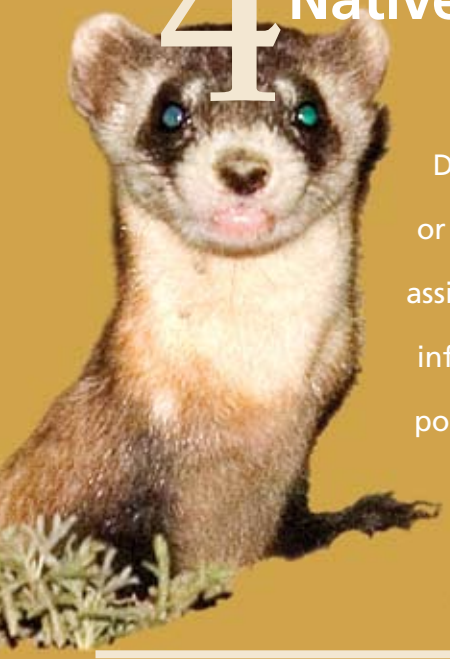
4 Taking Action to Protect and Restore Native Species



Despite their pristine appearance, national park resources can be degraded or incomplete. Certain species and physical resources may need active assistance to overcome nonnative disease, nonnative invasive plant and insect infestations, habitat fragmentation and loss, erosion, and air and water pollution. The job of national park managers is to understand the condition of the resources in their care and, when deteriorating because of human impacts, take appropriate action to ensure resource protection. The decision to act, though informed by science, requires judgment. Managers evaluate the severity and scale of the problem, the likelihood of resources to recover on their own, the potential for loss if no action is taken, and the possibility that a treatment will introduce undesirable side effects. They also consider legislation, feasibility, timing, and cost. A watch-and-see decision may be best in some circumstances. The articles in this chapter, however, detail active approaches to protecting and restoring park resources. They describe strategies for the control of invasive species, the direct restoration of native species and habitat, and the manipulation of natural processes to foster native species recovery. In addition, they discuss the benefits of broadening and uniting conservation efforts to realize efficiencies and greater effectiveness of long-term and complex treatments through shared expertise, expense, and labor. Altogether the articles describe management actions aimed at protecting and restoring native biodiversity, resilience of ecosystems, and the enduring character of the National Park System.

"When the National Park Service began [in 1916], the appearance of nature—of simple beauty—was mistaken for nature itself. Today we know that scenic beauty can mask dying species and disappearing ecosystems." **—Robert G. Stanton**

Uniting efforts to restore eastern brook trout

By Catherine Schmitt

THE BROOK TROUT IS THE ONLY TROUT NATIVE TO the eastern United States, having survived numerous ice ages of the past several million years. Wild brook trout (*Salvelinus fontinalis*) are prized by anglers and valued by resource managers as excellent indicators of watershed health. Today the healthiest, naturally reproducing populations are found in the coldest, cleanest waters, and the loss of this habitat makes their future insecure.

"Brook trout habitat" calls to mind crystal, gurgling streams on lush temperate mountainsides, or the sandy mouths where rivers empty into Great Lakes or salty bays—the same scenes that are common to our national parks. But looks can be deceiving. Even in a national park what appears pristine may actually be degraded or incomplete. Eastern brook trout occupy only about 5% of their historical habitat and the naturally reproducing populations of this species are in decline throughout their native range, which includes 16 units of the National Park System for certain and probably 2 more. Populations have been eliminated or greatly reduced in almost half of the areas that historically supported the species, mostly as a result of land management practices. Competition with introduced species like the European brown trout, barriers such as culverts and dams, and changes in streambank habitat caused by insect infestations, disease, and timber harvest have reduced brook trout numbers. Self-sustaining populations will not come back without active assistance from resource managers and conservationists.

Assessing the status of this species within its natural range, which is along the spine of the Appalachian Mountains and the coastal plain from Maine to Georgia and west to the Great Lakes, is a complex task that involves many organizations and individuals. In the past, national park staffs have cooperated in local assessments and fact-finding exercises to better track and manage fish populations, but not as part of a cohesive or coordinated effort. However, eastern brook trout have emerged as an important focal species, and scientists, managers, anglers, and conservationists are uniting in collaborative, geographically broad initiatives to better understand the species and the efforts needed to restore and protect its habitat. The Eastern Brook Trout Joint Venture is one initiative that has prompted biologists who are already working on brook trout conservation in national parks to join with other governmental and private entities in conservation and management activities. The venture is the first pilot project of the National Fish Habitat Initiative, which was created with congressional, public, and private funds in 2005.

In many national parks participating in the joint venture, biologists have taken a lead role in this partnership, prompting restoration, collaborative protection and management, enhanced information and data exchange, and a better understanding of the regulatory and policy changes needed to protect the species. They are working to address brook trout population and habitat concerns and to elevate the importance of this species as a key component of both small and large ecosystems.

Stanley Brook empties into the Atlantic Ocean in Acadia National Park, Maine. The brook is home to a sea-run population of wild brook trout. The overlay shows a brook trout close up and is not part of the original photo.

In 2006, Bruce Connery, National Park Service biologist at Acadia National Park (Maine), surveyed resource managers at more than 20 units of the National Park System in the eastern United States that host brook trout. Whereas managers at all 11 units that responded have an idea of which streams in their parks have brook trout, only 8 of them have good information about water quality and the status of brook trout populations. "Though this survey has demonstrated the value of collaborative efforts, it also illustrated many gaps in our knowledge and management capabilities for fish and their habitats," according to Connery. "Support through the Eastern Brook Trout Joint Venture and other initiatives could greatly extend and strengthen conservation efforts already under way." All park respondents suggested that more information was needed about fish and their habitats so that long-term conservation strategies and cooperative restoration programs can be implemented.

For example, in Acadia National Park, Connery is working with scientists and managers from various organizations to answer a range of questions about brook trout and their habitat. Partners include the Maine Department of Inland Fisheries and Wildlife, Maine Sea Grant, University of Maine, U.S. Geological Survey Cooperative Fish and Wildlife Research Unit, U.S. Fish and Wildlife Service, and USDA Forest Service. A day of sampling in October 2006 brought out a veritable who's who of fisheries and habitat scientists in the Northeast. Acadia presents a special situation, since some of the brook trout there are sea-run

Staff from the Maine Department of Inland Fisheries and Wildlife and NPS Biologist Bruce Connery (right) sample for sea-run brook trout in Stanley Brook at Acadia National Park in October 2006.

Brook trout have emerged as an important focal species, and scientists, managers, anglers, and conservationists are uniting in collaborative, geographically broad initiatives to better understand the species and the efforts needed to restore and protect its habitat.

populations (sometimes referred to as "salters" or "coasters"), which are even less well understood than their inland counterparts.

