NPS Submerged Cultural Resources Unit, John Brooks

NATURAL RESOURCE YEAR IN REVIEW

998

U.S. Department of the Interior • National Park Service

Summarizing and analyzing the year in natural resource stewardship and science in the national park system

▶Year at a Glance • A Spectrum of Challenges • NPS Science • Partners in Science
Resource Disturbances • Resource Restoration • New Horizons • Resource Interpretation

Natural Resource Year in Review—1998

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Designated the "Year of the Ocean" *by the United Nations, 1998 provided an opportunity for the National Park Service to emphasize preservation of marine resources in the national park system (see abalone story on page 12). Additionally, an executive order called for increased protection of coral reefs under federal care, including those in units of the national park system (see reef story on page 51). This reef in Biscayne National Park (Florida) encrusts cannon balls from the 1748 wreck of the British vessel* Fowey *and consists of brain corals, sea plumes, sponges, parrotfish, and many other organisms.*

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Legend—*The following symbols are used in this report:*

—*Indicates a story brief or an update of an issue described in a previous edition of* Year in Review.

GPRA —*Most of the articles in this report relate to NPS mission-oriented goals enumerated in the 1997 NPS* Strategic Plan, *which was designed to measure progress in fulfilling requirements of the Government Performance and Results Act (GPRA). Those articles that specifically address the long-term GPRA goals related to natural resource condition (goal I: disturbed lands/exotic species; threatened and endangered species; air and water quality; natural resource inventories) and visitor satisfaction, understanding, and appreciation (goal II) are indicated by the GPRA symbol.*

YEAR AT A GLANCE

January

- Regional representatives meet to outline initial elements needed in Natural Resource Initiative in response to December 1997 National Leadership Council decisions.
- Third Fundamentals for Natural Resource Management course begins at Albright Training Center.
- NPS strengthens its liaison with USGS Biological Resources Division (BRD) headquarters.
- Pulling Together Initiative awards combined federal and nonfederal grants to six park projects aimed at the control of invasive plant species.

February

- Independent review of mountain goat research and management in Olympic National Park (Washington) planned.
- Colonial Pipeline Corporation pays $147,000 for resource damage at two parks in the Washington, D.C., area caused by 1993 diesel fuel spill that entered Potomac River.
- Categories for natural resource budget and technical assistance accessed through NPS natural resource "unified call" expand to include services from NPS Natural Resource Program Center and USGS-BRD Species at Risk Program.

March

- Window glass manufacturer withdraws application to build plant near Shenandoah National Park (Virginia), a Class I area under the Clean Air Act, based on concerns over stream acidification and visibility degradation.
- Canon U.S.A., Inc., through National Park Foundation, funds 17 park resource management projects under its Expedition Into The Parks program.

April

- NPS participates in congressional briefing on the threat of exotic and noxious plant species.
- Director announces annual awards for natural resource stewardship.
- Four pilot CESUs recommended.
- Glacier Bay National Park (Alaska) releases environmental assessment of effects of proposed federal regulation on commercial fishing in park waters.
- "Inside Earth," the newsletter of cave- and karst-related resource management issues, makes initial appearance.
- *Environmental Contaminants Encyclopedia*, summarizing 118 toxic elements, compounds, and products, available on World Wide Web.

May

- Director Stanton forwards outline of proposed Natural Resource Initiative to Secretary Babbitt.
- New training manager for natural resources, Bob Karotko, on duty at Albright Training Center.
- Twenty-one park projects related to mine site reclamation receive monies from the Abandoned Mineral Lands Program, base-funded for the first time in 1998.
- Smoke from fires in Mexico and Central America degrades visibility (1–2 miles) and exceeds EPA standard for ozone and particulate matter in Great Smoky Mountains (Tennessee and North Carolina) and Mammoth Cave (Kentucky) National Parks.

June

- President signs Executive Order 13089, providing for greater protection of coral reefs.
- Pilot project to inventory geologic resources in Colorado parks gets under way.

July

- NPS and several state and private organizations agree on water rights and water-related resources protection in six parks near Little Colorado River in Arizona.
- Staffs from National Interagency Fire Center and Natural Resource Program Center meet to coordinate activities related to planning, air quality, Geographic Information Systems, vegetation mapping, research, and threatened and endangered species.

August

- Lands formerly known as New World Mine, adjacent to Yellowstone, transfer to Gallatin National Forest following two-year, $65 million federal buyout.
- Revised NPS research and collecting permit goes out for regional review.

September

- National Leadership Council identifies programmatic framework for Natural Resource Initiative action plan; Director Stanton establishes steering committee reporting to Deputy Director Galvin to oversee implementation.
- Director Stanton releases new director's order on wetland protection.
- NPS publishes proposed rule for regulation of personal watercraft in parks.

October

- Congress appropriates $2.5 million for U.S. Geological Survey program that focuses on water-quality issues in parks.
- National Parks Omnibus Management Act of 1998 becomes law, mandating inventory and monitoring in parks and the development and use of information for park decisions; law also protects information on sensitive resources.
- Exotic species fact book *Invasive Plants Changing the Landscape of America* mailed to parks.
- U.S. Coral Reef Task Force meets in Biscayne National Park (Florida) to coordinate interagency reef protection efforts—mapping and monitoring, research, and conservation programs.
- NPS sends revised regulations for management of National Natural Landmarks Program to Office of Management and Budget.
- Investigator's Annual Report debuts on NPS Intranet, centralizing location for reporting research activities, verifying data, and generating reports.

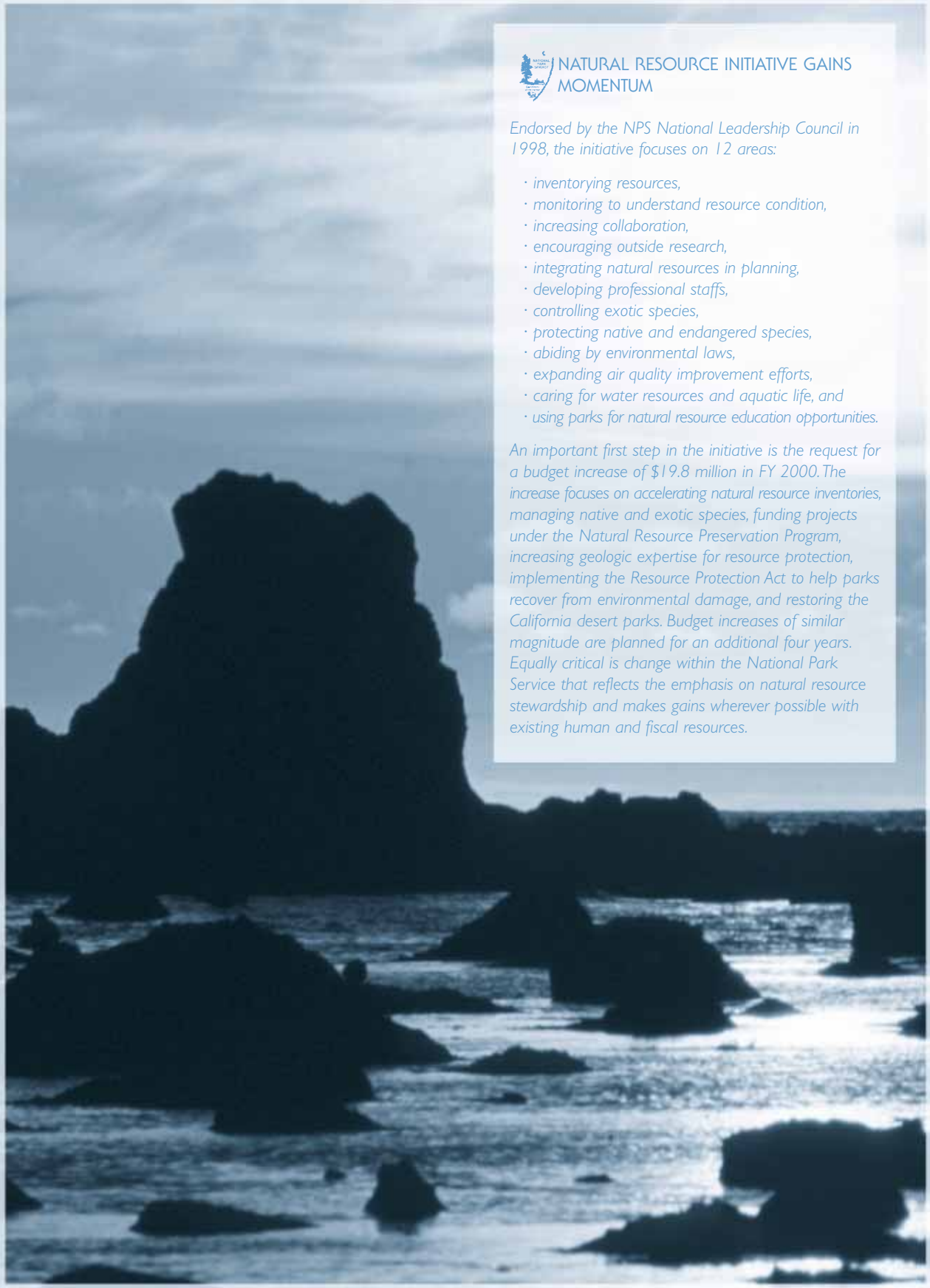
November

- Natural Resource Information Division issues two-CD set containing 18 years of resource management bulletin *Park Science*.
- NPS agrees to sponsor a total of seven American Indian cooperative education students preparing for careers in natural resource management.
- NPS and Canon U.S.A., Inc., announce second class of Canon Scholars, bringing to seven the total of Ph.D. candidates undertaking park-related research under program; announcement ceremony inaugurates first annual Canon Lecture on Science and the National Parks, presented in 1998 by Dr. Daniel Janzen.

December

- Director circulates letter to superintendents urging them to find ways to implement the Natural Resource Initiative in the parks.
- Yellowstone announces discovery of whirling disease in Yellowstone Lake cutthroat trout.
- Director Stanton delivers commencement address at Southern University, Baton Rouge, inaugurating Urban Recreation Research Center.
- Director Stanton and State of Missouri independently petition Secretary Babbitt to stop mineral leasing on federal lands adjacent to Ozark National Scenic Riverways to protect water and groundwater resources from impacts of lead mining.

Channel Islands National Park (California), ©1994 Jeff Selleck



NATURAL RESOURCE INITIATIVE GAINS MOMENTUM

Endorsed by the NPS National Leadership Council in 1998, the initiative focuses on 12 areas:

- *inventorying resources,*
- *monitoring to understand resource condition,*
- *increasing collaboration,*
- *encouraging outside research,*
- *integrating natural resources in planning,*
- *developing professional staffs,*
- *controlling exotic species,*
- *protecting native and endangered species,*
- *abiding by environmental laws,*
- *expanding air quality improvement efforts,*
- *caring for water resources and aquatic life, and*
- *using parks for natural resource education opportunities.*

An important first step in the initiative is the request for a budget increase of $19.8 million in FY 2000. The increase focuses on accelerating natural resource inventories, managing native and exotic species, funding projects under the Natural Resource Preservation Program, increasing geologic expertise for resource protection, implementing the Resource Protection Act to help parks recover from environmental damage, and restoring the California desert parks. Budget increases of similar magnitude are planned for an additional four years. Equally critical is change within the National Park Service that reflects the emphasis on natural resource stewardship and makes gains wherever possible with existing human and fiscal resources.

▲ ***Sea stacks,*** *Olympic National Park (Washington).*

THE YEAR IN REVIEW

by Mike Soukup

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Following publication of *Preserving Nature in the National Parks* (Richard Sellars, September 1997), the National Park Service spent much of 1998 crafting a Natural Resource Initiative that would respond to the implications of the book's message. One implication is that we must add a third area of emphasis—resource management—to the NPS culture to complement our well-established leadership in park development and operations. The challenges of the modern landscape now require this third pillar if parks are to be successfully protected in the 21st century.

After many discussions at all levels, and final deliberation by the National Leadership Council in August, a plan and a five-year budget initiative covering 12 program areas (with an initial request of roughly $20 million for FY 2000) were agreed to (see sidebar). Developing the details of how best to implement this plan nationally has been challenging, but the concept has been widely supported. The most frequent criticism has been that we are moving too slowly. This year's events reflected both ample evidence of the need to move forward in this area and signs of new emphasis in key areas of need.

One source of evidence indicating our need to emphasize natural resource management was from our pursuit of the requirements of the Government Performance and Results Act—GPRA (fondly pronounced "gipra"). In assembling our NPS *Strategic Plan,* we grappled with the need for NPS program activities to be fashioned in such a way that they determine and report measurable outcomes that can be achieved with current funding. After exhaustive efforts to identify currently measurable outcomes related to natural resource management in our parks, we recognized that we are sadly deficient in this area. Anyone who reads the strategic plan will realize that while the NPS mission is in large measure to preserve the resources that visitors come to see, we have little understanding or systematic measurement of how we are performing in the preservation of natural resources in parks. In and of itself, this exposure of the lack of a systematic approach to accumulating, using, and translating an understanding of the resources we manage is a sizable contribution to better park management. We hope that GPRA will continue to focus our attention on the discrepancy between the primary importance of preserving resources and the relatively small programmatic effort we can currently demonstrate. Recognizing this importance, we indicate articles in this report that relate to the first GPRA goal—preserving park resources—by calling attention to their titles with the following symbol: GPRA. (Articles that relate to the second GPRA goal—providing for public enjoyment and understanding of parks—are also notated in this way.)

One important milestone that compels action in a very sensitive and threatened habitat is Executive Order 13089—Coral Reef Protection—signed by President Clinton on 11 June 1998. Among other things, the National Park Service must revise the general management plans for all coral reef parks by FY 2004, with emphasis on reviewing the current levels of protection and committing to additional protective actions where needed, according to available science. This may necessarily include increased restrictions of activities that are incompatible with long-term sustainability of fish populations and preservation of reef communities.

Perhaps the most exceptional and far-reaching milestone for natural resources in 1998 is passage of the National Parks Omnibus Management Act of 1998, initiated by Senator Craig Thomas of Wyoming and piloted through the turbulent waters of Congress in the fall with the help of the Office of the Secretary and NPS Assistant Director for External Affairs Destry Jarvis. The act includes the mandate for science in parks and park management that has been sought by many supporters and critics of the National Park Service for decades (see the article on page 55).

In the following articles you will also see other areas of progress—strengthening our partnership with the U.S. Geological Survey and academe through the creation of four pilot Cooperative Ecosystem Studies Units, Great Smoky Mountain National Park pioneering the first all-taxa biological inventory anywhere, initiating the first Canon Lecture on Science and the National Parks, streamlining our research permitting process to make parks better places for all to do research, and more. Thus, the year was productive and ended on an optimistic note.

Natural Resource Information Division

Associate Director Mike Soukup

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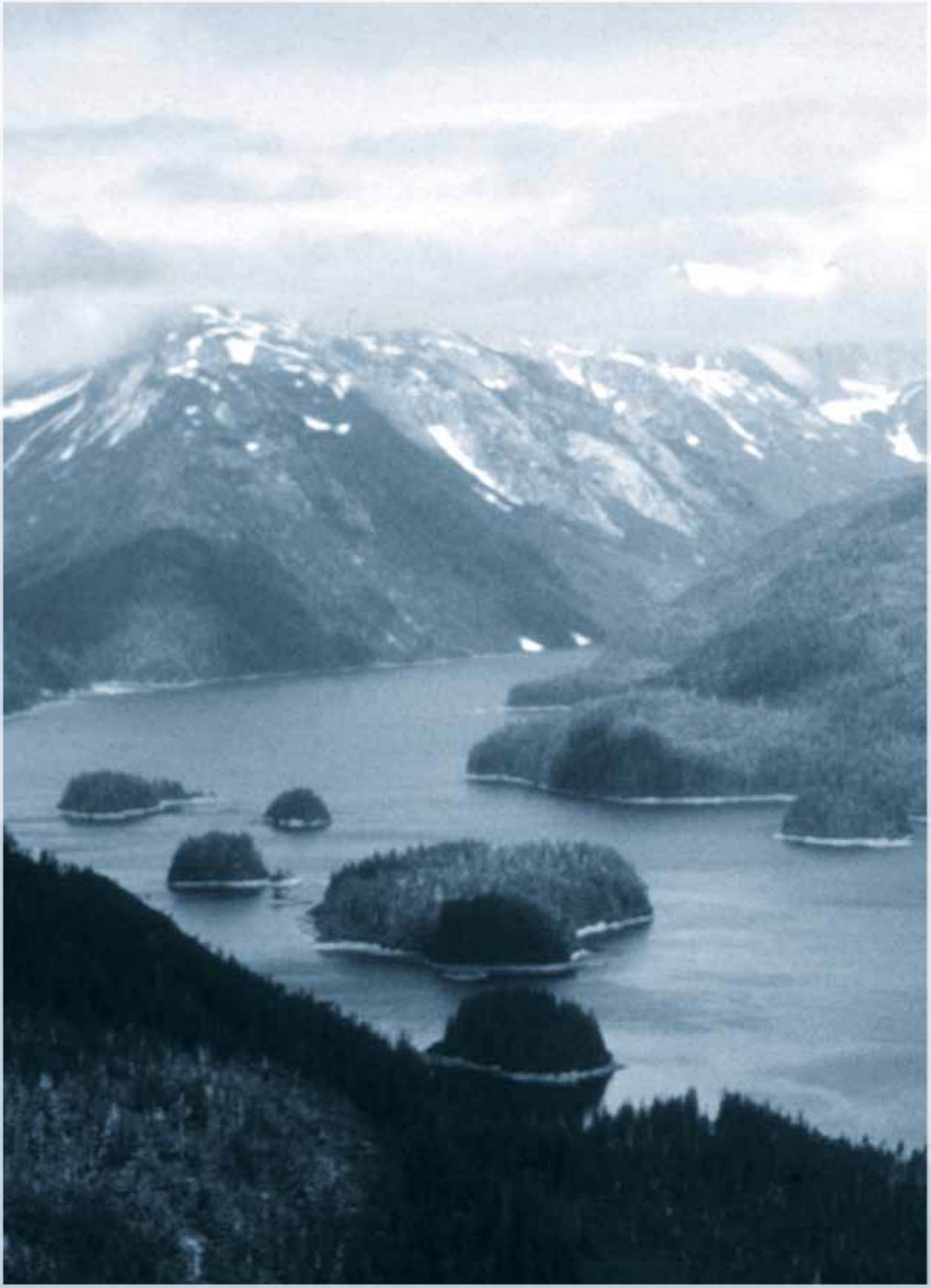

Wilderness waters in Dundas Bay *at Glacier Bay National Park and Preserve are among those that will be closed to commercial fishing as a result of The Wilderness Act, a 1997 Ninth Circuit Court of Appeals decision, and federal legislation passed in 1998.*

A SPECTRUM OF CHALLENGES

The condition of natural systems is not on the minds of most park visitors. Intent on experiencing the special character of the parks, they see instead the alluring scenery and awe-inspiring natural phenomena that are commonly believed to indicate healthy ecosystems. Yet behind this veneer is a multitude of deleterious influences that constantly wear down the integrity of these systems. As events in 1998 suggest, the spectrum of challenges to natural resource preservation has never been broader or more complex. To preserve natural resources, the National Park Service requires the professional insights of technical specialists and research partners trained in a variety of disciplines and armed with an understanding of the many factors that drive natural systems. Although more information is needed on the condition of resources and the dynamics of ecosystems, the following stories demonstrate that the National Park Service is meeting many preservation challenges through the acquisition and application of scientific information and technical expertise.

Consumptive Use

COMMERCIAL FISHING ISSUES IN GLACIER BAY RESOLVED THROUGH LEGISLATION

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Recent legislation crafted to phase out commercial fishing from the heart of Glacier Bay National Park (Alaska) will result in one of the largest protected marine ecosystems in the nation. This landmark action comes during the "Year of the Ocean," at a time when marine scientists are clamoring for protection of the world's oceans through establishment of marine protected areas. The elimination of commercial fishing in Glacier Bay will present an unparalleled opportunity for scientists and managers to increase their understanding of marine ecosystems released from commercial harvest.

Commercial fishing has occurred in the Glacier Bay area since before the turn of the century. Despite regulatory and statutory prohibitions as early as 1966, commercial fishing has continued throughout most of the park's 601,600 acres of marine waters. Disputes over control of the park's marine waters, economic importance of the fishery, political clout of the commercial fishing industry, and the lack of an equitable solution have thwarted efforts to resolve this issue.

The future of commercial fishing in Glacier Bay National Park and Preserve was finally decided by federal legislation after years of consideration and contentious debate. The new legislation, which is included within the FY 1999 Omnibus Appropriations Act, reflects much work and many years of public discussion and information gathering. The Glacier Bay provision responds to public comments received by the National Park Service that oppose commercial fishing in park waters, and advances the park's fundamental purpose of natural resource preservation. Equally important, it responds to issues of equity raised by longtime fishers and the State of Alaska.

The Appropriations Act provision will help to protect park resources by immediately closing all five wilderness waters, Geickie Inlet, and the upper east and west arms of Glacier Bay to commercial fishing activities. The act will also immediately prohibit Dungeness crab, king crab, and groundfish fisheries within all parts of the bay, and establish a phaseout of halibut, salmon, and Tanner crab fisheries. Only fishers meeting historical participation criteria will be allowed to continue fishing for the remainder of their

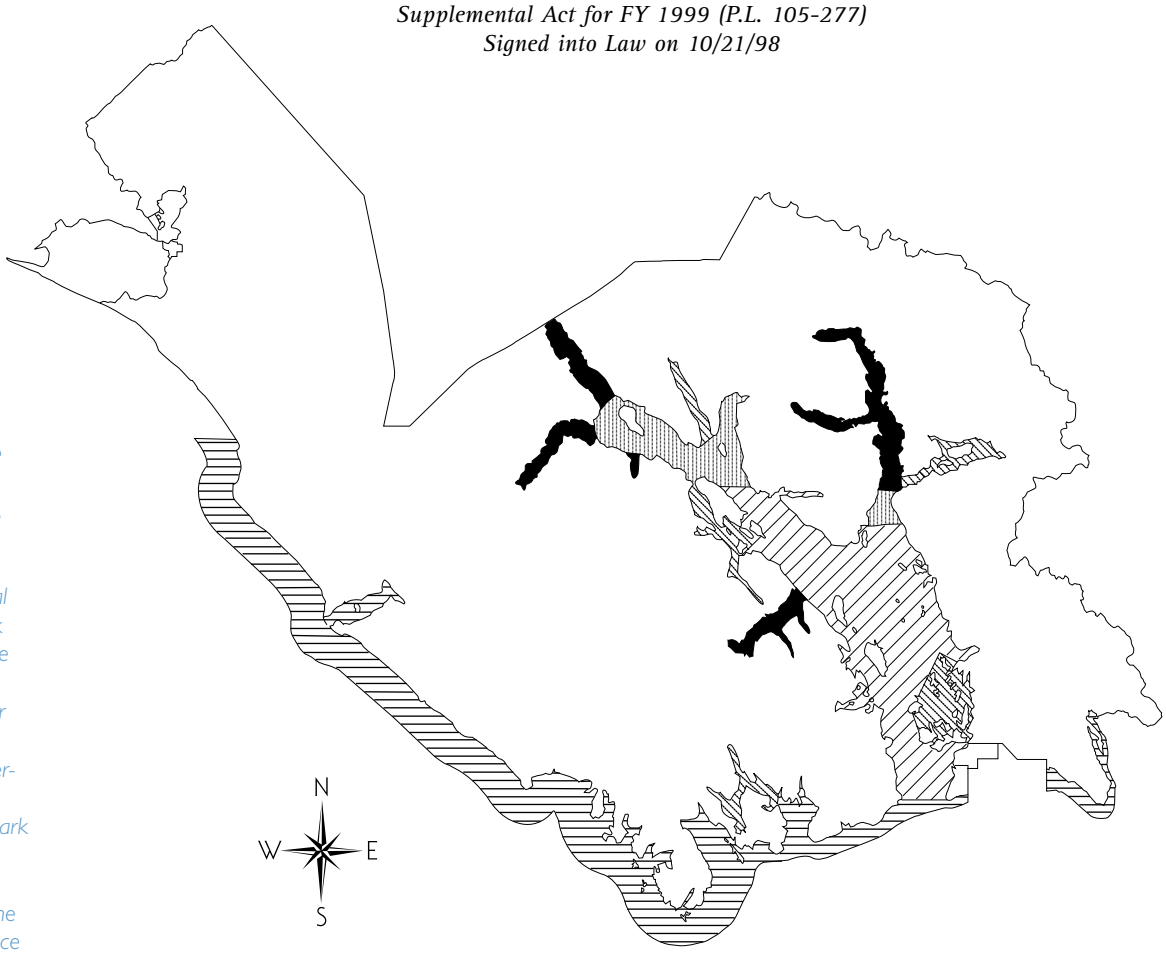
Glacier Bay National Park and Preserve, Rick Perkins

Commercial harvest of Pacific halibut *is one of the fishing activities affected by immediate closures in some wilderness and nonwilderness waters and an eventual phaseout in Glacial Bay proper. Regulations implementing the 1998 legislation are expected to be completed in 1999.*

National Parks Service

Commercial Fishing Within Glacier Bay National Park

Effects of the Omnibus Consolidated and Emergency Supplemental Act for FY 1999 (P.L. 105-277) Signed into Law on 10/21/98



Total Acres of Park Marine Waters: Approx. 601,600

- Areas Open to Existing Commercial Fisheries (Cooperative State/Federal Management) Approx. 271,080 Acres
- Area in Glacier Bay Proper Open for Qualifying Fisher's Lifetimes for Commercial Tanner Crab, Halibut, and Salmon Fisheries Approx. 170,800 Acres
- Areas Open Only to Winter Season Commercial King Salmon Troll Fishery for Grandfathered Individuals Approx. 48,490 Acres
- Nonwilderness Areas Closed to Commercial Fisheries Approx. 57,960 Acres
- Wilderness Areas Closed to Commercial Fisheries Approx. 53,270 Acres

Award-Winner Profile
SUPERINTENDENT HONORED FOR PARK PROTECTION

In April 1998 the National Park Service named Mark Woods the recipient of the Director's Award for Superintendent of the Year for Natural Resource Stewardship. Mark is superintendent of Cumberland Gap National Historical Park (Kentucky, Virginia, Tennessee) and led the 1997 challenge against the State of Kentucky's issuance of a surface coal-mining permit outside Cumberland Gap. Although state proceedings continue, the challenge to the state permit decision set a precedent for the National Park Service in protecting park resources and values from coal mining outside park boundaries. This precedent highlights the need for park managers to be proactive with respect to protecting parks from external development.

Mark Woods

lifetime. When these fishers retire, all commercial fishing within the bay proper will be prohibited.

