Yellowstone Science Interview:
Steven Smith

Tasmania and Yellowstone

A conversation on parallel administrative evolution

Tasmanian Devil

Yellowstone is a regular destination of park researchers and managers from many parts of the world, and occasionally we have an opportunity to compare notes. Such was the case with Dr. Steven Smith, a Tasmanian zoologist with the Department of Lands, Parks and Wildlife, who visited Yellowstone in July of 1991.

This interview provides some entertaining perspectives on the sometimes striking similarities between scientific and management issues facing American national parks and those facing the parks of other nations. Ed.

YS What brings you to Yellowstone?

SS I'm traveling on a Winston Churchill Memorial Trust Fund Scholarship. Funds are provided for Australians to travel overseas and to increase their personal qualifications.

I'm one of the first people to come from our national parks. I'm looking at wildlife conservation and general management in other World Heritage areas. My original goal was to visit areas in Chile, Argentina, the United States, and Canada. The two parks I intended to see in the U.S. were Yosemite and Everglades, but I extended the trip to visit others.

YS So the trip is almost over?

SS This is my last day after 4 months.

YS What is your role in the Tasmanian Parks?

SS I'm the zoologist for the Tasmanian Wilderness World Heritage Area [WHA], which is a group of national parks in Tasmania. These five Tasmanian national parks were added to the list of WHAs in 1982, and I was appointed as a specialist in 1986.

My task as a zoologist, along with a botanist, archeologist, earth scientist, and specialist planning officers, was to inventory the natural resources. Nobody lives in the area, and it's fairly remote, so very little research has been done there except for two or three preliminary studies.

YS Are these relatively new national parks?

SS Well, the first portion of one of them, Cradle Mountain National Park, was established in 1916. That was one of the first in Australia. The other areas have been added sequentially as the result of different historical events.

In 1982, following a big conservation debate about construction of a dam on one of the last major wild rivers in Tasmania, the government protected the river by establishing Wild Rivers National Park, which happened to also connect northern Cradle Mountain with some of the southwest biosphere reserves. So there's now a continuous area that's larger than Yellowstone National Park. It's about 2.8 million acres.

YS It sounds like your job is overwhelming. How did you organize it?

SS We've been concentrating on invertebrates because most of the birds and mammals are pretty well known.

YS Are some of the larger animals rare?

SS There are a couple bird species that are in the IUCN [*International Union for the Conservation of Nature. Ed.*] redbook of endangered birds. But the mammals are pretty secure.

YS Do you have an endangered species act?

SS In Tasmania, we're party to a number of different agreements that serve that purpose. There's an Australian list of threatened species, and there's a committee of conservation ministers from each of the six states. They agree on the list of Australian threatened vertebrates.

YS Do you have amphibians?

SS There are some ten species in Tasmania, and four endemic species.

YS It seems widely agreed now that they're very sensitive environmental indicators.

SS I've heard that. I don't have details about the population dynamics of ours, but we haven't lost any species.

YS Even in Yellowstone there is some very preliminary evidence that they're declining. They provide us with some useful baselines for studying environmental changes. There might be more sensitive species in the insect world, but we would have to start from scratch on them; we're like you, and don't know a lot about them, except for the aquatic insects. We have 80 years of work on aquatic insects. That brings up another question: in historical terms, how far back does your wildlife information go?

SS The earliest collecting was done in the late 1800s by naturalists. Tasmania was one of the bases for Antarctic ex-

Tasmanian map from Department of Lands, Parks, and Wildlife

ploration by Morrison, Scott, and others, who would spend a few days touring and collecting.

YS How does Yellowstone compare with Tasmanian parks?

SS Yellowstone is interesting because it's like looking to the future in Australian national parks, in levels of visitor use.

YS You don't have these levels?

SS No. I'm not sure of the exact numbers, but it would be in the order of 100,000 people annually.

YS What are your other biggest issues in research and management?

SS In terms of ecological management, fire management is certainly our most important issue, and one that, in terms of wildlife research, we need to know more about.

It's very controversial. The arguments run that if we exclude fire from the area, then we'll end up with major wildfires that will be more devastating than the small periodic wildfires. So national parks have a policy of lighting controlled burns to reduce fuel on the ground. On the other hand, some of the most severe fires in recent years have been controlled burns that escaped.

YS We still face a challenge getting people to understand how fundamental fire is to a wild ecosystem like the Yellowstone area.

SS I'm not sure if people really appreciate that fire is a part of Australian ecology as well. We expect major fires every 30 or 40 years, I suppose. Back in 1967, Tasmania had a fire that killed people and engulfed the capital city. That sort of event is likely to happen unless action is taken to reduce fuel loads. National parks are also expected to take such actions.

YS Over the last century, national park goals have evolved here. We are now preserving processes and not just species or objects. Are you seen by your people as preserving a collection of species, or an ecological system, or a little of both?

SS A little of both. In theory, we are protecting ecological processes. We've set aside areas we hope are large enough to allow natural processes to continue without artificial interference. That's really our goal.