Leading the project are Ben Letcher, a fish population ecologist at the Conte Anadromous Fish Laboratory in Turners Falls, Massachusetts, and Joe Zydlewski, of the Maine Cooperative Fish and Wildlife Research Unit. They are looking at the timing of brook trout migration between marine and freshwater environments. Acadia's streams may provide good baseline information on the different life-forms of brook trout, how habitats and genetics may be involved, and what threats exist in both protected and unprotected areas. "For the National Park Service, whose mission is to maintain or perpetuate natural populations and processes to their full integrity," Connery says, "learning about the populations and how they move in these streams and interact with the marine environment will help us understand what is required if we expect to manage and protect these fish and the small streams they inhabit." The Maine researchers also plan to examine the genetics of Acadia's brook trout, an approach that is supported by the Eastern Brook Trout Joint Venture. Only four of the park units Connery surveyed have complete genetics data; those that do are using the information to guide management decisions.

In Lake Superior, biologists with the National Park Service and cooperating agencies created two brood stocks from Isle Royale National Park (Michigan) to rehabilitate coaster brook trout populations at Isle Royale and Pictured Rocks National Lakeshore (Michigan) in the late 1990s. Subsequent monitoring revealed that genetics can vary among streams and trout around the lake. As a result, biologists halted stocking at Pictured Rocks pending further research on genetics and migration patterns, according to Jay Glase, fishery biologist for the Great Lakes national parks. Monitoring population genetics will continue to be part of the ongoing effort to rehabilitate and manage coaster brook trout populations in the Great Lakes.

Though native, genetically distinct brook trout populations can be compromised by stocking of hatchery-raised or nonnative trout, different species can coexist. In Great Smoky Mountains National Park (Tennessee and North Carolina), brook trout are no longer losing range to introduced rainbow and brown trout, according to Steve Moore, lead fisheries biologist. Instead, long-term monitoring has revealed that the native species may be doing better than previously thought. Moore hypothesizes, however, that the apparent tenacity of the species is the result of acidic deposition. Rainbow and brown trout are less tolerant of low stream pH, which may benefit native brook trout populations despite other negative consequences of acidification.

As in Acadia and other national parks, collaborative research and management are aiding the species locally, regionally, and globally. The Eastern Brook Trout Joint Venture has emerged as a model of the kind of grassroots action envisioned in the National Fish Habitat Action Plan; this and similar efforts like the Great Lakes partnership are leading to the realization that collaboration among managers, scientists, landowners, and others results in the greatest chance for success in conserving native species. ■

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Successful bald eagle program highlights the continued recovery of Channel Islands National Park

By Kate Faulkner, Peter Sharpe, and Yvonne Menard

THE U.S. CHANNEL ISLANDS, WHICH ARE HOME to Channel Islands National Park (California), are often called the Galapagos of North America. Never connected to the mainland, the islands are home to many species of animals and plants that are found nowhere else on Earth. However, this amazing oasis of biodiversity was irrevocably altered beginning in the mid-1800s when settlers introduced nonnative livestock. Feral pigs, sheep, rats, and pesticides devastated native plant and animal populations, pushing some species to extinction. Working in cooperation with numerous partners, the National Park Service has undertaken a wide range of efforts in recent years to protect and restore the biodiversity of the Channel Islands. In 2006 a program to restore bald eagles (*Haliaeetus leucocephalus*)—once an important part of the ecosystem—paid off. For the first time in more than 50 years, a bald eagle chick hatched unaided by humans on the Channel Islands.

The bald eagle restoration program was made possible through a partnership among state and federal agencies, including the National Park Service. The partnership was assisted by nongovernmental partners such as the Institute for Wildlife Studies, a nonprofit working for more than 25 years to restore wildlife on the Channel Islands, which carries out the fieldwork for the eagle restoration program.

From 2002 to 2006, biologists imported 61 bald eagle chicks from Alaska and the San Francisco Zoo to Santa Cruz Island, one of five islands that make up Channel Islands National Park. Only four years after starting the restoration program, biologists were surprised in 2006 by two successful bald eagle nests on Santa Cruz Island, each fledging one chick. In 2007 one nest with one chick has been documented and the chick fledged in late June.

In April 2006 the first bald eagle chick in more than 50 years hatched on the Channel Islands. Its radio and satellite transmitters have allowed biologists to track this bird, known as A-49, moving among the islands and visiting the mainland of California. Monitoring efforts have provided essential data on mortality and movements of the birds following fledging and departure from release sites.

Thrilled with public interest in the first chick, now known as A-49 (see photo), Channel Islands National Park, in partnership with the Institute for Wildlife Studies and the Ventura County Office of Education, established a Webcam in 2006 that brought live streaming images of the chick and its parents into the schools and homes of people around the world. The Channel Islands EagleCAM and associated discussion board, which can be found at http://chil.vcoe.org/eagle_cam.htm, developed a devoted following. The discussion board proved to be a fun and easy way to find play-by-play descriptions of the nest action, explore updates from biologists in the field, and get to know other eagle enthusiasts around the world. The project was so engaging that in July 2006 when the first eagle chick fledged at three months of age, EagleCAM devotees held a worldwide virtual toast. Because of the success of the Webcam, it has been reestablished on Santa Cruz Island to watch nesting activity in 2007. Volunteer observers take shifts

For the first time in more than 50 years, a bald eagle chick hatched unaided by humans on the Channel Islands.

throughout the day to document the birds' behavior. The solar-powered camera runs daily between dawn and dusk. Additional park Webcam information and archival footage can be found at http://www.nps.gov/chis/photosmultimedia/webcams.htm.

Bald eagles were once a very important component of the Channel Islands' ecosystem. However, human harassment, collection of eggs, and ultimately the pesticide DDT resulted in the complete extirpation of the species from the islands. Southern California, once the center for manufacture of DDT, trails the rest of the United States in the recovery of bald eagles because high levels of DDT remain in the surrounding marine ecosystem. A successful federal and state lawsuit against manufacturers and distributors of DDT provided the funds to begin the bald eagle restoration program at Channel Islands National Park in 2002.

DDT severely reduced numbers not only of bald eagles but also peregrine falcons (*Falco peregrinus*), California brown pelicans (*Pelecanus occidentalis californicus*), and other seabirds. However, bald eagles, feeding higher on the food chain, have been the slowest to recover. All the bald eagle chicks introduced through this program are outfitted with blue wing tags, a conventional radio transmitter, and a satellite Global Positioning System transmitter. These have provided essential data on mortality and movements of the birds following fledging and departure from release sites. Additionally, movement-activated cameras mounted at bait stations help to detect unmarked birds and birds whose radio transmitters are no longer active.

Reestablishing bald eagles has been part of a larger effort to restore and protect the special ecosystem of the Channel Islands. In recent years the park and partners like The Nature Conservancy, which co-owns Santa Cruz Island with the National Park Service, have eliminated nonnative animals, such as feral pigs, sheep, rats, and cattle. Species once threatened with extinction, like the island foxes, are moving toward recovery. The story of the restoration of the Channel Islands is featured in a recent edition of *The Nature Conservancy* magazine, at http://www.nature.org/magazine/winter2006/features/index.html. Restoring a healthy bald eagle population is a significant part of bringing back the natural productivity and diversity of the Channel Islands.