The act helps protect the livelihood of commercial fishers dependent on fishing within Glacier Bay proper by:

- authorizing continued commercial fisheries in the park's nonwilderness waters outside of Glacier Bay proper, where more than 80% of the biomass has been harvested in the past;
- allowing halibut, salmon, and Tanner crab fishers with a documented history of fishing in Glacier Bay the opportunity to continue fishing in this area for their lifetime, and allowing "grandfathered" king salmon trollers continued access to historically fished areas in the upper east and west arms during winter openings; and
- providing financial compensation to Dungeness crab fishers who have fished for at least 6 of the last 10 years in designated wilderness waters, but must immediately cease fishing within those waters.

Although the Glacier Bay provision is a reasonable solution to a very complex and contentious issue, many details remain. The National Park Service expects to complete final regulations implementing the requirements of the act during 1999. The National Park Service and the State of Alaska will jointly develop a fisheries management plan to cooperatively manage the outer waters of the park where commercial fishing will continue.

NPS Water Resorources Division, Leslie Krueger

The future view from Little Mountain *along the Natchez Trace Parkway will look much the same as it does today—free of surface mining disturbance—thanks to negotiations between the National Park Service, Mississippi Lignite, and the Mississippi Department of Environmental Quality. Proposed mining operations will be located out of the immediate view and will address other aesthetic and resource concerns: air quality, water quality and quantity, noise, and preservation of dark night skies and aquatic life.*

Mining

MINING AND POWER GENERATION ALONG THE NATCHEZ TRACE PARKWAY

by Kerry Moss and Mark VanMouwerik

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Natural resource preservation ran headlong into the electrical power demands of the 21st century at Natchez Trace Parkway (Alabama, Mississippi, and Tennessee) in 1998. This situation occurred when the Mississippi Lignite Mining Company, in partnership with Tractabel Power, proposed construction of the "Red Hills Power Project." A combined 5,800-acre, surface lignite (low-grade coal) mine and 440-megawatt, coal-fired power plant, the proposed project would border the parkway for 5 miles, with portions extending to within 500 feet of the boundary.

Powerful state and local interests supported the Red Hills Project citing economic and employment benefits for the county. In contrast, the National Park Service raised concerns about potential impacts to aesthetic and physical resources along the parkway, specifically natural-landscape vistas, night sky, natural soundscape, air quality, water quality and quantity (including flow patterns), and aquatic life. However, through the collaboration of the NPS Natural Resource Program Center, Southeast Regional Office, and Natchez Trace Parkway and a cooperative relationship with Mississippi Lignite and the Mississippi Department of Environmental Quality, the Park Service gained significant permanent changes to the proposed mining operations. These changes not only would protect parkway resources, but would also help avoid triggering a portion of the Mississippi State surface coal-mining law. Had it been triggered, the law would have required "joint approval" by the NPS Director and the state permitting agency for the project to be permitted—a potentially difficult situation for all parties involved. As a result of this cooperation, a large-scale mine and power plant operation will be developed with minimal impacts on the Natchez Trace Parkway.

Impacts upon aesthetic resources were mitigated through an important agreement and major monetary and logistical concessions by Mississippi Lignite to forgo the future mining

MINING IN WILDERNESS

In 1998 the National Park Service followed the same approach to managing proposed mining operations in wilderness that it developed the previous year: applying NPS regulations, basing mitigation measures or denials on resource impacts identified through the National Environmental Policy Act process, and acquiring mineral rights when feasible. Proposed mineral exploration and operation plans in wilderness within Olympic and North Cascades National Parks (Washington) have been returned to the mineral owners for further information, while an existing operation and a proposed operation in Mojave National Preserve wilderness are slated for validity examinations. The National Park Service is seeking to acquire the mineral rights to an underground talc mine in Death Valley National Park (California).

***Although mining equipment** may vary slightly from that depicted in this coal-mining operation in Texas, the lignite mine near Natchez Trace Parkway would be similar in size and appearance—approximately 1 ½ miles long, 200 feet deep, and 900 feet wide.*

NPS Water Resources Division, Leslie Krueger

of several planned open pits. The pits were to be located immediately east of the Jeff Busby Developed Area and Little Mountain Overlook, both popular attractions at the parkway. This area is home to one of three campgrounds in the parkway and features some of the darkest night skies in the southeastern United States.

Concerns over possible air quality impacts were addressed through an exhaustive examination of predicted pollution sources and power plant control technology. National Park Service air quality experts communicated their findings and recommendations to power plant design engineers for their consideration in increasing the effectiveness of pollution control equipment on the plant.

Negotiations between the Park Service and Mississippi Lignite brought about mitigation of several potential disturbances to water resources. The Park Service was concerned that water quality, quantity, and aquatic life could be impacted because two streams flow through and adjacent to the area of the project before reaching the parkway. Although the mining company had provided baseline data on water quality and quantity as required in their permit, and had proposed to gather additional data during the life of the mine, both sets of information were insufficient. Negotiations resulted in an agreement that the mining company will increase its monitoring of stream water quality, install new gauging stations along streams flowing through the parkway, construct new monitoring wells to measure groundwater quality and its contribution to stream flow, and study stream biology. Mississippi Lignite will regularly report its findings to the National Park Service and if adverse impacts are discovered, it will work with the Park Service toward mitigation.

The National Park Service is pleased with the cooperation it received from Mississippi Lignite and the State of Mississippi to protect parkway resources. The interdisciplinary approach within the National Park Service among parkway and technical resource specialists also proved successful. The negotiations avoided potentially adversarial relationships among the many parties that could have lasted for years and may not have adequately protected park resources. Instead, cooperation led to an outcome that was acceptable to all.

Recreational Use

PERSONAL WATERCRAFT USE TO BE REGULATED IN THE PARKS

by Chip Davis

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Personal watercraft use in national park system units has grown dramatically during the last decade. Concerns over environmental impacts, visitor conflicts, wildlife disturbance, noise, and accidents involving these water vehicles have increased at a similar rate. On 15 September 1998 the National Park Service made public a proposed rule to manage personal watercraft use in national parks. The public and special interest groups submitted thousands of comments, which will be considered in developing the final regulation. Completion of the personal watercraft use rule is scheduled for spring 1999. Until these regulations are finalized, parks will follow an interim management policy established by the director.

Also known by the commercial names Jet Ski, Sea Doo, Waverunner, etc., personal watercraft cause significant problems in the parks. They are typically propelled by an inboard, two-cycle, internal combustion engine driving a water jet. They are usually less than 16 feet long and carry one to three people in a sitting or standing position. The engines, which use a gas-oil mixture and are generally operated at sustained high speeds, deposit significant amounts of harmful and long-lasting pollutants such as MTBE (a gasoline additive) into lakes, rivers, and coastal waters. Personal watercraft also disrupt threatened and endangered wildlife species during feeding and nesting activity, as they are able to access shallow waters because of their prop-free design. Park visitors engaged in more traditional park activities, such as hiking, camping, bird-watching, and canoeing expect solitude and natural sounds to be part of their park experience. The high-pitched whine of personal watercraft and the resulting disturbance of wildlife lead to frequent complaints to park management.

Many accidents occur when very young or inexperienced operators are allowed to use personal watercraft without proper supervision or instruction. Experienced users also cause accidents when engaged in acrobatic maneuvers such as sharp turns and wave jumping. Personal watercraft have been involved in numerous accidents resulting in serious injuries and fatalities in national parks. Conflicts with other visitors in boats and at swimming areas are very common. Currently, national park system units use state boating laws, U.S. Coast Guard regulations, and federal regulations specific to the National Park Service to manage boating activity and enforce safety restrictions. Legal requirements involving personal watercraft vary widely from state to state. Under the NPS servicewide regulation, personal watercraft use would only be allowed in a limited number of areas, primarily national recreation areas, national seashores, and national lakeshores. The proposed rule prohibits personal watercraft use in units of the national park system unless the National Park Service determines that such use is appropriate for a specific unit based on that unit's enabling legislation, resources and values, other visitor uses, and overall management objectives. The proposal incorporates and distinguishes two methods of authorizing personal watercraft use. The first method is available for a relatively small group of park units where authorization might be appropriately and successfully accomplished through locally based procedures. The second method, unit-specific rule making through the *Federal Register*, is available for all other park units where authorization is deemed appropriate.

Personal watercraft use is just one of many emerging recreational pursuits that the National Park Service must address. New technological developments and experimental designs in vessels, aircraft, all-terrain vehicles, snowmobiles, bicycles, rollerblades, climbing gear, and many other types of equipment challenge NPS management strategies and regulations.

Glen Canyon National Recreation Area

Concern over safety, *environmental impacts, conflicts with other park uses, and noise prompted the National Park Service to publish a proposed rule in 1998 to regulate the use of personal watercraft in national parks. Regulations are anticipated in spring 1999.*

PRESCRIBED FIRES UP IN 1998

Prescribed fire and hazard fuels reduction accomplishments increased 24%, from 69,481 acres in 1997 to 86,126 acres in 1998. The increase is attributable to new rules for the use of funds for these activities, growth in the number of parks with fire management plans, and enhanced availability of personnel to carry out these fire applications. This year's accomplishments are in line with projections reported to Congress, suggesting that the new funding rules will increase fire accomplishments by 25% over each of the next four years.

Public Perception

THE POLITICS OF PRESCRIBED FIRE AT DEVILS TOWER

by Chas Cartwright and Kurt Pindel

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A 280-acre prescribed fire burned through forest and grassland at Devils Tower National Monument (Wyoming) on 29 April 1998. Conducted by the National Park Service, the U.S. Forest Service, and state and local firefighters, this was the park's third prescribed fire since approval of the Fire Management Plan in 1993. The previous two prescribed fires were conducted under less than ideal weather and fuel moisture conditions, accomplishing none of the targeted resource management objectives. In contrast, preliminary data indicate that the 1998 burn met all resource objectives, including reduction of the forest canopy, pole-sized trees, and dead and down fuels. Although the prescribed fire was declared "out," the controversy surrounding the burn had just started.

The spark that lit the fuse was the burn location. The local public was outraged at the blackened trees marring the primary view of Devils Tower. Articles in local and regional newspapers were highly critical of park management. Most northeast Wyoming residents believed that the park should not try to conduct ecosystem management, but should focus solely on managing for scenic values and economic concerns. Some local residents called for salvage logging of fire-blackened trees for

© 1998 Andy Karoly

Flames from the controversial 1998 prescribed fire *move up the south flank of Devils Tower, Wyoming.*

SMOKE TO BE MANAGED

Sequoia–Kings Canyon National Parks and their interagency counterparts signed a memorandum of understanding in 1998 to address the effects of smoke from prescribed natural fires on regional air quality. As the year came to a close, the partners were developing EPA-recommended sections of a smoke management plan for the application of best available control technologies to manage smoke in order to meet California state and federal health and welfare standards. The plan encompasses smoke dispersion evaluation; burn planning, administration, and authorization; public education and awareness; emission inventory and reduction techniques; economic and environmental assessment; and oversight by the State of California.

beautification purposes. Local businesses were worried that visitation would decrease, resulting in a drop in revenues. While the visiting public was curious about the burn, they understood the overall purpose of prescribed fire. However, despite concerted efforts by the National Park Service to publicize the natural role that fire plays in ecosystems, especially since the 1988 Yellowstone fires, the general public is often unable or unwilling to tolerate the effects of this powerful force of nature.

The uproar was heard all the way to the Wyoming congressional delegation, who immediately sought further information on the fire. While the park's strategy was to focus on the purpose and ecological success of the prescribed fire, the representatives were more interested in what the park would do to fix the "problem." Clearly, the park's education agenda and the representatives' emphasis on changing fire policy were incompatible. The press also added to the controversy with a few highly inaccurate articles, one of which portrayed the superintendent as an arsonist.

As resource managers certainly know, it is important to assess acceptance of prescribed fire by local communities before a burn takes place and to expand communication efforts with the public at all points in the process. The message must be kept simple by emphasizing safety and overall ecosystem health as desired outcomes. Although the prescribed fire at Devils Tower met all legal requirements for public notification, local constituents felt strongly that the park needed to be more comprehensive in contacting all nearby residents. This experience also underscores the importance of using the fire management planning process to address the visual impacts to be expected from prescribed fire. Furthermore, it points out the value of aiming educational efforts at children so that they may grow up with a different viewpoint of fire from the one symbolized by Smokey the Bear. The National Park Service should continue to enlist public support for using scientific information to manage parks. Ultimately, park managers still must do what is best for the resource.

Shaping Growth

BLACKSTONE RIVER PROTECTS NATURE IN A CHANGING CULTURAL LANDSCAPE

by Nancy Brittain

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The national heritage area movement began chiefly as a method for protecting regional landscapes of historic significance in places where the National Park Service could not or would not be expected to own and manage land—places where people live and where their history is still unfolding. Several of the 16 designated national heritage areas, such as the Hudson River Valley and the Delaware and Lehigh Navigation Canal in Pennsylvania's coal region, commemorate areas of historic significance that are directly tied to natural resources. In the Blackstone River Valley, which was designated a national heritage corridor in 1986, the explosion in water-powered manufacturing, which signaled the beginning of the Industrial Revolution, was predicated on a river powerful enough to fuel the dozens of mills springing up along the corridor's 46-mile course. Today, as yesterday, a tension exists in this historic setting in Rhode Island and Massachusetts between the forces of change and the resource base from which change often draws.

Now in its second decade and one of the first NPS heritage areas, Blackstone River faces the great challenge of shaping growth through an integrated resource management approach: balancing historic preservation, environmental conservation, and economic development. This new-style "park" emphasizes management and stewardship through partnerships, which can become complicated when the agendas of different partners conflict.

For the first time, in 1997 a Natural Resources Inventory and Assessment was developed for the corridor. The advisory committee, composed of many partners active in natural resource protection throughout the valley, agreed early in the assessment process that management recommendations could not relate solely to ecological functions of the landscape. As a result, protection strategies for the corridor tend to focus on actions that are likely to gain the broadest support. However, they also take into account regional impacts of growth and transportation and the area's overall conservation purpose.

A key to natural resource protection in the valley is influencing local decision making and even the thinking of the local populace. A prime example occurred in Grafton, Massachusetts, in 1998 when the Grafton Land Trust sought to protect 124 acres of hay fields, pasture, wetland, and woodland amid a much larger landscape. Miscoe Brook, constituting a significant portion of the Grafton watershed and aquifer, also runs through the property. The town had the first option to buy the land through a Massachusetts farmland protection program, but residents needed to be convinced. With help from the corridor's staff real estate specialist and a key partner in the management of the corridor, Donna Williams of the local land trust, residents voted to approve $1.5 million to purchase the land. The town of Grafton will eventually allow a small, clustered development on a portion of the property to offset some costs, but the net result is protection of critical resources and wildlife habitat, which might not have happened without a compelling argument.

Incrementally, these small successes add up to greater protection of the cultural landscape and survival of natural systems and habitat. The challenge of working in an ever-changing environment has broad applications for traditional national parks, too, as they grapple with growth and infrastructure along their boundaries.

The view from Lookout Rock *in Northridge, Massachusetts, is representative of the scenic character of portions of the Blackstone River Valley National Heritage Corridor. Numerous partners, including the National Park Service, strive to manage area growth in ways compatible with historic and natural resource conservation. The entire scene from this spot is protected thanks to the efforts of the Massachusetts Department of Environmental Management.*

Big Bend National Park, PRIMENet amphibian crew

Couch's spadefoot toad *is one of the amphibian species being studied in Big Bend National Park (Texas) as part of the EPA-NPS intensive ecosystem monitoring activities. Three parks conducted similar research during 1998 aimed at developing methods for identifying amphibian population trends.*

Indicator Species

AGENCIES SEARCH FOR REASONS FOR AMPHIBIAN DECLINE GPRA

by Kathy A. Tonnessen and Gary Williams

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When deformed frogs make the front page of the *Washington Post* (9/30/96), we know that amphibians have captured the interest and concern of the public. Since 1995, when reports of frogs and toads with missing limbs and extra body parts started coming in, federal agencies such as the Department of the Interior and the Environmental Protection Agency (EPA) have launched efforts to find out the extent and causes of amphibian deformities and population declines. Thus, 1998 became the unofficial "year of the amphibian," with both the NPS Inventory and Monitoring Program and the NPS-EPA Park Research and Intensive Monitoring of Ecosystems Network (PRIMENet) initiating activities to better characterize amphibian populations in parks.

During the year, the Inventory and Monitoring Program started inventories of amphibians and reptiles in 13 parks, and it plans to fund inventories in an additional 13 parks out of the FY 1999 Inventory and Monitoring Program budget. The participating parks' natural resource staffs have joined with university and federal agency scientists to devise plans for carrying out these biological inventories and to come up with preliminary strategies for monitoring populations through time. Only with long-term data sets will the parks be able to determine changes in amphibian numbers that are caused by either natural factors or human-related stresses, such as climate change, habitat alteration, exotic species, UV radiation, and contaminants.

PRIMENet had already funded development of amphibian monitoring methods in Big Bend and Shenandoah National Parks, with interim results presented by U.S. Geological Survey collaborators at the PRIMENet annual meeting held in November 1998. This amphibian program was expanded in 1998 with the addition of $500,000 of EPA research funds to be spent in a number of PRIMENet parks in 1999. (PRIMENet, formerly called the Demonstration Intensive Site Project [DISPro], changed its name to reflect that the program has moved beyond the concept of a "demonstration project" and is now a functioning set of index sites.)

> "Only with long-term data sets will the parks be able to determine changes in amphibian numbers that are caused by either natural factors or human-related stresses . . ."

The National Park Service is looking forward to the success of an FY 2000 budget initiative for the Department of the Interior to sponsor amphibian inventory, monitoring, and research on public lands. We anticipate that departmental scientists and resource managers will launch significant efforts to understand the status and trends in frog, toad, and salamander populations should this $8.1 million–per–year initiative be approved.

PRIMENet PROGRESS

The cooperative agreement between the Environmental Protection Agency and the National Park Service was extended three years in 1998 to provide for the continued design and implementation of PRIMENet (formerly DISPro). During the year, the Park Service focused on completing installation of equipment needed for monitoring wet and dry deposition, ozone, and visibility in 14 parks. The EPA and NPS jointly operate the UV monitoring network in those parks. Additionally, eight research projects were started, which include work on nitrogen deposition, UV radiation, climate, and ozone-stressor effects on natural resources.

Approximately 275,000 plastic fragments, *19,000 rubber gloves, 14,000 milk jugs, and 11,000 balloons were among the items of trash painstakingly recorded and disposed of by staff at Padre Island National Seashore from 1994 to 1998. Data collected over 10 years of trash monitoring suggest that between 21% and 62% of the trash comes from Gulf of Mexico shrimping, while 15% is attributable to offshore oil and gas activities.*

NPS SCIENCE

The National Park Service plays an important scientific role in fulfilling its resource stewardship mission—acquiring and applying the best and most comprehensive scientific information available to preserve resources and manage park visitors. A portion of that information comes from research obtained from the National Park Service's natural and social science research partners. Equally critical is information collected through its scientific inventory and monitoring activities. Inventories of biological and physical resources account for the presence, class, and distribution of natural resources in parks; long-term monitoring helps to reveal resource condition and detect ecosystem change. Together, inventory and monitoring are potent partners that give early warning of resource degradation. As the stories from 1998 indicate, the scientific functions of the National Park Service, including its technical expertise, are fundamental to the long-term maintenance of natural resources.

Long-term Monitoring

SHORELINE STUDIES AT PADRE ISLAND POINT TO TRASH SOURCES

by John Miller

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Trash is a problem at beaches throughout the nation. At Padre Island National Seashore, Texas, shoreline trash has become one of the park's foremost natural resource problems. Approximately 90% of all shoreline trash items found at the seashore are made of plastics, in spite of the fact that an international treaty known as MARPOL prohibits dumping trash at sea, with specific restrictions on dumping plastics. Many marine managers across the nation are seeking ways to clearly identify the sources of shoreline trash so they can try to eliminate the dumping problem at the source.

Padre Island might be able to provide some answers. After more than a decade of studying the nature and origin of shoreline trash at the seashore, park resource management staff began analyzing data in 1998 from inventory methods the park pioneered. Padre Island has fine-tuned shoreline trash monitoring techniques and resource management staff have begun to identify the sources of the trash.

For 10 years, resource managers at Padre Island National Seashore have tested shoreline trash collection methods in order to determine the survey frequency and distance needed to provide scientifically valid data. Beginning in 1994, and based on findings from previous studies, the park initiated the "Shoreline Trash Point Source Investigation" to identify the amount of trash washing onto the beach from specific sources. This is one of the first long-term, comprehensive, shoreline trash monitoring projects to be conducted in the United States. The labor-intensive project required daily cataloging and removal of 43 different kinds of trash items from 16 miles of shoreline within the park. Upon completion of the 1998 monitoring season, the park had collected 958 days' worth of marine trash data, cumulatively surveyed more than 12,500 miles of shoreline, and recorded and removed nearly 400,000 trash items.

Statistical analysis of the data shows that surveys conducted one day per week provide information that can be used to predict the amount and kind of trash that will occur for the entire week. Statistical models derived from the data collected also indicate that surveys should be made every 8–10 miles. This means that at Padre Island, collections can be conducted at miles 1, 8, and 16, instead of all miles 1–16.

Additionally, statistical analysis has allowed the park to identify possible sources of the trash. Using data on monthly shrimping efforts provided by the National Marine Fisheries Service, a statistical correlation has been established between Gulf shrimping efforts and the number of specific trash items that wash ashore. A regression

Padre Island National Seashore, Roddy W. Wilder

Entangled in shrimp netting, *an endangered Kemp's ridley sea turtle washed ashore on South Padre Island, south of the park, in 1993, signaling the threat to resources posed by waterborne trash.*

Medical waste and drums *containing a variety of toxins are among the trash items at the park that pose safety hazards to today's visitors.*

model has been developed indicating that increased Gulf shrimping efforts directly correlate with increased numbers of specific types of trash items washing onto the adjacent shoreline.

To solve the marine trash problem, point sources must be identified. Actions implemented to reduce the amount of trash being dumped into our oceans are ineffective if the source is unknown. This shoreline trash study demonstrates that monitoring marine trash can aid in identifying probable point sources. This valuable information will be summarized in a technical report in 1999 and can be used for improving the management of marine resources everywhere.

WHITE ABALONE: GOING, GOING, GONE? GPRA

by Gary E. Davis

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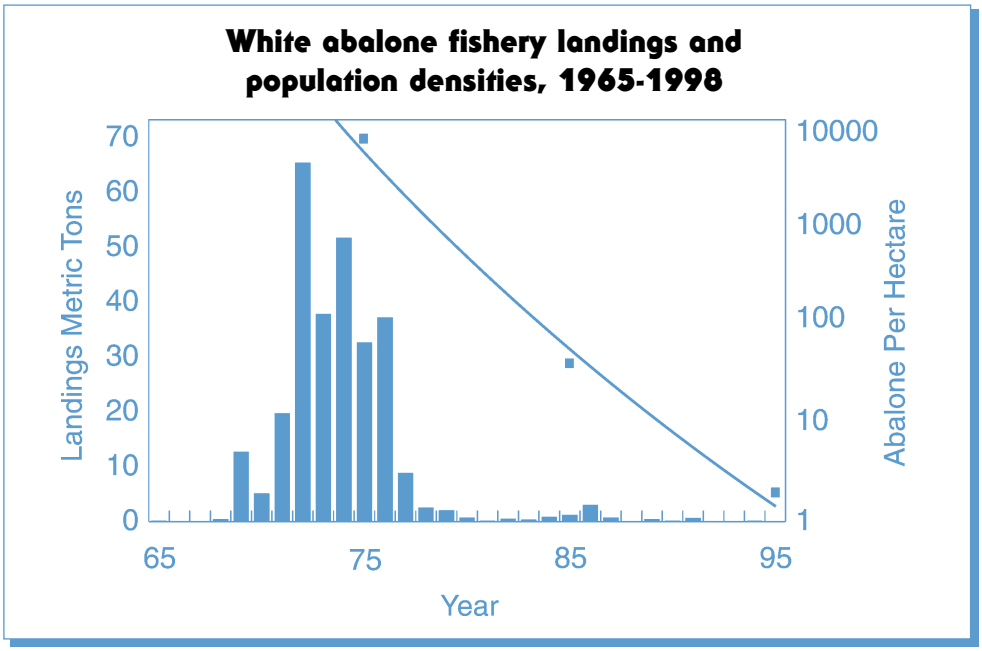
Impossible! Scientifically managed fishing will not cause extinction of fecund marine invertebrates. Everyone believed that imposing size limits, fishing seasons, and restricting take, plus the difficulty of finding the last few animals, would always leave enough surviving white abalone to prevent extinction in the sea. Recent monitoring of these delectable marine snails in Channel Islands National Park, California, challenges this conventional wisdom with disturbing news. Unless people intervene at once, all the white abalone will be gone in a few years.

How could this happen? When other abalone species became hard to find in the 1970s, divers exploring deep reefs discovered abundant white abalone. Average-sized reefs—the size of two soccer fields (1 hectare)—contained 2,000 to 10,000 white abalone at the center of white abalone distribution, the California Channel Islands. Divers took 20 to 60 metric tons (22–66 tons) of white abalone a year until no more legal-sized white abalone were left. By 1980, annual landings of legal catch were only a few kilograms. Biological inventories of the newly expanded Channel Islands National Park in 1980–81 revealed that the remaining white abalone population was down to only 12 per hectare (about 2.5 acres). Subsequent monitoring documented a continuing decline to only one per hectare by the late 1990s. Surveys of the park by submarine in 1996 and 1997 showed that the last few survivors were widely scattered, too far apart to effectively reproduce, and found only large shells, indicating that white abalone last reproduced in the 1960s. Survivors of the legal fishing were so few and so sparsely distributed that significant reproduction has not occurred since the fishery began in the 1970s. Those survivors are now dying of old age, alone on small, isolated deep reefs.