Having said that, there are some rare species that we must protect. We could say that extinction of these species in a natural setting is a natural event, but I think that consensus of opinion is that we should make some exceptions in the case of species threatened with extinction, to preserve them for the sake of preserving diversity.

YS Give us an example of how that works.

SS There's a fish that lives only in one area, and it's threatened by the expansion of introduced European trout. We are trying to captive breed the fish, and we're looking for alternative water bodies, that are isolated and not accessible to European trout, to establish new populations of the fish.

In terms of fire policy, I don't think that politically it's possible for us to let fires burn freely in the parks—to say we won't do anything and just see what happens—because we are neighbored by state forests that have large timber resources. We would like to have natural ecological processes operating as much as possible, but there are some constraints.

YS Endangered animals generate these legal imperatives; they sometimes require us to break away from the rule of letting the system function without interference. But, in our culture at least, there also seem to be moral imperatives. For example, even if something is going extinct for reasons that are somehow defined as natural, our society would probably decide that species should be propped up and kept going. Species have an almost sacred value in western societies.

SS Yes, and it seems a bit arbitrary if we look at extinctions as natural events, but there are so many things happening outside the park that are not natural. In the case of the fish that I mentioned, it has become rare because its original habitat was flooded by a large hydroelectric dam and trout were artificially introduced. The flooding also enabled other fish species to invade its habitat.

The orange-bellied parrot, which is on the IUCN list of endangered species is another example. We do have some in the park in southwest Tasmania, but they migrate to overwinter on the southwest Australian mainland, and probably has become rare and threatened because of alteration of its wintering range. So what we do within the park isn't necessarily the whole story as far as the species go.

YS Yellowstone faces similar complications. Some birds that summer and nest here winter in Central America. In the largest sense, that is a part of our ecosystem, or we are part of theirs, and they still use DDT down there.

But let's return to the fish for a moment. We hear complaints now that fishing is too manipulative a use of national park wildlife, but fishing is enormously popular here. Is fishing legal in your parks?

SS Yes. It's a major tourist attraction, but the policy now is not to stock fish in waters within the national parks. We are not taking action to remove the exotic fish that are already there, but no lakes in the parks are stocked, and we do not introduce trout to any new waters.

YS That's very similar to our policy. Exotic fish are one of our biggest exotic problems, and they've caused massive ecological changes in the original fish fauna that was here.

SS The trout are established in many of the waters and they're self-perpetuating.

YS Has Tasmania's isolation as an island helped prevent exotic problems?

SS The exotic species we have problems with within the parks, compared to the mainland of Australia, are relatively few. We're very fortunate in not having the European fox to deal with, and also we don't have the dingo.

YS Why would the dingo be a problem?

SS There are fossils of the Tasmanian devil and Tasmanian tiger throughout the Australian mainland. They disappeared from the mainland about two and a half to three thousand years ago, which coincides roughly with the arrival of the dingo, which never reached Tasmania.

YS The dingo isn't considered native to Australia?

SS Well, it's been there for two and a half to three thousand years.

YS If that's not native, what is?

SS The marsupials that evolved in isolation from other mammals some 30 to 45 million years ago. Australia was isolated until 15 million years ago, when it was carried northward. When it reached Southeast Asia, there was a gradual invasion of mammals—first of all bats and rats, but in more recent times human beings. When the dingo arrived, 3,000 years ago, the biggest marsupials, the Tasmanian devil and Tasmanian tiger, disappeared from the mainland.

YS But you still have the Tasmanian devil in Tasmania?

SS The Tasmanian devil is widespread and common. It's mainly a scavenger, but it can take small animals.

Tourism Tasmania

YS What about the Tasmanian tiger?

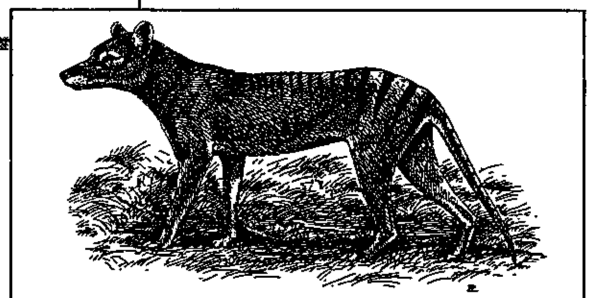
SS It was a more active hunter, a true marsupial hunter. It became more and more rare in the early part of the century, and the last one died in captivity in a zoo in 1936.

YS Usually a species like this lingers in people's imaginations, and maybe in reality, long after the "last" one is gone. Is there still a chance there are a few around?

SS We haven't any convincing evidence, like droppings or prints, since 1936. It's difficult to know because there was very little scientific research done then, and we're not really sure what the droppings look like. There are good illustrations of the prints. It's something of a mystery.

YS So every once in a while you get tantalized with a report that they might survive.