In order to return the bald eagle to Channel Islands National Park, biologists imported 61 chicks from Alaska and the San Francisco Zoo to Santa Cruz Island from 2002 to 2006. Two juvenile bald eagles exercise their wings and think about taking their first flight from one of two release towers on the island.

The goal of the program is eventually to establish bald eagle nests on all five islands. Many of the birds introduced into the ecosystem are still too young to reproduce. In the next several years, many of these birds will reach maturity and more nesting territories will likely be established. The signs are good that the bald eagle is back to stay on the Channel Islands. ■

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Black-footed ferrets in recovery

By Brian C. Kenner

THE YEAR 2006 MARKED THE 25TH ANNIVERSARY of the night a rancher's dog near Meteetze, Wyoming, killed a strange animal at his food bowl and the world learned that the black-footed ferret (*Mustela nigripes*), believed extinct at the time, still survived in a small, isolated population. That night, Shep unwittingly set in motion one of the most intensive, expensive, and controversial endangered species recovery programs in the history of the Endangered Species Act.

The trials and tribulations of restoring this little-known predator to its former range are well documented. The captive breeding effort, which began with only 18 animals salvaged from the Meteetze population, has produced more than 2,600 animals for restoring black-footed ferrets in several Great Plains states. In South Dakota a self-sustaining wild population of black-footed ferrets has grown and thrived in the Conata Basin/Badlands Recovery Area, which includes parts of Badlands National Park and Buffalo Gap National Grassland. The NPS Natural Resource Preservation Program funded restoration of ferrets to the national park, where a small population remains. Most of their descendants, however, have moved to the adjoining USDA Forest Service grassland. By the end of 2006, at least 200 animals comprised the population in the recovery area, with annual production of around 50 litters of two to four kits. The site has proven so successful that wild-born kits considered excess to the habitat are relocated to other recovery sites in South Dakota. Wind Cave National Park may soon begin reintroduction in part with kits from the Conata Basin/Badlands.

In South Dakota a self-sustaining wild population of black-footed ferrets has grown and thrived in the Conata Basin/Badlands Recovery Area.

Veterinarian JoGayle Howard and geneticist Samantha Wisely of the National Zoo in Washington, DC, collect sperm from an anesthetized Conata Basin/Badlands ferret. Analysis revealed that the sperm of wild-born males, unlike that of the captive breeding males, did not show signs of genetic mutations, which can be caused by inbreeding.

In 2003, scientists from the National Zoo made an important discovery about the Conata Basin/Badlands that speaks to the success of this population: The sperm of wild-born males, unlike that of the captive breeding males, did not show signs of genetic mutations due to inbreeding. This discovery makes this wild population very important to the continued genetic viability of the species. Other recovery sites in Wyoming and Montana have had some success, but outbreaks of sylvatic plague and other diseases that destroy prairie dog populations have prevented establishment of other self-sustaining ferret populations.

Because ferrets depend on prairie dogs as their primary prey and live in prairie dog burrows, ferret recovery is directly linked to the viability of prairie dog towns. The four prairie dog species native to the United States occupy less than 1% of their historical range, so potential threats to prairie dog colonies carry significant implications for ferret populations.

One threat faced by prairie dogs results from six years of drought in western South Dakota, which has greatly reduced grass production in the Conata Basin. As prairie dog colonies rapidly expand outward toward remaining grass, often onto private grazing lands, they leave areas nearly devoid of vegetation. Ranchers become less tolerant of encroaching prairie dogs as year after year of below-normal precipitation reduces available grass. Thus the State of South Dakota, the USDA Forest Service, and the National Park Service have all been developing prairie dog management

Black-footed ferret, Badlands National Park, South Dakota.

plans. The USDA Forest Service, whose plan calls for a quarter-mile prairie dog–free buffer zone between the grassland population and private land, is also considering control measures in the interior of the grassland.

A second threat emerged in 2005 when a large prairie dog colony on the Pine Ridge Indian Reservation adjacent to Badlands National Park was nearly depopulated by sylvatic plague. This colony's proximity to the Conata Basin triggered an interagency effort to document the extent of the disease and monitor progress toward the Conata Basin/Badlands colony. In 2005 and 2006 the NPS Wildlife Health Team, based in Fort Collins, Colorado, joined staffs of Badlands National Park and other federal and state agencies to conduct extensive dusting around prairie dog burrows in Conata Basin to eliminate plague-carrying fleas while the U.S. Geological Survey began researching plague vaccines for prairie dogs. In December 2005, Badlands biologists, working with area coyote hunters, found one plague-positive coyote on the edge of the Conata Basin. The National Park Service, USDA Forest Service, and State of South Dakota are working to develop a contingency plan for saving Conata Basin/Badlands ferrets if an outbreak of plague occurs.

The restoration of black-footed ferrets to Conata Basin/Badlands by the National Park Service and USDA Forest Service has been one of the most important aspects of the species' recovery. One of the lessons learned from this work is that after the initial excitement of the project has passed, agencies are faced with the need for continual monitoring and response to threats that require ongoing financial commitment and dedication of staff. The saga of black-footed ferrets continues, and though much progress has been made in the 25 years since Shep's discovery, the chapter in which the species is secure has yet to be written. ■

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Recovery efforts increase piping plover population at Sleeping Bear Dunes National Lakeshore

By Zoé Lebrun-Southcott and Alice Van Zoeren

Data collected from the long-term banding program at Sleeping Bear Dunes show that the 12-year-old BO:RX has had a large impact on the genetics of the Great Lakes piping plover population.

BO:RX IS BACK! THE NEWS traveled quickly among the staff at Sleeping Bear Dunes National Lakeshore (Michigan) on 11 April 2006. BO:RX is the code for the band combination of a well-known, 12-year-old male piping plover nesting at Sleeping Bear Dunes since 1997. His arrival signaled the 2006 piping plover monitoring and protection season at the lakeshore.

In 1986, with only 17 breeding pairs counted, the Great Lakes population of piping plovers was listed as endangered under the U.S. Endangered Species Act. Sleeping Bear Dunes National Lakeshore, along with several partnering organizations, initiated an extensive recovery effort at that time. Although the population of Great Lakes piping plovers is steadily increasing, it remains well below the recovery goal of at least 150 pairs by 2020. Until the population is large enough to sustain losses from natural predators, beach changes, habitat degradation, devastating storms, development, and recreation, managers will continue to take action on behalf of the piping plovers.

In 2006, final tallies showed that Sleeping Bear Dunes was home to a large percentage of the nesting Great Lakes piping plovers. Of the 53 pairs counted, 20 were located at Sleeping Bear Dunes. Forty-four of the 94 chicks fledged were from the national lakeshore. These numbers illustrate the paramount importance of the national park program to the recovery of the Great Lakes population of piping plovers. Other national lakeshores, including Indiana Dunes, Pictured Rocks, and Apostle Islands, are participating in the piping plover recovery efforts. Although no new nests were confirmed at Indiana Dunes or Pictured Rocks in 2006, Apostle Islands protected four nests.

