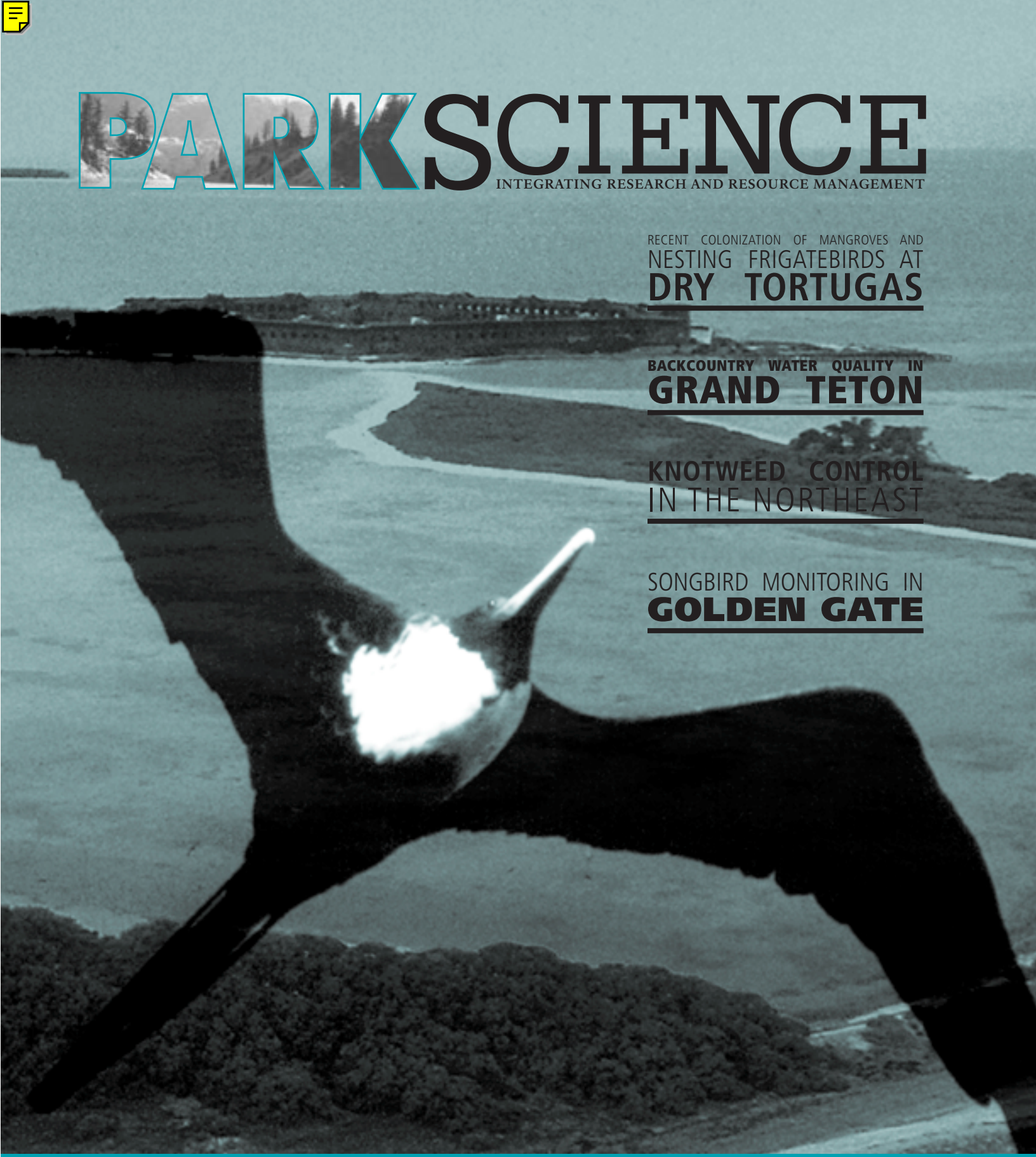
PARK SCIENCE

INTEGRATING RESEARCH AND RESOURCE MANAGEMENT



RECENT COLONIZATION OF MANGROVES AND NESTING FRIGATEBIRDS AT **DRY TORTUGAS**

BACKCOUNTRY WATER QUALITY IN **GRAND TETON**

KNOTWEED CONTROL IN THE NORTHEAST

SONGBIRD MONITORING IN **GOLDEN GATE**

VOLUME 21 • NUMBER 1 • FALL / WINTER 2001

UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE

A MOST VALUABLE RESOURCE

This issue of *Park Science* combines the skills and energies of over 50 people in reporting on research and its application to resource management. Naturally, this variety reflects a multitude of fascinating and critical studies and applications going on in the national parks. Bit by bit this work adds to our understanding of park ecology and improves park management. In this issue, for example, we find two approaches for dealing with the problem of exotic vegetation. In the first, Tom Gardali and his co-authors focus on songbirds as indicators of ecological recovery following the eradication of exotic plant species at Golden Gate National Recreation Area, California. In the other, Kathleen Reeder and Brian Eick describe a partnership with the U.S. Department of Agriculture to first understand and then systematically control two species of knotweed at Johnstown Flood National Memorial, Pennsylvania. Each provides useful insights into the complex process of striving to foster the return of native vegetation and ecological function following exotic plant control.

Two articles provide international perspectives, reminding us that we are part of a broad, international network of scientists and managers endeavoring to conserve parks for people. In particular, John Dennis' report on the meeting of the Man and the Biosphere Program of UNESCO points out how we might improve the participation of the National Park Service in the U.S. portion of this program by learning from examples of several international biosphere reserve models. Also, German forester Thomas Meyer profiles the national parks of Germany in an enjoyable article comparing the history, goals, and resource management issues of the German parks with our own park system. The comparison is fascinating and, along with the MAB report, demonstrates that natural resource management is a global commodity, at times exported and imported by the National Park Service.

I am especially pleased to run a profile, albeit brief, of the recent book, *Yellowstone in the Afterglow,* by Mary Ann Franke of the Yellowstone Center for Resources. The book summarizes the many scientific investigations about the effects of the fires of 1988 on the park and concludes that for the most part the park and its resources are quite durable in response to fire. I certainly was not surprised to hear this but was very happy to read about it in a popular, science-based publication. Thirteen years ago I spent 23 days in Yellowstone as an information officer relating details of the North Fork fire to media and offering hope about the ecological resilience of the ecosystem. By summer's end—fires still burning and emotions hot—this story had worn out its welcome. Nevertheless, renewal would again become the theme of news reports the following spring. Nearly half a career later the information on the lessons learned from the fires is refreshing, relevant, and valuable. Not only does it deepen our understanding of long-term effects of fire on a natural ecosystem, but it also will help us manage future demands for fire information more effectively.

Many other articles appear in these pages, too, echoing individual and group efforts alike to link science and park management. The variety is altogether impressive and enjoyable, and the people behind the science are indeed a most valuable resource in their own right.

Jeff Selleck
Editor

PARKSCIENCE
VOLUME 21 • NUMBER 1 • FALL / WINTER 2001

DEPARTMENTS

ON THE COVER
Once absent at Dry Tortugas National Park, Florida, mangroves and nesting magnificent frigatebirds now thrive in this subtropical marine ecosystem (see cover story on page 20).

COVER STORY

FEATURES

HIGHLIGHTS

Gambusia habitat restored in Big Bend

The Big Bend mosquitofish *(Gambusia gaigei)* is a federally endangered species whose only habitat in the wild is a few warm-water springs at Rio Grande Village in Big Bend National Park (Texas). A remnant of a wetter climate, the tiny, live-bearing fish has endured despite severely limited natural habitat. Furthermore, use of the area for farming before the park was established and subsequent park development worsened the situation. Farmers established roads, constructed ditches for irrigation, and drained the natural spring-fed wetlands to create arable land; the Park Service paved roads, installed a picnic area and freshwater pipeline, and developed a right-of-way for maintenance of an electric power line. By the 1960s, park resource managers were aware of the mosquitofish's tenuous existence and constructed ponds that became the core of their habitat. Beavers helped in the 1980s by building a dam in the runoff channel, but the fish still relied upon the artificial habitat that was vulnerable to leaks, toxic spills, and malfunctioning water pumps.

Recognizing the need for self-sustaining habitat, resource managers applied for funding from the NPS Water Resources Division to restore eight acres of natural, spring-fed wetlands. The project began in 1999 with the removal of an asphalt road and picnic area and recontouring of soils to retain water (fig. 1). The pipeline, power line, and a maintenance facility were also relocated out of the wetland habitat. Aerial photos, detailed topographic mapping, and soil analysis were key to understanding the former extent of the wetlands and in determining suitable upland sites for this infrastructure.

Now in the revegetation phase, the habitat restoration combines plant propagation and transplanting techniques. The park elementary school operates a greenhouse to propogate native plants for restoration projects in the park. For this project, the students are growing primarily salt-tolerant wetland grasses. Transplants also include cottonwoods, willows, baccharis, and cattails. Park Service staff and additional volunteers, including Student Conservation Association aides, Boy Scouts, area students, and local river outfitter employees are carrying out the revegetation (fig. 2). Resource managers watch for and control encroaching nonnative species in the newly disturbed area and have already removed tamarisk, palm trees, buffelgrass, and rabbit's-foot grass. Thorny mesquite thickets in the wetland area, another result of pre-park agricultural practices, are being returned to wetland grasses through active removal and prescribed burning by park fire management staff.

The final phase involves consultation with the Water Resources Division and the U.S. Fish and Wildlife Service's recovery team for Big Bend mosquitofish to consider further enhancements to the habitat. These include considering alternatives to the current practice of pumping water from mosquitofish habitat for domestic uses and mitigating the impact of several farm-era earthen berms that alter drainage in the area. The group will also consider creating an additional pond within the restored wetland.

The park has established two scientific projects to monitor and document restoration results. One uses vegetation and insect monitoring transects as indicators of change in wetland function. The other is a network of soil and surface water monitoring devices (i.e., piezometers) to demonstrate hydrologic change in the system.

Figure 1. The habitat restoration at Big Bend began with the removal of an asphalt road and re-contouring of the land to retain warm-water spring runoff for the endangered Big Bend mosquitofish.

Figure 2. Employees transplant native wetland grasses to the restoration site. These and other transplants restore organic matter to the soil and retain moisture. When inundated, the vegetation provides shade and shelter for the mosquitofish, and supports the fish's diet of aquatic insect larvae. With removal of drainage structures and return of wetland soil and plant function, areas of permanent standing water will increase and seasonally wet areas will become more persistent.

Writer-editor assists Northeast Region natural science program

The Northeast Region's Philadelphia Support Office has engaged the services of a part-time writer-editor to provide natural science publications support for the Chesapeake and Allegheny Cluster parks. This person works closely with the Chesapeake-Allegheny Cluster Chief Scientist John Karish and other persons in the Philadelphia Support Office (PHSO).

General duties are developing, editing, and disseminating information about critical natural resource management issues. The incumbent also publicizes research results pertaining to the physical and social sciences, natural resources, and biology in the Northeast Region's national parks.

The primary goal of the writer-editor is to present new technical information and research results in a style understandable and relevant to general audiences and professionals. In addition to providing material for fact sheets and site bulletins, this person contributes to *Natural Resource Year in Review* and *Park Science*. Editing responsibilities include proofreading publications for the PHSO Technical and Natural Resource Report series. In order to provide natural resource information to as wide an audience as possible, the writer-editor is working with a web-page development

team to incorporate natural science information in the Philadelphia Support Office's website. That website will link to the National Park Service site.

The person who held this position in fiscal year 2001 was Kathleen K. Reeder, who began working with the National Park Service through a cooperative agreement with The Pennsylvania State University in November 2000. Ms. Reeder has expertise in writing expository prose in both the academic and government spheres. Beginning in October 2001, writing and editing duties was assumed by Betsie Blumberg, who has a bachelor's degree in anthropology and master's degrees in anthropology and agronomy. In addition to teaching freshman courses in rhetoric, composition, and technical writing at Penn State, Ms. Blumberg has edited textbooks written by faculty for distance education and workforce education training for the Penn State World Campus, and agricultural extension materials for Penn State's Department of Agricultural Communications.

Strategy for managing the West Nile virus in the Northeast Region

West Nile virus has generated much publicity since it was first identified in New York City in 1999. Although very few humans have died of the infection, apprehension about the number of people at risk—and misunderstanding about the process of transmission itself—have continued to grow. According to Wayne Millington, Integrated Pest Management Coordinator for the Northeast Region, continued education for park employees and managers, including how to identify potential vectors (carriers) and minimize human risk, have been the key to preparing for the 2001 cycle of this disease.

The virus, which can cause encephalitis (an inflammation of the brain) in humans, is spread in the Northeast primarily by members of a mosquito species that prefers to feed on birds. In fact, West Nile virus presents a far greater threat to specific bird populations in the Northeast Region than to humans. Although mortality has occurred in very small numbers of other bird species, the American crow, fish crow, and blue jay seem to be most susceptible. Of these three, the American crow has had the highest mortality rate. For example, in 1999 and 2000, more than 10,000 of them died from the virus. Because of this susceptibility, crows are used by most state and federal agencies as an early indicator for the movement of the virus into an area.

The risk that a mosquito carrying the virus will bite a human is extremely low in sparsely populated areas. The threat of infection is greater in cities because the density of the human population makes it more likely that the vector species will find a human rather than a bird to bite. In fact, the few human deaths that have been recorded occurred in areas where people worked or lived under very crowded conditions. For, example, a 70-year-old woman who died of the disease during 2001 lived in a county that has 1,543 people per square mile.

Preparation for the 2001 season in the Northeast Region included regional training meetings for park staff and superintendents. Information about the virus, its vectors, their habitat identification and management, and risk reduction procedures were sent to each park. Every park in the region was also encouraged to communicate with their local and state health departments, and with local or state mosquito control offices, to share information and collaborate in all regional management efforts. Parks that already have experience minimizing the threat of the West Nile virus have assisted those that trained their staff for the first time.

All resource materials compiled by Mr. Millington are available to park visitors, neighbors, and parks outside of the region. Anyone who wishes to have more specific information about the West Nile virus in the Northeast may contact Mr. Millington at (814) 863-8352.

The American crow is highly susceptible to the mosquito-borne West Nile virus and is a management concern for national parks, particularly in the Northeast.
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Preserving water resources amid development:

Strategy outlined in Northeast Region report

A newly issued management plan in the National Park Service's Northeast Region may serve as a valuable reference for other parks that share the challenge of preserving the integrity of water resources as urbanization threatens their watersheds. Conducted as a cooperative study by the United States Geological Survey (USGS) and the National Park Service, this plan analyzes the characteristics and susceptibility of water and aquatic life at Cold Harbor and Gaines' Mill, two of eleven geo-

graphically distinct units that are collectively known as the Richmond National Battlefield Park, Virginia.

Although water quality is sufficient now, the Park Service is aware that changes in land use can alter many characteristics of the surface and groundwater, such as flow rate, sediment load, and pollution content. The NPS-USGS team, therefore, began planning how to preserve water resources in August 1999 as development increased near the park's various units, all of which lie outside the city of Richmond. They have conducted a comprehensive analysis of existing information, including all legislation that pertains to the subject areas' water resources and the historical context and condition of the streams. Their research has yielded thorough descriptions of the sites' respective watersheds, geology, hydrology, topography and soils, vegetation, floodplains, riparian areas and wetlands.

Ultimately, the researchers provided evidence that three kinds of information must be obtained in order to assess the impact of development in the future: baseline data about present water quality; inventories of riparian flora and fauna; and inventories of water-dependent flora and fauna. In addition to identifying the methodology needed to establish baseline data, the report recommends efficient, cost-effective strategies for monitoring the water resources and for managing the habitats to protect the flora and fauna dependent on them.

To receive a copy of this management plan, please contact John F. Karish, Chief Scientist, National Park Service, Philadelphia Support Office, Northeast Region, 209B Ferguson Building, University Park, PA 16802-4301. He may also be reached by phone at (814) 865-7974; or via e-mail at john_karish@nps.gov.

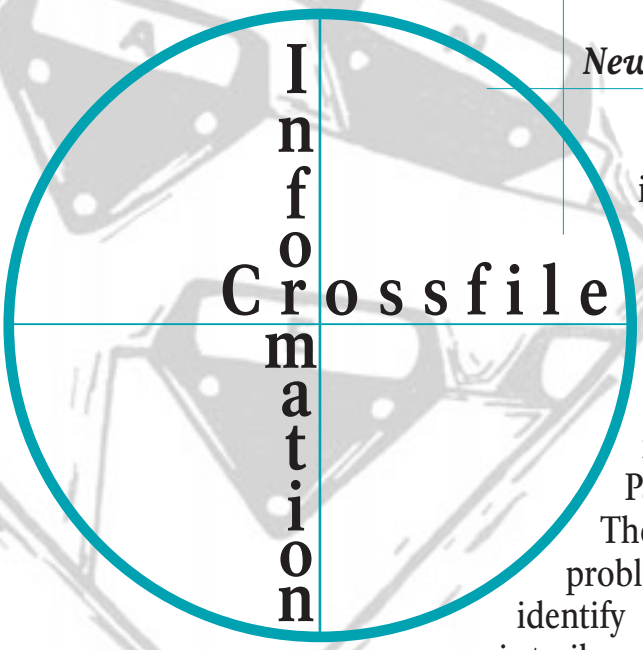
Fisheries enforcement task force on the Potomac

In spring 2000 and 2001, a multiagency task force conducted a fisheries enforcement operation on the Potomac River and adjacent national park system lands administered by the George Washington Memorial Parkway and the Chesapeake and Ohio Canal National Historical Park. The operation took place in the Little Falls-Chain Bridge area that straddles the Washington, D.C.-Maryland-Virginia border (see photo). During the seven days that the task force was active each year, citations were issued for 560 violations. These included the illegal catch of striped bass and shad, use of cast nets, snagging, fishing without a license, and a multitude of *Code-of-Federal Regulations* public use violations associated with alcohol, litter, graffiti, fires, and nighttime closures. Hundreds of pounds of highly prized anadromous striped bass were seized, some of which were donated to a homeless shelter.

The fisheries enforcement task force operated on the Potomac River and lands administered by the George Washington Memorial Parkway and the Chesapeake and Ohio Canal National Historical Park.

The task force was formed as a result of tips to an environmental crimes hotline and complaints about public use violations on NPS-administered lands. This stretch of the Potomac River is very popular for fishing because it is particularly narrow and fish are highly concentrated during the spring spawning runs. With the construction of a fish weir on the nearby Little Falls Dam, species such as striped bass, shad, and perch are now able to use an additional 10 miles of excellent spawning habitat up to the base of Great Falls.

