



Alliances for Science: Partnerships and Innovation in Resource Conservation

One of the great benefits of the Natural Resource Challenge initiative of the past eight years has been the establishment and growth of scientific institutions that emphasize collaboration in meeting the science needs of the national parks. Serving groups of parks with similar resources and geographic settings, Inventory and Monitoring networks, Research Learning Centers, and Cooperative Ecosystem Studies Units facilitate broad, ecoregional approaches to research, resource management, and resource education. About 10 years old, these key institutions are maturing and, as many of the

“Who but a fool would take his left hand by his right, and say to himself, how d’ye do? Partners! I must have partners!” —Herman Melville

following articles suggest, are models for effective planning, implementation, and communication of science. Research Learning Centers, for example, have been very successful in coordinating the involvement of citizen scientists in collecting resource inventory

data through popular activities called “bioblitzes.” The information generated is useful to park managers, and the collaborative experience engages citizens in educational and intellectual ways that deepen their appreciation for national parks. The articles also demonstrate clever educational partnerships that use park examples to teach science and resource management principles as students collect data for park purposes. Other helpful alliances have come about from viewing park resources at the landscape scale. A variety of agencies and conservation organizations with many of the same goals as the National Park Service manage marine and land-based natural and recreational resources. Approaching conservation regionally is efficient and holistic because responses to habitat loss, altered natural processes, and invasive species now incorporate landscape ecology principles. Overall this chapter exemplifies the power of smart, collaborative partnerships in the use of science for the improvement of park management.



Alliances for science provide new knowledge about park resources

By Leigh Welling

THE NATIONAL PARK SERVICE (NPS) ESTABLISHED the Natural Resource Challenge (NRC) in 1999 as a multiyear and multiprogram initiative to increase science-informed resource management within the Service. Many of the programs established under the Challenge have begun to collaborate in new ways that increase the effectiveness of individual programs and enhance the overall value of the broader NRC initiative. The added value and benefits of these collaborations include increased data for decisionmaking, reduced costs through leveraged funds, shared expertise and resources, enhanced communication with park managers, and better scientific information products for public audiences.

Examples of existing collaborations among three NRC programs—Inventory and Monitoring (I&M) networks, Cooperative Ecosystem Studies Units (CESUs), and Research Learning Centers (RLCs)—are explored below. In 2006 the 32 I&M networks, 17 CESUs, and 17 active RLCs conducted a range of activities that combined expertise and resources from

these three programs in innovative ways to help parks meet their science needs. The collaborations can be grouped generally as (1) planning and implementing science and research and (2) science communication. Many other examples and opportunities exist for how these programs can work together to support science-informed decisions.

Planning and implementing science and research

Acquiring new knowledge about park resources and ecosystems is critical for making informed management decisions. In order to accomplish this, park staffs must engage with their partners and resource programs to proactively plan and implement science and research. Collaborative efforts to support parks in this process include identification of park research needs and catalogs, small grant programs that encourage park-based research and create student opportunities to help address the highest-priority information needs of parks, and citizen engagement in baseline data collection and long-term monitoring of resource health.



Monitoring such atmospheric stressors as mercury and nitrogen in the park at high elevations helps Acadia National Park staff assess watershed conditions and contributes to an overall understanding of park health.

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Identifying research needs in Acadia National Park

In 2006–2007 the Rocky Mountains CESU worked with the Schoodic Education and Research Center to develop a Research Opportunities Catalog for Acadia National Park (Maine). The process included a series of workshops with park managers and scientists to identify research priorities. The catalog will be available in fall 2007 in database form and is coordinated with the prototype Watershed Condition Assessment in progress at the park (see photo, previous page). The catalog will be used by the park, the Schoodic Center, and investigators to address research priorities for Acadia and coastal Maine.

Tehabi interns meet park needs and gain practical experience

For the past five years the Rocky Mountains CESU has worked with the Utah State University Tehabi Student Internship Program to cultivate student work and learning opportunities across national parks, I&M networks, and RLCs in the NPS Intermountain Region. As part of the program, students receive training from park, CESU, and I&M staff at a field camp at Grant-Kohrs Ranch National Historic Site (Montana) and are then assigned to a “mentored” work experience in parks and networks throughout the region.

Citizen science for the common loons of Glacier National Park

The common loon (*Gavia immer*) is a Montana Species of Special Concern. The state maintains the largest breeding population in the West, 20% of which is in Glacier National Park. Because resources for baseline inventories and species monitoring are limited, citizen scientists are helping bridge the information gap by gathering data for state and federal managers. More than 300 volunteers have been trained by staff at the Crown of the Continent Research Learning Center since 2005 to observe nesting habits and reproductive success of loons at lakes throughout the park. The project has received funding through the Glacier National Park Fund and the Rocky Mountains CESU, and data management for the work is being supported in part by staff of the Rocky Mountain I&M Network.



Jami Belt, biological technician at Glacier National Park, trains volunteers in identification and ecology of the common loon.

Science communication

Effective science communication is a key to raising awareness of resource issues, identifying and articulating appropriate management concerns and research questions, and encouraging participation in resource stewardship. Collaborative work includes shared support and sponsorship of research seminars, joint workshops on complex issues, and coordination of a range of communication products for internal and external audiences.

Communicating science in San Francisco Bay Area parks

Scientific information is generated through a variety of sources in the San Francisco Bay Area. Lacking is a comprehensive plan to disseminate this information to the variety of audiences that use it. To address this need, a joint project has been initiated by the San Francisco Bay Inventory and Monitoring Network, Pacific Coast Science and Learning Center, Natural

Resource Program Center Office of Education and Outreach, and Golden Gate National Park Association to develop a comprehensive communication strategy. Goals are to enhance awareness and communicate the efforts and findings of scientific endeavors within the network to both internal and external audiences. The strategy will identify and conceptualize key messages from scientific and resource protection endeavors, enhance communication among network parks, assist transfer of critical information among scientists (including research questions), and extend the reach of scientific information to nonscientists.

Reporting ecological conditions in the National Capital Region

The Integration and Application Network of the University of Maryland Center for Environmental Studies, the National Capital Region Network, and the Urban Ecology Research Learning Alliance have jointly developed an integrated approach to communicate vital signs monitoring concepts and natural resource issues in national parks. They developed a conceptual framework based on the key issues and stressors to park resources and on the visualization of results in a variety of contexts where they can be

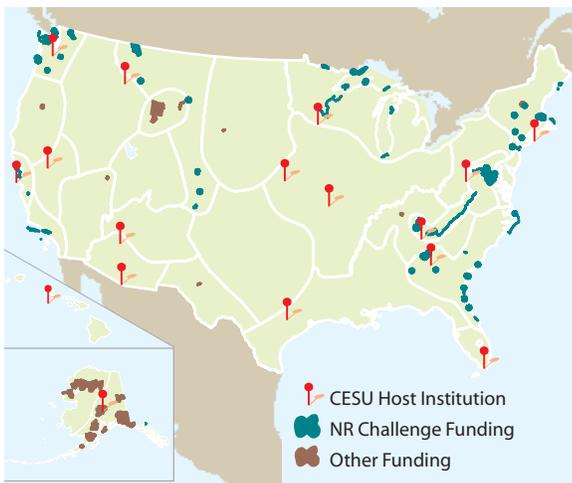
applied. Using this framework, they are implementing multiple ways to produce a synthesis of the monitoring results that is visual, contextualized, geographically and temporally referenced, and dynamic.

The potential for future collaboration

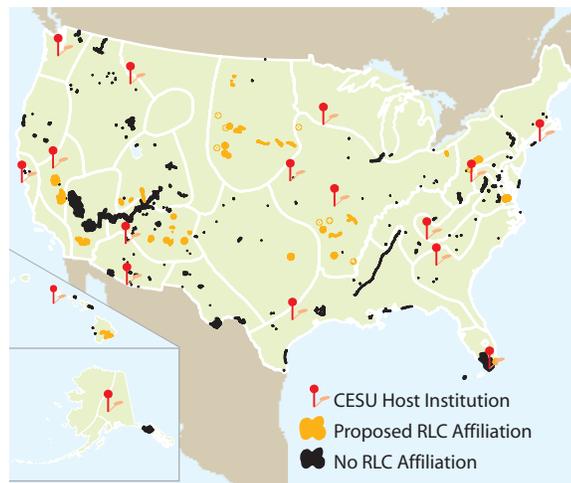
Though I&M networks and Cooperative Ecosystem Studies Units have established relationships whereby they serve all units in the National Park System, not all parks yet have access to a Research Learning Center. Most of the 17 active Research Learning Centers serve multiple parks and collectively reach around 100 of the 391 units in the National Park System (see map 1). Additional opportunities exist to establish Research Learning Centers (map 2) to link with existing I&M networks and CESU frameworks. This development would enhance the efficiency and effectiveness of Natural Resource Challenge goals and provide a local node for science facilitation and communication serving all national parks. ■

leigh_welling@nps.gov

National Coordinator, NPS Research Learning Centers, Glacier National Park, Montana



Map 1—The map shows national park units that are served by a Research Learning Center funded by the Natural Resource Challenge (green) or another source (brown). White lines reflect Inventory and Monitoring network boundaries. Host institutions for the 17 CESUs are shown in red.



Map 2—The national parks shown here have opportunities to build stronger alliances for science by funding additional RLCs within existing I&M and CESU networks; parks shown in yellow are affiliated with proposed RLCs and those shown in black have yet to identify an RLC affiliation.

Citizen scientists assist in resource stewardship through Research Learning Centers

By Susan Sachs, Theresa Thom, Joy Marburger, and Sallie Hejl

WHEN IT COMES TO ACCOMPLISHING THEIR SCIENTIFIC goals, researchers in national parks are commonly constrained by time and space—too little time on their side and too large a space to cover by themselves. In 2006, through the development of clear protocols with researchers, staff at several Research Learning Centers in national parks across the country used “citizen scientists” to assist in monitoring, data collection, and research activities. These citizen science programs educate volunteers about resource issues, help managers and scientists obtain valuable data, and allow volunteers to contribute to the stewardship of invaluable park resources.

