased lands in Gardiner: a 75,000-square-foot general repair shop, an 80,000-square-foot vehicle storage garage, and a power house. These Art Moderne buildings were constructed of poured-in-place concrete characterized by smooth wall finishes with horizontal bands of large, steel sash windows. The company later constructed a bunkhouse for its drivers and two employee houses in Gardiner. The location selected was partially occupied by the park's North Entrance Ranger Station, which was originally built as a U.S. Army soldier station. In exchange for the site, YPTC agreed to pay for the construction of a new ranger station closer to the park boundary. R.C. Reamer provided plans for that Rustic-style building. The historic district includes 19 buildings, representing both Art Moderne and Rustic styles of architecture, that are significant reminders of the Yellowstone Park Transportation Company's response to the introduction of

automobiles into the park. The park hopes to receive about \$8 million in line-item construction funds to stabilize and restore buildings in this complex beginning in 2006–2007.

Backcountry cabins.—Prompted by proposals to remove hazard fuels from around cabins still used by park rangers for boundary and backcountry patrols, the historical architect completed determinations of eligibility for the Buffalo Plateau and Lower Black-tail Deer Creek snowshoe cabins and the Crevice Mountain ranger station. All three cabins are located in the Montana portion of the park and are eligible for listing on the National Register with state significance.

List of Classified Structures

The List of Classified Structures (LCS) is a nationwide computerized database containing information about National Park Service-owned historic buildings and structures. The current LCS includes 952 Yellowstone buildings and structures eligible for listing in the National Register of Historic Places. Intermountain Regional Office staff specialists Sayre Hutchison and Pam Holtman continued working with Lon Johnson, the park's historical architect, to update or amend the information in the LCS as needed. As of September 2001, 240 of the listed structures had updated information. Yellowstone is a participant in the pilot program to test an asset management program FMSS (Maximo) database, which should be far more accurate than the LCS or current building inventories and facilitate the park's ability to monitor the condition of historic structures.

Compliance with NHPA

As required under the National Historic Preservation Act, park divisions that undertake projects that could potentially affect National Register-eligible or listed properties must complete the Section 106 review process with guidance from the cultural resources staff. The historical architect coordinated this compliance, addressed other regulatory and NPS cultural resource requirements, and helped to ensure that the park's historic properties are properly managed and cared for. Cultural resources staff represented historic preservation concerns on a range of projects, including: the proposed visitor education center in the Old Faithful Historic District; rehabilitation of the Canyon Visitor Center; a new Heritage and Research Center near the North Entrance; efforts

to improve the interpretation of Fort Yellowstone; construction of a new public restroom building; and rehabilitation of the park administration building and the former cavalry stables/old fire cache in the Mammoth Historic District.

Historic roads and bridges. A programmatic agreement provides the mechanism to complete Section 106 requirements for the principal park road system improvements. The park has an interdisciplinary team that provides primary planning and compliance work for road projects and monitors on-site construction impacts. Elaine Hale, whose position was again wholly funded by the Federal Lands Highways Program in FY2001, devoted her time to representing cultural resource concerns related to road projects. However, after being accepted for graduate work in anthropology (archeology emphasis) at the University of Montana, she was transferred from a term position to a Student Career Experience Program appointment. Upon successful completion of her studies and associated NPS work, she will be eligible for non-competitive conversion to a permanent appointment in Yellowstone or elsewhere in federal employment.

Branch of cultural resources staff discussed road reconstruction activities and their effects on cultural resources with the Wyoming State Historic Preservation Office (SHPO) staff during their annual consultation visit to Yellowstone on September 17–18. The SHPO staff traveled the Canyon-to-Tower segment of the Grand Loop Road, scheduled for reconstruction in spring of 2002, and discussed data recovery for the Tower Soldier Station site. Park staff agreed to work with SHPO representatives on the design of a proposed parking area at the Calcite Springs Overlook to avert adverse effects on cultural resources.

East Entrance Road, Fishing Bridge-to-Indian Pond.—Major reconstruction activities for this segment were completed in 2000, including a second chip-sealing of the asphalt tiles on the deck of the historic Fishing Bridge structure. The redwood piers, benches, bollards, and stair railing were re-stained or replaced as needed.

Material excavated from a quarry pit in the Bridge Bay area was stockpiled within the boundary of a prehistoric archeological site in the Fishing Bridge area for use as fill for the Bridge Bay Campground in 1962 and the relocation of the Lake Junction road in 1971. Cultural resource and landscape architect staff completed an archeological inventory of the Natural Bridge/Bridge Bay



Today's Albright Visitor Center was built by the U.S. Army for use as quarters.

reclamation area and submitted the inventory report in spring 2001. An environmental assessment for reclamation of the abandoned quarry was done by the Wyoming Abandoned Mine Lands Division (AML). After the project was approved, the excess excavated material was removed from July through September with financial assistance from AML. Park crews removed approximately 35,000 cubic yards of excess material from the main stockpile behind the Hamilton store which was used to reclaim the abandoned quarry. Maintenance workers spread topsoil conserved from a nearby project and recontoured the site. They also restored the small remnant of a barrier beach that had been documented by geologists and archeologists, using satellite imagery provided by the USGS to verify the presence and continuity of the slight rise in the landform.

Sylvan Pass-to-East Entrance.—Park and FHWA staff developed plans for reconstruction of the road from Sylvan Pass to the East Entrance to a 30-foot width; the road will retain its current alignment and curves, with widening occurring on both the cut slope and fill slope sides. The historic stone guard-walls are in bad repair, having been previously patched and repaired in a haphazard fashion. The fill-slope retaining walls range from mortared cut stone to metal bin-walls. Rock fall has filled the ditches with debris, and the post-and-metal rope retaining system has completely failed in most locations. This road offers dramatic mountain views with steep drop-offs, a few opportunities to pull off the road near watercourses, and blind curves that need to be negotiated at slower speeds. The park road team has emphasized that the widened road needs to retain its tight curves, vertical rock cuts that simulate the existing shape and form, and masonry features that convey the road's historic character. Initial plans also

include a roadside pull-out to interpret the historic Corkscrew Bridge, an area that is susceptible to rock fall damage. Several large box culverts on this road segment need to be dismantled and reassembled to accommodate the widened road.

Several historic sites along the abandoned road alignment that were initially identified as road camps are outside the area of potential effect of the current road widening, but the Office of the Wyoming State Archeologist has been contracted to provide additional documentation in anticipation of possible wetland reclamation in some portions.

Fishing Bridge-to-Canyon.—OWSA conducted National Register testing of eight prehistoric archeological sites in this area and documented the remains of the historic Canyon incinerator, the bus complex, and the Otter Creek bear feeding station. The road team and the FHWA design engineers entered into the final phase of design to rehabilitate and resurface this 15-mile segment of the Grand Loop Road through Hayden Valley. In the environmental assessment, which was released in October, park staff concluded that the work would have no adverse effect on historic properties, and the Wyoming SHPO concurred. During this "3-R" project, culverts will be cleaned, several informal parking areas will be paved, and thermal vent damage in the Mud Volcano parking area will be repaired. A slumping drylaid rubblestone wall will be dismantled, reinforced, and restacked in the same manner that it was originally constructed.

North and South Rim drives.—The archeologist partially completed inventory of these roads, documenting road features and completing the historic context. There are plans to do additional inventory of the Inspiration Point and brink of the Upper Falls roads in 2003.

Madison-to-Norris.—Park staff monitored road reconstruction activity that began in spring 2001 on the Madison-to-Norris section of the Grand Loop Road. Traffic through the construction zones was allowed until September, when total closure of the road was needed to remove and widen the decks of two historic Gibbon River bridges. Before removing the bridge decks, construction workers carefully dismantled the quarried stone abutments, losing only a few of the original stones to unavoidable crumbling and breakage. The remaining stones were labeled as to their location on the structure, placed on pallets, and covered with protective plastic while the girders were replaced and new concrete bridge decks

constructed. The stones are scheduled for reattachment to the bridge in 2002. When severe erosion resulted in removal of the piers beneath Gibbon River Bridge II, stone was salvaged that will be used in the construction of the extended wing walls.

At Terrace Spring north of Madison Junction, crews completed reconstruction of a large box culvert and relocated a double culvert outlet for the thermal waters flowing under and along the road. Workers removed numerous other stone masonry culvert headwalls and conserved the stones as they replaced metal culvert pipes to accommodate the new 30-foot road width. Cultural resource specialists helped ensure that new stone used in the road reconstruction was suitable in texture and color to mix with the historic stone on bridges and headwalls, and that the quality of workmanship on the culverts met park standards. They also assisted engineers in designing a new bridge across the Gibbon River that will be required as a result of the road realignment through the Gibbon Canyon.

Tower-to-Canyon (Dunraven Road).—Engineering designs for the first phase, Canyon Junction to the Chittenden Road, were developed in 2001. Park staff determined that this reconstruction would have no adverse effects on historic properties and the Wyoming SHPO concurred, but the parties have agreed to work together to design the new parking area at Calcite Springs. The Office of the Wyoming State Archaeologist conducted data recovery on two features of the Tower Falls Soldier Station archeological site.

Reconstruction will widen the driving surface to 24 feet along 9.66 miles from Canyon Junction to the Chittenden road. The speed limit will remain at 35 mph, and the alignment will remain the same except for minor shifts in the centerline to facilitate expanded and safer parking at Dunraven Pass, and to decrease the impact on alpine slopes. Only minor repairs to the historic masonry box culverts are required. Existing pullouts will be improved and a few new pullouts added. The log guardrail will be replaced with W-beam, matching the guardrail on other segments of the Grand Loop Road.

Norris-to-Golden Gate.—Cultural resource specialists arranged for the Shoshone-Bannock Tribe to complete an ethnographic inventory of the Obsidian Cliff National Historic Landmark-to-Apollinaris Springs area, and for additional ethnographic resource inventory of the Norris-to-Golden Gate corridor. The park's archivist-historian, historical

architect, and staff landscape architects collaborated on a cultural landscape inventory of the historic designed landscape at Apollinaris Springs that should be completed in 2002.

Outreach

The branch chief gave several presentations to employees on "These Old Houses" (and other cultural resources) in the spring and early summer. In December, the branch chief, archivist-historian, and other park staff attended initial meetings to discuss 100th anniversary celebrations of the North Entrance (Roosevelt) Arch in 2003 and the Old Faithful Inn in 2004.

MUSEUM COLLECTIONS

In 2001, Yellowstone's museum staff consisted of Susan Kraft, the supervisory museum curator; Beth Raz, a permanent, subject-to-furlough museum aide; and temporary museum technicians Sean Cahill and Jon Dalheim. Sean Cahill, who specializes in historic vehicles, became a term employee in the fall. In late spring, Susan Kraft began a three-month detail as Acting Director of the NPS Northeast Museum Services Center in Boston, and librarian Kathryn Kirby did a fine job filling in as acting curator. Unfortunately, shortly after Kraft's return in July, she was diagnosed with a life-threatening illness and was on sick leave for the remainder of the calendar year. In November, Nancy Hatcher from Harpers Ferry National Historical Park in West Virginia was detailed to Yellowstone to be acting museum curator for a three-month period.

During the year, the temporary and term museum technicians and a portion of the museum aide's salary were funded using special NPS project monies, which enabled the staff to complete or advance a number of projects, and to assist in the curator's absence.

Preservation and Access

A variety of projects contributed to the preservation of important components of the museum collection and to the accessibility of these collections for research, education, and other purposes.

Works of art. One of the most significant works of art in the park's collection, an 1887 oil painting by noted Western landscape painter James Everett Stuart, was loaned out for professional conservation treatment. *Great Falls and Cañon of the Yellowstone*

was purchased for the park by the Yellowstone Park Foundation in 1999, but was in need of conservation (the process of treating damage while preserving as much original material as possible). This impressionistic work, which depicts an artist painting the Lower Falls, was soiled, had a small tear in its canvas, and had lost several large flakes of paint. It was sent to a professional art conservator for cleaning, stabilization, and inpainting (the process of filling in areas of lost paint using a medium which can be distinguished from the artist's original work). The conservation work will be completed during 2002 using funds provided by the Yellowstone Association.

Although Stuart spent five seasons sketching and painting in Yellowstone, he is little known outside of scholarly circles. This situation may change with the publication of *Drawn to Yellowstone*, a book by art historian Peter Hassrick, that devotes part of a chapter to Stuart. Yellowstone's museum and archives staffs provided considerable assistance to Hassrick during the writing of the book. Yellowstone is fortunate to have two Stuart paintings in its museum collection. An earlier acquisition, the earliest known painting of Constant Geyser, is also in need of some conservation treatment. This work will be accomplished in 2002 with Yellowstone Association funds.

Five drawings by Private Charles Moore were professionally photographed and digitized following



James Everett Stuart's "Great Falls and Cañon of the Yellowstone."

their conservation. Moore was an amateur artist on the Washburn-Langford-Doane expedition of 1870 who made the first known sketches of what would become Yellowstone National Park. During the year, the curator discovered that an additional drawing in the park's collection, previously attributed to photographer and artist William Henry Jackson, may indeed also be by Moore.

Photographs. Beth Raz continued working with the Northeast Document Conservation Center in Massachusetts to reformat flammable cellulose nitrate negatives onto safety film. This project, which began in 1999, offered parks and NPS centers the opportunity to compete for Washington office funding to have their nitrate negatives reformatted. Yellowstone's proposal was the top-scoring project, and by the end of 2001 nearly 12,000 negatives had been copied and returned to the park. The project has saved the park more than \$30,000. When the project is complete, the curator will have the option of transferring the original nitrates to specialized NPS storage, thereby sparing the park the substantial cost of properly accommodating nitrate film in the new Yellowstone Heritage and Research Center.

The museum staff also continued with the second year of a project funded by the NPS Museum Collections Preservation and Protection (MCP) program, to re-house several thousand photographs and objects, including unframed works of art and glass negatives.

Cataloging. Museum collections are managed on a fiscal year basis. In fiscal year 2001, museum staff and contractors cataloged 5,482 objects in the following categories: 1,824 from archeology; 1,746 from history; 118 from the archives; and 1,781 from the natural sciences, including specimens from the park herbarium. The projected cataloging goal for FY2001 was only 500 items; the park exceeded that goal tenfold. A number of works of art in the collection were recataloged during the year by a contractor who improved the description and other data on each work in the database, and added to the database artworks previously cataloged only on old typed catalog records.

The park's museum collection, as reported on the FY2001 NPS Collections Management Report, now contains an estimated 5,113,761 items. This figure includes the archives, which account for more than 4.8 million items.

Digitization. Many of the images scanned last year in a project funded by the Recreation Fee

Demonstration program were loaded into ANCS+, the museum catalog database. Using ANCS+, researchers may now view on screen many of the park's most frequently requested historic images. Work began on preparing captions and citations for these images in preparation for placement on the park's web site.

Historic vehicles. Sean Cahill continued working on preservation and maintenance of the park's historic vehicles, using Recreation Fee Demonstration and Cultural Cyclic Maintenance funds. Cahill assisted in the drafting of a successful project proposal that funded his work for part of the year, and participated in the drafting of job safety analyses dealing with the historic vehicles. He worked on stagecoaches, motorized maintenance vehicles, and other historic vehicles, and made repairs and safety improvements to the Gardiner warehouse in which they are stored, implementing recommendations made by professional vehicle conservators.

Herbarium. The herbarium continued to be used extensively, especially during the summer months, both by park personnel and outside researchers. Backlog cataloging funds awarded in 2001 made it possible to catalogue 1,717 specimens, primarily non-vascular plants such as mosses, liverworts, lichens, and fungi that had been added to the collection from the 1930s to the 1980s, but never entered in the NPS's Automated National Catalog System (ANCS+). The herbarium collection now includes approximately 7,900 specimens of vascular and non-vascular plants that have been identified, mounted, and catalogued into ANCS+. In addition, the catalogue entries that had originally been done in ANCS and then integrated into ANCS+ were amended and corrected to maximize their usefulness. All of the remaining non-archival vascular plant genus folders were replaced by acid-free folders. During the 2001 field season, 53 specimens were collected to be eventually mounted and catalogued into the herbarium. These specimens were needed to strengthen the collection, especially by documenting the native flora in under-collected portions of Yellowstone, and the arrival and spread of exotic species.

Notable Acquisitions

The Davis Collection. In 2001, a major fundraising effort undertaken by the Yellowstone Park Foundation resulted in acquisition and donation of the bulk of the Susan and Jack Davis collection for the park museum. Curator Susan Kraft described it as

the foremost collection of its kind in the nation, encompassing images, artifacts, and documents dating from the earliest years of Yellowstone's history, continuing through the golden age of Yellowstone collectibles and into the modern era. It is a major achievement for the park to acquire this collection, intact and together, which is already partly catalogued and has been well cared-for by its devoted collectors. The autumn 2001 issue of *Yellowstone Science* featured this important acquisition and an interview with the Davises.

Shortly after her arrival in Yellowstone in 1993, Kraft met the Davises and was impressed by their collection. Several years later, learning of the Davises' interest in selling their collection and their dream and goal of seeing the collection come to Yellowstone, she began preparing grant proposals for the estimated \$680,000 needed to appraise and purchase the collection. In 1999, Kraft made an initial presentation to the Yellowstone Park Foundation board, accompanied by a display the Davises put together in one of their historic Haynes cases providing a small sampling of the riches they had to offer. Kraft persisted in promoting the acquisition of this collection and, in the ensuing years, the Yellowstone Park Foundation, particularly board members Ron and Jane Lerner, worked with the Davises to produce a wonderful catalog and have the collection appraised. The Lerner's then spearheaded a major burst of fundraising, culminating in the Yellowstone Park Foundation's raising funds sufficient to acquire all but the Davis's postcards in 2001. The park inventoried and took custody of the collection in September.

Acting Superintendent Frank Walker, Susan and Jack Davis, Yellowstone Park Foundation staff and board members, and other Yellowstone staff celebrated the acquisition at the historic Gallatin Gateway Inn on November 8, 2001. Susan Davis began collecting Yellowstone memorabilia in 1967, and after her marriage to Jack, continued acquiring treasures for more than 30 years. The collection numbers some 20,000 items, including a 1905 Limoges china pitcher bearing pictures of Yellowstone scenery, Shaw and Powell blankets and dishes from the stagecoach days, pre-1917 ephemera and documents from the Wylie Camping Company, and two rare 1890s pamphlet-guides written by the Wittich Brothers of Livingston, Montana.

At the November ceremony, the Davises also donated two Thomas Hine stereographs that date to 1871. Thomas Hine was a pioneer photographer



The park acquired two rare Wittich guides to Yellowstone, circa 1890s, as part of the Davis Collection.

based in Chicago, who traveled to Yellowstone that year with Captain Barlow on the Hayden survey. Hine produced some 200 glass plates that summer, but upon his return home, nearly all of his negatives were destroyed in the great Chicago fire. Historians think Hine had time to produce 16 Yellowstone stereographs, but the whereabouts of the images were unknown until Dr. James Brust found seven of them in the New-York Historical Society 120 years later. These photographs were featured in a 1999 article in *Montana The Magazine of Western History*. In 2000, Susan and Jack Davis discovered two additional Hine stereographs in their collection—some of the earliest photographs ever taken of what is now YNP.

Until construction of the new Yellowstone Heritage and Research Center is complete in about 2004, the Davis collection will be stored in Bozeman, Montana. The Davises catalogued much of the collection using guidelines provided by Yellowstone to ensure a smooth eventual transfer to the NPS automated catalog system. Items from the collection were featured in a 1995 exhibit at the Museum of the Rockies and again this year at the Museum of the Yellowstone in West Yellowstone, Montana. In the future, the park hopes to rotate items from the Davis Collection to displays in the Heritage Center or other visitor centers and museums across the ecosystem.

The Davises' postcard collection is expected to be acquired in 2002, using additional funds raised by the Lerner.

White motor buses. In autumn 2001, eight White Motor Company motor coaches were purchased. They were used by the Yellowstone Park Company (YPC) from 1936 to 1939. The 14-passenger, canvas-roofed yellow buses (model 706) were once part of a 98-bus fleet that transported visitors around the park. Similar coaches were used in other

western parks, and Glacier's "red jammers" remained on the road until recently. As a result of safety and environmental concerns, Glacier entered into a partnership with the Ford Motor Company (who bought the White Motor Company years ago) to redesign the buses. Two of Yellowstone's old coaches were already in the park's museum collection, and AmFac Parks and Resorts uses one of them at the Lake Hotel for daily interpretive tours and special events, but Bruce Austin, a philanthropist from California and a member of the Motor Bus Society, had contacted the park to encourage purchase of the eight buses, owned by the Skagway Streetcar Company in Alaska. To locate the buses, Austin and Robert Goss of Gardiner, Montana, had researched the YPC records and found that the buses were listed on Yellowstone's insurance records until 1954, when they began to be sold off. The "Skagway Ladies," which were still in use for public tours, were in good operating condition and had undergone very little alteration—they still bore the original YNP license plates—but the owners had decided to replace them with older buses.

In early 2001, park staff met to discuss options for obtaining and using the White buses, but no obvious government or private funding source was available. The historic buses appealed to many participants, but had some limitations for ongoing park initiatives related to exploring mass transportation and "greener" transportation. Meanwhile, other private parties were reportedly interested in purchasing the Skagway Ladies. In July, Bruce Austin arranged to take Acting Superintendent Frank Walker for a ride around West Yellowstone in a Yellowstone-era White bus. Mr. Walker, persuaded that the buses would be popular with today's park visitors, decided to use donated funds to purchase the eight buses from Skagway. At his request, the park's Business Management Office and the park concessioner sent mechanics to inspect the fleet and, finding them in good condition, arranged for their transfer to the park. The first two buses were delivered on October 8, and the rest shortly thereafter. They were covered with white protective fabric for the winter and will one day offer visitors a quality experience with the historic flavor of the park's past.

Photo archives. In May, archives technician Harold Housley made color copies of all 84 of the park's stereo images by Bundy and Train for east coast philanthropist Hallam Webber, given in exchange for Hallam's donation of color copies of

100 stereo images by W.I. Marshall. The park had virtually none of these important images prior to this exchange. The park also received several collections of photographs taken by Civilian Conservation Corps employees who worked in Yellowstone during the Great Depression. Park volunteer Mary Bolhuis arranged for the reproduction of dozens of photographs while completing oral histories with CCC veterans of Yellowstone.

Museum objects. Notable acquisitions made during the year included the painting *Old Faithful* by Paco Young. The painting was donated on the occasion of the creation of the Yellowstone National Art Trust, a Bozeman-based organization dedicated to nurturing the arts in Yellowstone National Park. The painting was commissioned by YNAT director Laurie Simms, and hangs over the fireplace of the Old Faithful Inn dining room.

Research, Technical Assistance, and Outreach

Demand for access to the museum collection remained extremely heavy in 2001. More than 1,000 research and reference requests—about 30 percent from park staff and 70 percent from outside researchers—were met during the year, often consuming in excess of 40 hours per week of staff time. Use of the museum collection by park staff occupied approximately 40 percent of the time the museum staff spent assisting researchers. Requests came from authors of books, journal articles, dissertations, and theses about Yellowstone; filmmakers; park interpreters, landscape architects and resource managers; visiting scientists; environmental organizations; members of the media; members of American Indian tribes in the park for consultation meetings; elderhostel groups; Yellowstone Association Institute classes; the Yellowstone Park Foundation; neighboring museums; and the general public. The greatest demand continued to be for historic images (including photographs, postcards, and stereographs) and artwork. Use of the herbarium also continued to be heavy, particularly during summer months. Products generated by many of these researchers, including books, articles, documentaries, and web pages, ultimately serve to educate millions of people annually about the park.

Yellowstone's museum and archives staffs provided considerable assistance to art historian Peter Hassrick during the writing of his book *Drawn to Yellowstone*, which focuses on the history of artists in Yellowstone. The curator and other staff assisted the park anthropologist in meeting requests from

tribal members for information about collection items subject to the Native American Graves Protection and Repatriation Act. Museum staff members also participated in meetings to plan the redesigned Canyon Visitor Center and the new Old Faithful Visitor Education Center, and provided assistance to the Division of Interpretation in modifying and relabelling exhibits in the Albright Visitor Center. The curator oversaw the completion of room-by-room function sheets for, and participated in planning meetings concerning the Yellowstone Heritage and Research Center.

Yellowstone Heritage and Research Center

The curator, acting curators, archivist-historian, museum technicians, botanist-herbarium curator, archeologist, and branch chief all contributed to planning the Yellowstone Heritage and Research Center (HRC), the park's proposed new museum, archives, and library facility. This building was proposed for line-item construction in 1995. In July 2001, the branch chief traveled with project engineers to Denver where, following a presentation by Chief of Maintenance Tim Hudson, the NPS Development Advisory Board approved approximately \$6.1 million for the first phase of construction beginning in FY2002. Throughout the year, planners and resource specialists contributed to the preparation of an environmental assessment on the proposed construction; the document was nearly ready for release at year's end.

RESEARCH LIBRARY AND ARCHIVES

Lee Whittlesey continued to function as both historian and archivist for the park. The Yellowstone research library and archives were jointly managed by Whittlesey and his staff, Harold Housley, Alissa Cherry, Kathryn Kirby, and Barb Zafft. Charissa Reid worked intermittently on oral histories, assisted by Housley and part-time staff and volunteers Sally Plumb, René Farias, and Mary Bolhuis. Whittlesey augmented his professional skills by taking classes in history at Montana State University, and in May 2001 was awarded an honorary Doctor of Science and Humane Letters by Idaho State University, where he was a keynote speaker at the spring commencement ceremony. Whittlesey received this honor for his writings in natural and historical research related to Yellowstone.

Library

The library recorded 2,723 patrons in 2001, nearly 50 percent more than the previous year; 425 were NPS staffers and 2,298 were independent researchers or concession employees. The increase may be attributed in part to an increased awareness that the library has a computer with Internet access available for sign-up use, and by the new presence of both the library and archival finding aids on the Internet. In September, the park library officially became part of the Wyoming Libraries Database System (WYLD), making the library catalog available on the Internet and enabling park staff to search all Wyoming libraries for their own needs.

Cathy Gaupp completed a \$2,500 contract involving the YCR central files/records. In October, Northwest Community College in Powell, Wyoming, donated two greatly needed microfilm readers to the library, enabling researchers to access microfiche records that had been unreadable in recent years due to equipment failure.

Renee DeVille, visiting book and document conservator, gave a talk on rare-book repair and spent several days training the librarians in the art of rare-book repair in January. In July, Harold Housley attended a two-day training class presented by the NPS in Philadelphia on using the Re:Discovery (ANCS+) cataloging system, and subsequently presented training on Re:Discovery for park staff and for Brian Sparks of the Park County Museum.

Oral Histories

An oral history project on the history of the Civilian Conservation Corps (CCC) in Yellowstone was supervised by Charissa Reid and conducted by Bozeman, Montana, teacher Mary Bolhuis using Challenge Cost Share funds. Bolhuis attended a reunion and found numerous surviving members of the CCC who had worked in Yellowstone in the 1930s. She interviewed several dozen men and recorded their stories of working in Yellowstone. At the end of 2001, other park staff were continuing to transcribe the interviews for permanent retention in the park library and archives. Oral history project staff also completed and filed final transcripts of the oral histories on ungulate management in the park.