Working in cooperation with staff from other agencies and many dedicated volunteers, National Park Service (NPS) staff and interns monitor and protect the nesting piping plovers at Sleeping Bear Dunes and throughout the region, with the goal of increasing the chances for reproductive success.

Protection activities include surveying shorelines for nesting plovers, establishing rope fencing around potential nesting areas, erecting exclosures (small fenced areas that keep out predators) around nests, and daily monitoring until the chicks fledge. In addition, chicks and adults are banded with a distinctive color combination that allows staff to document their behavior; determine fledging success; and track population genetics, migrations, habitat use, and behavior.

To bolster the population, eggs salvaged from abandoned nests are raised at the University of Michigan Biological Station by volunteer zookeepers from around the nation. In 2006, 8 of the 17 captive-reared chicks released back into the wild came from nests at Sleeping Bear Dunes.

One of the primary obstacles to the recovery of this population is predation. Evidence suggests that predation increases as nesting density increases; hence recovery efforts may face escalating losses from predation as the population recovers. A predator control program for gulls and crows is being piloted within the lakeshore on North Manitou Island in conjunction with the U.S. Department of Agriculture, Wildlife Services; the Michigan Department of Natural Resources; and the U.S. Fish and Wildlife Service.

A high percentage of chicks disappear in the first 10 days after hatching. Research into the causes of this mortality will help managers decide how best to protect the population of piping plovers.

So far the results are promising. Since the program started in 2003, the number of chicks that have fledged on North Manitou Island has increased each year, to a record 31 in 2006. As the population of piping plovers increases, however, questions arise regarding the intensity of predator control that may be required to maintain such successful fledging rates in the future. Managers will be faced with difficult decisions as the survival of an endangered shorebird clashes with the natural predatory actions of other species that share its habitat. This issue is further complicated because human activities have allowed for populations of some predators to become unnaturally high.

Crowded nesting conditions, due to increased nest density, could enhance chick protection as piping plovers engage in communal parenting. In addition, chicks may fledge earlier in dense colonies, thereby reducing their vulnerability to predators.

As the population recovers and the number of nesting pairs increases at Sleeping Bear Dunes and throughout the Great Lakes region, the birds will disperse into other areas of suitable habitat. When this occurs, the population will be more widely distributed and hence more stable. Suitable habitat, therefore, even if it is not currently occupied by the recovering population, must be maintained and protected to increase the overall population of piping plovers. ■

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Managers will be faced with difficult decisions as the survival of an endangered shorebird clashes with the natural predatory actions of other species that share its habitat.

Controlling honeysuckle to restore woodcock habitat

By Constance A. Ranson and James Anderson

AT THE TIME OF THE FIRST BATTLE OF THE FRENCH and Indian War (3 July 1754), Fort Necessity was situated in western Pennsylvania's native climax forest. Today, at Fort Necessity National Battlefield, natural resource managers are working to restore the historical landscape in the face of an aggressive invasion of Morrow's honeysuckle (*Lonicera morrowi*), an exotic shrub introduced from Japan around 1875. It dominates the hillsides surrounding the Great Meadows and is invading wetland and dry meadows adjacent to the fort. The honeysuckle is inhibiting forest regeneration, leading to an increase in nesting predation of shrubland birds and a decrease in native plant and animal diversity. Located southwest of the fort and at a slightly higher elevation are approximately 25 acres (10 ha) of honeysuckle-dominated habitat used in spring as a singing and display area by the American woodcock (*Scolopax minor*), a shrubland bird species whose population is in decline. Park management and partners are interested in conserving and enhancing this area as woodcock breeding habitat.

To understand the current ecosystem of the woodcock habitat and plan the restoration of the area, national park staff competed for $106,000 in FY 2003–2006 funding from the Department of the Interior's Cooperative Conservation Initiative. The funds were appropriated for the purpose of (1) documenting the distribution of plant communities dominated by the exotic honeysuckle within the woodcock breeding habitat; (2) providing a baseline data set of animal and plant communities occupying the honeysuckle, emphasizing woodcock population size; (3) developing and testing honeysuckle control strategies (e.g., mechanical, chemical); and (4) developing a habitat management plan to promote woodcock habitat and control honeysuckle. The work was undertaken by a team from West Virginia University, a member of the Great Lakes/Northern Forest Cooperative Ecosystem Studies Unit, and staff at Fort Necessity National Battlefield. The research was completed and the findings were published by West Virginia University in 2006 in a report titled "Management Plan for a Degraded Meadow Infested with Morrow's Honeysuckle."

The American woodcock is a species of management concern at Fort Necessity National Battlefield because of loss of breeding and nesting habitat.

The comprehensive survey of the woodcock habitat resulted in the discovery of species of concern not formerly known in the park, including two plants (adderstongue fern [*Ophioglossum vulgatum*] and slender wheatgrass [*Elymus trachycaulus*]) and two birds (prairie warbler [*Dendroica discolor*] and golden-winged warbler [*Vermivora chrysoptera*]).

To determine the most efficient method of honeysuckle control, the investigators established test plots where honeysuckle was mechanically removed or treated with herbicide, and compared efficacy, labor required, and cost of different methods. They also analyzed the total nonstructural carbohydrate in honeysuckle roots sampled every month for one year and found that it was lowest in the roots by the end of May, immediately after leaf-out and flowering, and highest in the roots in October, a finding shared with the Northeast Region Exotic Plant Management Team. Test plots revealed a reduction in native woody plants, possibly due to herbicide affecting nontarget species and increased deer herbivory on natives after the honeysuckle was removed. The resulting honeysuckle management plan for 2007 will involve mowing in the spring by park staff and herbicide treatment in the fall by a contractor. Native plants will be purchased, as well as "borrowed" from other areas within the park, and planted within the treatment area. Monitoring flora and fauna within woodcock habitat and control areas, both before and after treatment, will continue to be a partnership effort between park managers and West Virginia University.

Honeysuckle is inhibiting forest regeneration, leading to an increase in nesting predation of shrubland birds and a decrease in native plant and animal diversity.

This project has involved not only partnering with West Virginia University and the Great Lakes/ Northern Forest Cooperative Ecosystem Studies Unit, but also other federal agencies (USDA Forest Service, U.S. Fish and Wildlife Service), park neighbors, local schools, county conservation districts and watershed groups, private organizations, and private landowners, all of whom have voiced an interest in forming a cooperative weed management area to address the local and regional problem of exotic plants and the need for education, information, and resource sharing. A cooperative weed management area is a local organization that integrates all invasive plant management resources across jurisdictional boundaries in order to benefit entire communities.