SS Right. A research project by the World Wildlife Fund was done on the Tasmanian tiger in 1980. They tried to piece together information from recent sighting records, historic records, bounty claims that were paid out between 1880 and 1910, and other records. They wanted to see if there is a possibility that



The Tasmanian Tiger, analog of the Yellowstone wolf. Photograph of a captive animal in New York, probably in the 1930s, © NYZS/The Wildlife Conservation Society. Drawings of the Tasmanian Devil (p. 11) and Tiger (above right) from Extinct and Vanishing Mammals of the Old World, *by Francis Harper (1936)*

there is still suitable habitat in areas where the modern sightings occur.

Certainly it does seem the sightings concentrate in areas where there is suitable habitat. Whether it's a psychological phenomenon of some sort, or that people want to keep the areas famous for sightings, or the animals really are there, we don't know.

YS That is almost eerily similar to the wolf situation in Yellowstone Park. There are sightings, and even proof of the recent migration of at least one animal from currently occupied wolf habitat in northern Montana. But we're still without proof of a reproducing population.

We also have a lot of confusion in the sightings; people routinely turn in photographs of coyotes that they think are wolves. How similar in appearance are the Tasmanian devil and the Tasmanian tiger?

SS Not very similar. The Tasmanian devil is sort of like a corgi [*a small herding dog. Ed.*] in appearance: very stocky, with a very thick broad jaw, and jet black with a white blaze across its chest and across its rump. It doesn't look much like the American cartoon character.

But the Tasmanian tiger—there is a really incredible similarity between its skull and a wolf's. The dentition is remarkably similar. The animal is about wolf size, with a short coat and sandy color, with chocolate brown stripes towards the rump. The tail is very stiff, kind of like a kangaroo's.

YS It's hard for non-Australians to picture an animal like this, so much like our larger canids, that is also a marsupial. It doesn't sound like much was known of its natural history.

SS Some of the best records actually came from animals that were sent to the New York Zoo. It's the only institution that's got detailed records of them. This female was sent to the zoo with three pouched young, so the young developed in the pouch. The young were described as being rat-sized, and as they grew the pouch stretched to the ground. The young left the pouch and got back in through the hind legs. One of the young died and two of them lived for eight years. They were never bred in captivity.

YS What would be the Tasmanian equivalent of our large herbivores?

SS Kangaroos. In Tasmania we have the eastern gray kangaroo, which is one of the biggest species. It's mainly a dry plains animal. Our most common hopping animal, is the wallaby. It's the basis of the fur industry, and the sport shooting industry, which is managed by the National Parks and Wildlife Service.

We also now have introduced deer. There's a deer-hunting sport industry, and also a deer-farming industry.

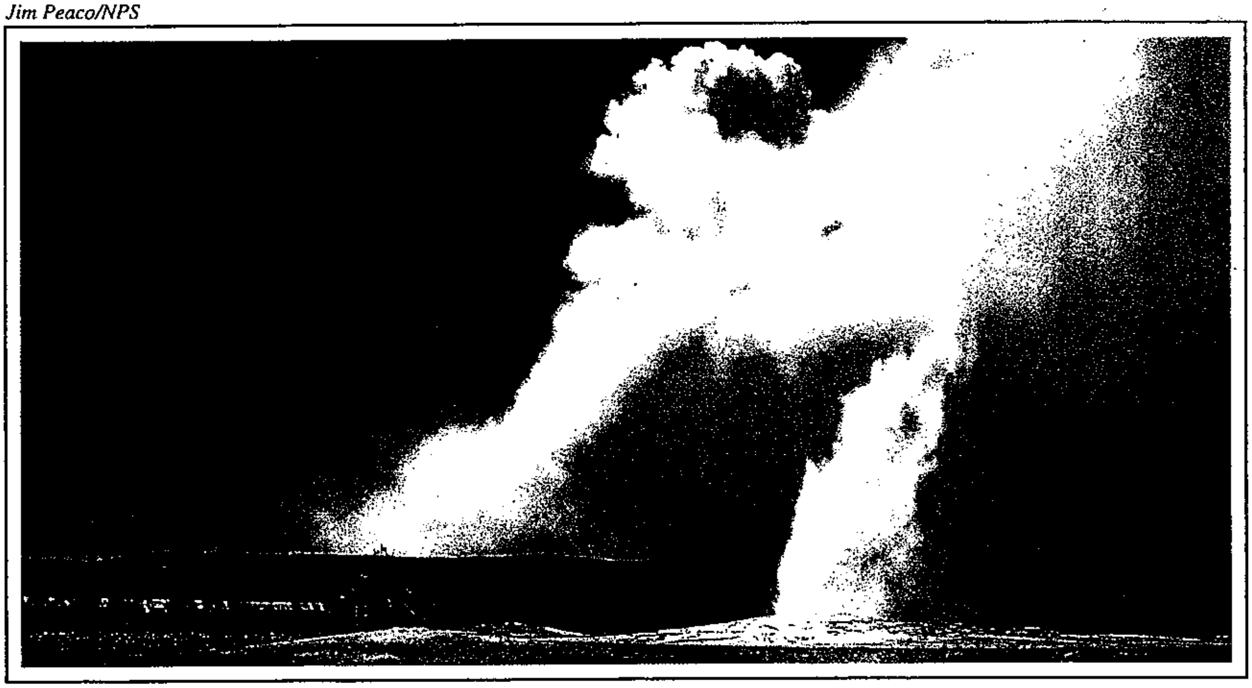
YS You don't allow hunting in the parks?