Reid and Whittlesey interviewed Superintendent Michael Finley before his retirement in June 2001. The transcript of this interview was excerpted in the summer issue of *Yellowstone Science* magazine, and Whittlesey placed Finley's office records and per-

sonal papers into the park archives in July. Reid developed a protocol for interviewing other long-term employees upon their transfer or retirement from the park, and attempted to obtain oral histories from several departing rangers, some of whom were reluctant to be recorded.

Reid's attendance at the conference of the International Bear Biologists Association in Jackson, Wyoming, in May and a subsequent posting in the IBA newsletter resulted in her finding several dozen people who had been associated with bear management in Yellowstone and were willing to record interviews. A \$4,000 grant from the Yellowstone Association, awarded in October, will allow park staff to begin work on the oral history of bear management in 2002.

Research and Technical Assistance

Lee Whittlesey researched a number of issues and completed reports at the request of park managers or needed by staff working to meet requirements of the National Historic Preservation Act. These included: a history of the Mail Carrier's House in the Mammoth Hot Springs Historic District; a compilation of published materials on the history of landscaping in Mammoth; a history of the Canyon Bus Complex, 1909–1996; a manuscript on the history of the Haynes Warehouse/stockroom in Mammoth; and a history of Apollinaris Spring.

In addition to working on publications of his own (*see Appendix II*), Whittlesey reviewed manuscripts by other writers: Joel Janetski's revised *The Indians of Yellowstone Park*; Jeanne Eder's Ph.D. dissertation "An Administrative History of Indians of Yellowstone National Park, 1851–1925;" Mike Yochim's "Some Flaws in the Theories of Charles Kay," which was published in a biology journal; Paul Schullery's manuscript "Lewis and Clark Among the Grizzlies;" and Mike Yochim's article for *Montana the Magazine of Western History*, "Beauty and the Beet: A History of Dams in Bechler."

The park archivist-historian regularly provided advice to outside researchers: Mary Ellen Strom, a professor from Tufts University who was researching



the history of the Northern Pacific Railroad; Elaine Turney of Texas Christian University on her bison management thesis; and Steve Mishkin, a lawyer from Seattle, on a history of law and legal matters in Yellowstone. He rendered historic and geographic aid to the GIS thermal mapping project, reviewed text for the new exhibits in the Yellowstone Historical Center's museum, which opened July 15, aided Bob Flather in his research of backcountry cabins and other resources, and wrote the text for the Yellowstone Association's 2003 history calendar and helped review photographs for it.

Notable Acquisitions

The following items were acquired for the archives and library in 2001:

- a copy of the 1902 Herbert Angelo diary, from family member Richard Shipley;
- the large Bob Whelan/Todd Fredrickson photo collection from Los Angeles (park photos 1915–1925), purchased for \$2,300;
- the H.B. and Isabel Weatherwax scrapbook (1910), purchased on eBay;
- copies of the 1903 and 1910 Streeter diaries, obtained through descendant David Thorpe;
- a collection of the material Mary Bolhuis accumulated during her research on the Civilian Conservation Corps in Yellowstone, 1933–1941 (*see Oral Histories*); and
- a 1920s film on Yellowstone geysers by Burton Holmes, purchased in August.

In October, the archivist went to Los Angeles to obtain the Whelan collection and deliver two 1920s celluloid film-prints to the Los Angeles Photo-Kem and Triage studios to be properly conserved.

Records from the National Archives

Yellowstone's archival collection is managed under a long-standing agreement with the National Archives and Records Administration (NARA), permitting park records to stay on site to be used by park staff and visiting researchers. The archival collection numbers an estimated 4,832,521 documents that were officially accessioned into the NPS catalog record in 2000.

Fee demonstration funds, originally approved in 1999, continued to be used to obtain copies of Yellowstone-related records from the National Archives in Kansas City. The park received the final installment of copies of important records from 1930 to 1967 in August, and most of these records had been inventoried into the park archives by year's end.

Outreach

In the spring, the park historian spent a week at the Minnesota Historical Society with Paul Schullery researching Langford family materials for their book, *Myth and History in the Creation of Yellowstone National Park*. On June 8, he presented the keynote speech, "How Yellowstone Was Set Aside and a Primer on its Conservation History," for the Greater Yellowstone Coalition annual meeting. In July, he attended the grand re-opening of the Museum of the Yellowstone, which showcased some of the Davis Collection, and presented a speech on "Human Deaths in Yellowstone." He presented a paper on the history of Indian legends at the park's sixth biennial science conference in October.

The park historian gave numerous talks and tours to park staff and former employees throughout the year, and taught several classes at the Yellowstone Institute, including one on the history of early Yellowstone photographers and stereographers, one entitled "Southern (Yellowstone) Roadside History," and a four-day horse-packing trip on the history of poachers and poaching in Yellowstone.

The archivist-historian took numerous opportunities to acquire objects for the park collection. In April, he and ornithologist Terry McEaney traveled to Dillon, Montana, to examine the large stuffed bird collection owned by Dennis and Kathy Jones for possible donation to the park museum. On June 8–10, he attended the annual National Park Paper Show in Billings, Montana, in order to purchase or trade for objects for the park. In September, he traveled to Rocky Mountain National Park, Colorado, to speak to that park's library, archives, and museum staff and additional library trainees on archival management techniques, and in October he spoke on "The Yellowstone National Park Library and Archives" at the Montana Library Association's annual meeting.



Bison graze the banks of the Firehole River after a June snowfall. Visitor photo.

Part III. Natural Resource Programs

AIR, LAND, AND WATER

Air Quality

Clean Air Partnership. Resource management specialist Mary Hektner continued to represent the park in the Greater Yellowstone Area Clean Air Partnership, which also includes Grand Teton National Park; Gallatin, Custer, Beaverhead, Shoshone, Bridger-Teton, and Targhee National Forests; Red Rock Lakes National Wildlife Refuge; the Idaho National Environmental and Energy Laboratory; and the Montana, Idaho, and Wyoming Departments of Environmental Quality. The partnership serves as an advisory group to the Greater Yellowstone Coordinating Committee and is a forum to facilitate air program coordination and the implementation of consistent air quality management strategies.

Mercury contamination. A mercury deposition monitor funded by the Environmental Protection Agency was installed at the Yellowstone Lake air quality station as part of a nationwide network to determine the range and concentration of mercury contamination. Fish and other wildlife commonly attain mercury levels of toxicological concern when directly affected by mercury-containing emissions from human-related activities. Human health concerns arise when humans consume fish and wildlife from affected ecosystems. The best estimates to date suggest that human activities have about doubled to tripled the amount of mercury in the atmosphere, and the atmospheric burden is increasing by about 1.5 percent per year (U.S. Geological Survey 2001, *Mercury Contamination of Aquatic Systems*, <http://wi.water.usgs.gov/pubs/FS-216-95>).

The objective of the Mercury Deposition Network is to develop a national database of weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. The data will be used to assess spatial and seasonal trends in mercury deposited to surface waters, forested watersheds, and other sensitive receptors. Park staff are also working with the U.S. Geological Survey to develop proposals and seek funding to evaluate the contributions of mercury from natural sources.

Air emissions inventory. As part of a service-wide program, the NPS Air Resources Division contracted for an air emissions inventory in Yellowstone in 2000. The inventory was designed to:

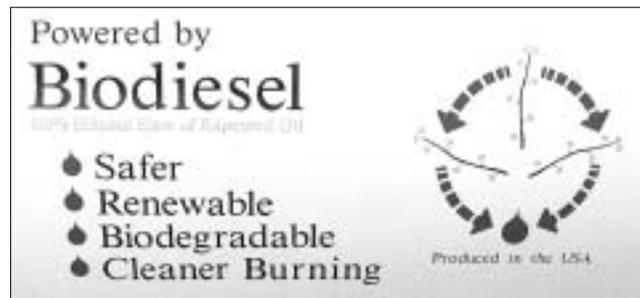
- provide an understanding of the sources and magnitude of in-park emissions and a basis for contrasting them with emissions from the surrounding area,
- identify existing and potential strategies to mitigate in-park air emissions, and
- evaluate and ensure the compliance status of the park relative to state and federal air pollution regulations.

The inventory evaluated three types of air emission sources:

- stationary sources include fossil fuel-fired space and water heating equipment, generators, fuel storage tanks, paint and chemical usage, and woodworking equipment;
- area sources include prescribed burning, campfires, wastewater treatment plants, highway maintenance, and miscellaneous visitor activities;
- mobile sources include vehicles and equipment operated by visitors, tour operators, and NPS and concessioner employees.

The report, released in 2001, recognized a number of energy and water conservation, recycling, and alternative fuel initiatives that have already directly or indirectly reduced air emissions around the park. It recommended continued promotion of sustainable development in the design, retrofit, and construction of park facilities for their associated air quality benefits. Of the park's stationary air emission sources, residential wood stoves were estimated to be the largest emitters. Park officials are aware of this issue and have discussed measures that include wood stove removal, phase-out, and/or replacement with units that meet USEPA New Source Performance Standards for residential wood stoves. The report also noted the park's proactive efforts to procure alternative fuel vehicles, particularly in light of its relatively isolated location and limited access to alternative fuel supplies, and its efforts to acquire four-stroke snowmobiles and marine engines, which are cleaner burning than conventional two-stroke engines.

Snowmobile emissions and air quality concerns continued to stay in the news as the park's winter use planning and compliance process continued.



In February 1995, Dodge Truck, Inc., donated a new ¾ ton 4 × 4 pickup to the park. Above is the logo painted on its side. It runs on 100 percent biodiesel, and averages 17 miles per gallon, the same as when it was tested with regular diesel fuel. No modifications were made to the truck's engine or fuel system. Emissions tests showed that smoke, hydrocarbons, nitrogen oxides, and carbon monoxide were reduced by using biodiesel.

Disturbed Lands and Mining Impacts

Turbid Lake Road. The five-year project to reclaim the 2.5-mile segment of the Turbid Lake Road between Turbid Lake and the Pelican Valley trailhead was completed in 2001. With the help of the Montana Conservation Corps and Fee Demonstration funding and a generous donation from Canon U.S.A., Inc., park staff de-compacted the last 0.6 miles of abandoned roadbed, reshaped road cuts to restore original drainage, and transplanted native sedges, grasses, forbs, and trees into the former roadbed. Six acres of prime grizzly bear habitat have been restored, including 1.35 acres of wetlands.

NPS Natural Resource Preservation Program Disturbed Lands Reclamation funding for the remaining three miles of the road between Turbid Lake and the East Entrance road was secured in 2001. The work is scheduled to begin in 2002 and be completed in 2004.

Gravel pits. A very successful partnership with the Wyoming Department of Environmental Quality Abandoned Mine Land Division (AML) culminated in the restoration of three abandoned park gravel pits (Lone Star Geyser, Sedge Creek, and Natural Bridge/Bridge Bay pits) totaling 23.6 acres. The pits, which were abandoned between 1950 and the early 1970s, posed threats to public safety, had little revegetation, and in some cases were eroding into streams. The AML used a grant from the Office of Surface Mines to hire an engineering firm to design and oversee the restoration work, which has permanently closed the pits and restored them to a more natural condition.

Mining reclamation. Park staff continued to participate in planning and technical meetings, and to

monitor reclamation projects associated with three mining areas located outside the park: the New World Mining District Response and Restoration Project, the TVX Mineral Hill Gold Mine, and the McLaren Mill tailings.

Resource management specialist Mary Hektner continued to serve as the Department of the Interior Project Coordinator for cleanup of historic mining impacts in the New World Mining District adjacent to the park's Northeast Entrance, which is proceeding smoothly. The U.S. Forest Service continues to identify sources of pollution and conduct site investigations to refine cleanup activities. Approximately 24,000 cubic meters of contaminated waste rock and tailings were placed in a repository constructed in the headwaters of Soda Butte Creek.

Reclamation of the Mineral Hill mine is nearing completion. Park staff worked with NPS Water Resources and Geologic Resources staff and the Montana Department of Environmental Quality to explore options for treatment and removal of the McLaren mine tailings, which are located upstream and just outside the park's northeast boundary.

Wetlands

As part of the park-wide road reconstruction program, wetland delineation and mapping was initiated along the Grand Loop Road between Norris and Golden Gate. In addition, areas for potential wetland restoration were delineated along two abandoned road corridors near the East Entrance and Turbid Lake. A restoration plan for 1.3 acres of wetlands along the Turbid Lake Road corridor was prepared and submitted to the Army Corps of Engineers as mitigation for impacts anticipated in the reconstruction of the Canyon-to-Tower (Dunraven) road segment. More than 10 project clearances were reviewed to ensure that impacts to wetland resources would be avoided or minimized.

AQUATIC RESOURCES

Lake Trout Removal

Since the 1994 confirmation of the presence of lake trout (*Salvelinus namaycush*) in Yellowstone Lake, park fisheries biologists have been seeking ways to minimize its threat to the native Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*). Since 1995, more than 43,000 lake trout have been removed from Yellowstone Lake via gillnetting. Most of these fish have come from West Thumb and

Breeze Channel, where most of the gillnetting effort has been concentrated. Bioenergetics modeling (estimates of how many cutthroat trout a lake trout may consume) suggests that a mature lake trout can eat from 50 to 90 cutthroat trout per year. The lake trout control project has thus saved a large number of cutthroat.

In 2000, refinements in netting techniques, combined with additional seasonal personnel dedicated to the netting program, enabled park staff to double the 1999 gillnetting effort and remove almost 13,000 lake trout from Yellowstone Lake in 3,354 netting units. (One net unit is 100 m of net set over one night.) During 2001, the arrival in mid June of a new boat designed specifically for gillnetting on Yellowstone Lake greatly improved working conditions for employees (running water, heat, adequate working space, and safety features) and the efficiency of gillnetting operations.



Lake trout cannot replace this cutthroat trout tributary spawn, an essential food source for many species.

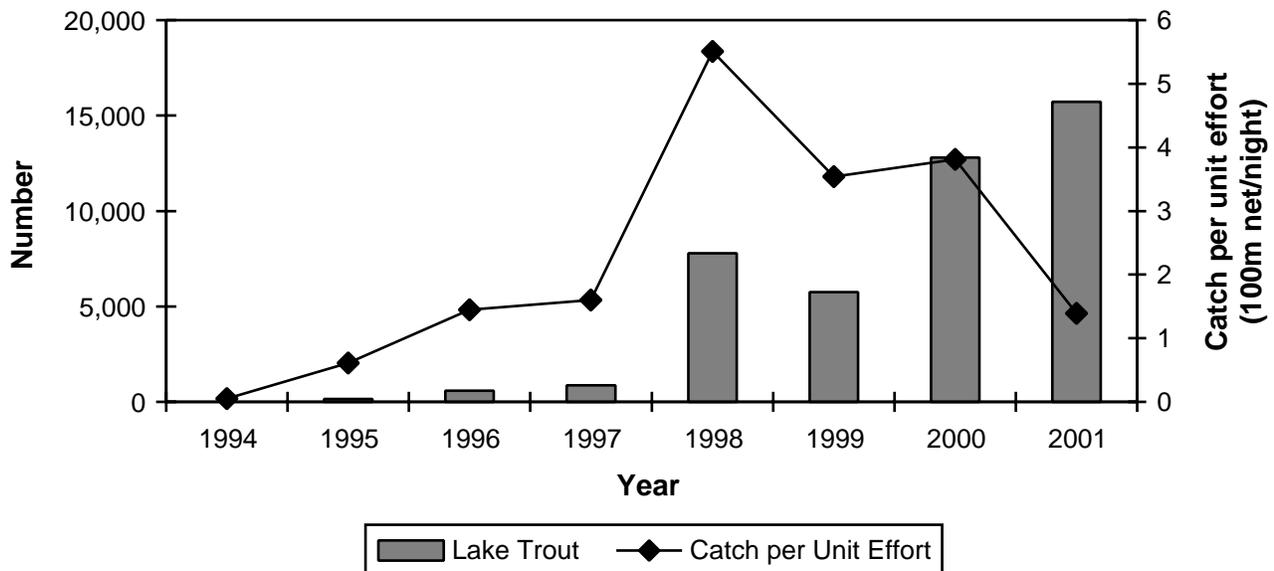


Figure 1. Number of lake trout removed each year since verified in Yellowstone Lake, along with catch per unit effort, 1994–2001. Catch per unit effort is standardized by 100 m of gillnet set over one night.

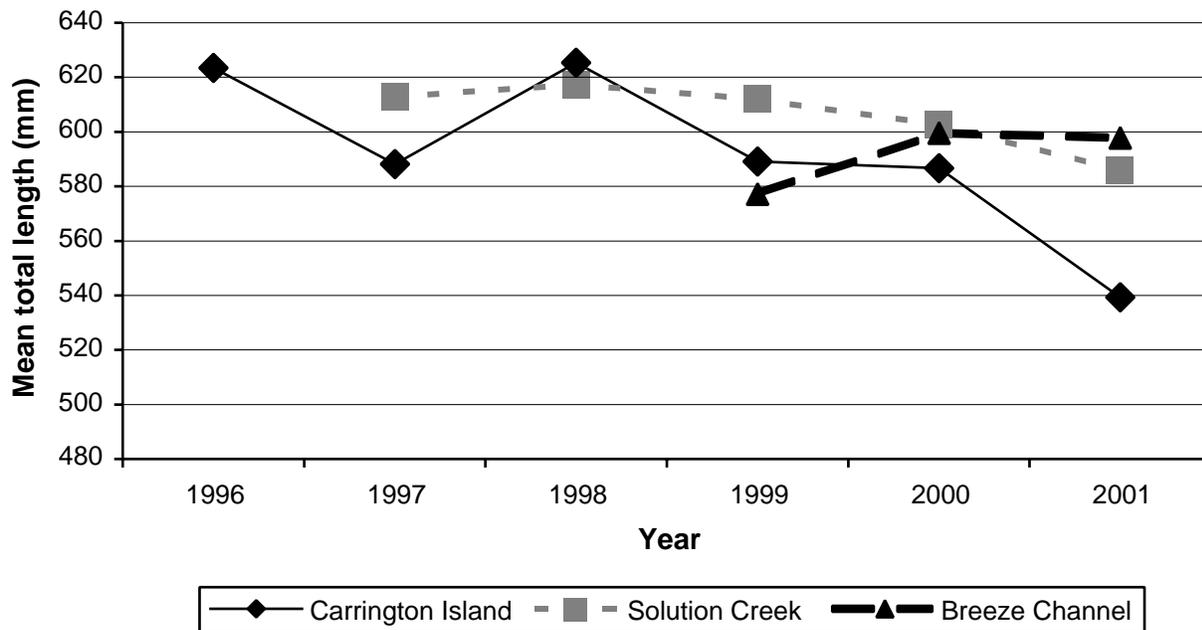


Figure 2. Mean total length of lake trout removed from or near spawning areas, Yellowstone Lake, 1996–2001.

Gillnetting results for 2001. More than 15,000 lake trout were removed from Yellowstone Lake in 2001. The catch per unit effort was less than half that of 2000, indicating that the netting effort may be controlling the growth of the lake trout population (Figure 1). In August, personnel from the Idaho Department of Fish and Game donated time and equipment to repeat hydroacoustic surveys that had been done in 1997 and 1998. Density estimates in the West Thumb area of the lake, where the highest

densities of lake trout have been found, were 10 percent less than in previous years. The mean total length (TL) of lake trout caught near Carrington Island, and in Solution Creek and Breeze Channel during spawning all decreased from previous years (Figure 2).

NPS fisheries personnel employed two basic gillnetting strategies: control and spawner sets. Distribution sets, employed in previous years, were discontinued in 2001. Other experimental sets (using

various mesh sizes, set depths, and set durations) were tried on a limited basis throughout the summer.

- Control nets continue to be the most effective method for removing lake trout from Yellowstone Lake. This netting effort primarily targets the smaller lake trout (<450 mm TL) in water 50–75 m deep to maximize the removal of the non-predatory life history phase and minimize the by-catch of Yellowstone cutthroat trout. Small-mesh, monofilament gillnets ranging from 19 mm to 44 mm bar measure are fished from May through October. To try to capture larger lake trout when they are found in shallower water 5 m to 15 m deep, larger mesh control nets (51 mm to 89 mm) are fished between ice-off and the beginning of thermal stratification.
- Spawner nets target spawning lake trout from mid-September through mid-October, when lake trout move onto their spawning grounds. Monofilament gillnets ranging in size from 51 mm to 70 mm bar measure are fished at two known spawning locations in West Thumb and another possible spawning site in Breeze Channel. Several other locations throughout West Thumb were sampled at this time in an attempt to locate additional spawning grounds.

Long-term prospects. Although recent numbers from the lake trout removal program are encouraging, we have by no means declared victory over the lake trout crisis in Yellowstone Lake. Lake trout densities in West Thumb remain high and a serious threat to the Yellowstone cutthroat trout. We still do not know the extent of the lake trout population lake-wide, and we have so far been unable to develop a technique to remove lake trout in the mid-size range (400 to 600 mm total length). This component of the population co-exists with the cutthroat trout population, making it impossible to effectively gillnet them without incurring an unacceptable mortality rate on cutthroat trout. We are still investigating new methods to begin targeting this segment of the population before they reach full maturity and perhaps pioneer new spawning sites.

In 2002, we anticipate having 250 nets (~100 m each) ready for

use when the ice comes off the lake. With an experienced crew and a fully operational gillnetting boat, we expect to be able to accomplish even more during the next season. New hydroacoustic equipment will enable us to determine areas of high density, the size range of fish in given areas, and the depths at which the fish are residing. By combining this data with detailed bathymetry data produced by USGS and GIS technology, we will be able to identify lake areas where increased or decreased effort will result in improved efficiency. We will also be able to use this technology to evaluate the effectiveness of our removal efforts by estimating minimum lake trout population strength annually.

Cutthroat Monitoring in Lake Tributaries

To assess the current and potential impacts from lake trout and whirling disease in Yellowstone Lake and its tributaries, park fishery staff annually monitor the population structure of spawning Yellowstone cutthroat trout entering certain tributaries. In 2001, fish traps and weirs located on Clear, Arnica, and Bridge Creeks enabled biologists to gather information on the cutthroat trout entering these streams to spawn.

Clear Creek. The Clear Creek fish trap has provided information on the numbers and size of trout entering the stream to spawn since the early 1950s. In 2001, park fishery staff operated the fish trap from May through July and counted 10,789 trout migrating upstream. A total of 7,482 fish (nearly 69 percent of the upstream run) passed downstream through the trap on their return to the lake. These



Yellowstone cutthroat trout.

counts are comparable to totals recorded from 1997 to 1999, indicating that this component of the population has remained relatively stable for the past several years. However, when compared to long-term data, these upstream counts are significantly less than the highest counts recorded during the late 1970s and early 1980s (Figure 3). Trapping procedures are scheduled for 2002.

Arnica Creek. In 1997, park fishery biologists expanded the number of monitored streams by installing a fish trap in Arnica Creek that was similar to that used at Clear Creek. This stream was selected because it historically contained one of the largest spawning migrations of cutthroat trout in an area of the lake where large lake trout have become abundant. Unfortunately, malfunctions in counters, traps, and weir design have prevented an accurate count since monitoring was reinitiated in 1997, and 2001 was no exception; the fish trap and counting system had to be pulled early in the season because of problems with the counter. Numerous changes will be made next year to try to obtain a more precise count.

Bridge Creek. Beginning in 1998, park fishery biologists began to monitor the spawning run of cutthroat trout in Bridge Creek by installing a counter near the mouth of the stream. In addition to its close proximity to the lake field office, Bridge Creek supports a large spawning run of Yellowstone

cutthroat trout relative to the size of the stream. Bridge Creek is also used as a test facility and designed to reduce the amount of required maintenance, which could enable fishery staff to monitor small, remote backcountry streams in the future.

In 2001, upstream and downstream migrating trout were counted as they passed through an electronic fish counter. A total of 1,140 fish were counted migrating upstream, and 697 or 61 percent of the upstream migrants passed downstream through the trap on their return to the lake. Spawner counts are planned for 2002.

Cutthroat Monitoring at LeHardys Rapids

Since 1974, dipnetting at LeHardys Rapids has been used to collect spawning Yellowstone cutthroat trout from the Yellowstone River. LeHardys Rapids provides an excellent sampling site as mature cutthroat trout congregate in the pools around the rapids before moving upstream to spawn. Cutthroat trout size, age, sex ratios, and growth rates are monitored.

Annual sampling. From May 23 to June 11, three-person crews sampled spawning cutthroat trout weekly. Dipnetting was limited to pools along the edges of the rapids, where fish tend to congregate during the spawning run. Captured fish were placed in large tubs, anesthetized with Tricane-S, measured to total length, weighed, and visually identified to sex and stage of maturity. To obtain length-specific

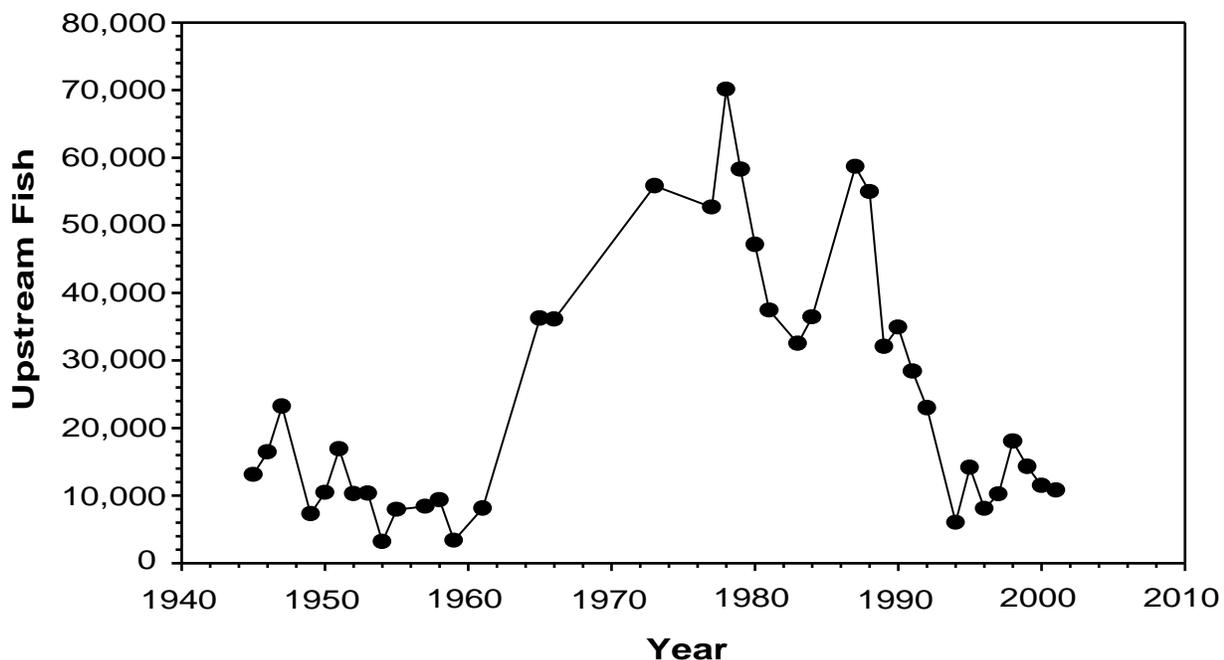


Figure 3. Upstream spawner counts of cutthroat trout entering Clear Creek, 1945–2001.

stratified age and growth data, scales were taken from captured mature fish (10 fish samples of each sex in each 10-mm size class). All captured fish were marked with a caudal punch, revived, taken upstream of the rapids, and released.