Exotic vegetation control is the initial step in restoring the Great Meadows to the diverse native habitat that existed there around 1754, and in restoring American woodcock habitat. Restoration of the native habitat and cultural landscape is most likely to succeed through the cooperative efforts of the parks and partners in researching and implementing the best methods to protect and enhance these habitats for both biological value and historical ambience. The information obtained from this project can be globally applied to other habitat restoration projects where control of exotic vegetation must be the first step. ■

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Morrow's honeysuckle is an invasive plant species that has infested American woodcock habitat at Fort Necessity National Battlefield in dense thickets (top). A multiyear resource management research project culminated in 2006 in a plan for the removal of honeysuckle vegetation by mechanical means (bottom) and herbicide treatments.

Control of nonnative plant invasions through efficient partnerships at Assateague Island National Seashore

By Ron Dean and Jonathan Chase

SUCCESSFUL COLLABORATIVE PARTNERSHIPS HAVE augmented the National Park Service's (NPS) management of invasive nonnative plant species at Assateague Island National Seashore (Maryland) and adjacent lands. In 1999, park staff began managing invasive nonnative plant species and to date has met the challenge of limiting their expansion with remarkable success. However, being unable to handle large infestations of invasive plant species alone, park managers requested the assistance of the NPS Exotic Plant Management Team (EPMT) program in 2005 to help restore large areas of degraded habitat.

Assateague Island National Seashore is administered by the NPS Northeast Region, which operates an EPMT. However, the park is nearer and more easily served by the National Capital Region EPMT. This circumstance has given the park and the regional EPMTs the opportunity to approach the work collectively and to share resources. In 2005 the Northeast Region EPMT worked with park staff to treat several populations of invasive plants, including African weeping love-grass (*Eragrostis curvula*), multiflora rose (*Rosa multiflora*), and the prolific clonal tree-of-heaven (*Ailanthus altissima*). In 2006 the National Capital Region EPMT re-treated populations of weeping love-grass and began new control treatments of Japanese black pine (*Pinus thunbergiana*), Japanese honeysuckle (*Lonicera japonica*), and white paper mulberry (*Morus alba*).

This intra-agency partnership has been very successful. Though managers do not expect to eradicate all invasive plant species from the national seashore, this partnership enabled the National Park Service to bring 13 of 15 targeted species down to manageable levels by

Known to occur on Assateague Island National Seashore since the 1960s, African weeping love-grass (before and after treatment; left, top to bottom) gradually escaped from roadside corridors into natural areas where over time it was able to establish dense colonies, making it a prime target for eradication. Control crews cut the tussocks in late spring 2005; new growth was treated with an herbicide and follow-up treatments have helped ensure continued reduction. In 2006, plants treated included Japanese black pine (before and after, right, top to bottom) and other invasive species.

This partnership enabled the National Park Service to bring 13 of 15 targeted species down to manageable levels by 2006.

2006. Quantitative monitoring of treated infestations supports this observation and indicates a steady decline in the number of populations and total area infested by nonnative plants.

Another success has been the establishment of a similar partnership among the National Park Service; the U.S. Fish and Wildlife Service, which operates adjacent Chincoteague National Wildlife Refuge; and the Maryland Department of Natural Resources, which manages neighboring Assateague Island State Park. The National Park Service has helped guide, and joined in, the control of invasive nonnative plant species within those jurisdictions. This assistance has led to the formation of a cooperative weed management area in which all participating land management agencies benefit from coordinated monitoring and treatment efforts. The partners anticipate continued success.

Assateague Island is a barrier island located along the coasts of Maryland and Virginia that encompasses some 48,000 acres (19,440 ha) of aquatic and terrestrial coastal habitats. The ever-growing pressures of development on the East Coast have made this national seashore an increasingly important refuge for many sensitive and rare plant and animal species that are part of distinctive coastal communities. At Assateague, as elsewhere, invasive nonnative plants frequently outcompete native species. They disrupt natural ecosystems by rapidly occupying expansive areas, preventing native communities from recovering from disturbance.

Invasive nonnative plant species are implicated in the listing of 35%–46% of all U.S. threatened and endangered species (Alonso et al. 2001). These invaders have also contributed to the continued decline of more than 40% of listed native species (Ecological Society of America 2004) and are considered the second greatest threat to biodiversity after habitat loss (National Invasive Species Council 2004). Observing no jurisdictional boundaries, invasive nonnative plants are often spread by wildlife and human activity. Moreover, once established, they may be extremely difficult to eradicate. Coordinated cooperative efforts among land management agencies are frequently necessary to effectively combat the threats they pose.

Both intra- and interagency partnerships have facilitated the sharing of knowledge and resources and increased the efficiency of invasive nonnative plant management in and around Assateague Island National Seashore. This approach is helping to preserve and protect our natural heritage and is an example of effective management of nonnative species invasions on a landscape scale. ■

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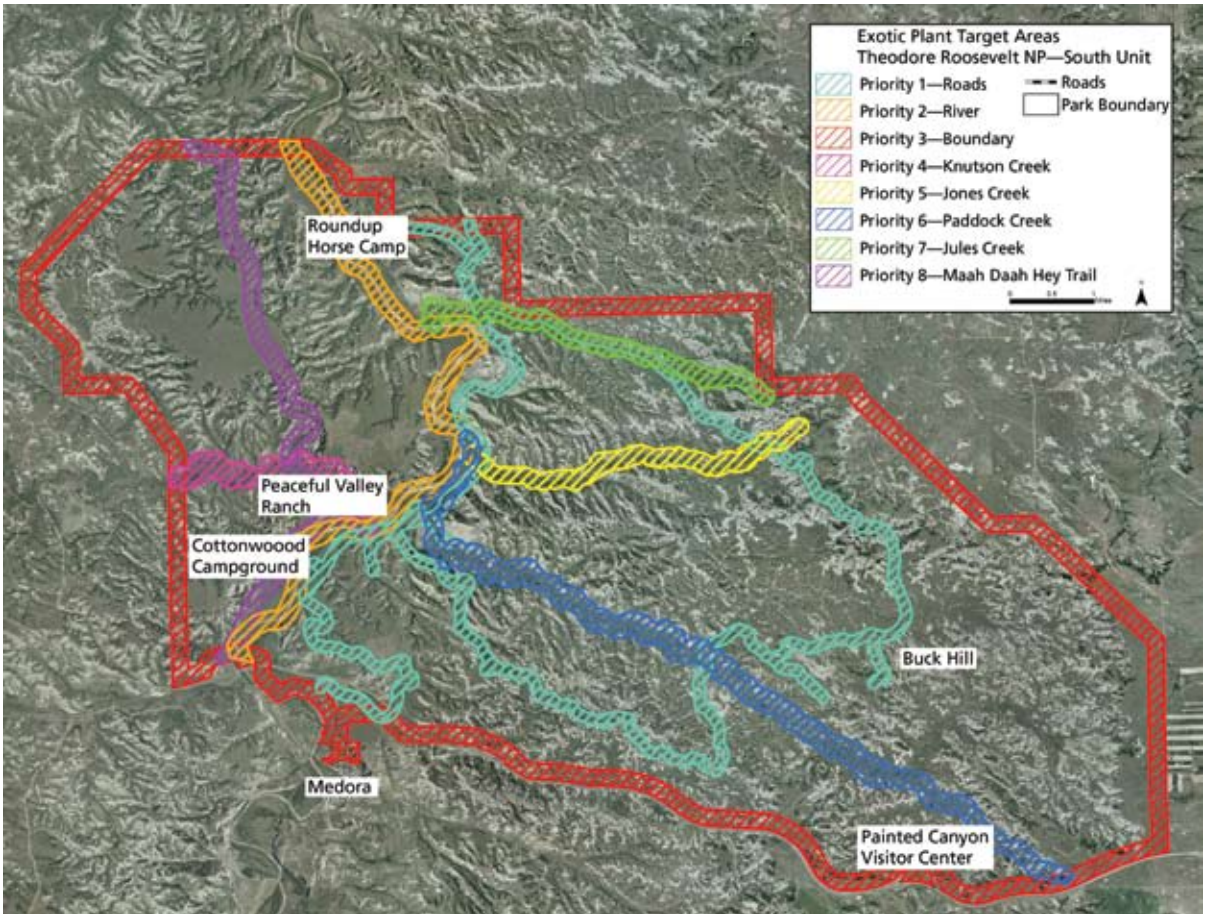
Northern Great Plains Exotic Plant Management Team treats record number of acres in 2006