As a result of the task force operation, the National Park Service and other natural resource agencies were able to get a better understanding of visitor use patterns in the area as well as to gather intelligence on commercial fish poaching and other fisheries violations. This information is being used to target educational and enforcement activities to reduce poaching and ensure that critical fish species are able to reach the newly accessible spawning habitat. Before the start of law enforcement efforts, the National Park Service estimated that over 200 striped bass were being poached in the area each day. The Park Service is now working with the Potomac Conservancy and other organizations to reduce poaching through education. The task force members included NPS rangers, U.S. Park Police, U.S. Fish and Wildlife Service, Maryland Department of Natural Resources, Virginia Department of Game and Inland Fisheries, Virginia Marine Resources Commission, Maryland National Capital Park Police, D.C. Harbor Police, and Arlington County Police. PS



New method to assess trail problems

The deterioration of trails from increasing visitation is a problem throughout the United States. Yu-Fai Leung and J. L. Marion developed a method, called the *trail problem-assessment method* (TPAM), to efficiently identify specific portions of trails that require repair (1999. Assessing trail conditions in protected areas: Application of a problem-assessment method in Great Smoky Mountains National Park, USA. Environmental Conservation 26(4):270–79). The method uses multiple indicators to evaluate tread problems. Park managers can use this method to help identify problem areas and take management actions to repair trails.

The authors applied TPAM to survey the condition of 72 backcountry trails (328 mi or 528 km; 35% of all trails) in Great Smoky Mountains National Park. Twenty-three indicators were measured, grouped into three categories to evaluate (1) trail type and use; (2) location, number, and lineal extent of pre-defined tread problems; and (3) design problems (e.g., excessive trail grades) and trail structures (e.g., number and relative effectiveness of constructed water bars and drainage dips for the diversion of water runoff from treads). The indicators were coded and could therefore be rapidly recorded on a simple form. The investigators recorded the distance from the trailhead to features such as water bars, and recorded starting and end distances from the trailhead for highly degraded segments. A recording was made only if a critical indicator condition had been reached. For example, soil erosion was not recorded unless it exceeded a depth of 11.8 in (30 cm) for a lineal distance of 9.8 ft (3 m).

The survey revealed serious deterioration of trails throughout the park, with damage being somewhat worse in the central and eastern portions of the park. Soil erosion of trail treads was the most extensive and possibly the most significant problem (14.9 mi or 24 km of trails had soil erosion exceeding 11.8 in or 30 cm). Rutted treads along with wet soils also contributed to excessive tread width (2.2 mi or 3.6 km in 176 locations or 0.7% of the surveyed trails). Users widen trails by trying to avoid poor or treacherous conditions in the main tread. Wet, muddy soil (752 incidents over an aggregate of 11.3 mi or 18.2 km) was the most frequent type of deterioration, in spite of a drier than average summer. Trails with wet, muddy treads tended to be concentrated where the use by horses was high.

The survey also revealed the effectiveness of trail structures. For example, water bars were rated as more effective than drainage dips for diverting water from the trail treads. Park officials have already used results of the survey in planning the management of trails.

TPAM has some limitations. For example, it cannot be used for determining average tread condition. Identifying which indicator condition constitutes a serious problem and determining the beginning and end of a deteriorating trail segment also are challenges. The authors suggested research be done to compare the precision of TPAM with other methods. A new article by the authors in the Journal of Park and Recreation Administration (fall 2001, volume 19(3):97–117) compares and contrasts TPAM with the point-sampling trail assessment method, providing an illustration of both methods and guidance in selecting between them.

Long-term ecological monitoring of Cape Cod National Seashore

Cape Cod National Seashore is one of 11 national park system units conducting prototype long-term ecological monitoring under the NPS Inventory and Monitoring Program. The seashore represents the Atlantic and Gulf coast biogeographic region, and protocols for monitoring its resources are suitable for monitoring resources elsewhere in the same biogeographic region.

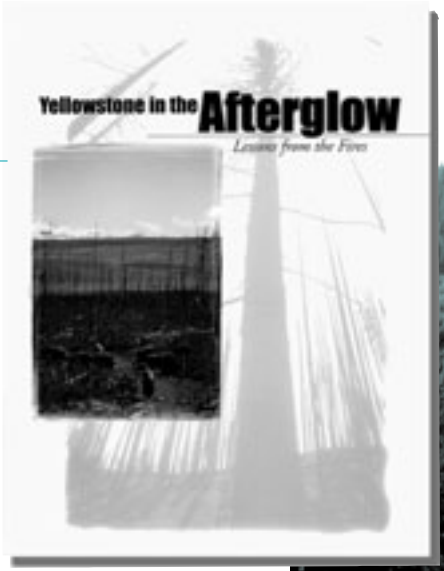
A 59-page technical report (Roman, C. T., and N. E. Barrett. 1999. Conceptual framework for the development of long-term monitoring protocols at Cape Cod National Seashore. Cooperative National Park Studies Unit, USGS Patuxent Wildlife Research Center) presents conceptual models for long-term monitoring of each major ecosystem type on the seashore: estuaries, salt marshes, barrier islands, spits, dunes, ponds, freshwater wetlands, and coastal uplands. The authors explain the complex relations among the natural or anthropogenic agents of change, stresses, and responses in ecosystem structure, function, or processes. The models are provided in the form of matrixes designed to reveal changes in ecosystems due to natural or anthropogenic sources of stress at various temporal and spatial scales.

The importance of Great Smoky Mountains National Park for wood thrush

Large, intact forests are believed to be important population sources for Neotropical landbirds. Great Smoky Mountains National Park, at the border of Tennessee and North Carolina, is one such area, with 508,198 acres (205,665 ha) of contiguous forest in the center of 4.9 million acres (2 million ha) of public land. The park's temperate climate, broad temperature and moisture gradients, and steep, complex topography all contribute to a diversity in bird species unlike any other area in North America. To evaluate the role the park plays in maintaining regional songbird populations, three researchers studied the productivity of the wood thrush (*Hylocichla mustelina* [Simons, T. R., G. L. Farnsworth, and S. A. Shriner. 2000. Evaluating Great Smoky Mountains National Park as a population source for the wood thrush. Conservation Biology 14(4):1133–44]). Great Smoky Mountains National Park is estimated to support a wood thrush breeding population of approximately 10,000 nesting pairs.

The high productivity of wood thrushes in the Great Smoky Mountains (3.31 nestlings per successful nest) indicates that the park provides high-quality nesting habitat. But daily nest survival rates also were below those reported in studies of wood thrushes in other areas, suggesting that the park may support more diverse and abundant predators. The researchers concluded that although Great Smoky Mountains National Park is a substantial population source for wood thrushes on a local scale, its potential to sustain regional or continental wood thrush populations is limited. Their findings indicate that large areas of suitable habitat outside protected areas and other public lands are necessary to sustain continental breeding populations of Neotropical birds.

Lessons from the Yellowstone fires of 1988



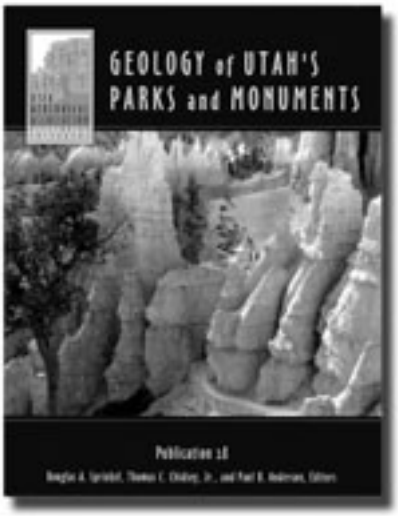
In spring 2001, as the snow melted off the millions of acres of Western forest and grassland that had been hit by the previous summer's record-breaking fire season, land managers began looking for signs of ecological change. They could find some clues about what to expect from the newly released *Yellowstone in the Afterglow: Lessons from the Fires* (Franke, M. F. 2000. National Park Service, Mammoth Hot Springs, Wyoming. YCR-NR-2000-03). Yellowstone National Park produced the 118-page book to summarize the results of several-hundred research projects that have been conducted since 1.4 million acres burned in the greater Yellowstone area in 1988. Many dire predictions were made that summer about the park's future—that wildlife would be reduced, that the forests would have to be replanted, that increased erosion would cause flooding downstream of the park, that visitation would decline. Instead, the research conducted in a variety of disciplines by dozens of scientists from academia and government have largely documented the resilience of the Yellowstone ecosystem in response to large fires.

The moose population on Yellowstone's Northern Range appears to have declined in part because of the loss of old-growth forest, and aspen seedlings are growing in burned areas where aspen had not previously existed, but these are the exceptions. For the most part, the fires of 1988 did not affect the abundance, distribution, or diversity of the park's plant and animal communities. In addition to demonstrating how such conclusions were arrived at, *Yellowstone in the Afterglow* explains the history of the park's controversial fire management policy and how public perceptions of the park and of wildland fire have changed over the years. The book is available in PDF format on the park's website at www.nps.gov/yell/publications/pdfs/fire/afterglow.htm.

New book showcases geology of Utah parks

Utah's parks and monuments contain some of the most spectacular geology and landscapes found anywhere in the world. To celebrate Utah's geologic parks during the millennium year, the Utah Geological Association (UGA) published a guidebook that highlights the geology of the state's parks and monuments (Sprinkel, D. A., T. C. Chidsey, Jr., and P. B. Anderson, editors. 2000. Geology of Utah's Parks and Monuments. UGA Publication 28. 644 pages. ISBN 0-9702571-0-4).

Scientific research into various aspects of the great Yellowstone fires of 1988 is summarized in a recent publication by the park entitled Yellowstone in the Afterglow.



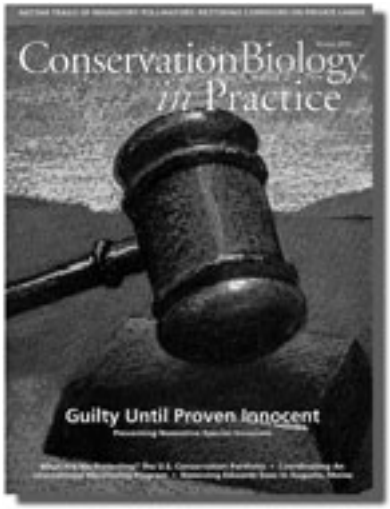
The book is viewed as a model for other states as far as its comprehensiveness, readability, and usefulness in explaining geology. It describes the geology of five national parks (Arches, Bryce Canyon, Canyonlands, Capitol Reef, and Zion), five national monuments in the national park system (Cedar Breaks, Dinosaur, Natural Bridges, Rainbow Bridge, and Timpanogos Cave), and one NPS-administered national recreation area (Glen Canyon), as well as one BLM national monument, one BLM national recreation area, 10 state parks, one geologic area, and one tribal park. In addition, the book has several topical papers, including a survey of paleontological resources in Utah's national parks and monuments.

A companion CD-ROM also is available (Anderson, P. B., and D. A. Sprinkel, editors, Geologic Road, Trail, and Lake Guides to Utah's Parks and Monuments, UGA Publication 29, ISBN 0-9702571-1-2). This compact disc contains road, trail, and lake logs that serve as geologic guides through most of the parks described in the book. The CD-ROM provides general descriptions of each park's geology and detailed descriptions of many geologic features at selected stops. The guides are intended for any park visitor interested in geology, as well as geologists, teachers, and students.

The National Park Service played a major role in the development of the publication and compact disc. Five NPS employees wrote parts of the book, while an NPS employee prepared one section of the compact disc. In addition, the NPS Geologic Resources Division provided financial support in developing the book and helped find and coordinate writing by NPS authors.

New conservation biology journal published

A new journal is now being published that is intended to "bridge the gap between conservation science, practice, and policy." The Society for Conservation Biology launched *Conservation Biology in Practice* in 2000. The journal is designed for conservation practitioners and policy makers who "are short on time but long on information needs." The editors want to "put conservation science into practice and conservation practice into science." Articles in the quarterly magazine cover new conservation biology research, innovative case studies, "hands-on" management tools and techniques, and practical resources for practitioners.



The winter 2001 issue (volume 2[1]) illustrates the topics the journal is covering. Among the features, Jason and Roy Van Driesche discuss preventing nonnative species invasions. J. Michael Scott, Robbyn J. F. Abbitt, and Craig R. Groves provide an overview of the lands being protected in the United States. Sarah DeWeerdt reports on the work of the Declining Amphibian Populations Task Force. And Ron Hiebert (Research Coordinator, Colorado Plateau Cooperative Ecosystem Studies Unit) describes an exotic plant ranking system, an automated web-based tool that can help managers prioritize decisions on the management of exotic plants.

The National Park Service is one of six partners who contributed start-up funds for the journal, help identify editorial material, and promote the journal. Associate Director Mike Soukup is on the editorial advisory board.

More information about *Conservation Biology in Practice*, including subscription information, can be found on the Internet at www.cbinpractice.org, or by contacting the editor, Department of Zoology, Box 351800, University of Washington, Seattle, WA 98195-7075; telephone 206-221-7075.

A guide for managing coral reefs

Coral reef ecosystems are one of the nation's most diverse ecosystems and are very valuable for fisheries, recreation, tourism, scientific research, education, and shoreline protection. Indeed, the value of most coral reef ecosystems is estimated to be in the billions of dollars. They are also fragile and face increasing stresses from many sources.

In 2000, the ecosystem science and conservation working group, an ad hoc committee of the U.S. Coral Reef Task Force, prepared a booklet to assist those involved in planning and managing coral reefs (Coral Reef Protected Areas: A Guide for Management. National Park Service Publication D-1449. 17pp.) Both federal and state agencies helped prepare the guide. The Park Service was a contributor to the booklet and compiled, edited, and published it. The guide is intended for use in developing coral reef management plans and reviewing plans for protected areas. Although the booklet is principally concerned with protected coral reefs under U.S. jurisdiction, it can assist those managing coral reefs elsewhere.

The guide has 13 elements, each of which is covered in one or two pages. References are provided at the end of many of the sections for those seeking additional information. Among the 13 elements are: planning and stakeholder cooperation; marine wilderness areas; enforcement; mapping; monitoring; restoration; and education and outreach.

Copies of the document may be obtained by contacting James Tilmant, NPS Water Resources Division, 1201 Oak Ridge Dr., Fort Collins, CO 80525. The guide is also posted on the Internet in PDF format at http://coralreef.gov/blueprnt.pdf. PS

Meetings of Interest*

January 24, 2002

The Sixth Symposium of Biological Research in the Jemez Mountains, New Mexico, will be held in Santa Fe. The goal of the symposium is to exchange results of ongoing biological research in the Jemez Mountains. For more information contact Stephen M. Fettig, Bandelier National Monument (505-672-3861, ext. 546; stephen_fettig@nps.gov).

March 18-22

The NPS Pacific West and Alaska Regions are sponsoring the West by Northwest 2001 Workshop in Seatle, Washington. Titled "Navigating the Future: Protecting and Sharing the Legacy," the workshop will have three themes: (1) walking the talk of the Organic Act: prohibition on impairment of park resources and values; (2) demonstrating results and accountability: an examination of performance management stratetgies for protection of resources; and (3) rising to the challenge: meeting planning and compliance needs. This training workshop provides NPS staff and partners an opportunity to share information, network, and learn about programs, policies, and standards. For more information, visit www.pwr.nps.gov/prog/natres/wxnw2002/wnwindex.htm.

May 15-17

The National Park Service along with eleven other federal and state agencies and non-profit groups are sponsoring the Fourth Conference on Research and Resource Management in the Southwestern Deserts, to be held in Tucson, Arizona. The theme of the conference, "Meeting Resource Management Information Needs," acknowledges the importance of and increasing need for data to support decision making. Conference sponsors hope to improve the preservation of natural and cultural resources by increasing understanding of current research and resource management challenges, and to achieve more collaboration through discussion of current research and future research needs. Among the invited speakers are Karen Wade, NPS Intermountain Regional Director, who will speak about the Natural Resource Challenge Program, and Nancy Kaufman, U.S. Fish and Wildlife Service Region 2 Director, who will discuss how that bureau is planning to meet its information needs. Additional information on the conference can be found at www.werc.usgs.gov/sdfs/meetings.html.

August 4-9

The Ecological Society of America (ESA) and the Society for Ecological Restoration (SER) will be meeting jointly next summer in Tucson, Arizona. The theme of the meeting is "A Convocation: Understanding and Restoring Ecosystems." The organizers are calling this conference a convocation, because it is the coming together of two organizations, ESA and SER, that share the common purpose of using basic ecological knowledge to solve practical environmental problems. The meeting will include practitioners, managers, regulators, academic scientists, agency researchers, educators, and interested citizens. The organizers also are encouraging ecologists and restorationists in Mexico and Latin America to attend. Esteemed Harvard biologist E. O. Wilson will be giving the keynote address to the conference. For further information on the conference, consult www.esa.org/tucson, or contact the program chair: Paul H. Zedler, Institute for Environmental Studies and Arboretum, University of Wisconsin-Madison (608-265-8018; esa@mail.ies.wisc.edu).

*Readers with access to the NPS Natural Resources Intranet can view a comprehensive listing of upcoming meetings, conferences, and training courses at www1.nrintra.nps.gov/NRMeet/index.cfm.

notes from abroad

Park Management in Germany

A young and growing park system draws inspiration from the U.S. national park model

Article and photos by Thomas Meyer

Located in central Europe, Germany is about the size of Montana and has a long history of settlement and a high population density[1]. Thus, Germany's landscape is very fragmented and lacks uninhabited natural areas such as old-growth forests. In this setting, Germany has only been able to establish national parks on lands altered by human use; areas suitable for the highest preservation status have been hard to find. Nevertheless 14 national parks exist in my country today (figure 1). They are situated in less populated regions and are generally small compared to parks in North America. However, their objective is similar to U.S. national parks: to allow natural succession, protect natural landscapes, and provide for recreation.

Because of our land use history, the present focus in German parks is on protecting succession so that natural landscapes can develop once again. Our parks are in transition because the primary resource for which they were created is not (entirely) present. Almost 70 years ago Shenandoah National Park (Virginia) became the first "transition park" because its mixed hardwood and evergreen forest had been logged from previous settlement, leaving only small patches of old-growth forest (Engle 1998; Conservation Foundation 1985). As one can imagine, land uses such as agriculture and forestry leave footprints on sometimes fragile ecosystems. Yet, as we all know, resource management is a tool used by park administrations around the world to restore degraded ecosystems. In this respect national parks in Germany and the United States are similar, and, as you will see, an intriguing blend of both similarities and differences in the history and management of the two park systems exists.

1 Two-hundred thirty people per square kilometer or 89 people per square mile compared with 28 per square kilometer or 11 per square mile in the United States.

National park by "accident"

Germany's first national park was established in the Bavarian Forest in 1970 with the objective of attracting tourists to its remote location. However, the denomination "national park" was merely a public relations strategy to promote a park that was intended purely as a recreational area. Consumptive uses such as timber harvest and hunting were to continue. Thanks only to a few people who were in charge of managing those 13,000 hectares (32,123 acres) was the Bavarian National Park transformed into a "real" national park according to international standards.