A total of 31 mature cutthroat trout were netted at LeHardys Rapids during the 2001 field season, with the largest number (16 fish) taken on May 29. Mature cutthroat averaged 421 mm in total length, significantly larger than the 25-year average of 392 mm. Males were larger (432 mm) than females (398 mm). The total catch in 2001 was the second smallest in the 27 years of sampling, and 197 less than in 2000. Because of the extremely low water conditions, cutthroat trout may have been able to ascend the rapids in the middle of the river and did not require the use of the pools on the banks. Continued weekly spawner monitoring is planned for the 2002 field season.

Broodstock. Due to the low numbers (less than 10 pairs) of fish captured at LeHardys Rapids this field season, the Wyoming Game and Fish Department did not collect gametes from fish there this year to supplement their broodstock. Fifty pairs of fish were instead collected at Clear Creek, a tributary to Yellowstone Lake.

Whirling Disease Research

Since November 1998, when the whirling disease parasite was verified in Yellowstone cutthroat trout from Yellowstone Lake, park managers and fishery biologists have sought to obtain the baseline information needed to determine the spatial extent and severity of infection there. Because the diagnostic form of the parasite is embedded in the head of affected fish, lethal procedures that involve internal examination of individual fish are the only currently accepted methods for reliable disease detection.

During 1999 and 2000, two sampling schemes were used to examine the distribution of the parasite in Yellowstone Lake. Throughout the summer, larger cutthroat trout that were by-catch during lake trout gillnetting operations were retained for histological analyses. Examination of nearly 900 fish revealed that mild whirling disease infections were widespread in these older cutthroat trout. Prevalence ranged from more than 25 percent of the population in the northern portions of the lake to about 10 percent in the southern arms. Because of the mobility of these fish, however, the source of the infection could not be determined with any degree of certainty.

A more reliable method of detecting parasite presence is to expose cutthroat fry to potential areas of infectivity during periods when water temperature and stream flow are optimal for the parasite to attack. This “sentinel cage exposure test” was used at about a dozen tributaries where Yellowstone Lake cutthroat trout spawn. Results from 1999 suggested that only one of the sites (near Fishing Bridge) was a source of whirling disease infection. None of the fry tested exhibited any clinical signs of the disease. In 2000, the sampling procedures were modified to include a broader range of water temperatures by exposing several groups of young cutthroat during different months in the same tributary streams. Laboratory examination of fish exposed in 2000, completed in fall 2001, found fish that tested positive for whirling disease in Clear Creek and Pelican Creek.

In 2001, the number of streams where multiple exposure tests were conducted was increased. Digital temperature loggers were placed in 50 known cutthroat trout spawning tributaries to Yellowstone Lake in early June. Classification of all known cutthroat trout spawning tributaries was completed by multivariate analyses of basin physiochemical characteristics. Streams used for sentinel cage exposures were chosen to represent the widest range of temperature and flow characteristics available in the upper Yellowstone basin. Age-zero Yellowstone cutthroat trout were obtained from the Wyoming Game and Fish Department’s Clark Hatchery that were first generation fish from adults originating at LeHardys Rapids in the Yellowstone River. Age-zero fishes were exposed to waters of 12 tributary streams to Yellowstone Lake and the Yellowstone River proper downstream from Fishing Bridge. A minimum of 60 trout were exposed in each stream during three separate 10-day periods from July 12 through September 7. As a control, fish were also held in living stream tanks at the Yellowstone Lake lab during these periods. Each group of fish removed from the cages was transferred to the Wild Trout Laboratory in Bozeman, held in isolation for 90 days, and then transferred to the Bozeman Fish Health laboratory to undergo histological and PCR analyses to determine if whirling disease was present.

In the same streams that were used for sentinel cage testing of trout, the first survey of *T. tubifex* worms and substrate conditions was also completed. *T. tubifex* are the alternate host of the whirling disease parasite, and their presence is required for the disease to persist. It appears from work this year that

T. tubifex worms are not uniformly distributed in streams of the upper Yellowstone basin. Genetic testing of these worms is underway to determine the geographic isolate of the worms and whether the infection is indeed *Myxobolus cerebralis*, the parasite that causes whirling disease. Comparing this worm distribution information and data regarding fish infection prevalence and severity with water temperature and stream flow data will assist managers in detecting current sources of infection and predicting other areas with high probability of becoming infection sources. The overall goal is to determine what portion of the annual Yellowstone cutthroat trout year class is succumbing to whirling disease each year. Results will have implications for management in Yellowstone National Park and for many other regional managers concerned about whirling disease.

Westslope Cutthroat Trout Restoration Potential

Since 1997, the Aquatic Resources Center has sought to increase what is known about the life history and genetic status of westslope cutthroat trout (*O. c. lewisi*), historically the only native trout in the Gallatin and Madison Rivers. Initial surveys indicated that the only genetically pure populations were in Fan Creek, a major tributary of the Gallatin River. For a graduate research project to examine seasonal movements of westslope cutthroat trout in the Fan Creek drainage, fishery crews used electrofishing equipment to capture 48 cutthroat trout in portions of the North Fork of Fan Creek just upstream of its confluence with the East Fork in May. Captured fish ranged from 96- to 345-mm total length and represented at least three distinct year classes. Larger cutthroat trout were implanted with radio tags for seasonal movement studies and fin clips were collected for genetic analysis. As in previous surveys, several of the cutthroat trout were in spawning condition. Cutthroat trout that were too small to be equipped with radio tags were implanted with Passive Integrated Transponder (PIT) tags. Sampling several km downstream in early June yielded low abundance of cutthroat trout hybridized with rainbow trout. No mature fish were captured at that site.

The annual summer sampling of the North Fork of Fan Creek was postponed until September because of concerns about potential stress to fish caused by high water temperatures associated with the ongoing drought. At three established monitoring sites,

approximately 100-m sections were electrofished. Multiple pass depletions yielded estimated westslope cutthroat abundance of 72, 56, and 54 trout, respectively, per survey section. Capture probabilities were similar (about 0.55) in the two upper sections, where abundance estimates were almost identical. However, the capture probability was poor (0.30) in Section 1, where estimated abundance was greatest. Several trout longer than 150 mm TL were captured in the two upper sections. Fish caught in the lower area were all less than 140 mm TL. Mottled sculpin (*Cottus bairdi*) were found only in Sections 1 and 2.

In the East Fork of Fan Creek, between 30 and 40 cutthroat trout were captured at both long-term monitoring sites, but very poor capture efficiencies resulted in much different abundance estimates (180 trout per 100 m in Section 1 but only 52 fish per 100 m upstream in Section 2). Although average length of trout in the downstream section was 35 mm more than that in the upstream section, few fish in either area exceeded 200 mm. Mottled sculpin were at least twice as abundant as trout in each section, but abundance estimates could only be made in Section 1. In 2001, a juvenile whitefish (*Prosopium williamsoni*) was captured in Section 1. This was the first collection of this species since our surveys began, suggesting that this stream is important for multiple native species.

Estimated fall abundance of cutthroat trout in the Fan Creek main stem was much less than that observed in either of the upper two tributaries. Only 15 trout were captured within the 100-m study site, which is about a mile downstream from the confluence of the East and North Forks. Sculpin were very abundant, with an estimated density of more than 4,500 per km of stream. Two brown trout (*Salmo trutta*) caught at the site provide additional evidence that there are no barriers in Fan Creek that would prevent migration of non-native competing species into areas where westslope cutthroat trout reside.

Arctic Grayling and Fisheries of the Gibbon River

For the past three years, aquatic resources personnel have collected fishery and habitat data from the Gibbon River in association with the Madison-to-Norris road reconstruction project, during which a portion of the road will be removed and replaced with an entirely new road segment. The study is designed to document changes in



Arctic grayling.

sedimentation rates as a result of the road construction and determine if a fluvial (river dwelling) form of Arctic grayling (*Thymallus arcticus*) exists anywhere in the drainage. Although anglers frequently report catching grayling above and below Gibbon Falls, it is unclear whether the fish dispersed downstream from the headwater lake-dwelling populations in Wolf and Grebe Lakes.

In 2001, 17 spawning grayling ranging from 254 to 316 mm were marked with elastomer tags near the Wolf Lake outlet; all but two were aged as three-year-old fish. Similar to 2000, earlier than usual spawning runs of grayling due to low water and early snow melt in 2001 hindered park fishery staff from tagging enough fish to document downstream dispersal.

During the summer sampling in the road construction areas, two grayling (376 and 337 mm TL) were captured in sample areas at Tuff Cliffs and the Gibbon Picnic Area, but none were captured above Gibbon Falls. Neither fish had been previously captured. With the exception of the meadow site where no rainbow trout were collected, brown trout, rainbow trout, brook trout, and mottled sculpin were common; brown trout were the most abundant species (Figure 4).

Yellowstone Cutthroat Trout Population Surveys

Slough Creek. In response to concerns that increasing angler use, particularly in the “upper meadows,” is causing serious riparian damage and

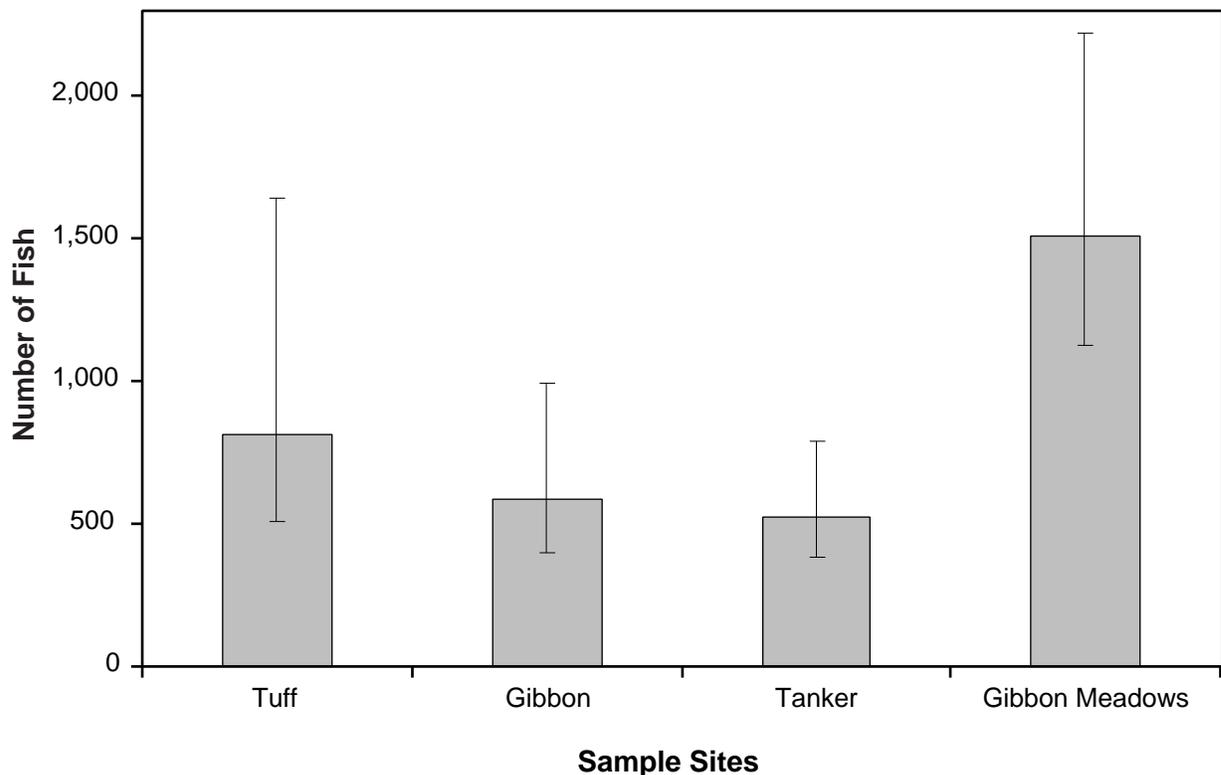


Figure 4. Estimated abundance (number of fish per km) of brown trout in four locations of the Gibbon River, presented in an upstream direction starting with Tuff Cliffs. Error bars depict 95 percent confidence limits based on a Poisson distribution.

SAMPLE AREA	TOTAL ESTIMATE	RELATIVE ABUNDANCE (#/KM)	ADULTS (>330 MM/TL)
Second Meadow	910 (357–3,640)	540 (212–2,160)	203 (92–1,353)
Elk Tongue Cabin area	1,511 (821–3,216)	1,317 (716–12,803)	207 (112–440)

Table 1. Slough Creek cutthroat trout estimates, 2001. Values in parentheses are 95 percent confidence intervals based on a Poisson distribution.

negatively affecting the cutthroat trout resource of the stream, a study of population estimates was initiated in Slough Creek in 2001. The number of adults found at two mark-and-recapture sections sampled in early fall was similar, but lower estimated abundance in the Second Meadow section may indicate limited sampling efficiency there (Table 1). The trout population structure was similar to that observed in 1988–1989, when numerous young-of-the-year and older trout comprised most of the population. No whirling disease was found in any of the subsample of captured trout that was tested.

Antelope Creek. Antelope Creek, which flows adjacent to the Canyon-to-Tower road, was surveyed to monitor potential impacts from proposed road reconstruction. In 2001, electro-fishing was again used to determine species composition and relative abundance of fish in three separate sections of the creek. Yellowstone cutthroat trout was the only species found. Relative abundance averaged 46 cutthroat trout fish per 100 meters of stream, slightly less than the 2000 estimate of 533 fish per kilometer. Fin clip samples taken from each fish to determine its genetic composition have not yet been processed. No known stocking activities have taken place in Antelope Creek.

Road Construction Inventories

Aquatic resources staff continue to monitor streams located within proposed road reconstruction projects throughout the park. In 2001, two new studies were initiated to document baseline conditions and describe the aquatic communities at areas likely to be affected by road construction. In Middle Creek, non-native brook trout and rainbow trout were captured along with Yellowstone cutthroat trout/rainbow trout hybrids. Genetic analyses to determine

the degree of hybridization have not yet been completed.

Several sites in Obsidian Creek were electro-fished in conjunction with the Mammoth-to-Norris road construction project. Although this stream was historically fishless, non-native brook trout (*S. fontinalis*) were stocked there earlier in this century, and surveys in 2001 suggest that brook trout continue to be abundant.

GEOLOGY AND GEOTHERMAL RESOURCES

Drs. Paul Doss and Nancy Hinman both resigned during the summer to return to their respective universities. David Susong, research hydrologist with the U.S. Geological Survey, filled in under an inter-agency agreement for the remainder of the year.

Two plans to help guide the geology program were drafted during the year. The *Integrated Geologic Resources Management Plan* summarizes the geologic resources and provides general guidance for the geologic resources program. The *Thermal Monitoring Plan* provides a comprehensive framework for long-term monitoring and the collection of data to improve our understanding of the Yellowstone geothermal system.

Databases

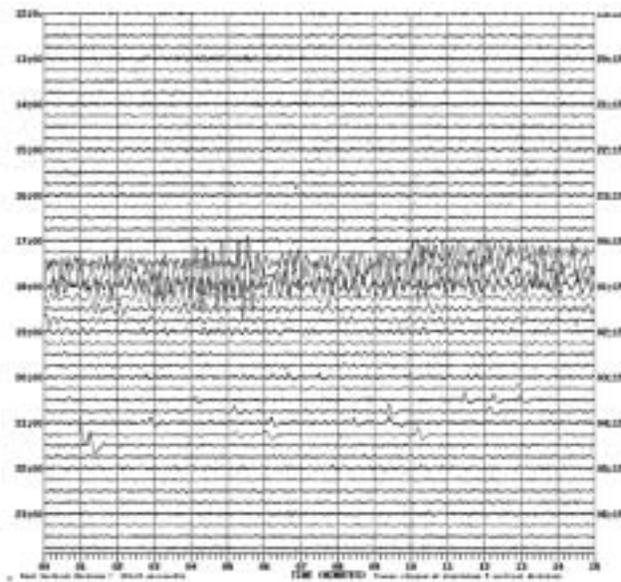
Geyser observation database. The THERMO database was developed to store observational data on thermal features that have historically been collected in notebooks and generally not been available to researchers other than the principle investigator. Volunteers Mary Beth Schwartz and Virginia Rodriguez worked on populating the database with historic data from the Old Faithful and Norris areas. The database is currently located on several computers and must be periodically merged and updated. Ultimately, this database should be developed into a centrally hosted web-based application that is available to a large number of users.

Electronic geyser eruption catalog and database. Ralph Taylor, volunteer at Old Faithful, completed the compilation of all the electronic data that has been collected for nearly a decade on eruption intervals using small data loggers with thermistors placed in the runoff channels. Analysis of this data provides the basis for monitoring changes in geyser activity and for models for eruption prediction. A catalog of the database listing features, types of data,

frequency of data, period of record, and collector was prepared for posting on the YNP web site. Researchers interested in the data can request copies of the database from the YCR. This database should be made available on the Internet in the future.

Partnerships

Yellowstone Volcanic Observatory. The U.S. Geological Survey (USGS), University of Utah, and YNP entered into an agreement in 2001 to establish the Yellowstone Volcano Observatory (YVO) based in existing facilities at the University of Utah and YNP. The partnership provides for improved collaborative study and monitoring of active geologic processes and hazards of the Yellowstone volcanic field and its caldera, site of the largest and most diverse collection of natural thermal features in the world. It will also allow for better interpretation of geologic events because park staff can access real-time data online. The new observatory is modeled after other USGS volcano observatories in Alaska, California, the Pacific Northwest, and Hawaii. Together, the five observatories monitor 43 of the approximately 70 potentially hazardous volcanoes in the United States. Ground-based instruments and satellite data are used for real-time monitoring of active and restless volcanoes, including a modern digital seismic and GPS network operated for many years by the University of Utah Seismograph Stations under a cooperative funding agreement with the USGS and additional support from the NPS.



Seismic data collected by YVO at Norris Junction.

Campaign-style leveling stations and GPS techniques are used to monitor deformation. A newer, continuously recording GPS network has been established by University of Utah and USGS scientists.

Temperature mapping. The YCR Infometrics 760 infrared instrument was lent to the U.S. Forest Service Fire Research Lab for use in remote sensing of fire behavior. The lab is testing the instrument for application and developing methods for flying it on an aircraft to measure surface temperatures. In exchange for use of the instrument, the lab agreed to provide YNP with ground surface temperature maps of the Old Faithful and Norris Geyser Basins.

Chemical analysis of water. Working through the National Park Service's Cooperative Ecosystem Studies Unit (CESU) at the University of Montana, the geologic resources program established an agreement with the Murdock Biogeochemistry Laboratory to do chemical analyses of water from Yellowstone. Analytical capabilities include major ions, metals, nutrients, and total organic carbon. The laboratory will be used for the chloride flux program and can also provide services for other programs.

The chloride flux program continued under the direction of retired USGS geologist Irving Friedman. Planning was begun to transfer the monitoring program to the YCR, a transition that will probably take about two years, depending upon YCR staffing. The first year will move sample collection and processing to the YCR, with data analysis continued by Friedman. The second year, much of the data processing and analysis will be done in the YCR in consultation with Friedman.

Historic maps of thermal basins. A set of maps of backcountry thermal areas in the Bechler area was prepared in the early 1980s. Although the original set on Mylar has yet to be located, a number of these maps were found in paper form and scanned at the University of Montana under a CESU agreement, putting them in an electronic format that is compatible with the Spatial Analysis Center's GIS system. This is one of the most comprehensive thermal data sets in the park and needs to be entered into the geothermal inventory database. When the geothermal inventory re-surveys these areas, the maps and data will provide a baseline for assessing changes to the geothermal systems.

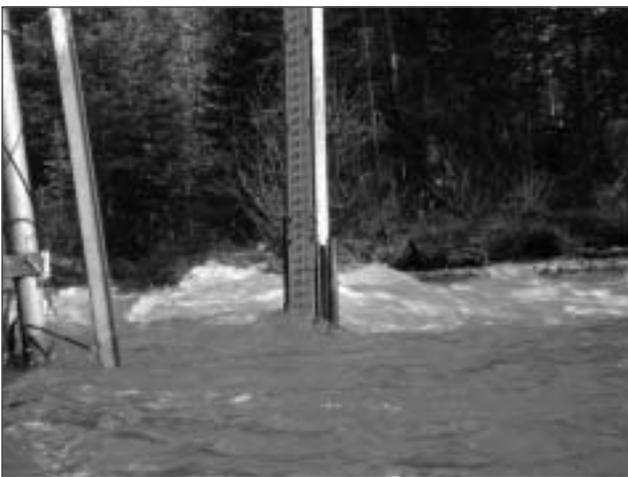
Yellowstone Lake bathymetry. USGS researchers Lisa Morgan and Pat Shanks continued the Yellowstone Lake detailed bathymetry study with funding from Yellowstone National Park and the

USGS. The central part of the lake was surveyed, completing the second one-third of the lake. Field-work scheduled for 2002 will complete the study.

Reese Creek flume study. The goal of the study is to calibrate the Reese Creek flumes to measure supercritical flow. Colorado State University has completed the first phase, which was a literature search. Although a number of studies have designed flumes to measure supercritical flow, none have addressed the question of calibrating parshell flumes. The second phase of the study, performing small scale experimental tests on parshell flumes in the lab to assess calibration potential, was begun.

David Susong consulted with personnel from the Resource Management Operations and Visitor Protection Division on the operation and maintenance of the flumes. Sediment needs to be removed, and measurements need to be compiled in an annual table that is available to all water rights holders.

Montana/NPS Reserved Water Rights Compact. The cooperative agreement with the state of Montana for the administration of the water rights in the Yellowstone Controlled Groundwater Area that expired in 2000 was renewed. The contracts for the operation of the Soda Butte stream gages were continued with the U.S. Geological Survey and the Gallatin National Forest. New equipment was purchased to measure Soda Butte Creek at the boundary, and discharge on Reese Creek. The NPS Water Resources Division is evaluating the operation of the gages on Soda Butte Creek and will have recommendations in fiscal year 2002.



The Soda Butte Creek stream gage. Photo courtesy Chris Gable, NPS-WRD.

Support of Park Operations

Geologic resources staff assisted with ongoing projects, provided training, and responded to crises to assist other park divisions.

Road construction. The Norris-to-Madison road construction is impacting some sensitive thermal areas. Geologic resources staff monitored construction activities in and near the thermal basins, including the realignment of the outlet of Terrace Spring.

Large holes opened in the road to the Grebe Lake gravel pit where it traverses a small thermal area when it was subject to heavy truck traffic. Geologic resources staff evaluated the activity in the thermal area and the potential for additional road collapses and consulted with maintenance staff on solutions to the problem.

Thermal accidents. Park geologists participated in the investigation of two thermal accidents involving visitors that occurred at Maiden Grave Springs and prepared a summary of the probable events based on evidence around and in the springs.

Sedimentation of Mammoth sinkholes. David Susong consulted with maintenance personnel on the sediment that is filling the sinkholes in the Mammoth parade ground. Storm events have washed large volumes of sediment into the sinkhole where Clematis Creek terminates; if this process continues and the sinkhole becomes plugged, the creek will develop a new channel—possibly through a developed area.

Backcountry thermal activity. After evaluating the thermal activity that developed beneath the fire pit at a backcountry campsite in the Lone Star Geyser Basin, Nancy Hinman and David Susong recommended changing it to a no-wood fire site and rehabilitating the original fire site. The increased thermal activity was probably due to the low ground water levels from the extended drought.

Norris sewage treatment plant. Seasonal geologic technician Tim Thompson provided input on proposed construction activities for the new Norris sewage treatment plant. The principal geothermal resource concern is blasting in close proximity to Norris Geyser Basin.

Facilities and Equipment

Physical sciences laboratory. After considerable effort and expenditures, the physical sciences laboratory trailer was brought into compliance with OSHA requirements.

Instrument purchases. Equipment was purchased to upgrade the geologic resources program's

ability to monitor geothermal and hydrologic resources:

- conductance and pH meters and digital temperature probes for measuring field parameters of water samples,
- velocity meters for discharge measurements on Reese Creek and of thermal runoff, and
- stream gage equipment for Soda Butte Creek.

Geothermal Inventory

(See Part IV, *Spatial Analysis Center, New and Ongoing Projects, Thermal Areas.*)

Hydrothermal monitoring. Volunteers and staff continued monitoring several geysers on Geyser Hill, deploying data loggers on Lion, Little Cub, Aurum, Depression, Boardwalk, and Plate geysers on Geyser Hill; on Pyramid Geyser; and on Lone Pine Geyser at West Thumb. The Geyser Hill monitoring was a continuation of work started in 1997 (Aurum and Depression geysers) and 1998 (Plate, Boardwalk, Lion, and Little Cub geysers). The logger on Pyramid Geyser is a continuation of monitoring there begun in 1995.

Paleontology

Staff from both the cultural and natural resources programs continued to work with other divisions to investigate fossil localities and collect information concerning the significance of the park's fossil resources. Although no funding is currently available to support staff specifically dedicated to the park's paleontological needs, the Branch of Cultural Resources continued to provide ¼ FTE from existing personnel to coordinate and facilitate basic paleontological functions. The Branch of Natural Resources provided funds to contract research expertise and provide field documentation of several fossil localities for specific management purposes. Several proposals to investigate specific fossil areas have been previously developed and submitted for funding consideration.

Paleontological inventory on Mt. Everts.

Through the Intermountain Region Natural Resource funds, the National Park Service approved a two-year program to survey the rock formations and alluvial deposits within the fossil-rich Cretaceous uplift of Mt. Everts, located in the northern part of the park and bounded on its western edge by the North Entrance Road. The stratigraphy of Mt. Everts, although not well established, is known to contain Cenozoic and Mesozoic fossiliferous exposures, and

the Cretaceous strata display an interfingering of marine and terrestrial units. A variety of fossil types, including aquatic and terrestrial plants, vertebrates, invertebrates, and trace fossils has been recovered there. A field survey is needed to provide baseline geographic data on fossil localities, stratigraphic data related to the geology of the localities, paleontological data related to the identification of paleotaxa present, and geologic data related to the depositional environment of the fossiliferous units.

An interdisciplinary team representing a wide array of geologic and paleontologic expertise, some with previous experience on Mt. Everts, were identified and field visitation was arranged for as many people as possible. Participants in the current two-year project include: Dr. William Cobban, paleontologist emeritus with the USGS and expert on the Cretaceous index fossils; Dr. Scott Wing, paleobotanist with the Smithsonian; Dr. Karen W. Porter, senior research geologist with the Montana Bureau of Mines and Geology; Dr. Thaddeus Dyman, paleontologist and stratigrapher with the USGS; Dr. Gail Wiggert, California Department of Energy, trace fossil and sediment analysis; and Vince Santucci, paleontologist with the National Park Service at Fossil Butte. Dr. Jason Hicks, paleomagnetic expert with Denver University; Dr. Kirk Johnson, paleobotanist with the Denver Museum of Science and Nature; and Dr. William Fritz of Georgia State University have expressed an interest in joining field investigations for this project in 2002.