SS No. The only hunting is sport fishing.

Effects of the 1988 fires

How accurate were the predictions, and what next?

Jim Peaco/NPS



by Dennis H. Knight

On September 19-21, Yellowstone hosted the Second Biennial Scientific Conference on the Greater Yellowstone Ecosystem. Entitled "The Ecological Implications of Fire in Greater Yellowstone," the conference featured more than 60 papers and posters in two intensive days (see page 20 of this issue for more on the conference events). Dennis Knight, of the University of Wyoming, served as conference summarizer, and has allowed us to publish his observations here.

With our encouragement, Dennis has taken the generalist's view of the conference findings. Rather than discuss the work of specific investigators, he has synthesized the many types of work being done into an overview that concentrates on the general directions of fire research in the Yellowstone area. Ed.

During and after the 1988 fires, there were many predictions on how greater Yellowstone area (GYA) ecosystems would be affected. Some were based on research that had been done previously; others stemmed more from anecdotal evidence or untested hypotheses. Five years later, 225 scientists and managers from six federal agencies, six state agencies, and 24 colleges and universities gathered in Mammoth to compare the results of their research. Like the fires themselves, the meeting was historic. As Superintendent Bob Barbee observed, "The opportunity to learn did not go to waste." Numerous reports are now being written that will affect management and research in the future. Some of the highlights are presented in this summary.

Vegetation Change

The paleoecologists at the conference described fire frequency and vegetation changes as far back as 10,000 years ago. At that time, Engelmann spruce was beginning to invade the tundra vegetation that had predominated over GYA landscapes since the retreat of the glaciers. A spruce-dominated woodland apparently persisted for many centuries. However, with continued warming and drying, forests of lodgepole pine and Douglas-fir became more common throughout the area. About 5,000 years ago a cooling trend began, and predictably, Engelmann spruce and subalpine fir became more abundant. Douglas-fir now persists only at the lowest elevations.

Prior to 1988, ecologists had learned that fires in stands of Douglas-fir occurred on average every 20-50 years, depending on location, and that stands dominated by lodgepole pine, Engelmann spruce, and subalpine fir burned every 200-300 years. All available evidence now suggests that, prior to 1988, the most extensive fires occurred 285 years previously, in about 1703. Lake-bottom sediments, with layers of charcoal, indicate that the length of time between fires was shorter about 8,000 years ago when the climate was drier. Even then, however, the GYA must have been a "non-equilibrium landscape" characterized by large-scale fires that burned large areas. Notably, such fires burn unevenly. Data presented at the conference indicates that 75 percent of the land area that was subjected to crown fire in 1988 is within 200 m of a less severely burned or unburned patch (50 percent was within 50 m).

Succession following the 1988 fires has been highly variable from one area to another. Lodgepole pine was a very successful pioneer species, as predicted, but the density of new seedlings in burned areas varies greatly (from nearly zero to over 100 seedlings per square meter!). Lodgepole pine seedling density is correlated with heat severity, the prefire abundance of serotinous cones, elevation, seed-bed characteristics, and postfire climatic conditions. Intense fires may burn most of the seeds contained within the serotinous cones, though the heat tolerance of the seeds appears to be considerable.

Generally, lodgepole pine seedlings were most dense where serotiny was high in the forest that burned; within any serotiny class, seedlings were more dense near the edges of burned areas where burn intensity was moderate. Engelmann spruce, subalpine fir, whitebark pine, and aspen can be early invaders along with the lodgepole pine in some areas. Regardless of species composition, new even-aged stands are developing. Tree age can vary greatly in these "even-aged stands," with the broadest range of ages occurring where, for whatever reason, the initial density of tree seedlings and other plants was sparse. Nevertheless, more than 75 percent of lodgepole pine seedlings present today in burned areas were established within the first two years after the fires.

One of the most surprising results of the 1988 fires has been a dramatic increase in the number of aspen seedlings. Abundant seed apparently was dispersed into the burned areas and soil moisture conditions apparently were favorable, probably because of the relatively moist year that followed the fires combined with less soil drying due to lower rates of transpiration. Aspen also are capable of root sprouting following fires. Higher densities of sprouts did occur in some burns, but notably, not in others. In all cases, the aspen continues to be heavily browsed by elk, causing some stands to persist only as shrubs.