Introduced in 2000 as part of the Natural Resource Challenge, Research Learning Centers advance research and educational opportunities in national parks and adjacent lands. These centers facilitate public-private partnerships that include a wide range of people and organizations, such as researchers, universities, educators, and community groups.

Global citizen, local volunteer: The Purple Loosestrife Project

The Great Lakes Research and Education Center, established in 2002 to facilitate research and provide educational opportunities in 10 national parks in the Great Lakes region, helps coordinate a project with the U.S. Geological Survey (USGS) that trains citizen scientists in data collection for monitoring the spread of

the exotic plant purple loosestrife (*Lythrum salicaria*) in wetlands.

The Great Lakes Research and Education Center began sponsoring workshops on purple loosestrife biology and volunteer monitoring in 2003, with more than 51 volunteers and organizers participating since then. Volunteers collect data such as plant height, stem number, presence of flowers, and water depth. Their findings are displayed on the USGS Purple Loosestrife Web site. These studies will help answer questions about the ability of the species to spread in response to climate change, as well as how the plants in Europe may differ genetically from those in North America. Volunteers in seven countries now participate in the project: Australia, Canada, Greece, Tunisia, Turkey, United Kingdom, and United States.

Using students to monitor ground-level ozone

Since 1998 an international team of researchers has been spending one week each year in Great Smoky Mountains National Park (Tennessee and North Carolina) studying the effects of ground-level ozone on plants. Staff at the Appalachian Highlands Science Learning Center are working to determine exactly when plants first begin showing symptoms of ozone damage and the rate of injury progression that occurs before and after field visits. After seeing the research protocols, it became apparent that the process could be taught to middle and high school students. Now in its sixth year, the ozone garden biomonitoring project uses hundreds of students and teachers each year to track ozone effects on behalf of the researchers. Evaluations have shown that students are gaining a deeper understanding of the impacts of an invisible air pollutant, and researchers are gaining a more complete picture of the progression of injury.

Volunteers expand loon observation capacity

Glacier National Park (Montana) has been assessing the status and trends of the common loon (*Gavia immer*), a Montana Species of Special Concern. According to one-day surveys from 1988 to 2004, Glacier National Park provides habitat for 20% of the breeding loons in Montana. The loon reproductive rate, however, appears to be lower than elsewhere in the state and less than that needed to sustain the



High school students collect data in the ozone biomonitoring garden at the Appalachian Highlands Science Learning Center in Great Smoky Mountains National Park.

population. During 2005 and 2006 the Crown of the Continent Research Learning Center worked with a park wildlife biologist to develop a citizen science program, thus increasing the number of trained people who monitor loon numbers and nesting success throughout the breeding season (see previous article). In 2006, 77 volunteer loon observers (including 33 staff members) conducted 474 surveys on 73 lakes. The results of the study indicated that a season-long population estimate (45 adults, 16 pairs, and 5 chicks) differed substantially from a one-day population estimate (36 adults, 9 pairs, and 4 chicks), which was Glacier's previous standard. Glacier's managers continue to use these data to make decisions about how to manage loon habitat to increase nesting success and loon population numbers. Support for this project was provided by The Glacier National Park Fund, the Rocky Mountains Cooperative Ecosystem Studies Unit, and NPS Volunteer-In-Parks funds.

Ivory-billed woodpecker searches in South Carolina

The ivory-billed woodpecker (*Campephilus principalis*), once the inhabitant of extensive floodplain forests in the southeastern United States and in Cuba, was thought to be extinct, until its apparent rediscovery in Arkansas in 2004. Historical records and recent potential sighting reports brought resources and expertise together to evaluate the possible presence of the woodpecker species in South Carolina. Congaree National Park became a focal point for these search activities.

The Old-Growth Bottomland Forest Research and Education Center at Congaree National Park hosted and coordinated all field activities associated with this effort in 2006. National Park Service staff provided logistical and technical support and played a leading role in training volunteers in bird identification and equipment use. Volunteers experienced Congaree National Park in a special way as they assisted with the search for the ivory-billed woodpecker. Forty-six citizen scientists contributed more than 2,000 volunteer hours as they surveyed approximately 7,210 acres (2,920 ha) within the national park and field-tested search protocols now in use throughout the region. They documented more than 98 species of resident and migratory birds, and though they did not film an ivory-billed, volunteers investigated hundreds of large cavities, foraging evidence, and double-knocks and



In 2006 and 2007, amid giant tupelo and cypress trees, volunteers search the floodplain forests of Congaree National Park for the ivory-billed woodpecker.

other vocalizations that give researchers hope of confirming the existence of the ivory-billed woodpecker in South Carolina.

Citizen scientists integral to science advancement across the National Park System

Seventeen Research Learning Centers now serve more than 100 units in the National Park System. Through their ongoing efforts these centers have enhanced the ability of park managers and staff to make more scientifically sound decisions. The citizen scientists who help support these centers are instrumental in the success of these efforts, allowing NPS researchers to conquer the constraints of time and space. ■

susan_sachs@nps.gov

Education Coordinator, Appalachian Highlands Science Learning Center, Great Smoky Mountains National Park, North Carolina/Tennessee

theresa_thom@nps.gov

Director, Old-Growth Bottomland Forest Research and Education Center, Congaree National Park, South Carolina

joy_marburger@nps.gov

Research Coordinator, Great Lakes Research and Education Center, Indiana Dunes National Lakeshore, Indiana

sallie_hejl@nps.gov

Resource Education Specialist, Crown of the Continent Research Learning Center, Glacier National Park, Montana

Conserving biodiversity: Bioblitzes focus on the variety of life in the national parks



Tightly defined in time (24 to 48 hours) and space, a bioblitz (also bioquest or foray) brings the diverse capabilities of local natural historians, professional and amateur scientists, and students to the national parks en masse to explore, share findings, and educate the public about biodiversity. In the following articles, organizers with the National Park Service (NPS) parks and Research Learning Centers and their partners share brief summaries of the bioblitz events that took place in 2006 in the national parks. These park units are within coastal, piedmont, mountain, and urban ecosystems. The bioblitzes focused on diverse, often understudied, taxa such as fungi, beetles, and spiders.



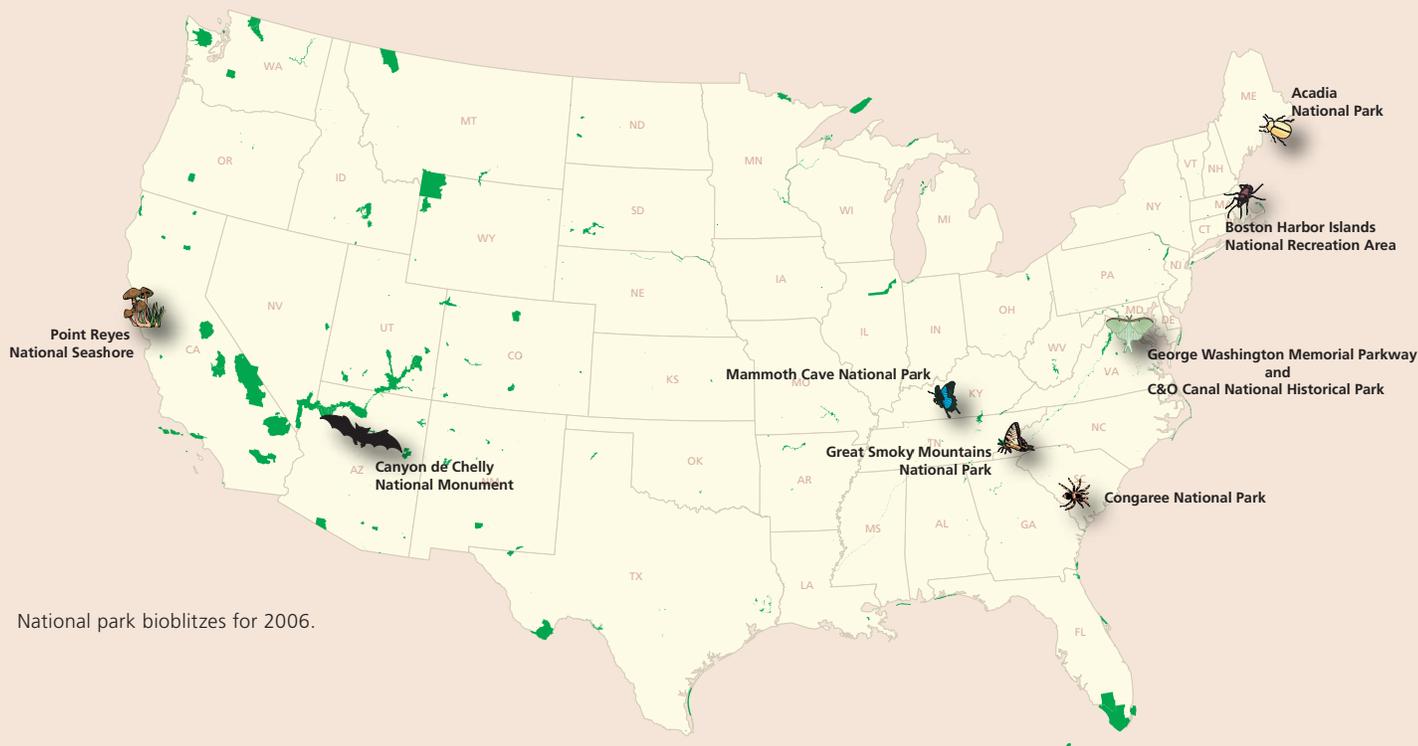
Bioblitzes represent important contributions to systematic inventory and monitoring programs and can provide basic data needed for resource protection and conservation, which enhances park managers' abilities to protect resources. The bioblitzes often focus on groups not surveyed through the NPS Inventory and Monitoring Program. Though they do not comprehensively inventory a park's resources, bioblitzes develop important information on species occurrences, richness estimates, and identification of rare, endemic, and invasive species. Such data address the unfunded inventory needs of parks and are an excellent way to identify and help prioritize possible monitoring needs. Among the hundreds of species counted in each event are surprising discoveries of not only rare species but also species new to the park, county, state, region, and to science.