Prior to fieldwork, a literature search was conducted to identify research previously conducted in the Mt. Everts area. Fossil localities were identified, stratigraphic interpretations synopsised, and fossils previously collected from Mt. Everts and held in repositories outside of YNP were located. The known and questioned depositional characteristics of the area were synopsised and combined into a handout with a literature list, fossil species list, and stratigraphy charts.

A pedestrian inventory of the exposed formations was conducted, including downslope areas, river and stream washout areas, and Cretaceous exposures of the same formation north of the park boundary. The significant fossil localities were recorded, photographed, and documented. Volcanic ash was collected in various locations for analysis useful in paleoclimate reconstruction. Unique inventory specimens (species not previously collected from the region) were collected for identification and research.

Field investigations will continue in 2002, culminating in the production of individual research reports, articles for consideration of publication in scientific journals, and possibly a CD format publication.

Road reconstruction. Road construction in 1994 unearthed large fossil leaf and fossil wood specimens in the Lake Butte area of the East Entrance road. This inadvertent discovery alerted park managers of the need to identify potential fossil bearing areas before construction and develop a plan for recovery. Reconstruction of the Sylvan Pass-to-East Entrance segment of the road is scheduled to begin in 2003.

Verification of funding for a paleontological survey by the Federal Highways road reconstruction program came late in the 2001 fiscal year. The four-year study project, which was developed through the NPS's Cooperative Ecosystem Studies Unit at the University of Montana, will include a pedestrian inventory of the road corridor to identify potential fossil bearing areas; the development of a strategy to monitor new road construction impacts; the development of an in-the-field fossil preservation strategy; a description of the exposure to the Langford Formation, including recommendations for the preservation of the geologic resource; evaluation and assessment of the significance of any fossils recovered during construction; and recommendations for the interpretation of fossils and other geologic resources. Fieldwork on this project will begin in 2002.

Fossil site documentation. Much of the 2001 effort was spent in field research of several areas on Mt. Everts. Site documentation was completed for a fossil coral locale, a new fossil leaf local with cycad, fern, conifer, and dicot leaves, and the vertebrate fossil previously thought to be a plesiosaur.

Fossil leaf sites were documented on Top Notch Peak in association with a communications tower siting. The site is a secondary deposit of three or four species of angiosperms. New fossil leaf and petrified tree stumps were also investigated on Calfee Creek and Miller Creek at the request of the backcountry trail crew. Several fossil locales were located, but more work needs to be done to complete the documentation of the fossil sites located along these trails.

Several attempts were made to locate the Buffalo Plateau ammonite and fossil coral site. Although the original site could not be located, a new fossil coral, crinoid, and possibly trilobite locale was documented. Field work will continue to re-locate the ammonite site with the help of the researcher who originally found it.

Paleobotanist with the Smithsonian Dr. Scott Wing accompanied YNP staff to a fossil leaf site on the Yellowstone River, first reported by YNP civil engineer Nancy Ward. Dr. Wing felt the site was worthy of further investigation, and attempts were made to locate the stratigraphic unit from which the fossils were eroding. A large stump of a petrified tree was found near the top of the unit, but the *in situ* location of the fossils was not discovered. Dr. Wing's archival research indicated that several other fossil leaf sites had been reported near this area by Erling Dorf in the 1960s. Funding is needed for continued work on the park's high altitude Eocene leaf sites.

Fossil repository project. A proposal was submitted to the Yellowstone Park Foundation to fund field documentation and specimen recovery of several of Yellowstone's important fossil localities. The increasing public interest in fossils and corresponding escalation in the commercial fossil market create additional pressures in managing park fossils.



Smithsonian paleobotanist Dr. Scott Wing (foreground) helped park staff investigate a new Eocene leaf site.

Although the Yellowstone Foundation has approved the project for funding solicitation, funds for this project were not obtained for the 2001 field season.

Volunteer projects. A project was begun in 2000 to inventory fossils previously collected in YNP that are stored in repositories outside the park. Dr. Thomas Reeves compiled information on fossil research previously conducted in the park, identified the principal investigators, the specimen collected, and the institution responsible for the fossil collections. A paleontological bibliography was also compiled to list all publications resulting from the research and identify which materials were available through the YNP archives.

Each repository was contacted by telephone to identify an appropriate contact for information concerning the collections. A cover letter describing the project and a request for information concerning the collected fossils was sent to each repository contact. Some information concerning YNP fossils held in outside collections has now been received.

This project coincides with the NPS system-wide assessment of the status of paleontological programs. The goal is to assure that fossils held in non-NPS repositories are stored to NPS standards and cataloged into the Automated National Catalog System (ANCS+) museum accessions system. Follow-up phone calls will be made to repositories for which no response has been received. Consultation with the curatorial staff of the Smithsonian, where a large collection of YNP fossil specimens is housed, has identified the need for a memorandum of understanding. Although an inventory and evaluation of the collection would benefit both institutions, it cannot be accomplished without considerable staff time investment. Funding sources for this project will be investigated.

VEGETATION

Plant Inventories

New native plants. New collections and clarifications resulted in eight new native vascular plant species being confirmed to occur within the park.

- Previous reports of fourwing saltbrush [*Atriplex canescens* (Pursh) Nutt.] were based on misidentifications or specimens whose material was so limited that a definitive identification was uncertain. A very small population of fourwing saltbrush was found along the Yellowstone River trail just within the park boundary.



Erigeron humilus in willow. Photo by Jennifer Whipple.

- Investigation of the Yellowstone material housed at the Montana State University Herbarium for the Inventory and Monitoring Initiative led to the discovery of a specimen of Missouri milkvetch [*Astragalus missouriensis* Nutt.] that was collected in the vicinity of Mammoth Hot Springs in the early part of the twentieth century. This specimen had apparently been previously overlooked and not included in any vascular plant species list for the park.
- Alpine springbeauty [*Claytonia megarhiza* (Gray) Parry], fan-leaved daisy [*Erigeron flabellifolius* Rydb.], arctic-alpine daisy [*Erigeron humilus* Graham], yellow mountain-heather [*Phyllodoce glanduliflora* (Hook.) Cov.], and dwarf buttercup [*Ranunculus pygmaeus* Wahlenb.] were located by Ken Aho during fieldwork funded by the NPS to develop baseline information on high elevation vegetation in the Absaroka Mountains.

Aho's work, which is being done in connection with his Montana State University Master's thesis and will continue during the summer of 2002, is the first extensive plant ecological work to be done in the park's alpine zone of the Absaroka Mountains. Aho also located at least one more species that may be new to the park, but it has not yet been possible to confirm the initial identification. Additional material needs to be collected to facilitate the identification of this and several other species reported by researchers but not yet confirmed.

The presence of alkali Sacaton [*Sporobolus airoides* (Torr.) Torr.], originally collected in 1892 in the Mammoth area but subsequently not encountered, was confirmed by the relocation of a site near Mammoth Terraces. An outside researcher, Erwin

Evert, relocated low northern sedge [*Carex concinna* R. Br.] in the Slough Creek drainage. This inconspicuous and rarely encountered sedge was first collected by Tweedy in 1885 in Slough Creek and had not been seen since.

Additional exotic vascular plant species were confirmed in the park, primarily in developed areas and along roadsides.

- Several infestations of small hop clover [*Trifolium dubium* Sibthorp], which looks superficially similar to the widespread exotic black medic [*Medicago lupulina* L.], were discovered in the vicinity of the Norris Geyser Basin. Small hop clover appears to have the potential to spread widely on thermally influenced ground.
- A patch of western ragweed [*Ambrosia psilostachya* DC.], a rhizomatous plant which is native to the western United States but is not apparently part of the native flora of the park, was found just north of Norris near Nymph Lake where it has invaded the thermally influenced disturbed ground along the edge of the roadbed.
- A chickweed [*Cerastium* sp.] that appears to be a new species for the park was located in early June adjacent to the Boiling River, but its identification could not be confirmed since it was already in fruit. Additional material will need to be collected.

All three of these recent invaders demonstrate the vulnerability of the thermal areas to major changes in vegetation due to the spread of exotics. This has been especially well illustrated by the spread of several species including Dalmatian toadflax [*Linaria dalmatica* (L.) Miller] and mullein [*Verbascum thapsus* L.] on the Mammoth Terraces, irrevocably changing both the native plant community and the appearance of the thermal area.

The proceedings of the biennial conference on exotic organisms in the greater Yellowstone area resulted in the publication of an annotated checklist of exotic vascular plants in Yellowstone National Park in the *Western North American Naturalist*, Volume 61, No. 3, July 2001. This list includes all of the exotic species that had been identified and located through the field season of 1999, with information about the earliest known report for each species and a brief synopsis of its current status in the park. A joint effort between Resource Management Operations and Visitor Protection and YCR personnel resulted in the publication of another paper from the biennial conference in the *Western North*



Trifolium dubium, an exotic plant species, was discovered in the Norris Geyser Basin.

American Naturalist on managing a complex exotic vegetation program in Yellowstone National Park.

Summer fieldwork focused on rare plant surveys that were conducted in association with various construction projects. The primary focus was on the road from Norris Junction to Golden Gate. In addition, some of the culverts on the wagon route up Slough Creek were surveyed to prevent inadvertent impacts on species of special concern during replacement of the culverts. Other construction sites investigated for rare plants included the new contact station at Lewis Lake campground; the fuel cell site by the West Entrance station; the immediate vicinity of the Old Faithful Visitor Center; proposed sites for the new Norris sewage facility; the new repeater on Top Notch Peak; the Boiling River trail reroute; the new campfire circle at Norris campground; powerline reroutes at Mammoth and Madison Junction; and sewer line replacements at Lake, Fishing Bridge, and Mammoth. The vicinity of two backcountry cabins, Nez Perce and Crevice, were examined for the presence of plant species of special concern. The summer field season resulted in the documentation of 33 additional sites for species of special concern or rare plants. Additionally, approximately five known rare plant sites were examined opportunistically in order to determine the persistence of the species of special concern at those sites.

Vegetation Management and Research

Hazard tree removal. The management biologist assisted the Business Management Division with hazard tree evaluations and removals in the Lake concessions trailer court and Roosevelt cabins employee and visitor areas, respectively. Further

consultation and coordination on roadside hazard trees were undertaken with South District resource management personnel. The management biologist also provided a legal deposition on the park-wide hazard tree management policy and program for a developing court case.

Fire management. The management biologist served as the fire behavior analyst during the active 2001 fire season. Duties involved aerial fire reconnaissance to provide updated fire growth and activity, projecting long- and short-term fire behavior given current and predicted weather scenarios, compiling weather and fire behavior predictions for daily shift plans, and sharing such information with park employees, the Public Affairs Office, and neighboring land management agencies. About 7,400 acres burned in the park during the 2001 fire season. The management biologist aided the fire effects crews by relocating and re-sampling vegetation plots originally established in 1988 at Cascade and Lewis Lakes.

Exotic vegetation management. The management biologist participated in weed control efforts with area resource management coordinators. Additional consultation efforts occurred with Montana State University contractors on a pilot program to inventory the northern range for certain exotic plant species. This inventory program is anticipated to expand in scope and area over the next three field seasons.

The third and final field season for exotic seedbank/native species reclamation trials in the area known as the Gardiner triangle was completed. Efforts to control non-native annual species were highly successful, but revegetation trials using native stock were largely unsuccessful.

Aspen and willow research. The management biologist continued work with researchers from Oregon State University to describe woody (aspen) vegetation conditions in relation to wolf/elk dynamics resulted in an article published in *Biological Conservation*. Vegetation plots were re-sampled during the 2001 field season. Consultation with biologists from the USGS-BRD and Brigham Young University resulted in the analysis of aspen tissues to identify inter- and intra-annual trends in secondary metabolite production in aspen. The management biologist further consulted with researchers from Montana State University to investigate abiotic influences on aspen performance, and with researchers from Colorado State University on hydrological influences of willow physiology and demographics.

Integrated Pest Management

Annual pesticide use proposals and pesticide use logs were compiled as part of the parkwide integrated pest management (IPM) program. As the park's IPM coordinator, the management biologist responded to 17 pest management complaints involving insects (10) and small mammals (7). A rodent-proofing project involving the Maintenance Division and the Branch of Cultural Resources was completed at the Norris Geyser Basin Museum, while another rodent monitoring/exclusion project was initiated with the North District resource management operations staff at the Norris Ranger Station Museum.

Consultation with University of Montana biologists has led to the establishment of monitoring plots in communities dominated by *Ribes* plants to study the transmission of white pine blister rust from intermediate to ultimate host.

WILDLIFE RESOURCES

The Wildlife Resources Team (WRT) is an assemblage of wildlife biologists, biological technicians, administrative assistants, and volunteers within the Yellowstone Center for Resources that works to achieve the mission of the National Park Service and Yellowstone National Park. During 2001, the WRT conducted a broad array of wildlife resource management, monitoring, and research activities, with principal emphasis on issues relevant to bear, bird, bison, other ungulates, lynx, and wolf conservation, as described below. Of special note:

- Staff work that led to the initial implementation of a federal interagency Record of Decision for long-term bison management issued on December 20, 2000.
- Continued monitoring of threatened and sensitive species populations.
- Creative new fundraising and partnerships for mission-critical wildlife ecology research.
- Leadership in bear management practices that enabled YNP to continue to have the lowest rate of negative human–bear interactions in the greater Yellowstone area.
- Inventory of lynx abundance and distribution.
- Research on large and meso-predator life history and predator–prey interactions; the habitat use, population demographics, and vital rates of northern range ungulates; multi-trophic level responses to restoration of the gray wolf; and

epidemiology and pathogenesis of *Brucella abortus*.

- Collaboration with the park's environmental education staff to make wildlife-related presentations to park visitors.

The team worked with private sector and competitive fund sources to supplement the FY2001 park base allocation of \$889,400 to bring the total WRT operational budget to \$1,105,600. In December 2001, permission was received to add two new permanent GS-11 wildlife biologist positions to the team to provide additional expertise for bison and ungulate conservation management.

Bears

Yellowstone National Park is mandated to protect and maintain populations of grizzly bears (*Ursus arctos*) and black bears (*Ursus americanus*) as part of the park's native fauna and to provide park visitors the opportunity to safely enjoy the park's natural resources. The Interpretive, Maintenance, Resource Management Operations and Visitor Protection, and Yellowstone Center for Resources divisions all contribute to management efforts designed to prevent and reduce bear-inflicted human injuries, bear-caused property damages, and subsequent human-caused bear mortalities. To be successful, bear management must be a parkwide, multi-divisional effort.

The Bear Management Office (BMO) coordinates implementation of the park's Bear Management Plan and records data related to bear management activities in the park. The YNP superintendent is a member of the Yellowstone Ecosystem Subcommittee (YES) of the Interagency Grizzly Bear Committee, which is responsible for coordinating management of grizzly bears and their habitat among the state and federal land management agencies in the Yellowstone ecosystem. The YNP bear management biologist is a member of the Interagency Grizzly Bear Study Team (IGBST) as a cooperator on bear food habits, habitat use, and population research in the park; of the Yellowstone Ecosystem Grizzly Bear Technical Team, assisting with policy recommendations designed to ensure scientifically-based resource decisions; and of the Bear Taxon Advisory Group, which collaborates with scientists from around the world to promote the conservation of all bear species. The BMO is also responsible for nuisance wildlife capture and management in the park. In 2001, the BMO consisted of one permanent biologist, one



Grizzly on an elk carcass. IGBST photo.

two-year term biological technician, and two summer seasonal technicians.

Population monitoring.

Bear sightings.—There were 1,064 bear-sighting reports recorded in YNP in 2000, including 551 of grizzly bears, 416 of black bears, and 25 of unidentified species of bear. In addition, 43 observations of grizzly bear sign were reported, 5 of black bear sign, and 24 of sign from unidentified species of bear. The first bear activity of 2001 was recorded in January in the Lamar Valley area, with grizzly bear sightings on January 1 and 13, and a black bear sighting on January 5. The first grizzly bear activity during the post-den emergence period was recorded on March 4 at Milepost 17 along Highway 191. The first post-den emergence black bear activity was recorded on March 9 near the Washburn Hot Springs overlook north of Canyon Junction. The last recorded black bear activity of the year was a visual observation on November 18 near the Hellroaring foot-bridge across the Yellowstone River. The last recorded grizzly bear activity was a set of fresh tracks observed in the snow near Steamboat Point on December 1.

Grizzly females with cubs.—As part of grizzly bear population monitoring in the GYE, the IGBST counts the number of adult female grizzly bears with cubs-of-the-year (COY) annually. Bear sightings reported to the BMO by NPS employees are an integral component of this program. Adult female grizzly bears with COY are the most reliable segment of the population to count. The smaller average home range sizes of females with COY, as well as the number of cubs per litter and pelage-color combinations of different family groups, aid in identifying individual adult females.

In 2001, 42 female grizzly bears with 78 COY were counted in the GYA, with an average of 1.9 cubs per litter. Of these females with cubs, 12 females with 25 COY were observed in the park, with an average litter of 2.1 cubs. Grizzly bear family groups observed in the park included 1 one-cub litter, 9 two-cub litters, and 2 three-cub litters. Some of these females had home ranges entirely within the park boundaries; others had home ranges that overlapped the park boundary and were observed both inside and outside of the park.

Observation flights.—As part of the IGBST grizzly bear population monitoring program, in 2001 the BMO conducted two series of aerial observation flights in five of the Bear Management Units (BMUs) located within the park. During the first series of flights (27.9 observation hours in late June), 31 grizzly bears were observed with a mean group size of 1.5 bears; 9 black bears were also seen. The Lamar BMU had the largest number of grizzly bears (19). During the second series of flights (25.3 observation hours in mid to late July) 39 grizzly bears were observed with a mean group size of 2.2 bears; three black bears were also seen. The Pelican/Clear Creek BMU had the largest number of grizzly bears (23).

No radio-collared bear was observed during the first flight series, and only one during the second. This suggests that either the collared bears have learned to avoid detection from overhead flights or that only a small proportion of the grizzly bears in the park are collared. The IGBST will use these data with observation flight data collected from outside of the park to calculate a minimum population estimate for grizzly bears in the Yellowstone ecosystem.

Bear mortalities.—There were five known grizzly bear mortalities and three known black bear mortalities within the park in 2001. All five of the grizzly bear mortalities were due to natural causes: two were cubs-of-the-year that the evidence suggested were probably killed by wolves; the other

three were sub-adult or adult bears that died of undetermined natural causes. Two of the black bears died from natural causes. The third, an adult male, was euthanized after sustaining severe injuries from a collision with a vehicle at about 10 p.m. on August 9, 2001, south of the Firehole picnic area. After being hit by the car, the bear climbed a tree in a pullout at the edge of the Firehole River. The next morning, the bear was still in the tree and had blood dripping from its mouth. At about 3 p.m. that afternoon, Bear Management Office personnel darted the bear and examined it to determine the extent of its injuries. After consulting a veterinarian from Livingston, Montana, the decision was made to euthanize the bear as the jaw injury would have prevented it from feeding. The necropsy found that in addition to the broken mandible and laceration to the foot, the bear had broken ribs and severe bruising to the abdomen and intestines.

Grizzly bear recovery status.—The grizzly bear has been listed as a threatened species under the Endangered Species Act (ESA) since 1975. The Grizzly Bear Recovery Plan sets forth three population goals that must be achieved before the grizzly bear will be considered for a status change within the Yellowstone ecosystem: 1) to have a six-year average of 15 adult females with COY per year both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone; 2) to have 16 of the 18 BMUs in the recovery zone occupied by females with young from a running six-year sum of observations, with no two adjacent BMUs unoccupied; and 3) to have known human-caused mortality not exceed 4 percent of the minimum population estimate based on the most recent three-year sum of females with cubs minus known adult female deaths. In addition, no more than 30 percent of the known human-caused mortality can be females. To meet the recovery requirements, these mortality limits cannot be exceeded during any two consecutive years, habitat-based recovery goals must be established, and

TABLE 2. STATUS OF THE YELLOWSTONE ECOSYSTEM GRIZZLY BEAR POPULATION.

Recovery Goal	Target Number	Results as of 2001
Females with cubs of the year	(6-year average) ≥ 15	35
Distribution of females with young in BMUs	(6-year sum) ≥ 16 of 18	18 of 18
Human-caused mortality	≤ 14.5	9.7
Human-caused female mortality	≤ 4.3	2.6

there must be a demonstration that “adequate regulatory mechanisms” are in place to ensure conservation of the species if it is removed from the special protections granted by the ESA.

The three population goals were met in the Yellowstone ecosystem for the first time in 1994, but the mortality limits were exceeded in each of the next three years. The population goals have now been achieved every year since 1998. Habitat-based recovery criteria as well as a conservation strategy are being developed to specify how the grizzly bear will be managed within the current recovery zone and state plans for management outside of the recovery zone. If both the habitat and population recovery parameters continue to be met, then the population can be considered for a status review and removal from threatened status when the conservation strategy, state management plans, and the habitat-based recovery criteria are agreed upon.

Grizzly bear food sources. Ungulates (mostly elk and bison), cutthroat trout, and whitebark pine nuts have been identified as three of the highest sources of net digestible energy available to grizzly bears in the park. The annual availability of these food sources is monitored by YNP staff.

Winter-killed ungulate carcasses.—The Yellowstone ecosystem is unique among areas inhabited by grizzly bears in North America because of the substantial use of ungulates as food during the spring season, as indicated by analysis of bear scats, bear feed sites, and bear hair. On average, approximately 79 percent of the energy obtained by adult male and 45 percent of the energy obtained by adult female grizzly bears in the Yellowstone ecosystem is estimated to come from meat. In contrast, in Glacier National Park, over 95 percent of the energy obtained by both adult male and female grizzly bears comes from vegetation. Ungulates rank as the second highest source of energy (kcal/g) available to grizzly bears in the Yellowstone ecosystem. Ungulates are also important to bears because they provide a high quality food source during early spring before most vegetal foods become available. Grizzly bears feed on ungulates primarily as winter-killed carrion from March through May.

Between the beginning of April and mid-May each year, the BMO surveys 28 routes covering 78.9 km of winter range in the Firehole River drainage, 19.8 km in the Norris Geyser Basin, 17.0 km in the Heart Lake area, and 194.8 km on the northern winter range. Survey routes are hiked, snowshoed, or

skied by teams of at least two people. All ungulate carcasses, as well as bears and bear sign (tracks, scat, feeding sign) observed from the survey routes, are recorded. Data collected include species, sex, and age class of carcasses located, evidence of scavenging or predation by grizzly bears, black bears, and other carnivores, and UTM locations of carcasses.

In 2001, three bison carcasses, 21 elk carcasses, two mule deer carcass, and one pronghorn carcass were recorded along the 301.5 km of survey routes completed. The overall rate of one ungulate carcass per 7.2 km of survey route in the areas of thermally influenced ungulate winter range (Firehole thermal area, Norris Geyser Basin, and Heart Lake area) was slightly lower than the average of one large mammal carcass per 6.7 km of survey route recorded from 1992 to 2000. A long-term average has not yet been established for the northern winter range surveys, which have been conducted under the current format for only four years.

Cutthroat trout spawning.—Grizzly bears are known to prey on cutthroat trout in at least 36 different streams tributary to Yellowstone Lake. Beginning May 1 each year, 12 streams within or near the Lake and Grant Village developed areas are checked daily for the presence of adult cutthroat trout. Each week from the time spawning begins until most adult fish return to the lake, teams of two or more persons do visual counts of adult trout to estimate peak periods and the relative magnitude of spawning runs. This data is used to manage visitor use and set opening dates for recreational facilities in the Lake and Grant Village developed areas, which are adjacent to clusters of spawning streams. Management of recreational activities in these areas is necessary to reduce the potential for bear-human conflict. In past years, bear predation on spawning cutthroat trout in Yellowstone Lake tributaries within or near park developed areas has led to conflicts between humans and bears. While making fish counts, observers record bear sightings, scats, tracks, hair, and fish parts. The bear tracks are used to determine the number, species, and association of family groups of bears.

In 2001, a total of 272 spawning cutthroat trout were counted during the peak week in the 12 monitored streams. Grizzly bear activity was observed on four (33%) of these streams and black bear activity on one (8%). The number of spawners counted in each stream during the peak week in 2001 was lower than the averages recorded from 1995 to 2000.

Whitebark pine seeds.—During years with low availability of natural bear foods, especially in the fall, bears often seek alternate foods in association with human activities and both the number of bear–human conflicts and human-caused bear mortalities increase. As part of an ecosystem-wide whitebark pine survey, cone counts are conducted at 19 whitebark pine transects located within the Yellowstone ecosystem. Park staff conduct cone counts on the 10 transects located within the park. Cone counts at these 10 transects averaged 20.5 (\pm 24.2 SD) cones per tree in 2001. This was greater than the long-term (1987–2000) average of 14.3 (\pm 31.3 SD) cones per tree, per year for all transects located within the park.

Confrontations and conflicts with humans.

Confrontations.—Confrontations include incidents of bears charging, approaching, and following people, and entering backcountry campsites and frontcountry developments. In 2001, there were 97 reported incidents of bear–human confrontations (incidents of actual or perceived aggression in which no one was hurt) in the park, 39 involving grizzly bears and 52 with black bears. The species of bear could not be determined in two confrontations.

Bear-inflicted human injuries.—There were no bear-inflicted human injuries in YNP in 2001. The annual averages for the past 10 years (1991–2000) are 1.1 (\pm 1.3 SD) grizzly bear and 0.2 (\pm 0.4 SD) black bear inflicted injuries per year.

Bear-caused property damages.—There were five reported incidents in which bears damaged property but did not obtain human foods in the park in 2001, including one with a grizzly bear and one with a black bear. The species of bear was unidentified in the other three incidents. The annual averages for the 1991–2000 period are 2.2 (\pm 2.6 SD) incidents of property damage by grizzly bears, 1.6 (\pm 1.1 SD) by black bears, and 1.5 (\pm 1.8 SD) by unidentified species.

Obtaining human foods.—There were four incidents in which bears obtained human foods or garbage in the park in 2001, three involving grizzly bears and one a black bear. The annual averages for the 1991–2000 period are 1.7 (\pm 1.7 SD) for grizzly bears and 1.9 (\pm 2.0 SD) for black bears.

Bear management actions. In 2001, there were 335 bear-related incidents in which management action was taken, including:

- 288 incidents where park personnel responded to roadside bear-jams to ensure the safety of park visitors;
- 17 incidents of management hazing of bears;
- 16 temporary closures at campsites, trails, or other areas;
- 11 postings of bear warnings at campsites, trails, or other areas;
- 1 incident where a black bear was trapped in a developed area in the park and translocated to a backcountry area;
- 1 incident where a grizzly bear that was marooned on an island in Yellowstone Lake was trapped and moved to the mainland; and
- 1 incident where a black bear that had been hit and severely injured by a car was captured and euthanized.

Grizzly bear management captures/removals/relocations.—No nuisance grizzly bears were captured in the park or elsewhere in the Yellowstone ecosystem in 2001 in order to remove them from the ecosystem. The annual average for such captures during the 1991–2000 period is 0.2 (\pm 0.4 SD) for the entire ecosystem, and 1.0 (\pm 1.1 SD) for grizzly bears within the park. Nor were any nuisance grizzly bears captured outside the park and released in the park, as is sometimes done.