The long absence of national parks in Germany can be explained by a different conservation tradition from the United States. Early conservation efforts in Germany focused on species conservation and preservation of natural monuments, leading to the creation of the first nature reserves around 1900. Although some politicians were inspired by the national park idea, their plans failed, in part, because Germany lacked pristine areas and the concept of transition parks had not been established. Additionally, two world wars intervened and diverted attention from the conservation movement.

A second national park was established in the Alps in 1978, followed by three more parks in the Waddensea coastal zone of the North Sea. Thereafter, the potential for additional parks was scant until 1989 when the German Democratic Republic (GDR or East Germany) became more open to the West. With the fall of the Berlin Wall a group of East German conservation leaders went on a study tour of the United States to learn about protected areas and to incorporate new ideas in their latest conservation projects. The former East Germany was less densely settled than its western counterpart and possessed many promising conservation sites. Although several areas suitable for national park designation had been identified in the years of the GDR, their protection as "national parks" was prohibited because the idea was American or capitalist! The conservationists met with NPS officials and visited Shenandoah National Park where they were fascinated to view the results of America's first transition park project. By the time of Germany's reunification in 1990 five parks in the former GDR had been created, setting aside an additional 130,000 hectares (321,230 acres—figure 2, page 14). About 5% of the former East Germany was protected as nature reserve, biosphere reserve, or national park—a great success for nature conservation!

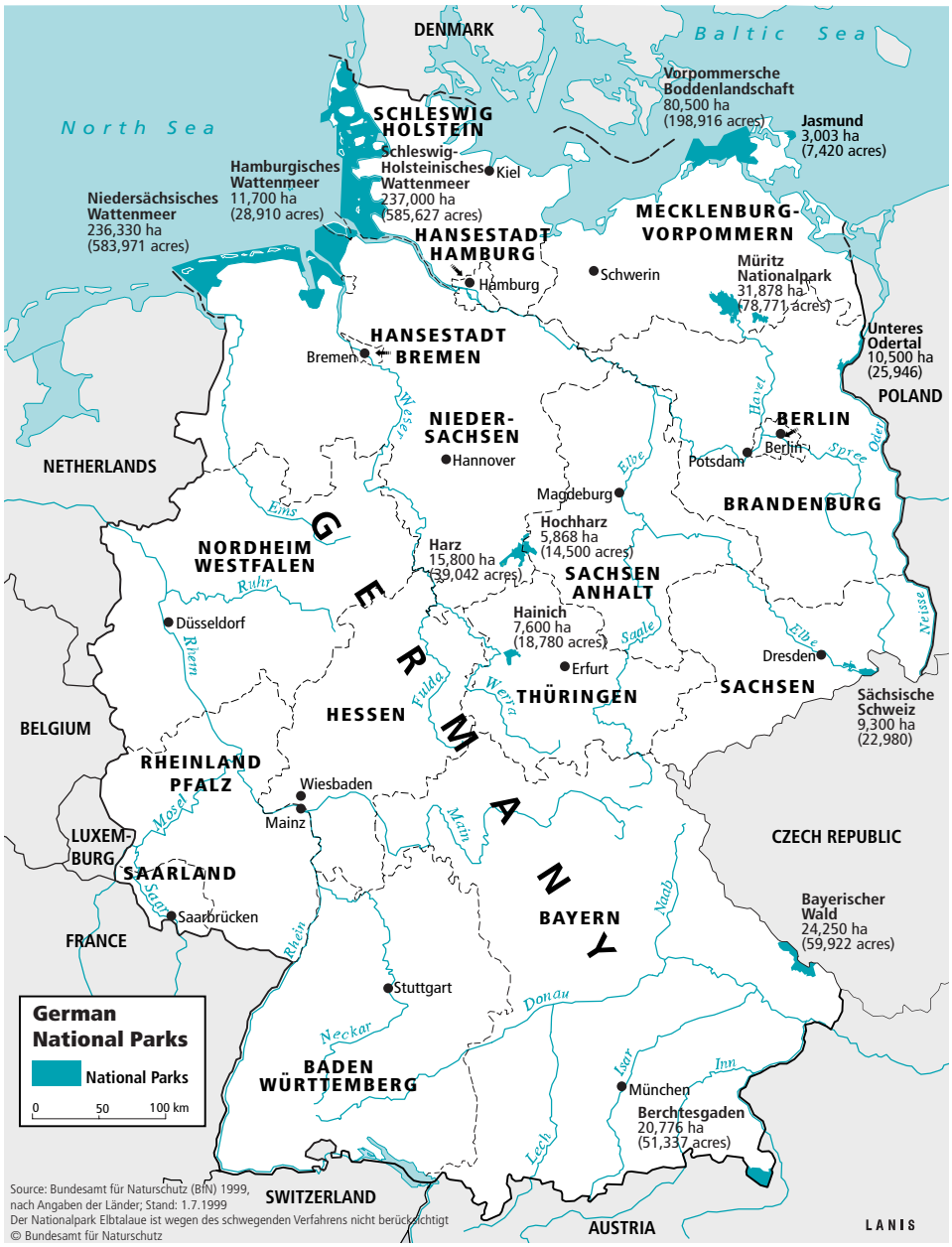


Figure 1. German national parks by state. (Adapted by the NPS Natural Resource Information Division from the original by LANIS-Bund—the German Federal Agency for Nature Conservation, 1999.)

Management Guidelines Needed

In 1973 the International Union for Conservation of Nature and Natural Resources (IUCN) set up criteria for classification of protected areas. The long experience of U.S. parks heavily influenced those standards for national parks around the world. In fact, German park managers aim to meet the IUCN standards since they promote the national park idea better than German law. The IUCN revised its standards in 1992, requiring national parks to fulfill management criteria, such as preservation of ecological integrity and exclusion of any use that might deteriorate it, in at least 75% of an area. This explicit requirement was necessary because forestry, mass tourism, and mining are incompatible with national parks. Nevertheless, natural resource restoration operates with tools commonly associated with forestry, including thinning and replanting. Accordingly, park zoning must distinguish restoration zones from natural areas. Currently only three out of 14 German parks qualify as national parks by IUCN definition.

Natural Landscapes—Step by Step

By far the largest challenge for managers of recently created German parks is addressing the many concerns related to restoring ecological function in cultivated areas. Centuries of forestry, mining, and hunting have left behind a landscape with logging roads, planted forests, introduced species, and unnaturally high deer populations. Restoration work is needed to remove structures like roads, buildings, and bridges and to de-channelize streams. Field trials in the Bavarian Forest have shown that leaving roads intact does not mitigate the human impact. In this case the wilderness ethic nurtured in the United States influenced park managers to undo human impacts where feasible in order to have "wild" landscapes inside park boundaries. The retention of wild landscapes in Germany is a philosophy that parallels, for example, the watershed rehabilitation program in Redwood National Park (California), although removal of logging roads there is mainly to mitigate erosion.

In German national parks meadows and former fields can usually be left completely to natural succession. Only when cultural landforms are crucial to the survival of threatened species are they perpetuated by active management. This policy is comparable to the management of historic landscapes and cultural zones in U.S. parks, even if we do it for different reasons. Due to the small size of German national parks, we try to keep as little area as possible under permanent vegetation management, preferably less than 5%. In contrast, nature reserves, which are smaller in size and permit more active management, are usually better suited for this goal. Furthermore, historic landscapes receive a different protection status

that allows active management to preserve the historic context.

Managers of our young parks generally have two options regarding any resource problem: do something about it or let nature regulate it. The decision to act or not applies to animal populations, plantation forests, roads, and exotic species alike and depends on the philosophy of the park manager, funding, and the feasibility of the proposed remedy. Each park might take a different approach. Surely surprising to the American reader is that national parks in Germany are not within federal, but rather state, authority. Also, states have not officially agreed upon a park management policy. Nevertheless, most park managers are eager to comply with the already mentioned international standards and are advocating wilderness ideas similar to those in the United States. Thus, we are developing an informal management policy that is adapted to our situation in Germany but according to the spirit of John Muir and Aldo Leopold.

Figure 2. (above) The white cliffs of Jasmund National Park attract more than 1.5 million visitors per year.

Figure 3. (right) The natural zone of Hochharz National Park encompasses trees that were killed by a bark beetle infestation (Ips typographus) *20 years ago following windthrow.*

Unique Problems?

In three German parks, where spruce plantations partially cover the park, managers worry about bark beetle infestations and lacking recruitment of native tree species. Trees killed by insects are a normal occurrence in a forest ecosystem and, in general, park managers agree that national parks should protect such processes. Unfortunately, all parks have close neighbors, and since Germany is densely populated, they observe cautiously what happens inside the park boundaries. Private forest owners bordering parks oppose such "large-scale experiments" as they refer to natural processes (figure 3). Local acceptance of parks is crucial and requires managers to respect the fears of park neighbors that insect infestations might spread. In the Bavarian Forest, a buffer zone of at least 500 meters (547 yards) width serves as a barrier where infested trees are removed or stripped of their bark.

Another issue related to plantations is the uniformity of forest stands—often including nonnative tree species (figure 4). How does one deal with this problem? Leaving such stands alone might lead to a natural forest with natural species in a couple hundred years. On the other hand, thinning helps speed up that process by breaking up structures and giving seeds of other species a chance to invade the gaps. This technique adds diversity to almost bare forests. Clear-cuts could also (very fast indeed) help to jump-start a new, natural forest. Except for small acreages, however, this option is not applicable in most parks. Only a decade ago, clear-cuts were banned in Germany by law and today forestry is concentrating on selective harvesting. Reinventing clear-cuts for conservation purposes would surely be a very unfortunate decision.

Wildlife needs regulation in all of Germany because predators like wolves, bears, and bobcats were eradicated centuries ago and are missing in our ecosystems. Without hunting, deer and elk populations would otherwise increase dramatically and have a great impact on vegetation and natural regeneration of our forests. Although hunting for trophies is fairly common in Germany, it is prohibited inside parks. In protected areas elk and deer are regulated by imitating predation, with rangers culling preferably young, weak, and ill animals. Trophies of these "regulated" animals become property of the park.

Figure 4. (left) Müritz National Park, created in 1990, inherited several thousand hectares of pine plantations. Thinning is an option to break up these uniform, unnatural forests.

Figure 5. (below) Former tank shooting range—today the largest forest succession in Hainich National Park.

The situation in Germany's Hainich National Park is somewhat similar to Shenandoah, where farmlands from pre-park days were left alone and a new forest grew up in its place. In Hainich, large areas were cleared in the 1980s to create a Russian-tank shooting range. Today it is the largest forest succession in Germany and has been protected in a national park since 1997 when the military abandoned the area (figure 5). Because only native species revegetate these lands, no further management is needed.

Parks and People

Experience has shown that protected areas in Germany only have a chance to function if created on state property. This is especially true for national parks because they usually exclude or end any detrimental uses that were previously legal. In Germany private landowners living adjacent to parks mostly oppose the parks because they fear restrictions, park expansion, and insect diseases that might escape from within the boundary. Even though visitor spending has a high positive impact on local economies and many jobs can be attributed to the parks, this negative attitude prevails. Studies have shown that the greater the distance between a park and its neighbors, the greater its acceptance. Therefore, the main goal of park interpreters is to address these problems and to educate not only visitors from far away but also park neighbors.

Conclusion

Although the many park management problems described in this article are mostly related to Germany's fragmented and "civilized" landscape, managers in some U.S. national parks are probably dealing with similar issues. Considering that untouched landscapes are decreasing year by year, the ability to find ways to deal with human influence in protected areas will become increasingly important. Perhaps this overview of current park management in Germany will encourage further thinking about resource management in disturbed landscapes and arouse interest in visiting our parks to see what results the "best idea America ever had" has produced abroad. PS

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MAB NOTES

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A PROGRESS REPORT ON U.S. AND INTERNATIONAL BIOSPHERE RESERVES

By John G. Dennis

Biosphere reserves are internationally recognized terrestrial and coastal or marine areas where management seeks to achieve sustainable use of natural resources while ensuring conservation of the biological diversity of the areas. The first biosphere reserves were designated in 1976 as part of the United Nations Educational, Scientific, and Cultural Organization's (UNESCO) Man and the Biosphere Program (MAB). Biosphere reserves are nominated by national governments for inclusion in the world network of biosphere reserves. Each nation's sites remain under the sovereign jurisdiction of the nominating country. Today, a total of 391 biosphere reserves are recognized in 94 countries. Of these, 47 are in the United States, with 23 involving 30 units of the national park system (table 1, page 18). Although in the past few years some people in the United States have expressed concern that international recognition as a biosphere reserve could cause loss of private property rights, such recognition is sought and obtained voluntarily by the land manager, does not change land ownership status, and does not reduce private property rights. In fact, 13 of the 99 land management units that are part of the 47 biosphere reserves recognized in the United States involve some degree of non-governmental ownership.

In 1994 the United States adopted a strategic plan for the U.S. biosphere reserve program and fully participated when the international biosphere reserve program met in Seville, Spain, in 1995 to develop the Seville Strategy and the Statutory Framework of the World Network of Biosphere Reserves. In 2000, the United States, with a three-person delegation, was one of 46 countries that met in Pamplona, Spain, to learn from each other's experiences in implementing the biosphere reserve concept enunciated in the Seville Strategy (figures 1 and 2).

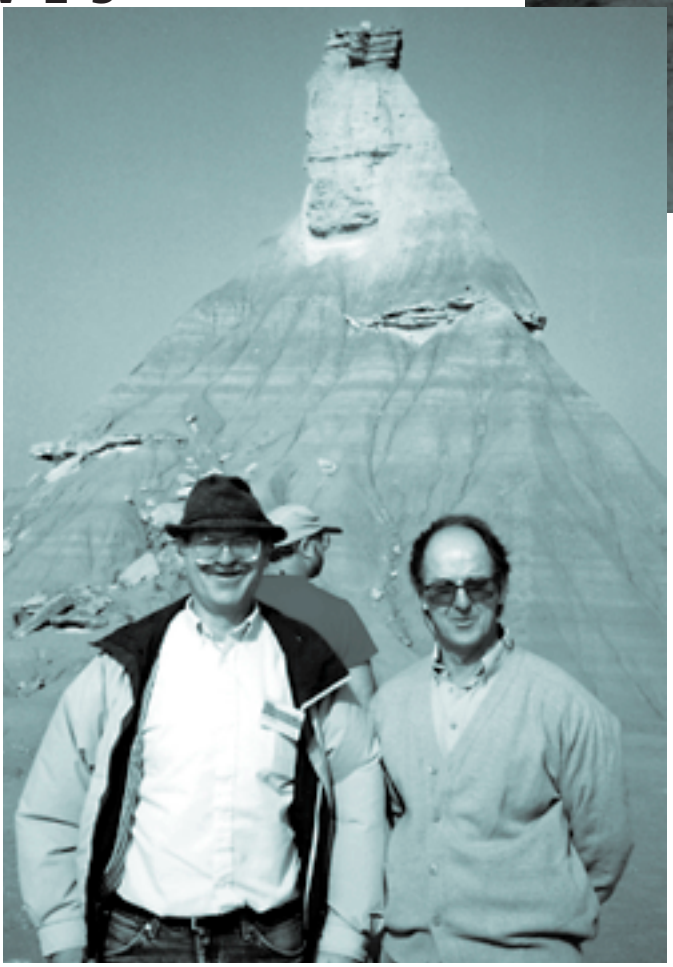

Figure 1. Participants of the international MAB review meeting in Pamplona, Spain, visited Bardenas Reales, a Spanish biosphere reserve designated in November 2000. Shown are the author (left) and Javier Castroviejo Bolibar, chairman of the Spanish MAB National Committee.

Figure 2. Located in northern Spain near the Pyrenees Mountains, Bardenas Reales Biosphere Reserve sustains high biological diversity through a mosaic of traditional land uses such as grazing and agriculture and natural disturbances that diversify habitat types.

INTERNATIONAL ASSESSMENT AT PAMPLONA

The Seville Strategy contains four broad goals: (1) to use biosphere reserves to conserve natural and cultural diversity; (2) to use biosphere reserves as models of land management and sustainable development; (3) to use biosphere reserves for research, monitoring, education, and training; and (4) to integrate functions within biosphere reserves and strengthen the world network. The Pamplona review, organized into 10 concurrent work groups followed by plenary sessions, assessed the progress of biosphere reserves in integrating the four goals. As the NPS representative for national park-related USMAB (United States Man and Biosphere Program) issues, I participated in the Pamplona review and will discuss the recommendations of the work groups.

RESEARCH AND MONITORING

One work group explored the success of biosphere reserves as sites supporting international research and monitoring programs using examples from Brazil, Indonesia, Canada, Egypt, United States, and Sweden. The group's recommendations encourage the MAB program to harmonize its research initiatives with several international programs; encourage regional networks of biosphere reserves to develop and adopt research and standardized monitoring projects related to conservation and sustainable development, especially at the landscape scale; and encourage biosphere reserves to share results and incorporate the social sciences, local communities, and volunteers into their research and monitoring programs.

SUSTAINABLE CONSERVATION

Presentations from Viet Nam, Czech Republic, and Egypt formed the basis for discussion about the role of biosphere reserves in conserving genetic resources and declining species. Recommendations encourage engaging the scientific community to inventory the potential for, and size constraints of, using biosphere reserves as gene pools of wild and domestic species; involving both local interest groups and national governments and science organizations in ensuring long-term sustainability and local economic viability of the humans involved with the reserves; and designing projects to rehabilitate degraded ecosystems in ways that also have them serve as scientific underpinnings of multilateral environmental initiatives.

Examples from Kenya, Cambodia, Colombia, Argentina, and Sweden provided models for discussions of land management and sustainable development and a conclusion that more work is needed to make biosphere reserves ideal, functioning models for sustainable land, coastal, and marine resource management. Recommendations for carrying out this work include: using social science-based efforts to increase the active partnership of local communities and nongovernmental organizations; developing information systems that incorporate traditional knowledge, enhance information exchange among partners, and generate technical approaches regarding land use and land tenure decisions and conflict resolution in biosphere reserves; applying clearly stated management objectives to integrating biosphere reserves into regional plans and monitoring the success of bios-

phere reserves in contributing to regional-scale sustainable development; and publishing examples of successful integration of biosphere reserves into their broader regions.

Canada, Germany, Niger, China, Uganda, and Argentina provided examples for examining possible roles of biosphere reserves in helping to develop quality economies. Recommendations focus on three broad themes. There is need to highlight the importance of sustainable economic and social development and demonstrate approaches to achieving this development, especially with respect to fostering diverse agricultural activities. Economic activities must be profitable, sustainable, and socially and environmentally responsible. Efforts to develop new economic activities should build on and complement existing regional activities by drawing on special characteristics of the region and its cultural identity and by creating and marketing brand names and symbols that reflect the special character of the region.