A bioblitz enhances public awareness of biodiversity in national parks. Each bioblitz in 2006 was associated with public programs to build awareness and understanding and to create advocacy for park resources. Bioblitzes facilitate educational and intellectual interactions among participants. They offer students hands-on experience and interaction with career scientists, especially taxonomists, whose numbers are declining in today's institutions but whose skills are needed for managing biodiversity. Broad and diverse media coverage of these events offers excellent, far-reaching venues to discuss conservation and park issues. Additionally, educational programs and curriculum development can follow these bioblitzes. Great Smoky Mountains National Park staff created a high school mentoring program that involved their "Beetle Blitz" researchers.



Bioblitzes not only benefit from volunteers but actually rely on the donation of time from professional taxonomists and experienced amateurs. These partnerships are vital to the parks and increase the richness of the bioblitz experience by bringing together different skills. Partners share the common goals of greater understanding to protect park resources and new interactive and educational outreach opportunities. Volunteers make the events possible through their support and participation on the teams.





National park bioblitzes for 2006.

Congaree SpiderBlitz

By Theresa A. Thom and David C. Shelley

AS PART OF ONGOING RESEARCH AND INVENTORY work at Congaree National Park (South Carolina) the Old-Growth Bottomland Forest Research and Education Center hosted the first ever SpiderBlitz in October 2006. Dr. Robert Wolff, an entomologist at Clemson University, led the program with the assistance of park staff. Volunteers helped with this full day of data collection, and their efforts made the SpiderBlitz a great success. A total of 41 citizen scientists from South Carolina and Georgia donated 135 hours as they learned about, collected, and examined spiders. Following a brief introduction to spiders and how to collect them, citizen scientist teams collected spiders in various park habitats in morning, afternoon, and evening sessions. Specimens were brought back to the Research and Education Center lab, where they were examined under dissecting microscopes. Preliminary results indicate that more than 150 species were collected, with roughly 40 species newly documented in the park. The Congaree SpiderBlitz was the first of what is hoped will be many bioblitzes to be held at Congaree National Park. ■

theresa_thom@nps.gov

Ecologist/Director, Old-Growth Bottomland Forest Research and Education Center, Congaree National Park, South Carolina

david_shelley@nps.gov

Education Coordinator, Old-Growth Bottomland Forest Research and Education Center, Congaree National Park, South Carolina



Designed to encourage public participation, the Congaree National Park SpiderBlitz introduced volunteer citizen scientists of all ages to a variety of park habitats and led to new species discoveries for the park.

Such data [generated by bioblitzes] address the unfunded inventory needs of parks and are an excellent way to identify and help prioritize possible monitoring needs.

Fungal Forays at Point Reyes National Seashore

By Ben Becker and Christie Anastasia

MORE THAN 200 CITIZEN SCIENTISTS PARTICIPATED in the first ever Fungal Forays at Point Reyes National Seashore, California. This rapid biodiversity assessment was designed to sample fungi from habitats throughout the park to help expand our understanding of fungal distribution and biodiversity. Point Reyes National Seashore is typical of most national parks with a good inventory of its vertebrates and vascular plants, but with little knowledge of its fungal biota. The goal of the Fungal Forays is to address this need and produce a useful database for ecologists while making basic knowledge of the region's fungi publicly accessible. Taxonomists from UC–Berkeley, Humboldt State

University, and San Francisco State University and experts from the Mycological Societies of San Francisco and Sonoma counties joined many other enthusiasts and even several park visitors, who participated in the study to round out their park visit. So far the forays have increased the park's species list from 110 to more than 440, with at least 8 species new to science. Because of the ephemeral nature of fungal fruiting structures, the Pacific Coast Science and Learning Center and its scientific partners are repeating the surveys in 2007 and 2008 and expect to find many additional park records. ■

ben_becker@nps.gov

Director and Marine Ecologist, Pacific Coast Science and Learning Center, Point Reyes National Seashore, California

christie_anastasia@nps.gov

Education Coordinator, Pacific Coast Science and Learning Center, Point Reyes National Seashore, California



Laid out on waxed paper and accompanied by collection data, fungi gathered as part of the 2006 Fungal Forays at Point Reyes National Seashore await identification by mycologists.





New bioblitz discoveries in national parks near the nation's capital

By Brent Steury, Stephanie Flack, Mary Travaglini, Arthur Evans, Giselle Mora-Bourgeois, and P. Scott Bell

THE GEORGE WASHINGTON MEMORIAL PARKWAY and Chesapeake and Ohio Canal National Historical Park (Virginia and Maryland) teamed up with The Nature Conservancy's Maryland/DC Chapter on 24–25 June 2006 to conduct a bioblitz on national park lands within the Potomac River Gorge, a 15-mile river corridor that is recognized as one of the most biologically significant natural areas in the eastern United States.

A total of 135 volunteer biologists and naturalists formed 18 field research teams and represented 30 institutions, including the Maryland and Virginia Natural Heritage programs, the Smithsonian Institution, and area universities. The teams focused their surveys on historically undersurveyed groups of invertebrates and nonvascular plants.

Highlights of the 30-hour search include a fly species new to science; new Virginia records for 51 beetles, five true bugs, a fly, a bee, and a copepod; a state rare dragonfly previously unrecorded from the parks; and hundreds of other new park records, including species of land snails, crayfish, flatworms, spiders, syrphid flies, caddisflies, stoneflies, an antlion, wasps, true bugs, moths, beetles, fungi, slime molds, algae, mosses, and vascular plants. ■

brent_steury@nps.gov

Supervisory Biologist and Natural Resources Program Manager, George Washington Memorial Parkway

sflack@tnc.org

Potomac Gorge Project Director, The Nature Conservancy in Maryland/District of Columbia, Bethesda, Maryland

mtravaglini@tnc.org

Potomac Gorge Habitat Restoration Manager, The Nature Conservancy in Maryland/District of Columbia, Bethesda, Maryland

arthurevans@verizon.net

Research Associate, Department of Entomology, National Museum of Natural History, Smithsonian Institution; and Department of Recent Invertebrates, Virginia Museum of Natural History, Richmond, Virginia



Invertebrates, plants, fungi, and slime molds collected during the Potomac River Gorge bioblitz are sorted and identified in a makeshift laboratory at George Washington Memorial Parkway.

giselle_mora-bourgeois@nps.gov

Science Education Coordinator, Urban Ecology Research Learning Alliance, National Capital Region, Washington, DC

p_scott_bell@nps.gov

Acting Natural Resource Program Manager, C&O Canal National Historical Park, Maryland

Great Smoky Mountains Bioquest

By Paul Super and Susan Sachs

GREAT SMOKY MOUNTAINS NATIONAL PARK

(Tennessee and North Carolina) held its first bioquest in 2000 as part of its All Taxa Biodiversity Inventory. From 2000 through 2006, more than 30 bioquests have been held, focusing on both taxonomic groups (beetles, fungi, lichens, slime molds) and specific habitats (karst and caves, leaf litter, and high-elevation sites). Over the years the logistics for and focus of bioquests have changed. Most bioquests are now several days long and include better follow-up on difficult identifications and more geo-referenced data for common species. As an important part of bioquests researchers bring their students to study with other experts. Serendipitous results of bioquests include finding new, potentially invasive nonnative species and unusual phenomena (e.g., deformed, acid-loving diatoms in high-elevation springs).



High school student volunteers consult butterfly and moth identification guides in the Lepidoptera Quest at Great Smoky Mountains National Park.

The Lepidoptera (butterflies and moths) Quest is an example of the increased efficiency and productivity of successive bioquests. In 2000 a Lepidoptera Quest brought together researchers, adult volunteers, and high school students to collect 706 species in 24 hours, including 25 undescribed species, producing a checklist. In 2004 a Lepidoptera Quest collected fewer species over four days, but 500 species were digitally photographed, 642 species were submitted for DNA sequencing, and more than 300 species were preserved cryogenically. The 2004 quest produced more than 3,000 geo-referenced records as the researchers are accompanied by volunteers who record GPS locations and associated metadata. ■

paul_super@nps.gov

Science Coordinator, Appalachian Highlands Science Learning Center at Purchase Knob, Great Smoky Mountains National Park, North Carolina

susan_sachs@nps.gov

Education Coordinator, Appalachian Highlands Science Learning Center at Purchase Knob, Great Smoky Mountains National Park, North Carolina



(Above right) Investigators Joe Keiper (left) and Chris Thompson (right) search for flies along the intertidal wrack line at Acadia as part of the blitz.

(Right) Volunteers for the 2006 Schoodic Diptera Blitz at Acadia National Park stand up to be counted.