One grizzly bear was captured and moved in order to increase its chances of survival. This occurred after visitors in a boat reported seeing a bear standing on the shore of Dot Island on May 26. On May 29, bear management and resource management personnel investigated the island and found fresh



“Dottie,” the Dot Island bear. Edgerton family photo.

tracks of one or more yearling-sized bears as well as old tracks from an adult sized bear. They also caught a brief glimpse of a yearling bear as it ran into a forested portion of the island. Remote motion sensing cameras were installed with a scent lure to attract the bear(s) so that the number and age of bears on the island could be determined before trapping attempts were made. No photos of bears were obtained (the cameras were set up at a height to take a photo of an adult bear and could have missed a yearling), and no fresh tracks of an adult-sized bear were found near the lure. Because of the grizzly bear's threatened species status, YNP management decided to move the yearling. Park management also did not want to risk having visitors encounter the bear on the island's confined space where they would not normally expect to encounter one. A bear trap was baited and set, and the yearling grizzly had been caught by the next morning. The bear was released at Grizzly Bay. To give the bear the greatest chance of survival, given its smaller than average size and weakened condition, the bear was not chemically immobilized, ear-tagged, or radio-marked.

Black bear management captures/removals.—One nuisance yearling black bear was captured in a developed area in 2001 and relocated to a remote backcountry area; the annual average for the 1991–2000 period is 0.7 (\pm 1.3 SD). An adult male black bear that had been hit and severely injured by a car was captured and euthanized. The necropsy confirmed that the bear could not have recovered from his injuries and the death is listed as a human-caused road-kill mortality.

No nuisance black bears were relocated into the park in 2001, and no nuisance black bears from within the park had to be captured and removed. The annual average for the 1991–2000 period is 0.1 (\pm 0.3 SD) black bears captured and removed.

Birds

Threatened and endangered species.

Bald eagle.—In 1995, the U.S. Fish and Wildlife Service reclassified the bald eagle from endangered to threatened due to significant population gains made over the last three decades. Certain specific populations, however, are not completely recovered due to heavy metal contamination problems in the Great Lakes region, and habitat encroachment and development problems associated with riparian zones in the desert southwest. The Yellowstone bald eagle population continues to incrementally increase, and

new nests are appearing in unexpected places. In 2001, four new bald eagle nests were located in the park, and 15 eaglets fledged from 31 active nests.

Nest substrate instability, as a result of the 1988 Yellowstone wildfires, caused minimal problems this year for nesting pairs. However, in the next couple of decades we expect large numbers of trees to topple to the ground, which will undoubtedly result in nest failure, loss of nest sites, or sudden changes in location of a nesting territory. Although bald eagles have occasionally been documented taking over previously occupied osprey nests, the incidence of takeover appears to be gradually increasing due to competition for nest sites.

Whooping crane.—This endemic North American species continues to rank as the rarest and most endangered crane in the world. Current estimates place the wild population at 277 cranes and the captive population at 121 cranes, for a total world population numbering 398 whooping cranes.

In the greater Yellowstone and Rocky Mountains, only one whooping crane remained alive in 2001 and continued to summer in the Centennial Valley of Montana. A missing "ultralight" whooping crane was last seen on September 6, 2001, near China Hat, a geologic formation located 15 miles north of Soda Springs, Idaho, where it had been spending the last few summers. This bird was not found in the fall in the San Luis Valley of Colorado during migration, nor in the Rio Grande Valley of New Mexico (two winter concentration areas for cranes). The Whooping Crane Recovery Team has classified this crane as a mortality of a four-year-old, unless new information surfaces.

Species of special concern.

Peregrine falcon.—The peregrine falcon is managed as a species of special concern in YNP, which continues to be a stronghold for peregrines in the northern Rockies. No new eyries were found in 2001, leaving the total number at 16. This is the most peregrine eyries ever recorded in the park. In addition, 31 young fledged from these eyries, which is record production for YNP. The year 2001 marked the third year since the peregrine falcon was removed from the list of endangered species, and two more years of intensive monitoring are required to fulfill federal requirements for full recovery.

Trumpeter swan.—The number of adult swans in the park has declined steadily since 1961 and currently stands at 17 individuals. This is the fourth lowest number recorded since trend data has been

collected, and represents numbers reminiscent of the early 1930s. Swan recruits from Paradise Valley have helped to maintain the Yellowstone swan population for the time being. There were only two nest attempts in 2001, compared with seven in 2000, six in 1999, and nine in 1998. In 2001, no cygnets fledged in YNP. This was somewhat unexpected, because years with drought-like conditions are usually favorable for swan production. During two other severe drought years (1988 and 2000), Yellowstone fledged seven cygnets per year. Except for these years, cygnet production over the last 13 years has ranged from zero to five cygnets.

Molly Islands colonial nesting birds.—The Molly Islands colonial nesting bird census was conducted in mid May, early June, early August, and mid September 2001. The Molly Islands (two small islands named Rocky Island and Sandy Island due to the nature of the nesting substrate) are closed to public entry because of the sensitivity of the area. The census techniques applied this year were consistent with those conducted over the last several years; however, this year both boat and aerial surveys were employed.

Pelicans arrived at the Molly Islands well before Yellowstone Lake was ice-free. On the highest part of Rocky Island, a total of 154 pelican nests were initiated in one aggregation. Double-crested cormorants constructed 76 nests within this pelican aggregation. High water levels did not threaten the colonial nesting birds this year. As the season progressed, 122 American white pelican nests and 60 double-crested cormorant nests remained, and all were successful. Of the 90 pairs of California gulls that attempted to nest, 60 pairs were successful in raising young. There



American white pelicans nesting on Sandy Island, 2001.

were three Caspian tern nest attempts on Rocky Island in 2001. The following young fledged from Rocky Island in 2001: 120 American white pelicans, 65 double-crested cormorants, 95 California gulls, and 3 Caspian terns.

On Sandy Island, 110 American white pelican nests were initiated in three large aggregations, and 35 double-crested cormorants nested and 18 successfully fledged young. California gulls did not nest on Sandy Island in 2001. The following young fledged from Sandy Island in 2001: 85 American white pelicans and 10 double-crested cormorants.

The total fledging count for the Molly Islands included 205 American white pelicans, 75 double-crested cormorants, 95 California gulls, and 3 Caspian terns. As the exotic lake trout management program continues on Yellowstone Lake, the status of the Molly Islands birds will play a critical role in assessing the impacts of this fish on endemic piscivorous birds. At this time, however, lake trout do not appear to have adversely affected colonial nesting bird production. Climatic conditions appear to play the most important role in influencing bird production on these islands.

Osprey.—A total of 96 osprey pairs nested in both 2001 and 2000, fledging 54 young in 2001 and 64 in 2000. Tree nest-site instability and weather continued to affect osprey productivity in the park. The incidence of bald eagles taking over osprey nest sites was documented at two sites.

Harlequin duck.—The harlequin duck population continues to vary slightly from year to year, with generally 16–20 pairs residing in the park. Monitoring annual productivity is not cost effective, as data collection is extremely time-consuming and difficult due to the remoteness of many of the areas in which harlequins are found. Productivity is extremely variable from year to year and is highly influenced by weather, such as flooding.

Common loon.—The common loon population continues to fluctuate from year to year because of variable weather conditions. There were nine nest attempts in 2001 and seven young managed to reach fledgling age, compared to nine nest attempts and eight fledglings in 2000, and 14 nest attempts and two fledglings in 1999. A total of 35 adults were found in the park in 2001, compared to 34 in 2000, and 42 in 1999. These adult numbers have ranged between 34 and 51 individuals over the last 13 years. The moderate loon production and the low adult numbers are a reflection of drought conditions.

Birds added to park checklist. Two new bird species were added to the Field Checklist of Birds of YNP in 2001. Two previous bird records were discovered in the files that deserved attention. On April 15, 1993, Terry McEneaney observed a red-shouldered hawk on Fountain Flats; the first record for YNP. On August 25, 1997, a palm warbler was observed with a group of warblers on the Old Gardiner Road (Montana) in YNP by the staff ornithologist.

As of 2001, 315 bird species have been documented in the park since it was established in 1872. A newly revised bird checklist was made available to the public in March 2001. This checklist is available on the park web site.

Globally important bird area designation. On March 17, 2001, Yellowstone was designated a Globally Important Bird Area (GIBA) by the American Bird Conservancy in association with the Nature Conservancy. There are 100 GIBAs in the U.S. and approximately 3,500 sites worldwide. Only six U.S. national parks have this unique designation: Yellowstone, Big Bend, Big Cypress, Channel Islands, Denali, and Everglades.

Yellowstone was selected in recognition of its value to the conservation of birds and their habitats. Some of the attributes for the Yellowstone GIBA designation include:

- one of the most significant American white pelican breeding colonies in the northern Rockies, and the only one in the NPS system;
- an important migratory stopover, wintering, and nesting area for trumpeter swans;
- one of the highest concentrations of nesting peregrine falcons in the northern Rockies;
- home to one of the highest concentrations of great gray owls in North America;
- an important nesting area for harlequin ducks;
- one of the most intact coniferous forests in the world;
- an important regional molting area for waterfowl (Yellowstone Lake); and
- one of the highest concentrations of nesting Barrow's goldeneyes in North America.

Common raven predation of eared grebes. On May 1, 2001, the staff ornithologist witnessed a remarkable common raven predation event. Hundreds of eared grebes were migrating through the park that day. As the grebes maneuvered through the snow squalls, some began to land on the cloud



An eared grebe trapped on Yellowstone Lake ice in spring 2001.

shadows on the ice of the West Thumb of Yellowstone Lake, confusing the frozen lake for open water. One by one the grebes landed on the ice, spread out over an area measuring approximately two square miles. The grebes were unable to take off because the ice was too slippery for their feet, and take-offs require that their feet make contact with open water.

Over the course of a three-hour period, 141 eared grebes were stranded on the ice. A raven was observed flying out to one of the stranded grebes and stabbing the helpless prey with its long beak until it was dead. The raven then did the same thing to the next closest grebes. Later, three other ravens joined in on the killing. Two bald eagles also joined in and consumed grebes that were previously dead. Employing this technique, ravens killed 92 of the 141 grebes.

Bison

Wild, free-ranging bison continue to thrive in the Yellowstone area, summering throughout the park and in some adjacent, high-elevation ranges, and migrating to winter range in geothermal areas and lower elevation grasslands both in and outside of the park. Controversy has grown for the last three decades over the management of bison leaving the park in winter. Bison moving from the park onto public or private land in Montana have been shipped to slaughter or shot because some of them may carry brucellosis. An interagency effort that lasted over 10 years resulted in the signing of a *Record of Decision for Final Environmental Impact Statement and Bison Management Plan for the State of Montana and Yellowstone National Park*. This decision document was signed in December 2000.

The Interagency Bison Management Plan (IBMP) employs an adaptive management approach. This allows the agencies to gain experience and knowledge before proceeding to the next management step, particularly with regard to managing bison on winter range outside YNP. The IBMP employs nine areas of focus:

- a late winter/early spring population limit of 3,000 bison,
- bison vaccination,
- spatial and temporal separation of bison and cattle at the west management zone,
- spatial and temporal separation of bison and cattle at the north management zone,
- a contingency plan for handling a large migration of bison out of the park,
- vaccination of cattle in the area surrounding the park,
- protection from threats to the state of Montana's brucellosis class-free status, and
- monitoring and testing of bison.

A variety of management questions remain to be answered in this first phase of implementing the IBMP. Studies of the efficacy and safety margins for potential brucellosis vaccines and management studies of delivery mechanisms were conducted in 2001. Resolution of these issues is imperative prior to proceeding with the second step of the plan. Studies to more carefully understand the temporal separation needed to reduce the risk of brucellosis transmission from wild bison to domestic cattle address two questions: How long does the aborted material remain on the ground at the abortion site? If predators do not scavenge aborted material, how long would the *Brucella* organisms remain viable at the site? In order to reach the final phase of the IBMP, NPS staff must be able to vaccinate bison within the boundaries of YNP. Thus, the park initiated a project to evaluate how easy it would be to safely approach bison in a manner that would provide opportunities to safely deliver a vaccine to calves and yearling animals. The data from all of these research efforts will be used to modify parts of the final plan, as appropriate.

Collaborative research. Considerable effort continues by U.S. scientists to seek an improved brucellosis vaccine. As it turns out, a great deal of research was done in the former USSR on brucellosis during the Cold War, when *Brucella abortus* was identified as an important pathogen with potential

use as a biological weapon. At the time, Soviet scientists were provided extensive resources to study the disease, as well as vaccines to prevent it.

Ironically, what was developed out of a climate of mutual fear now forms the basis for collaboration. In 2001, through an innovative partnership sponsored through the U.S. Defense Threat Reduction Agency (DTRA); the World Foundation for Environment and Development (WFED); and the Nuclear Threat Initiative, Yellowstone resource management staff participated in the development and implementation of new Russian research in brucellosis vaccine development. The progress made will supplement U.S. research geared toward use on Yellowstone's bison. These innovative investigations will be conducted primarily by three Russian research institutes: the Research Center of Toxicology and Hygienic Regulation of Biopreparations (RCT&HRB), the State Research Center for Applied Microbiology, and the All-Russian Research Veterinarian Institute. The Russian home of the European bison (*Bison bonasus*) is the Priosko-Terssny State Nature Preserve. The preserve is located 15 km from RCT&HRB and will be a collaborator in the development of vaccine delivery systems.

With support from the private sector and DTRA, NPS staff from Yellowstone and the USGS Biological Resource Management Division traveled to Russia to discuss the status of Russian brucellosis vaccine development and communicate the park's brucellosis risk management needs. These meetings will form a basis for developing collaborative scientific investigations of brucellosis. In September 2001, a Russian scientific delegation traveled to the U.S. to meet with cooperating experts from



Officials from Russia's Priosko-Terssny State Nature Preserve will collaborate on brucellosis research.

academia, WFED, and the U.S. Departments of Defense, Interior, Agriculture, and Energy and visit YNP to view America's wild bison in the field. Dr. Roman Borovick, Director of the RCT&HRB and a leading Russian brucellosis scientist, summed up the Russian team's reaction to the park by remembering that as a boy, he had been amazed to see "a large green spot on a U.S. map." He added he could not have imagined that in his lifetime he would ever visit such a natural wonder in the heart of America.

While the project's success is not guaranteed, the National Park Service is very proud to participate in efforts to strengthen U.S.-Russian cooperation in connection with development of valuable non-military uses of former Soviet bio-weapons science, a perspective applauded by all sides.

Development of field operating procedures. All of the agencies involved in implementation of the IBMP gathered in January 2001 to begin the process of developing a field operations plan. This planning process led to meetings held in February, May, June, and July. In addition, two conference calls were conducted in late April and early May to decide on operational details for hazing bison that were still outside the park in May and June. A draft operating procedure document was agreed to in principle by all in attendance at the July meeting. The Montana Department of Livestock proposed a few edits in November. The document remains unfinished.

Yellowstone's superintendent initiated a request for a solicitor's opinion to clarify the extent of the authority for National Park Service employees to take actions outside the boundaries of the park in the course of implementing the Interagency Bison Management Plan. The review of information will continue into 2002.

Implementation of the Interagency Bison Management Plan. While the details of field operating procedures were being discussed and developed, field operations began. The agencies have learned much from the first year of operations and plan to complete the procedure agreement in 2002.

The YCR Bison Management Office collated information provided by other staff and agencies and distributed 29 status reports, weekly from January to mid June and monthly thereafter except for October and December. These reports summarize weather conditions and hazing operations, and keep track of the cumulative total number of animals captured and the results of brucellosis testing. The reports also track natural and other non-IBMP mortality of bison

observed by park staff, visitors, and personnel from partner agencies.

In June 2001 the winter bison management period ended with the hazing of the last animals back into the park. Hazing operations throughout the winter were successful in keeping bison from spending extended periods outside the park. Of 14 animals captured in the West Yellowstone area during the winter, five tested positive for brucellosis and were transported to slaughter. An additional mortality resulted from implementation of the IBMP, when one bull was killed in the West Yellowstone area on June 26 because operations were unable to haze it away from private property and back into the park.

The operations were initiated again in October 2001 for the period that extends until June 2002. By the end of December the agencies had conducted numerous hazing operations. One bull was shot and killed on November 28, when repeated attempts to haze the animal back into the park had failed. Four of six bison captured during December tested positive for brucellosis and were transported to slaughter. The remaining two animals were released in the vicinity of the trap facility.

Vaccination approach study.

Methods.—During 2001, the Bison Management Office began assessing the feasibility of remotely vaccinating the Yellowstone bison herd. A series of mock vaccination approaches were conducted on small bison groups in designated habitat areas in the park. The basic design of the project was to sample bison behavior responses to four types of transportation modes (foot, horseback, snowmobile, and vehicle) across the four seasons. The methodology and techniques used to reach the closest safe distance to bison evolved as experience was gained. Distances were determined using a laser range finder and will be analyzed to help develop a system for delivering a safe and effective vaccine to calf and yearling bison both inside the park and within zone two of the management areas outside the park. Field data collected includes multiple sets of independent variables: topography, weather, wind speed and direction, direction of approach (in relation to the wind), precipitation type, number of humans present, and habitat type. These will be used to evaluate any significant effect they may have in relation to the behavior exhibited by the bison during an approach sequence.

Results.—Crews gathered data from 208 approaches and determined a sense of the minimum



Bison management staff conduct a vehicle approach study.

and average minimum safe distance from which crews can approach bison. For all types of approaches in all areas, the average minimum distance to bison was $50 \text{ m} \pm 60 \text{ m}$. In the Madison/Firehole area, the average minimum distance to bison was $33 \text{ m} \pm 22 \text{ m}$. However, in the northern range, the average minimum distance was $100 \text{ m} \pm 102 \text{ m}$. If one looks at average minimum distance by mode of transport values, these ranged from $68 \text{ m} \pm 72 \text{ m}$ on horseback to $14 \text{ m} \pm 14 \text{ m}$ with vehicles. However, by looking at the large standard deviation, it is apparent that there was a great deal of variability within as well as among approaches. In general, minimum distances to bison were much greater on the northern range regardless of approach type.

The minimum distance to bison when approached by horseback tends to be greater than by other transportation types. This was in part due to a large learning curve by the observers on horses, and a change in study methodology that emphasized maneuverability rather than directional approach methods. This technique was identified during horse approaches and can also be adjusted to foot approaches to facilitate future bison approaches and ultimately successful remote vaccinations. Snowmobile and vehicle approaches can only be used at certain times of the year, but bison are often seen on or near the roadways during late fall and early spring, and approach distances using snowmobiles or vehicles at those times were closer than those obtained on foot or horseback.

Throughout the park and year, the distance at which bison could be approached ranged from less than 5 m to greater than 500 m. However, approach distances generally were found to be from 20 m to 100 m. Considering the current technology for

ballistic delivery of vaccines (30 m optimal with a maximum distance of 60 m proposed by some manufacturers), most of the bison approached during 2001 could have been successfully vaccinated.

The field crew discovered a range of distances in which bison tolerate approach by humans. At the beginning of 40 percent of the approaches, the bison group was more than 100 m away. In 78 percent of these cases, the crew could reach 100 m without any reaction from the bison. However, in 6 percent of the cases, the bison took flight before the team reached that 100 m separation distance. Whenever a crew successfully came within 100 m of a bison group, they could always approach to within 75 m. This study also found that there is a 74 percent chance a crew could get to within 50 m of a bison group, and a 26 percent chance they could get within 30 m.

Although crews analyzed many parameters that might affect bison behavior, it was not possible to analyze the synergy of these and other parameters, such as presence of predators of which the bison were aware but not the crew. No pattern for predicting bison behavior *a priori* could be determined with any certainty. The feasibility of a remote vaccination program is not simply a question of how close vaccinators can get to bison, but of how reasonably we can expect the remote vaccination event to work safely and efficiently when all of the individual elements of the process are combined. Considering the variability in bison behavior, the question becomes: is it feasible to approach *and* vaccinate bison in the field?

Bison behaved similarly and could be approached with all transportation types to approximately equal distances in all areas of the park except on the northern range, where they showed greater wariness. There are two possible explanations for this behavior. One explanation is the open topography of the northern range. Unlike bison in the Madison/Firehole or Hayden areas, bison on the northern range often distance themselves from humans and roads, and they may therefore not be as habituated to humans as bison in other areas of the park. A second reason could be the frequency of invasive studies on this population. Bison on the northern range have been intensely studied (darted by ground and air) for many years. These past interactions may have conditioned bison to react more negatively toward any human activity.

Crews met with the most success in the northern range by using horses, which enabled them to cover

large amounts of ground quickly and efficiently. The use of horses enabled the crew to learn very quickly how to approach bison throughout the park, but especially on the northern range. The more approaches crews attempted, the more they learned. Thus, the approach methodology evolved very quickly. By the end of the 2001 fall season, which was conducted almost exclusively on horseback, crews had learned how to effectively approach bison on the northern range, nearly eliminating flight reactions and bringing approach distances in line with those achieved in other areas of the park. There is still a difference in reactions between the northern range herd and those of the Madison/Firehole and Hayden Valley, but by continuing to improve/refine the strategy for approaching groups of bison on the northern range, remote vaccination of bison in this area of the park appears to be feasible.

In any area of the park, observers could approach as close as 10 m to both adults and calves in open habitat if safety parameters such as trees and rocks were present. Very rarely did crews report feeling threatened by bison. While conducting horse approaches in all areas other than the northern range, bison commonly showed curious or semi-aggressive behavior, coming towards horse riders in open country to investigate.

The feasibility of implementing a brucellosis vaccination program in YNP looks good. During 2002, the Bison Management Office will begin Phase II of the bison vaccination project. This will incorporate knowledge and techniques from Phase I while adding simulated vaccination gun discharges (.22 caliber or gas powered rifles) and assessing bison reactions. The next questions to answer will be:

- What is the probability that a vaccination crew could get to within 100, 75, 50, or 30 m of a bison group?
- What is bison behavior likely to be in response to a simulated gunshot noise?
- Could a crew fire enough shots to vaccinate all of the calves and yearlings in a group of bison?

Brucella viability study. The IBMP directs the partner agencies to conduct research regarding the viability of *Brucella abortus* bacteria in the environment in the northern and western boundary areas. The results of this research will enable the agencies to further refine their ability to adjust the temporal separation between cattle and bison. Staff from the Bison Management Office collaborated with the

principal investigators to conduct this study, which was co-supervised by Jack Rhyan of USDA-Animal and Plant Health Inspection Service (APHIS); Keith Aune of Montana Department of Fish, Wildlife and Parks (MTFWP); and Tom Roffe of U.S. Geological Survey (USGS-BRD).

The *Brucella* viability study is designed to gauge how long the *Brucella* bacteria might remain viable in aborted fetuses deposited on the ground; i.e., how long it would take for the bacteria to become inactive or non-infectious. As a pilot project, a total of 123 cattle fetuses that had been soaked in RB-51 (the vaccine strain of *Brucella abortus*) were left at two study sites (near Gardiner and West Yellowstone, Montana) in February, March, April, and May. To prevent scavenging and contact with other animals, each fetus was placed in a cage that was surrounded by a 5,000-volt, low amperage, electric fence. In order to see whether different levels of UV light would affect the bacteria's viability, half of the study animals were placed in cages covered in shade cloth, the other half in direct sunlight. Twice a week, tissue samples were taken from the top, bottom, and abdomen of each fetus (in order to determine whether being in contact with the ground or open to the air would affect the length of viability) and sent to Iowa State University's Veterinary Diagnostic Laboratory in Ames, Iowa. Bacteria in samples taken from the tops of the fetuses rarely persisted more than 30 days; bacteria persisted longest on the bottom of the fetuses.

Staff also measured UV light, temperature, and snow depth at the deployment sites in order to determine the effects of changing weather on *Brucella* viability. Bacteria in fetuses deployed early in



Some bison leave the park during winter in search of forage at lower elevations.

the test period remained active for a longer time, but all bacteria were inactive by mid June. This indicated a seasonal effect; higher temperatures and levels of UV light tended to decrease the viability period. After minor study changes, the *Brucella* persistence study will be continued for three more years.

Fetal disappearance study. The IBMP directs the partner agencies to conduct research regarding the rate of fetal disappearance in the management zones near the park boundary. The results of this research will enable the agencies to refine their ability to adjust the temporal separation between cattle and bison. The principal investigators are the same group that is leading the *Brucella* viability study.

The fetal disappearance study is designed to examine how long aborted fetuses might remain in an environment before disappearing as a result of scavenging and decomposition, and how far a potentially infected fetus may be moved within the environment. Fetuses were deployed once a month in March, April, and May at sites both inside and outside the park's boundaries in the areas of Gardiner and West Yellowstone, Montana. Because of the limited number of sites authorized for use outside the park, fetuses were deployed in greater density at such sites than in park sites. In March, cattle fetuses were used due to the lack of bison fetuses available from private ranches and slaughter, but APHIS was able to obtain bison fetuses for the April and May deployments. All fetuses were inspected and approved by the Montana Department of Livestock as disease-free prior to use at a study area.

Cameras were set up at about half of the sites to record which scavengers contributed to the fetuses' disappearance. The resulting photos and visual inspections showed evidence of grizzly and black bears, mountain lions, coyotes, red foxes, wolves, eagles, hawks, ravens, magpies, and skunks. Preliminary results suggest that fetuses deployed inside the park showed a faster rate of disappearance (i.e., a lower rate of persistence) in both study areas. Most of those deployed inside the park were fully scavenged in less than 15 days, while fetuses remained on the ground for greater than 15 days at study sites outside the park, despite the expectation that the greater overall density of fetuses at such sites might attract more predators. Both scavenger distribution and abundance appeared to be significantly different inside the park. Human disturbance outside the park may be a factor in the difference, assuming that

human activities cause scavengers to avoid these areas. The results of this pilot year of work were evaluated and minor changes will be made to the fetal disappearance study that will be continued for three more years.

Aerial population count flights. Approximately once a month, NPS staff conducted aerial surveys of the bison population across the entire bison range in the park. Six flights had to be cancelled for various reasons: adverse weather, fire restrictions, the nationwide flight restrictions due to the terrorist attacks, and conflicting schedules. The number of bison increased to more than 3,000 after the 2001 calving season.

Ground classification counts. Ground classification of bison on the northern range and in Hayden Valley were conducted between July 16 and July 26, 2001. Most of the bison classified on the northern range were located in the Lamar Valley. Other smaller groups and individual bison were located in Little America and on Crystal Bench. Bison observed during monthly aerial surveys on Cache/Calfee Ridge and the Mirror Plateau were not classified. The July 2001 aerial bison survey counted 719 bison on the northern range, of which 252 (35%) were observed during the ground classification effort. Determination of the sex of calves and yearlings was not part of the classification protocol.

Most bison classified in the Hayden Valley area were centrally located between Trout Creek and Elk Antler Creek. Included in the Hayden Valley area survey were small groups and individual bison classified near the Canyon corrals, Mud Volcano, Lake Hotel, and Fishing Bridge/Storm Point. The July 2001 aerial bison survey counted 2,557 bison in the Hayden Valley area, of which 2,053 (80%) were observed during the ground classification effort.

The sample obtained during this classification effort represents 70 percent (2,305) of the current estimated parkwide bison population of 3,283 animals. Based on this sample, the current herd structure is estimated to be 23 percent bulls, 37 percent cows, 13 percent yearlings, 15 percent calves, and 12 percent unknown.