By Taryn N. Flesjer and Chad W. Prosser

THE NORTHERN GREAT PLAINS EXOTIC PLANT Management Team set a new season record in 2006 by treating nearly 4,000 acres (1,620 ha) among 14 National Park System units in Wyoming, North Dakota, South Dakota, and Nebraska. Since its establishment in 2002, the team has treated nearly 13,000 acres (5,265 ha) in accordance with multiple goals related to controlling the spread of invasive nonnative species and restoring native plant communities.

Based at Theodore Roosevelt National Park, the Northern Great Plains Exotic Plant Management Team includes three satellite units, with personnel stationed at Theodore Roosevelt, Wind Cave, and Badlands national parks. Separation of the units allows the team to work within several parks simultaneously, thus saving substantial time and travel costs.

Over the past five years the team has gained on-the-ground experience and logistical knowledge that, combined with annual training and refinements to standard operating procedures, contribute to ultimate efficiency and cost-effectiveness. All equipment is calibrated and in good condition at all times so the team can apply control treatments to nonnative plants almost immediately upon arrival at a park, stopping the spread of weeds in priority areas along roads, trails, railroads, canals, and streams. The team uses prevention and herbicide along with mechanical and biological control methods as part of an integrated pest management approach to control the spread of exotic invasive plants. Because of the success of this approach, the Northern Great Plains Exotic Plant Management Team and its Environmental Assessment received a finding of "No Significant Impact," signed by the Midwest and Intermountain regional directors in September 2005.



Prioritized treatment areas at Theodore Roosevelt National Park concentrate on areas of high visitor use and high probability of spread of exotic plants along roads, trails, boundaries, and streams.

Each exotic plant infestation presents different challenges and potential solutions, so the Northern Great Plains Exotic Plant Management Team must carefully select the most efficient treatment method in each of 14 park units. They include (right, top to bottom) manual control, biological controls (beetles), and application of herbicide by backpack sprayer, helicopter, and all-terrain vehicle.

The team employs a variety of application techniques. At many parks the team applies herbicide using backpack sprayers or sprayers mounted on all-terrain vehicles. Aerial treatment or horseback patrols control leafy spurge and Canada thistle at other parks. Partners such as the Montana Conservation Corps help with exotic plant removal at some parks. The team also works on several native plant restoration projects at various parks.

In 2006 a significant project eliminated Russian olive and salt cedar trees in two parks. Team members met for eight days to finish cutting and treating these trees in the parks, resulting in the removal of 1,972 Russian olives and 256 salt cedars at Scotts Bluff National Monument and 1,370 Russian olives and 198 salt cedars at Fort Laramie National Historic Site. Continued monitoring by the team and parks will be needed to control any regrowth that occurs.

In the parks that have been treated each of the five years the team has existed, a significant decrease in exotic plant patch size and density has been achieved as well as an increase in recovery of native species. At Devils Tower National Monument, one area formerly blanketed with yellow leafy spurge has been decreased to several smaller, less dense patches noticeable only when one walks through them. Other smaller infestations have been completely eliminated.

In addition to the ongoing work of controlling exotic plants, the team conducts several outreach programs. They present their accomplishments and activities annually to personnel from partner parks, host parks, the Midwest Regional Office, and the Washington Office. The team has been invited to speak at various state Weed Control Association meetings and has been featured in several local newspapers and National Park Service newsletters.

Since 2002 the team has received exceptional assistance in the field and the office from the parks it serves. The Northern Great Plains Exotic Plant Management Team's accomplishments to date are a testament to strong support from parks and partners alike. ■

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Fighting cheatgrass and restoring fire regimes at Zion National Park

By Kelly Fuhrmann

DRASTIC TIMES CALL FOR DRASTIC MEASURES. The spread of cheatgrass (*Bromus tectorum*) across the western United States has become an epidemic that has changed ecosystems on a landscape scale, altering vegetation communities and fire regimes. Hence, after the largest wildfire in Zion National Park's (Utah) recorded history, the National Park Service (NPS), custodian of the public land management preservation and protection mandate, made an uncharacteristic decision to apply on a large-scale an aerial herbicide in order to combat likely infestation of cheatgrass. In many cases the cost of restoring plant communities on a large scale and the timeliness of restoration actions prohibit the implementation of critical restoration decisions. Fortunately Zion National Park had the support of the national Burned Area Emergency Response (BAER) Program, which provided the initial assessment of fire impacts and the financial support for emergency landscape-scale stabilization and rehabilitation.

The primary concern after the Kolob fire was the dominance of cheatgrass, which increases in abundance and density after fire.

In June 2006 the human-caused Kolob fire burned 10,516 acres (4,259 ha) in Zion and 17,632 acres (7,141 ha) total. This fire altered the landscape on an unprecedented scale, resulting in the loss of native vegetation, with probable replacement by nonnative species. Preliminary results from a collaborative U.S. Geological Survey–NPS research project, initiated in Zion Canyon in 2005 and funded by the Joint Fire Science Program, suggested that the use of herbicide to combat nonnative annual grasses and forbs is most successful if it is applied during the fall season after a fire disturbance where the herbicide can reach the soil surface directly. Post–Kolob fire restoration was the perfect opportunity to expand upon the Zion Canyon research project and try the herbicide application on a larger scale. However, park staff had less than two months to complete the compliance and contracting processes and apply the treatment to get the most effective results. Working with the BAER Team of professional hydrologists, soil scientists, and biologists provided the means to meet the time constraint and reach the goal of encouraging native perennial plant reestablishment in areas that are being threatened by cheatgrass invasion.