TABLE 1.
UNITS OF THE U.S. NATIONAL PARK SYSTEM AND ASSOCIATED BIOSPHERE RESERVES

PARK UNIT	BIOSPHERE RESERVE	YEAR DESIGNATED, EXTENDED
Big Bend National Park (TX)	Big Bend	1976
Channel Islands National Park (CA)	Channel Islands	1976
Denali National Park and Preserve (AK)	Denali	1976
Everglades and Dry Tortugas National Parks (FL)	Everglades & Dry Tortugas	1976
Glacier National Park (MT)	Glacier	1976
Noatak National Preserve (AK) and Gates of the Arctic National Park (AK) (part)	Noatak	1976, 1984
Olympic National Park (WA)	Olympic	1976
Organ Pipe Cactus National Monument (AZ)	Organ Pipe Cactus	1976
Rocky Mountain National Park (CO)	Rocky Mountain	1976
Sequoia and Kings Canyon National Parks (CA)	Sequoia and Kings Canyon	1976
Virgin Islands National Park (VI)	Virgin Islands	1976
Yellowstone National Park (WY, MT, ID)	Yellowstone	1976
Haleakala and Hawaii Volcanoes National Parks (HI)	Hawaiian Islands	1980
Isle Royale National Park (MI)	Isle Royale	1980
Big Thicket National Preserve (TX)	Big Thicket	1981
Redwood NP (CA)	California Coast Ranges	1983
Congaree Swamp National Monument (SC)	South Atlantic Coastal Plain	1983
Death Valley and Joshua Tree National Parks (CA)	Mojave and Colorado Deserts	1984
Cape Lookout National Seashore (NC) and Cumberland Island National Seashore (GA)	Carolinian-South Atlantic	1986
Glacier Bay National Park (AK)	Glacier Bay-Admiralty Island	1986
Golden Gate National Recreation Area and Point Reyes National Seashore (CA)	Central California Coast	1988
Great Smoky Mountains National Park (TN, NC)	Southern Appalachian	1988
Mammoth Cave National Park (KY)	Mammoth Cave Area	1990, 1996

COORDINATION, COOPERATION, AND COMMUNICATION

Presentations from Russian Federation, Estonia, Benin, and United States provided the basis for an exploration of different approaches for managing biosphere reserves that concluded that coordination is the key function in managing biosphere reserves. Recommendations focus on creating specific institutional mechanisms to support coordination, including (as key components) a capacity to encourage participation and consensus, the ability to integrate knowledge into common projects, and the ability to speed the flow of information. Additional recommendations encourage having the international biosphere reserve program develop guidelines for creation, roles, and functions of these institutional mechanisms.

> "Coordination is the key function in managing biosphere reserves."

Discussion of how to coordinate national biosphere reserve networks drew on presentations from China, Canada, France, India, Ukraine, Cuba, and Belarus that emphasized that coordinating structures need dedicated support if they are to achieve their functions of information exchange, project coordination and development, and fund-raising and advocacy. To advance the functioning of biosphere reserves, the work group recommended close coordination between individual biosphere reserve coordinators and their national biosphere coordinating structure; creation of an adequately supported human and financial structure at the time a biosphere reserve is nominated for international recognition; and international cooperation in fund-raising and personnel exchanges as a means of helping foster individual biosphere reserves.

Other participants examined ways for raising visibility and support for the world network of biosphere reserves using case studies from Madagascar, Morocco, Belarus, Argentina, and Brazil. Broad discussions regarding communication, publication of success stories, importance of biosphere reserves for generating income for local human populations, and the coordination role of regional networks led to six recommendations. Key points include needs for guidelines on how to approach potential donors to projects, for awareness-raising mechanisms, and for increasing the involvement of nongovernmental organizations in biosphere reserve activities designed to bring biosphere reserves together.

An examination of the linkage of biosphere reserves to decision making at the national level drew on examples from Cuba, Republic of Korea, Ecuador, Finland, and Germany and concluded that the biosphere reserve concept is not yet well appreciated at this level. Recommendations to improve this linkage urge MAB national committees to demonstrate within the context of their own national situations the added values that biosphere reserves bring in areas of social and sustainable develop-

ment, science, technical assistance, conflict resolution, capacity building, and citizen participation in environmental concerns. The recommendations also urge MAB national committees to participate in developing national strategies for sustainable development, promote biosphere reserves as places in which nations can implement activities as part of international environmental programs, and encourage international exchange activities as a means of raising national awareness of and pride in a nation's own biosphere reserves.

Presentations from Russian Federation, South Africa, Spain, Egypt, Democratic Republic of Congo, and the MAB international office supported an exploration of education, awareness building, and training regarding biosphere reserves that developed themes concerning awareness of economic and social benefits, information exchange regarding education and public awareness, awareness of characteristics of recipient groups, need to use a diversity of methods, and importance of two-way communication. Recommendations evolving from these themes include: connect biosphere reserves using information webs, develop education and awareness programs to use two-way communication involving diverse methods, and encourage biosphere reserves to help develop environmental awareness and opportunities for equitable sharing of benefits through activities that bring together a wide range of participants and information sharing actions.

PERIODIC REVIEWS NEEDED

Article 9 of the Statutory Framework for biosphere reserves encourages countries to review each of their biosphere reserves every 10 years. Presentations of review experiences in United Kingdom, Indonesia, Switzerland, Argentina, Egypt, and Poland showed the practical value of this process in helping nations understand and improve the awareness, support, and function of these dynamic conservation and sustainable use models. Recommendations include using the review to ensure that biosphere reserves fulfill all three key functions of a biosphere reserve: conservation, sustainable development, and support of research, education, and training. Other recommendations pertain to actively involving in the review both local stakeholders and multidisciplinary groups of experts through workshops and field visits; stimulating development and use of new evaluative indicators of success of a biosphere reserve; and sharing the experiences of national reviews internationally to help other nations conduct their own productive reviews.

ASSESSMENT AND OPPORTUNITIES FOR U.S. BIOSPHERE RESERVES

The Seville Strategy, Statutory Framework, and recommendations of the Pamplona review meeting together offer the world a strong, interactive tool for exploring techniques to achieve environmental conservation and sustainable development. The United States Man and Biosphere Program, including the national park system, has a large and well distributed number of sizable, active, and in some places multiorganizational biosphere reserves. The USMAB, again including the national park system, also has clear examples of biosphere reserves that, in terms of the Pamplona review, are failing to contribute research and monitoring, are focal points for people who oppose any program affiliated with the United Nations, are not viewed as models of sustainable development, are lacking in effective coordination, are not supporting quality economies, have not been reviewed, antagonize national decision makers, and are failing to educate stakeholders about the opportunities that biosphere reserves can bring to regions of the United States.

The experiences reported by other nations at Pamplona offer ideas for USMAB. The success of some U.S. biosphere reserves and dysfunction of others suggest a need for USMAB to conduct periodic reviews and to compare the results with those of other countries. Given other countries' experiences, a USMAB review likely would reveal advantages U.S. biosphere reserves could gain by having dedicated biosphere reserve coordinators, active and multiorganizational awareness programs, well developed research and monitoring programs, and demonstration projects designed to explore the characteristics, economic and conservation benefits, and costs of sustainable uses of landscapes and to involve the cooperation of public and private entities. Similarly, such a review likely would identify steps that USMAB would need to take at both national and local levels to make biosphere reserves productive models of conservation and sustainable development. Many of the steps this review likely would reveal would provide mechanisms for implementing actions identified in the USMAB Strategic Plan for the United States Biosphere Reserve Program. As USMAB moves from the State Department to the USDA Forest Service and as it undergoes a new self-evaluation, now is the time for it to apply its Strategic Plan to make the U.S. biosphere reserves effective models of conservation and sustainable development. PS

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Recent colonization of mangrove and frigatebird populations in the Dry Tortugas

By
Thomas W. Doyle, Thomas C. Michot,
Richard H. Day, and Christopher J. Wells

Dry Tortugas National Park is a remote enclave of islands in Gulf of Mexico waters at the end of the Straits of Florida noted for its vintage Spanish-American fort, colorful corals, and teeming tern populations (figure 1). In recent decades researchers have observed ecological change above the water line, notably the establishment of a mangrove forest and nesting of magnificent frigatebirds (Fregata magnificens).

Figure 1. Located 70 miles (114 km) west of Key West, Florida, Dry Tortugas National Park is known for its massive Spanish-American fort, coral reefs, and colonial seabirds. The mangrove forest and seabird surveys were conducted on Bush and Long Keys (background); Fort Jefferson is located on Garden Key (foreground).

Background

Historically, the Tortugas shoals have been valued as an important military outpost and nesting ground for diverse seabirds. The notoriety of these islands was gained from mariners and naturalists alike, most notably John James Audubon, famed artist and ornithologist, who frequented the area in the mid-1800s to observe the rich bird life. The Dry Tortugas was declared a national treasure and bird sanctuary as early as 1908 and incorporated into the national park system in 1935.

The Carnegie Institute maintained a remote marine laboratory on Loggerhead Key at the turn of the last century (i.e., 1900) where many scientific studies of bird and marine life were conducted. In the volumes of historical biological investigations, mangroves and the magnificent frigatebird are of little note. Naturalist John Henry Davis mapped the vegetation of the Dry Tortugas in 1935 and observed the conspicuous absence of mangroves that were ubiquitous in the nearby Marquesas atoll and all other keys of the Straits of Florida. Davis planted thousands of red mangrove *(Rhizophora mangle)* propagules that persisted as seedlings a few years but ultimately failed to take permanent root. In recent years, healthy populations of mangroves and frigatebirds have naturally colonized Long and Bush Keys (figures 2 and 3).

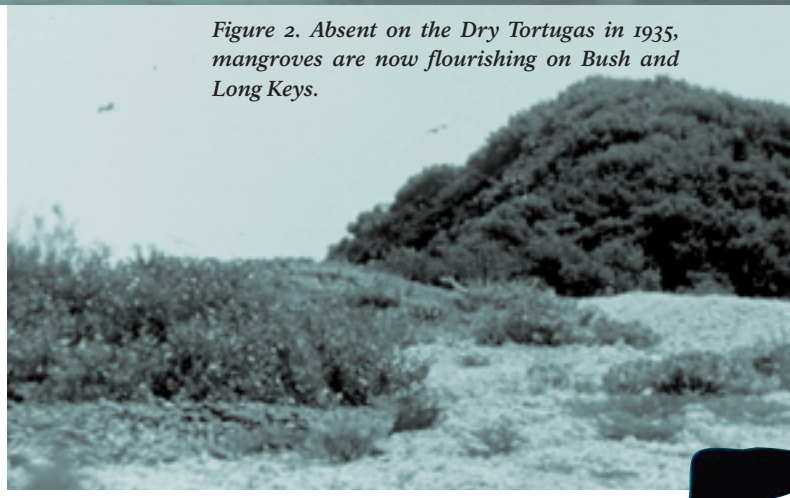

Figure 2. Absent on the Dry Tortugas in 1935, mangroves are now flourishing on Bush and Long Keys.

We conducted a historical and ecological survey of mangrove colonization of the Dry Tortugas to determine forest age, tree growth, and stand structure of these islands. Published accounts and both ground and aerial photography provided a reasonable chronicle of mangrove establishment in shoal sections of Long and Bush Keys, islands adjacent to historic Fort Jefferson and Garden

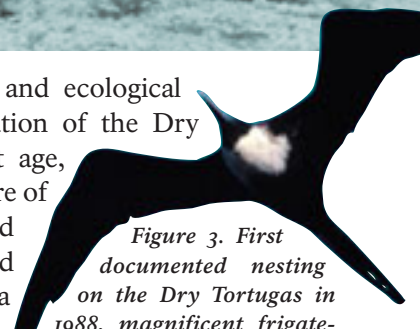

Figure 3. First documented nesting on the Dry Tortugas in 1988, magnificent frigatebirds are now common nesters, their breeding success linked to the surge in mangrove vigor of the past several decades.

Key (figure 4). Presently, robust populations of mangrove trees of all three neotropical species, black mangrove (*Avicennia germinans* (L.) Stearn), white mangrove (*Laguncularia racemosa* (L.) Gaertn.f.), and red mangrove thrive on these keys. In the fall of 1995 and 1997, we measured tree size and density by species in fixed circular plots of mangrove habitat on Bush and Long Keys. We collected surface and soil water samples to characterize the salinity, pH, and nutrient concentrations for each site. Porewaters were extracted at three depths (5, 15, and 25 cm [2, 6, and 10 in]) below the soil surface using a sipper tube and syringe by vacuum suction.

Review of historic seabird surveys

Ornithologists and park staff have provided bird counts on these islands fairly continuously since the early expeditions by Audubon in the 1830s. Frigatebirds have been observed on this site for most of the 20th century either roosting or feeding but only recently confirmed as nesting in the area. We observed nesting frigatebirds perched in the most developed mangrove stands (> 15 m [50 ft] in height) along the extended shoal of Long Key. This colony is thought to have migrated from previous nesting grounds in the Marquesas atoll (32 km or 20 mi to the east) circa 1988–89. The first nestlings at the Tortugas were observed in the spring of 1988 from a total nest count of 9 breeding pairs. By 1993 the nest count had increased to 70 breeding pairs. In recent years, the population has ranged between 50 and 100 breeding pairs.

As we discovered, Bush Key has undergone much shoreline erosion on its north end as evidenced from recent aerial photography compared with historic photos and maps taken from Davis (1942). A brown pelican *(Pelecanus occidentalis)* roost in the remaining mangrove trees on the north end of Bush Key may be hastening the death of these trees along with loss of substrate from beach erosion (figure 5). The red and white mangrove trees along this beach were once established around interior ponds in the center of the island and have grown to 20–25 cm (8–10 in) diameter at breast height (dbh) over the last 50 years. We did not take any plot data at this site because of the degraded condition of the trees and forest. Red mangrove saplings are colonizing the understory and edge of the surviving emergents inside the beach dune, but many are extremely chlorotic (yellowish in appearance due to lack of green chlorophyll) and dying from high concentrations of phosphate and nitrate accumulated from unflushed pelican guano. Early Carnegie Institute studies on these pond systems around 1900 document the presence of sapling-size red and white mangrove recruits. The largest trees might approach 100 years but are no older at this site.

Forest surveys

We established forest plots on the east end of Bush Key in a mixed mangrove stand of all three species: red, white, and black mangrove (see figure 4). The largest canopy trees approached 14 cm (6 in) dbh and 7.5 m (25 ft) in height and are estimated to be about 25 years of age. Internode measurements (i.e., length of stem between leaf scars) of understory red mangrove saplings indicate that they are growing well despite shade conditions and nominal organic soil atop coarse coral debris regularly inundated by saline Gulf water. We found nutrient levels (nitrate and phosphate) in the interstitial water at this site to be comparable to lagoonal concentrations and significantly greater than open Gulf waters. Unlike northern Bush Key where accumulated pelican guano may be detrimental to mangrove health, eastern Bush Key and Long Key are tidally flushed so that the nutrient input of nearby bird colonies is effectively diluted and provides fertile growing conditions for the mangroves.

We also documented tree plots on the north and south ends of Long Key in a fairly large stand of mixed mature mangroves of all three species (see figure 4). The largest and tallest trees, 25 cm (10 in) dbh and 15 m (49 ft) in height, respectively, were central in the stand; however, we did not measure them in order to minimize stress of fledgling frigatebirds. This stand resides in the vicinity of Davis's failed red mangrove plantings of the early '40s. Personal accounts and dated aerial photography confirm a stand age of 50 years or younger. Twin hurricanes in the mid-40's and 60's were among the most intense to hit the Tortugas in the 20th century, scouring island vegetation, shorelines, and park infrastructure. The natural colonization and success of all three mangrove species over the last few decades onto coral wrack under such exposed and harsh saltwater conditions surprisingly compares with the growth and stature of mainland populations of riverine mangroves in brackish waters of Everglades National Park.

The added nutrient input of a resident frigatebird colony into lagoonal waters may be augmenting the growth rate of mangroves as evidenced in accelerated height-growth relations of decade-old saplings. Growth rates, based on internode elongation follow seasonal patterns that allow aging of yearly flushes. Increased elongation patterns follow the 1989 growth year that may be concomitant with nesting history and water quality changes from input of frigatebird guano. Nutrient analyses of collected water samples demonstrated orders of magnitude differences in nitrate and phosphate concentrations in the vicinity of frigatebird and pelican roosts than in adjacent beach and lagoonal waters (figure 6). These results indicate that seabirds that depend on mangroves for nesting and roosting also increase nutrients in surrounding soils and waters that in turn may enhance mangrove photosynthesis and water use efficiency, resulting in enhanced growth.

Researchers have observed ...
the establishment of a mangrove forest
and nesting of magnificent frigatebirds.

Figure 4. Historic photos and contemporary aerial images of Bush and Long Keys helped the researchers reconstruct the history of mangrove colonization at Dry Tortugas. Arrows denote the locations of the tree plot survey sites on the east end of Bush Key (bottom left, foreground) and south ends of Long Key (top, background).

Hurricanes

Hurricanes may also have played a critical role in determining the long-term success of mangrove colonization in the Tortugas atoll. Historical accounts of early explorers, lighthouse keepers, and military correspondence refer to the presence of mangroves, bushes, and trees (or the lack thereof) dating to the mid-1700s. Accounts of hurricane impact by island residents and mariners demonstrate the vulnerability of these exposed low-relief islands to violent storms and erosion of emergent vegetation. The relatively small size and open exposure of these islands to sea conditions and hurricane impact may explain the recurrence of mangroves in years after an extended absence of storms. In contrast, the destruction and paucity of mangroves following major hurricanes is pronounced.