Acadia National Park Bioblitz

By *Jim McKenna*

ACADIA NATIONAL PARK (MAINE) HAS HOSTED FOUR annual bioblitzes to document the biodiversity of lesser-known taxonomic groups within the park (ants, butterflies and moths, beetles, and flies). Acadia's bioblitzes have given managers important baselines for use in park management. For example, an Acadia bioblitz is a single 24-hour event conducted in 6% of the park's landholdings. Despite these narrow spatial and temporal boundaries, the fiscal year 2006 Coleoptera bioblitz collected 310 species of beetles, 60 of which were new records for the park and 48 of which were new records for the state of Maine. ■

jim_mckenna@nps.gov

Coordinator, Schoodic Education and Research Center, Acadia National Park, Maine





Beetle Blitz at Boston Harbor Islands National Recreation Area

By Mary Raczko and Jessica Rykken

IN 2006 A 24-HOUR BEETLE BLITZ CONTRIBUTED TO the Boston Harbor Islands National Recreation Area (Massachusetts) All Taxa Biodiversity Inventory (ATBI). The park organized the event and partnered with the Harvard Museum of Comparative Zoology, the Thompson Island Outward Bound Education Center, and the Island Alliance. Despite consistent rain for the first 18 hours of the event, 30 people, including professional researchers, amateur entomologists, students, a representative from Taiwan National Parks, and a youth group from Ohio, collected 205 beetles from two islands. At least 20 of the 70 species collected are new records for the park. On Thompson Island, citizen scientists were led by park rangers and helped collect specimens while learning about the “micro-wilderness” of the islands. A smaller group of participants braved the wind and rain to venture to Lovells Island by boat for more collecting. Public contributions to the ATBI continued throughout the year through school programs, nature walks, and camping programs. Volunteers will soon be able to follow up on the results of their efforts via a publicly accessible database. ■

mary_raczko@nps.gov

Partnership Liaison, Boston Harbor Islands National Recreation Area, Massachusetts

jrykken@oeb.harvard.edu

Postdoctoral Research Fellow, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts



Volunteers search for beetles, including the six-spotted tiger beetle (*Cicindela sexguttata*, inset), at Boston Harbor Islands National Recreation Area.

Canyon country critters discovered at Canyon de Chelly National Monument

By Elaine F. Leslie



SITUATED IN THE HEART OF THE NAVAJO

Reservation, Canyon de Chelly National Monument (Arizona) initiated two bioblitzes in 2005 and followed up with coordinated All Taxa Biodiversity Inventory (ATBI) efforts in 2006. Park staff united with the surrounding Navajo Nation volunteer community of Chinle and Tsaile to conduct inventories of raptors, riparian avifauna, bats, and invertebrates. Diné College and Northern Arizona University students joined in the work. Park staff and students are being trained in the methods of field collection, preservation, and cataloging. In 2006 alone the park collected more than 5,000 specimens, including 470 arthropod taxa, 6 bat species new to the park, and several raptors that were once thought to be migratory but are now confirmed as residents.



Bat blitz participants document a rare spotted bat (*Euderma maculatum*) at Canyon de Chelly National Monument.

The park, with the assistance of Neil S. Cobb, director of the Merriam-Powell Center for Environmental Research, will feature a 2007 ATBI workshop to teach students of all ages about the natural history of species like tarantulas and scorpions, resulting in an expected fivefold increase in collection of arthropods by the end of the summer. ■

elaine_leslie@nps.gov

Chief, Native Species and Ecosystems Branch, Biological Resource Management Division, Fort Collins, Colorado

Butterfly Blitz continues to add species at Mammoth Cave National Park

By Kurt Helf

TEN AMATEUR LEPIDOPTERISTS; RICK OLSON AND Kurt Helf, ecologists with Mammoth Cave Science and Resources Management Division; and Jeffrey Marcus, assistant professor at Western Kentucky University, participated in the second Butterfly Blitz at Mammoth Cave National Park (Kentucky). The blitz was held 7–9 July 2006 and added 23 species and likely hundreds of moth species to the park list. In addition, Drs. Marcus and Helf helped the public learn names and characteristics of butterflies and moths. Twenty-five visitors, ages 6 to 60, armed with nets, patrolled the park trails during the day to observe, capture, and identify butterflies. They checked baited traps left the night before for additional moths and butterflies. In the evenings, Dr. Marcus used a mercury-vapor lamp and white sheet to attract night-flying moths. During the first Butterfly Blitz (in 2005), researchers, students, and visitors documented 58 butterfly and 800 moth species, with hundreds of additional specimens waiting to be identified. They discovered one moth new to science, one rare Olympia marble butterfly (found only in four populations in Kentucky), and two moth species that are each found in only one other location in the state. ■

kurt_helf@nps.gov

Invertebrate Ecologist, Cumberland Piedmont Network



A biologist checks a moth trap and provides public orientation at the Butterfly Blitz at Mammoth Cave National Park.



Science meets history: Cooperative Ecosystem Studies Units create opportunities for innovative collaborations and improved understanding

By Christine Whitacre, Kathy Tonnessen, Trinkle Jones, Ron Hiebert, Pat O'Brien, and Larry Norris

COOPERATIVE ECOSYSTEM STUDIES UNITS (CESUs) are research centers that allow universities, federal land management agencies, and other partners to work collaboratively to produce research, technical assistance, and educational opportunities designed to address complex resource issues. In recent years the numerous CESU partners working within the National Park Service (NPS) Intermountain Region have provided specialized assistance to meet the science and history needs of the region's national parks. Additionally, by linking natural and cultural resources research, these parks have had the opportunity to work creatively with university departments that have not traditionally participated in park research. As a result, a number of projects have been undertaken through CESUs in the NPS Intermountain Region from 2002 to 2006 that foster innovative collaboration and use science to enhance the understanding and preservation of culturally significant natural resources.

For example, the Desert Southwest CESU has undertaken collaborations that will help to protect natural and cultural resources and promote heritage tourism. In 2003 the University of Arizona, the Arizona–Sonora Desert Museum, and the National Park Service collaborated on plans to inventory and preserve Spanish colonial botanical stock that today still propagates and grows in Arizona and Sonora, Mexico. During the Spanish colonial missions era, settlers brought to Arizona domestic plants—apple, peach, apricot, pear, quince, persimmon, grape, and similar species—that survive today. Similarly, in northern Mexico, missionaries like Father Eusebio Francisco Kino established missions with working farms and orchards during the first half of the 17th century. Based on the research and preservation efforts of Desert Southwest CESU partners, historical agricultural sites such as orchards will be reestablished at two sites near Tucson, Arizona: Tumacacori National Historical Park and Tucson Origins Heritage Park. Other partners working to preserve these historical agricultural resources include the NPS Western Archeological and Conservation Center and Mexico's Instituto Nacional de Antropología e Historia.

In 2005 and 2006 the Colorado Plateau CESU administered and partially funded three projects to improve the management and care of entomological, paleontological, and other natural history collections stored at

Colorado Plateau national parks and other partner institutions, including Northern Arizona University and Colorado State University. Within the National Park Service, collections management has been a cultural resource management function; however, many parks have extensive natural history collections that include type specimens for new species and rare natural resource items. As a result, natural resource collections, such as the 4,500 moth and butterfly specimens at Colorado National Monument, benefited from the expertise of CESU partners who helped to catalog and improve the storage of various collections. Additionally, new species were discovered among the existing collections, which were documented and published for the first time.

Through the Rocky Mountains CESU, in 2005 the University of Colorado at Boulder partnered with Sand Creek Massacre National Historic Site (Colorado), the National Park System's newest park, to explore the cultural and natural landscape that was present at the time of the massacre, which the park was created to preserve and memorialize. On 29 November 1864, U.S.

At Sand Creek Massacre National Historic Site (Colorado), scientists with the Rocky Mountains CESU used dendrochronology, or tree-ring dating, on existing stands of riparian cottonwood trees to identify "witness trees" that may have been alive at the time of the 1864 massacre that the park was established to memorialize.





Researchers working at Sand Creek Massacre National Historic Site were unable to definitively date any of the 92 standing trees they studied to 1864, the year of the massacre; however, the tree pictured is estimated to have germinated in 1865, one year after the massacre.

Collaboration between the National Park Service and highly qualified CESU partners is proving invaluable for improving the understanding and protection of the cultural resources found in our national parks.

volunteer soldiers attacked a village of Cheyenne and Arapaho Indians. Because the park’s authorizing legislation calls for the National Park Service to protect the cultural landscape of the site as it appeared at the time of the massacre, NPS scientists and university partners used dendrochronology, or tree-ring dating, on existing stands of riparian cottonwood trees to identify “witness trees” that may have been alive at that time. Though none of the standing trees were definitively dated to 1864, the evidence suggests that a number of cottonwoods were alive at the time as seedlings or saplings. This study also provided historical climatic reconstructions related to floods and droughts that affected these cottonwood stands over the past 150 years. For example, scientists were able to determine that the limited establishment of cottonwood seedlings along the park’s Big Sandy Creek was the result of drought, lack of large floods, and land-use practices of the last 50 years. These data sets will be pivotal in drafting a general management plan for the new park that will preserve and protect both natural vegetation communities and the cultural context for this nationally significant historic site.

Clearly collaboration between the National Park Service and highly qualified CESU partners is proving invaluable for improving the understanding and protection of the cultural resources found in our national parks. When science meets history, it is possible to understand not only the natural processes that shaped history but also how to better preserve the cultural resources in our care. ■

christine_whitacre@nps.gov
Cultural Specialist, Rocky Mountains CESU, Missoula, Montana