The primary concern after the Kolob fire was the dominance of cheatgrass, which increases in abundance and density after fire, resulting in increased fuel loads. This in turn promotes a plant community prone to frequent fires. Cheatgrass displaces native grasses and herbaceous plants because, as a winter annual, it is able to establish earlier in the growing season, thus increasing competition and depleting soil moisture. Native plants are eventually crowded out. As cheatgrass continues to increase after each fire, the time between fires becomes shorter. Because native shrubs and trees are slower to reestablish after fire, the increased fires fueled by cheatgrass eventually eliminate most of them from the landscape. With cheatgrass dominance, wildfires tend to occur earlier in the season when native perennials are more susceptible to injury by burning. The result is a conversion from native shrub and perennial grasslands to annual grasslands adapted to frequent fires. This adaptation to and promotion of frequent fires is what gives cheatgrass its greatest competitive advantage in ecosystems that evolved with less frequent fires. Cheatgrass fuels fire, and fire in turn promotes the increased growth of cheatgrass.

To combat the expected cheatgrass invasion, park resource managers chose a restoration approach that included the use of Plateau® over the extent of the burned area in the park. The U.S. Environmental Protection Agency has thoroughly tested this herbicide and approved it for use. Plateau® is highly selective, targeting many of Zion's invasive, nonnative species such as cheatgrass, ripgut brome (*Bromus diandrus*), annual mustards (*Brassica L.*), puncture vine (*Tribulus terrestris*), and field bindweed (*Convolvulus arvensis L.*). In addition, the active ingredient in the herbicide is nontoxic to a wide range of nontarget organisms, including mammals, birds, fish, aquatic invertebrates, and insects; does not bioaccumulate; and has limited mobility in soil. Park staff also applied a mix of native grasses and forbs over 500 acres (200 ha) of the burned area, which before the fire was heavily infested with cheatgrass. This mix consisted of bottlebrush squirreltail (*Elymus elymoides*), sand dropseed (*Sporobolus cryptandrus*), scarlet globemallow (*Sphaeralcea coccinea*), and Palmer penstemon (*Penstemon palmeri*).

Cheatgrass expansion has dramatically changed fire cycles and plant and animal communities over vast areas of the West by creating an environment where fires are easily ignited, spread rapidly, cover large areas, and occur frequently. The Kolob fire burned rugged lands in and adjacent to Zion National Park over four days in June and July 2006. The intensely hot, human-caused fire quickly consumed old-growth piñon-juniper forest and caused concern for the recovery of native vegetation.

These species are all native to Zion National Park and are not affected by the herbicide.

Though the decision to launch a massive restoration effort was based on scientific findings, such an unprecedented action requires follow-up to ensure that the chosen methods have been effective. Zion National Park staff has teamed up with the Northern Arizona University School of Forestry in establishing a network of plots throughout the restoration site in order to track changes in vegetation community composition. As park employees look forward to results from the first year of monitoring, anticipation is high for the potential of such actions to inform decisions on restoration in other western landscapes. Sharing lessons learned with the larger land management community will strengthen the National Park Service's ability to detect trends, understand ecosystem processes, and make innovative decisions in the West. ■

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Rehabilitation of the fire area incorporated an aerial herbicide treatment and native seeding application, which was the largest undertaking of its kind in NPS history. Contracted helicopter pilots carried out the applications during a two-week period in October and November 2006; they sprayed approximately 9,000 acres (3,050 ha) in Zion National Park.

Partnering for resource protection in Redwood National and State Parks

By Darci Short

HOME TO THE WORLD'S LARGEST TREES, REDWOOD National and State Parks (California) harbor ancient, old-growth redwoods (*Sequoia sempervirens*) and habitat for federally threatened coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*), steelhead trout (*O. mykiss*), and other wildlife species. The parks comprising Redwood National and State Parks were established to protect the world-renowned redwoods, which grow on the alluvial terraces and floodplain along Redwood Creek, and the aquatic and terrestrial species dependent on this ecosystem. However, the ability to restore ecosystems impacted by past and ongoing logging requires partnerships with adjacent and upstream private landowners. Reducing sediment threats caused by logging in the upper watershed helps protect resources downstream where the parks are located.

In 1978, the Congress expanded Redwood National Park to protect significant resources from impacts associated with ongoing logging operations occurring adjacent to and upstream from the park. The newly acquired land included more than 38,000 acres (15,390 ha) that had previously been commercially logged. The park expansion legislation also authorized implementation of an erosion prevention program on private lands upstream of the park in the Redwood Creek watershed. Since then, park staff and private landowners have developed a collaborative relationship regarding erosion control and signed formal agreements to "voluntarily cooperate to identify, prioritize, and correct . . . potential sediment sources within the Redwood Creek basin."

In 2006 the National Park Service completed a two-year partnership project with the Pacific Coast Fish, Wildlife, and Wetlands Restoration Association, a local nonprofit, and Green Diamond Resources Company, an adjacent industrial timberland owner, to reduce sediment threats from a network of roads that crossed both park and private lands in the Coyote Creek basin. This basin, located at the southeastern edge of the parks, is a 5,000-acre (2,025 ha) tributary area of the Redwood Creek watershed that had been used for timber production and ranching. The National Park Service manages about 40% of Coyote Creek, with the remainder held in private ownership.

During restoration of Coyote Creek basin, the National Park Service and its cooperators installed new, larger-diameter culverts at stream crossings. The old culvert at this crossing was severely rusted and substantially undersized for even moderate winter storm flows. The new culvert is 60 inches (150 cm) in diameter, which is large enough to accommodate a 100-year flood.

Before this partnership project, 36 miles (35 km) of roads crisscrossed the Coyote Creek watershed, half of them within Redwood National Park. Many of the roads were abandoned and needed to be removed (decommissioned) to prevent erosion. Other roads were still being used but needed intensive maintenance to prevent future failures that could damage resources.

During the project, park staff and partners treated 8 miles (13 km) of road, about 6 miles (10 km) of which were decommissioned and on private lands. These roads, located on unstable slopes, were posed to deliver a significant volume of sediment to Coyote Creek during heavy rainfall, accompanied by impacts on listed salmonid species. Assessments of the roads revealed

Reducing sediment threats caused by logging in the upper watershed helps protect resources downstream where the parks are located.

that treatment would prevent more than 48,000 cubic yards (36,720 cu m) of sediment from washing into the streams. On national park lands, an additional 1 mile (1.6 km) of road was decommissioned, and 1.5 miles (2.4 km) were upgraded as part of the Lyons Ranches Rural Historic District. Road upgrades included replacing undersized and failing culverts and improving road-surface drainage. These improvements will protect the integrity of the upgraded roads as valued cultural resources in the historic district, which is eligible for listing on the National Register of Historic Places.

The California Salmonid Restoration Grant Program supplied $458,000 to the project, and the Green Diamond Resource Company added $175,000. Park staff provided restoration expertise and project oversight on the portion of the project within Redwood National and State Parks. The Pacific Coast Fish, Wildlife, and Wetlands Restoration Association managed the project. This nonprofit group has also received grants to decommission other privately owned roads within the Coyote Creek watershed and expects to complete this other work in 2008. The National Park Service is pursuing funding to remove 1 mile (1.6 km) of logging road constructed in 1989 that cuts across prairies and oak woodlands in the heart of the historic district. Treatment of this road would complete nearly all erosion control necessary for restoring the Coyote Creek watershed.