It remains to be seen if new aspen clones will develop because of the fires. Data presented at the conference suggest that most tree-sized aspen on the northern winter range in Yellowstone National Park developed between 1870 and 1890, a period when both elk and beaver populations might have been low because of intensive hunting and trapping. The cause of aspen and willow decline continues to be a controversial issue, with most of the evidence pointing to heavy browsing by elk. Elk browsing also may limit the establishment of new trees in burned Douglas-fir woodlands, but the magnitude of this effect has not been determined.

Animal Populations

The effects of the 1988 fires on animals were as variable as the effects on plants. Generally, there was no observable adverse effect on the trumpeter swan, bald eagle, and peregrine falcon. The osprey, mountain bluebird, various species of woodpeckers, and the cavity-nesting Barrow's goldeneye and bufflehead appeared to benefit. The greatest diversity of bird species was observed where fires were of moderate intensity and resulted in a patchy mosaic of burned and unburned forest. Even woodpeckers were uncommon in large, severely burned forests. The Clark's nutcracker was observed caching whitebark pine seeds in burned areas.

Changes in insects and other terrestrial invertebrates depended on burn

Renee Evanoff

intensity. Predictably, significant declines in litter-dwelling species were noted when the forest floor burned. This was in contrast to reptiles and amphibians which typically burrow into the soil or which select moist habitats that would burn with less intensity. Some insects were favored by the fires, especially those that could invade fire-damaged but surviving trees.

Insect-caused mortality was higher after the fires on fire-damaged Douglas-fir, Engelmann spruce, and subalpine fir (due, respectively, to Douglas-fir beetles, spruce beetles, and wood borers). Some lodgepole pine mortality was caused by the pine engraver. The mountain pine beetle remains an important cause of lodgepole pine mortality in general in the west, but very little mortality in the GYA can be attributed to this beetle during the last five years.

The 1988 fires had a significant effect on some winter ranges. Burned forage, in combination with hunting pressure, low forage production during the dry summer, and a severe 1988-1989 winter, led to a 38-43 percent reduction in the northern Yellowstone elk herd. The scarcity of food during the winter appeared to force some elk to feed on the bark of lodgepole pine. Though conifer bark normally is viewed as low quality food, the heat of the fires may have volatilized some of the resinous compounds, thereby making it more palatable. Moreover, because of the nutrient-rich phloem layer, tree bark can be quite nutritious. By 1993 the elk populations throughout the park had essentially recovered. Burned areas were used more for grazing than unburned areas (regardless of the pattern of burning). New willow sprouts became an important food in burned riparian habitats.

With regard to other large mammals, pronghorn antelope have become more abundant since 1988, possibly because of more nonforested habitat at lower elevations. Moose, in contrast, may have declined in abundance because of less winter cover. Bison mortality apparently was affected more by severe weather conditions than by the fires. Grizzly bears have less whitebark pine seeds available to them, but close observations indicate that roots and rodent caches are being used more often. At this time it appears that the grizzly and black bear populations have been affected very little if at all.

Aquatic Ecosystems

Popular hypotheses prior to 1988 were that large scale fires in the GYA would lead to the nutrient enrichment of aquatic ecosystems because of higher rates of nutrient leaching from watershed soils, and that fish productivity would increase because of the additional nutrients. Several studies found that the streamwater was enriched with nitrogen, and one study found some evidence for increased fish growth rates in rivers. However, after five years there was no evidence that the growth of cutthroat trout had changed appreciably in Yellowstone Lake. Investigators found great year-to-year variation in growth and suggested that fishing harvests and population year-class abundance probably had a more important effect than the fires.

High sediment loads were observed in the streams draining some burned watersheds, but usually only after heavy thunderstorms or during spring runoff. While some fish mortality was attributed to these episodes of erosion, no significant effects on fish populations could be detected. Changes in other aquatic organisms, such as diatoms and benthic invertebrates, were observed in small streams, but there were no obvious effects on the organisms of the larger rivers. Streamflow increased in some watersheds due to less transpiration from vegetation, but abnormal flooding did not always occur.

Overall, the magnitude of the effects of fire on aquatic ecosystems appears to be dependent on channel gradient, the steepness of valley slopes, the amount of surface runoff, the percentage of the watershed that burned, the proportion of the riparian vegetation that burned, and the degree to which the upland and riparian vegetation has recovered. A wide range of these watershed conditions were available for study in the GYA.

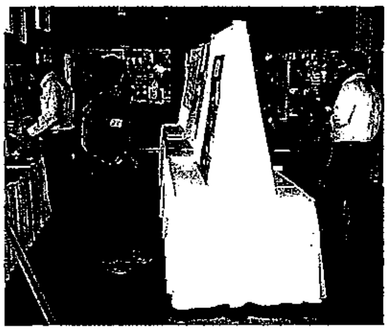
What next?

The papers presented at the conference indicate once again that ecosystems are highly variable from place to place and from one year to the next. For example, lodgepole pine was an early invader in many areas, as predicted, but not everywhere. Also, erosion was accelerated in some areas, but the amount of soil loss and subsequent sediment deposition in streams varied greatly from place to place, and in most cases was within the normal variation observed before the fires.