In 1998, scientists, attorneys, fishers, and mariculturists from the United States and Mexico, representing fishing cooperatives, conservation organizations, universities, state and federal agencies, and private enterprise, joined forces to



Award-Winner Profile
BOB COOK WINS TRISH PATTERSON–SCA AWARD

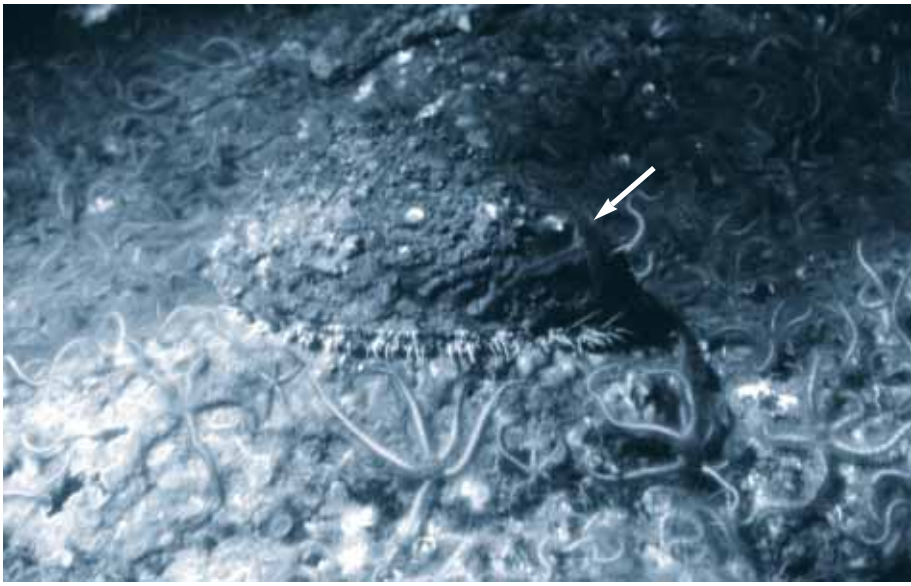
Given in recognition of resource management excellence in a small park, the Trish Patterson–SCA Award went to Bob Cook in 1998 for his work the previous year at National Park of American Samoa. Bob was the first resource manager to serve at the South Pacific park. From this tropical jungle wilderness, largely unexplored by NPS staff, Bob established an inventory and monitoring program and conducted inventories of freshwater streams, terrestrial snails, and coral reefs. He also collected baseline data on feral pig activity and reviewed the status of the population and habitat of the flying fox fruit bat. As a result, issues affecting park natural resources have been better defined and prioritized. In turn, this led to a broad expansion of the park resource management plan, enhancing the ability of the park to hire a resource management crew to address the top-priority resource issues.

Natural Resource Information Division

Bob Cook

develop a four-step strategy to prevent white abalone extinction and restore the species to a viable condition. Using public education, existing governmental processes, and research, they plan to: (1) locate survivors by surveying historic habitat; (2) collect brood stock; (3) breed and rear a new generation of brood stock in captivity; and (4) reestablish wild populations with refugia in Channel Islands National Park and other protected areas. The National Marine Fisheries Service designated white abalone a candidate for endangered species listing in 1998 and funded a status review for a listing determination.

The condition of white abalone is perilous, but monitoring in the park gave a confident early warning. With persistence and a willingness to explore new ways to care for marine species, there is still hope for restoring them and preventing other losses in the sea.



National Park Service

Once abundant on deep rocky reefs *at Channel Islands, white abalone are now too few and far between to reproduce on their own. Rapid and severe exploitation during the past 25 years has left this mollusk teetering on the brink of extinction. A plan to recover the species is based on laws to protect those remaining, a captive breeding and restoration program, and educational outreach.*

RIPARIAN MONITORING FOCUSED ON STREAM RECOVERY IN CANYONLANDS

by Charlie Schelz

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After nearly 50 years of use, the road above Peekaboo Camp in Salt Creek of the Needles District of Canyonlands National Park (Utah) was closed to vehicles in 1998. The rough, four-wheel-drive route ran in and across the creek in many places and provided access to Angel Arch, a popular destination 12 miles from the trailhead. The closure is the result of a lawsuit brought by a wilderness advocacy group to reverse a park decision to allow limited vehicular use of the road. In 1992 the park began a backcountry use planning process and examined the long-standing policy of unrestricted use of the Salt Creek road. The issue is a classic example of balancing resource use and preservation. Although the preferred alternative in the environmental assessment for the backcountry management plan was for road closure, the park decided to limit use through a permit system. The court overturned that decision last July.

Salt Creek is the only perennial stream in the park besides the Colorado and Green Rivers. It has been the subject of three studies by various independent researchers who attempted to determine the effects of vehicular traffic on the ecosystem. All of these studies, although neither well funded nor extensive, found deleterious ecological effects of the road and its use. The extensive literature on the effects of such roads on ecosystem processes has also shown many negative consequences, especially in arid environments. These include increased erosion, habitat destruction, soil and water pollution, noise pollution, exotic invasions, and wildlife elimination and dispersion.

With the road now closed and left to the forces of nature, the park Division of Resource Management has initiated a riparian monitoring program to document ecological change and natural recovery in Salt Creek. In 1998, the park established 12 permanent plots in Salt Creek that record biological, hydrologic, erosion, and vegetation features as they appear now. The park plans to measure these same features again in the future, possibly every three to five years. It also plans to establish plots in the section of Salt Creek that is still open to vehicles and in similar adjacent canyons.

The monitoring program has many objectives and methods. First, the park wants to determine any change in vegetation composition, cover, and structure at each plot using a cross-sectional, line-intersect method. The park plans to measure, photograph, and map stream channel characteristics. Permanent panoramic photo-points will be set up above and in the stream channel at each plot. Aquatic macroinvertebrate populations will be

Located in the Needles District *of Canyonlands National Park, the scenic four-wheel-drive road to Angel Arch was closed to vehicles in 1998. The area is now the site of resource monitoring designed to increase ecological understanding of riparian recovery in an arid landscape following disturbance.*

Southeast Utah Group, Charlie Schelz

monitored along both open and closed sections of the road, and a permanent bird survey transect will be set up in the closed section of Salt Creek. Amphibian and insect surveys may also be added in 1999. Finally, the park plans a Riparian Functioning Condition Analysis, developed by the Bureau of Land Management, at each site to assess the quality of the riparian condition by examining vegetation, hydrology, and erosion.

This study is the first of its kind in the semiarid environment of the Colorado Plateau. Now in its infancy, the monitoring program is envisioned as long-term and will add much to the ecological understanding of riparian recovery and change in an arid environment following disturbance.

YOSEMITE PLANS CONSOLIDATED

In December, Interior Secretary Babbitt called for pulling together the Yosemite Valley Implementation Plan, Yosemite Valley Housing Plan, Yosemite Valley Lodge Development Concept Plan, and Lower Yosemite Falls project into one comprehensive plan with an environmental impact statement. Slated for 2000, this plan will build on the park General Management Plan in shaping the future of Yosemite Valley by restoring natural and cultural resources, balancing use and preservation, and reducing traffic congestion and overcrowding.

Planning and Preservation

SCIENCE-BASED PLANNING AT TALLGRASS PRAIRIE NATIONAL PRESERVE

by John Neal and George Oviatt

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In spring 1997, a volunteer team of park and program professionals from across the Midwest Region met to begin the development of a general management plan/environmental impact statement for the newly established Tallgrass Prairie National Preserve. The team took advantage of the lack of resource management precedents at the new preserve and developed a plan that uses good science as its basic building block.

It was clear from the very beginning that resource management at the preserve would be challenging. The National Park Service can own only up to 180 acres of the 10,894-acre preserve, located in the Flint Hills of Kansas. The current owner is the National Park Trust. Ninety-eight percent of the land base will remain in private ownership, making partnerships and consensus-building essential to effective management. Currently, a 35-year grazing lease is in effect, which is managed by early, intensive double-stocking of cattle and the burning of every leased acre each spring. The area also has a 30-well active gas lease in operation. In addition, the preserve lacks site-specific baseline data on natural resources before 1996.

In order to generate a successful management plan, the team had to clearly understand and adhere to the legislation that established the preserve. This legislation

emphasizes several key features, such as the development of a general management plan within four years, maintenance and enhancement of the tallgrass prairie, specific interpretive themes, establishment of a 13-member advisory committee, a ceiling of 180 acres for NPS landownership, and the need for a cooperative agreement between the property owner and the National Park Service.

To get buy-in by all interested parties, the planning team had to build a broad consensus through public involvement. Public input was gathered through a series of newsletters, open house meetings, an Internet site, and the participation of individuals and organizations representing various interests in the planning process.

To develop the nuts-and-bolts resource management aspects of the plan, the team had to develop and use good science that was useful to management and could stand up to public scrutiny. The team collected some baseline data, but because of the short time frame given to develop the general management plan and the limited funds, data also had to be extrapolated from scientific databases that feature information from other studies in tallgrass prairie ecosystems. Answers to many of the basic science questions were provided by panels of subject matter experts charged with the task of addressing needs for the general management plan. Technical experts from other federal and state agencies provided additional information.

As a result of these efforts, Tallgrass Prairie National Preserve has a draft preferred alternative that, after consultation and public review and comment, will ensure that natural resources always come first. The opportunity to start from scratch has yielded a unique plan that can serve as a model for other natural resource parks.

Geologic Resources Division

The Tallgrass Prairie planning team *inventoried resources, including approximately 30 natural gas wells inside the boundary of the new preserve.*

RECURRENT THEMES OF WATER RESOURCES MANAGEMENT PLANS

by David L. Vana-Miller

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Aquatic ecosystems play a central role in the social, economic, environmental, and political mosaic of units of the national park system. Scientists and managers are increasingly called upon to respond to disruptions of water resources that threaten the quality of human life and environmental sustainability. However, fewer than 9% of those parks with significant water resources have some type of water specialist on staff. For the remaining parks, the development of water resources management plans can assist in the development of a parkwide strategy to ensure that park managers and policy makers have adequate and timely information to protect, use, and enhance water resources. A water resources management plan identifies high-priority management and research areas and proposes a conceptual framework for building a comprehensive, integrated, and durable water management program that will position a park to address the issues of the next century in a realistic manner.

> "… fewer than 9% of those parks with significant water resources have some type of water specialist on staff."

During 1998 the Water Resources Planning Program,

The water resource management planning process *illuminates water resource issues in parks, such as the effects of oil and gas infrastructure and activities, and is the basis for better management of these resources.*

Padre Island National Seashore (Texas) by Geologic Resources Division

WETLAND PROTECTION STRENGTHENED

A new set of wetland protection procedures was issued in 1998 in Director's Order #77-1: Wetland Protection *and an accompanying manual. Last updated in 1980, the guidance identifies those procedures that work well and those that are ineffective. In particular, wetland protection is strengthened through wetland inventory requirements and procedures for avoiding, minimizing, or compensating for wetland impacts during restoration activities. Additionally, the procedures eliminate unnecessary paperwork and review for projects that have a negligible effect on wetlands.*

GEOLOGY LINKED TO RESOURCE PROTECTION

A geologic map produced in 1998 by a Mesa Verde National Park (Colorado) volunteer shows how rock type prescribed the location of the cliff dwellings at the park and influences the distribution of threatened and endangered plants. Both associations are important in the preservation of these resources.

initiated by the NPS Water Resources Division in 1991, completed water resources management plans for Cape Cod National Seashore, Theodore Roosevelt National Park, Obed Wild and Scenic River, and Chickasaw National Recreation Area. Although these parks have obvious hydro-ecological differences, the water resources management plans, taken together, continue to demonstrate recurrent themes of plans completed during the last several years. These themes include the following:

- Effective managerial solutions to problems concerning water resources will be achieved only with the understanding that changes in environmental conditions are directly linked to socioeconomic patterns and processes, especially land use.
- Interactive partnerships among policy makers, hydrologists, and park resource managers are essential for developing a comprehensive approach to integrating water sciences with management of water resources.
- Viewing water problems holistically and integrating management and research needs into a watershed context link the sciences involved in water research and management.
- The transfer of scientific information to regional and local leaders and the public should be done in a manner that will produce an informed and responsive citizenry who are willing and able to provide direct feedback on water-based programs.
- Proposed recommendations are seemingly connected to issues that are related directly to societal needs, namely restoring and rehabilitating ecosystems, maintaining biodiversity, and understanding the effects of modified hydrologic flow.

In all likelihood, these same themes will continue to appear in future water resources management plans; they are ultimately the foundation for any water resource management program. However, the development of water resources management plans is limited by resource constraints. To date, water resources management plans have been completed for 27 parks, representing only 10% of parks with significant water resources. Nonetheless, these parks have benefited in several ways from their water resources management plans. For example, they obtained approximately 40% of available funding from one competitive program because proposed water resource management actions, developed in their plans, were well thought-out and firmly grounded in science. Clearly the road is long, but the task is not daunting.

Resource Inventory

PROGRAM CENTER TAKES ON GEOLOGIC INVENTORIES GPRA

by Bruce Heise and Joe Gregson

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In 1998 the Natural Resource Program Center completed the first phase of a pilot project ultimately intended to inventory the geologic resources of the national parks. Preliminary findings of the pilot Geologic Resources Inventory suggest several applications for overall park resource management from an enhanced understanding of the parks' geology. Examples include the use of geologic data to construct fire histories, identify habitat for rare and endangered plant species, identify areas with cultural resources and potential for paleontological resources, and locate potential hazards for park roads, facilities, and visitors. Digital geologic maps will enhance the ability of managers to develop precise hazard and resource models in conjunction with other digital data.

The inventory, conducted jointly by the national Inventory and Monitoring Program and the Geologic Resources Division, stems from the 1997 NPS Strategic Plan, which recognized a geologic map as one of 12 essential data sets for parks. National Park Service, U.S. Geological Survey, and state geologists subsequently identified a park systemwide inventory as a critical first step for managing, interpreting, and understanding the geologic resources in the parks. The group determined that an inventory should consist of these four components:

1. a bibliography of geologic literature and maps,
2. an evaluation of park geologic resources and issues,
3. an assessment of geologic map coverage and production of digital products, and
4. a report describing the park's geology.

Because of their proximity to the offices of the Natural Resource Program Center and the U.S. Geological Survey, the Colorado parks were selected for the first series of scoping sessions necessary to assess the quality and extent of geologic information available for each park. Each session included a field trip led by an authority on park geology, followed by an on-site meeting dedicated to reviewing the four inventory items listed. Each meeting ended with a summary session to determine inventory needs and deliverables and to tentatively assign cooperator responsibilities.

These sessions have been successful in evaluating the issues and resources at each park, gaining program understanding and cooperation, and maximizing returns from existing projects and knowledge. The Geologic Resources Inventory team plans to complete production of products for Colorado parks and to move on to additional pilot work in Utah in FY 1999.

***The pilot geologic inventory** of Colorado parks identified park needs for geologic products and facilitated their development, including this digital geologic map (1:24,000) of a portion of Curecanti National Recreation Area. To develop the map, an NPS technician digitized the 1971 Geologic Map of the Black Canyon of the Gunnison River and Vicinity by the U.S. Geological Survey. The map is now available in a Geographic Information Systems format that can easily be used in management applications.*

NEOTROPICAL MIGRANTS

Forty round-trip plane tickets were donated to the National Park Service by American Airlines in 1998 to promote dialogue among park managers in Latin America and the United States. Resource managers now have a better chance of meeting face-to-face to coordinate strategies for the protection of wintering and breeding habitats of long-distance migrants such as birds and bats. An ad campaign for the airline will publicize the complex international conservation issue regarding Neotropical migrants by stating, "Everyone needs a place to land."

BATS SURVEYED AT GRAND CANYON

by Elaine Leslie

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Grand Canyon National Park (Arizona) is an expansive area that is home to a diversity of wildlife, including as many as 10 bat species that are candidates for federal protection under the Endangered Species Act. Because of the park's range in elevation and habitats from mixed conifer forests to desert and river environments, it hosts both boreal and southern bat species. Following an initial inventory of bat species along the river corridor in 1996 and 1997, the park, in cooperation with Bat Conservation International, Inc. (BCI), dedicated efforts and funding to complete the river inventory, begin forest surveys, and establish long-term monitoring goals.

Before the 1996 and 1997 inventories, the most recent bat species list (1978) compiled for the river corridor included only seven species. Survey methods used in the 1998 follow-up inventory included traditional mist netting, use of harp traps, and cave exit counts, in addition to the Anabat system. This technique, which employs a bat detector that transforms ultrasound to an audible output, enables users to identify bat species. Through this combination of methods, the 1998 surveys more than doubled the 1978 figures by adding nine new species, including spotted, silver-haired, hoary, western mastiff, Mexican long-tongued, red, and big free-tailed bats.

Monitoring of cave populations of Townsend's big-eared bats, western mastiff bats, and Mexican free-tailed bats has proven crucial in the recovery of these maternity and roosting colonies. Surveys detected declines in, or a complete absence of, populations that are known to have existed in cave systems throughout the park. In 1996 the park erected a bat-navigable gate over the entrance to Stanton's Cave, the location of a maternity roost of Townsend's big-eared bats that had been repeatedly disturbed by years of archeological excavations and visitor day-use. The population has since recovered from just a few individuals to nearly 80! Monitoring plans for 1999–2000 include collecting more data on migratory species such as the Mexican free-tailed bat. Grand Canyon National Park hosts the largest colony of this species in Arizona, and although the park affords habitat protection during the breeding season for this migratory species, little is known about the habitat in Mexico upon which it depends for overwintering. Future plans include looking beyond park boundaries with the goal of securing partnerships for the preservation of overwintering habitat.

The Grand Canyon surveys and monitoring efforts have yielded not only invaluable information but also a wide range of concerns. The park provides abundant roosting and foraging habitat for bats, from extensive cave and fissure systems to old-growth forest; however, recreationists prefer the same areas favored by bats. Thus, the disturbance of critical habitat is being addressed in the implementation of various park management plans (e.g., Colorado River Management Plan, Cave Management Plan, and Backcountry Management Plan). Future monitoring of bat populations and distribution, and analysis of the new baseline, will enable resource managers to recommend sound management actions.

In continuing efforts to protect the world's resources, nothing is more important than transforming data into knowledge. Communicating this knowledge to an informed and supportive public will afford the best long-term protection and preservation of sensitive natural resources, including the bat species of Grand Canyon National Park.

The big-eared bat *was one of 16 bat species documented in recent surveys along the Colorado River in Grand Canyon National Park. Surveys such as these establish baselines for comparing with future conditions and serve as a basis for scientific decision making.*

Social Sciences

SURVEY RESEARCH PROVIDES MANAGEMENT INFORMATION GPRA

by Jean E. McKendry

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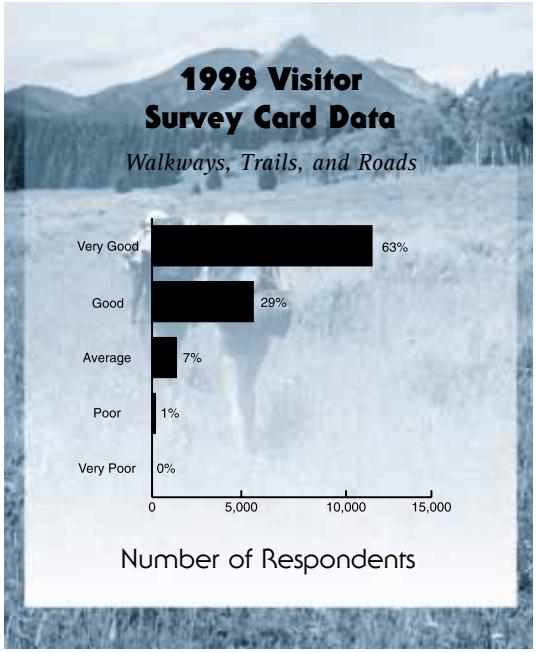
To effectively balance resource preservation with visitor use, NPS managers must understand public values, attitudes, and behaviors regarding the national park system. Survey research is an important tool for achieving this understanding. In 1998 the National Park Service sponsored surveys related to fees, Government Performance and Results Act (GPRA) standards, visitor use, gateway communities, and more.

FEE DEMONSTRATION PROGRAM SURVEY The National Park Service is supporting a sustained program of survey research conducted by various universities to monitor and understand response to the Fee Demonstration Program. The research is supported by funds from newly instituted recreation fees. Results from a 1997–98 visitor survey consistently indicate that park visitors generally support the new fees, provided the funds remain in the park or with the National Park Service. Also, managers at the 100 fee demonstration parks were surveyed about fee collections and their impact on park operations.

GPRA SURVEY In 1998 the Visitor Survey Card was developed to help the National Park Service comply with GPRA. Distributed in 310 units of the park system, the survey card measured each park's performance related to GPRA goals concerning visitor satisfaction and visitor understanding and appreciation of park values. The survey results have been published for each unit, cluster, and region.

VISITOR USE SURVEYS The Visitor Services Project conducts approximately 10 detailed visitor studies per year. Since 1988 this project has completed nearly 100 studies; produced an annual report, *Serving the Visitor*; and created a national database of all survey responses. The Visitor Services Project studies completed in 1998 include Jean Lafitte National Historical Park and Preserve, Acadia National Park, Whiskeytown National Recreation Area, and others. Park staff use the data in planning, operations, and policy making. For example, Jean Lafitte staff are using the study to help identify transportation needs.



The Visitor Survey Card *reports results pertinent to the Government Performance and Results Act for visitor satisfaction and visitor understanding and appreciation of park resources. Data are based on 21,696 visitor responses from surveys conducted at 281 parks. The satisfaction measure is the combined percentages of "very good" and "good" responses. The evaluation score is based on a range from "very poor" = 1 to "very good" = 5.*

During 1998, researchers conducted additional survey research throughout the National Park Service. Examples include general visitor studies completed at Mount Rushmore National Memorial, Yosemite National Park, Statue of Liberty National Monument, and Alcatraz Island, part of Golden Gate National Recreation Area. A landowner/visitor use study at Great Egg Harbor Scenic and Recreational River and a gateway communities study at Sequoia–Kings Canyon were also conducted.

Additional survey research is planned for 1999. Examples include continued research related to the Fee Demonstration Program and new studies of fees and backcountry users, a revised Visitor Survey Card, 10 new Visitor Services Project studies, a public opinion survey, and socioeconomic studies of winter use and bison management at Yellowstone. Social science survey research like this will continue to provide park managers with critical information about visitors and local communities, both to help protect park resources and to provide for visitor enjoyment.

SURVEY APPROVALS OPTIMIZED

Visitor surveys require approval of the Office of Management and Budget, and the typical approval process can last up to six months. Recently the National Park Service, together with the Department of the Interior and the Office of Management and Budget, developed a proposal to streamline approvals as an exercise in "reinventing government." A three-year pilot effort was launched in 1998 that will dramatically reduce the approval period for most visitor surveys, saving significant time and money.

Ecologist Kate Kendall *of the U.S. Geological Survey and Glacier National Park Assistant Superintendent Butch Farabee gather grizzly bear hair samples from a passive hair trap, one of 618 set up in the greater Glacier area for the bear DNA study. The DNA gathered from these samples will allow scientists to determine and monitor bear population trends in a nonintrusive and cost-effective way.*

PARTNERS IN SCIENCE

Caring for natural resources in the national park system is a complex and often daunting responsibility that requires more scientific information sources and technical know-how than the National Park Service can rightly develop on its own. The Park Service does not conduct basic research, and certain scientific knowledge is so specialized or so specific to a locality that this expertise is better obtained elsewhere. For such needs the Park Service relies on its many partners, including other federal entities, academic institutions, nongovernmental organizations, and corporations, for their services, skills, and resources. The stories from 1998 highlight several contributions made by these science partners. They clearly illustrate the value of partnerships in deepening our understanding of complex ecosystem processes, in applying science to resource management, and in studying the relationship between people and parks.

Research Advance

SAMPLING GRIZZLIES WITH NONINVASIVE TECHNIQUES

by Katherine C. Kendall

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How do you count grizzly bears in 2 million acres of rugged, mountainous wilderness? In the Glacier National Park ecosystem (Montana, Alberta), Biological Resources Division researchers in conjunction with numerous partners are attempting to do so without capturing or even trying to see bears. Calendar year 1998 marked the start of a four-year project to monitor the grizzly bear population using noninvasive sampling and DNA fingerprinting. While conventional bear studies rely on radiotelemetry with its attendant trapping, collaring, and aerial tracking, new genetic technology now allows scientists to identify the species, sex, and individual identity of bears from small samples of hair or scat collected long after the bear has moved on.

To estimate population size, a small army of technicians was deployed on foot to install hair traps in each of 126 cells of an 8 sq km grid superimposed on maps of the study area. Bear hair traps consisted of a scent lure surrounded by a single strand of barbed wire stapled to trees. When bears passed over or under the wire to investigate the lure, they often left hair on the barbs. Fourteen days after the traps were set up, crews returned to collect the hair samples and move the traps to other sites within the cells. During five trap sessions in 1998, more than 5,500 hair samples were collected from 630 traps.

Another goal of the project is to develop a noninvasive protocol for monitoring the bear population trend that

> "... new genetic technology now allows scientists to identify the species, sex, and individual identity of bears from small samples of hair or scat ..."

can be implemented by existing park staff. Pilot studies conducted in previous years suggest that surveys for bear scat and hair on rub trees could achieve that objective. To test this, backcountry and bear management ranger staff surveyed all 800 miles of Glacier's trails at least three times last summer. Their labors yielded 1,300 hair samples and 700 scats. Data from these samples will be used to estimate the power of bear sign surveys to detect population change.

USGS Biological Resources Division, Kate Kendall

Oblivious to a remotely operated camera, *a grizzly bear snaps its own picture while rubbing in scent lure, a putrid mix of fish and cattle blood. Although offensive to humans, the attractant is very effective at luring bears into the hair-sampling stations without providing a food reward.*

USGS Biological Resources Division, Mike Maples and Pete Metzger

Award-Winner Profile
KATE KENDALL RECEIVES TOP RESEARCH HONOR

The 1997 Director's Award for Natural Resource Research was presented to Kate Kendall, research ecologist with the USGS Biological Resources Division, Glacier National Park. A longtime researcher in parks of the northern Rocky Mountains, Kate continually links important ecological issues to park management considerations. Much of her research has centered on the highly visible area of grizzly bear ecology. Her recent application of a noninvasive grizzly bear sampling technique, as reported in this chapter's lead story, holds potential for broad application in other parks and with other species. She is also concluding a study of the status of whitebark and limber pine communities in response to blister rust disease in Glacier, Grand Teton, and Yellowstone National Parks.

© George Scherman

Kate Kendall in grizzly bear den.

After the labor-intensive task of preparing samples for DNA extraction, the samples are sent to a genetics lab. While full analyses will require at least several more months, early results are encouraging. More than 90% of the hair samples and 80% of the scats have yielded usable DNA. Forty-five percent of the hair samples analyzed for species to date are grizzly. Once individual identities are determined, mark-recapture models will be used to estimate the population density of grizzlies in the greater Glacier ecosystem. The data will also permit evaluation of the adequacy of hair trap density in relation to the precision (confidence interval) of the population estimate.

Hands-off genetic sampling does have limitations, however. For example, the age of animals cannot be determined through genetic means, and in some cases study objectives require observing or handling animals. When dealing with small amounts of DNA such as those obtained from scat samples, duplicate analyses must be run to obtain reliable results. The possibility always exists that some bears will not be attracted to the traps, which can cause errors in density estimates. However, DNA fingerprinting with subsequent intensive monitoring can provide defensible data on absolute minimum numbers and demographics of grizzly bears using an area—all without ever having to *see* them, much less trap and mark them!