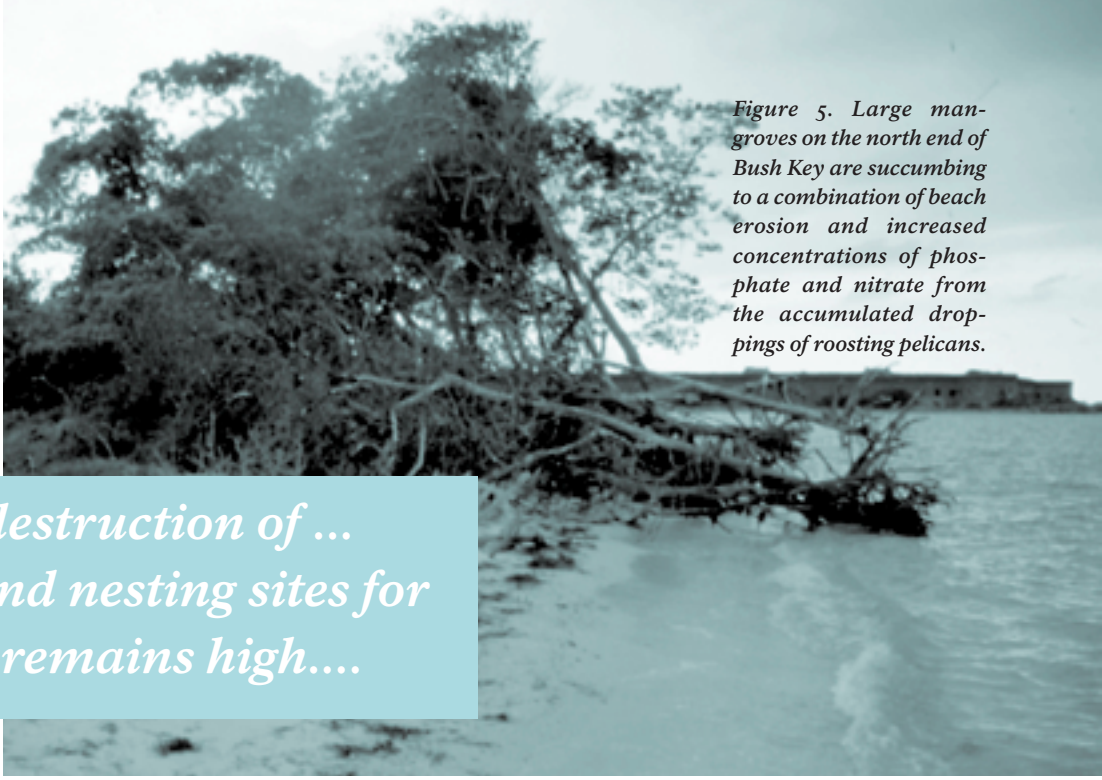

Figure 5. Large mangroves on the north end of Bush Key are succumbing to a combination of beach erosion and increased concentrations of phosphate and nitrate from the accumulated droppings of roosting pelicans.

The current risk of destruction of ... mangrove habitat and nesting sites for colonial waterbirds remains high....

Summary

Our study documents the recent natural colonization of mangroves and nesting frigatebirds at Dry Tortugas National Park. Affected by many factors, the dynamic process illustrates both the fragility and resilience of this subtropical maritime system. The period between major hurricanes, notwithstanding human harvesting of mangroves for fuelwood, may allow mangrove recruits the opportunity and time to develop sufficient size and density to colonize the islands and to attract frigatebirds dependent on mangroves for nesting. The current risk of destruction of the prevailing mangrove habitat and nesting sites for colonial waterbirds remains high because of island exposure and vulnerability to hurricane winds and surge. The probable interaction of breeding bird populations on mangrove community development and decline poses an interesting research question for Dry Tortugas National Park and associated wildlife refuges of the Florida Keys. Finally, the increased nutrient loading potential of island substrates from bird guano appears sufficient to stimulate stem growth of mangroves and may also be affecting other natural and cultural resources not investigated in this study. PS

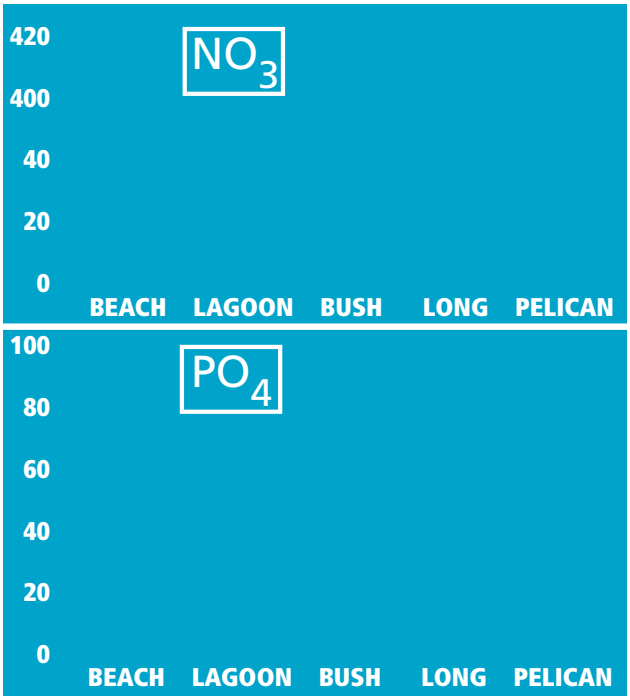

Figure 6. Graph showing relatively high concentrations (micromoles) of phosphate and nitrate at the Long Key and Bush Key study sites, attributed to magnificent frigatebird and brown pelican guano.

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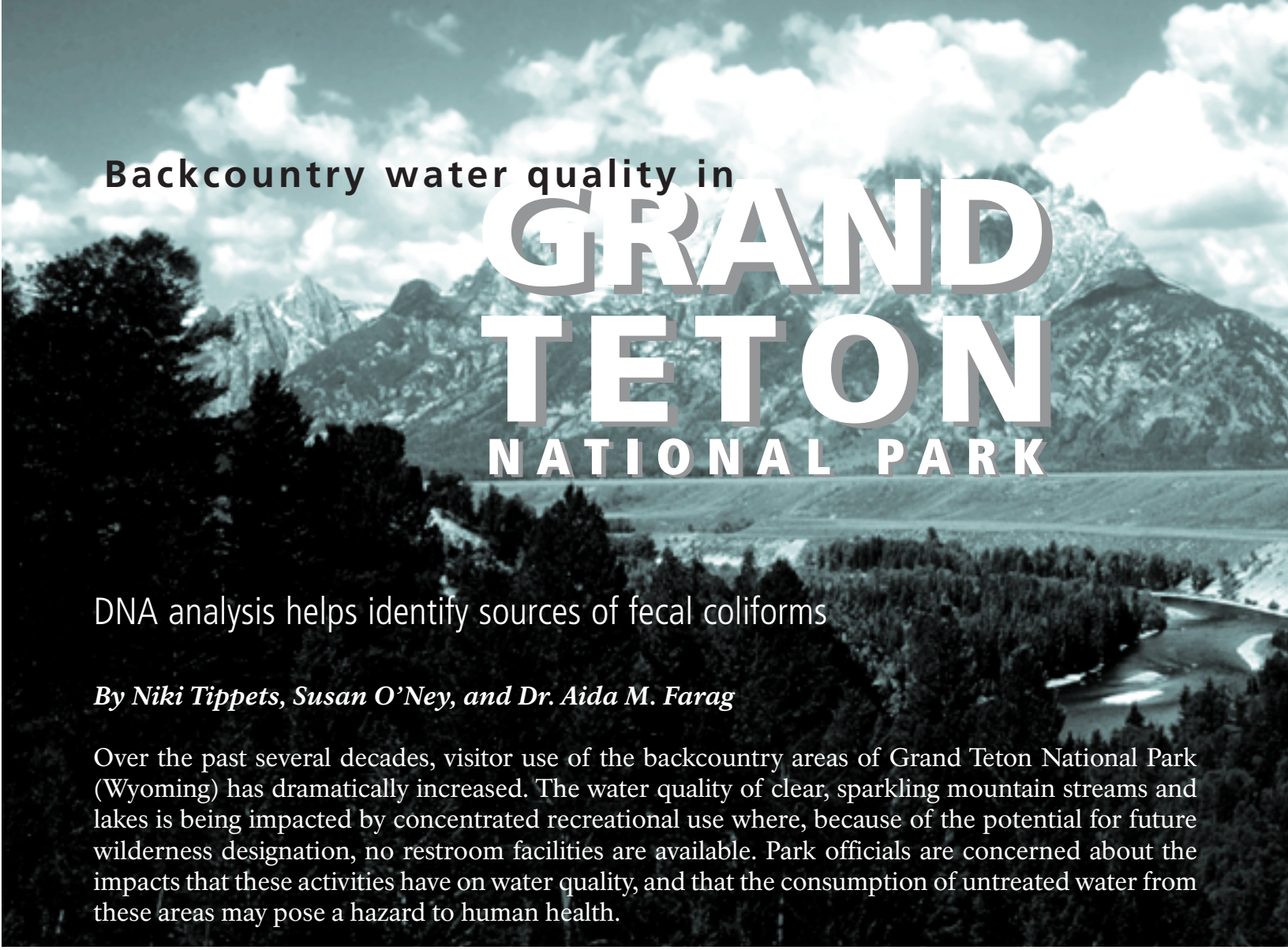

Backcountry water quality in GRAND TETON NATIONAL PARK

DNA analysis helps identify sources of fecal coliforms

By Niki Tippets, Susan O'Ney, and Dr. Aida M. Farag

Over the past several decades, visitor use of the backcountry areas of Grand Teton National Park (Wyoming) has dramatically increased. The water quality of clear, sparkling mountain streams and lakes is being impacted by concentrated recreational use where, because of the potential for future wilderness designation, no restroom facilities are available. Park officials are concerned about the impacts that these activities have on water quality, and that the consumption of untreated water from these areas may pose a hazard to human health.

Figure 1. Backcountry use of Grand Teton National Park, Wyoming, has dramatically increased in recent years, resulting in water quality degradation of creeks and streams and causing management concern.

BACKGROUND

Fecal coliforms reside in the intestines of warm-blooded animals, including humans, and are excreted in waste materials. The presence of high numbers of these bacteria in surface waters (creeks and streams) may indicate that unsanitary conditions exist that may pose human health concerns. Coliform counts and species of fecal streptococci were identified in water samples collected from the backcountry in Grand Teton National Park in the mid-1970s (McFeters 1975, Stuart et al. 1976). Similar studies in streams of the Sierra Nevada in California in the 1980s (Suk et al. 1987) detected decreased water quality in backcountry areas with extensive human presence when compared to other areas with minimal human presence. Grand Teton National Park personnel (Mark Magnuson, NPS, personal communication) also identified high concentrations of unknown bacteria in the early 1990s. This evidence led resource managers to the belief that the backcountry surface waters of Grand Teton should be evaluated more thoroughly by using recently developed techniques previously unavailable to the earlier investigators. The new techniques analyze DNA to determine the mammalian source of the fecal coliform (Samadpour et al. 1993, Samadpour et al. 1994). With this additional information, natural resource managers would be able to evaluate specific sources contributing to resource degradation (i.e., duck, bear, raccoon, human), and more effectively formulate policies and procedures to address the problem.

In 1996, Grand Teton National Park, the NPS Water Resources Division, and the third author cooperatively designed and initiated a backcountry water quality study in the park. Initial funding for this project was provided by the NPS Water Resources Division with later funding from the NPS Recreational Fee Demonstration Program. Because *Escherichia coli (E. coli)* is prevalent in nature, we used it to identify the source of fecal coliforms. While fecal coliforms are not

Figure 2. Biological Technician Karin McCoy collects a water sample in Grand Teton National Park as part of a water quality study begun in 1996. The information from the study provides a baseline of park water quality and is helping managers design appropriate solutions to water quality problems.

necessarily pathogenic, they are frequently associated with and may indicate hazardous disease organisms. The Environmental Protection Agency developed water quality standards for levels of *E. coli* in recreational waters based on specific levels of risk of acute gastrointestinal illness. The recommended steady state geometric mean value is 126 *E. coli* per 100 milliliters of water (USEPA 1986). On a few occasions, Grand Teton' s waters exceeded this limit, but on average they were well below this number. Our objectives for the study were to (1) establish baseline conditions of park backcountry surface waters to be used as a tool for measuring future changes, and (2) evaluate the effects that backcountry users may be having on the water quality of selected backcountry streams.

METHODS

We collected water samples following the methods suggested by Suess (1982). In the early years of the study, a local contractor completed the laboratory analyses. In 1999 the public health officer, John Collins, of the NPS Intermountain Region generously donated equipment to the park, allowing us to complete lab work on-site.

The new techniques analyze DNA to determine the mammalian source of the fecal coliform.

We filtered and incubated samples for analyses of fecal coliforms using the membrane filter (MF) procedure described in Standard Methods (APHA 1992). We selected positive fecal coliform colonies and sent them to Dr. Mansour Samadpour, University of Washington, for analysis of the *E.coli* isolates. He performed genetic fingerprinting using ribosomal RNA typing on each *E. coli* isolate. These patterns or DNA types, referred to as ribotypes, were then used to match specific strains of *E. coli* from water samples with ribotypes from known, potential sources. Dr. Samadpour maintains a ribotype database from source samples collected around the country. This facilitates the positive identification of the coliform source, especially human versus nonhuman origins.

THE STUDY

The third author implemented the study under contract during the summers of 1996 and 1997 (Farag 2001) with initial investigations focusing on surface waters of Avalanche, Garnet, and Cascade Canyons. In 1998, the first author assumed management of the project, expanding it into additional backcountry areas. The park has continued to collect data annually. In 2001, the second author took over the study.

In 1996 and '97, we found fecal coliforms in two of the three canyons investigated. Through DNA analysis (or source tracking) we determined that a variety of wildlife contributed fecal coliforms to the waters. In Cascade Canyon, some of the fecal coliforms were of human origin. In 1998, we also found human fecal coliforms in Paintbrush, Cascade, Bradley, and Avalanche Canyons. In 1999, as the study expanded, we found human fecal coliforms in Avalanche, Leigh, Upper and Lower Death, Lower Granite, and Hanging Canyons, at Guide's Wall and Hidden Falls, in Glacier Gulch, at Taggart Lake, and again in Cascade Canyon.

In 2000, we again detected human coliforms in Cascade Canyon, as well as an increase in the number of human coliforms identified in Granite, Death, and Open Canyons. Additional samples were collected near several grazing and boat launch areas within the park to

evaluate the impact of livestock and other activities on surface waters. We found a high number of bovine, bison, and horse coliforms at these additional sites, much as we expected.

IMPLICATIONS

Many of the waters in Grand Teton National Park are identified as Class I areas under the Clean Water Act of 1977 and therefore further water quality degradation is prohibited. The data collected in this study are helping to establish baseline coliform levels for backcountry water quality. They will also help managers determine the effects of increased backcountry use on the quality of park surface waters. This information can be used to guide decision making related to the location of camping zones, limitations on backcountry use, and designing educational programs for park visitors.

In Cascade Canyon, some of the fecal coliforms were of human origin.

Based on study results, resource managers at Grand Teton National Park have recommended that an evaporation-style toilet facility be installed at the base of Cascade Canyon. This site sustains intense use and is visited by an estimated 90,000 people per summer. Park management is currently evaluating the appropriateness, feasibility, and associated costs of this facility and other options, including area use limits. Grand Teton National Park utilizes a resource council to conduct preliminary reviews of proposed projects. The council will determine any additional planning required for compliance with the National Environmental Policy Act. The installation of a toilet facility in Cascade Canyon may be tiered to the development of a backcountry management plan, currently under review. Managers will have to weigh the concerns associated with human waste disposal in the backcountry in order to make their decision. These include human health problems as a consequence of either direct contact or contamination of drinking water, aesthetic concerns of visitors who find improperly disposed of human waste, and the conflict posed by the installation of structures in a wilderness management area. Once management has chosen and implemented a course of action, we will continue monitoring surface waters at Cascade Canyon to assess the effects of the action on water quality.

ACKNOWLEDGMENTS

Karin McCoy has supported the study over the last two years by her dedication to sampling and laboratory analysis.

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Songbird monitoring in the
Golden Gate National Recreation Area:

A MULTIFACETED TOOL FOR GUIDING THE RESTORATION OF REDWOOD CREEK

By
Thomas Gardali, Carolyn Shoulders, Daphne Hatch,
Aaron L. Holmes, Sandra E. Scoggin, and Geoffrey R. Geupel

The goal of many habitat restoration and management projects is to restore ecosystem function. Yet a paucity of basic ecological information exists for land managers to use in designing projects. Armed with such information, managers would have a "head start" toward achieving their goal. Additionally, effective restoration suffers from the difficulty of measuring success and the lack of informational means to make improvements.

Restoration of Redwood Creek, Golden Gate National Recreation Area (GGNRA, fig. 1), is currently under way thanks to funding from the National Park Service Recreational Fee Demonstration Program. One of the first steps is the large-scale removal of GGNRA's highest priority exotic pest plant, cape-ivy *(Delairea odorata)*. Cape-ivy is a fast growing, nonnative vine that blankets native plants (fig. 2), diminishes plant species richness, reduces structural diversity, and may reduce recruitment of light-dependent species such as red alder *(Alnus rubra)* trees in the riparian zone.

Figure 1. Location of the restoration site at Redwood Creek and the reference site at Lagunitas Creek, both in Golden Gate National Recreation Area, California.

As part of GGNRA's broader efforts to monitor songbirds, we have been studying the songbird community in Redwood Creek since 1997. We have found that songbird monitoring is a valuable tool because we can (1) examine the effect of nonnative plants on the bird community, (2) assess the immediate effects of

the restoration activities (i.e., disturbance created by removing of cape-ivy) on the songbird community while (3) simultaneously providing specific information on the habitat requirements of a diverse and healthy songbird community, (4) provide a practical means of measuring the success of the restoration project, and (5) act as an information feedback loop to refine and improve restoration and management (i.e., adaptive management).

To illustrate the utility of songbird monitoring for restoration and management programs we present preliminary results and specific recommendations based on three years of study.

CAPE-IVY REMOVAL AT REDWOOD CREEK

Redwood Creek is a coastal California stream that flows through Muir Woods National Monument into a relatively undeveloped valley and eventually into the Pacific Ocean, Marin County, California. To the millions of casual visitors who travel along Redwood Creek on their way to or from Muir Woods, the riparian corridor of willows (*Salix* spp.) and red alder trees might appear to be well protected and "wild." However, the valley has a history of various land uses including grazing and row crop agriculture and is currently threatened by the highly invasive cape-ivy.

Cape-ivy is notoriously persistent in its growth habit, and within the last 12 years data have shown that cape-ivy alone now makes up approximately 40% of the vegetation cover along the creek. Cape-ivy will resprout from the tiniest piece of root, stem, or even leaf. This eliminates mere cutting as a viable control mechanism. Instead, all roots must be grubbed out and removed from the site. To find the extensive roots on a densely vegetated site, the site must be cleared to expose the ground surface (fig. 3). Therefore, the removal method employed at GGNRA entailed "brushcutting" all herbaceous vegetation on a site, then raking it up. Roots of native species, such as blackberry *(Rubus ursinus)*, thimbleberry *(Rubus parviflorus)*, hedge nettle *(Stachys chamissonis)*, and others were left undisturbed, but roots of cape-ivy were raked up or grubbed out by hand. Since cape-ivy resprouts quickly, roots that first escaped notice typically resprouted with only slight fog drip or light rains, making easy the task of finding and pulling them before the site was naturally revegetated. Initial clearing, cutting and raking required six weeks for an eight-person Marin Conservation Corp crew. However, follow-up removal of cape-ivy resprouts continued almost weekly for the following nine months.

To date, vegetation data from transects on both removal and control areas show cape-ivy removal has been very successful, virtually eliminating the plant. The natural appearance of the site rebounded immediately in the first growing season, with rooted native species growing well. Three years after removal, native plant species have recovered to numbers close

> [To eradicate cape-ivy,] all roots must be grubbed out and removed from the site.