NPS

Burned lodgepole pine bark was more palatable to elk, who consumed it in several locations following the fires.

Jim Peaco/NPS



Fire conference participants at paper and poster sessions.

Animal responses also were variable. This variability, occurring within a relatively small area (such as the Yellowstone landscape), provides excellent opportunities for scientists to improve their predictive abilities. Such high variability also suggests that caution should be used in making broad generalizations, whether for a national park, national forest, or an extensive mosaic of federal, state, and private lands. Nevertheless, predictions about fire behavior and the effects of fire can now be based on much more information than was available in 1988. This represents a significant scientific accomplishment.

There is still, however, much to be learned. Indeed, some of the spatial and temporal variability in the way ecosystems responded to the 1988 fires is puzzling. Explanations may be possible only with additional research on, for example, the effects of fire and other variables on microbial organisms in the soil, or trees other than lodgepole pine and aspen. Studies that focus on small scales, individual species, or specific ecosystem processes should be complemented with more holistic research at the scale of several watersheds or whole districts.

Scientists should also consider doing experiments with the young postfire ecosystems. For example, what would happen if dense stands of lodgepole pine saplings are killed by another fire (or some other mechanism) within 5-10 years after a stand-replacing fire in old-growth? If aspen are present, whether as root sprouts or young seedlings, the effect could be the rapid development of a new aspen grove where a pine stand might otherwise have occurred. Similarly, what would be the effect of reduced browsing on aspen and Douglas-fir adjacent to winter ranges? Additional fenced exclosures should be established to determine if (or where) the elk population is capable of preventing the reestablishment of the forests and savannas that were burned in 1988.

Other experiments could be done by fertilizing streams or lakes to simulate the effects of the fires, or by manipulating postfire riparian vegetation along portions of some streams. The knowledge gained thus far by taking advantage of the 1988 fires could be augmented greatly with carefully designed, more controlled experiments. Some would be appropriate for Yellowstone or Grand Teton National Parks; others might be acceptable only on adjacent national forest lands. The best science, pursued in as many directions as possible, should be encouraged so that there is more information available for evaluating the "natural regulation policy" and other management paradigms.

The value of long-term data for determining the effects of disturbances became eminently clear during the conference. The nature of mature ecosystems depends to a large extent on the history of an area and what happens during the first few years after disturbances. Answers to numerous important questions would not have been possible without the long-term records of the U.S. Geological Survey, U.S. Fish and Wildlife Service, USDA Forest Service, Soil Conservation Service, and National Park Service. The magnitude of the 1988 fires, along with their value for understanding ecological phenomena beyond the boundaries of the GYA, mandate that long-term research and monitoring programs should be continued (including those initiated in 1989). Moreover, such data (including historic photographs) should be carefully archived and used more frequently.

The value of simulation modelling for understanding ecological interactions also was quite evident during the conference. Several models were described. Whether designed for large-scale questions and used in conjunction with satellite imagery and geographic information systems, or for small-scale questions pertaining to a specific process, the simulation approach to ecological research helps prevent scientists and managers from becoming too simplistic in the interpretation of their data.

A larger modelling effort is now called for, primarily because the value of an individual study is greatly enhanced when it is integrated with others. Simulation models also help in establishing research priorities. Developing defensible ecosystem models that are useful at the scale of landscapes is a significant challenge, but, with managers and scientists working together more closely than in the past, this goal should be possible. The payoffs will be substantial for education, new scientific methods, visitor satisfaction, the best possible stewardship for two of the world's favorite national parks, and improved ecosystem management throughout the region.

Dennis Knight is head of the Botany Department at the University of Wyoming. His book Mountains and Plains: The Ecology of Wyoming Landscapes, *will be published by Yale University Press in the spring of 1994.*

NBS Awaits Funding

We have previously reported on the creation of the National Biological Survey (NBS), which was scheduled to open for business on October 1. As of this writing (early November), the proposed NBS is preparing to get underway as the newest agency in the Department of the Interior, but is not formally operational pending the outcome of current Congressional budget deliberations.

A fair amount of general information about the NBS is now available. The development of the NBS is reported on in *Science* 261:976-978 (August 20, 1993) and *BioScience* 43(8):521-522 (September 1993).

New Study Outlines Needs for Biological Survey

Those interested in the idea of a national survey of biological resources should know of a new study on the subject. In October, the National Research Council (NRC) and the National Academy Press published a study, *A Biological Survey for the Nation*, which explores the nature of such a survey, as well as the role the NBS might play in that survey.

In his opening statement released with the study, Peter Raven, Director of the Missouri Botanical Garden and Chair of the Committee on the Formation of the National Biological Survey, explained the relationship between this new study and the NBS: "Our charge was to describe what kind of biological survey will best serve the needs of the nation. Our deliberations focused on scope and direction, research and information needs, and coordination with other programs, both federal and non-federal. It is important to note that we were not asked to examine whether the new agency should be established or to evaluate the specific proposal submitted to Congress."