Whether estimating population size, trend, or genetic fitness, noninvasive genetic methods hold enormous potential for surveying other elusive forest carnivores and sensitive species. Genetic sampling can provide unequivocal information needed for resource stewardship. For instance, it can be employed to establish the presence of rare animals where this was impractical in the past. Not only are noninvasive techniques less stressful to study subjects, but they also help preserve the solitude and untrammeled character of national parks. Genetic sampling is bound to become an important inventory, monitoring, and research tool in natural areas in the future.

Named for the smoke-like haze *that envelops the woodlands and hollows, Great Smoky Mountains National Park is the location of an ambitious scientific undertaking—the world's first inventory of all forms of life in a discrete area. The project is expected to take about a decade and will involve numerous partners.*

INVENTORY OF BIODIVERSITY TAKES SHAPE IN THE SMOKY MOUNTAINS GPRA

by Becky Nichols

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The assemblages of living organisms in Great Smoky Mountains National Park in Tennessee and North Carolina are some of the richest and most diverse in the temperate world. New taxa are routinely discovered not only by scientists but also by the public. For example, a trail maintenance worker recently discovered a new species of earthworm on the Appalachian Trail. Nevertheless, formal inventories have not been comprehensive, and fewer than 10,000 (10%) of an estimated 100,000 faunal and floral species are known in the park.

Existing and impending threats in the park region include invasion by exotic species, air pollution, and forest diseases. Protection of natural resources from these threats requires advanced management techniques that are enhanced by information on the identity and status of the species. This need for information precipitated the inception of an All Taxa Biodiversity Inventory.

The inventory will be comprehensive and include all life-forms. On 24 April 1998 at the Twin Creeks Natural Resources Center in Gatlinburg, Tennessee, the park made a formal announcement of the multi-year project. Deputy Director Deny Galvin of the National Park Service, many other officials and scientists from a broad range of disciplines, and local and national media attended the meeting. The inventory is expected to take 10–15 years and will be funded through the volunteer science and education organization Discover Life in America. This nonprofit group consists of a variety of public and private financial sources, including Friends of the Great Smoky Mountains National Park and the Great Smoky Mountains Natural History Association. The park and the organization will form a cooperative agreement to conduct the inventory, which will begin with a two-year pilot study.

In May 1998 the board of directors held its first meeting and adopted the draft by-laws and elected officers. A website was developed at www.discoverlife.org. This site gives details about the mission and recent activities and offers opportunities for involvement by the public. The Natural History Association assisted with the development of a brochure about the inventory.

More than 100 scientists, managers, educators, and other interested individuals attended a general planning workshop on 14–17 December 1998 in Gatlinburg. The main goal of the workshop was the development of plans for the pilot study. The participants addressed sampling design, collecting protocols, databases, fund-raising, sorting and curation of specimens, website development, communications and public relations, facilities planning, and educational programs. Pilot sampling will begin in spring 1999. Protocols and design will be refined during this time. The comprehensive phase of the inventory is expected to last for about a decade.

Blue Ridge spring salamander, © 1995 Steve Tilley

Driven by a sense of urgency, *the All Taxa Biodiversity Inventory seeks to document the Great Smoky's exceptional biodiversity, including salamander species, before some of it is lost to threats such as air pollution, exotic species, and urbanization. Since the project began, a new worm species has been discovered and numerous invertebrate finds are anticipated.*

TNC OFFERS TRAINING

Under contract to the National Park Service, The Nature Conservancy offered its training course "Vegetation Monitoring in a Management Context" to 21 NPS participants in June 1998. The course met with rave reviews for its value in providing a scientific basis for preparing an inventory and monitoring plan.

The 1988 fires *provided an opportunity to study forest recovery in Yellowstone. Vegetation growth in the Twin Lakes study plot (left), where soils are rhyolitic, covered only about 25% of the ground three years after the burn; 10 years after the fires, 60–90% of the ground was covered. In contrast, plants in the Petrified Tree plot (right), where soils are andesitic, covered 100% of the site just one year after the burn. This response is typical for vegetation growing on the volcanic andesitic soils, especially at lower elevations (< 7,600 feet above sea level).*

GEOLOGY SIGNIFICANT IN DETERMINING VEGETATION GROWTH IN YELLOWSTONE

by Don G. Despain

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The 10th anniversary of the great 1988 fires in Yellowstone National Park (Wyoming, Montana, Idaho) has allowed researchers with the Biological Resources Division (BRD) to draw some conclusions about their studies of the fires' aftermath. They have found that the ecosystem was not destroyed by the flames and that the growth of vegetation has varied in some fascinating ways—even being effected by the type of bedrock beneath the regenerating plants.

In permanently marked plots, researchers found that numerous seeds were already buried deep enough in the soil to escape the heat. Melting snows in spring 1989 brought them to life. Rhizomes and other underground plant parts also sprouted and the ground was quickly covered with vegetation. The amount of growth, the species diversity, and the species growing within the research plots were affected more by the elevation of the sites and the characteristics of the soil derived from different rock types than by differences in fire intensity. Soils derived from the basic andesitic (volcanic) rocks are higher in plant nutrients and water-holding capacity. Those derived from the acid rhyolitic (also volcanic, but higher in silica) rocks are lower in both of those categories.

After 10 years, plots on andesitic soils had a thick ground cover with plants overlapping to cover 120–140% of the surface. On the rhyolitic soils, cover was only 35–90%, but even this was greater than the prefire ground cover of 20–60%. Douglas-fir seedlings predominated on the low-elevation andesitic sites, while lodgepole pine dominated at higher elevations and on all the rhyolitic sites. On average, 20 to 25 different species per plot were documented on andesite, while only 12 to 17 species occurred on the rhyolitic sites. Plants grew faster on the warmer, lower elevations, and a given level of plant cover was reached earlier than on higher elevations. Some flowers and grasses, such as dragon's tongue and heart-leafed arnica, did better in the early years and became less conspicuous as time went on, while others, such as pine grass and showy aster, steadily increased. Seeds of two species that had not been frequently observed in the park were waiting in the soil for the fires. Shiny-leaf ceanothus seeds sprouted and began a shrub

SCIENCE INFORMATION SHARED

The Biological Resources Division unveiled its Science Information Service (SIS) on the World Wide Web in 1998. This new tool helps put managers and researchers in touch with one another by making available research abstracts on 1,800 research projects relevant to park resources. It can be accessed on the web by clicking on "Current Projects (SIS)" at http://biology.usgs.gov.

layer that will last for a century or more before it will be shaded out by the now tiny Douglas-fir trees. Bicknell's geranium seeds also responded to the heated soil; however, as a biennial it did not last very long before retreating to the cover of the soil to await the next fire, perhaps another 250 years from now.

Throughout the research, Geographic Information Systems have proven to be important for correlating the differences in recovery of vegetation with the different soils. The bedrock geology map of the park was overlain by a map showing the extent of the burn and a map showing the extent and location of the different vegetation responses. Made available to the park by BRD researchers, this map provides a visual representation of places where one would expect to see these different effects. The information will also be useful to researchers studying fire effects, such as those who look at landscape-level effects, those who follow changes in animal distribution and population status, and stream ecologists and hydrologists.

Global Climate Change

GLACIER NATIONAL PARK CLIMATE CHANGE RESEARCH DELIVERS INSIGHTS

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People are more aware than ever that global climate changes are taking place. What do these changes mean for national parks, and what is their role in the preservation of park natural resources? To answer such questions, the Department of the Interior began a broad program of global climate change research in the late 1980s. Since 1989 an interdisciplinary team from the U.S. Geological Survey, National Park Service, U.S. Forest Service, and University of Montana has conducted research at Glacier National Park (Montana) with the primary objective of understanding how this 1.1 million–acre mountain wilderness responds to the present climate so that impacts of future climate change can be predicted.

Over nine years this research team has increased the sophistication of predictive computer models, which organize available information about this complex ecosystem and, in computer code, represent known ecological relationships. Liberal use of new technologies in remote sensing and Geographic Information Systems

Using different climate scenarios, *the ecosystem model can pinpoint in space and time the likelihood of future fires, as depicted in this 3-D simulated fire map. Although actual events will vary with future climate trends, the model provides park managers with sneak previews of park landscapes to aid decision making today.*

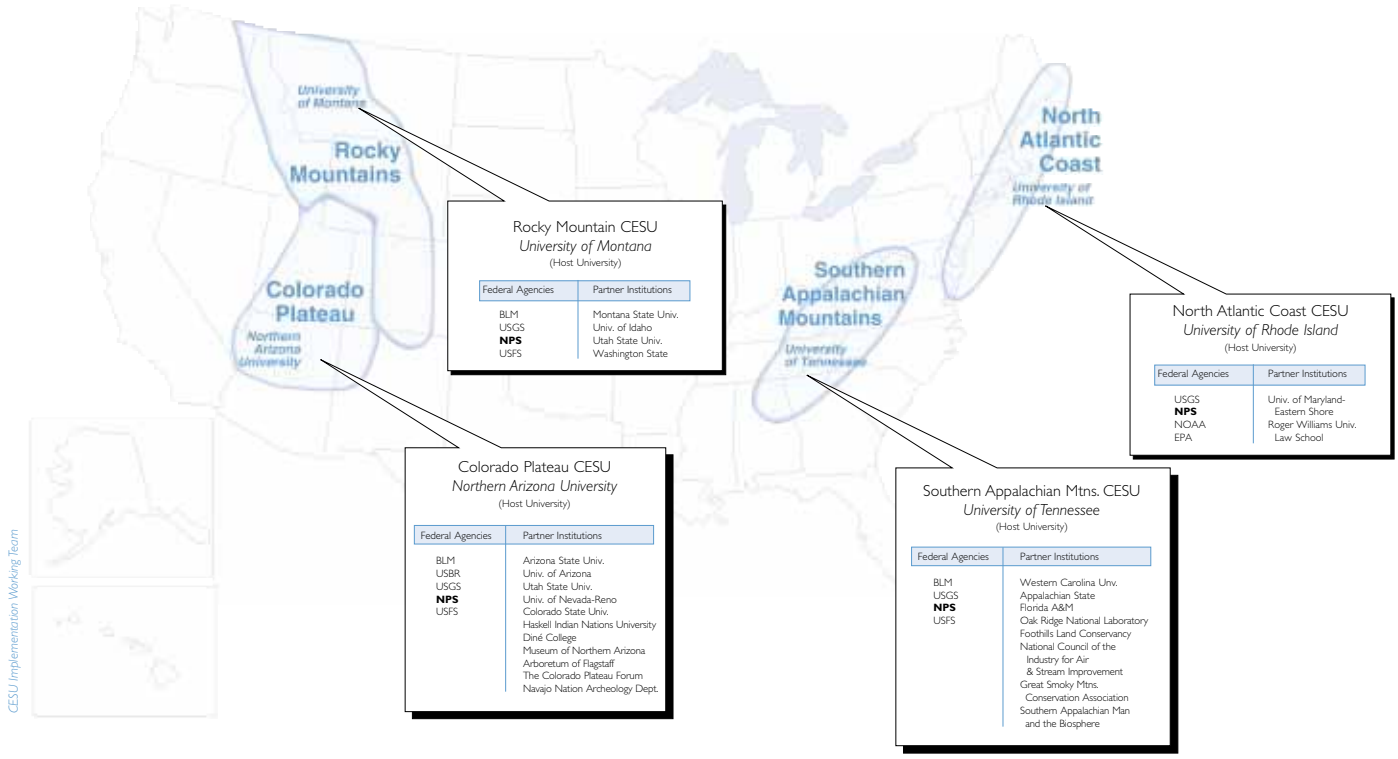
were combined with the models to produce quantitative estimates, 3-D maps, and computer animations of ecosystem dynamics. Using information from satellites and digital representations of landscapes, the team built interactive computer models to estimate ecosystem attributes such as tree distribution, density, and size. In addition to predicting these and other physical attributes, the models can estimate how the parts interact. For instance, once climate data were incorporated, the models calculated and displayed daily estimates of snowpack density, soil moisture, evapotranspiration, stream discharge, and other dynamic ecosystem attributes for a 150 square-mile mountain watershed. Thus, for any part of the park on any given day, it is now possible to predict specific measures of the ecosystem's condition.

Research scientists monitor climate changes *in Glacier National Park using automated weather stations, such as this one located above St. Mary Lake. The data are used with the ecological models to estimate responses of natural resources to future climate change.*

To ensure that the computer-based view of the ecosystem was accurate, key ecosystem outputs such as stream discharge were monitored for seven years and results were compared to model outputs. Close matches between computer-estimated and actual ecosystem measurements suggested that the park's basic responses to climate were accounted for by the models. This means that future climate scenarios can be put into the models to reveal how this ecosystem might look and act in the future. With a future 30% increase in precipitation and a slight increase in annual average temperature (the most likely climate scenario for Glacier within 50 years), the cedar-hemlock forests are favored to expand in lower elevations while accumulation of coarse woody debris and other forest responses should increase the frequency of large, stand-replacing forest fires in other areas. Testing slightly different future climate conditions, the team found that stream temperatures rise earlier in the summer, altering the abundance and distribution of stream organisms, while subalpine fir trees become more nitrogen-stressed at tree line.

Will such changes really occur? Glacier's ecosystem has already altered in response to climate change. One of the most visually dramatic changes is the shrinkage of glaciers, which in turn affects other parts of the ecosystem. Fewer than one-third of the glaciers present in 1850 still exist today, and most remaining glaciers are mere remnants of their previous size. Such irrefutable evidence of climatic change is one reason why Vice President Gore chose Glacier's backdrop in September 1997 to underscore his views on the serious threats of climate change to U.S. citizens.

Although we can never know exactly what the future holds, the capability to evaluate numerous scenarios can result in better decision making now. The models can identify which parts of the ecosystem most readily respond to change, suggesting that monitoring efforts be focused on those areas as early indicators. Similarly, some ecosystem components change more profoundly than others, which can suggest priorities for monitoring and management. Finally, the consequences of management activities such as fire suppression, under future climate scenarios, can be evaluated for unintentional effects or for cost-effectiveness.



Pilot biogeographic areas *of the Cooperative Ecosystem Studies Units (boundaries approximate).*

Acquiring Research

PROGRESS ESTABLISHING COOPERATIVE ECOSYSTEM STUDIES UNITS

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More than ever before, resource managers need rigorous science and responsive technical assistance in order to make sound management and policy decisions. Agencies must work together to address complex environmental issues that transcend administrative boundaries. Federal agencies are working to devise efficient ways to share resources and expertise.

The National Park Service has been active in an interagency working group to establish Cooperative Ecosystem Studies Units (CESUs). CESUs will provide research, technical assistance, and education to federal land management, environmental, and research agencies. They will also provide support in the biological, physical, social, and cultural sciences needed to address natural and cultural resource issues and interdisciplinary problem solving at multiple scales and in an ecosystem context. Participating agencies include the Bureau of Land Management, the Bureau of Reclamation, the USGS Biological Resources Division, the U.S. Forest Service, the Department of Energy, and the National Oceanic and Atmospheric Administration.

The objectives of the CESU network are to:

1. provide resource managers with high-quality scientific research, technical assistance, and education;
2. deliver research and technical assistance that is timely, relevant to resource managers, and necessary to develop and implement sound adaptive management approaches;
3. ensure the independence and objectivity of research;
4. create and maintain effective partnerships among the federal agencies and universities to share resources and expertise;
5. take full advantage of university resources while benefiting faculty and students;
6. encourage professional development of federal scientists; and
7. manage federal science resources efficiently.

These entities will function as "virtual" organizations, linking several institutions to increase federal access to expertise and facilities. Each CESU consists of several federal agencies, a host university, and partner institutions that bring additional expertise to the CESU to complement the skills of the host university. Each CESU also includes at least one university that primarily serves minority students or that attracts minority students to its environmental science programs. A role and mission

statement, and annual and strategic plans will guide the activities of the CESU. A managers' committee provides feedback and advice from the field.

Through a formal competition in 1998, four pilot CESUs were selected by the interagency CESU Implementation Working Group. They are being established for the following biogeographic regions: (1) the Colorado Plateau, hosted by Northern Arizona University; (2) the Rocky Mountains, hosted by the University of Montana; (3) the Southern Appalachian Mountains, hosted by the University of Tennessee; and (4) the North Atlantic Coast, hosted by the University of Rhode Island.

Selected NPS employees will be stationed for duty at CESUs. Cooperative agreements will allow the National Park Service to efficiently transfer funds to the host universities or partner institutions for research, technical assistance, and education, while maintaining authority and oversight of NPS activities with a CESU. Additional CESUs will soon be established. CESUs are powerful new tools for NPS managers as they work to partner with other agencies to integrate the results of science into NPS decision making.

NPS ESTABLISHES SOCIAL SCIENCE RESEARCH CENTER

by Gary E. Machlis and Ron A. Harris

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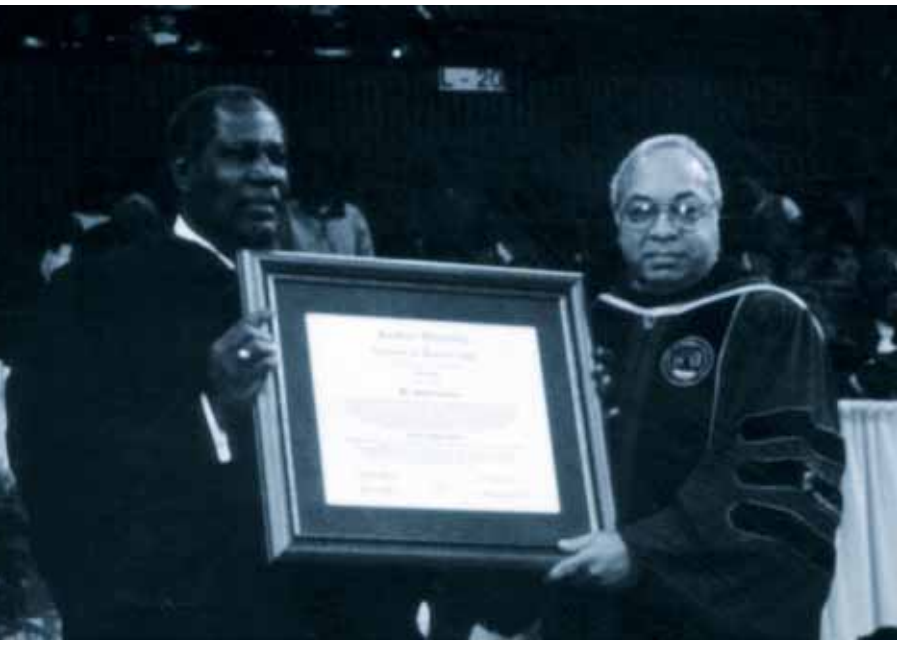
More than 40% of visits to the national park system are to urban sites. The National Park Service plays an important role in shaping the environment, civic life, cultural heritage, economy, and future of the nation's cities. This role must be based on sound stewardship of resources and an accurate understanding of the relationship between people and parks. Hence, social science research related to urban park management is a necessary and important function of the National Park Service. The Urban Recreation Research Center was first proposed in the NPS social science plan, "Usable Knowledge," and approved by the Park Service in 1996. In 1998 the Urban Recreation Research Center was established at Southern University and A&M College, a "historically black college or university."

The objectives of the Urban Recreation Research Center are (1) to assist managers of urban NPS sites in protecting resources and providing visitor services through a program of social science research, technical assistance, and education; (2) to create a wider diversity of scientists conducting research on urban recreation and increase the pool of minority students interested in NPS careers; and (3) to provide technical support to NPS partners to strengthen the role of parks in urban communities. Research conducted by the center will contribute significantly to visitor services and education programs at sites in major cities, such as New York, Los Angeles, Washington, D.C., Philadelphia, Atlanta, and New Orleans. Faculty and students at the center will examine the needs of urban youth for recreation and environmental education, problems related to high-density visitation, and ways to make parks more meaningful to people with different cultural and ethnic backgrounds. The center will also advise the National Park Service on federal programs providing technical assistance to cities to create local parks and urban greenways.

The Urban Recreation Research Center is located in the School of Public Policy and Urban Affairs at Southern University and A&M College. Dr. Ron Harris of the faculty is the director of the new center. The center will make a difference in urban parks by providing usable knowledge to help managers conserve the natural, cultural, and recreational resources of the nation. Several faculty members have a part-time appointment with the Urban

NPS Director Bob Stanton *(left) received an Honorary Doctorate in Public Policy and Urban Affairs last December from Southern University System President Leon R. Tarver II and Southern University and A&M College Chancellor Edward R. Jackson (not shown) at the campus in Baton Rouge, Louisiana. Director Stanton also delivered the commencement address, inaugurating the Urban Recreation Research Center.*



Recreation Research Center: Dr. Alfredo Lorenzo (urban forestry), Dr. Patricia Melson (recreation and leisure), and Dr. Christie Onwujuba (public administration). Several graduate students will serve as research assistants; one is serving as an intern with the Social Science Program in Washington, D.C., beginning January 1999. The NPS Visiting Chief Social Scientist, Dr. Gary Machlis, has been appointed as Adjunct Professor of Public Policy and Urban Affairs and will work with the faculty, present guest lectures, and advise students. In December, NPS Director Stanton toured the Urban Recreation Research Center, met with faculty and students, and delivered Southern University's winter commencement address.

SCHOLARSHIP PROGRAM COMPLETES SECOND YEAR

by Jean E. McKendry

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In 1998, the Canon National Parks Science Scholars Program named its second class of Ph.D. scholarship recipients. These scholars represent some of the country's best university students working in conservation, environmental science, and park management. Each Canon Scholar receives $25,000 per year for up to three years to conduct research important to the future of the national parks.

The Canon National Parks Science Scholars Program is underwritten by Canon U.S.A., Inc. Other collaborating organizations include the National Park Service, the National Park Foundation, and the American Association for the Advancement of Science (AAAS). The Natural Resource Stewardship and Science directorate coordinates the program. Each year the associate director, drawing on suggestions from park superintendents, selects research questions in four areas: biological, physical, social, and cultural sciences. The American Association for the Advancement of Science assembles scientific panels to evaluate submitted proposals and select the winners. The National Park Foundation transfers scholarship funds provided by Canon for tuition, fieldwork, a stipend, and other expenses. The students must complete a dissertation, prepare an article for park managers on the significance of their research, and present a public lecture about their work.

The 1998 Canon Scholars are Elizabeth Barrie (Indiana University), Kurt Menning (University of California, Berkeley), and Karen Short (University of Montana). Barrie will investigate the meaning of interpretive experiences at Yellowstone National Park. Menning will study the landscape-level effects of restoring fire at Sequoia National Park. Short will explore the effects of fire on understory birds at Saguaro National Park and Chiricahua National Monument.

In 1999 the Canon National Parks Science Scholars Program will be expanded, with eight new Canon Scholars selected each year through 2001. It is expected that members of the first class of Canon Scholars will complete their research by 2000. In total, Canon U.S.A. has made a five-year, $2.5 million commitment to the development of young scientists. The Canon National Parks Science Scholars Program is poised to become one of the most important and prestigious fellowships in the fields of conservation, environmental science, and park management.

Held last fall at the headquarters of the American Association for the Advancement of Science in Washington, D.C., the Canon National Parks Science Scholars Program awards ceremony was also the venue for the first annual Canon Lecture on Science and the National Parks. The 1998 lecturer was Dr. Daniel Janzen, professor of conservation biology at the University of Pennsylvania. In his lecture, Dr. Janzen called for increased "bioliteracy" and the development of widely accessible science databases.

Attending the Canon National Parks Science Scholars awards ceremony *were (from left to right) 1998 Canon Scholars Karen Short and Kurt Menning; AAAS Executive Officer Dr. Richard Nicholson; Canon U.S.A., Inc., President and CEO Mr. Haruo Murase; NPS Director Bob Stanton; 1998 Canon Scholar Elizabeth Barrie; and Mr. James Leiby, Government Marketing Division, Canon U.S.A., Inc. The ceremony took place at AAAS headquarters in Washington, D.C., in November.*

Floating marshes and forest wetlands *comprise the complex estuarine resource of the Barataria Preserve unit of Jean Lafitte National Historical Park, site of recent 3-D seismic oil exploration activities. To reduce compaction of marsh vegetation, reduced-weight, aluminum marsh buggies were used to drill and set explosives.*

RESOURCE DISTURBANCES

The natural resources held in trust by the National Park Service are remarkably diverse and awe-inspiring. However, maintaining them in an unimpaired condition is a daily struggle for professional resource managers. Both external and internal influences disrupt the very resources that inspire public pride. Nonnative species, environmental contamination, noise pollution, and even legitimate park uses caused great concern and required remedial action in 1998. To be effective resource stewards, managers must first recognize a decline in resource condition before they can begin to understand its causes and work out suitable remedies. Even then, finding solutions can be complex, time-consuming, and expensive. Science tools such as inventories, monitoring, and research provide direction and suggest many courses of action. However, for the National Park Service to be most effective in preserving natural resources, it must elevate science to a level commensurate with the demands of the widespread and often confounding natural resource disturbances confronted in parks today.

Oil & Gas Development

JEAN LAFITTE LEARNS FROM 3-D SEISMIC OIL EXPLORATION EXPERIENCE

by Sandee Dingman

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Petroleum exploration technology advanced into the national parks in 1998 when a three-dimensional seismic operation was undertaken in Jean Lafitte National Historical Park and Preserve (Louisiana), the first such operation in a national park. This new technology presented challenges for park managers to protect resources while providing for the exercise of nonfederal oil and gas rights consistent with the park's enabling legislation. Cooperative planning with the operator, Burlington Resources, was crucial to reducing the resource impacts of this intensive operation.

As a geophysical exploration technique, 3-D seismic technology is a relatively new application of an old skill: listening. Energy waves are generated near the earth's surface by detonation of an explosive charge known as a source. The energy travels through the earth to a subsurface target, where it is reflected back to the surface to be recorded on a grid of receivers. The recorded energy waves are then computer-analyzed to identify potential petroleum reserves. It is the grid of sources and receivers that makes 3-D different from the 2-D or straight-line operations of the past.

The Burlington Resources operation covered 32,000 acres, including 6,360 acres of the park's Barataria Preserve unit, a highly productive estuarine complex of floating marshes and forest wetlands. Within the park, 477 sources were detonated on precise alignments along 36 miles of source lines. The generated energy was then recorded by 1,300 receivers along 54 miles of receiver lines laid out in an overlapping grid.

During 18 months of planning, a number of creative solutions were developed to protect sensitive resources such as rare plant communities, popular hiking and canoe trails, archeological sites, and long-term research plots. Bio-remediating explosives were used to avoid water and soil contamination. Travel routes were carefully designed and equipment was modified to reduce weight to minimize compression of the organic marsh substrate and resulting hydrologic modifications. Very sensitive resources were designated as avoidance areas for all motorized equipment. Park newsletter and local newspaper articles kept the community informed, and a new interpretive wayside paid for by the operator explained this complex operation to park visitors.