Elk and Other Ungulates

Yellowstone National Park staff again shared costs and duties with the Northern Yellowstone Cooperative Wildlife Working Group (the National Park Service; Montana Department of Fish, Wildlife and Parks; USDA Forest Service; and USGS

Biological Resources Division) to complete counts of ungulate herds on the northern range.

Elk. The annual winter count conducted on December 21, 2000, found a total of 13,400 elk on the northern range inside and outside the park. On March 23 and 26, 2001, the annual classification of the northern elk herd was completed using a 206 BIII Bell Jet Ranger helicopter piloted by personnel of Hawkins & Powers Aviation of Greybull, Wyoming, and two park staff observers. Total helicopter time for the survey, including ferrying the helicopter from Greybull, was 8.7 hours. Total cost for the helicopter and per diem for the pilot was \$5,390. Nearly all of the northern winter range, especially the Gardiner Basin, was snow-free where elk were observed. Snow depths in elk count units comprising the upper Lamar Valley ranged from approximately 0 to 2 m. No recent snowfalls had occurred; all snow appeared crusted on the surface due to recent warm temperatures.

Elk were classified in 40 different count units throughout the northern range, 28 units in the park and 12 outside. Data were recorded on a micro-cassette and transcribed later. Elk were classified as calves, cows (includes yearling and adult females), spikes (yearling males), and branch-antlered bulls (adult males). Bulls were identified by verifying the presence of antler pedicels. Approximately 15 percent of the classified bulls and no yearling males had dropped their antlers. Only data from the observer that classified the largest number of elk are included in the final count, so the classification as a whole represents data collected by both observers.

A total of 1,869 elk were classified: 653 (35%) north of the park and 1,216 (65%) in the park. Ratios of 29 calves, 60 bulls (including yearlings), 6 spikes, and 54 adult (branch-antlered) bulls per 100 cows were calculated. Elk were widely distributed on the northern winter range: elk were observed in 32 of 40 count units surveyed. The estimate of 29 calves:100 cows was near the average of 28:100 for the period of 1995–2000; however, the estimate of 60 bulls:100 cows was close to the five-year high of 65:100 estimated in 1998, versus 23–51 bulls per 100 cows in other years. The high bull ratio may have been due to the visibility of bulls in units 28 and 53, where green-up conditions on south slopes lured bulls to areas lacking tree cover. These results should be interpreted as an index of population structure rather than as an absolute measure of sex and age ratios.

Mule deer. In the aerial mule deer count and

recruitment survey conducted on April 29, 30, and May 2, 2001, MTFWP sighted 2,112 mule deer, 249 more than in 2000. Of those sighted, 976 deer were classified: 706 adults and 270 fawns, making a fawn-adult ratio of 38:100. During an aerial survey conducted on December 11, 2001, MTFWP classified 703 deer, finding ratios of 61 fawns and 18 bucks to each 100 does. In the 2000 winter survey, the ratios were 68 fawns and 24 bucks to each 100 does.

Pronghorn. In a pronghorn survey on April 3, 2001, from Mt. Everts to the Carbella fishing access north of Gardiner, Montana, park staff counted 206 animals (192 from the air and 14 from the ground). This count is larger than that made in 2000.

Bighorn sheep. In a helicopter survey of bighorn sheep habitat on the northern range on April 29–30, and May 2–3, 2001, MTFWP counted a total of 182 sheep (103 ewes, 22 lambs, and 57 rams). This count is a return to near the seven-year mean of 184 sheep, and a 21 percent increase over 2000's count of 150.

Lynx

Historically reduced by persecution and habitat destruction, the Canada lynx (*Lynx canadensis*) in the conterminous U.S. was listed as a threatened species by the U.S. Fish and Wildlife Service during 2000. Despite evidence that lynx were still found in the park, no rigorous effort had been made to document their presence. In 2001, WRT staff began a three-year survey to collect the baseline information needed to assess the status of the lynx in YNP. A GIS-based topographical analysis was used to identify prime lynx habitats. Intensive surveys will be conducted in these prime habitats through 2004 using ground-based and aircraft-based snow tracking during the winter, and hair snares to obtain DNA samples in the summer.

From January to April 2001, 28 ground-based snow tracking surveys were completed on transects distributed widely throughout the park, ranging from 0.6 to 129 miles in length and totaling 286 miles. One probable and one possible lynx track were detected during snow tracking surveys. Tracks of red squirrels, weasels, and marten were abundant. Tracks of snowshoe hares were less abundant in habitats dominated by lodgepole pine compared to sites that principally supported Engelmann spruce and subalpine fir. Staff also identified tracks of wolves, red fox, coyote, grizzly bear, black bear, and river otter. The habitat model appeared to successfully predict the location and extent of lynx habitat in YNP.

Staff completed four air-based snow tracking surveys in northwest, southeast, and east central YNP on transects that totaled 488.4 miles in length. The aerial surveys enabled staff to effectively search large areas for lynx tracks. No lynx tracks were detected using this method, but staff saw individuals and tracks of grizzly bears, coyotes, and bobcats.

For the summer sampling, staff set up 160 hair-snare stations on 32 transects on the east side of the park, sampling a 200-square-mile area (14×14 miles). From July to October 2001, staff collected a total of 154 hair samples: 38 from the hair snares, 90 from the ground near the snares, and 26 from nearby trees. The sample sets (one per storage vial) each contained from 1 to > 50 hairs and were sent to the Carnivore Conservation Genetics Laboratory (Dr. Scott Mills), University of Montana, Missoula. Results of species- and individual-level identification of hair are expected in April 2002.



A YCC volunteer checks a hair snare pad for lynx hairs.

Wildlife Management and Monitoring

Road-killed wildlife. A total of 94 large mammals were fatally hit by vehicles on park roads in 2001, the annual average during the 1989–2000 period was 106 (± 20 SD). The largest number of road-kills recorded in the park was 148 in 1994.

Mule deer ($N = 32$, 34%) and elk ($N = 24$, 26%) were the species most often killed in vehicle collisions in 2001. Other such mortalities included 17 bison (18%), 8 coyotes (9%), and 8 moose (9%). The average for all park roads combined was 0.4 road-kills per mile of road. The highest rate was on U.S. Highway 191 (1.5 per mile of road), the only road segment in the park with a 55 mph speed limit; all other roads are posted at 45 mph or lower. Highway 191 comprises approximately 7 percent of the paved roads in YNP but accounted for 32 percent of the road-killed large mammals documented in the park. Also substantially higher than the parkwide average were the Madison Junction-to-West Entrance road (0.9 road-kills/mile) and the Gardiner-to-Mammoth road (0.8 road-kills/mile).

Radionuclide concentrations study. Atmospheric nuclear weapons testing from 1945 to 1980 and nuclear power plant accidents, such as the Chernobyl accident in Russia in 1986, have resulted in radionuclides being distributed across the northern hemisphere. Other more local sources of radionuclides in the environment come from research laboratories. Operations at the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL) have the potential to release radioactive contaminants into the air and water. Large mammals have been sampled on and near the INEEL compound for nearly 30 years. In 2000, INEEL requested tissue samples from large mammals in the park so that they could quantify radionuclide concentrations over a larger geographic area. The Bear Management Office was assigned to coordinate the tissue collection effort in YNP. One- to two-dozen tissue samples (1.5 lbs. each) are to be collected annually from large mammals that die of natural causes or are fatally hit by vehicles on park roads. In 2001, 12 tissue samples were sent to INEEL: 5 bison, 3 elk, 2 mule deer, 1 moose, and 1 pronghorn.

Elk management. In 2001, Bear Management Office (BMO) personnel immobilized two bull elk in separate incidents that involved tangled antlers.

On September 10, the communications center received a report of a bull elk with wire and rope

tangled in its antlers. Mammoth rangers found the bull elk in the Mammoth Hotel cabin area with a badminton net in its antlers. Two BMO personnel free-darted the elk with a mixture of Telazol and Xylazine so that the net could be cut off.

On September 11, BMO personnel were contacted by ranger personnel regarding a rutting bull elk that had coaxial cable stuck in its antlers. With the help of ranger personnel, BMO personnel free-darted the elk with a mixture of Telazol and Xylazine on the parade grounds in front of the Nature Store. The elk then ran up the hill behind the Nature Store where a ranger on horseback was able to haze the animal back to level ground to reduce the risks of injury as the sedation took effect. When the elk finally lay down and became immobile across the road from the chapel, the cable was removed.

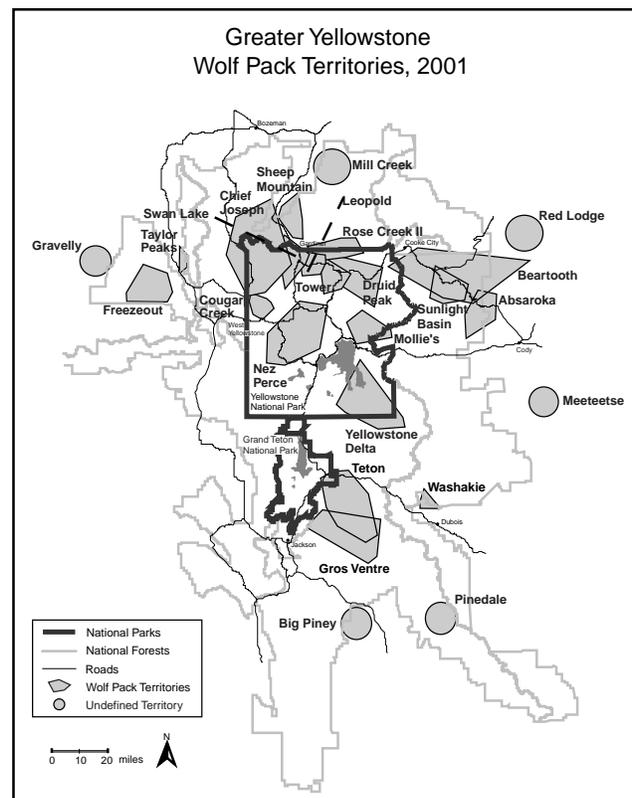
To make sure that these elk were not hunted and consumed within 45 days of being chemically immobilized, in both cases they were ear-tagged with a notice that the BMO should be contacted prior to consumption. On November 14, a hunter who had killed the cable elk north of Gardiner called the BMO. Since the 45-day post-immobilization required by the FDA had passed, the hunter was allowed to keep and consume the elk at his discretion.

Wolves

Population monitoring and management.

Population status.—At the end of 2001, at least 218 wolves in 25 packs were present in the greater Yellowstone area (GYA). Removal of wolves from the endangered species list in Idaho, Montana, and Wyoming requires 30 breeding pairs distributed throughout the three northern Rocky Mountain recovery areas (GYA, central Idaho, and northwest Montana) for three successive years. A breeding pair is defined as a pair with at least two pups-of-the-year that survive until December 31. In 2000, there were 30 breeding pairs in the northern Rocky Mountains, making it the first countdown year to removing the wolf from the endangered species list. Last year the U.S. Fish and Wildlife Service (USFWS) determined that there were 28 breeding pairs in the northern Rockies, but later discovered 2 more that brought the total to 30. In 2001, there were 34 breeding pairs in Idaho, Montana, and Wyoming (13 in the GYA), making it the second countdown year. Currently, Montana and Idaho have written draft plans.

When the wolf reintroduction program began in 1995, Yellowstone National Park (YNP) staff were



Wolf pack territories. At least 218 wolves (25 packs and 4 wolves without established territories) occupied the greater Yellowstone area in 2001.

responsible for population data ecosystem-wide. Since February 1999, Michael Jimenez of the USFWS has reported on Wyoming packs outside YNP, and the USFWS Helena office has reported on Montana packs outside YNP, aided in 2001 by Turner Endangered Species Fund personnel. The GYA wolf population data presented here therefore distinguishes between inside and outside YNP, the sum being the GYA total.

At the end of 2001, approximately 132 wolves in 10 packs were located inside YNP (8 breeding pairs), and at least 86 wolves were located outside YNP: 9 packs in Wyoming (5 breeding pairs) and 6 in Montana (no breeding pairs). Of the 10 YNP packs, only the Tower pack did not breed, and the Chief Joseph pack lost both breeders. One new pack formed inside YNP when a dispersing female (#151) from the Leopold pack paired with an uncollared wolf and had a litter of at least three pups in the Madison Flats–Cougar Creek area of YNP. They were named the Cougar Creek pack. Rose Creek's Tower subgroup splintered, but one wolf returned

with an uncollared wolf, and they were named the Tower pack. Five new packs formed outside the park: Freezeout, Pinedale, Meeteetse, Big Piney, and Red Lodge.

Pack size in the GYA ranged from 2 to 37 and averaged 8.9. (Excluding the Druid Peak pack, mean pack size was 7.7.) Pack size inside YNP ranged from 2 to 37 wolves and averaged 13.1. (Excluding the Druid Peak pack, mean pack size was 10.4.) The very large Druid Peak pack (37 wolves) is unusual and may be a record for wolf pack size. The Druid Peak wolves are not expected to remain together. At the end of 2001, the pack had already splintered into 4 subgroups, and no more than 16 wolves were sighted in the core (alpha pair) group.

Reproduction.—At least 77 pups survived to December 31, 2001, in the GYA. Forty-three (56%) of these pups were born in YNP. At least 17 litters were born to 16 packs. The Druid Peak pack had at least two litters and possibly more, as four females localized in April but left their dens to join the pack at the main Lamar Valley den, and the fate of any pups born to these females was unknown. Recovery plan standards define a breeding pair as a male and female wolf that successfully raise at least two pups to December 31. Chief Joseph, Sheep Mountain, and Freezeout lost adult breeders, so they could not be counted as breeding pairs at the end of 2001, hence the total of 13 breeding pairs. Litter size in YNP ranged from 2 to 7 and averaged 5.0 ($N = 10$). Although the Druid Peak pack had 12 pups total, it is unknown how many pups were born to each female.

Mortalities.—At least 16 wolves died in the GYA in 2001: 6 from the YNP population. (For further information on wolf mortalities outside the park, see the USFWS Rocky Mountain Wolf Recovery 2001 Annual Report, available at www.r6.fws.gov/wolf/annualrpt01/index.htm.) This number does not include pups that died within the first four months of life. At least 13 wolves died due to human-caused mortality (9 in control actions, 2 by vehicles, 1 to handling, and 1 shot illegally), and 3 died due to natural causes (prey, drowning, and other wolves). No control actions occurred within YNP. Since 1995, 53 percent of all wolf deaths have been due to human causes.

Population movements.—Most wolf population expansion in 2001 was outside YNP. The YNP population expanded by 11 percent, while the outside YNP population grew by 45 percent. The population on the park's northern range was even more stable,

increasing from approximately 72 to 77 (7%) wolves. In the rest of the park, wolves increased from approximately 52 to 61 (17%), due primarily to the new Cougar Creek pack and reproduction in Mollie's pack. This represents fairly modest population growth compared to 2000, when wolves in the park increased by 65 percent and by 63 percent on the northern range. The large increase in 2000 was likely due to the relatively low 1999 population because of poor pup survival, and extraordinary reproduction in the Druid Peak pack.

The Druid Peak pack continued to pressure the Rose Creek II pack. Several interactions between the two packs were observed and resulted in loss of territory for Rose Creek II. At the end of 2001, the Druid Peak pack occupied territory from Lamar to Slough Creek and north of the Yellowstone River to Cottonwood Creek. Rose Creek II territory historically included the area from Crevice Creek to Slough Creek. Despite this pressure, the Rose Creek II pack was never located west of Bear Creek (i.e., outside the park).

Drought conditions prevailed again in 2001, possibly causing unusual elk movements. Three wolf packs had extraterritorial moves in November and December that coincided with early elk movements from summer range. The Nez Perce pack (18 wolves) traveled outside the park to Ashton, Idaho, and other unrecorded locations south of YNP for the first time. They also made two forays, lasting about a week each, to the northern range where they made several elk kills, similar to 2000. They had a skirmish with the Druid Peak pack, and at least two wolves from the Nez Perce pack were injured. The Yellowstone Delta pack (16 wolves) traveled south into the Bridger-Teton Wilderness about six weeks earlier than usual. The Druid Peak pack (37 wolves) traveled further north than had been previously recorded. All other packs remained in their usual territories.

Wolf-prey relationships. Wolf-prey relationships were documented by observing wolf predation directly and by recording the characteristics of wolf prey at kill sites. Wolf packs were monitored during two winter-study sessions, 30-day periods in March and November–December during which wolves were intensively radio-tracked. The Leopold, Rose Creek II, and Druid Peak packs were monitored by two-person teams from the ground and from aircraft; the Chief Joseph, Mollie's, Nez Perce, Sheep Mountain, Tower, Cougar, and Yellowstone Delta packs were monitored from aircraft only. YNP staff recorded and

entered into a database behavioral interactions between wolves and prey, predation rates, the total time wolves fed on their kills, percent consumption of kills by wolves and scavengers, characteristics of wolf prey (e.g., nutritional condition), and characteristics of kill sites. The abundance and sex-age composition of elk within wolf pack territories were estimated from the ground and fixed-wing aircraft.

Project staff detected 161 definite and 196 probable kills made by wolves in 2001, including 311 elk (87% of total), 6 bison, (2%), 6 deer (2%), 6 coyotes (2%), 1 moose (<0.5%), 1 pronghorn (<0.5%), and 26 unknown prey (7%). The composition of elk kills was 33% calves (0–12 months), 36% cows, 17% bulls, 4% elk of unknown sex, and 10% elk of unknown sex and age. Bison kills included three calves, two yearlings, and one adult, all of unknown sex. Of the bison kills, one was killed during February, two in April, and three during the summer months. The Nez Perce pack made two of the summer kills; the third was made by the Druid Peak pack. The moose and pronghorn kills were made by the Druid Peak pack; the moose kill during

late winter, and the pronghorn kill in October.

During winter, wolves residing on the northern range killed an average of 1.8 elk/wolf/30-day study period.

During the March winter study, wolves were observed for 261 hours from the ground. The number of days wolf packs were located from the air ranged from 10 (Yellowstone Delta) to 21 (Leopold, Rose Creek II, and Druid Peak). Of the 108 definite or probable wolf kills detected, there were 98 elk, 2 mule deer, 1 moose, and 7 prey of unknown species. Among elk, 31 (32%) were calves, 40 (41%) were cows, 18 (18%) were bulls, 6 (6%) were of unknown sex, and 3 (3%) were of unknown sex and age.

During the November–December winter study, wolves were observed for 174 hours from the ground. The number of days wolf packs were located from the air ranged from 3 (Yellowstone Delta) to 12 (Swan Lake and Leopold). Of the 41 definite or probable wolf kills detected, there were 35 elk, 2 coyotes, and 4 unknown prey. Among elk kills, there were 15 (43%) calves, 11 (31%) cows, 6 (17%) bulls, and 3 (9%) adult elk of unknown sex.



Mollie's pack.



Microbiologists working in the pink filament channel at Octopus Spring in July.

Part IV. Yellowstone Center for Resources and Parkwide Support

This section describes the work accomplished or coordinated by the YCR staff who provide services for other YCR branches and other park divisions.

- The Spatial Analysis Center, responsible for the park's geographic information system, global positioning systems, and other resource databases;
- Resource Information, which produces publications and provides special programs on natural and cultural resource topics;
- Research Support, which oversees permitting for visiting and park researchers; and
- Funding and Personnel Support for the YCR Division.

SPATIAL ANALYSIS CENTER

The Spatial Analysis Center (SAC) is the home for the park's geographic information system (GIS), global positioning systems (GPS), image analysis, soil information support, and a park resource database system. Its main business is the acquisition, analysis, organization, presentation, and storage of information, especially that concerning the cultural and natural resources of the park. SAC's goals are to maintain an up-to-date GIS lab, provide GPS equipment and expertise, increase the GIS and GPS skill level of park staff, acquire new data and make it useful, provide information and technical support to park staff, and make information available to outside agencies and the public.

In 2001, SAC provided GIS support to the Administration, Interpretation, Maintenance, and Resource Management Operations and Visitor Protection divisions, along with the YCR and external researchers. A wide variety of projects were performed throughout the year, including production of daily fire maps for the Public Affairs Office during the heat of the fire season, design of a 1988 fire map for the Mt. Washburn exhibit, updating the digitally mapped trail layer with reroutes completed during the summer, development of

a road signs layer with GPS assistance from park law enforcement rangers, analysis of wetland habitat for whooping cranes, assistance with producing National Historic Landmark and Historic District maps for the historic architect, and development of 7th level watersheds for Grand Teton National Park.

New and Ongoing Projects

Landscape alterations. SAC staff created a spatial coverage of landscape alterations (places where people have dug up or built things) with information documented by Aubrey Haines, Mary Meagher, and Lee Whittlesey.

Well locations. SAC staff created a spatial coverage of all well locations in the park, including water wells, test wells, monitoring wells, and USGS drill holes.

Thermal areas. A spatial inventory of thermal areas, including point locations collected with GPS units and converted into GIS layers, was continued for the fourth year. Data such as temperature, pH, and conductivity were collected and attached to each

point location, along with a digital photograph of the feature. In 2001, 1,513 features in the Joseph's Coat area, the Norris-to-Mammoth corridor, and the Norris, Lower, and Lone Star geyser basins were added, bringing the total number of sampled features to more than 5,400.

A literature search for thermophiles known to occur in Yellowstone was completed, enabling us to expand the previous 1996 inventory, which only contained information about 35 organisms that were first discovered in Yellowstone. The database now includes all known microbes and all thermal features in which the microbes have been found: 406 different organisms in 105 thermal features, with a total of nearly 700 organism/pool combinations. Microbe locations were also linked to the physical and chemical characteristics of their habitats and to digital photographs of each thermal pool.

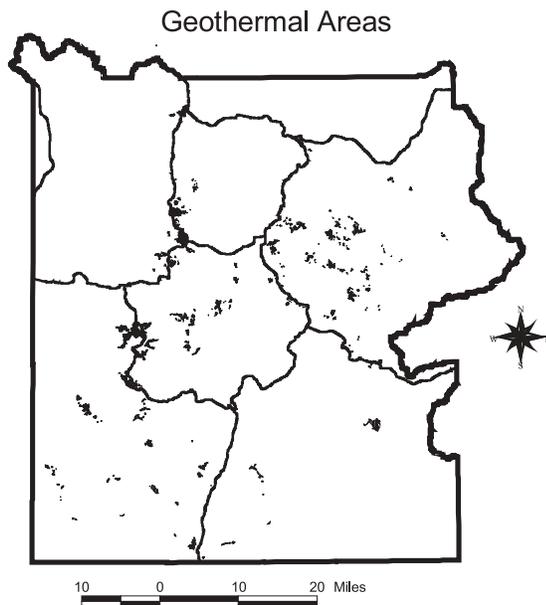
Aquatic resources. SAC staff continued converting research data collected by the fisheries and aquatic management program into a digital database, including information about backcountry fish and macroinvertebrate surveys, gill netting for lake trout, and stream temperature measurements.

Ungulates. SAC staff combined multiple ungulate databases into single databases, quality-checked the data, fixed errors, and filled in holes.

Fire mapping. Each year, SAC staff work with the Fire Cache to create accurate fire perimeters and burn severity maps of all fires each year using imagery from LANDSAT satellites. Several of the SAC staff supported the Fire Cache during the summer of 2001 by providing daily maps of fire starts and fire perimeters, digitally mapping fire perimeters, and error checking GIS fire data. SAC staff also began a project to help document the park's fire history by creating a GIS layer that shows fire locations dating back to the 1800s.

Fire hazards near buildings were assessed in a project called "Wildland Urban Interface," spearheaded by the Fire Cache. A 400-foot buffer was instituted around developed areas and cabins, and then these data were used to calculate acreages of forest cover within those areas. Maps and data were produced that can be used in future studies.

Road reconstruction. SAC staff continued to support projects associated with the Federal Highways program. This involved continuing to update databases for rare plants, archeology sites, and wetlands. SAC staff also provided GPS support for mapping rare plant locations, delineating wetlands,



This map, created by the Spatial Analysis Center in a project completed in 2001, shows Yellowstone's hydro-geothermal areas. The original 1996 coverage was used as a base. Using one-meter digital ortho-quads, field observations, historical data, and Thermal Inventory Project data, the original boundaries were refined and subdivided, and the coverage was attributed to include general park location, basin or area division and names, group and/or complex division and names, and division of areas based on pH grouping of inventoried areas.

and documenting archeological sites and historic structures. Copies of pre-1990 data were acquired to incorporate into databases.

Partnerships. SAC staff continued to share cross-boundary data of mutual interest with a variety of different agencies, including Gallatin County, Montana; United States Forest Service (Gallatin, Targhee, Bridger-Teton, and Shoshone national forests); Montana Fish, Wildlife and Parks; Montana State University; University of Wyoming; and many others.

SAC staff worked with resource management staff at Craters of the Moon National Monument to collect base GIS layers for the additional acreage acquired by the monument in November 2000. Information collected includes roads, trails, hydrology, soils, vegetation, benchmarks, grazing allotments, wilderness study areas, and geographic names information system.

New Hardware and Software

SAC continues to run its GIS software on Windows NT. In 2001, three new desktop computers and one new laptop computer were added in the GIS lab, bringing the total number of computers with GIS capabilities to 18 (not including computers purchased for the inventory and monitoring program). Three new Trimble GeoExplorer 3 GPS units were added, bringing the total number of GPS units available for staff use to 20 (including two units for the inventory and monitoring program), and all Trimble software products were upgraded to the most recent version. A new medium-format scanner was also added to the GIS lab.

Resource Database Development

SAC staff continued to work on a database designed to make relevant resource and infrastructure information more accessible to people involved with project planning, compliance, and implementation. In 2001, this work involved the development of detailed GIS layers tied to a database of information about each developed area and road corridor. The information will include data about historic structures and other important cultural resource information, surficial and bedrock geology, soils, wetlands, important natural resources (e.g., threatened and endangered species, species of special concern, important or delicate habitats), existing infrastructure (roads, trails, and buildings), and other subjects of interest. In 2001, the Alaska Regional Office GIS

staff, along with I&M personnel in Fort Collins, Colorado, made an ArcView extension available that has been incorporated into the park's compliance database. This extension allows the user to query the data for detailed information. Photographs, drawings, and other scanned documents that help clarify a resource situation can also be attached. The user can now create maps, charts, and reports based on one user-friendly interface. When this project is completed in 2002, the database will be accessible over the park's Intranet.

Outreach

SAC staff continued to make GIS technology directly available to park employees by providing equipment, data, and training. The GIS lab was available to all employees and spatial data was accessible over the park network. SAC staff supported GIS software on 20 computers outside of the lab and provided data on CDs to those who were not networked. SAC staff also provided GPS training that included collecting field data with GPS units, differentially correcting the GPS data, and converting this corrected data into usable GIS layers.