Among other things, the new NRC study recommends a "National Partnership for Biological Survey," described as a "national, multisector, cooperative program of federal, state, and local agencies; museums; academic institutions; and private organizations." The purpose of this partnership would be to "collect, house, assess, and provide access to the scientific information needed to understand the status of the nation's biological resources...."

A Biological Survey for the Nation is available from the National Academy Press (P.O. Box 285, Washington, D.C. 20055 (800) 624-6242) for $26.

Aubrey Haines Workshop Traces Park History

Former Park Historian and author Aubrey Haines led a one-week tour of Yellowstone Park cultural sites, accompanied by park staff from several divisions.

Former Yellowstone Park Historian Aubrey Haines spent the week of August 9-13 with a variety of NPS staff from the park, the regional office, and the Midwest Archeological Center, touring important cultural and historic sites. The workshop, sponsored by the Yellowstone Association and led by park Historian Tom Tankersley, was designed to acquaint key personnel with various important sites and past issues in research and resource management.

Special emphasis was placed on several areas of past development, such as the sites of hotels and soldier stations, some of which are currently undergoing archeological investigations as part of the cultural compliance process in ongoing highway construction projects.

Aubrey Haines first came to Yellowstone shortly before World War II, and continued his association with the park during military duty and stints in other NPS areas. During the 1960s, he undertook research that resulted in several works, the best known of which is the two-volume book *The Yellowstone Story* (published in 1977). Because of his long involvement with the park as a ranger, engineer, and historian, Aubrey has an exceptional grasp not only of administrative history but of the infrastructure issues—roads, buildings, waste disposal, and many other service-related matters—that have always consumed so much of the energy of managers. Thus it was considered highly useful to arrange for this workshop, and to involve people from several park divisions, including the Yellowstone Center for Resources, Maintenance, Rangers, and Interpretation, as well as concerned staff from the Regional Office and the Midwest Archeological Center.

Jim Peaco/NPS photos

Yellowstone Association Funds *Yellowstone Science* II

At their fall meeting at Old Faithful, September 24-25, the Board of Directors of the Yellowstone Association approved funding for the production of a second year of *Yellowstone Science*. Under the agreement, the editorial staff will in the next few months investigate a variety of ways to make the publication at least partly self-supporting. Subscription sales and sales at a variety of outlets will be studied as part of this process.

During the past summer, *Yellowstone Science* was offered at Yellowstone Association sales outlets in some park visitor centers, with a gratifyingly good response from visitors. This is a hopeful sign that our audience is sufficiently enthusiastic to support the publication well into the future. More than 300 requests for subscription information resulted from these visitor center sales. We will keep readers apprised of progress.

Fire Conference Report

"The opportunity to learn did not go to waste."

Second Biennial Scientific Conference Highlights Fire Research

On September 20, more than 200 scientists, managers, journalists, and other interested parties gathered at Mammoth Hot Springs to review the first five years of research following the fires of 1988. The conference, entitled "The Ecological Implications of Fire in Greater Yellowstone," provided saturation-level information from dozens of studies in and around Yellowstone Park.

This year's conference was co-sponsored by the American Institute of Biological Sciences, the Ecological Society of America, the International Association of Wildland Fire, Montana State University, the Montana and Colorado-Wyoming Chapters of the Society of American Foresters, the University of Wyoming, the U.S. Fish and Wildlife Service, the USDA Forest Service, the Yellowstone Association, and the National Park Service.

With 58 scheduled papers and 15 posters, concurrent sessions were necessary both days, greatly increasing the pace of activity over our first conference in 1991. Besides presentations on many aspects of fire ecology, papers also addressed education, economics, fire history, and fire management systems.

Five keynote speakers spoke on various "big picture" topics. Sunday evening, September 19, David Peterson, Chief of the NASA Ames Research Center's Ecosystem Science & Technology Branch, opened the conference presentations with "From the top down: scale and process in forest ecosystems." Peterson's talk ranged from the latest in NASA orbital imaging of specific ecosystems to invoking poetry in the cause of ecosystem research and protection.

The opening keynote Monday was provided by Dick Rothermel of the USDA Forest Service Fire Sciences Laboratory in Missoula, whose talk "fire growth maps for the 1988 greater Yellowstone area fires," provided a refresher on the events of 1988. Referred to by Superintendent Barbee as one of the "fire gods," Rothermel's experiences as a leading fire behaviorist enabled him not only to give an orderly summary of the chaotic events of 1988, but also to set the context for all the papers that followed.

Jim Peaco/NPS

Above: Yellowstone Center for Resources Director John Varley cuts off NBS plant ecologist Don Despain's tie to emphasize the informality of the conference. Above right: Yellowstone Superintendent Bob Barbee (left), Assistant Superintendent Joe Alston, and Mark Boyce discuss policy following Boyce's Leopold lecture.