Essential to successful implementation of the planned operation was the use of third-party compliance monitors hired by the operator with approval by the park. Monitoring was accomplished by wetland scientists, who provided on-site control of all field operations under the

VEGETATION MAPPING

Vegetation-mapping products from the USGS Biological Resources Division—funded and —administered program for vegetation mapping on NPS lands increased in 1998. However, at the current funding level, the program would take 30 years or more to fill all park vegetation-mapping needs. Plans for 1999 are to realize efficiencies in the overlap of vegetation-mapping products for NPS fire management under the FirePro program (i.e., development of park-specific fire fuels maps and plots for fire effects monitoring) and those intended for general resource management use. The resulting products will serve both purposes.

Jean Lafitte National Historical Park

Jean Lafitte National Historical Park

Organic matting *was employed on exposed substrates to stabilize soils until plants from the surrounding marsh could recolonize damaged sites.*

guidance of the park's natural resource management specialist. The monitors maintained daily contact with the many field crews and provided comprehensive documentation of field activities during 74 days of continuous operations.

Thanks to cooperative planning and effective monitoring, resource damage was minor and localized. In the few areas where damage occurred, the substrate was stabilized with organic matting and, where needed, replanted. Most plant communities had recovered by the end of the growing season. Aerial photography and visual inspections will continue for three years, as planned, but no long-term impacts are anticipated.

To share insights regarding 3-D seismic operations, Jean Lafitte hosted a workshop in May for other parks with nonfederal oil and gas rights. As 1998 drew to a close, Big Thicket National Preserve (Texas), Big Cypress National Preserve (Florida), and Padre Island National Seashore (Texas) were all in the planning or implementation process for other 3-D seismic operations, and more are likely to follow.

EXOTIC INSECT JEOPARDIZES EASTERN HEMLOCKS

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First detected in Shenandoah National Park (Virginia) 10 years ago, the hemlock woolly adelgid is an aphidlike insect that sucks sap from branchlets of eastern hemlock. The tree loses strength and sheds its needles, which can lead to death unless conditions are ideal for survival. Though isolated trees may avoid the threat posed by this nonnative insect infestation, hemlock stands may not survive beyond 5–10 years. This has grave implications for associated species.

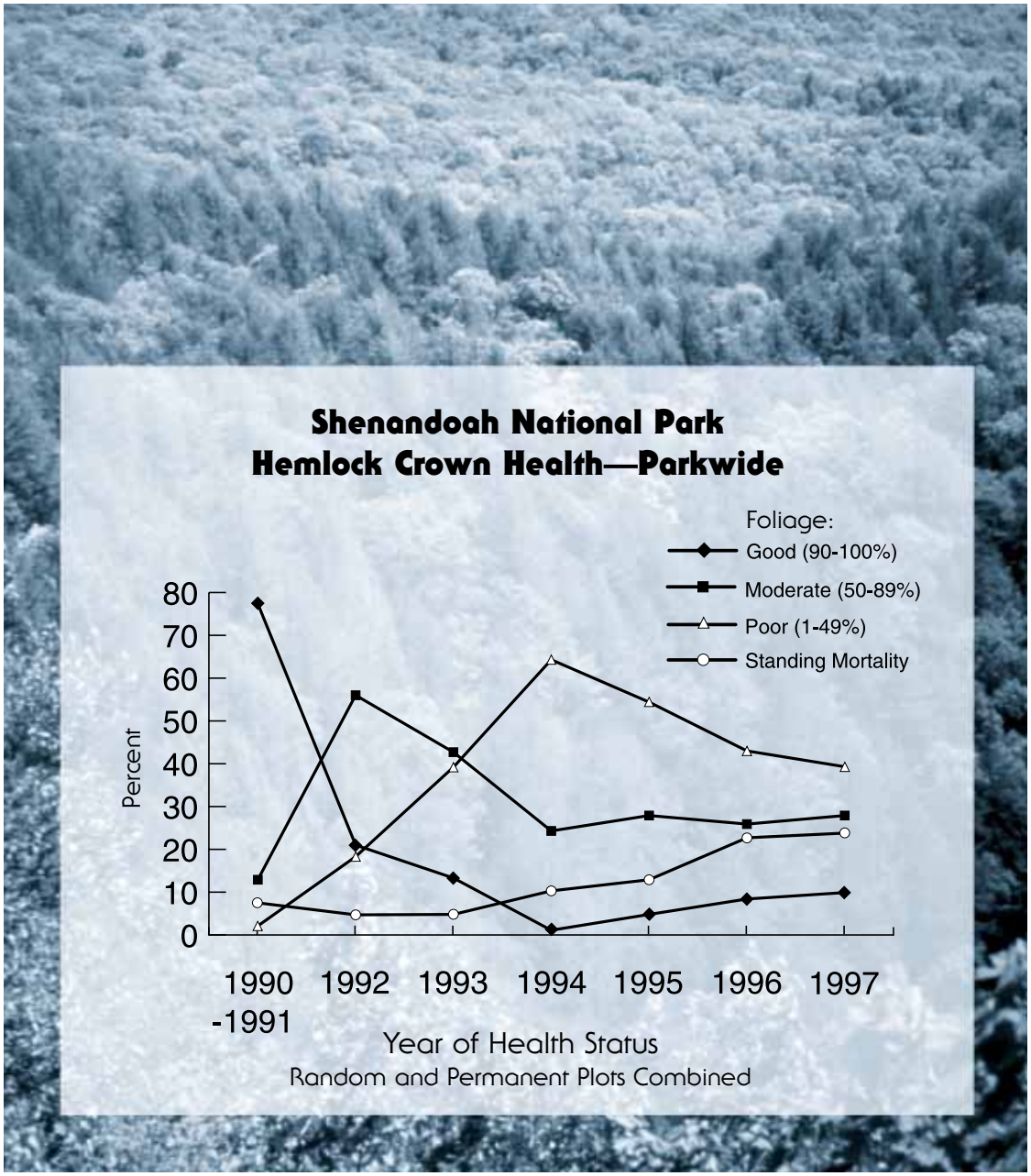
Fading tree-crown color, from robust deep greens to grayish tones, led to the discovery of the infestation in Thornton and Frazier Hollows, and by 1993 the insect was found in hemlocks throughout the park. Since 1991, formerly full-crowned trees (77% of the population) have been reduced to thin, partial crowns with much associated mortality. Interestingly, this negative trend slowed down during 1996–98, which led the park and researchers from the USGS Biological Resources Division to surmise that the harsh winter of 1995–96 contributed to adelgid decline. However, two recent, mild winters and a drought in 1998 may cause further hemlock decline, given that moisture stress hinders the hemlock's ability to resist effects of the insect.

The park and the Biological Resources Division are working together to ferret out the risk factors associated with the infestation and to create a model that predicts associated mortality. Using Geographic Information Systems and statistical analyses of the park's annual hemlock crown assessment data, the team found areas of higher risk potential. Heavier impacts seem to occur at lower elevations, probably indicating the importance of winter cold in controlling the insect. They also found that slope, light conditions (such as site aspect and position), and distance to streams correlated with hemlock condition. The results of this preliminary analysis are helping to guide 1999 research, which will look at several years of imagery and weather and climate data to correlate and model

hemlock stand vulnerability as a result of site, landscape, and regional factors.

While research is aimed at understanding factors contributing to the infestation and decline, resource management activities seek to protect the tree species. Shenandoah has adopted the following objectives: (1) preserving a seed source for future hemlock reestablishment, (2) preserving individuals in important cultural sites and recreation areas, and (3) reducing the risk of falling trees in highly visited areas. In FY 1998, recognizing the dire situation of the hemlock forest, resource managers increased the frequency and breadth of their efforts to suppress the hemlock woolly adelgid. Nevertheless, treatments are still limited to areas accessible by vehicles equipped with hydraulic spray equipment, which are used to apply insecticidal soap or horticultural oil. This approach is employed by other federal agencies too. High-value individual hemlocks located far from roads may be treated with systemic insecticides on a case-by-case basis.

With such limited treatments, the long-term hope for the eastern hemlock in Virginia may be the introduction of natural, albeit nonnative, biological controls. The U.S. Forest Service and the Connecticut Agricultural Experiment Station are carefully testing several Asian insects on the East Coast with such a purpose in mind.



Graph—Shenandoah National Park; James Akerson; Photo—Shenandoah National Park

ZEBRA MUSSELS AT ST. CROIX

Following another year of active monitoring, education, access management, and research, the St. Croix National Scenic Riverway (Wisconsin and Minnesota) is still considered free of reproducing populations of the exotic freshwater zebra mussel, which threatens native mussels. During the year there was no duplication of the 1997 finding of nearly 50 juvenile zebra mussels on a plate sampler, although the species was again discovered on boats and sporadically on native mussels and other hard substrates.

Shenandoah National Park

The presence of white, woolly masses *on hemlock branchlets is a sure sign of hemlock woolly adelgid, the nonnative insect species responsible for the alarming decline in hemlock health in Shenandoah. Larvae are the size of aphids and produce cottonlike tufts that stay with the species throughout its life.*

Although small, *a patch of yellow toadflax in an otherwise pristine-looking meadow in Rocky Mountain National Park is symbolic of the far-reaching threat of invasive plant species. The park has begun to focus on assessing, controlling, and monitoring 12 problem exotics with the help of park neighbors and innovative funding programs.*

Both Rocky Mountain *National Park and Weir Farm National Historic Site raised awareness of invasive plant problems in and around their parks during 1998 by forming weed-control teams funded partly by the Pulling Together Initiative. As one of its activities, the Rocky Mountain team pulled nonnative dalmation toadflax from an upland shrub and grassland meadow.*

PARKS CULTIVATE PARTNERSHIPS TO TACKLE NOXIOUS WEEDS

GPRA

by Jeff Connor and Greg Waters

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Invasive nonnative plants are the most serious threat to native plants, and the spread of some noxious weeds poses tremendous economic damage to public and private lands. Control of nonnative plants, however, is doomed unless adjacent landowners unite in their efforts. Such unions by parks and local communities in Colorado and in Connecticut have been highly successful.

Rocky Mountain National Park and its gateway community of Estes Park teamed up in 1998 to assess, control, and monitor 12 problem plants. The partnership came about because the town feared the spread of leafy spurge from inside to outside the park, and the park wanted to prevent the spread of diffuse knapweed to inside its boundaries. Ultimately, the park and Estes Park became one of six demonstration sites in Colorado where public and private entities are working together.

Monies supporting the partnership came from several sources, primarily the National Fish and Wildlife Foundation's Pulling Together Initiative and a matching grant from the Colorado Noxious Weed Management Fund. Additionally, NPS Fee Demonstration Program project funds and Larimer County Parks and Open Space provided grants to combat leafy spurge, diffuse knapweed, and 10 other noxious weeds. The park, home owners' associations and private landowners, the U.S. Forest Service, Bureau of Reclamation, Colorado Division of Wildlife, Estes Park Rotary, Estes Valley Improvement Association, Estes Valley Land Trust, Estes Park Parks Department, Estes Park Recreation District, Estes Park School District, YMCA of the Rockies, and Boulder County Open Space contributed matching funds or supported costs of the program.

In 1998 about 1,500 acres of public and private lands were mapped and 100 acres were treated with herbicides. On 20 acres the weeds were mowed and pulled out by hand. About 95 acres were treated with biological control insects. All the leafy spurge inside Rocky Mountain National Park and all the diffuse knapweed inside the park and within $^1/_2$ mile outside of the park boundary were controlled.

Weir Farm National Historic Site and its neighboring private landowners in the towns of Ridgefield and Wilton, Connecticut, were invaded by nonnative plants. The park, which also received funds from the Pulling Together Initiative, spearheaded the formation of a team to control invasive plants throughout the local community. The team consists of two garden clubs, two town conservation commissions, an environmental education center, a watershed preservation organization, and the park itself. Its objectives are to inform the local community of the problem with invasive plants and to hold field days to demonstrate plant identification and weed-control techniques.

In 1998 several articles appeared in local papers and in magazines, a local radio station featured discussions, and a local cable channel periodically showed slides of various noxious weeds and offered advice for control. Several public lectures focused on identification of and control measures for invasive plants, and on alternative landscape plantings. Practical work sessions gave people experience in controlling invasive plants, such as Asiatic barberry, autumn olive, oriental bittersweet, winged euonymus, and multiflora rose. An invasive plant symposium, bringing together federal, state, and local interest groups, is planned for 1999.

EXOTIC SPECIES FACT BOOK PUBLISHED

In October, parks received the fact book Invasive Plants Changing the Landscape of America. *This reference summarizes the impacts of noxious weeds upon ecosystems of the United States and is intended for use by decision makers, resource managers, and others who need information about invasive plants. The book is published by the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, which is cochaired by the National Park Service, and is available from the U.S. Government Printing Office (www.access.gpo.gov).*

AT WHAT COST? DECIDING WHETHER TO CONTROL EXOTIC PLANTS GPRA

by Sue Rutman

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By accident or on purpose, many African plant species, particularly buffelgrass, have invaded the desert Southwest, where the climate is similar to that in parts of Africa. Ecologists in southern Arizona have been alarmed about the invasion and have called it the "Africanization" of the Sonoran Desert.

Buffelgrass is a 1- to 4-foot-tall, drought-tolerant perennial bunchgrass with many stems arising from a base. It is fire-tolerant and can colonize disturbed and undisturbed sites. In Organ Pipe Cactus National Monument in Arizona, buffelgrass was first recorded in 1984. Its abundance increased rapidly. By the late 1980s, the grass had colonized more small areas, and by the mid-1990s the native vegetation along the southern boundary of the monument was being replaced by monotypic stands of buffelgrass. The prospect of losing an important piece of the most biologically diverse North American desert seemed imminent. The dismal thought of buffelgrass replacing the organ pipe cactus, with its sweet nectar and fruit; the giant saguaro, with its distinctive shape; and the ironwood tree, with its life-giving shade; spurred action by park resource managers.

Many plant ecologists were against mechanical removal because they feared disturbance of the soil would favor the species, not eradicate it. Despite those concerns, the staff at Organ Pipe Cactus National Monument tried to mechanically remove the buffelgrass from a small test area. The next year, some seedlings were removed from the same area. Since then the area has been free of buffelgrass.

Impetus for further action came from consulting the NPS Natural Resources Report *Handbook for Ranking Exotic Plants for Management and Control.*[1] This publication outlines an analytical approach (modified for our purposes) to prioritizing management actions by considering the significance of impacts from an exotic species and the feasibility of control. In view of the potential for ecosystem-wide effects and the success in the test area, the scope of the project was broadened during 1998. In just several months, about 40 tons of buffelgrass were removed from thousands of acres. By the end of winter 1998–99, about 41,472 hectares, or 10,240 acres (95%), of the formerly infested area was free of buffelgrass.

A classic Sonoran Desert park, *Organ Pipe Cactus National Monument faced the potential loss of biodiversity from a progressive invasion of nonnative buffelgrass. After carefully considering the ecological consequences of the infestation, staff removed 40 tons of the species from over 10,000 acres. A program is now in place to monitor effectiveness of the removal.*

For monitoring the effectiveness of the removal, plots were established and inspected every three months during the first year. Early results suggested that mechanical removal was effective if seedlings were removed the following year. Few new plants have established themselves in most plots. Reestablishment of plants was primarily a problem only in sites where wildland fires had occurred accidentally.

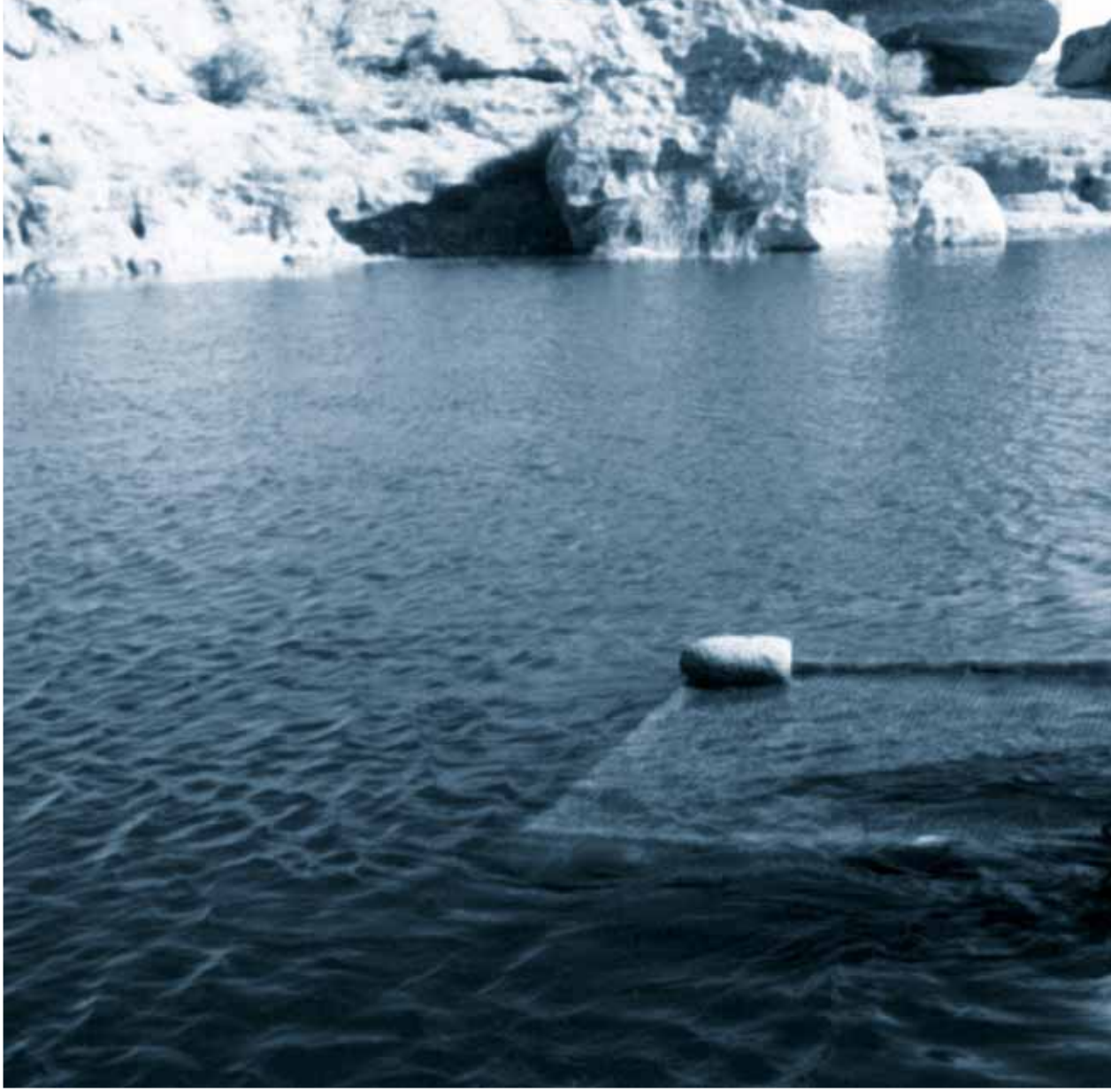
Control of buffelgrass will require continued vigilance and removal; however, this effort seems worthwhile. Time spent removing the grass—accomplished by part-time staff and volunteers—was roughly the same as or less than that spent picking up refuse along the single highway through the monument. With an ecosystem at stake, this time is a small cost.

[1]Hiebert, R. D., and J. Stubbendieck. 1993. *Handbook for Ranking Exotic Plants for Management and Control.* Natural Resources Report NPS/NRMWRO/NRR93/08. National Park Service, Denver, Colorado.

LAKE MEAD SWAT TEAM

The exotic plant SWAT team headquartered at Lake Mead National Recreation Area (Nevada and Arizona) and funded through FY 1999 was busy in 1998 treating six nonnative species in nine units of the national park system in the Southwest. The crew of 10 spent nearly 3,600 hours treating or following up on earlier treatments of tamarisk, Russian olive, ailanthus, pampas grass, oleander, and date palm at the parks. This regional approach to exotic species control is proving efficient and effective and may be used elsewhere in the national park system.

Researchers retrieve carp *from Lake Mead in preparation for a follow-up study on the effects of the endocrine-disrupting chemicals on park fish populations.*



NEW PROBLEM FOR YELLOWSTONE CUTTHROAT

Caused by a microscopic parasite of European origin, whirling disease was found in 11 of 41 Yellowstone Lake cutthroat trout sampled during the fall. The disease attacks the cartilage of some fish species, causing whirling behavior and often death either from the disease itself, starvation because of inability to feed normally, or increased vulnerability to predators such as the non-native lake trout, which were first confirmed in Yellowstone Lake in 1994. Park biologists do not know what effect the disease will have on the native cutthroat population. Indeed, many questions remain unanswered, such as why some fish are more susceptible than others, what role alternate hosts play in disease transmission, and how the disease can be controlled.

External Development

SOURCE OF CHEMICALS THAT FEMINIZE LAKE MEAD FISH DISCOVERED

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Researchers from the U.S. Geological Survey have found high levels of the female hormone vitellogenin in male carp in Lake Mead (Nevada and Arizona). Normally, only female carp produce vitellogenin, a compound that promotes egg-laying. The presence of this chemical in male carp indicates that something, possibly a pollutant, has "feminized" the males. Since certain synthetic chemicals can mimic or block the activity of natural hormones, causing significant impacts on fish, wildlife, or humans, Lake Mead National Recreation Area staff took action to determine the source of the problem.

The Water Resources Division assisted Lake Mead National Recreation Area staff in contacting experts from around the world to help decide how to handle this problem. An advisory group of these experts was convened to develop strategies for identifying the chemical(s) responsible for the endocrine impacts on the carp's normal hormonal functioning. At the group's urging, Shane Snyder, an environmental toxicologist and chemist at Michigan State University, began a study to identify the chemical compounds responsible for the endocrine disruption.

The study results, published in 1998, suggest that natural and synthetic hormones originating in women's urine are among the culprits. Human female reproductive hormones,

including estradiol (natural estrogen) and ethinyl estradiol (the synthetic hormone in the birth control pill), were identified as the initial prime suspects in endocrine disruption of Lake Mead fish. Ethinyl estradiol is much more resistant to breakdown in the environment and in current wastewater treatment systems than are natural estrogens. Other potentially endocrine-active synthetic chemicals in Las Vegas Wash, the site of the study, include butyl tins and perchlorate.

Initial discussions were held with operators of the Las Vegas wastewater treatment plants to determine if remedies are available to remove the estradiol and ethinyl estradiol compounds from treated discharges. However, this treatment process will be difficult and expensive. Instead of focusing on the sewage treatment option, the Park Service will concentrate on more completely documenting the effects of these chemicals in the water column on fish and fish populations. With this goal in mind, the Southern Nevada Water Authority and the National Park Service are supporting a study of the effects of the chemicals on caged fish. In addition, endangered fish studies are being considered; if endangered fish are at risk, managing the level of the disruptive chemicals becomes even more important.

The suspect chemicals (estradiols, organochlorines, and phenols) are changed by the human body into a less estrogenic and more water-soluble form that can move around easily in surface water. Once these chemicals are transported to other media (such as sediments, fish guts, or human guts), they may be changed by bacteria back into the more estrogenic form, which is more hazardous, more endocrine-active, and less soluble (less mobile) than the parent compounds.

As the city of Las Vegas continues to grow rapidly, and as the flow of treated sewage into Lake Mead increases, endocrine disruption and other impacts on water quality and park resources may also grow and will need to be closely monitored and mitigated.

Award-Winner Profile
KENT TURNER HONORED

The 1997 Director's Award for Natural Resource Management was given to Kent Turner, chief of resource management at Lake Mead National Recreation Area (Nevada and Arizona). An effective administrator, Kent has developed a professional and respected resource management staff. Through their efforts, park natural and cultural resources are now widely recognized as both important and varied. Under his guidance, Kent's staff devised and implemented monitoring strategies for the relict leopard frog, desert tortoise, and desert shrub plant communities. Seventy percent of the park boundary is now protected through partnerships with adjacent land managers. A burro management plan is complete and more than 900 burros have been removed from the park. Nineteen springs and eight other sites are free of non-native tamarisk, and a native plant nursery has been established. This robust resource management program, assembled and nurtured through Kent's energies and support, has strengthened partnerships with park neighbors and improved the information upon which management decisions are made.

Natural Resource Program Center

Kent Turner

PROTECTING THE NATURAL "SOUNDSCAPE" IN PARKS

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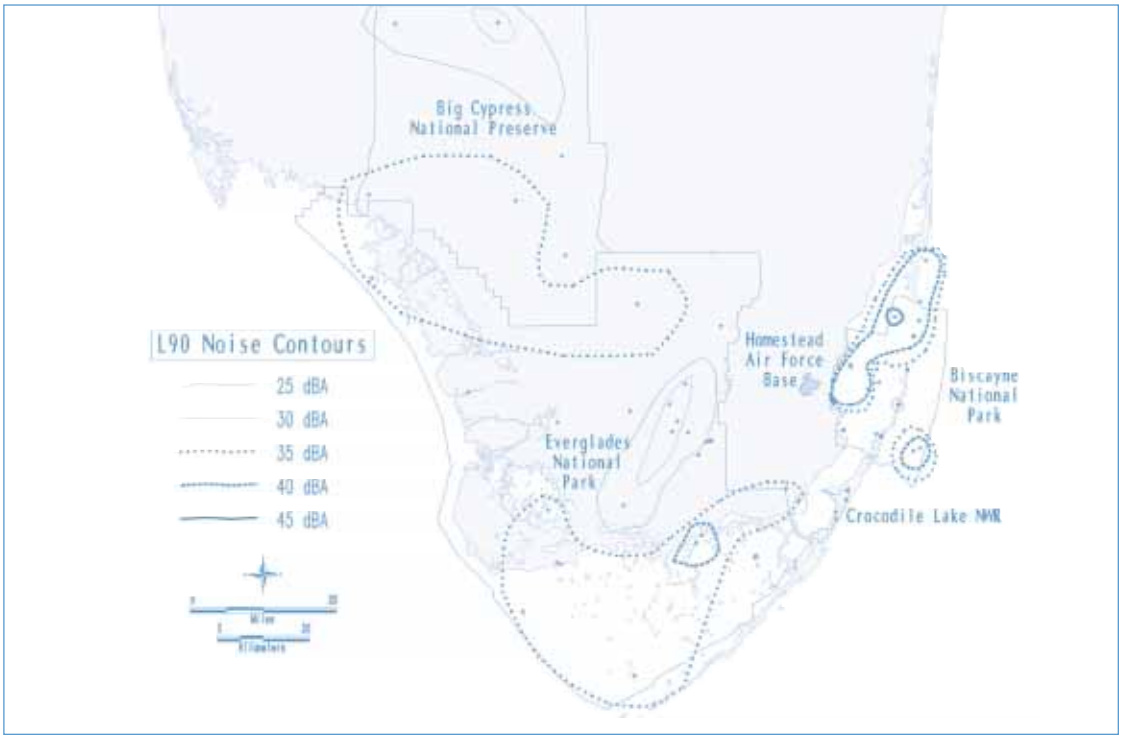
"There are many places in the national park [system] which look very much as they did 200 years ago but very few places which sound like they did even 20 years ago."