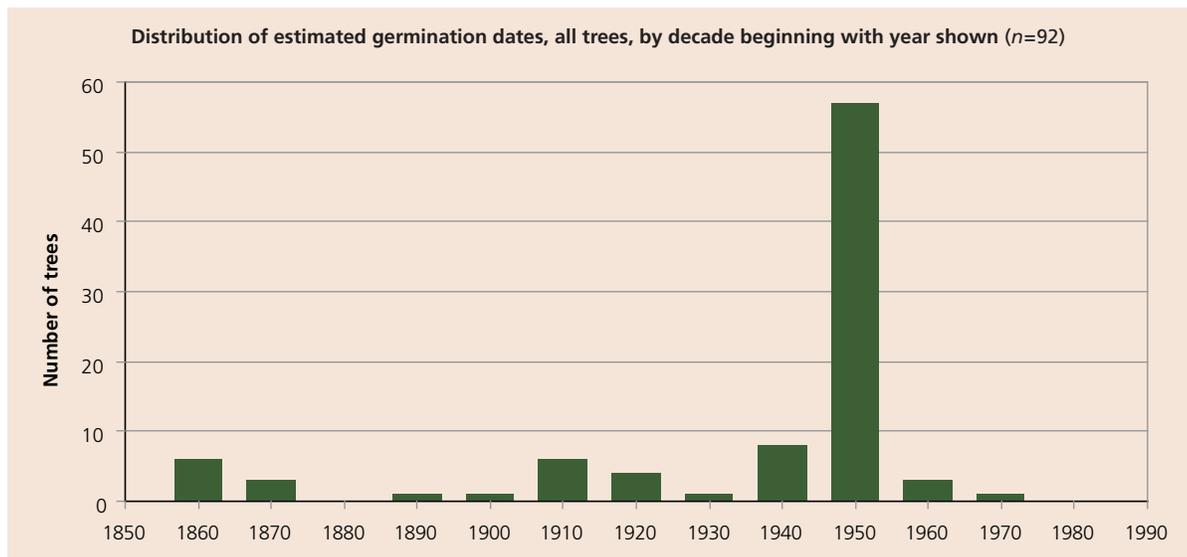
kathy_tonnessen@nps.gov
Research Coordinator, Rocky Mountains CESU, Missoula, Montana

a_trinkle_jones@nps.gov
Cultural Specialist, Colorado Plateau CESU, Flagstaff, Arizona

ron.hiebert@nau.edu
Research Coordinator, Colorado Plateau CESU, Flagstaff, Arizona

pat_o'brien@nps.gov
Cultural Specialist, Desert Southwest CESU, Tucson, Arizona

Inorris@ag.arizona.edu
Research Coordinator, Desert Southwest CESU, Tucson, Arizona



The graph shows that there has been very little establishment of cottonwood trees along Big Sandy Creek in Sand Creek Massacre National Historic Site since about 1965. Scientists have determined that this pattern is the result of drought, lack of large floods, and land-use practices during the last 50 years. Data of this sort will be used to inform the park’s general management plan.

The NPS Data Store: Improving resource management through data sharing

By *Chris Dietrich*

NATURAL RESOURCE RESEARCH AND MANAGEMENT in national parks both require and generate data. A typical field project may involve a literature search, a database of field observations, and maps and reports that document findings. An ongoing challenge in the National Park Service (NPS) has been ensuring that such information can be shared reliably and used to inform resource managers. The Natural Resource Geographic Information Systems (GIS) Program, located at the Natural Resource Program Center in Fort Collins, Colorado, has developed a Web-based application called the NPS Data Store that national parks and programs can use to consistently document and distribute data they generate.

The NPS Data Store (<http://science.nature.nps.gov/nrdata/>) is a Web-based clearinghouse of data sets and their associated descriptive documentation (metadata). Containing more than 20,000 metadata records, the Data Store catalogs databases, GIS layers, base maps, data standards, and natural resource monitoring protocols. In most cases it provides direct download links so that data sets can be immediately retrieved by users. The Data Store shares data in several ways to make it easily available to researchers, GIS specialists, and resource managers. Data are typically found by performing a search using the application interface. The Data Store also provides Web services to deliver data to national parks and programs. The NPS Metadata Tools and Editor, a companion metadata editing tool for the Data Store, provides the means to document a data set and format the metadata so that they are compatible with NPS and other national systems.

Integration and data sharing

In 2006 the NPS Data Store began an exciting new phase by actively integrating with partners using Web services. Web services deliver metadata to other Web applications so that data cataloged on the Data Store are shared with a broader audience. The Data Store began providing records to GOS, the federal Geospatial One-Stop (<http://gos2.geodata.gov/wps/portal/gos>), in January. Sharing data via GOS represents a great stride in fulfilling National Park Service obligations to participate in the National Spatial Data Infrastructure and makes data easily available to many more users.

Over the course of the year, three Inventory and Monitoring Program (I&M) networks also established Web services between their Web sites and the Data Store. For example, the Northeast Temperate Inventory and Monitoring Network (NETN) sends a query over the Web that returns search results from the Data Store. Users see metadata with data download links delivered from the Data Store directly on the NETN data access Web page (<http://www1.nature.nps.gov/im/units/netn/data/data.cfm>). The query results are updated as frequently as records are updated on the Data Store. Fred Dieffenbach, NETN data manager and biologist, explains the value of Data Store Web services: “The data access page developed by the Northeast Temperate Network helps park staff and cooperators find relevant data easily. It also shows that data and metadata standards are not simply arbitrary requirements, but are instead important components that make it possible to share and use NPS data.”

These integration efforts are major milestones in NPS efforts to minimize data redundancy, improve efficiency, reduce duplication of effort, and facilitate access to data for park planners and resource managers.

Sensitive or very large data sets

The Data Store can also make data discoverable without making them immediately available online. Examples include data sets that are too large to easily download or that contain sensitive information like locations of endangered species, cultural resources, or fossils. Brian Witcher, South Florida/Caribbean Inventory and Monitoring Network data manager, says: “One of the real values of the Data Store is the ability to make all NPS data discoverable. This is critical for researchers interested in understanding and protecting park resources. Sensitive data can be found by NPS cooperators and the public and still be protected.” Through the metadata record, researchers and contractors to the National Park Service can see that these kinds of data exist. Sensitive data are still safeguarded because acquiring them necessitates contacting the person responsible for managing the data.

Single point of access

The Data Store directly supports resource management by providing a single point of access for data spanning a wide range of subjects. This makes it easy to bring

The Data Store has proven to be an effective and reliable tool for sharing data, improving resource management, and preserving institutional memory.

together data from multiple disciplines for analysis and resource management efforts. One recent project at Canyonlands National Park (Utah) used data produced by two different Inventory and Monitoring Program resource inventories to support fieldwork for a third inventory. GIS specialists Aneth Wight and Gery Wakefield depend on the Data Store as a source for developing maps for resource management projects. They used it to find GIS layers produced by the Base Cartographic and Geologic Resources Evaluation inventories. The two data sets were combined to create a map identifying sampling locations for fieldwork supporting the Vegetation Mapping Inventory.

The Data Store is becoming widely recognized by resource managers and researchers as the place to go for NPS data. Brent Frakes, Rocky Mountain Inventory and Monitoring Network data manager, says: “A number of cooperators from research institutions and other government agencies have contacted me about initiating resource-related projects in parks. When I talk to them I often discover that they have already found relevant data sets on the NPS Data Store without me directing them there. The Data Store is a well-known source for NPS data sets of all kinds.”

Repository for long-term knowledge

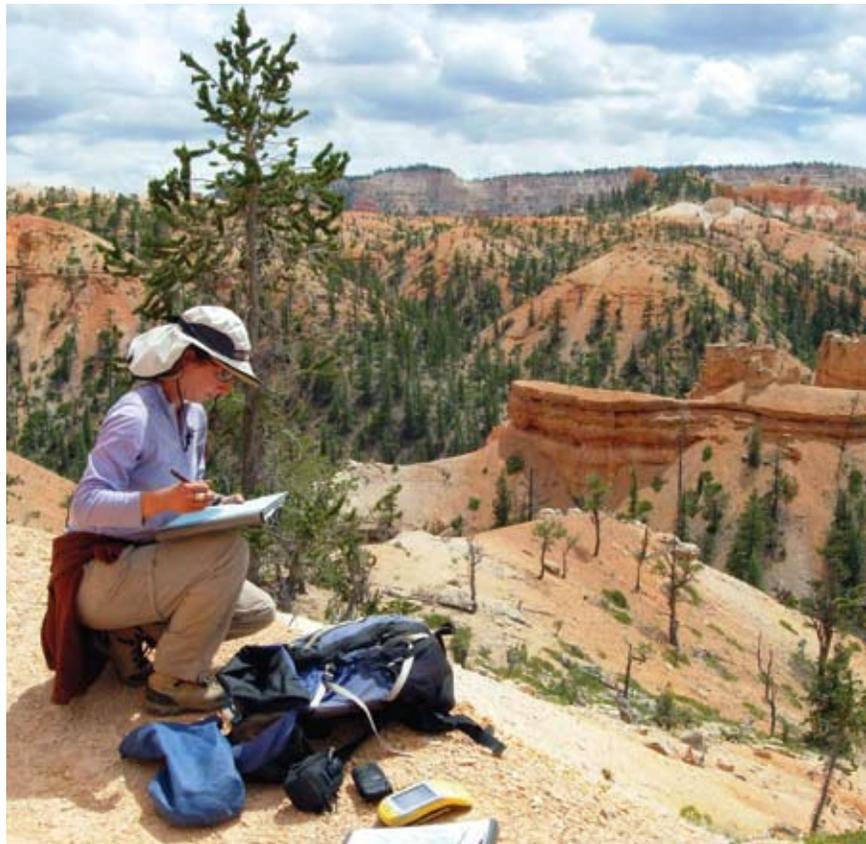
Another way the Data Store improves resource management is by capturing the many years of knowledge and expertise accumulated by long-serving NPS employees. Documenting legacy data sets with metadata posted on the Data Store makes data available that might otherwise remain undiscovered in someone’s office. Once entered in the Data Store, these data will remain available for years to come. And as employees move within the National Park Service, having the Data Store as a single point of access for data streamlines data management and keeps data easily accessible regardless of a person’s physical location.

The Data Store has proven to be an effective and reliable tool for sharing data, improving resource management, and preserving institutional memory. Using Web services to deliver data to national park units and programs, the Data Store provides resource managers with dynamic access to Service-wide information from a single source. The Data Store also enhances the NPS knowledge base, preserving it for long-term use by the

National Park Service and others. By integrating with other NPS and federal data systems using Web services, the Data Store makes data available to a wide range of potential data users and positions the National Park Service as a leader in information technology and data sharing. ■

chris_dietrich@partner.nps.gov

Metadata Systems Manager, Natural Resource GIS Program, Fort Collins, Colorado



A technician collects vegetation mapping data using a Global Positioning System unit along the Fairyland Trail in Bryce Canyon National Park, Utah. The data will be used to generate a vegetation classification for the park and will be stored and shared on the Data Store, a standard procedure for vegetation inventories conducted under the Inventory and Monitoring Program.