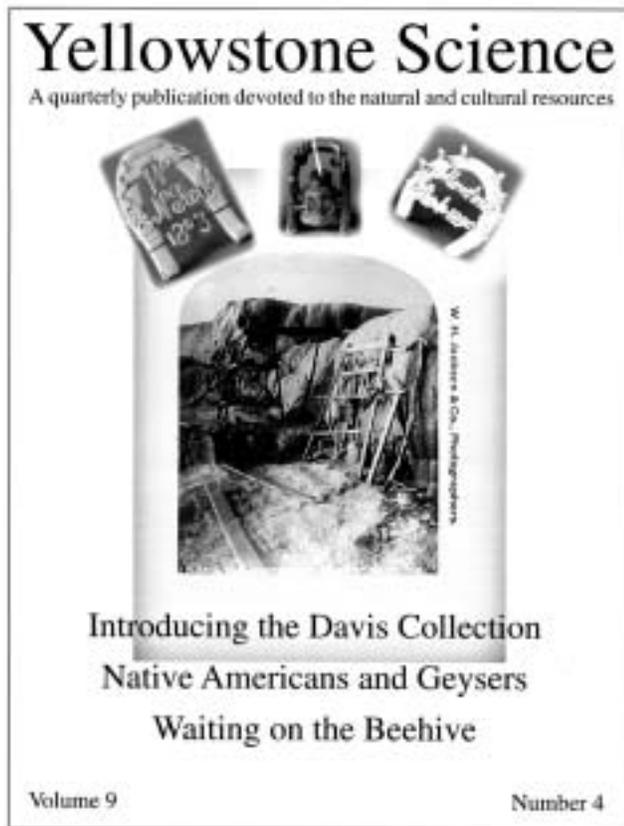
RESOURCE INFORMATION

With the departure of Sue Consolo Murphy to the cultural resources branch, former Yellowstone district interpreter Roger Anderson arrived in July 2001 to become the new head of the Resource Information and Publications group. Kevin Schneider and Tami Blackford rounded out the permanent staff, with Kevin serving as a full-time writer-editor and Tami working as a half-time writer-editor. Alice Wondrak, a Ph.D. candidate and Canon National Parks Science Scholar, continued part-time work as a writer-editor through the Student Career Experience Program.

The resource information group received additional staff support from writer-editor Mary Ann Franke, who returned for the spring and summer. Writer-editor Sarah Stevenson and visual information specialist Renée Evanoff worked throughout the year, lending their expertise to a variety of publication projects and providing assistance with the biennial scientific conference.

Publications

Now in its ninth year, the quarterly journal *Yellowstone Science* reached over 2,000 individuals and institutions with a variety of articles on



Yellowstone Science interviewed Jack and Susan Davis about the park's acquisition of their collection.

Yellowstone's natural and cultural resources. In 2001, the publication published excerpts from an oral history interview with outgoing Superintendent Mike Finley, in which he reflected on his 32-year career with the National Park Service, and an interview with Laura Joss, former cultural resources branch chief, on the evolution of the park's cultural resources management program. Additionally, feature articles addressed Yellowstone's architecture, invasive species management in Yellowstone Lake, American Indian relationships to the park's geothermal features, rural residential development trends in the Greater Yellowstone Ecosystem since the listing of the grizzly bear for protection under the Endangered Species Act, the longstanding tradition of "savage Christmas," and a look at archeological research along the canyons of the Yellowstone River. The last issue of the year contained an interview with Jack and Susan Davis on their extraordinary collection of Yellowstone memorabilia, and included several full-color images representative of the collection. *Yellowstone Science* continues to be supported by a grant

from the Yellowstone Association and donations from its loyal readership.

Yellowstone in the Afterglow: Lessons from the Fires, published in late 2000, was widely praised throughout 2001 for its comprehensive examination of the effects of the 1988 wildfires. Written by Mary Ann Franke, the initial printing of 1,000 copies was quickly exhausted, prompting a second printing in the fall.

Additional publications produced in 2001 included the *2000 Wolf Project Annual Report*, the *2000 Yellowstone Bird Report*, and four issues of *The Buffalo Chip*, the park's resource management newsletter. Sarah Stevenson assisted the executive director of the Greater Yellowstone Coordinating Committee in producing a 40-page briefing document highlighting the mission and work of theGYCC.

The resource information staff provided technical support to YCR and other park staff with writing, editing, and technical graphics assistance. This included scanning images, producing graphics, assisting with software issues, and helping with audio-visual needs, including PowerPoint presentations. The staff also produced numerous flyers, posters, and other promotional materials for numerous park events. Resource information staff provided support to YCR and other park staff with writing, editing, and technical graphics assistance.

In 2001, the resource information office secured a storage facility in Gardiner, Montana, to warehouse publications and initiated a reorganization of the publications workspace.

Sixth biennial scientific conference. Resource information staff coordinated the park's sixth biennial scientific conference on the Greater Yellowstone Ecosystem. The conference theme was "Yellowstone Lake: Hotbed of Chaos or Reservoir of Resilience?" The three-day gathering, with nearly 150 in attendance, was noteworthy for its interdisciplinary nature; the conference addressed the management issues, natural features, and the human history associated with Yellowstone Lake. The program committee accepted papers from 39 speakers and invited 5 guest presenters. Session topics included archeology, climate and environmental change, fisheries and ecosystem-level functions, and hydrothermal and geologic process in the Yellowstone Lake basin.

The conference's guest speakers were: Dr. Cathy Whitlock from the University of Oregon, who

presented the opening keynote address; YCR director John Varley, who presented the Aubrey Haines Lecture; Dr. Robert Smith of the University of Utah, who presented the A. Starker Leopold Lecture; and Dr. Nigel Trewin from the University of Aberdeen, Scotland, who spoke at the Superintendent's International Luncheon. Dr. Lisa Morgan of the U.S. Geological Survey was scheduled to present an additional keynote address on the third day, but was unable to attend the conference. The work of award-winning cinematographer Bob Landis was the highlight of the opening reception, which was held in the map room of the Mammoth Hot Springs Hotel.

Kevin Schneider was instrumental in organizing the conference, working closely with the park's concessioner, AmFac, who hosted the event, and communicating regularly with conference presenters and participants. Writer-editor Sarah Stevenson produced the conference agenda and abstract booklet, and returned on-assignment to Yellowstone to



Dr. Nigel Trewin addresses attendees at the Sixth Biennial Scientific Conference.

oversee final preparations and to handle conference registration. Visual information specialist Renée Evanoff created artwork and produced registration and other promotional materials in support of the event. Other park divisions also assisted with paid staff and volunteer support; Hank Coleman from telecommunications provided the sound system at all venues, and Jim Peaco from the Division of Interpretation videotaped the presentations.

Registration fees covered all conference expenses and yielded a profit of \$5,429, which will go toward the production and printing of the conference proceedings. An agreement was made with the George Wright Society to produce and publish papers from the proceedings. Twenty-two papers were submitted for publication, and it is anticipated that the proceedings will be available in late 2002.

External Assistance

Throughout 2001, Kevin Schneider provided half-time assistance as part of a larger team preparing a servicewide environmental assessment on the impacts of benefits-sharing agreements in national parks.

Presentations, Seminars, and General Information

The resource information staff responded to hundreds of requests for information on a variety of park topics including, but not limited to, wolves, bison, bears, ecosystem management, resource issues, threatened and endangered species, geology, bioprospecting and benefits-sharing, and fisheries. Requests were made in person, through email, phone calls, and in writing. Resource information staff made 17 presentations to groups ranging from high school and university students to teachers, park staff, the visiting public, and professional organizations. As part of his work with the benefits-sharing EA, Kevin presented several talks on the subject to a variety of internal and external audiences. Roger spoke at the annual conference of the Montana Teachers' Association in Bozeman, Montana, and presented evening programs for the public at the Bridge Bay amphitheater. Additionally, the resource information staff coordinated dozens of talks by YCR staff with subject matter expertise.

Staff also maintained a master bibliography of publications relevant to the park, periodically updating the list, and making many of these available via the publications racks in the YCR lobby.

RESEARCH SUPPORT

In 2001, Yellowstone's Research Permit Office authorized 259 research permits to 228 different principal investigators. Of the 259 permits, 40 of those were new research projects initiated in 2001. This year, the management of 17 educational projects was transferred to the Division of Interpretation's Environmental Education Office.

Yellowstone has become an increasing popular place to do research, attracting investigators from 47 states and 6 foreign countries. Seventy-three projects were lead by investigators in Montana, 21 by investigators from Wyoming, and 14 by investigators from Idaho.

Yellowstone's researchers investigate a variety of subjects. A breakdown by topic is as follows:

Air, Soil, and Geology	44
Microbiology	49
Lakes, Streams, and Groundwater	7
Vegetation	35
Wildland Fire	7
Bears	8
Birds	3
Bison	8
Elk and Other Ungulates	9
Fish and Aquatic Life	16
Wolves	5
Other Wildlife Species	18
Archeology and Paleontology	14
Ethnographic Resources	1
Geographic Information Systems	4
Education and Interpretation	27
Resource Management Planning	4



Screens used to shade a microbial mat from ultraviolet rays at Octopus Spring. One of many research projects undertaken by researchers from outside the NPS.

FUNDING AND PERSONNEL

Base Operating Budget

A base operating budget of \$2,661,900 for the YCR was approved by Superintendent Finley in February 2001. This represented an increase of \$93,300 over FY00 funding levels. The additional funds were used to help defray the cost of benefits increases and reestablish key positions within several resource programs.

Additional Funding

Recreation Fee Demonstration funds. No new funding was granted for resource management projects in FY01 under this program. The overall amount allocated to YCR since the inception of the program remained at \$1,300,000 for 18 individual projects.

Fishing fee program. The YCR received authorization to use \$285,100 from fishing permit fee revenue to partially cover the estimated \$712,000 total cost of the aquatic resources program in FY01.

Federal Lands Highway Program. Federal Highways funded \$409,000 for natural resource inventories, archeological surveys, and resource compliance along the road corridors in the park scheduled for major repair or reconstruction in the near future.

Special Emphasis Program Allocation System. The Branch of Natural Resources received \$297,000 to continue the lake trout control program on Yellowstone Lake, to begin a baseline inventory of aquatic thermophiles, and to conduct a paleontological inventory of Mt. Everts in FY01.

The Branch of Cultural Resources successfully competed for a total of \$216,700 in special emphasis program funding. These funds were used for ethnographic resource inventories, two cataloging projects, two archeology projects, to preserve and increase the accessibility of the museum collections, and to prepare a disaster management plan for the collections housed in the Albright Visitor Center.

Other NPS and federal funds. The YCR administered funds and provided support for a number of other federally-sponsored projects in FY01, most significantly the bison management plan and court-ordered environmental impact statement and the Benefits-Sharing EIS, with funds carried forward from prior year authorizations. Funds were also managed for the USGS-BRD grizzly bear studies (\$15,000) in the park.

Private funds. A total of \$85,500 was donated to the park by private organizations or individuals in support of a lynx population survey, wolf recovery program operations, and whirling disease surveys.

Personnel

There were 200 personnel actions processed in FY01, with significant changes in nearly every major resource program area. Of special note were the following:

- Sue Consolo Murphy, Resource Management Specialist, was selected to replace Laura Joss as the Chief of Cultural Resources effective FY01 (October 1, 2000). Roger Anderson was selected to replace Sue as the supervisor of the Resource Information and Publications group.
- Geologists Dr. Paul K. Doss and Dr. Nancy Hinman resigned from the Yellowstone staff in June 2001 to return to their respective universities after laying the foundation for a physical resources and geothermal monitoring program. David Susong of the Utah District of the USGS accepted a temporary appointment as acting park geologist through the fiscal year while recruiting efforts began for a new permanent geologist.
- A third recruiting effort for an aquatic resources team leader proved to be very successful, and Dr. Todd Koel joined the Yellowstone staff on February 11, 2001. Fisheries biologist Patricia Bigelow also came aboard in FY01, and the aquatic resources program became fully staffed for the first time since the NPS assumed control of the program following the closure of the USFWS office in the park in 1996.
- Yellowstone National Park and the Yellowstone Center for Resources became a host site for the Greater Yellowstone Network biological inventory program authorized under the national Natural Resource Challenge program. Inventory coordinator Lane Cameron, along with cartographic technicians Patrick Flaherty and Chad Jacobson, settled in to begin work with the GIS and natural resources staffs of Yellowstone and Grand Teton National Parks and Bighorn Canyon National Recreation Area.
- Several programs expanded with the addition of new positions. Dr. Kerry Murphy and Mark Biel joined the Wildlife Resources Team as permanent biologists working with mid-sized carnivores and

bison management, respectively. The Branch of Cultural Resources selected Elaine Hale for a new Student Career Experience Program position as a Cultural Resources Technician while she works toward a Master's degree in anthropology. The Spatial Analysis Center permanent staff doubled with the addition of GIS Specialist Shannon Savage.

- Wildlife biologist John Mack, a 12-year veteran of Yellowstone who was instrumental in the preparation of both the wolf reintroduction and bison management environmental impact statements, departed from the YCR in June to become the Chief of Resource Management at Bandelier National Park.
- While on a detail assignment to the NPS North Atlantic Regional Office, park curator Susan Kraft began experiencing abdominal pain that upon her return to Yellowstone was diagnosed as a serious illness. She began a leave of absence to seek medical treatment in August that extended through the end of this reporting period.
- Sadly, seasonal cartographic technician Donay Hanson was killed in August in a head-on automobile collision on Montana Highway 89 near Livingston, Montana, enroute back to her duty station at Mammoth Hot Springs after spending her lieu days with friends at her permanent home in Bozeman, Montana.

Contracting

Twenty-seven contracting actions were processed in FY01, totaling obligations of \$811,200 in contracts or task agreements. Significant contracting actions involved the legal consultation services necessary to prepare the NPS servicewide Benefits-Sharing (Biodiversity) EIS, administration of the Montana Water Compact, archeological surveys and evaluations, a variety of wildlife and aquatic resources studies, and a cultural resources study on the administrative history of the park.

Procurement Actions

There were 904 procurement actions processed in FY01, totaling approximately \$882,500.

Clerical Support

There were 1,158 pieces of correspondence and 329 travel authorizations processed in FY01.

Table 1. Yellowstone Center for Resources distribution of FY01 funds.

Program	Park Base	Nat Res Project Funds	Cult Res Project Funds	Fish Fee	FLHP	Fee Demo	Other NPS	Other Federal	Private	Total	% of Total Funding
Support: Mgt, Admin, Sci, Pubs, GIS	854,900	-	-	-	22,300	-	-	-	2,400	879,600	22.2%
Natural Resources	1,458,800	297,000	-	285,100	150,600	-	-	15,000	82,800	2,289,300	57.7%
Cultural Resources	348,200	-	216,700	-	236,100	-	-	-	300	801,300	20.2%
Bison Management EIS	-	-	-	-	-	-	-	-	-	-	0.0%
Biodiversity EIS	-	-	-	-	-	-	-	-	-	-	0.0%
Total:	2,661,900	297,000	216,700	285,100	409,000	-	-	15,000	85,500	3,970,200	100%

**Table 2. Funding history of the Yellowstone Center for Resources.
(Records prior to 1993 reflect funding only for the former Research Division.)**

NATIONAL PARK SERVICE FUNDS													
FY	ONPS	Fee	PFRP	Nat Res Project Funds	Cult Res Project Funds	WRD	FLHP	Fee Demo	Other	USFWS	Other Federal	Donations to NPS Accounts	Total
83	165,500	-	-	-	-	-	-	-	-	104,000	-	-	269,500
84	501,300	-	-	-	-	161,400	-	-	-	104,000	-	-	766,700
85	588,400	-	-	-	-	133,000	-	-	-	104,000	-	3,512	828,912
86	607,400	-	-	150,000	-	112,000	-	-	-	136,550	-	9,310	1,015,260
87	719,300	-	-	200,000	-	108,000	-	-	-	115,000	-	6,758	1,149,058
88	767,000	170,000	-	250,000	-	172,000	-	-	-	104,000	5,400	2,824	1,471,224
89	793,400	406,000	1,863,000	56,000	-	108,000	-	-	-	133,000	4,000	3,017	3,366,417
90	847,400	-	755,000	56,000	-	75,000	-	-	-	111,650	12,000	2,157	1,859,207
91	916,300	-	785,200	56,000	-	-	-	-	-	148,123	15,000	55,101	1,975,724
92	1,025,660	-	685,000	25,000	-	-	-	-	-	182,050	10,000	10,100	1,937,810
93	1,004,600	-	785,000	16,000	-	-	-	-	-	188,000	-	20,000	2,013,600
94	1,250,000	65,000	-	260,000	33,200	156,000	43,300	-	164,600	55,000	24,600	10,000	2,061,700
95	1,500,000	65,000	-	420,000	45,000	6,800	303,600	-	53,000	20,000	-	5,300	2,418,700
96	1,544,100	274,500	-	404,000	201,100	119,800	626,700	-	38,000	-	64,958	31,504	3,304,662
97	1,674,100	213,400	-	204,000	228,400	-	433,700	340,000	42,700	-	398,300	48,000	3,582,600
98	2,245,600	284,800	-	130,500	242,100	24,000	330,800	31,000	-	-	65,300	37,700	3,391,800
99	2,531,900	285,000	-	-	221,900	-	396,500	298,000	152,900	-	105,200	56,700	4,048,100
00	2,568,600	280,000	-	237,500	101,000	-	214,900	631,000	1,418,000	-	41,300	52,700	5,545,000
01	2,661,900	285,100	-	297,000	216,700	-	409,000	-	-	-	15,000	85,500	3,970,200

APPENDIX I. PERSONNEL ROSTER FOR FISCAL YEAR 2001

		<u>FTE</u>	<u>Borrowed FTE</u>
Headquarters/Professional Support			
Roger Anderson	Resource Management Specialist	0.20	
Rebecca Anthony	Administrative Support Assistant	0.11	
Tami Blackford	Technical Writer-Editor	0.50	
Wayne Brewster	Deputy Director	1.00	
Ann Deutch	Administrative Assistant	0.76	
Renée Evanoff	Visual Information Specialist	0.47	
Lisa Fox	Resource Management Specialist		0.68
Mary Ann Franke	Technical Writer-Editor	0.38	
Christie Hendrix	Administrative Support Assistant	1.00	
Harry Laney	Engineering Equipment Operator		0.03
Michelle Le Beau	Administrative Assistant	0.58	
Melissa McAdam	Supervisory Budget Analyst	1.00	
Joy Perius	Budget Analyst	0.99	
Kevin Schneider	Technical Writer-Editor	1.00	
Paul Schullery	Resource Naturalist	0.41	
Stacy Stermitz	Administrative Assistant	0.01	
Sarah Stevenson	Technical Writer-Editor	0.15	
Beth Taylor	Secretary	1.00	
John Varley	Director	1.00	
Alice Wondrak	Technical Writer-Editor	0.25	
Advanced Resources Technology/Spatial Analysis Center			
Donay Hanson	Cartographic Technician	0.17	
Michael Lacyk	Cartographic Technician	0.29	
Kendra Maas	Office Assistant	0.78	
Viktoria Magnis	Cartographic Technician	0.26	
Jeanette McBride	Cartographic Technician	0.13	
David Merwin	Cartographic Technician	0.25	
Steve Miller	Cartographic Technician	1.00	
Rhonda Pfaff	Cartographic Technician	0.21	
Ann Rodman	Supervisory GIS Specialist	1.00	
Shannon Savage	Cartographic Technician	1.00	
Natural Resources			
Rebecca Anthony	Biological Science Technician/Clerk	0.19	
Robert Auger	Biological Science Technician	0.06	
John Bauer	Biological Science Technician	0.11	
Beth Bear	Biological Science Technician	0.40	
Mark Biel	Wildlife Biologist	1.00	
Pat Bigelow	Fisheries Biologist	0.75	
Eric Bindseil	Biological Science Technician	0.09	
John Bowers	Maintenance Worker		0.04
Shelley Buranek	Biological Science Technician	0.40	
Susan Chin	Biological Science Technician	0.33	
McCrea Cobb	Biological Science Technician	0.52	
Eric Deluca	Biological Science Technician	0.08	
Paul Doss	Geologist	0.69	

		<u>FTE</u>	<u>Borrowed FTE</u>
Thomas Duster	Biological Science Technician	0.07	
Brian Ertel	Biological Science Technician	1.00	
Rene Farias	Administrative Support Assistant	0.10	
Steve Gale	Biological Science Technician	0.46	
Trisha Giambra	Biological Science Technician	0.84	
Susan Glenn	Biological Science Technician	0.38	
Rachael Gray	Biological Science Technician	0.46	
Deb Guernsey	Program Assistant	1.00	
Kerry Gunther	Wildlife Biologist	1.00	
Peter Hamel	Biological Science Technician	0.34	
Mary Hektner	Resource Management Specialist	1.00	
Jason Hicks	Biological Science Technician	0.02	
Nancy Hinman	Geologist	0.63	
Michael Humling	Biological Science Technician	0.06	
Darren Ireland	Biological Science Technician	0.50	
Cole Irvin	Biological Science Technician	0.29	
Todd Koel	Supervisory Fisheries Biologist	0.64	
Jeffrey Lutch	Biological Science Technician	0.67	
John Mack	Wildlife Biologist	0.72	
Dan Mahony	Fisheries Biologist	1.00	
Mimi Matsuda	Biological Science Technician		0.06
Scott McBurney	Biological Science Technician	0.21	
Terry McEneaney	Wildlife Biologist	1.00	
Rick McIntyre	Biological Science Technician	0.50	
Kerry Murphy	Wildlife Biologist	1.00	
Keith Neal	Trails Maintenance		0.04
Tom Olliff	Natural Resources Program Manager	1.00	
Glenn Plumb	Supervisory Wildlife Biologist	1.00	
Tiffany Potter	Biological Science Technician	0.63	
Roy Renkin	Vegetation Management Specialist	1.00	
Freya Ross	Biological Science Technician	0.23	
Barbara Rowdon	Biological Science Technician	0.37	
Cynthia Sanders	Biological Science Technician	0.38	
William Sauerresig	Clerk Typist		
Gretchen Schenk	Biological Science Technician	0.06	
Amy Schmoller	Biological Science Technician		
David Schmoller	Biological Science Technician	0.05	
Jim Sinclair	Biological Science Technician	0.06	
Doug Smith	Wildlife Biologist	1.00	
Jason Thoene	Biological Science Technician	0.25	
Tim Thompson	Physical Science Technician	0.10	
John Treanor	Biological Science Technician	0.33	
Don Wethington	Maintenance Worker	0.40	
Brian Wheat	Biological Science Technician	0.28	
Jennifer Whipple	Botanist	0.81	
Davina White	Biological Science Technician	0.33	
Travis Wyman	Biological Science Technician	0.64	

		<u>FTE</u>	<u>Borrowed FTE</u>
Cultural Resources			
Rebecca Anthony	Administrative Support Assistant	0.18	
Sean Cahill	Museum Technician	1.00	
Sue Consolo Murphy	Cultural Resources Program Manager	1.00	
Katrina Cooksley	Archeology Technician		0.08
Jon Dahlheim	Museum Technician	0.98	
Kirk Dietz	Museum Technician	0.16	
Elaine Hale	Cultural Resources Technician	1.00	
Harold Housley	Archives Specialist	0.89	
Ann Johnson	Archeologist	1.00	
Lon Johnson	Cultural Resources Program Manager	1.00	
Kathryn Kirby	Library Technician	0.81	
Susan Kraft	Supervisory Museum Curator	0.83	
Megan McCullen	Cultural Resources Assistant	0.29	
Sally Plumb	Cultural Resources Technician	0.12	
Beth Raz	Museum Aide	0.93	
Charissa Reid	Cultural Resources Assistant	0.32	
Jacqueline St. Clair	Archeologist		0.03
Jim Sinclair	Maintenance Worker		0.15
Inara Smith	Cultural Resources Assistant		0.01
Rosemary Sucec	Cultural Anthropologist	1.00	
Lee Whittlesey	Archivist	1.00	
IGBST & BRD			
Christopher McQuery	Biological Science Technician	0.02	
Greater Yellowstone Network I&M Program			
Jerald Cameron	Biologist	0.75	
Patrick Flaherty	Cartographic Technician	0.02	
Michael Grieco	Cartographic Technician	0.31	
Brenk Holoviak	Cartographic Technician	0.23	
TOTAL FTE		57.14	1.15

APPENDIX II. PUBLICATIONS, REPORTS, AND PAPERS

The following professional publications, administrative reports, and information papers published in 2001 were authored or co-authored by Yellowstone Center for Resources staff.

Professional Publications

- Bangs, E., J. Fontaine, M. Jimenez, T. Meier, C. Niemeyer, D. Smith, K. Murphy, D. Guernsey, L. Handegard, M. Collinge, R. Krischke, J. Shivik, C. Mack, I. Babcock, V. Asher, and D. Domenici. 2001. Gray wolf restoration in the northwestern United States. *Endangered Species Update* 18(4): 147–152.
- Fritts, S.H., C.M. Mack, D.W. Smith, K.M. Murphy, M.K. Phillips, M.D. Jimenez, E.E. Bangs, J.A. Fontaine, C.C. Niemeyer, W.G. Brewster, and T.J. Kaminski. 2001. Outcomes of hard and soft releases of wolves in central Idaho and the greater Yellowstone area. Pages 125–147 in D.S. Maehr, R.F. Noss, and J.L. Larkin, editors. Large mammal restoration: Ecological and sociological challenges for the 21st century. Island Press, Washington, D.C.
- MacNulty, D.R., N. Varley, and D.W. Smith. 2001. Grizzly bear, *Ursus arctos*, usurps bison calf, *Bison bison*, captured by wolves, *Canis lupus*, in Yellowstone National Park. *Canadian Field-Naturalist* 115:495–498.
- Mech, L.D., D.W. Smith, K.M. Murphy, and D.R. MacNulty. 2001. Winter severity and wolf predation on a formerly wolf-free elk herd. *Journal of Wildlife Management* 65:998–1003.
- Ripple, W.J., E.J. Larsen, R.A. Renkin, and D.W. Smith. 2001. Trophic cascades among wolves, elk and aspen on Yellowstone National Park's northern range. *Biological Conservation* 102:227–234.
- Schullery, P., and L. Whittlesey. 2001. Mountain goats in the greater Yellowstone ecosystem: A prehistoric and historical context. *Western North American Naturalist* 61:3, pp. 289–307.
- Smith, D.W. 2001. Beaver survey in Yellowstone National Park, 1999. Yellowstone Center for Resources. 11pp.
- Smith, D.W. 2001. Wildlife art: Does it make a difference for wolves? *Wildlife Art* 20(6):102–105.
- Smith, D.W., K.M. Murphy, and S. Monger. 2001. Killing of a bison (*Bison bison*) calf, by a wolf (*Canis lupus*), and four coyotes (*Canis latrans*), in Yellowstone National Park. *Canadian Field-Naturalist* 115(2):343–345.
- Varley, N., and K.A. Gunther. 2001. Grizzly preys on bison calf. *International Bear News* 10(2), May, pp. 17–18.
- Whittlesey, L. 2001. "Yellowstone National Park," in Paul S. Boyer, ed., *The Oxford Companion to United States History*, Oxford, New York: Oxford University Press.
- Whittlesey, L., and P. Schullery. 2001. "Abstract of Greater Yellowstone Bison Distribution and Abundance in the Early Historical Period" p. 855 in Program Abstracts: The Wildlife Society Eighth Annual Conference, September 25–29, 2001. Bethesda, Maryland: The Wildlife Society.
- Wondrak, A. 2001. Seen any wildlife? Community conflict and a struggle for the soul of Estes Park, Colorado. *Cultural Geographies* 9(1).
- Wondrak, A. 2001. Time Machine. *Yellowstone Science* 9(1), pp. 10–11.
- Wyman, T. 2001. Grizzly bear attacks bull bison. *Yellowstone Science* 9(3), pp. 7–8.
- Wyman, T. 2001. Grizzly bear attacks bull bison. *International Bear News* 10(2), May, pp. 18–19.