—Chip Dennerlein, Alaska Regional Director
National Parks and Conservation Association

The National Park Service is moving to define and resolve a set of problems involved in protecting and restoring an overlooked and often abused resource: the soundscape. One aspect of the noise pollution issue in parks, air tour overflights, has been a focus of the National Park Service since 1975. However, the deterioration of the soundscape due to all sources of human-caused noise is just starting to be addressed. One cluster of parks—Biscayne, Everglades, and Dry Tortugas National Parks, and Big Cypress National Preserve in south Florida—may point the way to the future of noise management in the national park system through the lessons learned and the techniques developed in those parks.

For the past few years, these parks have been the subject of noise monitoring and analysis. Initially, the catalyst was a supplemental environmental impact analysis led by the Air Force and the Federal Aviation Administration (FAA) and related to the proposal to convert the former Homestead Air Force Base, devastated by Hurricane Andrew in 1992, into a major single-runway, civilian airport. The issue has evolved into one of soundscape protection as the parks came to recognize that all human-caused noise was the problem, not just noise from aircraft.

Monitoring began in 1997 when the National Park Service sent a contractor into the field to collect the first scientific information on the nature and magnitude of natural sounds and some of the sources of human-caused noise intrusions in Everglades and Biscayne. Shortly thereafter the Federal Aviation Administration collected



The L90 noise contour map *depicts background noise levels in A-weighted decibels, minimizing the effects of human-caused sounds, in three south Florida parks. Points on the same contour line have the same value and are based on noise monitoring and analysis work, which began in 1997. The map represents a first attempt to define the natural soundscape in these parks.*

data in the area using a different method. Unfortunately, both methods have faults. The FAA approach, in particular, was keyed principally to the collection of data on aircraft noise, not on the levels of quiet the National Park Service seeks to protect. Another complication was trying to extrapolate noise data from the collection points to broader areas for the purpose of defining a park's soundscape.

In November the NPS contractor went back into the field. This time, in addition to conducting hour-long monitoring at six sites missed by the Federal Aviation Administration, the contractor set up unattended monitoring stations to collect data on diurnal variations in noise level. These data, coupled with the previous data, have begun to provide some answers.

A combination of unattended monitoring and targeted monitoring to establish daily and seasonal noise variations, and to identify the nature and levels of intrusive noise, is proving to be a better sampling strategy. The National Park Service is drafting a manual describing this method and, in 1999, plans to define a credible process for describing a park's soundscape based on disparate data. Additionally, a statistic called "L90," the sound level exceeded 90% of the time, is a useful estimate of the natural soundscape, particularly under relatively noisy conditions. A policy is being drafted that spells out obligations of the National Park Service to inventory, monitor, and protect the soundscape. Many concepts related to soundscape preservation are already discussed in the NPS education package "The Nature of Sound," and a forthcoming NPS director's order will provide further direction on this issue. Finally, Biscayne, Everglades, and Big Cypress are in various stages of developing noise management plans that detail what can and must be done to protect their soundscape resources.

MELALEUCA CONTROL CONTINUES

Big Cypress National Preserve (Florida) continues to succeed in its partnership with Dade County and the Florida Department of Corrections for the control of melaleuca. At a cost of $220,000 in 1998, the partners re-treated 701,736 seedlings and resprouts of the nonnative tree species on 35 square miles of infested lands treated initially in 1997. The preserve also found matching funds from the Miami–Dade County Wetland Trust Funds for initial melaleuca treatments through FY 1999. A private contractor is available to the preserve and to Everglades National Park for five years to carry out the control effort.

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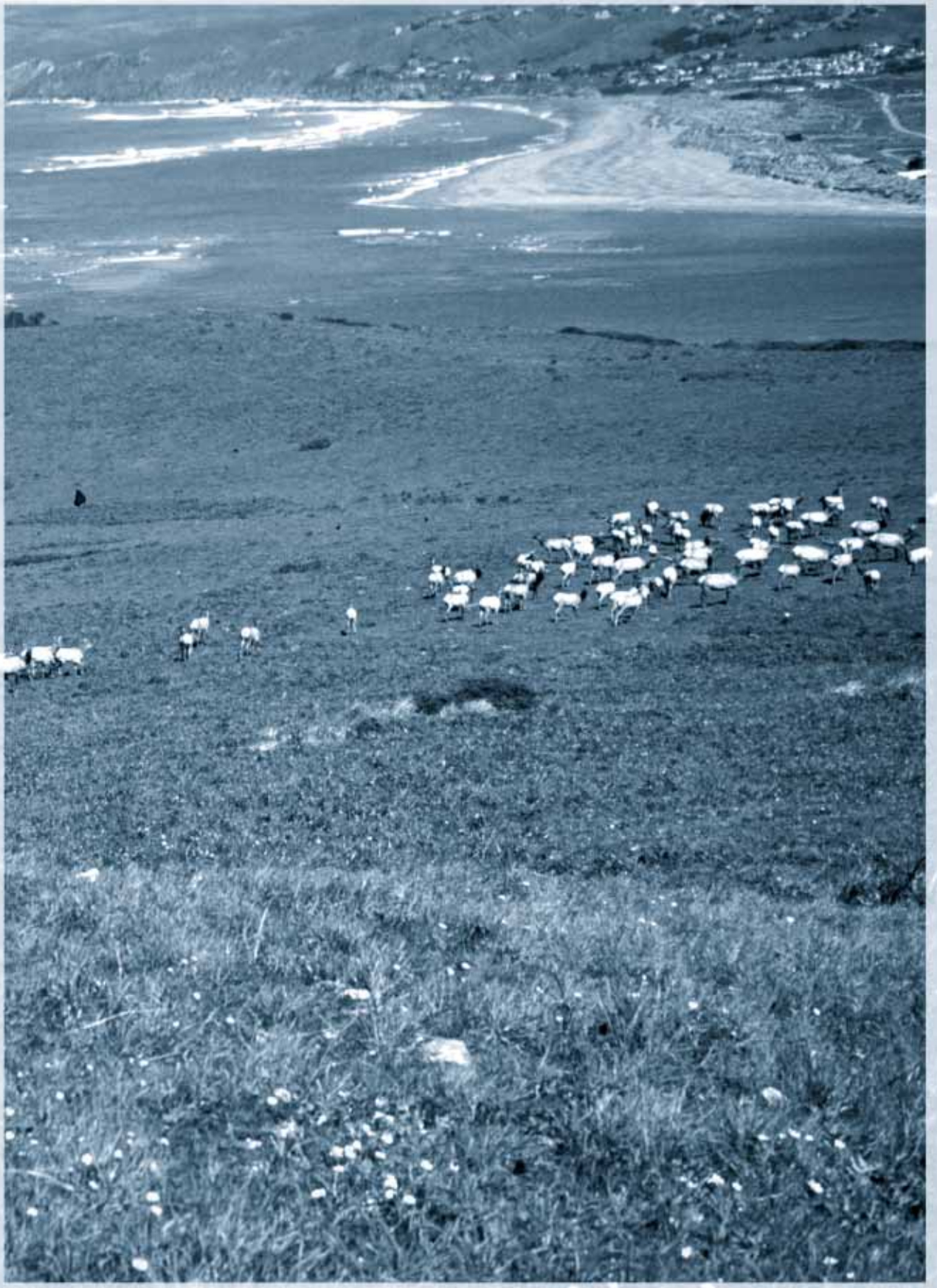
Companion to this sawgrass prairie landscape *in Everglades National Park are the sounds emanating from wind, water, wildlife, and the many other natural wonders and ecological processes preserved in the park. Recent noise monitoring in the four south Florida parks is aimed at determining the natural soundscape in these parks and protecting it from the intrusions of human-caused noise.*



Reintroduced to Point Reyes National Seashore *in 1978, a herd of 10 tule elk increased to more than 500 in 20 years. The species has been restricted to a fenced reserve on Tomales Point, but in 1999, 45 elk will be released to roam 18,000 acres of park wilderness.*

RESOURCE RESTORATION

If parks are to be complete, then damaged or extirpated natural resources must be restored. Without all the organisms and the chemical and geophysical components that define a place and their myriad interrelationships with each other, parks would not be truly representative of whole, naturally functioning ecosystems. The stories presented here tell of ecological restoration of wildlife species, wetlands, and watersheds through the use of state-of-the-art techniques and indicate many successes in this exciting area of resource stewardship. Much of the progress comes from the ability of park staff to integrate several technical disciplines and scientifically apply them to restoration activities. Also important are planning and flexible funding for projects whose duration and complexity may be uncertain. How much work is left to do? Because of fragmented natural systems and resource disturbances, ecological restoration will probably always be part of the natural resource management program in national parks. These activities are a positive force in the quest to sustain park ecosystems.

Wildlife

ENDEMIC TULE ELK TO RANGE FREELY AT POINT REYES NATIONAL SEASHORE

by Thomas Kucera

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The tule elk, a subspecies of elk endemic to California, was the dominant grazer of central and coastal California for thousands of years. Market hunting and habitat loss following the gold rush nearly drove the tule elk to extinction. The several thousand in existence today all descend from a few survivors protected in the 1870s. After an absence of nearly 130 years, 10 tule elk were reintroduced to Point Reyes National Seashore in 1978, where they were contained in a 2,600-acre, fenced reserve at Tomales Point. The population now exceeds 500. This rapid population growth on a limited reserve alerted the public, state agencies, and park staff to potential resource damage, including impacts on rare plants and an endangered butterfly, and elk die-offs due to overpopulation.

Several scientific review panels and the Tule Elk Management Plan, finalized in May 1998, recommended that a free-ranging herd of tule elk be established at Point Reyes. In early December 1998, park staff, cooperators, and contractors captured 45 tule elk at Tomales Point, attached radio collars, and moved the animals to a temporary holding facility for acclimation and disease testing. They will be released after three months to become a free-ranging herd in an 18,000-acre wilderness area at Point Reyes National Seashore.

***The free-ranging elk** will wear radio collars, allowing staff to closely monitor their movements.*

To reduce the possibility of elk leaving the park and causing agricultural and other damage, Point Reyes National Seashore staff selected a new range that would be as attractive as possible to the elk. This range is a recently burned wilderness that has been free of livestock for more than 20 years and is isolated by a steep, densely forested ridge that rises over 1,000 feet. All animals carry radio collars, and close monitoring by field personnel for the next several years will allow early detection of trouble.

Soon visitors will be able to see tule elk grazing on native range behind no fences, somewhat as Sir Francis Drake described 500 years ago: "infinite was the company of very large and fat Deere, which there we saw by thousands as we supposed in a herd." The restoration of free-ranging tule elk to the coastal ecosystem will leave only one large mammalian component missing: the grizzly bear. That restoration, however, is unlikely to happen anytime soon.

CANON CONTINUES SUPPORT

For the fourth year in a row, Canon U.S.A., Inc., donated $1 million in cash and equipment to parks through the National Park Foundation to support biological research and resource management. During the year, this program, called "Expedition Into the Parks," funded 17 projects in 16 parks. In Denali National Park and Preserve, staff conducted an intensive, data-rich survey of grizzly and black bear habitats using Geographic Information Systems and Global Positioning Systems. This information will help direct recreational planning in the area of the park south of the Alaska Range.

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Carrying black-footed ferrets in backpacks, *resource managers hike into the Badlands wilderness, the release site for the restoration program. In just five years the program has succeeded in establishing a wild population of the black-footed ferret in the South Dakota park.*

Curious and alert, *a nocturnal black-footed ferret pops out of its burrow in a prairie dog town. The ferret relies on the prairie dog as both its principal food source and its landlord.*

Threatened and Endangered Species

GREAT EXPECTATIONS FOR THE BLACK-FOOTED FERRET AT BADLANDS GPRA

by Glenn E. Plumb, Ph.D., and Bruce Bessken

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During summer and fall 1998, members of the interagency South Dakota Black-footed Ferret Implementation Team were among the happiest people you may ever encounter in a prairie dog colony at midnight. Not since 1985, when the last known thriving, wild, free-ranging population of the nocturnal black-footed ferret was observed at Meeteetse, Wyoming, have 24 wild-born litters with more than 50 kits and a minimum count of 65 adults been witnessed in one population. The black-footed ferret habitat provided by the black-tailed prairie dog colony complex of Badlands National Park and Buffalo Gap National Grassland in southwestern South Dakota now supports the largest wild black-footed ferret population in the world.

Since 1994, captive-bred black-footed ferrets have been regularly reintroduced into Badlands National Park in order to acquire new and reliable information about how to conduct cost-efficient black-footed ferret reintroduction operations. Five years of restoration efforts have resulted in a high degree of captive-bred black-footed ferret survivorship and the establishment of a wild population. In order to achieve these goals, the recovery team invoked a broad recovery program philosophy of adaptive management.

Adaptive management involves regular assessment and revision of management techniques based on field observations. In the black-footed ferret recovery program, biologists conducted annual testing of field techniques and, based on what was working, adopted or abandoned certain reintroduction techniques. Through this adaptive management system, the team developed a reintroduction program that increased short-term survivorship of captive-bred black-footed ferrets at 30–60 days after release from 25% in 1994 to approximately 80% by 1997. Indeed, the program has been so successful that black-footed ferret reintroduction programs in Montana, Arizona, and Colorado are using techniques developed in South Dakota.

The current level of success enjoyed by the South Dakota black-footed ferret project clearly demonstrates the utility of NPS Natural Resource Preservation Program (NRPP) funding. With two cycles of NRPP project funding (1993–98) and an adaptive management framework, captive-bred black-footed ferret survivorship greatly increased while the per capita cost of black-footed ferret release and population monitoring decreased. Thus, the park is now poised to shift into a long-term black-footed ferret population recovery program with base funding.

SEA TURTLE NUMBERS UP

For the fourth consecutive year, Kemp's ridley sea turtles nested in greater numbers than before along the south Texas coast on or near Padre Island National Seashore. Altogether, 13 nests were documented in 1998, with 4 belonging to individuals from the turtle recovery project, which was launched in 1978 to help the endangered species establish new nesting colonies. In addition to Kemp's ridley nests, 5 nests belonging to green sea turtles, 2 to loggerheads, and 1 to a hawksbill turtle were documented by staff of the Biological Resources Division and the park.

Volunteers Holly Sorensen and Tom Ford *erect a fence and string monofilament line over a plover nest to thwart predators such as gulls, crows, and raccoons. This strategy, plus human-use restrictions of some beaches during nesting season, appears to be contributing to a statewide increase in nesting plovers.*

PIPING PLOVER ON THE INCREASE AT SLEEPING BEAR DUNES GPRA

by Max W. Holden

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In 1998, 5 of the 24 nests of the endangered piping plover found in Michigan were located in Sleeping Bear Dunes National Lakeshore. In 1997, 5 of 23 nests were found in the park. Park staff attribute this high percentage of park nests to a recovery program that includes exclosure fences, beach closures, information programs, and volunteers.

In the 1920s the piping plover population in Michigan was estimated to be more than 200 nesting pairs. Because of loss of habitat, this number has declined drastically. The birds nest and feed on wide sandy beaches and are easily disturbed. The proliferation of residential home site development, all-terrain vehicles, dogs, and predators (including crows, gulls, and raccoons) have disturbed the quiet beach areas of the Great Lakes. Similar losses of habitat have occurred in Atlantic Coast nesting and wintering areas on beaches in Florida, resulting in a drop in plover nests and population. In 1986 the Great Lakes and Atlantic Coast piping plover populations were added to the Michigan and federal lists of endangered species. Since 1986 the breeding pairs in Michigan have increased from 12 to 24 pairs.

Beginning in 1986, Sleeping Bear Dunes National Lakeshore began management to protect the piping plover nests. Each spring, all the suitable nesting beaches in the park are searched for breeding piping plovers. The beaches at Dimmick's Point on North Manitou Island have been closed to public use each year from 1 May to 15 August since the piping plover was listed as endangered.

When pairs in breeding behavior are located, they are closely watched to determine if they nest and to locate the nest. Since 1989, as soon as a clutch is complete with four eggs, a fence has been erected around the nest to exclude predators. The nest is then monitored until hatching and the chicks are monitored until fledging.

In 1997 and 1998 the park had two nesting piping plover pairs at Platte Point, the most popular swimming beach in the park. The park closed a portion of this beach to protect the plovers, which affected public use of the beach. To mitigate this user impact, resource management staff and volunteers were stationed at the point to protect the birds from disturbance and to explain the delicate habitat conditions to visitors. The staff set up spotting scopes and invited approaching visitors to view the birds from a safe distance outside the closed area. At the same time, the visitors heard a discussion about the fragile nature of the piping plover, the importance of protecting its habitat, and other endangered species. In the first year that part of this beach was closed, park staff heard complaints from people unwilling to share the beach with an endangered species. But because staff and volunteers talked with so many beach users in 1997 and received good newspaper and television coverage, the public was more accepting in the second year. Three chicks from each of these two nests fledged on this very busy beach.

The endangered piping plover *has increased in Michigan over the past 13 years. With just 12 nesting pairs documented in Michigan in 1986, Sleeping Bear Dunes National Lakeshore began a nest protection program and by 1998 reported 5 of the state's 24 nesting pairs.*

RETURN OF RARE PLANT

Unrecorded at Assateague Island National Seashore (Maryland) for the last 32 years, the threatened sea amaranth was rediscovered on an open beach in summer 1998 by a park wildlife technician. Before the find, the plant species was known to occur only on Long Island and in the Carolinas. An annual, it sprouts only from seed, presumably transported by the ocean, and is considered an indicator of unimpaired natural shoreline processes. Only two plants were found at the park, and both were threatened by Hurricane Bonnie in August as they were beginning to fruit. With great potential to restore the species to the mid-Atlantic, one plant was removed to a greenhouse, where it thrived, producing hundreds of seeds. The other plant was inundated and died.

Wetlands

HATCHES HARBOR: PROGRESS ON RESTORING A SALT MARSH GPRA

by Norm Farris

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In fall 1998, Cape Cod National Seashore and the town of Provincetown, Massachusetts, began work on the largest saltmarsh restoration in the history of the state. The 90-acre restoration project, located between the Hatches Harbor Dike and the Provincetown Airport, requires collaboration among the National Park Service, Provincetown officials, and the Federal Aviation Administration. When completed, the salt marsh will provide increased habitat for saltmarsh plants and animals and provide the airport with additional protection from storm surges.

Many aspects of this project, including environmental permitting, have required a joint town and seashore effort. The National Park Service owns the 200-acre marsh where the project is located; the town leases the dike from the Massachusetts Department of Environmental Management. The roles and responsibilities of the seashore, town, and Federal Aviation Administration were codified in a memorandum of understanding, which establishes a National Park Service/Town Review Committee to review progress and advise project scientists, natural resource managers, and airport managers.

In 1930 almost half of the original 200-acre salt marsh was diked in an unsuccessful attempt to eliminate mosquitoes. The airport was built on the floodplain shortly thereafter. The dike's blockage of tidal flow dewatered and freshened the salt marsh, eliminating habitat for native saltmarsh grasses (*Spartina* spp.), fish, shellfish, and crustaceans. Spartina grasses in this area have been largely

***Marsh restoration** at Cape Cod involves constructing an adjustable culvert system in the dike to allow tidal seawater (left side of dike) to slowly reclaim the marsh (right side) over a period of 5–10 years. As a result, native spartina grasses, now seen only on the left (lower profile), will recolonize the area on the right now occupied by common reed.*

replaced by common reed (*Phragmites australis*). Phragmites has reduced the value of the wetland as habitat for young fish and shellfish, and changed water quality. Meanwhile, interruption of regular tidal flushing and predatory fish access allows mosquitoes to breed in abundance.

Restoring the salt marsh will have many benefits. Restoration will increase nursery habitat for commercially important shellfish, crustaceans, and fish, many of which reduce mosquito populations and are prey for larger animals. Productivity will rise for saltmarsh plants as well. In addition, restoration of regular tidal flow will allow the wetland to again grow upward along with rising sea level. This will provide increased storm surge protection for the airport.

To restore the salt marsh, the dike's present 2-foot-diameter culvert will be replaced by four 7-foot-wide by 3-foot-high box culverts with adjustable gates. The new culverts will be opened gradually over several years to increase tidal range and encourage salt-tolerant spartina to replace more salt-sensitive phragmites. The phased opening also allows project scientists to monitor and control changes to avoid, for example, a sudden die-off of vegetation. A rapid die-off would create open water and mudflats that would attract feeding birds, a safety hazard for the airport. Low (average 2-foot) earthen berms will be constructed around the airport's instrument landing system to maintain a stable water table in this sensitive area.

National Park Service, U.S. Geological Survey, and University of Rhode Island scientists have conducted pre-restoration environmental monitoring since 1997, collecting water chemistry, vegetation, fish, and shellfish. These data establish a base from which to track changes with restored tidal flow. All participants in this ambitious effort expect that knowledge gained at Hatches Harbor will be important to other restoration projects in the state and beyond.

FATE OF DAMS STILL UNCERTAIN

Congress has appropriated funds ($29.9 million) for the acquisition of the Elwha River dams in and near Olympic National Park (Washington). However, before the dams can be acquired, the Secretary of the Interior must demonstrate that the additional $83.3 million (1995 dollars) required to remove the dams and fully restore the Elwha River ecosystem and fishery will be available within two years of acquisition. No funds have yet been appropriated for dam removal and restoration, although the President's FY 2000 budget includes $12 million for this purpose.

PARTNERS RESTORE WETLAND IN THE SANTA MONICA MOUNTAINS NRA

by John Tiszler, Jim Benedict, Lisa Edgington, and Alan Hsu

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In 1998 state and federal agencies, nonprofit organizations, and the public began restoration of a valuable wetland in Santa Monica Mountains National Recreation Area, California. The history of the development and implementation of this project illustrates the unique problems and opportunities associated with restoration in urban areas and the strength of partnerships in accomplishing restoration goals. It also demonstrates that NPS funds are often best spent on the preparation of a technically sound restoration plan, for a completed plan makes the job of attracting non-NPS sources of funding for the restoration itself much easier.

Volunteers for the Zuma Creek wetland restoration *planted wiregrass, common tule, California bulrush, bull tule, and broad-leafed cattail within the marsh expansion area. Their efforts enhanced the existing marsh and expanded it ½ acre over its previous size.*

Santa Monica Mountains NRA, Jim Benedict

Lower Zuma Creek and Lagoon is a unique freshwater marsh and riparian habitat located on a coastal beach within the authorized boundary of Santa Monica Mountains National Recreation Area. The wetlands and surrounding riparian areas and uplands have been reduced and heavily impacted by long-term dumping of debris and surplus fill. Despite this situation, the site has high potential for successful restoration. The confluence of freshwater marsh, riparian, foredune, coastal sage scrub, and beach communities that will exist after restoration will create an unusually diverse habitat of high value to wildlife.

In fall 1993 the Los Angeles County Sheriff's Department requested that the Los Angeles County Department of Beaches and Harbors, which owns the beach and lagoon at lower Zuma Creek, clear vegetation along the creek and lagoon because they attracted transients and unlawful activity. The County Department of Beaches and Harbors' application to the California Department of Fish and Game for vegetation removal alerted land management agencies to the possible destruction of this valuable wetland habitat.

Representatives from the National Park Service, California Department of Fish and Game, California Department of Parks and Recreation, Santa Monica Mountains Conservancy, Resource Conservation District of the Santa Monica Mountains, and Santa Monica Bay Restoration Project met to discuss the problem. The group decided to restore wetland, riparian, and surrounding upland habitat in a way that would satisfy the sheriff's request for openness and visibility. The National Park Service, Department of Beaches and Harbors, and Bay Restoration Project were assigned the lead for the restoration project. The project includes the creation of $^1/_2$ acre of freshwater marsh and approximately $2^1/_2$ acres of dune, willow riparian, sycamore alluvial woodland, and coastal scrub habitat in the existing fill area, with an additional $4^1/_2$ acres of existing habitat enhanced (see table).

Funding for the restoration comes from the NPS Water Resources Division and an EPA grant. The Los Angeles County Department of Beaches and Harbors

Santa Monica Mountains NRA, Jim Benedict

The restoration effort *added 0.2 acres of coastal dune habitat adjacent to lower Zuma Creek.*

provided valuable in-kind services in the form of planning, support, personnel, and equipment. Volunteers from TreePeople and Eco-Heroes also provided in-kind support.

The final restoration plan was completed in April 1997 and work commenced in early April 1998. By the end of 1998, the site work was complete, native plants were planted, nonnative plants were removed, and interpretive trails were built. The addition of an underground irrigation system ensures the viability of the new plantings. A biological technician, hired for the duration of the project with funds from the Water Resources Division, will monitor and maintain the site.

Table. *Native habitat acreage before and after implementation of the lower Zuma Creek and Lagoon restoration project.*

Habitat	Acreage	
	Existing	Restored
Dune		
Enhanced	—	1.2
Created	—	0.2
Total Habitat	1.2	1.4
Willow Riparian		
Enhanced	—	2.4
Created	—	0.2
Total Habitat	2.4	2.6
Sycamore Alluvial Woodland/Coastal Scrub	0	1.5
Freshwater Marsh		
Enhanced	—	0.8
Created	—	0.5
Total Habitat	0.8	1.3
Total Acreage (Native Habitat)	4.4 (disturbed)	6.8

Award-Winner Profile
FACILITY MANAGER RECOGNIZED

Greg McGuire, facility manager and chief of area services at Fort McHenry National Monument (Maryland), was awarded the first Director's Award for Excellence in Natural Resource Stewardship Through Maintenance. During 1997, Greg developed a creative partnership among volunteers and federal, state, and local governments to clean up and restore a 5-acre, state-owned tidal wetland immediately adjacent to Fort McHenry. Periodic storm surges deposited trash in the tidal wetland, impacting natural resources and the visual experience of fort visitors. Greg viewed the wetlands as a shared resource protection and management challenge, and brought together several entities to carry out the cleanup. He applied for Challenge Cost Share funds to be combined with monies from the State of Maryland to fund the project. As a result of his efforts, the Chesapeake Bay Alliance brokered a partnership between the park and the National Aquarium in Baltimore to conduct research and additional restoration of wetlands within the park.

Greg McGuire

Heavy rains *from a 1997 New Year's Day storm saturated road fill and resulted in the failure of this hillside into Redwood Creek, just ½ mile upstream of the world's tallest tree. Emergency funds are helping the park address the severe erosion problem posed by 155 miles of remaining logging roads.*

AML GPRA PROGRAM FUNDED

With needs identified since 1987, the Abandoned Mineral Lands (AML) Program of the National Park Service was approved for base funding in 1998. The funds are awarded to parks for projects designed to address degraded lands and waters and mitigate safety problems related to abandoned mines. The program is administered by the NPS Geologic Resources Division, which supported 21 projects in 17 parks throughout five NPS regions during the year. These projects related to mine site reclamation, mine hazard mitigation, habitat conservation, site characterization, and future project planning. More than 140 park units manage issues related to abandoned mineral lands.