The Coyote Creek project demonstrates the value of partnerships in the stewardship of natural resources. Such collaboration is of mutual benefit to diverse stakeholders. In this case a nonprofit restoration group furthered its mission of restoring the north coast region to benefit the declining fishing industry, an industrial timber company leveraged funds to remove unneeded roads from its property and better protect its landholdings, and the National Park Service protected resources in the public trust from external threats. ■

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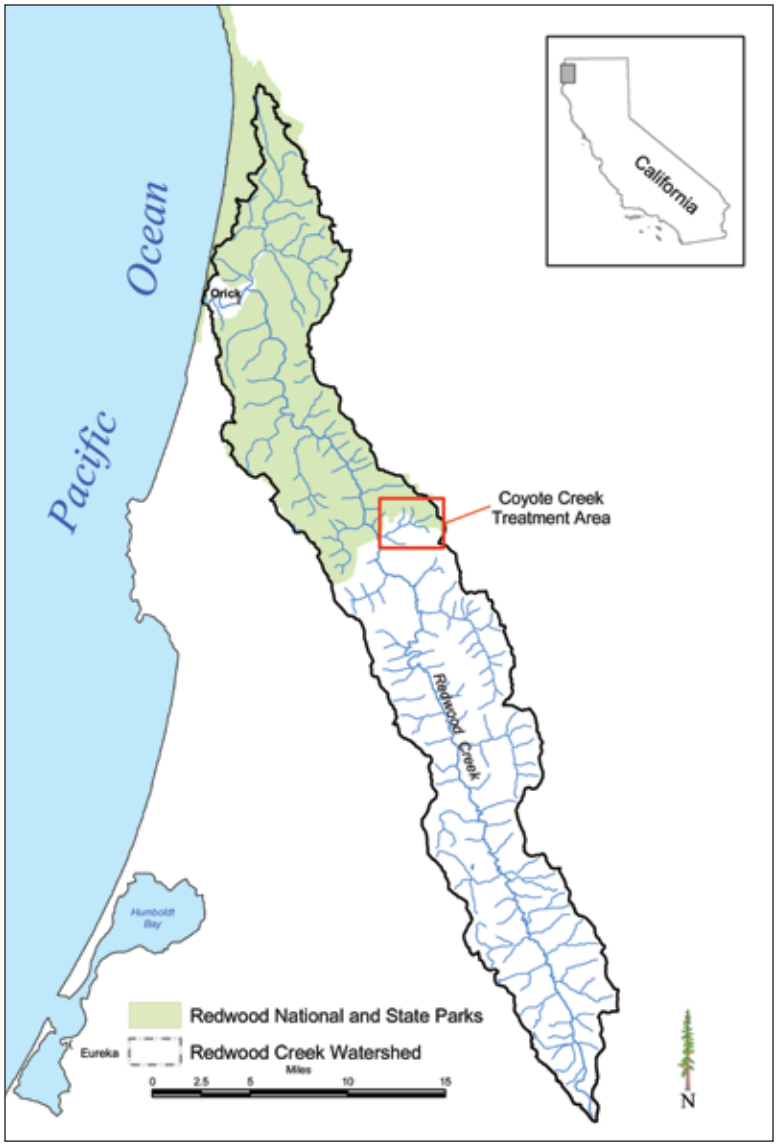

The National Park Service manages about 40% of the Coyote Creek basin, a 5,000-acre (2,025 ha) tributary area of the Redwood Creek watershed. The entire watershed has been used for timber production and ranching. In 2006 the National Park Service; the Pacific Coast Fish, Wildlife, and Wetlands Restoration Association; and Green Diamond Resources Company worked together to restore this watershed.

A cleansing on the Missouri River

By George Berndt

EARLY IN 2007 AN UNUSUAL LANDMARK disappeared from the middle of the Missouri River between Ponca, Nebraska, and Elk Point, South Dakota. For 75 years the 45-foot-tall (14 m) concrete pier (photo) stood sentinel with its partner on the Nebraska bank, part of the support system for a natural gas pipeline built in 1932 by the Northern Natural Gas and Pipe Line Company. Construction predated the establishment of Nebraska's Ponca State Park by two years, with the original piers built on opposite banks. For about two decades thereafter, park visitors viewed with amazement the world's largest pipeline bridge. By 1950 the river's natural flow ate away at the South Dakota bank, leaving that pier in the middle of the river. As a safety precaution the company dismantled the pipeline and the towers, but the piers remained.

The story of the mid-channel pier became more complicated when Congress amended the National Wild and Scenic Rivers Act in 1978, designating the reach between Gavins Point Dam and Ponca State Park as a national recreational river. As part of that process, an "Umbrella Report" prepared by the United States Army Corps of Engineers and the Bureau of Outdoor Recreation in 1977 indicated that such structures "must be removed upon termination of useful life."

The arrival of National Park Service operations staff in the early 1990s led to conversations about the pier's

Since the 1950s, a pier that once helped support a gas pipeline stood in a reach of the Missouri River designated in 1978 as a wild and scenic river (inset). Dismantled in early 2007 when river volume was very low, the pier (above) was about 25 feet (8 m) high with 12-foot-diameter (4 m) pillars beneath a concrete block 20 feet (6 m) high, 45 feet wide (14 m), and 3 feet (1 m) thick, and supported a steel superstructure and two 132-foot-tall (40 m) towers. Its partner—on the Nebraska side of the river a quarter mile away—remains standing.

Early in 2007 an unusual landmark disappeared from the middle of the Missouri River between Ponca, Nebraska, and Elk Point, South Dakota.

The Missouri River as it appears today—without the pier.

removal. In summer 2002, national park staff organized a meeting with Northern Natural Gas, the United States Coast Guard, the U.S. Army Corps of Engineers, and the Nebraska Game and Parks Commission to discuss the pier, its ownership, and the legality of its location in the river. The parties soon established that Northern Natural Gas owned the pier and that the Coast Guard had never issued an original permit authorizing its presence in the river. It then followed that the pier had to be removed or permitted. The only way to permit the pier was to show intended beneficial use, but its beneficial use ended in 1950. The only option left was removal.

Under the park's steady prodding, the removal effort gained momentum but permit issues slowed actual progress. By 2006 the necessary formalities for removal had been observed, but receding waters revealed a substantial channel between a prospective staging area on the South Dakota bank and the pier itself, complicating access. The right conditions finally materialized in late 2006 to allow demolition and removal of the concrete pier. Removal began on 8 January 2007 and ended several weeks later. Throughout the course of this outstanding public-private partnership, Northern Natural Gas proved to be an exemplary corporate citizen and cooperated wholeheartedly. In the end the project concluded another step in the national campaign to enhance the natural and recreational values of the Missouri National Recreational River. ■

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