Figures 2 (before, left) and 3 (after, above). Habitat restoration took place along Redwood Creek in Golden Gate National Recreation Area, Marin County, California, where cape-ivy—a persistent invasive plant species—blankets native vegetation. Able to resprout from root, stem, or leaf, cape-ivy must be completely removed, exposing the ground surface, and any remaining vegetation raked up. PHOTOS BY CAROLYN SHOULDERS.

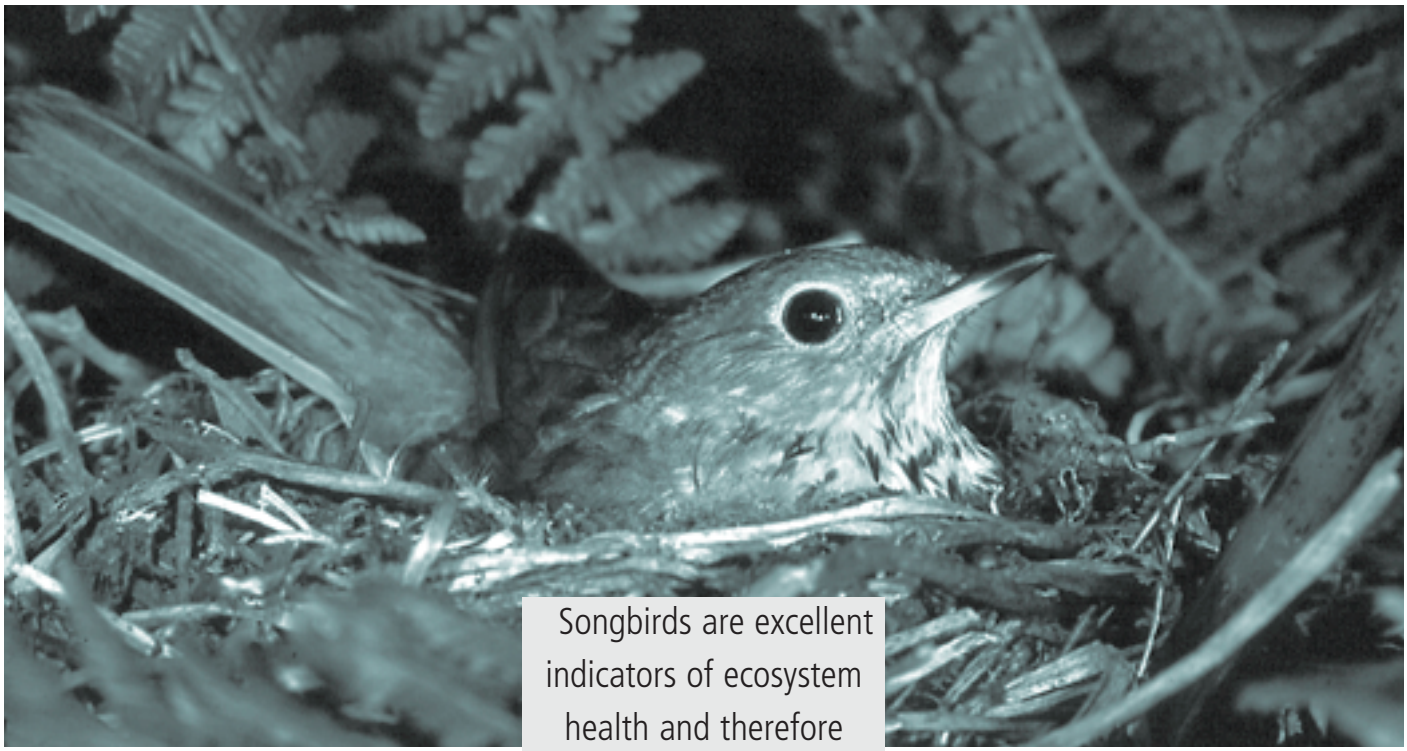

Figure 4. Swainson's thrush was one of three songbird species documented nesting in the native vegetation (lady fern). COPYRIGHT IAN C. TAIT.

to those measured before removal. However, other exotic species, particularly nonnative grasses, as a group, may be establishing at a level of cover similar to that of cape-ivy's before its removal.

Further restoration of Redwood Creek is indicated. Specifically, locally cultivated native plant species will be planted in areas where the nonnative grasses have become established after cape-ivy removal. These plantings will augment the existing riparian vegetation, speed recovery efforts, and have the potential to shade out the nonnative grasses.

Songbirds are excellent indicators of ecosystem health and therefore ideal organisms for guiding and measuring management and restoration.

SONGBIRDS AS INDICATORS

There are many reasons why songbirds are excellent indicators of ecosystem health and therefore ideal organisms for guiding and measuring management and restoration. From a practical standpoint, songbirds are relatively easy and cost-effective to monitor—few other taxa announce their presence in song each spring making detection an easy endeavor. In addition, researchers using songbird monitoring protocols and analyses benefit from the existence of nationally standardized programs and guidelines that aid in repeatability and interpretation of results (e.g., Ralph et al. 1995, Martin et al. 1997, Nur et al. 1999).

From a biological perspective, songbirds serve as sensitive indicators of environmental health because of their high metabolic rate, abundance, and distribution within and across habitats, and relatively high position in the food chain. For example, songbirds are sensitive to changes in food supply, vegetative cover, and predator densities. With songbird studies, we have the advantage of being able to monitor changes at the community (versus single-species) level due to the ease of detection.

For all of these reasons songbirds are nearly ideal study organisms to track the dynamics of natural cycles and anthropomorphic (e.g., restoration and management) changes within an ecosystem and may provide early warning signals of more broad-scale environmental change. Songbird monitoring, however, does not preclude monitoring of other targeted species or measures of ecosystem function. At Redwood Creek, the national recreation area also monitors federally threatened coho salmon and steelhead populations as well as stream flow and changes in channel morphology.

MONITORING TECHNIQUES

The primary field techniques we employed, point counts and nest monitoring, have been extensively used in bird studies (Martin and Geupel 1993, Ralph et al. 1995). Both methods possess a component of vegetation assessment that is done around the census station for point counts and the nest site for nest monitoring.

With the point count method it is possible to study the long-term and annual changes of bird populations, differences in species composition between habitats, and assess breeding status and relative abundance of species. One objective of point count vegetation assessment is to relate the changes in bird composition and abundance to differences in vegetation. These vegetative changes can either be over time or differences between habitats or study sites.

Nest monitoring provides direct information on reproductive success and the local habitat conditions that facilitate maintenance of viable populations, thereby providing specific vegetation information that can be used by land managers. Examination of nests also allows collection of life history data (e.g., clutch size, number of broods, numbers of nesting attempts) that provide important insight into "vulnerability of species to decimation or perturbations" (Martin and Geupel 1993).

RESULTS AND RECOMMENDATIONS

To assess the effects of the disturbance associated with cape-ivy removal, we compared bird species richness, diversity, and relative abundance from data collected before and after removal. We used a nearby creek, Lagunitas Creek, as a reference site. We found that songbird diversity (number of bird species weighted by abundance), richness (number of bird species), and relative abundance increased significantly from the breeding season before ivy removal to the breeding season after removal. Changes in these indexes at our reference site were also positive, although not significantly so. These preliminary findings show that there did not appear to be a negative impact to the songbird community resulting from cape-ivy removal. In fact, we observed three species of songbirds (Swainson's thrush, Wilson's warbler, and song sparrow) nesting in the vegetation that grew post-ivy removal (fig. 4). Additionally, many different species used cape-ivy removal areas for foraging and defended them as part of their nesting territory.

> We found that songbird diversity, richness, and abundance increased significantly from the breeding season before ivy removal to the breeding season after removal.

Management and restoration activities cannot avoid some disturbances to plants and animals. Indeed, successful cape-ivy removal requires pulling most of the understory plant species (see previous discussion and figs. 2 and 3). Minimizing these disturbances requires knowledge of the basic life histories of various taxa. For songbirds, the breeding season is a critical period and avoiding planned disturbance events during peak activity is desirable. Using data of the mean range of date of first egg laid and assuming that most songbirds require *at least* one month to raise and fledge young, we showed that the breeding season begins approximately mid-March and extends into mid-August. This range, for a given local area, should be taken into account when planning management activities, with particular attention given to avoiding disturbance during the peak of the breeding season.

In order to guide future restoration efforts for Redwood Creek, we examined structural and floristic vegetation characteristics that may influence bird species diversity, abundance, and nesting success. The following are some of the recommendations we made based on results from bird-habitat analyses (see annual reports Gardali et al. 1999, Holmes et al. 1999, Scoggin et al 2000).

RECOMMENDATIONS

Increase tree species richness (e.g., by planting red alder, willow, and California bay in suitable areas).

Small and total red alder trees showed a positive influence on the nesting success of song sparrows and Swainson's thrushes. Large California bay trees positively influenced the nesting success of Wilson's warblers. Willows were important nest substrates for 12% of all nests sampled (n = 421) and were predominantly used (~50%) by black-headed grosbeaks and warbling vireos. The abundance of warbling vireos, Pacific-slope flycatchers (e.g., fig. 5), Wilson's warblers, and black-headed grosbeaks were positively associated with tree species richness.

Plant tree species to restore riparian forest structure.

California bay should be planted where the upland (mixed hardwoods) grades into the riparian forest. The mean number of bays around successful Wilson's warbler nests was 2.5 and only 0.37 for unsuccessful nests. Thus, "shrubby" willows should be planted in patches (clumps) in wet areas or areas that flood (or have the potential to flood). Concentrated plantings will create usable habitat quickly while at the same time mimic the natural establishment of vegetation after scouring or soil deposition from a flood (RHJV 2000). To recreate currently occurring red alder densities, the red alders should be planted at varying intervals (from 1–25 m or 3.3–82 ft) but at an average of 6–7 m (6.37 m ± 1.14 m or 20.9 ft ± 3.7 ft; n = 25 nests). This will also allow space for the propagation of understory plant species (see following discussion). Successful song sparrow nests had a mean of 4.5 red alder trees within 11.3 m (37 ft) of the nest while unsuccessful nests had 1.5.

Plant understory species in suitable and appropriate areas to restore riparian forest structure and increase foliage (e.g., California blackberry, willow, sword fern, lady fern, and red elderberry were important nesting substrates for many species).

Bird species diversity was positively associated with a diverse shrub structure. Therefore, understory species should be planted below existing tree canopy where removal of nonnative plant species has occurred and in between new tree plantings. In general, sword fern grows in the upper, dryer areas while lady fern is found more commonly at the stream edges or in the floodplain. California blackberry occurs throughout the watershed as large patches in forest openings and as dense "mats" below tree canopy.

Promote system-wide high structural diversity.

As supported by this study, the presence of early to late successional stages of riparian woodland systems has been identified as a key feature for the successful management of riparian bird communities (RHJV 2000). For example, warbling vireos prefer to establish territories in areas with large trees but have higher nesting success when nest placement is lower in smaller trees. The importance of

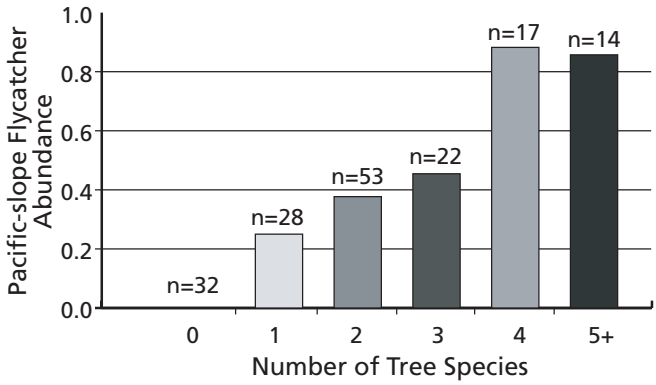

Figure 5. Tree species richness related to mean Pacific-slope flycatcher abundance.

small red alder trees for both song sparrows and Swainson's thrushes suggests improved productivity in early successional habitats.

Manage or create wide riparian corridors that approximate 100 meters.

Abundance of warbling vireos (e.g., fig. 6), Swainson's thrushes, and common yellowthroats were positively correlated with width of the riparian corridor.

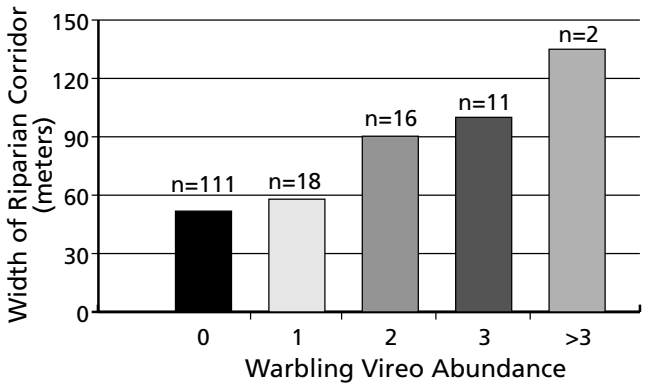

Figure 6. Warbling vireo abundance related to mean riparian corridor width.

Remove nonnative plant species

Nonnative plant species may decrease structural diversity by decreasing plant species richness. Structural diversity is an important habitat characteristic for reproductive success and bird species diversity and abundance. Shrub species diversity and structural complexity had a positive influence on bird species richness and diversity.

Protect and restore adjacent upland habitats.

Upland areas adjacent to riparian corridors may be of critical importance to the maintenance of healthy bird populations. Some species may benefit from a contiguous transition from lowland riparian to upland mixed hardwoods or coastal scrub. For example, we may interpret the positive relationship between Wilson's warbler nest success and California bay as testimony to the importance of adjacent habitats.

CONCLUSIONS

Land managers need many tools to repair and manage ecosystems. Restoration challenges such as cape-ivy removal benefit from the immediate feedback and the long-term planning information that songbird monitoring can supply. Additionally, monitoring can be supplemented with specific research questions to further assess restoration activities as well as investigate other processes that may limit populations of birds and other wildlife. As our preliminary results and recommendations have shown for Redwood Creek, songbird monitoring has the potential to contribute greatly to the informational needs of resource managers. PS

ACKNOWLEDGMENTS

Funding for this work was provided by the NPS Recreational Fee Demonstration Program, the Marin Audubon Society, and the Golden Gate National Parks Association. Diana Humple and Viola Toniolo provided useful editorial comments. This is Point Reyes Bird Observatory contribution number 970.

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Northeast parks' regional strategy to control KNOTWEED

SUPPORTED BY U.S. DEPARTMENT OF AGRICULTURE

By Kathleen Kodish Reeder and Brian Eick

In October 2000, jointly managed Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial received $100,000 from the U.S. Department of Agriculture's Animal and Plant Health Inspection Service emergency funds to support knotweed control spearheaded by these parks. Natural resources in both parks have been threatened by Japanese knotweed (*Polygonum cuspidatum* Siebold and Zucc.) and giant knotweed (*Polygonum sachalinense* F.W. Schmidt ex Maxim.) (fig. 1). Working with local conservancy groups, The Pennsylvania State University, and federal and local government agencies, the parks are facilitating the development of a coordinated strategy to control both species of this invasive, exotic weed throughout the Conemaugh River watershed.

Giant knotweed is rapidly invading the riverbank of the historic lakebed at Johnstown Flood National Memorial.

Figure 1. Identifying effective control measures for giant knotweed became a high priority as the plant began invading major sections of Johnstown Flood National Memorial and Allegheny Portage Railroad National Historic Site. Left untreated, giant knotweed can grow 8–12 feet in height, blocking views of historic resources and access to trails.

KNOTWEED CHARACTERISTICS

As with many nonnative plants, the introduction of knotweed was based on good intentions. Anecdotal evidence indicates that knotweed was first planted in southwestern Pennsylvania as a soil stabilizer on coal tailings piles and other mining lands in the first half of the 1900s. However, because the plants can spread through their rhizomes (or rhizome fragments) and by seed, they can easily invade disturbed soils, such as riverbanks scoured by flooding, or landscapes altered by construction or mining. Once established, both species of knotweed are extremely persistent.

The most prevalent, and problematic, species in the two parks is giant knotweed, which is rapidly invading the riverbank of the historic lakebed at Johnstown Flood National Memorial. If not controlled, the plant (capable of growing 12 feet high) will have an impact on visitor use by blocking views of historic resources and access to trails. Before treatments were begun, knotweed occupied a combined total of approximately 35 acres in the two parks. If it spreads until the entire riverbank is lined with large, dense stands, giant knotweed will significantly reduce native plant diversity and degrade the quality of wildlife habitat.

DEVELOPING A CONTROL STRATEGY

Realizing in 1995 that controlling the pervasive knotweed would require a comprehensive, long-term strategy, the parks developed a program based on three goals: (1) obtaining an understanding of the plant's reproductive ecology in order to reduce invasions; (2) developing an integrated pest management plan based on proven treatment methods; and (3) promoting regional awareness of knotweed and effective control measures.

To obtain information about the reproductive ecology of both knotweed species, the National Park Service funded a two-year study by Amy Niewinski and Dr. Todd Bowersox at The Pennsylvania State University School of Forest Resources. The research report, issued in 1999, indicated that the giant and Japanese knotweed populations sampled have the potential to produce viable seeds (Niewinski, A. T., T. W. Bowersox and L. H. McCormick. 1999. Reproductive ecology of giant *(Polygonum sachalinensis)* and Japanese *(Polygonum cuspidatum)* knotweed. National Park Service Technical Report NPS/PHSO/NRTR-00/079. University Park, PA. 37 pp.). The seeds, which have no dormancy requirement, remain viable in the seedbed and are capable of establishing new, perennial populations. Non-shaded locations that are free of a well-developed leaf litter provide the best potential for seedling establishment. Conversely, knotweed is unlikely to become established in forested ecosystems with sufficient amounts of shade and abundant leaf litter.

TEST TREATMENT

Unfortunately, information about eradication treatments was inconsistent. The National Park Service, therefore, funded research by Drs. Larry McCormick and Todd Bowersox (McCormick, L. H., and T.W. Bowersox. 1998. Eradication and control of Japanese knotweed at the Staple Bend Unit, Allegheny Portage Railroad National Historic Site. Penn State School of Forest Resources, University Park, PA. 15 pp.) to develop an effective method of eliminating knotweed while allowing the establishment of native plant species. The two-year study, begun in 1996, revealed that two herbicides, glyphosate and imazapyr, are effective in controlling knotweed. However, imazapyr readily treavels to the roots of non-target vegetation. In other words, imazapyr would kill trees adjacent to the treatment areas even if those trees were not directly sprayed. Glyphosate will not kill plants that are not directly sprayed. The parks, therefore, chose to base their integrated pest management plan on using glyphosate.

> The herbicides glyphosate and imazapyr are effective in controlling knotweed.