Emergency funds *are being used to restore abandoned logging roads, such as this one (left) that crossed a headwater stream in an old-growth redwood forest. The road was excavated down to the original stream channel (middle), restoring the natural slope and hillside hydrology and greatly reducing the threat of erosion. One year after restoration (right), vegetation is aggressively reclaiming the area.*

Disturbed Lands

RELIEF FUNDS EXPEDITE WATERSHED RESTORATION PROGRAM GPRA

by Darci Short

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In 1998, work began on repairing the damage caused to Redwood National and State Parks by the 1997 New Year's Day storm that hit much of northern California. This storm caused extensive damage to roads, trails, and buildings throughout both parks. The greatest damage was caused by landslides or culvert failures along old abandoned logging roads incorporated into the park during the 1978 park expansion. In total, 91 road sites suffered varying degrees of damage, cutting off access to about 30 miles of road segments.

> "The storm funding … add[ed] approximately 10 times the annual funds formerly available for this work."

As a result of the storm damage, Redwood National and State Parks received $8.99 million as part of the 1997 Natural Disaster Relief Act and $1.19 million from the Federal Highways Administration Emergency Relief for Federally Owned Roads program. Approximately 80% of the funds are earmarked for removing unneeded road segments isolated by landslides or culvert failures, and 15% for repairing essential park access roads. The remainder is for repairs to damaged trails and buildings.

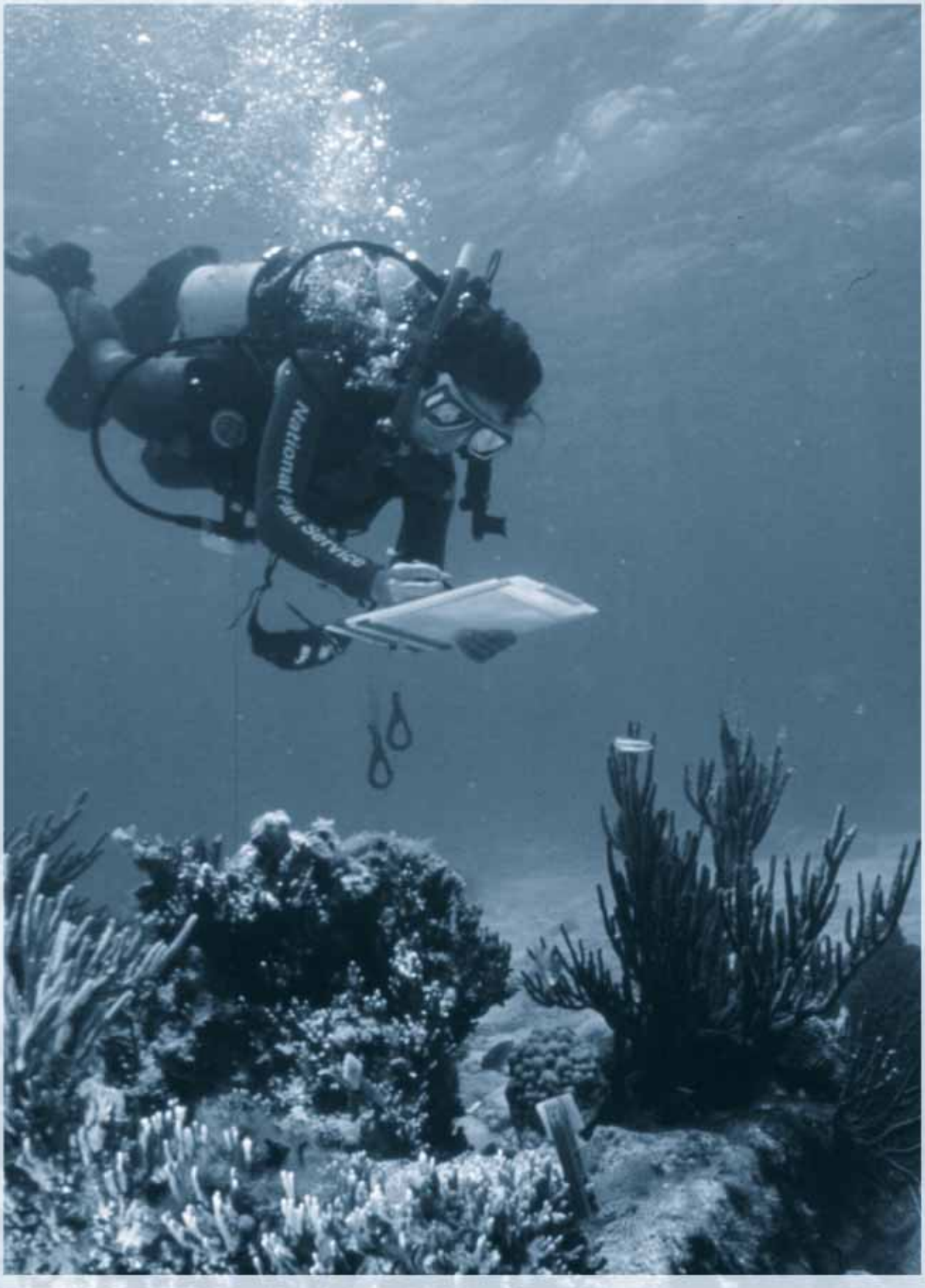
The parks had already been removing unneeded roads as part of the ongoing watershed restoration program. Since park expansion in 1978, approximately 200 miles of roads have been removed or treated for erosion control. The storm funding supplements the existing base-funded Redwood Creek watershed restoration program, adding approximately 10 times the annual funds formerly available for this work. Without the supplemental funds, it would take many years to remove these roads. Left untreated, they pose a great threat to park ecosystems and downstream aquatic and riparian resources.

The storm damage came at a time when the national park had just completed an inventory of potential erosion that could result from the 155 miles of park roads that remain in the Redwood Creek watershed. The park had developed a prioritization scheme based on the existing quality of aquatic and riparian ecosystems within the tributary watersheds, the erosion and sedimentation threat from upslope roads, proximity to ancient redwood groves, and the disturbance levels in cultural and scenic landscapes. The 1997 storm "tested" the stability of these roads. The resource damage highlighted the urgency to remove the abandoned logging roads before additional, more serious damage occurs.

The highest-priority area of the park in need of restoration work is the Lost Man Creek watershed. This watershed provides habitat for the threatened coho salmon and two bird species (northern spotted-owl and marbled murrelet) listed as threatened under the Endangered Species Act. Road removal in the Lost Man Creek watershed will allow for more rapid recovery of the heavily logged watershed, providing the best protection for these threatened species and adjacent downstream park resources. Storm damage funds will pay for the removal of 30% of the roads within the Lost Man Creek watershed in the next few years.

SEQUOIA RESTORATION CONTINUES

The last of 194 buildings in former visitor lodging and employee housing areas was demolished in September, completing one phase of the Giant Forest restoration in Sequoia National Park (California). Ecological restoration began as roads, parking lots, walkways, and building pads were recontoured; compacted soil was loosened; and disturbed soil was protected from erosion with wood chips or soil retention blankets. In October the first 4,570 grass, forb, shrub, and tree seedlings were planted on the site of the Giant Forest Lodge, beginning the revegetation phase in these formerly developed areas beneath the giant sequoia trees.



An NPS diver *sketches iron ballast from a shipwreck amid a coral reef at Dry Tortugas National Park (Florida). Diving is a common resource management activity in units of the national park system for making reef observations and monitoring coral reef communities.*

NEW HORIZONS

Every year, natural resource management in the National Park Service advances through the skillful use and development of legal, technological, and administrative tools. As the following articles demonstrate, some gains are the result of individuals with the training, ingenuity, and drive to recognize opportunities to apply existing tools in new ways or modify them for use in new situations. Others are the product of synergism and represent the collective contributions of several partners working toward a well-defined goal. Also evident in this evolutionary process are fortuitous timing, perseverance, and innovation. In 1998 these elements meshed, propelling the state of natural resource management forward toward new horizons.

New Perspective on Marine Resources

PRESIDENT MANDATES CORAL REEF PROTECTION

by James Tilmant

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Coral reefs around the world are in peril because of degraded water quality, overharvest of reef organisms, predatory imbalances, infectious diseases, and stress from excessive recreational use. The biological diversity of coral reefs is in decline even in many protected areas. On 11 June 1998 President Clinton signed Executive Order 13089 directing all agencies to increase their efforts to protect our nation's coral reef resources. The executive order calls for the establishment of a U.S. Coral Reef Task Force, cochaired by the Secretaries of the Interior and of Commerce. The Task Force will develop and implement a comprehensive program of inventory, monitoring, and research to map and identify the major causes and consequences of degradation of coral reef ecosystems.

The Coral Reef Task Force met at Biscayne National Park in October 1998 and formed five interagency working group subcommittees to focus on ecosystem science and conservation, mapping and information, water and air quality, coastal uses, and international protection of coral reefs. The National Park Service is actively participating in these subcommittees.

Executive Order 13089 provides an opportunity to focus attention on improving protection of the coral reefs entrusted to the National Park Service. As coral reef habitats decline, those existing in our national parks, wildlife refuges, and national marine sanctuaries become increasingly important. Nine national park system units contain coral reefs, but the ecosystems within these parks are not adequately protected. None of the system's coral reef units prohibit all forms of fishing, and six units must allow commercial exploitation of the aquatic resources in accordance with mandated legislative provisions. Only two coral reef parks, Buck Island Reef National Monument and Virgin Islands National Park, have designated no-take zones in which all forms of resource exploitation and harvest are prohibited. Neither of these no-take zones is large enough to allow development of a completely natural, unexploited coral reef community within the protected zone. In addition to resource exploitation, all of the coral reef parks are suffering from the effects of coastal development and degraded water quality.

An increased funding initiative has been included in the President's proposed budget for FY 2000 that will allow for increased monitoring and protection at each of the coral reef parks. Until those funds are available, the National Park Service will use existing budgets to conduct protection measures. The management plans of all coral reef parks will be reviewed and updated within the next three years; mapping and documentation of the current health of the reefs will be completed; water and air quality will be evaluated and documented; and areas are now being considered for expansion where necessary to ensure adequate ecosystem function and protection.

Submerged Cultural Resources Unit, John Brooks

A filter-feeding tunicate *grows on coral at Dry Tortugas National Park. The recent executive order calls for the increased protection of coral reef resources in parks and other federal waters.*

Submerged Cultural Resources Unit, John Brooks

Mojave National Preserve

Contract staff at Mojave National Preserve *haze burros into a holding pen before shipping them to markets where they will be sold as pets, breeding stock, and pack stock. Through cooperative measures, the park removed 520 burros in 1998 in a manner that was cost-effective and sensitive to animal rights concerns.*

Feral Wildlife

FERAL BURRO REMOVAL: NEW SOLUTIONS TO AN OLD PROBLEM GPRA

by Christopher J. Stubbs

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Mojave National Preserve

A perennial problem *in many western parks, feral burros damage plant communities and soils, compete with native wildlife for forage, and degrade water quality.*

Can the National Park Service remove 1,300 feral burros that are roaming free in a park larger than the state of Delaware? Staff at the 1.6 million–acre Mojave National Preserve in California believe so. Through cooperation and creative placement of the animals, Mojave staff removed 520 burros in 1998 alone.

Feral burro populations in Mojave are having deleterious and potentially irreversible impacts on native flora and fauna. Damage has been documented in plant communities, soils, wildlife, and water quality. Of particular concern is the competition for forage, which is negatively affecting the threatened desert tortoise. An adult burro consumes approximately 6,000 pounds of forage per year, and the herds reproduce at an alarming rate. Reproduction estimates for Mojave National Preserve suggest that the population grows an average of 25% each year.

The Natural Resource Preservation Program is providing funding for Mojave National Preserve to capture and remove all of its 1,300 remaining burros over a three-year period from 1999 through 2001. Geographic barriers and existing highway fences outside the park will keep other feral burros out of the preserve.

The greatest challenge and potential impediment to a successful burro removal program is placement of the animals once they are captured. In 1997 the Bureau of Land Management (BLM) wild horse and burro program, which puts the animals up for "adoption" by the public, took 600 burros from Mojave National Preserve. However, the market for burros under the BLM program is currently saturated; therefore the Park Service must consider other placement sources. In 1998, Mojave placed 420 burros through a private contractor at a substantially lower cost than the BLM alternative. The contractor sold these burros for pets, breeding, pack stock, and other recreational purposes. Also in 1998, Mojave National Preserve forged an innovative burro placement agreement with the Fund for Animals, a nonprofit animal rights organization. The Fund has agreed to take up to 1,200 animals at their Black Beauty Ranch, a 2,000-acre animal sanctuary in eastern Texas. One hundred Mojave burros were placed at the Black Beauty Ranch in September.

Working with private markets and the Fund for Animals is a significant departure from the typical federal burro adoption program, and represents a trend of collaboration in dealing with resource threats. Complex resource management issues such as feral burro removal will demand that the National Park Service and other federal land management agencies cooperate with industry, environmentalists, and animal rights groups to carry out its preservation mandate.

Doppler technology *allows resource managers to safely and accurately map flow velocity and depth of large rivers. In this map of the Green River at Dinosaur National Monument (Colorado and Utah), flow direction and velocity are indicated by black arrows—the longer the arrow, the faster the flow. Although hard to appreciate in this depiction, flow depth is indicated by a gradient scale of color from black (2 feet deep) to white (38 feet deep).*

Technological Tools

DOPPLER TECHNOLOGY APPLIED TO LARGE-RIVER STUDIES

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Resource managers often need river channel and hydraulic data to describe existing resource conditions or to estimate impacts of a past or potential change in the river's watershed. In small rivers, technicians obtain these data by wading and taking simple measurements of depth and velocity. This topographic and flow information is logistically difficult or impossible to obtain in rivers too deep to wade or during flood events. In the past, flow information from large rivers has been obtained by taking depth and velocity measurements from cables stretched across rivers. Not only are these techniques slow, resulting in very little information for the effort expended, they also limit the locations for data collection. In recent years, hydroacoustic equipment has been produced that fills these scientific data collection needs in large-river environments.

Hydroacoustic echo sounding is commonly used to measure water depth, providing topographic data for river channel mapping. A sophisticated multibeam, hydroacoustic echo sounder is now available that can also measure the velocity of river flows. By sending and receiving acoustic energy from different heights within the water column, and then applying the Doppler shift theory, the acoustic Doppler current profiler (ADCP) determines the velocity and trajectory of particles suspended in the water column. Recent advances have made these new ADCP echo sounder units operable in large rivers where average flow depths exceed 5 feet. Attaching an ADCP to a maneuverable boat, the three-dimensional velocity field of a reach of river can be measured quickly and accurately. When the ADCP is integrated with a navigation/tracking device, such as a survey-grade global positioning system (GPS), spatially precise map data can be collected on the channel bottom topography, the water surface, the three-dimensional flow field, and the discharge of a river reach.

In 1998, staff from the Water Resources Division used an ADCP, integrated with a GPS-GLONASS (combined U.S. and Russian satellite surveying system), mounted on a motorized raft to collect needed flow and topographic data on the Green River in Dinosaur and Canyonlands National Parks in Utah. The integrated system delivered spatial positions with 4-cm accuracy vertically, and 1–2 cm horizontally, correlated with detailed flow depth and velocity data. More than 15,000 data positions distributed over a 4-mile reach were measured in about 15 hours from a powerboat zigzagging back and forth across the river channel. Channel maps, water surface maps, and flow field (velocity) maps of two 4-mile reaches were constructed from the data obtained in June 1998. The river channel and hydraulic data collected using the ADCP and GPS-GLONASS are substantially more detailed and accurate than data obtained using conventional means, and take much less time to acquire.

INTERNATIONAL CONTINGENT AT FUNDAMENTALS TRAINING

In January, 20 resource managers from the National Park Service attended the third Fundamentals for Natural Resource Management at the Albright Training Center at Grand Canyon National Park (Arizona). In addition to NPS staff, five park managers from South Africa participated in the course. Their perspectives on such issues as subsistence uses and managing parks on tribal lands added a valuable dimension to the training. The fundamentals course provides a sound introduction to natural resource management in the national park system with two primary emphases: an ecosystem approach to management and planning, and the implementation of a resource management program that includes natural, cultural, and social science considerations.

NATURAL RESOURCE INFORMATION TOOLS MAKE THEIR WAY TO THE WEB

by Jen Coffey

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A migration to web-based information systems is gaining momentum throughout the National Park Service as the Internet continues to grow at an unprecedented pace and more parks get connected to the web. During the past year, natural resources has joined in this trend of adopting web technologies on both NatureNet, the National Park Service's public natural resource website (www.nature.nps.gov), and the Natural Resources Intranet (www1.nrintra.nps.gov), which is available to NPS personnel only.

A good example of a useful natural resource information tool that debuted on the web in March 1998 is the *Environmental Contaminants Encyclopedia* (www.nature.nps.gov/toxic/index.html). The encyclopedia is a tool that can be used to quickly ascertain general information about 118 environmental toxicology elements, compounds, and products. The website is particularly useful because it summarizes information on environmental contaminants in a single, easily searchable source. The encyclopedia is used not only by those in the National Park Service but also by other agencies and organizations, which makes the web the perfect medium for this information.

Another useful tool was made available in 1998 for downloading from both the Internet and the Intranet. The White-tailed Deer Management Simulator (lutra.tamu.edu/dms/dms.htm) is a general but powerful simulation tool developed for the National Park Service by Ken L. Risenhoover (Texas A&M University) and H. Brian Underwood (U.S. Geological Survey). The Deer Management Simulator helps natural resource specialists develop management strategies to deal with overabundant ungulate populations. The simulator also provides researchers with valuable information.

> "A migration to web-based information systems is gaining momentum throughout the National Park Service."

In December 1998 the Investigators Annual Report (IAR) was added to the web. This database, used by researchers holding permits from the National Park Service to report on research activities conducted within parks, is made available to both NPS and non-NPS users. Non-NPS researchers around the globe can now access the system via the Internet while park staff and IAR coordinators access the system through the Natural Resources Intranet. In both cases, the database is password protected. (For instructions on accessing the database, parks should contact their regional IAR coordinator, and non-NPS researchers should contact the park in which they want to conduct research.) Because researchers can enter their information directly into the database through their web browser, the web-based program saves both time and paper. A standardized research and collecting permit is also under development, with plans to add it to the Internet in 1999.

PUBLICATION RELEASED ON CD

Sixty-seven issues of Park Science, from the inaugural 1980 edition to the present, were electronically published in a fully indexed, two–CD-ROM set and released to readers in November. This new information tool provides an efficient way for resource managers and researchers alike to search for resource management topics and articles of interest.

***The White-tailed Deer Management Simulator** is one of the natural resource management tools that debuted on the web in 1998.*

Legal Tools

CONGRESS PLACES A POSITIVE IMPRINT ON PARK MANAGEMENT

by Mike Soukup

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In 1998, Congress enacted the National Parks Omnibus Management Act. "Omnibus" befits the statute, which covers a wide range of topics, including a major overhaul of NPS concession management. For natural resources the statute contains a mandate for the use of science in park management decisions throughout the organization. Thus, Congress has underscored the need for the Park Service to manage parks based on sound scientific and natural resource management principles and information.

Several of the act's provisions build on efforts already under way in many parks, and they reinforce the timeliness of the Director's Natural Resources Initiative unveiled last fall. Section 101 of the act directs the Secretary of the Interior to continually improve the National Park Service's ability to provide and demonstrate its scientific basis for its management, protection, and interpretation of park resources. The remaining natural resources–related provisions state how to achieve this goal. For example, section 102 requires the Park Service to develop a comprehensive training program for all employees to ensure that they are equipped with "the best, up-to-date knowledge, skills, and abilities" to protect park resources. The next section calls for enhanced management opportunities for career employees with specialized academic backgrounds, such as in the sciences and resource management, to assume park management positions, especially superintendencies.

Provisions in Title II relate to the role of research in park management. Section 202 sets forth a research mandate for the secretary to provide for the highest-quality science and its use in decision making. Section 203 builds on this direction by promoting cooperative agreements with universities and colleges to obtain multidisciplinary research results and information products to improve park management at local and regional levels. Later, the legislation encourages the pursuit of scientific study in parks by a broad range of entities so long as that research is commensurate with park protection. Section 204 reinforces efforts already under way in many parks to collect and maintain baseline data on park resources for the assessment of long-term trends in their condition. Another provision enables the Park Service to withhold the location of certain vulnerable resources in parks when responding to Freedom of Information Act requests.

Pulling all these provisions together is section 206, which designates superintendents as accountable for using the results of scientific study in their management actions. According to the act, the trend in the condition of resources will be a "significant factor in the annual performance evaluation of each superintendent." Finally, section 801 calls for an evaluation of NPS law enforcement programs, a critical component of resource stewardship.

Adherence to the direction contained in the Omnibus Act, coupled with the Natural Resource Initiative and other efforts, should help the National Park Service to be a successful and prudent manager of the nation's natural and cultural heritage in the 21st century.

***Published in the* Congressional Record,** *the National Parks Omnibus Management Act became law in October.*

October 13, 1998 CONGRESSIONAL RECORD — HOUSE H10679

TITLE I—NATIONAL PARK SERVICE CAREER DEVELOPMENT, TRAINING, AND MANAGEMENT

TITLE II—NATIONAL PARK SYSTEM RESOURCE INVENTORY AND MANAGEMENT

TITLE V—FEES FOR USE OF NATIONAL PARK SYSTEM

TITLE VI—NATIONAL PARK PASSPORT PROGRAM

TITLE VII—NATIONAL PARK FOUNDATION SUPPORT

TITLE VIII—MISCELLANEOUS PROVISIONS

The Gold Strike Casino *at Lake Mead National Recreation Area is a good example of the development, unrelated to mining, that can legitimately occur on many patented mining claims in parks. The recent solicitor's opinion will likely reduce the issuance of future park patents and associated facilities on parklands.*

SOLICITOR OPINIONS ADVANCE PARK PROTECTION

by Julia Brunner and Carol McCoy

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In 1997 and 1998 the Solicitor of the Department of the Interior issued four legal opinions that limit the rights of mining claimants on federal lands and confirm that the Secretary of the Interior has a duty to address park protection concerns external to park boundaries in departmental decisions. Both of these legal advances help strengthen the ability of the National Park Service to protect park resources from both internal and external development.

MINING CLAIMS Despite restrictions in most park enabling statutes, the solicitor previously advised the Park Service that owners of valid unpatented mining claims had the right to patent their claims in parks. An unpatented mining claim is a right established under the 1872 Mining Law by which the owner may extract the minerals and use, but not own, the surface. The patenting process allows claimants to obtain title to the surface and minerals of their claims. Such owners can develop their claims in a manner that creates long-term, conflicting uses in parks.

Spurred by recent federal court decisions, the solicitor reexamined the 1872 Mining Law and issued two opinions that significantly reduce the eligibility of claimants to patent their claims on withdrawn lands like parks. On such lands, patents may only be obtained *if* the secretary determines that a claimant complied fully with the patenting requirements of the 1872 Mining Law *by the date of withdrawal,* generally the date of park establishment. These requirements include fees, a survey, paperwork, and the discovery of a valuable mineral deposit as determined through a validity exam. If claimants fail any requirement, they are ineligible for a patent but still may be able to mine subject to NPS regulations. The solicitor's new direction is significant and should reduce the number of future patents in parks.

The third opinion states that claimants may only hold and patent one mill site consisting of 5 acres per associated mining claim. A mill site is an area that is nonmineral in character where claimants typically site support facilities. In reviewing claim records, the solicitor became aware that claimants possessed far more mill-site acreage than allowed under the 1872 Mining Law. For example, at Mojave National Preserve in California, a claimant submitted a proposed plan covering two unpatented mining claims and 18 mill sites for NPS approval. Under the solicitor opinion, the claimant is entitled only to two mill sites. Thus, this opinion also enhances park protection by clarifying the property rights of claimants.

EXTERNAL DEVELOPMENT As part of the secretary's deliberation on prospecting permit applications for lead in the Mark Twain National Forest adjacent to Ozark National Scenic Riverways in Missouri, the solicitor prepared an options paper dated 16 April 1998. The solicitor makes clear that, in the administrative record, the secretary must carefully account for potential impacts to park resources from external activities within the Department of the Interior's domain. While the solicitor does not conclude that the secretary *must* place park protection considerations above all others, this is a very positive step toward applying the 1978 Redwoods Amendment to the Organic Act beyond park boundaries.

Southwest willow flycatcher survey, by Robert Winfree; Glacier research at Glacier National Park

Researchers from the desert Southwest *to the northern Rockies and beyond will benefit from the simplified NPS research and collecting permit developed in 1998. To be implemented in late 1999, the new process will be easier for NPS administrators to manage and will encourage more researchers to include national park system units in their research design.*

Administrative Tools

RESEARCH AND COLLECTION PERMIT PROCEDURES REVISED

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Scientists and educators who have wished to conduct studies in units of the national park system have routinely dealt with a daunting assortment of permitting processes, forms, and other requirements, many of which are unique to a specific park. Indeed, the complex and extremely time-consuming NPS application process has deterred the inclusion of national park system units in broad regional studies and kept many scientists from working in units.

In September 1997 a team of 15 representatives of several parks and offices convened to do something about the unwieldy materials and processes of the NPS research and collecting permits. This dynamic team forged ahead in 1998 and generated an entire set of permitting materials that is appropriate for NPS-wide use and that complies with the Paperwork Reduction Act requirements. Upon completion the guidelines and other materials will be applicable to the widest possible range of scientific disciplines.

When the new system is implemented late in 1999, researchers can obtain applications and guidelines for study proposals and general permit conditions directly from parks, or even download them from a website on the NPS Intranet. Many, if not most, parks will also provide applicants with supplementary materials such as brochures, maps, and local regulations.

Each permit applicant must provide a study proposal explaining the who, what, when, where, why, and how of the proposed study. The guidelines outline exactly what information the parks need and include a list of common criteria for making a permitting decision. Applications must be submitted in writing. However, the process is designed to allow future development of electronic applications. The two-page application form has several new questions to determine whether a researcher's proposed activities, such as public surveys or commercial applications, require additional review and approval. Applications for studies throughout a large geographic area can be duplicated and submitted to more than one park, and permitting can be coordinated between or among the parks. The application includes a form for detailing plans for collecting specimens and for designating a repository for preserved specimens. Permits will be created and tracked with new computer software.

> "... an efficient process will increase the number of good scientific studies in the parks ..."