The conference banquet on Monday evening was highlighted by the A. Starker Leopold Lecture, delivered by Mark Boyce, Vallier Distinguished Professor of Quantitative Ecology, University of Wisconsin-Stevens Point. Boyce's title, "If I were superintendent..." ensured a full house, and in fact his talk may have made more headlines in regional papers than any other, as he espoused protecting ecological processes (through such actions as restoring wolves and native fishes, allowing natural fires to burn at every opportunity, and restriction of winter recreation) as the park's foremost goal.

The opening keynote on Tuesday, delivered by Monica Turner of the Environmental Sciences Division, Oak Ridge National Laboratory, was entitled "Landscape-level consequences of the 1988 fires: are big fires qualitatively different?" This question has intrigued many since 1988, when the very hugeness of the fires seemed to require the adjective "unique," even though it remained unclear just what consequences hugeness had in landscape ecology. Turner concluded that for most general purposes, the answer to the question is "no," and that though scale of fire has some obvious impacts on the landscape, ecological processes are not fundamentally different following very large fires.

This year's Superintendent's International Luncheon featured Monte Hummel, President and Chief Executive Officer of World Wildlife Fund Canada. Hummel's talk on "Endangered Spaces" amounted to a colorful overview of private sector initiatives in the Canadian conservation movement. Among the most intriguing insights was his observation that unlike United States citizens, Canadians have never really expected their government to take the lead in resource protection, and so have adopted very aggressive and well-orchestrated programs of their own to get the job done.

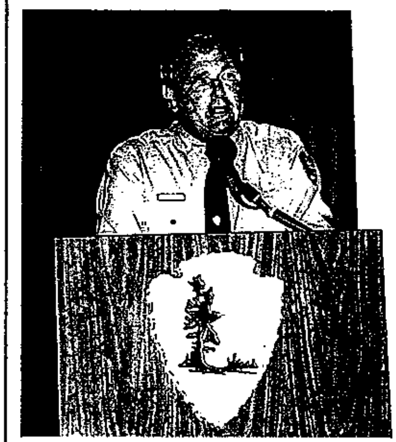
Dennis Knight, of the Department of Botany, University of Wyoming, accepted the challenge of summarizing the conference, as he did in 1991. His masterful synthesis, which captured the essence of the many papers presented and characterized future research potentials and needs, is published in this issue (see pages 15-18).

Several field trips were offered on Wednesday morning, but attendance was slight. It appears that most attendees cannot spare an additional recreational day during the fall season, when many must get back to classes. We may try for another time, before or during the conference, for the trips next time.

The various special meals and other features of the conference occurred without any major hitches, but, as usual, Yellowstone itself may have provided the most satisfying amenities. The Mammoth elk herd was in full attendance on the lawns around the hotel, with the fall rut underway and bulls bugling at all hours, and the park's aspen displayed the spectacular colors that have so much to do with public affection for this controversial species, whose fate was one of many subjects being discussed during those two busy days.

Superintendent Barbee's Opening Welcome

Jim Peaco/NPS



Five years ago this week, many of us—I see some of those faces in this room—had just survived the most amazing experience of our lives. For three months we had alternated between frantic, exhausting exertion and stunned awe as Yellowstone gave us an unforgettable lesson in ecological power and human frailty. And then, just about this time, in September of 1988, it was suddenly over. A little rain, a little snow, and it was over.

But of course it wasn't over. It was only the beginning. Ecologically, the fires were just the opening act of a very long drama, one that has run successfully on this stage for more than 10,000 years.

Politically, the fires had even more far-reaching effects. In the dialogues that ensued, the power-position-takers jockeyed so effectively with one another that none really made much of a gain. We still have a natural fire policy, we still can't control fires like those in 1988, and we still keep trying to make the most of the opportunities provided by Yellowstone and the challenges of its management.

Scientifically, our progress is clearest. From the first postfire research consortium, at Montana State University in the fall of 1988, it was plain that the scientific community recognized the unique opportunity the fires gave us, an opportunity to ask questions about how unmanipulated landscapes function on a scale rarely studied. And the scientific community did deliver: In Yellowstone Park alone, more than 250 research projects began on the post-1988 environment. Some final results of those studies you'll hear today. Some won't be final in our lifetimes.

What you are about to witness is a major part of all that creative enthusiasm. From many disciplines, and we're especially pleased to see the humanities represented, we will be hearing what the fires did, what the fires meant, and what the fires yet may mean.

That may be the best news of all to come out of this conference: the opportunity to learn did not go to waste. Whatever may become of the policy dialogues, it is reassuring to know that Yellowstone has not lost its ability to teach us, and inspire us. I hereby open this Second Biennial Conference on Science in the Greater Yellowstone, confident that these wondrous landscapes will continue to teach us, as long as we care to watch, and study, and learn.

Special Thanks

For their "above-and-beyond" help in making the fire conference such a success, we acknowledge the following groups and individuals.

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