Emergency resource assessments integrated with incident management teams

By Dave Anderson, Rebecca Beavers, Eru Gasser, Dan Pontbriand, Pam West, and John Yancy

WHEN SEVERE STORMS, FLOODS, WILDFIRES, OR other hazards affect a national park, the National Park Service (NPS) needs to account for not only the well-being of park visitors and its employees but also the natural and cultural resources in its care. For decades the incident command system has provided a familiar and flexible framework for managing responses to these occurrences, including fire suppression and other large-scale emergency activities. In 2005 this system was used to assist parks affected by hurricanes. For the first time, All Hazards Resource Advisors, who include natural and cultural resource specialists, participated in the incident management teams (IMTs) deployed to the affected national parks. They conducted rapid resource assessments to identify damage and minimize further risk to resources, prevent their loss, and begin restoration as soon as possible.

Reported in the 2005 edition of *Natural Resource Year in Review*, this function was largely successful, though many areas for improvement were identified. One need was to establish and train All Hazards Resource Advisors, who would be at the ready to assist park and incident managers with planning and decision making during such emergencies. Fortunately, 2006 did not bring landfall of a major hurricane to the National Park System. An advisory group used this opportunity to develop a qualification standard, training course, and a position task book; these materials were drafted in early 2007 through the All Hazards Incident Management Program and are now near publication.

An important part of planning for and refining emergency response procedures for the protection of natural and cultural resources was the development of a workshop to train the first All Hazards Resource Advisors. Held in Savannah, Georgia, 13–15 June 2006, the training was funded by the Natural Resource Preservation Program and the Recreation Fee Demonstration Program. Subject-matter experts (NPS employees from throughout the Park Service) presented in-depth information about hurricane dynamics, processes, and impacts on natural and cultural resources. An exercise helped participants prepare for an emergency assignment by reviewing protocols for interacting with an IMT and potential response-related health and safety issues.

Two primary themes of the Savannah workshop were (1) to summarize the incident command system and

NPS policies related to emergency response and (2) to discuss how two existing emergency teams are models for All Hazards Resource Advisors in the All Hazards Incident Management Program. The Burned Area Emergency Response (BAER) Program is an important element of the wildland fire community; however, use or deployment of BAER Teams is limited to fire. The Museum Emergency Response Team (MERT) developed out of need during past disaster recovery efforts and continues to evolve.

Both teams are specialized and operate first to protect life and property and then to secure and stabilize cultural and natural resources. For example, the BAER Teams (two are established as standing national inter-agency teams) consist of 13 individuals representing 10 disciplines (hydrology, soil science, geology, archaeology, botany, wildlife biology, forestry, Geographic Information Systems, environmental protection, and documentation), along with team leaders. The process developed by the teams can be adapted to any hazard and includes identifying issues, resources at risk, and needed expertise; conducting resource assessments; preparing treatment specifications; and implementing protection treatments. The process also encompasses developing the funding strategy, setting priorities, identifying and addressing environmental sensitivities, and coordinating activities with park staffs, incident managers, and others. The Savannah workshop introduced participants to this process, which they applied to the exercise.

The training workshop was a success, with 37 specialists taking part; most were Southeast Region staff, but representatives from all but two NPS regions attended. Additional participants were from a variety of Department of the Interior (DOI) and NPS divisions and programs, including the Geologic Resources Division, Spill Response Program, Environmental Health Program, Environmental Protection Program, Emergency Services, Museum Resource Center, DOI National BAER Program, and USGS Office of Emergency Operations.

After the training, Southeast Region staff selected a core group of All Hazards Resource Advisors to support an IMT for future emergencies. The team's first priority is to protect life and property while minimizing resource damage during initial efforts. The



Soil scientist Norm Ambos of the USDA Forest Service surveys a forest fire burn area for slope aspect and potential volume of sediment release from future rainfall. Scientific expertise, long a part of the Burned Area Emergency Response Program, is now available through the All Hazards Resource Advisors team for other types of natural disasters, such as flooding and hurricanes, to help protect and stabilize national park resources.

second priority is to stabilize threatened and endangered resources, especially historical and sensitive ones. The third goal is to develop accurate damage cost assessments in a timely manner, including the cost to recover and restore resources to their original condition, if possible, which can continue long after the emergency.

Resource managers in 2006 also developed a process for activating the All Hazards Resource Advisors team or particular expertise within the team. Little more than a month after the training, Tammy Risius, one of the new All Hazards Resource Advisors, applied her skills in response to a 22,000-gallon oil spill on the Savannah River near Fort Pulaski National Monument, Georgia. With the U.S. Coast Guard taking the lead in the spill response, Fort Pulaski staff and Risius assisted with incident command. Environmental Quality Division staff supported the entire response and damage assessment process, identifying potential funding sources for the park to recover costs.

Though cultural and natural resources have been recovered following past emergencies, this important responsibility cannot be left to chance. Park staffs must continue to be proactive—before an emergency—to safeguard as many resources as possible. When disaster

strikes, incident managers will be able to call on the All Hazards Resource Advisors team to conduct timely, on-site assessments. Appropriate expertise will be activated promptly and contribute to team efficiency and cost-effectiveness. This new capability provides a better opportunity for the National Park Service to preserve and rehabilitate park resources that are threatened by disasters. ■

d_l_anderson@nps.gov

Spill Response Program Manager, Environmental Quality Division, Washington, DC

rebecca_beavers@nps.gov

Coastal Geomorphologist, Geologic Resources Division, Lakewood, Colorado

erv_gasser@nps.gov

Natural Resource Specialist, Pacific West Region, Seattle, Washington

dan_pontbriand@nps.gov

Branch Chief, Emergency Services, Park Operations and Education, Washington, DC

pam_west@nps.gov

Director, Museum Resource Center, National Capital Region, Washington, DC

john_yancy@nps.gov

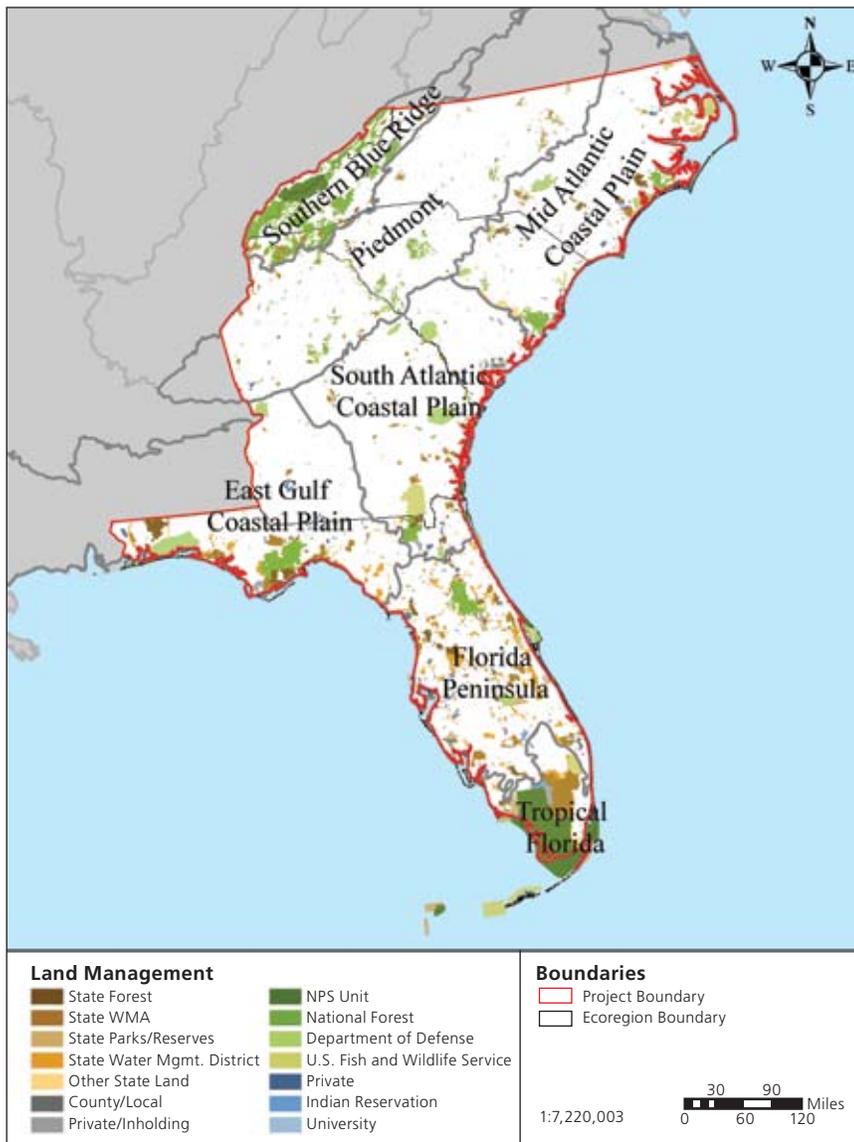
Natural Resource and Science Manager, Southeast Region, Atlanta, Georgia

Seamless Network pilot project identifies needs and opportunities for the National Park Service to work at the landscape scale

By Marcos Robles and Greg Eckert

THE NATIONAL PARK SYSTEM ADVISORY BOARD IN 2001 recommended that the National Park Service (NPS) “serve as a catalyst to encourage collaboration among public and private park and recreation systems at all levels—to build a national network of parks and open space across America.” The urgent need for collaboration is driven by an increasing number of chal-

lenges. Not only are landscapes changing and being rapidly developed, leading to habitat loss, fragmentation, and altered natural processes, but also the introduction of invasive species is changing natural communities and diminishing the quality of the experience for park visitors. From 2004 to 2006 the NPS Natural Resource Program Center; the NPS Southeast Regional Office; national, state, and county park staffs; and partners identified needs and opportunities to develop conservation and recreation networks based on landscape ecology principles applied at broad spatial scales. Known as the Southeast Seamless Network of Protected Areas (Seamless Network), the effort focused on biodiversity conservation, invasive species management, and resource-compatible recreational opportunities in Georgia, Florida, South Carolina, and North Carolina.