Figures 2, 3, and 4 (top to bottom). These three photos represent the three major stages in treating a targeted area in the Staple Bend Tunnel Unit of Allegheny Portage Railroad National Historic Site. The pre-treatment view (top) features knotweed emerging in spring (May 1998). The post-treatment view (middle) of the same scene, taken a year later, illustrates the effectiveness of the herbicide treatment in preventing the return of knotweed. The third photo in the series shows that by August 1999, native pioneer plant species, mostly pilewort, were able to flourish once the knotweed had been eradicated.

During spring and late summer 1998, the researchers tested the effectiveness of a foliar application of 4% glyphosate with a surfactant in water on a three-acre site that was completely covered by giant knotweed (see fig. 2). By the subsequent spring, there had been a 97% reduction in the number of adult plants. In July, surviving adult plants were treated with an application consisting of 4% glyphosate in water. Monitoring in September 1999 revealed that no adult plants had survived and knotweed seedlings comprised less than 1% of the cover (see fig. 3).

Most encouraging of all, native plant germination in the treatment area was phenomenal. Pilewort *(Erechtites hieracifolia)* and pokeweed *(Phytolacca americana)* quickly formed dense cover (see fig. 4). Seedlings of staghorn sumac (*Rhus typhina* L.), smooth sumac (*Rhus glabra* L.), and black cherry (*Prunus serotina* Ehrh.) were also found. Subsequent monitoring in 2000 revealed that nearly 100% of the groundcover consisted of native pioneer plant species, and surviving knotweed plants still formed less than 1% of the cover. Knowing that knotweed does not thrive under dense plant cover, the parks' managers expect that seed germination and rhizomatous spread from knotweed populations adjacent to the parks will be greatly reduced in areas where the native plant communities have been restored.

Figure 5. This scene features knotweed growing along the south fork of the Little Conemaugh River, approximately one-half mile upstream from the Johnstown Flood National Memorial boundary. The importance of convincing owners of neighboring lands, rights-of-way, and waterways to implement effective knotweed eradication methods is paramount to the success of the comprehensive regional plan to protect the resources of the watershed.

OUTREACH AND FOLLOW-UP

As effective as the described eradication treatment may be, the parks' natural resource staff are aware that their efforts will ultimately fail if others do not use similar control methods on neighboring lands, rights-of-way, and waterways (fig. 5). To encourage this local and regional awareness, the parks have participated in the development of the Kiski-Conemaugh Rivers Conservation Plan, a comprehensive regional plan that addresses the basin's land, water, biological, and cultural resources. Because of the parks' efforts, identification and control of invasive plants, particularly knotweed, have been added to the plan. The parks have, likewise, assisted the Conemaugh Valley Conservancy and the Southern Alleghenies Conservancy in developing control plans.

Fortunately, the grant funds awarded by the U.S. Department of Agriculture will enable the National Park Service not only to expand the treatment areas within the two parks, but also to support control efforts by other groups and to develop public outreach and education activities. In 2001, the cost of the initial treatment of knotweed in critical areas of the Allegheny Portage Railroad National Historic Site was approximately $500 per acre. Ultimately, although eradicating all knotweed from the landscape would be cost-prohibitive, the National Park Service hopes that a comprehensive regional management plan will protect the critical resources of the watershed and reduce the spread of knotweed throughout western Pennsylvania. PS

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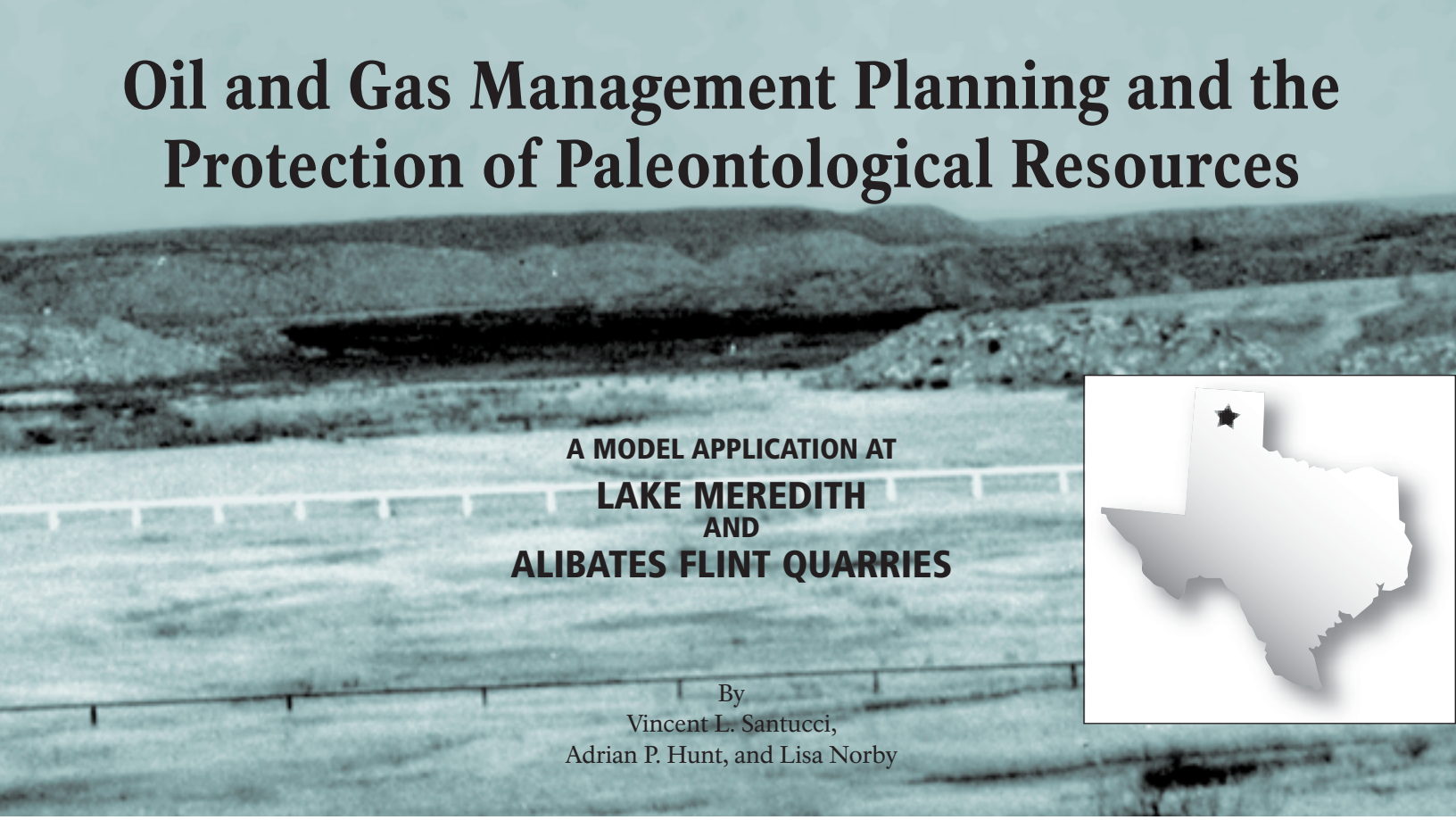
Oil and Gas Management Planning and the Protection of Paleontological Resources



A MODEL APPLICATION AT
LAKE MEREDITH AND ALIBATES FLINT QUARRIES

By
Vincent L. Santucci,
Adrian P. Hunt, and Lisa Norby

For the first time the National Park Service has addressed the protection of paleontological resources in a park as part of oil and gas management planning. The milestone came during the development of an Oil and Gas Management Plan / Environmental Impact Statement (EIS) for Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument. Still in draft form, the plan defines a long-term management direction for existing and anticipated oil and gas operations in the parks. Specifically it addresses the issues associated with the development of nonfederal oil and gas rights underlying these northwest Texas parks (fig. 1).

Assessing Risks to Fossils

As part of the plan, the National Park Service developed a *reasonably foreseeable development scenario* (RFD) to project future oil and gas development in the parks and to provide a basis to measure potential environmental impacts. The RFD estimated that over the next 15 to 20 years, in areas of the parks where drilling and production could be permitted, up to 85 new wells could be drilled. Ground-disturbing activities associated with oil and gas development can potentially damage or destroy nonrenewable paleontological (and other) resources.

GROUND-DISTURBING ACTIVITIES ASSOCIATED WITH OIL AND GAS DEVELOPMENT CAN POTENTIALLY DAMAGE OR DESTROY NONRENEWABLE PALEONTOLOGICAL RESOURCES.

Lake Meredith and Alibates Flint Quarries are located between two major structural basins in the Texas Panhandle. Paleontologists have obtained important collections of fossils from Triassic, Miocene, Pliocene, Pleistocene, and Holocene sediments in and around these two units of the national park system. However, the lack of adequate baseline paleontological resource data has limited the staff's ability to determine whether the oil and gas operations have adversely impacted the paleontological resources at the parks.

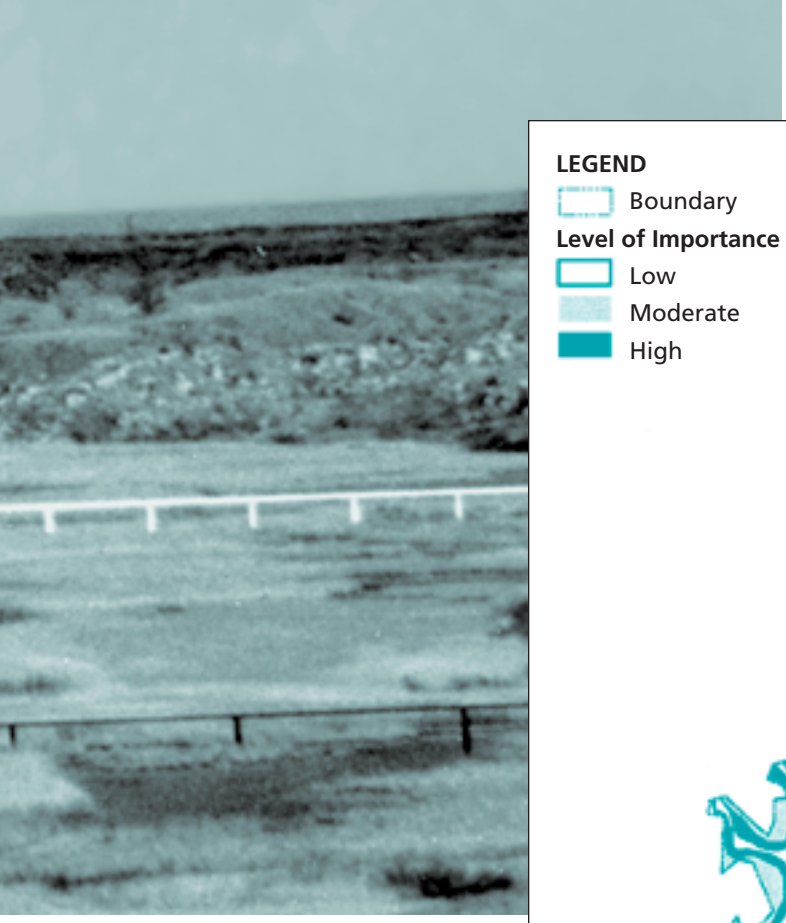


Figure 1. Oil and gas pipelines traverse the two Texas parks along with rights-of-way granting operator access. The recent park planning identified fossil-rich areas requiring protection from oil and gas activities.

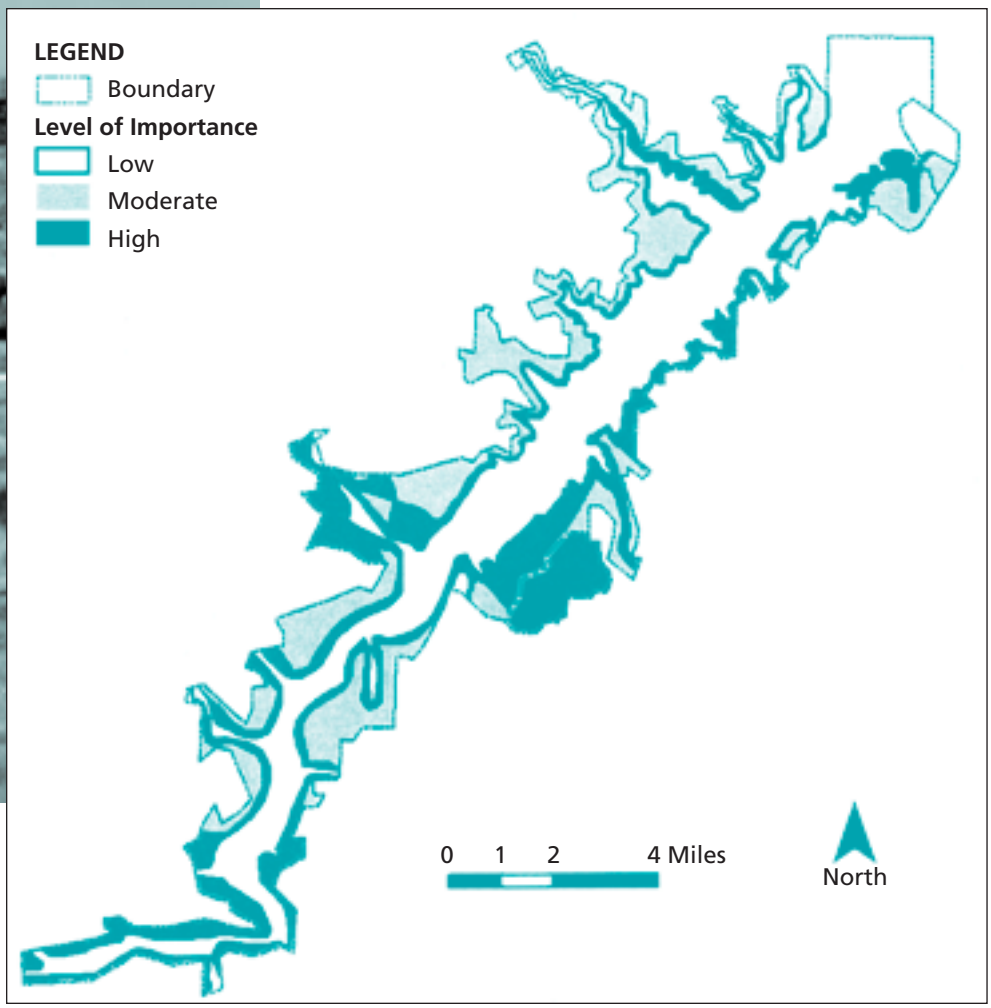


Figure 2 (above). A key tool in the oil and gas management planning process was the development of a paleontological resource sensitivity map, which identifies areas of high, moderate, and low probability for the occurrence of fossils. When preparing a plan of operation for oil and gas development in the parks, an operator must first hire a qualified paleontologist to survey the high-probability fossil areas.

Inventory Needed

Comprising park managers, staff of the Natural Resource Program Center, NPS paleontologists, and others, the oil and gas management planning team identified the need to consider the protection of paleontological resources in the planning process. Therefore, NPS paleontologists undertook a comprehensive paleontological resource inventory of the parks by reviewing literature, searching museum collections, and conducting field surveys. In the process the Park Service developed a "paleontological resource sensitivity map" identifying areas of high, moderate, and low probability for the occurrence of fossils (figure 2). First, NPS staff used geologic maps to determine surface exposures of fossil-bearing strata in the parks. They then correlated the predicted fossil areas with the actual occurrence of fossils in the field to fine-tune the sensitivity map.

During the inventory NPS paleontologists identified over a dozen paleontological localities consisting of diverse fossilized plants, invertebrates, vertebrates, and trace fossils. Significant paleontological resources were linked to the Upper Triassic (late Carnian) Dockum Group, including the remains of ancient amphibians (metoposaurs), reptiles (aetosaurs, phytosaurs, rauisuchians), and a great abundance of petrified wood (Murry 1989). The NPS staff documented six fossil localities from the Miocene-Pliocene Ogallala Group that contain root casts, silicified grasses, insect burrows, mammal bone beds, and a mastodon tooth (Hunt and Santucci in press; Wilson 1988). Additionally, within the national recreation area and national monument five Pleistocene paleontological localities are documented and include a site in which a nearly complete skull of the giant bison *Bison latifrons* (fig. 3, page 38) was collected (Anderson 1977; Dalquest and Schultz 1992; Hunt 2000). Resource management staff have entered the known paleontological resource localities into the parks' geographic information system database and plan to monitor these sites periodically in the future.

Standard Operating Procedures Developed

The oil and gas management plan / EIS identifies standard operating procedures for locating and protecting paleontological resources (Santucci 2000). These procedures outline circumstances when a paleontological survey is necessary and how the survey should be implemented. The procedures also provide guidance when an unanticipated discovery of fossils occurs during approved operations or fossils are damaged within previously identified paleontological localities.

Three alternative actions are identified in the EIS for paleontological resources. Alternative A is the continuation of current management practices in which proposals for oil and gas development are evaluated case by case. Alternatives B and C designate special management areas throughout the parks for protection of the paleontological resources. Additionally, alternatives B and C prescribe the application of the standard operating procedures for locating and protecting paleontological resources. For example, in high-probability fossil areas, the operator of any oil-and-gas-related, ground-disturbing activity, would be required to survey for paleontological resources and describe ways of minimizing fossil disturbance; the survey of medium-priority areas would be recommended.

The EIS is now being finalized; public comments have been received and are being incorporated into the plan. The record of decision is anticipated in early 2002. The National Park Service prefers alternative B.

Conclusion

The Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument Oil and Gas Management Plan and Environmental Impact Statement represents the first time that paleontological resources have been considered in this type of planning in the national park system. The benefits resulting from the consideration of fossil protection in the planning process are many. For example, the planning process focused NPS staff on the need for baseline paleontological resource inventories of the parks. It also prompted the development of new standard operating procedures for locating and protecting fossils, which may be a useful model for other parks addressing similar issues. Also, it has drawn national attention to the significance of fossils in these parks. Finally, it has strengthened the protection of nonrenewable paleontological resources at Lake Meredith and Alibates Flint Quarries. PS

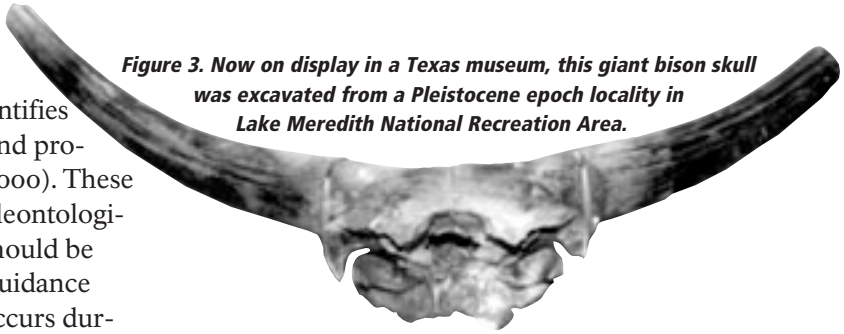


Figure 3. Now on display in a Texas museum, this giant bison skull was excavated from a Pleistocene epoch locality in Lake Meredith National Recreation Area.