Development of standard and clear guidelines for the administration of scientific research and collecting permits for the national park system will simplify the application process not only for applicants but also for permitting officials. In the long run, an efficient process will increase the number of good scientific studies in the parks, make available better scientific information for park managers, and improve the reporting of scientific studies in parks.

ALTERNATIVE TRANSPORTATION

The shuttle-bus system envisioned at Zion National Park (Utah) progressed in 1998 as buses were ordered in June and construction on a visitor transit center and maintenance facility began in August. Meanwhile, at Grand Canyon National Park (Arizona), staff began assisting the Federal Transit Administration late in the year in preparing their report that addresses congressional inquiries over the costs associated with a light-rail transportation system proposed for the South Rim. Construction on the light-rail system is expected no earlier than summer 2000.

Great Sand Dunes National Monument *(Colorado) is the site of an aquifer-system-modeling project funded by the Recreational Fee Demonstration Program. During 1998 fee demonstration funding of natural resource management projects was roughly equivalent to that provided by the Natural Resource Preservation Program, the largest dedicated funding source for natural resource projects, excluding inventories.*

FEE DEMONSTRATION FUNDS BOLSTER NATURAL RESOURCE PROTECTION

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From 1997 to 1998 the National Park Service collected $140 million in fees through the Recreational Fee Demonstration Program. Authorized in 1996 for three years, the program originally allowed the National Park Service to retain a portion of user fees collected in certain parks, with the remainder to be returned to the U.S. Treasury. In 1998, legislation creating the program was amended to extend it through FY 2001 and allow retention of all receipts. Congress intended the funds to be used in support of the backlog of various park improvement projects that paying park visitors can appreciate.

An initial group of projects worth $79.6 million was approved in September 1997 and strongly emphasized the backlog of park infrastructure needs; an additional $61.9 million in projects were forwarded for additional approvals. Based on project titles alone, at least 46 of the approved projects out of more than 800 titles related principally to natural resource protection. These totaled about $3.9 million for exotic species control, threatened and endangered species inventory, resource impact studies, and habitat and species restoration. These figures demonstrate the importance of this new funding source for resource protection. In November 1998, with increased receipts anticipated, $55 million in additional projects were approved. Although first priority was given to critical health and safety needs, nearly 40% of the receipts retained by fee demonstration parks (excluding the cost of fee collection) went to natural or cultural resource protection projects. In addition, 20% of the receipts collected were distributed to projects in parks where no fees are collected or to projects that apply broadly to the national park system. Additional natural resource–related projects are likely to be approved from these funds in the future.

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MAJOR FUNDING FOR WATER RESOURCES

In October, Congress funded a $2.5 million program under the Clean Water Action Plan that focuses activities of the U.S. Geological Survey (USGS) on water-quality issues in national parks. All projects to be pursued stem from needs identified in park resource management plans and were developed cooperatively between parks and USGS district offices. In spring 1998, 35 of 77 projects were selected, which fall into three categories: cyclic, long-term monitoring studies; intensive or synoptic studies; and technical assistance. This appropriation dwarfs NPS funds for projects and technical assistance related to water resources and provides a tremendous boost to parks.

The number and value of 1998 resource protection projects from the fee demonstration funds are difficult to determine precisely. Many of the nearly $16 million in resource protection projects involve cultural resources, especially structures. Numerous other projects, whether primarily for resource protection, health and safety, or visitor services, meet multiple objectives. For example, projects to add or replace bear-resistant food containers at Glacier Bay, Lassen, Crater Lake, and Olympic are ascribed to health and safety; however, in addition to protecting visitors, these projects protect bears by helping to prevent their habituation to human food sources. As another example, trail and campground restoration projects are categorized in some cases as resource protection projects and in others as visitor services projects. Additionally, many water-related projects meet multiple objectives.

Beyond these multipurpose projects, at least $4.5 million—over 10% of the value of projects—has been spent on projects with natural resources as their principal direct beneficiary, based on an analysis of project titles. A closer examination of all project descriptions would likely yield even more. These natural resource projects include exotic species control at Glacier, White Sands, Cuyahoga Valley, Pictured Rocks, Theodore Roosevelt, Death Valley, and Haleakala; restoration of native species, including threatened and endangered species, at Badlands, Assateague Island, Haleakala, Hawaii Volcanoes, and Joshua Tree; and a paleontological excavation at Badlands.

Fee demonstration projects even include resource inventory, monitoring, and studies. Although these projects are not as visible to the public as most, visitor center displays and other means can be used to explain the need for these types of fee-funded projects. Examples of such projects are bear studies at Denali; a grassland assessment at Glacier; modeling of an aquifer system at Great Sand Dunes; a rare plant survey and development of beach survey techniques at Assateague Island; and grizzly bear population modeling, a geothermal inventory, aspen research plot installation, a pronghorn ecology study, and quantification of the importance of winter roads for bison at Yellowstone.

Geologist Frank Trusdell *of the U.S. Geological Survey determines the orientation of a lava core sample taken from a flow in Haleakala National Park. A rock's age is revealed by correlating the orientation of its minerals, determined at the time of formation, with gradual changes in the earth's magnetic field. This dating method was used in 1998 to update a geologic map used by interpreters at the Hawaii park.*

RESOURCE INTERPRETATION

Engendering public support for the natural resource management program of the National Park Service is critical to the long-term preservation of parks. Without it, resource managers are sure to face greater adversity and misunderstanding in their efforts to resolve the many issues facing parks today. To gain such support, the National Park Service is engaged in various activities that encourage visitors and park neighbors to learn about the role of science in park management. As the following reports for 1998 show, the most successful activities are designed specifically for this audience. They share the common approach of interpreting scientific information in nontechnical and engaging ways that stimulate consideration of the many challenges inherent in natural resource management. The benefits of resource interpretation are many: a better informed public and therefore empowered constituency of park supporters, a closer bond between parks and neighbors, and a public vested in the rational application of science in the care of park natural resources.

Geology

DOES ANYONE HERE SPEAK jē-ˈä-lə-jē? GPRA

by Jim F. Wood and Sharon Ringsven

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Geology may be the most universal characteristic of national parks. Unfortunately, the geologic story of a park can be difficult to tell, especially since most parks do not have a staff geologist, and park interpreters need to be able to obtain and understand scientific information as the basis for their educational programs. In 1998 several scientists from the U.S. Geological Survey (USGS) stepped forward to help various parks interpret their geologic stories.

Formerly, the outreach and information programs of the U.S. Geological Survey were largely focused on providing technical information to planners and city engineers, but in recent years they have added goals that include connecting with the public and the nonscientist. The science bureau has realized that collaboration with parks is an ideal way to make this connection. Indeed, parks have much to offer in partnership with the USGS outreach program: professional interpreters, textbook geologic features, and a large audience who comes to parks to learn.

Haleakala National Park has been fortunate to work with USGS geologists from the Hawaiian Volcanoes Observatory who use "common language." These geologists spent several weeks in 1997 and 1998 mapping and dating lava flows in the park. Prior to this work, geologic interpretation of Haleakala was based on work completed 30–60 years ago. This new information will allow the park to interpret its geologic history more accurately. Renewed interest in Haleakala National Park by the Hawaiian Volcanoes Observatory and money available through the NPS Fee Demonstration Program have enabled park staff to reconstruct badly outdated geology exhibits. A relief model is being made that will not only show topography of the entire park but also the ages of summit lava flows as mapped by the USGS geologists.

Lake Mead National Recreation Area (Nevada and Arizona) and Mojave National Preserve (California) also received assistance from USGS geologists in 1998. The National Cooperative Geologic Mapping Program of the USGS Western Region hired a geology education specialist, Melanie Moreno, specifically to work with parks. As a geologist and a former science teacher, Moreno has a combination of subject-matter knowledge and communication skills that works well for geologic interpretation. She has made geologic information accessible to park interpreters by organizing geoscience field trips for park staff and geologists at the two desert parks. Moreno selected the geologists who participated and coached them in presenting introductory materials in nontechnical

TRAINING MANUALS PUBLISHED

A geology professor on sabbatical from Oregon State University prepared geology training manuals during 1998 for three geologically significant parks: Crater Lake National Park (Oregon), Sunset Crater National Monument (Arizona), and Blue Ridge Parkway (Virginia and North Carolina). The manuals were written principally for park interpreters to assist them with the technical challenges of geology interpretation. Four more guides are planned for 1999.

Sharon Ringsven

National park interpreters *have perhaps the best opportunity of any federal employees to stand on-site and engage the public in learning about geology and its significance in defining a place. With the help of an interpretive ranger, children at a geology day camp in Capitol Reef National Park (Utah) contemplate an earlier time and the animal that left its footprints in stone.*

ELECTRONIC FIELD TRIP

The World Wide Web was the venue for an "electronic field trip" to Glacier National Park in November. The multimedia event united park scientists, students, and the public in exploring subjects ranging from the park grizzly bear population to the role of fire in the ecosystem. Researchers gave real-time oral presentations that complemented illustrations posted on the web, while interactive chats facilitated question-and-answer sessions, and 360-degree, panoramic photos depicted the park in an exciting way. A collaborative effort among School District 5 in Kalispell, Montana, the National Park Service, and the USGS Glacier Field Station, the field trip can still be experienced on the web at www.sd5.k12.mt.us/glaciereft. As the partners have demonstrated, this cyber-space forum has great potential to reach a broad audience with a message about the role of science in park management.

language. This approach was successful and provided interpreters with the geology basics and background needed to answer commonly asked questions from visitors.

The USGS Cooperative Mapping Program also aided staff from Lake Mead, Mojave, and Sunset Crater Volcano National Monument (Arizona) in the development of park geology World Wide Web sites. Through web technology, each park is now able to share its unique geologic resources with a growing audience of Internet users and provide its interpretive staff with a nontechnical interpreters' manual on park geology. The web page www2.nature.nps.gov/grd/usgsnps/project/interp.html provides links to each of these park geology websites and many other resources for developing interpretive geologic programs.

Building Constituencies

INTERPRETING THE LANDSCAPE THROUGH SCIENCE GPRA

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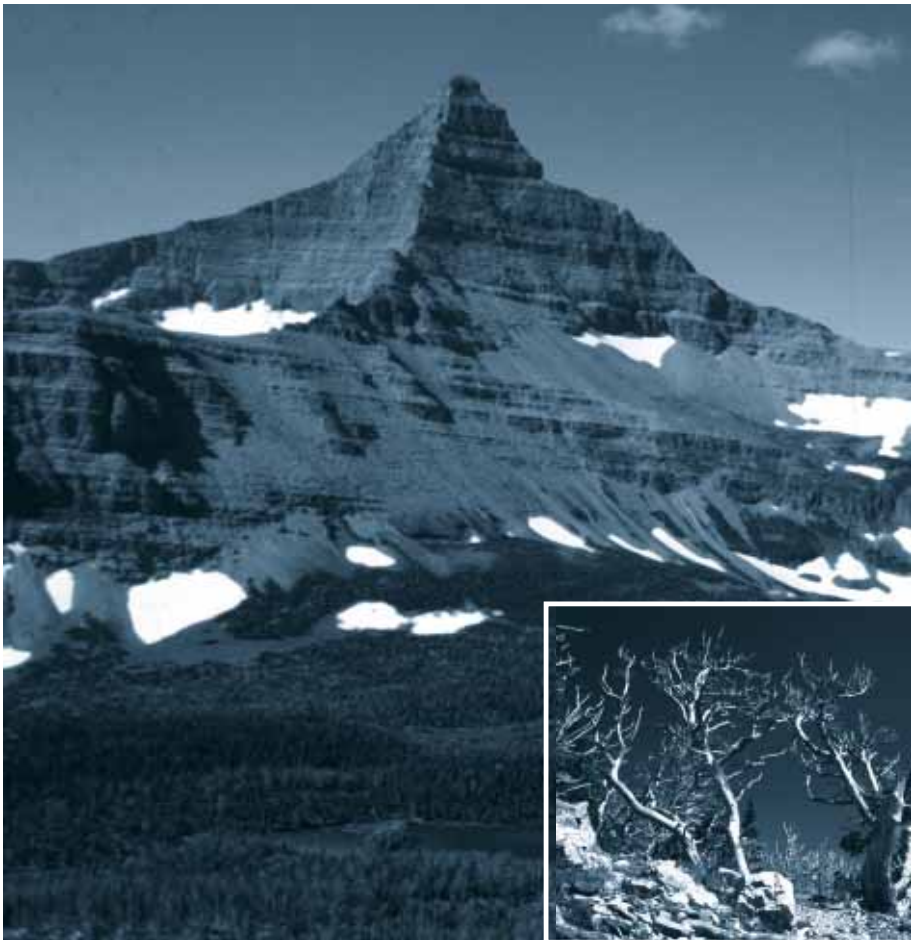
As biosphere reserve managers, officials at Glacier National Park, Montana, have a responsibility to foster research that provides land managers and adjacent communities with information regarding how to sustain the area's economies while protecting the park and adjacent wildlands. Park research has included cooperative efforts with two adjacent biosphere reserves, the Coram Experimental Forest in the Flathead National Forest and Waterton Lakes National Park in Alberta. Research findings are disseminated to agency managers and the research community via publications, seminars, and workshops. Research results are shared with the general public via local speaking engagements and park interpretive activities.

In 1998 the park tried a new approach to public outreach. In partnership with the Coram Experimental Forest, the Flathead Economic Policy Center, and seven other organizations, Glacier National Park sponsored the Flathead Living in the Landscape Community Celebration. In addition to a wide variety of activities designed to display the area's natural and human communities, the Flathead Celebration also included a conference entitled "Interpreting the Landscape Through Science," which involved presentations by scientists, resource managers, and local high school students. Extraordinary efforts were made to have the conference appeal to a broad segment of the local population. Registration was free, students were encouraged to bring their parents, and presenters were instructed to make their talks as nontechnical as possible and maximize opportunities for audience dialogue.

Approximately 120 citizens attended "Interpreting the Landscape Through Science," and judging by the frequency and depth of questions posed by the audience, the purpose of the conference was achieved. Conference proceedings are in press and will be distributed to participants, local school districts, natural resource agencies, and libraries. Major funding for the conference was provided by the U.S. Man and the Biosphere Program and by the U.S. Forest Service.

The idea for including a science conference in the array of celebration activities grew out of the desire to recognize the importance of 50 years of research at the Coram Experimental Forest, a milestone that was reached in 1998. Celebration planners saw the need to emphasize how the results of research at Coram, Glacier National Park, and elsewhere are applied by local land management officials to the benefit of the area's citizens. The involvement of local biosphere reserve managers and educators helped underscore the conference theme of linking the health of the area's natural resources to that of its human communities. Nine of the 24 presentations made during the two-day conference discussed research conducted in whole or in part within Glacier National Park.



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The Glacier science conference *featured numerous presentations on current research topics and resource management issues, including the widespread decline in whitebark pine. A Eurasian fungus called blister rust is responsible for the problem and is creating ghost forests of five-needle pines throughout the West.*

THE INDISPENSABLE RESOURCE STEWARDSHIP CONFERENCES GPRA

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Sponsorship of scientific conferences and workshops by units of the national park system seems to be on the rise nationwide, demonstrating the awareness of the benefits of such meetings. In 1998 these gatherings facilitated timely dissemination of current information for resource management, provided exchange of ideas on early research results and innovative management, raised awareness of needed research, and initiated development of new studies. In such meetings, park staff come together with cooperators, partners, and colleagues. New working relations and channels for information exchange are formed and old ones renewed. Staff of the National Park Service and other governmental agencies, universities, and private enterprises shared expertise and experiences and pooled efforts to improve research and management. New participants quickly gained insights into the myriad facets of the NPS mission and the strengths and needs of parks. These gatherings were also great opportunities for public involvement and support of natural resource stewardship.

The history of the initial impetus behind park science conferences is as varied as the subject matter. Some began as presentations of collective and baseline research results by contracted or cooperating universities. A good example is the 1975 Biological Investigations in Guadalupe Mountains National Park conference, which developed just three years after the park's establishment. In 1998 the Guadalupe Mountains symposium was organized for the park's 25th anniversary to brief staff, other researchers, and the public on scientific discoveries since presentation of the baseline studies. A similar 10th anniversary stewardship symposium was held in 1998 at El Malpais National Monument, New Mexico. Increasingly common at many of these forums are sessions that let park managers, researchers, and interest groups share their visions for stewardship and future research.

Several conferences have become annual or biennial successes. Parks in the Southern Arizona Group developed an annual conference that started as a management planning strategy between shared human and fiscal resources. This conference has expanded to include 10 parks, the Western Archeological and Conservation Center, and the Biological Resources Division of the U.S. Geological Survey. Its focus recently broadened to include interpretive applications. The North by Northwest Natural Resource Conference is another recurring meeting with a focus on regional resources. Its beginning was a planning workshop for the units under the previous Pacific Northwest Regional Office. The Alaska River Management Symposium in Anchorage, jointly sponsored by the National Park Service, Bureau of Land Management, and U.S. Forest Service, is another biennial workshop. It is held principally for outfitters, land managers, and academic and public interest groups. The annual two-day Beringia Days Conference in Alaska focuses on Russian and Alaskan regional biological and cultural richness and research issues. Several parks, such as Bandelier National Monument; Big Thicket National Preserve; Cape Cod National Seashore; and Big Bend, Glacier, and Yellowstone National Parks, held research and resource stewardship conferences in 1998. Others, such as Acadia, Shenandoah, and Great Smoky Mountains National Parks and New River Gorge National River, are planning their biennial 1999 workshops.

Many conferences in 1998 attracted nearly 200 participants each, and 20–60 presentations either targeted or were presented by park managers, interpreters, the public, academic cooperators, or scientific specialists. Many participants belong to the ranks of park staff and affiliated academic scientists. Registration revealed that attendance by representatives of other federal and state government agencies, private organizations, students, citizens, and other groups interested in the welfare of national parks has increased yearly.

From all appearances in 1998, resource stewardship conferences are eminently important sources of information for park staff who must meet the ever-mounting challenges of resource management now and into the next millennium.

Attendees of the Guadalupe Mountains *science conference participated in field trips, presentations, and poster sessions.*

The Biltmore stick, *used by foresters to calculate harvestable timber, combines the means to measure both height and diameter of trees in one simple instrument. Here, a participant in the Resource Acadia outreach program uses it to estimate tree height as part of a session exploring nonnative plant species, entitled "Green Invaders or Historic Treasures."*

RESOURCE ACADIA REACHES OUT TO AREA RESIDENTS GPRA

by Paul E. Super

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Twenty people picked their way along the edge of a small wetland with scattered blooming irises and stopped where the surrounding woodland opens into a vast freshwater marsh. The Acadia National Park botanist pointed out the location of a few persistent purple loosestrife plants and showed a picture of another wetland that is entirely overgrown by this invasive exotic. The people nodded their heads in understanding. These group members were park neighbors attending a Resource Acadia field seminar called "Acadia's Patchwork Forest Quilt." Their interest was a good indication that in 1998, as in previous years, Resource Acadia has made a difference.

First developed in 1993, Resource Acadia is an outreach program of field seminars that primarily targets residents of Acadia National Park's neighboring communities. Its mission is to join resource managers with researchers and interested park neighbors to increase public understanding and appreciation of the issues that affect resource management in the park. The seminar helped participants see park forests and wetlands as communities and highlighted the importance of using native species and cultivars for revegetation not only in the park but also around private residences. Other seminars in 1998 were about the decline of Neotropical migrant songbirds, mercury contamination of loons and freshwater fishes, and cultural resource issues.

Resource Acadia targets park neighbors because their actions can greatly affect a shared resource. Participants include reporters, teachers, local tour guides, and leaders of local associations. They can be recruited as management partners who provide valuable insight, assistance, and support for management initiatives and spread information throughout the community.

Resource Acadia programs are popular. In 1998 the number of participants per seminar usually exceeded 20. The programs continued to attract first-time participants; more than half of the participants were first-timers. On average, each participant attended 2.7 seminars.

A park interpreter designs, publicizes, and coordinates the seminars. Two related but seemingly conflicting issues may be presented, for example controlling invasive exotic plants while preserving apple trees and other historically important exotics. The primary presenters are researchers or resource managers. Formal presentations are supported by field trips to research sites. As one participant said, "You can't beat getting out into the resource with the experts!"

A limited number of training manuals are available upon request to those parks with an interest in starting a program like Resource Acadia.

WATER RESOURCE ISSUES COMMUNICATED

Big Cypress National Preserve (Florida) published a brochure in 1998 that complements its 1996 Water Resource Management Plan. Resource managers and interpreters prepared the product, which is targeted to the public, with information on the preserve's water resources and the many associated management decisions. Meanwhile, in April the Department of the Interior (DOI)–Mexico Border Field Coordinating Committee published its third fact sheet, which identifies and discusses water quantity and quality issues along the U.S.-Mexico border and their impacts on DOI-administered lands. Entitled "Water Resource Issues in the Rio Grande—Rio Conchos to Amistad Reservoir Subarea," this fact sheet addresses issues in three Texas units of the national park system: Big Bend National Park, Rio Grande Wild and Scenic River, and Amistad National Recreation Area.

NATURE NOTES HIGHLIGHTS PARK RESOURCE INFORMATION FOR CRATER LAKE VISITORS

by Steve Mark

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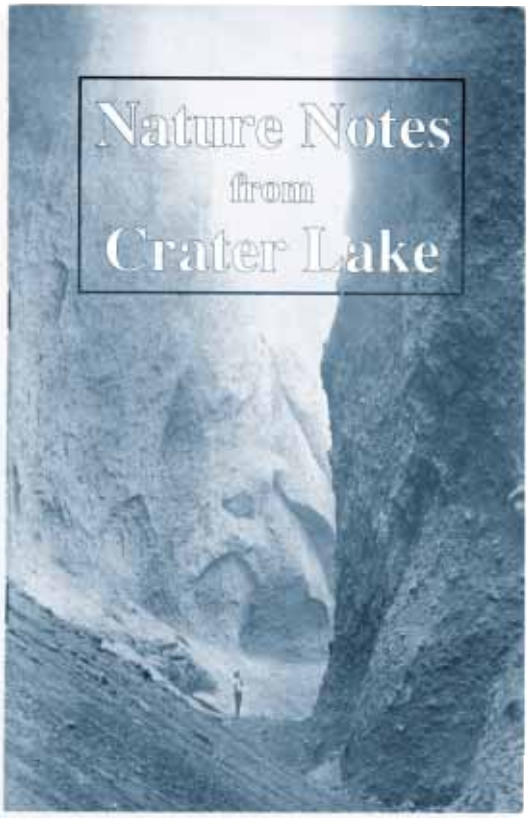
Interpreting resource management with publications is a challenge for staff in many parks. Peer-reviewed journals make important contributions to knowledge in a given field but reach a limited audience. Park newspapers, by contrast, are seen by thousands of visitors each year but lack the space to convey the importance of ongoing projects without oversimplification. Furthermore, information about resource management in newspapers competes with other types of messages. Articles appearing near the back of the newspaper may be perceived as relatively unimportant.

Publications sold through cooperating associations can play a vital role in communicating resource values and issues to visitors. Yet association offerings are dominated by commercial publications because of the need to generate sales. Since these items usually focus on only the most recognized features of a given area, the range of topics considered economically viable in small and medium-sized parks is limited. However, park staff can reach the public directly with publications by cooperating associations. *Nature Notes from Crater Lake* is one such example, and has proven to be an excellent way of putting new discoveries and the significance of ongoing resource management before the visiting public.

Published annually by the Crater Lake Natural History Association, *Nature Notes* typically features 8–10 short articles. Recent articles include "A Furry Encounter" with a flying squirrel, a closer look at the "True Firs of Crater Lake National Park," and "Understanding the Bimodal Eruptions of Mount Mazama." The authors are resource management staff and other individuals knowledgeable about natural resources in the area. Each article is reviewed by subject experts to ensure the accuracy of the information. Although somewhat eclectic, *Nature Notes* is popular with those who repeatedly visit Crater Lake. It is an inexpensive publication that highlights important information about resources and their management and thereby enhances visits, even first-time visits, to the park.

The 50th issue of *Nature Notes from Crater Lake* appeared in 1998, but the series has a pedigree stretching back to 1928. After a hiatus lasting three decades, a 1992 symposium celebrating the park's 90th anniversary brought about a revived publication that has appeared every year since then. Copies of the most recent issues of *Nature Notes* are available at the two Crater Lake Natural History Association outlets in the park. Because they represent a valuable and entertaining, ongoing record, all articles in volumes since 1928 (text only) are readily accessible on the park's website at www.nps.gov/crla/clnp-not.htm.



With its 50th edition published in 1998, *Nature Notes from Crater Lake has proven to be an effective means of communicating resource issues and values to park visitors. The publication appears annually and often features new discoveries important in resource management.*

A research submersible *(inset) is lowered into Crater Lake by helicopter, signaling the start of a two-year study of this deep lake's thermal features, plants, and animals. Such scientific endeavors and their discoveries are typical grist for Nature Notes from Crater Lake, an annual publication of the Crater Lake Natural History Association that highlights important information about park resources and management for the visiting public.*

DEEP ROVER

Spider and web, *Everglades National Park, (Florida).*

LOOKING AHEAD

RESOURCE MANAGEMENT, SCIENCE, AND THE 21st CENTURY

by Denis Galvin

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The biologist Edward O. Wilson has predicted that a day will come when "the flora and fauna of a country will be thought part of the national heritage as important as its art, its language, and that astonishing blend of achievement and farce that has always defined our species." Cast in that light, we see these resources in the context of the generations. We have inherited them from our predecessors; we seek to pass them on to our progeny. If we embrace Wilson's idea, we must turn to the question of what it will take to be successful in accomplishing that task.

For most of the 20th century we have practiced a curious combination of active management (deer are good, wolves are bad) and passive acceptance (if we leave it alone, it will be all right), while becoming a superb visitor services agency. In the 21st century that management style is clearly insufficient. Regional, and in some cases global, influences impact the resources of parks and protected areas. Our ignorance of natural resources and their interrelationship remains profound.

If we are to achieve our intergenerational task, we will need to expand existing inventory programs and develop effective techniques that monitor the vital signs of natural systems. We need to enlist others in the scientific community to help but also facilitate *their* inquiry. We need to integrate these efforts with an educational component so that child and adult, amateur and professional, benefit from the knowledge uncovered in these places. This information should be widely available, not just to those who visit the sites.

The information contained in these places should be part of a larger continuum that assists the surrounding community (regional and global) in making choices. If we return to the heritage idea, these parks and protected places should become increasingly "useful" to surrounding communities, not as board-feet of timber or tons of minerals, but as benchmarks of environmental information.

Some years ago I was on a program with the writer Barry Lopez. He had just finished writing *Arctic Dreams* and he expanded on the role of the storyteller in the Arctic. From that he sketched a role for his audience of park rangers: "You are storytellers," he said. "You tell stories so that people will recognize patterns to help them lead decent and dignified lives."

I can think of no better role for resource managers in the 21st century.

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