The map shows the project area for the Southeast Seamless Network of Protected Areas, which includes parts of seven ecoregions in Georgia, Florida, South Carolina, and North Carolina. From 2004 to 2006 the NPS Natural Resource Program Center; the NPS Southeast Regional Office; national, state, and county park staffs; and partners worked to identify needs and opportunities to develop conservation and recreation networks, developing more than 40 initiatives to address biodiversity conservation, invasive species control, and recreational opportunities.

The Seamless Network project placed national parks in a landscape context in order to understand their role in regional conservation and recreation programs, developing opportunities to work in partnership with multiple agencies, and promoting better natural resource management and enhanced recreational opportunities. In order to reach these goals, project leaders used a five-step process.

As a first step the Seamless Network project staff evaluated a suite of conservation and recreation frameworks and existing initiatives to determine the factors contributing to successful collaborations. The initiatives investigated include conservation sites in the ecoregional portfolios of The Nature Conservancy, the Southeast Ecological Framework of the U.S. Environmental Protection Agency, Important Bird Areas of Audubon, statewide recreation plans, and recently developed statewide wildlife plans. The next step was to identify and nurture the regional conservation approach.

In 2005–2006, project leaders held stakeholder workshops throughout the Southeast during which management partners developed more

Network-based conservation and recreation projects provide economies of scale; help land managers focus on common management issues, ecological threats, and constituent needs; and create a culture within and across agencies that is outcome-focused, regardless of administrative boundaries.... The National Park Service, through its mission and management units, has a unique role to play in developing and supporting landscape networks.

than 40 initiatives to address biodiversity conservation, invasive species control, and recreational opportunities. They produced 11 initiatives that primarily address recreation, 7 for invasive species, and 24 that concern biodiversity conservation. Common strategies are planning for conservation and recreation, acquiring land, developing multiagency cooperative arrangements, leveraging information technology and management tools, and establishing multiagency inventory and monitoring networks.

After completing this work, project leaders further evaluated existing large-scale partnerships and opportunities, such as the Southern Appalachian Man and the Biosphere Program, the Greater Okefenokee Association of Landowners, and the Florida Gulf Coastal Plain Ecosystem Partnership. The team then listed lessons learned and grouped them into a set of recommendations for appropriate scales of work. Recommendations include the development and use of spatial data sets and Geographic Information Systems-based analytical tools; the provision of incentives and support to unit managers to participate in networks, including training on how to participate in networks; and development of landscape-scale conceptual models of resource dynamics or recreational opportunities that include non-NPS units managed by partners.

It is clear that coordination and information sharing are very valuable, but they have their limits. Funding sources to support partnerships need to be made avail-

able to parks, including funding to support third-party nongovernmental organizations that can facilitate public agency actions. Nongovernmental organizations will also be critical to advancing landscape-scale approaches with private landowners—the most significant contributors to landscape dynamics that were not included in the Seamless Network pilot project.

Land managers understand that challenges facing parks are the driving forces behind landscape-scale conservation and recreation initiatives. Additionally, emerging directives to develop strategies that accomplish the NPS mission in light of climate change increase the imperative to advance networks. Network-based conservation and recreation projects provide economies of scale; help land managers focus on common management issues, ecological threats, and constituent needs; and create a culture within and across agencies that is outcome-focused, regardless of administrative boundaries. Networks also foster creativity that can lead to better solutions to management issues. The National Park Service, through its mission and management units, has a unique role to play in developing and supporting landscape networks. ■

mrobes@tnc.org

Conservation Science Specialist, The Nature Conservancy, Tucson, Arizona

greg_eckert@nps.gov

Manager, Ecosystem Management and Restoration Programs, Natural Resource Program Center, Fort Collins, Colorado

Parks and refuges sign oceans agreement with National Oceanic and Atmospheric Administration

By Cliff McCreedy

OCEAN RESOURCE MANAGERS ARE CONFRONTED BY a range of complex issues, such as overfishing and pollution, that cut across the boundaries of marine protected areas. Increased coordination between state and federal agencies will be needed to develop meaningful solutions to these challenges. On 21 August 2006, senior officials of the U.S. Department of the Interior (DOI) and the National Oceanic and Atmospheric Administration (NOAA) signed a new general agreement, known as the seamless network agreement, to coordinate activities and increase partnerships in more than 200 federally managed marine protected areas.

From above the Arctic Circle to below the equator, national parks, refuges, marine sanctuaries, and estuarine reserves conserve a rich assemblage of coastal, ocean, and Great Lakes resources. Although these protected areas are managed by different agencies and were created under separate authorities, they share similar resource management concerns. For example, the Florida Keys includes four national wildlife refuges, three national park units (Dry Tortugas National Park, Biscayne National Park, and Everglades National Park), the Florida Keys National Marine Sanctuary, and the Rookery Bay National Estuarine Research Reserve, all of which protect various habitats of the same ecosystem.

“The general agreement mandates that we work together to protect these invaluable natural and cultural resources,” said Kameran Onley, assistant deputy secretary, U.S. Department of the Interior. “We will now be more effective in our ability to attain greater results through the exchange of agency resources.”

Marine Management Specialist Cliff McCreedy, National Park Service Water Resources Division, worked with DOI and White House Council on Environmental Quality staffs to develop this initiative as part of the president’s U.S. Ocean Action Plan. The agreement will directly benefit national parks by

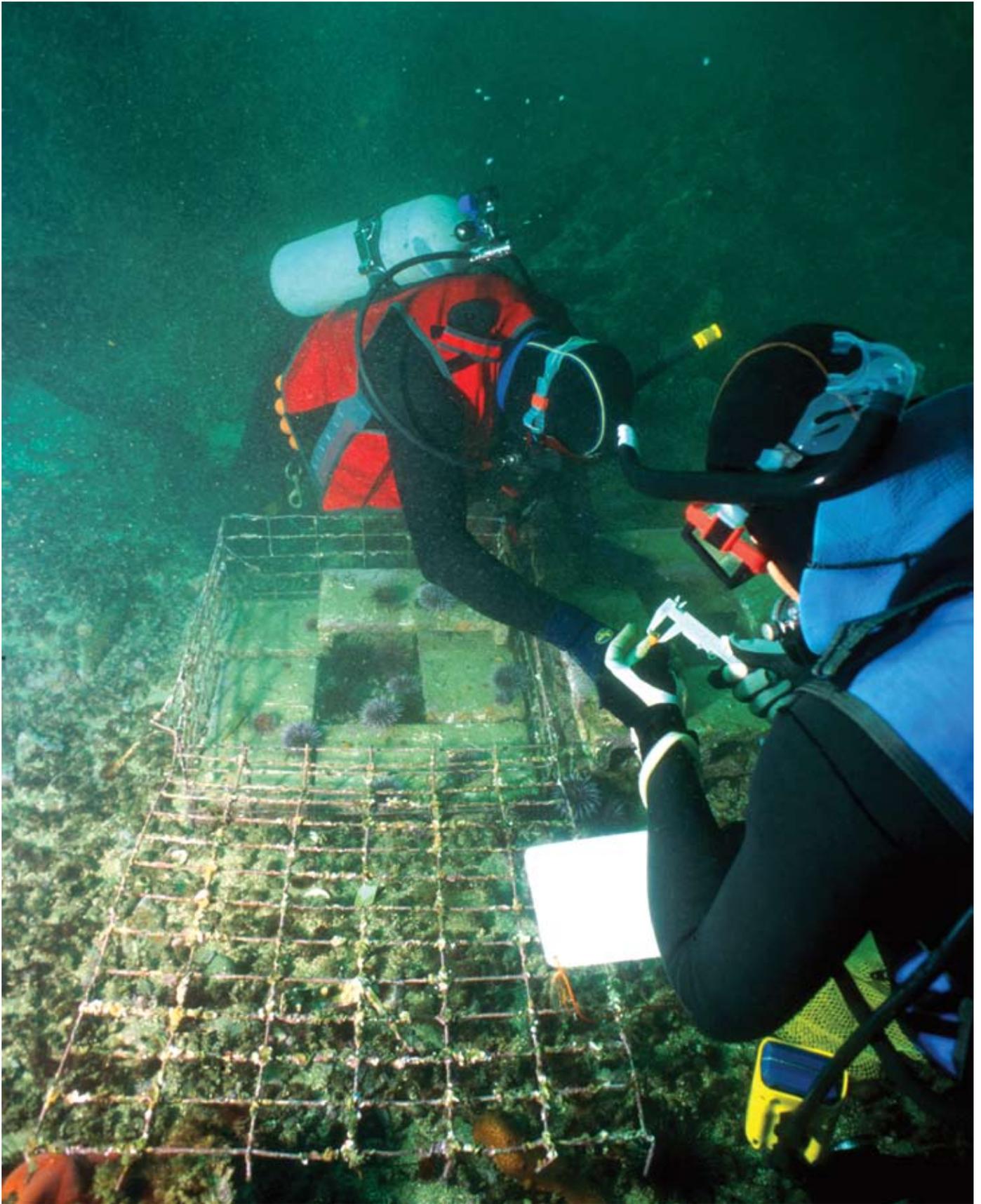
The seamless network agreement is designed to facilitate and enhance scientific understanding and conservation of coastal and marine resources by increasing coordination among federally managed protected areas and with state, public, and private partners.

enabling parks, refuges, sanctuaries, and estuarine reserves to exchange funding, assets, information, and technical support where they physically overlap, adjoin each other, or confront similar issues. Many parks and sanctuaries already share resources in a variety of ways. The seamless network agreement is designed to facilitate and enhance scientific understanding and conservation of coastal and marine resources by increasing coordination among federally managed protected areas and with state, public, and private partners.