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Research Permit and Reporting System:

The On-line LAUNCH Is UP

Research activities in the national park system are regulated through a Research Permit and Reporting System. Revamped in January 2001, the on-line permit system streamlines the permit application process.

A product of many park research activities is the collection of plant, animal, geologic, and other specimens that require care and storage per NPS standards. Proper collections management emphasizes the need for park research permit coordinators to work closely with park or regional NPS museum curators.

By Jonathan Bayless and Norm Henderson

The National Park Service reached an important milestone on 16 January 2001 when it became the first bureau in the Department of the Interior to enable researchers to apply on-line for a research and collecting permit. Although few people were aware of this development initially, the launch of the Research Permit and Reporting System (RPRS) at http://science.nature.nps.gov/research began an era of better service to researchers and improved access to research information for all. The first researcher to use the system logged on in the first hour of operation; nine months later over 2,700 research applications had been made. Like Friendship 7—the capsule that carried John Glenn as the first American into orbit—the launch of the new permit system is both a crowning achievement and yet only the first step.

Improvement on old system

The Research Permit and Reporting System provides many improvements on the former system designed to help the National Park Service facilitate research in a consistent, streamlined manner. Moreover, it contributes to making the national park system a better place for science, a goal that has required more than goodwill to achieve. The long and complicated history of permitting research and collecting in the national parks shows only mixed success in attempts to improve the bureau's reputation among researchers (Bayless 1999). Some scientists expressed frustration and anger at what they saw as an unfair and illogical research permitting process. They claimed a lack of consistency was causing them hardship when they dealt with unclear permit requirements. Investigators complained that the application procedures between parks were vastly different for no discernable reason, and that this was causing delay in the implementation of research programs.

Investigators complained that the application procedures between parks were vastly different for no discernable reason....

In 1996, at the request of the National Park Service, the Office of Management and Budget (OMB) reviewed the administration of the special use permit (SUP) for research activities and found that it was being used inappropriately for that purpose. The SUP process was intended for non-recurring special uses, and given that the National Park Service routinely reauthorized research, a specific research permit would be needed. Further, while the SUP form was originally approved as both an information gathering and permitting tool, it was being used strictly as a permit. To complete the form, parks gathered information using a multitude of techniques, all in violation of OMB rules and requirements. With the passage of Public Law 105-391 in 1998, the Service was given a research mandate to "assure that management of units of the National Park Service is enhanced by the availability and utilization of a broad program of the highest quality science and information." The law highlighted the need to overhaul the research and collecting permit process.

Task force

The successful on-line launch was due in large part to the efforts of the NPS permit task force, which developed the new approach (Winfree 1999). The task force consisted of 15 members from parks, support offices, and the Washington Office, including the authors, from a diverse background of scientific and program expertise. Headed by Tim Goddard, Computer Specialist, Natural Resource Information Division, Natural Resource Program Center, the task force identified several needs to implement a simplified yet comprehensive research-permitting program. Specifically, a new permit form, an OMB-approved application, and a comprehensive set of standard requirements would be needed. Their recommendations formed the foundation for the RPRS system.

Through a cooperative agreement between Yellowstone National Park and the Department of Energy, Idaho National

Engineering and Environmental Laboratory, came the next step: development of a conceptual software model of the system. The goal of integrating the model with the Investigator's Annual Report was realized through an interagency agreement with the U.S. Geological Survey (USGS), Biological Resources Division. Under guidance from the Natural Resource Information Division, the USGS Midcontinent Ecological Science Center currently maintains the RPRS software and servers. Dr. John Dennis, Biologist, Natural Systems Office, Washington Office, is responsible for policy support and assistance to park permit coordinators (available via waso_nrss_researchcoll@nps.gov).

New features

The Research Permit and Reporting System replaces the diverse array of earlier park research applications and creates a uniform standard for the national park system. This allows scientists, once they become familiar with the application process in one park, to repeat it easily in any other park. The system also allows the applicant to submit a research and collecting proposal of any content-format providing it has sufficient detail for staff to assess the impacts and benefits of the project, potentially eliminating the need for staff to rewrite proposals. The ability to report progress or research findings is possible through the incorporation of the existing Investigators Annual Report into the new system. Another innovation is the creation of a unique "study number" that links proposals, permits, reports, and citations and allows for tracking and updating.

The Research Permit and Reporting System will eventually be the primary method for researchers and government agencies to access information on past research, research needs, and to exchange information and applications with parks.

Park permit coordinators still evaluate each permit application, communicate with investigators, and coordinate other related matters. However, the process is now centralized and consistent. Park coordinators work with applications, permits, and reports through on-line access to the permit system without having to manage the software and databases that reside on a central server. Upgrades and problem solving are the responsibility of NPS programmers and contractors with the necessary skills and expertise. Two training courses in 2001 have provided 45 park coordinators with hands-on experience and increased knowledge on policy and procedural issues related to the permit system.

The system has had its share of technical problems in its first year. Computer viruses and Internet service interruptions have caused the system to go off-line; fortunately it has been restored in each instance within a day or two. While loss of passwords by park coordinators has caused frustration, it has been the simplest problem to fix. Also, some parks have poor Internet connections, via telephone modems, that can slow access speeds to a crawl. But overall most parks seem to be on-line and enjoying the power of the system.

Future

The Research Permit and Reporting System will eventually be the primary method for researchers and government agencies to access information on past research, research needs, and to exchange information and applications with parks. However, many system improvements will first need to be achieved to realize this potential. At the Third Conference on Partnership Opportunities for Federally Associated Collections held 12–15 November 2000 in Austin, Texas, we attended the "Permit Me" workshop on federal permits. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service discussed their permitting processes for importing and exporting threatened and endangered species, and the taking of migratory birds. Approximately 25 different permits are available on the Internet for these purposes, but only as downloadable forms that must be printed, filled out, and mailed back. The diverse and overlapping nature of many permits was of concern to many workshop attendees. The future challenge for the National Park Service will be to integrate the RPRS with all other government permits in a manner that is clear and understandable to scientists and specifies the correct permit for a particular situation. Indeed, the concept of a standardized Department of the Interior permit has already been discussed.

The launch of the current system is creating new visions for what features and capabilities are desirable in the next round of upgrades. For example, connectivity between databases, e-mail, and on-line systems are goals for improving the system. In addition, many specific policy application issues revealed by this initial launch must also be addressed. If the first release of the Research Permit and Reporting System is analogous to a space capsule orbiting Earth, then the system still has a long way to go before it attempts a lunar landing. Undoubtedly the success of this first step, with the continued cooperation and feedback of park research coordinators, is critical for the realization of all subsequent improvements. PS

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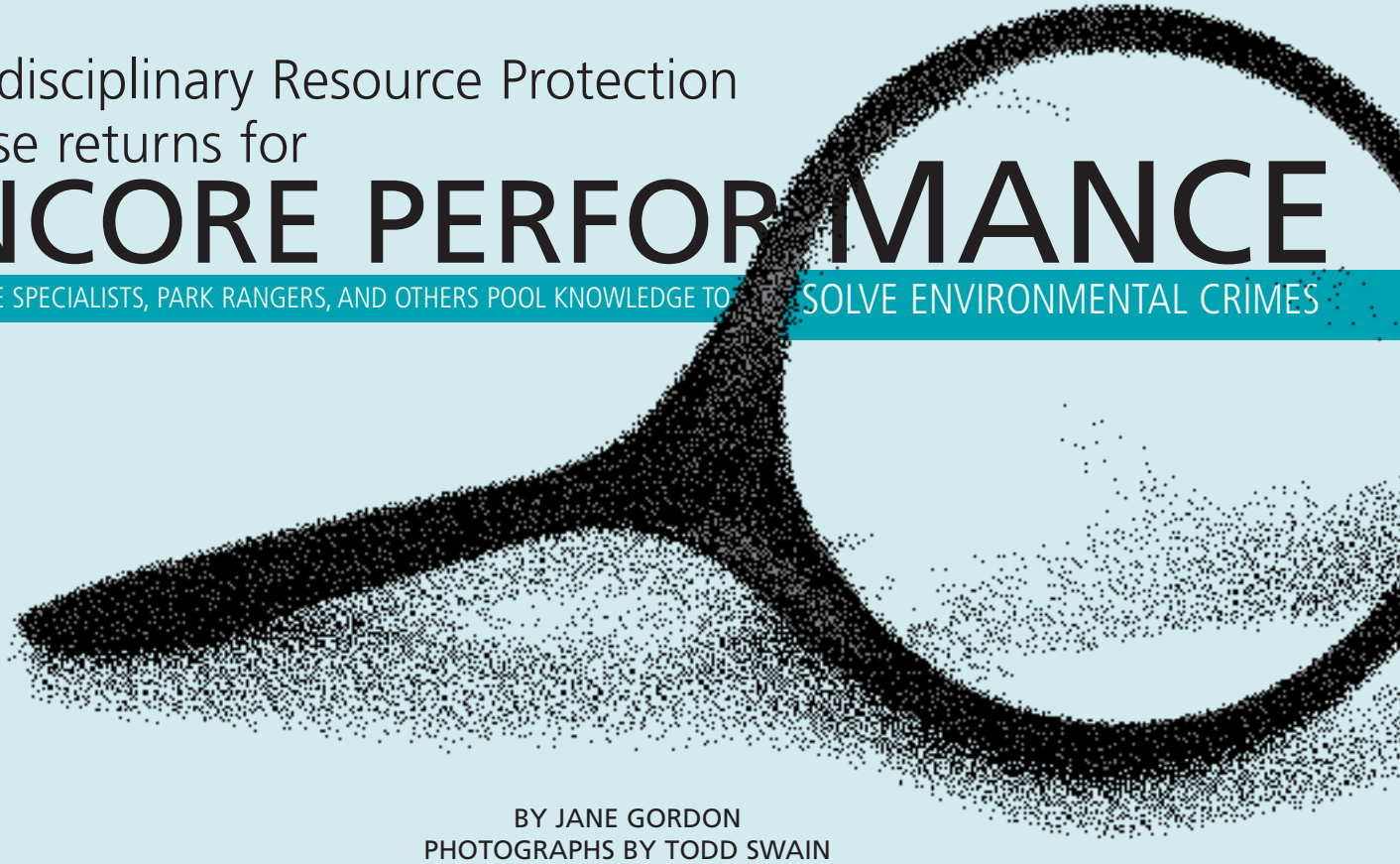
Interdisciplinary Resource Protection course returns for

ENCORE PERFORMANCE

RESOURCE SPECIALISTS, PARK RANGERS, AND OTHERS POOL KNOWLEDGE TO SOLVE ENVIRONMENTAL CRIMES



BY JANE GORDON
PHOTOGRAPHS BY TODD SWAIN

In October 2000 individuals from a variety of jobs within the National Park Service convened for the second annual Interdisciplinary Resource Protection Training. This innovative class focuses on the way different divisions in the Park Service can work together to investigate and prosecute resource crime. Included among the diverse group of participants were archeologists, botanists, wildlife biologists, law enforcement officers, hazardous materials specialists, and public information officers. At a time when specialization is increasingly common and necessary in the Park Service, this type of training fills a void. It offers Park Service staff the opportunity to come together and profit from the collective skills of the Service as a whole, rather than to work in isolation from one another. Beware, however, lest this description sound too rosy. This 50-hour class is not for the faint-hearted; work is intense with seldom an idle moment.

> Botanists,
> wildlife biologists,
> archeologists,
> law enforcement officers,
> hazardous materials specialists,
> and
> public information officers
> [participated in the course.]

The setting

The course is hosted at Camp San Luis Obispo, a former military base that is transformed into "San Luis Obispo National Historic Site" for the purposes of the training. Upon arrival, participants are briefed about the course: they will spend a day with federal legal experts pursuing case reviews and environmental law, followed by three intensive days of crime investigation scenarios. Groups are expected to function autonomously, electing their own leaders, choosing their own timelines, and pursuing their own investigations. The scenarios stimulate the bulk of learning, and the stage is set for complex and unpredictable investigations. San Luis Obispo National Historic Site has its own set of rules and regulations, military history, evidence of early cultures, wildlife, and recreational opportunities. Actors from a local university drama club people the site in a variety of functions and roles, playing villains, tricksters, salespersons, and jilted lovers. Villages replete with food stands, rock shops, condominiums, and crack houses emerge from the old

Figure 1. The annual interdisciplinary training course combines the skills and creativity of various park positions, including natural resource management, law enforcement, archeology, and public affairs.

Figure 2. In three days of intensive crime investigation scenarios that involve forensics, chemistry, botany, biology, and other disciplines, course participants put together a case to prosecute a natural resource crime in a national park. Part of the process involves documenting evidence and clues of a natural resource crime.

Figure 3. Course participants get an opportunity to fill various roles in the investigation. Here a public information officer relays news about the crime.

army base, while realistic props such as frozen bobcats appear in suspect freezers. Federal attorneys from Los Angeles staff a mock courtroom where participant cases culminate in trial.

During the daylong scenarios participants find that they must expand their concept of what the investigation process may involve. Problem solving and creative thinking are keys to success in this type of work. Participants scour the scenes for physical evidence, explore telephone records, and visit restaurants frequented by looters. They experiment with various materials and technologies, such as dental stone for fine print casting and video cameras for crime scene surveillance. They discover a variety of resources available to them, including a U.S. Fish and Wildlife Service forensics lab, on-call U.S. attorneys, local ornithologists, marine mammal specialists, entomologists, and hazardous waste cleanup specialists.

Practical scenarios

Inasmuch as resource crime runs the gamut from wildlife poaching to hazardous waste disposal to vandalism, the scenarios offer a variety of possible case studies. Each challenges participants to use the full range of their group's skills, including expertise in the natural, cultural, and forensic sciences (figs. 1–3). A daylong scenario might unfold as follows: the group's public information officer receives an anonymous tip about illegal waste dumping along the shore of Camp San Luis Obispo's protected river. Upon walking the riverbank, the group notices an unusually high number of dead fish along the shore. The fisheries and wildlife specialist identifies these fish as native steelhead trout *(Oncorhynchus mykiss)*, a species whose local population is already endangered. Under the guidance of the resource specialist, the group samples water quality, but is frustrated when they are unable to determine the cause of the fish kill.

The group decides to take a closer look along the shore.

A botanist notes an area of disturbed vegetation upstream of the fish kill. While two members collect additional water samples, the team's archeologist finds tire marks 300 yards from the shoreline. A quick check of the simulated historic site's rules and regulations reveals that this area is closed to vehicles. Realizing that the site may be a crime scene, one of the group's law enforcement rangers cordons off the area, protecting crucial evidence. Her efforts pay off when, upon closer inspection, the group discovers footprints and a pile of empty plastic containers nearby.

The team's archeologist finds tire marks 300 yards from the shoreline.

Clues at the scene lead the group to send two of its members to interview people in the local commercial district. Those remaining on-scene scour the area and subsequently make an important discovery that leads the group's hazardous materials specialist to suspect perchloroethylene as the chemical responsible for the fish kill. They send samples of their find to a local lab for identification. Meanwhile, investigation in town turns up new possibilities. Additional group members arrive to follow up on leads and conduct further interviews. An employee at a paint factory points investigators to a subcontractor whose job is to clean out chemical tanks in the area. While locating the subcontractor proves unsuccessful, interviews reveal that his girlfriend works at the local hamburger stand. Angry with her wayward boyfriend, or perhaps simply feeling the call for justice, she shares helpful information with the plain-clothes investigator.

Group members convene to share details. The sum of the clues and evidence is the basis for "probable cause" to search the premises of the suspected subcontractor. With the aid of an on-call assistant U.S. attorney, the group develops and executes a search warrant on his trailer on the south end of the historic site. The search is comprehensive and provides the links that ultimately bring the case to court.

The outcome of the investigation? That is never predictable. But if your interest is sparked, consider attending a future course to discover it for yourself.

Aftermath

After negotiating the three diverse, day-long scenarios, course participants commented that they had used materials and techniques that they never before would have considered using. All agreed, however, that the most valuable resource was the collective skills of the group members. The opportunity to witness colleagues at work is rare for many participants. Many admitted that they were previously unaware of the scope of certain positions outside of their own. With this new familiarity comes a host of new collaborative opportunities available at the park level.

The recognition of each other's talents is complemented by the participants' discovery of their own strengths and specialties. Many were surprised to see how important their skills are to the investigation. One botanist was shocked when her knowledge of local plant species led team members to elect her as group leader for the following day's investigation. As she directed the final day's activities, however, it became clear how well the group had profited from its shared knowledge. Without hesitation, team members collected evidence, conducted interviews, and documented the investigation at her command. And while the team leader handily oversaw the scientific aspects of the investigation, she demonstrated the same ease as she off-handedly referred to such new legal concerns as probable cause and consent searches.

The opportunity to take advantage of this training arises annually, usually in the fall. Course lodging, meals, and tuition are funded by the U.S. Attorney's Office in Los Angeles, which leaves only the cost of transportation and per diem to be borne by individual parks. As advertised, the training will help parks improve in the investigation and prosecution of resource crimes. Equally important, the integration of technically skilled and creative staffs—park rangers, resource specialists, scientists, legal experts, and others—facilitates synergism and teamwork in this important, shared aspect of park preservation. PS

About the Author

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National Park Service
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P.O. Box 25287
Denver, CO 80225-0287

PARKSCIENCE
INTEGRATING RESEARCH AND RESOURCE MANAGEMENT

VOLUME 21 • NUMBER 1 • FALL / WINTER 2001

www.nature.nps.gov/parksci

ISSN–0735–9462

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Park Science is a resource management bulletin of the National Park Service that reports recent and ongoing natural and social science research, its implications for park planning and management, and its application to resource management. Published by the Natural Resource Information Division of the Natural Resource Program Center, it appears twice annually, usually in the spring and summer. Additional issues, including thematic issues that explore a topic in depth, are published on occasion. Content receives editorial review for usefulness, basic scientific soundness, clarity, completeness, and policy considerations; materials do not undergo anonymous peer review. Letters that address the scientific content or factual nature of an article are welcome; they may be edited for length, clarity, and tone. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

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Park Science is also published on-line (ISSN-1090-9966). All back issues of the publication, article submission guidelines, and other useful information can be viewed and downloaded from the website www.nature.nps.gov/parksci.

Park Science accepts subscription donations from non-NPS readers. If you would like to help defray production costs, please consider donating $10 per subscription per year. Checks should be made payable to the National Park Service and sent to the editor.

Sample article citation
Tippets, N., S. O'Ney, and A. M. Farag. 2001. Backcountry water quality in Grand Teton National Park. [National Park Service publication] Park Science 21(1):25–27.