Administrative Reports

- McEneaney, T. 2001. The Yellowstone bird report, 2000. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, YCR-NR-2000-01.
- Smith, D.W., R. McIntyre, E. Cleere, G. Plumb, B. Phillips, B. Chan, M. Ross, J. Knuth Folts, D. Chalfant, and B. Suderman. 2001. Managing wolves and humans in Lamar Valley: A final report on the Druid road project 2001. YNP report 7pp.
- Smith, D.W., K.M. Murphy, and D.S. Guernsey. 2001. The Yellowstone Wolf Project: Annual report, 2000. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, YCR-NR-2000-01. 14pp.

Information Papers

- Gunther, K.A. 2001. Recovery parameters for grizzly bears in the Yellowstone ecosystem (rev.). Yellowstone Info. Paper No. BMO-6. National Park

Service, Yellowstone NP, Wyo. 4pp.
Gunther, K.A. 2001. Where are all the bears? (rev.).
Yellowstone Info. Paper No. BMO-4. National
Park Service, Yellowstone NP, Wyo. 2pp.
Gunther, K.A. 2001. Yellowstone National Park bear-
related injuries/fatalities (rev.). Yellowstone

National Park Information Paper No. BMO-1.
National Park Service, Yellowstone NP, Wyo. 2pp.
Gunther, K.A. 2001. Bears and menstruating women
(rev.). Yellowstone Info. Paper No. BMO-7.
National Park Service, Yellowstone NP, Wyo. 2pp.

APPENDIX III. PARTNERSHIPS

Yellowstone National Park is represented by YCR staff in the following external partnerships:

Cultural Resources

Cultural Resources Cluster Working Group

Mission: At the request of the regional director, a group of cultural resource specialists from parks around the Intermountain Region and the Rocky Mountain cluster meet periodically to review cluster and regional issues and make recommendations from the field.

Commitment: Occasional participation in one or two meetings per year located around the region.

Representative: Ann Johnson

2001 Highlights: Major issues existed in the region, partly as a result of the merger of the former Southwest Region in Santa Fe and the former Rocky Mountain region in Denver, and a lack of understanding of leadership roles and responsibilities among all the cultural resource specialists. At a November meeting, representatives discussed issues and potential solutions, and a subsequent survey was conducted of park cultural resource specialists by email, with recommendations to be considered by the regional director in the coming year.

Wyoming State Historic Preservation Review Board

Mission: The board reviews and makes recommendations on nominations of non-federal resources within the state to the National Register of Historic Places.

Commitment: Two meetings a year, rotated around the state.

Representative: Lon Johnson

2001 Highlights: Although federal agencies are not required to submit their National Register nominations to the board, the state group invited the park's historic architect to serve as a member because of his expertise. The group met in May to review nominations, and as a courtesy Lon presented the park's nominations for the Queen's Laundry Bath House, Mammoth Hot Springs Historic District, Fort Yellowstone National Historic Landmark, the North Entrance Road Historic District, and the proposed addition of Clear Creek and Peale Island cabins to the Lake

Fish Hatchery Historic District. The board supported all the nominations and appreciated the park's sharing of information. Queen's Laundry Bath House was subsequently listed on the register on July 25, 2001.

Yellowstone Museum Partnership

Mission: The Yellowstone Museum Partnership was established in 1998–99 to bring together greater Yellowstone area museums to coordinate their efforts in preservation and interpretation. Members include Yellowstone and Grand Teton national parks; the Yellowstone Art Museum, and the Western Heritage Center in Billings; the Pioneer Museum, and the Museum of the Rockies in Bozeman; the Livingston Depot Center, Gateway Museum, and International Fly Fishing Center in Livingston; the Buffalo Bill Historical Center in Cody; the Yellowstone Historic Center in West Yellowstone; the Montana Heritage Commission in Virginia City; the Wind River Historical Center in Dubois; the Park County Museum Board, and the Homesteader's Museum in Powell; the Museum of the Mountain Man in Pinedale; the National Museum of Wildlife Art in Jackson; the Peaks to Plains/Carbon County Historical Society in Red Lodge; the Gallatin County Historical Society; and the Montana Historical Society.

Commitment: The group generally meets twice a year, with the host rotating among the members.

Representative: Susan Kraft or Lee Whittlesey

2001 Highlights: The partnership thanked Yellowstone NP for promoting the organization and its member museums on the park web site and in the park's newspaper, *Yellowstone Today*. Partners were called upon for advice on plans for the Yellowstone Heritage and Research Center, and for technical assistance in the absence of museum curator Susan Kraft. The Branch Chief of Cultural Resources received help from some museum partners in recruiting candidates for acting curator, and in determining how to store the recently acquired Davis Collection until the new facility is constructed in about 2004.

Natural Resources

Bear Taxon Advisory Group

Mission: To support the conservation of all wild bear species from around the world through captive management, exhibition of captive bears, and financial support for research and management of wild bears.

Commitment: Annual four-day meetings.

Representative: Kerry Gunther

2001 Highlights: Participated in a workshop on polar bear ecotourism issues in Churchill, Manitoba, Canada. Assisted the U.S. Fish and Wildlife Service with the confiscation of illegally obtained polar bears from a circus in Puerto Rico. Assisted with the placement of nuisance wild bears into captive facilities.

Bison Management Operations Plan Working Group

Mission: This interagency working group was informally established shortly after the issuance of federal and state records of decision to implement the *Long-Term Bison Management Plan for Yellowstone National Park and the State of Montana*. Comprised of representatives from the USDA Forest Service; USDA Animal and Plant Health Inspection Service; Montana Department of Livestock; Montana Department of Fish, Wildlife and Parks; and National Park Service, the working group develops and periodically updates field-level protocols and procedures for implementing the overarching RODs.

Commitment: During 2001, the working group met monthly and participated in conference call and email correspondence on a weekly basis.

Representative: Glenn Plumb

2001 Highlights: A comprehensive draft compendium of field level procedures was developed that covered all aspects of bison management under the RODs, including bison capture, hazing, shooting, monitoring, carcass disposition, public information sharing, etc. Increased numbers of face-to-face meetings have also improved personal networks and mutual confidence among the interagency partners to the long-term bison plan.

Greater Yellowstone Area Whitebark Pine Subcommittee

Mission: This group is a cadre of biologists within the greater Yellowstone area in addition to members from academia and state and other federal agencies with a research and management interest

in whitebark pine. The mission is to work together to help ensure the long-term viability and function of whitebark pine ecosystems in the GYA.

Commitment: Roy attended two meetings.

Representative: Roy Renkin

2001 Highlights: The group discussed local trends and conditions in whitebark pine that include fire, insects, and diseases.

Greater Yellowstone Bald Eagle Working Group

Mission: Established in 1982, this group monitors eagle productivity and other information. Participants include GYA state and federal government agencies and non-governmental organizations.

Commitment: Previously annual meetings, but a meeting has not been held in the last three years. Information is communicated via email.

Representative: Terry McEneaney

2001 Highlights: The bald eagle is ecologically recovered in the greater Yellowstone area. The group is unified in its belief that the bald eagle can be delisted in this area, and the U.S. Fish and Wildlife Service is expected to take such action in the near future. Fifteen eaglets fledged from 31 active nests in 2001, four more nests than in 2000.

Greater Yellowstone Interagency Brucellosis Committee (GYIBC)

Mission: The GYIBC was formed through a Memorandum of Agreement between the Secretaries of the Department of Agriculture and Interior and the governors of Montana, Wyoming, and Idaho. The GYIBC has an executive committee and two subcommittees, the technical subcommittee, and the information and education subcommittee. Through its executive committee, the agreed upon scope of work for the GYIBC is to develop options and recommendations for the Secretaries of Interior and Agriculture, governors, and regional administrators and directors of member agencies in chartering a management program for brucellosis-affected wildlife populations and their habitat in the GYA; provide coordination of agency responsibilities without usurping agency mandates; encourage cooperation in resolving resource problems and conflicting interests related to brucellosis in wildlife; and provide guidance and oversight to subcommittees. The technical subcommittee, which serves at the direction of the executive committee, will develop a comprehensive, objective, and scientific base of

information and recommend strategies based on common understanding of brucellosis and its impacts on the resources of the GYA; serve as the scientific advisor to the GYIBC; and develop a GYIBC Cooperative Brucellosis Management Plan recommending methods for the eventual elimination of brucellosis from wildlife of the GYA. The information and education subcommittee will develop factual information regarding the purpose of the GYIBC for public distribution and will develop a brucellosis information and education strategic plan for the GYIBC.

Commitment: NPS-IMR Regional Director is represented on the executive committee by the Associate Regional Director for Natural Resources and Science. Yellowstone provides a representative for the technical subcommittee, currently, Wayne Brewster. He has served the first of a two-year term as the technical subcommittee's chairman. Technical and executive committee meetings are held three times annually.

Representative: Wayne Brewster

2001 Highlights: Participation in committee meetings as well as completion of technical subcommittee assignments were completed.

Greater Yellowstone Peregrine Falcon Working Group

Mission: The park works closely with two peregrine falcon working groups, Montana and Wyoming, and has been an active participant since peregrines have been found in greater Yellowstone.

Commitment: Wyoming has an informal working group, with coordination done over the telephone. Montana has a more formalized working group with an annual meeting.

Representative: Terry McEneaney

2001 Highlights: The peregrine falcon was officially delisted from the Endangered Species List on August 26, 1999. YNP is closely monitoring peregrines for five years post-listing to ensure its recovery and is managing peregrines as a species of special concern. In 2001, a record (tied in 2000) of 16 eyries were recorded in YNP, and a record 31 young fledged.

Greater Yellowstone Trumpeter Swan Working Group

Mission: The Greater Yellowstone Trumpeter Swan Working Group was organized in 1997, and Yellowstone's ornithologist was the first chairman. The group collects annual population and production data. Management activities are communi-

cated between agencies at meetings.

Commitment: Joint Greater Yellowstone Trumpeter Swan Working Group/Trumpeter Swan Implementation Plan meetings took place in West Yellowstone in June and in Idaho Falls in September.

Representative: Terry McEneaney

2001 Highlights: The group continued to coordinate trumpeter swan data for the GYA.

Grizzly Bear Conservation Strategy Working Group

Mission: To develop a multi-agency cooperative management strategy for the Yellowstone ecosystem grizzly bear population to be implemented by state and federal agencies upon delisting of the species. The objective of the Conservation Strategy is to describe and summarize the coordinated efforts to manage the grizzly bear population and habitat, and the public education and involvement efforts that will be applied to ensure continued conservation of the grizzly bear in the greater Yellowstone area; and document the regulatory mechanisms that exist to maintain the Yellowstone population as recovered through legal authorities, policy, guidelines, management programs, monitoring programs, and the commitment of participating agencies.

Commitment: Approximately 5–10 meetings per year, meetings are typically 1–4 days in length, for a total commitment of 15–25 person days per year.

Representative: Kerry Gunther

2001 Highlights: Addressed and incorporated public comment into the Draft Conservation Strategy. Met with Yellowstone Ecosystem Subcommittee managers to identify their concerns with the draft document.

Harlequin Duck Working Group

Mission: This group is an international (U.S. and Canada) and interagency (state, federal, and provincial) group designed to share harlequin duck information and data.

Commitment: Although unable to attend a formal meeting in recent years, the ornithologist plans to attend future meetings.

Representative: Terry McEneaney

2001 Highlights: This group did not meet in 2001.

Interagency Grizzly Bear Cumulative Effects Modeling Team

Mission: This group is a cadre of biologists representing each of the units of the greater

Yellowstone area whose mission is to implement and provide line officers with an assessment of grizzly bear habitat conditions and the effects of human activities on grizzly bear habitat for the GYA recovery zone. The purpose and role is to “develop and maintain the Cumulative Effects Model (CEM)/Access database and model, and provide coordination and consistency regarding all aspects of the Yellowstone Ecosystem CEM.”

Commitment: Roy Renkin has been the park representative for the past 17 years, and co-chairperson (with Kim Barber of the Shoshone National Forest) for the past seven years. The group met formally twice. Roy also worked on an analysis to update model coefficients.

Representative: Roy Renkin

2001 Highlights: The 2001 effort resulted in a science monograph to be published by the USGS-BRD entitled: Mattson, D., K. Barber, R. Maw, and R. Renkin. *In review.* Coefficients of productivity for Yellowstone’s grizzly bear habitat. USGS-BRD Science Monograph.

Interagency Grizzly Bear Study Team

Mission: To 1) conduct short- and long-term research addressing information needs for bear management; 2) monitor the bear population, including status and trend, numbers, reproduction, and mortality; 3) monitor grizzly bear habitats, foods, and impacts of humans; 4) provide technical support to agencies and other groups responsible for the immediate and long-term management of grizzly bears in the GYE.

Commitment: Two to four meetings annually. Meetings typically range from one to two days.

Representative: Kerry Gunther

2001 Highlights: The Interagency Grizzly Bear Study Team co-hosted the International Bear Conference in Jackson, Wyoming, in 2001. Study team members presented eight professional papers at the conference on a variety of bear topics including distribution, denning, conflicts, mortality, population estimates, and use of moths and mushrooms. Six of the eight papers have been accepted for publication in the *Journal Ursus*, the remaining two papers were submitted for publication and are currently in peer review. The YNP Study Team Member was an author or co-author on three of the papers and contributed data to several of the others. In addition, study team members including the YNP representative

published a paper on exotic threats to grizzly bears in the *Western North American Naturalist*.

Interagency Yellowstone Cutthroat Trout Status Assessment Workgroup

Mission: To develop tri-state Yellowstone cutthroat trout assessment protocols and update the condition of existing populations.

Commitment: Several two- or three-day protocol development meetings, and two week-long meetings for the status assessment. The Spatial Analysis Center spent three weeks making maps.

Representative: Dan Mahony

2001 Highlights: Completion of stream-specific status assessment for all known Yellowstone cutthroat trout populations within the park.

Intermountain Region Natural Resources Communication and Advisory Team

Mission: Intermountain Region Director Karen Wade initiated this team to create more proactive and effective systems to achieve natural resource goals, improve communications, and ensure accountability.

Commitment: Bi-annual meetings (generally three-day meetings in Denver) and work assignments.

Representative: Tom Olliff

2001 Highlights: The group initiated a resource newsletter, and worked on planning a regional resource conference and developing a regional resources strategic plan.

International Union for the Conservation of Nature Bison Specialist Group/North America

Mission: The IUCN Species Survival Commission has formally sanctioned the creation of the Bison Specialist Group/North America (BSG). The BSG will assess the conservation status of North American plains bison in Canada and the United States, including Department of Interior management units that include bison (USFWS Refuges, National Parks, and BLM) and issue a final report to IUCN for inclusion in the global “Red Book” of species conservation status.

Commitment: During 2001, the BSG convened at the Annual Meeting of the Wildlife Society in Reno, Nevada.

Representative: Glenn Plumb

2001 Highlights: The BSG approved a two-year working plan that includes graduate student Delaney Boyd at the University of Calgary under

Cormack Gates, and established a password-protected web site.

Montana Bird Records Committee

Mission: This interagency group reviews new and rare bird records, and keeps the park up-to-date on the latest advances in ornithology.

Commitment: Meets once or twice a year, depending on the volume of information.

Representative: Terry McEneaney has been chairman of this committee for several years

2001 Highlights: The group reviewed 2001 bird records.

Montana Fluvial Arctic Grayling Workgroup

Mission: This group develops short- and long-term goals and works toward the restoration of populations in the upper Missouri basin.

Commitment: A one-day meeting each year plus any required field activities.

Representative: Todd Koel

2001 Highlights: Grayling at Grebe and Wolf Lakes were tagged as part of a grayling migration survey in the Gibbon River. The updated five-year interagency Memorandum of Agreement was approved.

Montana/NPS Reserved Water Rights Compact Technical Oversight Committee

Mission: This agreement, signed in 1994 by the NPS and the state of Montana, guarantees that Yellowstone's historical water rights will not be violated and that geothermal aquifers with potential connections to Yellowstone's geyser systems will not be compromised. The agreement quantified Yellowstone's water rights and set up a process to protect these rights from outside development. The compact requires outside developers to demonstrate that no potential exists for adverse effects to the hydrothermal system and that any scientific doubt concerning the effects will be resolved in favor of hydrothermal protection for the park. A technical oversight committee of scientists with hydrothermal system expertise reviews the evidence and oversees the Yellowstone Controlled Groundwater Area.

Commitment: The park representative reviews new water well applications, reports consumptive uses, and monitors data and plans for the Yellowstone Controlled Groundwater Area as needed.

Representative: Tom Olliff

2001 Highlights: The committee worked on developing a monitoring plan for the controlled groundwater area.

Montana Wolf Management Plan Technical Committee

Mission: Montana organized a committee to provide biological information on wolves to help develop a wolf management plan for the state.

Commitment: Six meetings in Helena, Montana.

Representative: Doug Smith

2001 Highlights: The group completed a wolf management plan.

National Partnership for the Management of Wild and Native Coldwater Fisheries

Mission: This group provides leadership and recommendations for the Whirling Disease Initiative and the Montana Water Center.

Commitment: One three-day meeting each year.

Representative: Todd Koel

2001 Highlights: The partnership explored other possible initiatives. Yellowstone provided research priorities on whirling disease.

Neotropical Migrant Working Groups

Mission: Yellowstone typically participates in three neotropical migrant working groups. The two state working groups are the Partners in Flight of Montana and Wyoming. The third group, called the Western Working Group Partners in Flight, is international. They are currently focused on prioritizing species and developing conservation plans.

Commitment: Meetings occur twice a year, usually in different areas of the West. The staff ornithologist attended a Western Working Group meeting in Washington state.

Representative: Terry McEneaney

2001 Highlights: The Western Working Group continued to coordinate the Partners in Flight program in North America.

Northern Prairie Wildlife Species Viability Working Group

Mission: The Northern Prairie Wildlife Species Viability Working Group is an interagency and NGO forum that was established in 1997 to evaluate regional strategies for the conservation of native wildlife species across federal, state, tribal, and private land bases. The working group initially

included the USDA Forest Service; The Nature Conservancy; National Park Service; USGS Biological Resources Division; and Bureau of Land Management.

Commitment: Meetings of the working group have been held periodically along with conference calls and written and email correspondence.

Representative: Glenn Plumb

2001 Highlights: Members of the working group authored a summary manuscript describing processes for interagency management coordination to conserve wildlife species viability in the Northern Prairie that was submitted and accepted for publication to the *Wildlife Bulletin*.

Northern Yellowstone Cooperative Wildlife

Working Group

Mission: The Northern Yellowstone Cooperative Wildlife Working Group is an interagency forum established under a Memorandum of Understanding to facilitate cooperation and coordination of agency actions to assess ungulate populations on Yellowstone's northern range. Cooperation includes cost-shared funding and staff to implement an array of ungulate surveys.

Commitment: During 2001, Glenn Plumb chaired at two formal meetings and several informal meetings and discussions. Glenn Plumb and P.J. White will prepare the 2001 Annual Report.

Representatives: Glenn Plumb

2001 Highlights: The group collaborated to provide funding and staff time to conduct a variety of ungulate population abundance, distribution, and composition aerial surveys including elk, pronghorn, bighorn sheep, mule deer, and mountain goat.

Rocky Mountain Cluster Natural Resource Managers Group

Mission: The natural resource chiefs of the Rocky Mountain Cluster meet annually to discuss important cluster resource issues and funding initiatives, and to receive updates on servicewide issues.

Commitment: A two-day annual meeting.

Representative: Tom Olliff is chair through 2003.

2001 Highlights: Held first annual information workshop January 29–30 in Denver.

Upper Missouri Westslope Cutthroat Trout Restoration Steering Committee

Mission: The protection and restoration of geneti-

cally pure westslope cutthroat trout populations in the Upper Missouri River Basin.

Commitment: An annual one-day meeting.

Representative: Dan Mahony

2001 Highlights: Reviewed regional westslope cutthroat conservation agreement and management plan for Montana.

Wyoming Abandoned Mine Lands

Mission: In 1977, the Surface Mining Control and Reclamation Act established a coal mining tax that set aside money to reclaim abandoned coal mines in the states where these operations originated. All known abandoned coal mines in Wyoming have been reclaimed, and the Wyoming Abandoned Mine Lands program has funding available to reclaim lands and water adversely affected by non-coal mining activities including gravel pits and quarry sites. The park began working with the Wyoming Department of Environmental Quality in 1992 to identify and reclaim abandoned gravel pits and quarries. This partnership has resulted in the reclamation of six abandoned gravel pits and quarries totaling more than 68 acres, and five miles of access road. The work addressed safety issues, mitigated environmental degradation that was the direct result of past mining activities, and restored valuable wildlife and fisheries habitat.

Commitment: Park staff conduct resource inventories, prepare environmental compliance documents, work with the state to develop the reclamation plan, and provide on-site coordination, revegetation, and post-construction monitoring.

Representative: Mary Hektner

2001 Highlights: The Lone Star Geyser pit and associated access road, and the Natural Bridge/Bridge Bay quarry were reclaimed. Engineering plans were developed for reclaiming the Sedge Creek pit and access road, to be implemented in coordination with the reconstruction of the Grand Loop Road along Mary Bay.

Wyoming Bird Records Committee

Mission: This interagency group elected the staff ornithologist to the Wyoming Bird Records Committee in 1998. The group reviews bird records.

Commitment: Meetings occur once a year in the spring. The staff ornithologist was selected as committee chair, but resigned from this position as of fall 2001.

Representative: Terry McEneaney
2001 Highlights: The group reviewed 2001 bird records.

Wyoming Grizzly Bear Management Plan Committee

Mission: To develop a state plan for managing grizzly bears outside of the Recovery Zone within the state of Wyoming to be implemented once the bear is delisted. The state's goal is to have an adaptive management approach for managing grizzly bears that will allow existing recreational and consumptive uses and values to continue, while also building support and increased tolerance for an expanding grizzly bear population.
Commitment: Attended a three-day meeting.
Representative: Kerry Gunther
2001 Highlights: Completed a draft, started in 2000, of the Wyoming Grizzly Bear Management Plan for the Wyoming Game and Fish Department.

Yellowstone River Task Force

Mission: Commissioned by the governor of Montana in 1998 and continued through 2003, this task force seeks to bring together landowners, sportsmen, and community leaders to develop a shared understanding of the issues and competing values and uses that impact the upper Yellowstone River, and encourage a comprehensive approach to action taken along the river to ensure that its integrity remains intact.
Commitment: Monthly meetings and annual field trips. Yellowstone sits on the task force as an *Ex Officio* member.
Representative: Tom Olliff
2001 Highlights: Ongoing studies of watershed conditions and land use, geomorphology, hydrology, riparian trend analysis, fisheries analysis, wildlife (bird) analysis, and socio-economic assessment. Conducted an educational workshop (March 3) to help the public understand why and how we are conducting studies. Conducted a river demonstration workshop (May 5) held outdoors at five designated sites to demonstrate research techniques and answer questions.

Yellowstone Volcano Observatory

Mission: This cooperative venture between the USGS, Yellowstone National Park, and the University of Utah, created under the USGS Volcano Hazards Program, seeks to monitor earthquake

and volcano unrest to improve human safety. The group is in the early stages of developing a Volcano Hazards Response Plan for Yellowstone.
Commitment: Weekly telephone conferences prior to establishment, and monthly telephone conferences after establishment along with a steering committee meeting in the park to continue organization and outline activities.
Representative: Tom Olliff
2001 Highlights: A Memorandum of Understanding was approved, and the YVO was established. A steering committee met in the park in order to organize the YVO's structure and initial activities.

YCR and Parkwide Support Global Biodiversity Institute

Mission: Provides knowledge for better use of biodiversity and biotechnology through consultation and training in the use and conservation of biodiversity in developing countries.
Commitment: Periodic week-long training sessions in a developing nation that serves as the host country for neighboring countries' delegates.
Representative: John D. Varley, GBDI faculty member.
2001 Highlights: Two training sessions were presented in Africa during the year. The first, for 13 Francophone countries, was held in Cotonou, Benin. The second, for 18 East Africa countries, was staged in Dar Es Salaam, Tanzania. Yellowstone's experiences with biodiversity preservation and emerging bioprospecting challenges were presented to the students near the end of their four week course as a real-life case history. This is particularly helpful to the students, as much of the course is foundational or theoretical material, and there are few actual case histories beyond the rich experience of Costa Rica and the emerging experience of Yellowstone.

NPS Servicewide Benefits-Sharing EIS Task-Force and Advisory Group

Mission: The National Park Service is considering policy options on how best to manage a small group of permitted researchers in parks commonly characterized as bioprospectors. Bioprospecting is the search for valuable substances in Nature, usually bioactive molecules and genetic components, and is an

offshoot of permitted research and specimen collection in the national parks. By federal court decree, an EA/EIS process under the authority of the National Environmental Policy Act was chosen to facilitate this process, involve the citizens of our country in the potential decisions, and explore all reasonable alternative management scenarios.

Commitment: Yellowstone Park has a greater proportion of bioprospecting occurring in its boundaries than any other park in the system, and thus has a significant commitment to choose the management option that works best for the park and its resources. In 2001, it is estimated that the park expended 2.7 FTE toward this end.

Representatives: John D. Varley, Sue Mills, Kevin Schneider, Ann Deutch.

2001 Highlights: Yellowstone provided this effort's co-chair, job captain, and two analysts to the EIS Task-Force and participated in servicewide interdisciplinary Advisory Board activities. The effort was funded through Yellowstone base operations and servicewide planning funds. Work in 2001 included a transition from an EA process to a full EIS, which is now scheduled to be released for public comment in early 2003.

Technical Sub-Group of the Gallatin County MOU Group

Mission: Coordinate data and information exchange between federal, state, and local government agencies within Gallatin County.

Commitment: Attend scheduled meetings, inform others about the data we have available, and acquire data from others that is useful to

YNP. Coordinate on cross-boundary projects.

Representative: Ann Rodman

2001 Highlights: Members exchanged digital data in support of cross-boundary projects such as trail networks and winter wildlife habitat.

Thermo Biology Institute and Center for Life in Extreme Environments

Mission: Established by Montana State University-Bozeman in 1997 to conduct and promote research and education focused on the biology and interrelated physical and chemical processes of geothermal environments in the Greater Yellowstone Ecosystem.

Commitment: An annual meeting, periodic seminars, and administration and logistics associated with their permitted researchers in the park.

Representative: John Varley has a chair on TBI's Scientific Advisory Board; Christie Hendrix services all other commitments.

2001 Highlights: TBI's close proximity to the park provides a unique opportunity for in-depth analysis of life at high temperatures. Nine TBI faculty are leading park projects that range from the discovery and cultivation of new high temperature organisms and viruses, to examination of unique plant-microbe interactions, to understanding the interplay between the geochemical environment and the diversity of thermophilic life. The results of TBI research has resulted in 26 publications and invited presentations at national and international meetings, working with NPS interpreters on material for park visitors, and outreach to regional schools.

YELLOWSTONE CENTER FOR RESOURCES

ANNUAL REPORT 2001