During the first year, plans will be developed to address priorities identified in the agreement, including research, monitoring, enforcement, education, and outreach. In addition, a pilot regional workshop will be conducted to identify local priorities and projects that are consistent with the areas of focus in the agreement. Agencies will explore how to coordinate and facilitate financial and administrative activities to allow a timely transfer of funds and effective sharing of facilities, vessels, equipment, personnel, and other resources. ■

cliff_mccreedy@nps.gov

Marine Management Specialist, NPS Water Resources Division, Ocean and Coastal Resources Branch, Washington, DC



Science divers with the National Park Service monitor the kelp forest at Channel Islands National Park, California. The National Park Service, the NOAA National Marine Sanctuary Program, and the California Department of Fish and Game collaborate on the management of marine reserves in the Channel Islands.

Marine reserves attract scientific scrutiny and funds for research

By *Cliff McCreedy*

RECENT REPORTS BY THE U.S. COMMISSION ON

Ocean Policy and the Pew Oceans Commission have drawn the attention of state and federal policy makers to the beauty, value, and rapid decline of ocean resources. Pollution, overdevelopment, ocean warming, and overfishing are outpacing the ability of resource management agencies, including the National Park Service (NPS), to coordinate science-based solutions to these problems. To combat increasing threats to ocean resources, marine reserves—protected areas in which extractive uses are prohibited entirely or restricted to a few oceanic or other species—have been established in and around five national parks in an effort to restore depleted fish populations. Research and monitoring of the new marine reserves are required to determine their effectiveness. In 2006, marine reserves received helpful scrutiny from participants at an international scientific workshop held at Virgin Islands National Park, where the U.S. Geological Survey (USGS) announced that it will provide funds for research at three of these reserves.

Contrary to public perception, the National Park System is not immune to threats facing the world's oceans. Fishing occurs throughout most ocean parks. Unless specifically prohibited, NPS policies allow recreational fishing consistent with NPS and state fishing regulations and commercial fishing where authorized by enabling statute or regulation. However, these policies have generally failed to maintain fish population sizes and structures capable of ensuring ecosystem health and sustaining recreational fishing opportunities in many ocean parks.

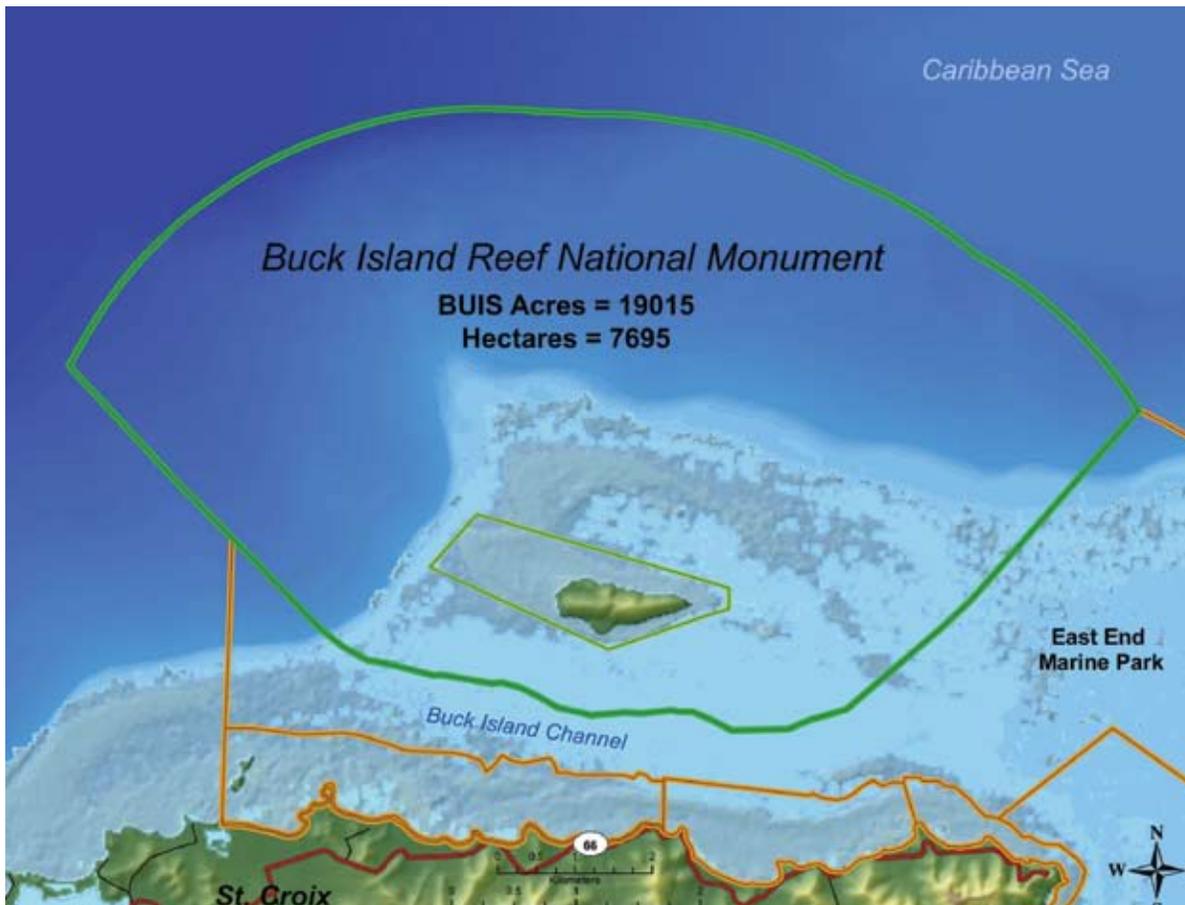
During the past several years, marine reserves have been created in or around five national parks in an effort to reverse negative trends. Most recently, on 14 November 2006, the State of Florida concurred with NPS regulations to establish a research natural area (RNA) at Dry Tortugas National Park (Florida). The new RNA is a no-take, no-anchor zone occupying 46 square miles (119 sq km) of the park that provides a sanctuary for species affected by fishing and loss of habitat. Marine reserves at Buck Island Reef National Monument and Virgin Islands Coral Reef National Monument (both in the U.S. Virgin Islands) share similar objectives. For example, both marine reserves seek to sustain tropical marine ecosystems and to protect fragile coral reefs and seagrass beds, and the

marine species they support, from fishing and anchor damage. Marine reserves have also been established at Glacier Bay National Park (Alaska) and Channel Islands National Park (California) in conjunction with the California Department of Fish and Game.

The National Park Service has a clear mandate to employ the best available science to evaluate the performance of these new marine reserves and to adapt its management and monitoring programs according to changes observed in resource condition. In expressing support for the Dry Tortugas National Park RNA, Florida Fish and Wildlife Conservation Commission Chairman Rodney Barreto said, “While we agree with a closure to fishing and its scientific importance, we must also ensure the objectives of a fishing closure are met, and we will monitor this area closely for progress and success.”

Programs such as the kelp forest monitoring program at Channel Islands National Park, vital signs monitoring, and the National Oceanic and Atmospheric Administration (NOAA) Biogeographic Assessments of coral reefs, fish, and invertebrates are yielding critical information to meet these adaptive management goals. However, important research and monitoring questions remain. For example, what are expectations for fisheries to rebound in light of pressures from fishing outside these reserves? Will marine reserves help reverse declines and restore ecosystem structure and function in spite of stresses other than fishing, such as coral bleaching and disease?

In July 2006 the NPS Water Resources Division (WRD) and the U.S. Geological Survey held an international workshop in the U.S. Virgin Islands to identify opportunities for future research and monitoring in the new marine reserves. Organizers included Gary Davis and Cliff McCreedy of the WRD Ocean and Coastal Resources Branch, Dr. Caroline Rogers of the USGS Caribbean Field Station, and Dr. Daniel Suman of the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. In addition to staff from the Virgin Islands national parks and the NPS South Florida/Caribbean Inventory and Monitoring Network, workshop participants included the NOAA Center for Coastal Monitoring and Assessment, the Florida Keys National Marine Sanctuary, and 30 other scientists and managers from the United States,



Map of Buck Island Reef National Monument (St. Croix, U.S. Virgin Islands), where all fishing is prohibited and anchoring is restricted. Marine reserves, or protected areas in which extractive uses are prohibited entirely or restricted to a few species, have been established in and around five national parks over the last several years. Marine reserves like the one found at Buck Island Reef National Monument have been established throughout the world with a variety of goals, usually conservation of biodiversity and enhancement of fisheries.

Mexico, and the Caribbean. Funding was provided by the NPS Office of International Affairs.

The workshop succeeded in establishing goals and specific questions for evaluating the performance of the Dry Tortugas and Virgin Islands marine reserves. Biological goals include understanding, documenting, and projecting changes in marine biodiversity, nutrition dynamics, and population sizes of fish in and around reserves. Engaging local and regional communities in monitoring programs and measuring and incorporating attitudes and perceptions toward fishing closures in research efforts were identified as social goals. The experiences shared by managers and scientists from different countries enriched the dialogue. The workshop report (see reference below) is available online at <http://snre.ufl.edu/funding/attachments/Attach%20Rogers%20et%20al.%20Marine%20Reserve%20Workshop.pdf>.

Perhaps the most valuable outcome of the workshop was that the USGS Eastern Region has agreed to dedicate more than \$300,000 annually to support competitive research grants to evaluate the three marine reserves in Florida and the U.S. Virgin Islands. State-supported agencies and academic institutions will apply for the grants, and the July workshop report will guide applicants in structuring research proposals and tailoring approaches to management regimes and resources in these reserves. ■

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cliff_mccreedy@nps.gov

Marine Management Specialist, NPS Water Resources Division, Ocean and Coastal Resources Branch, Washington, DC

"Alaska Stream Team" brings hands-on science study to Sitka National Historical Park and Tongass National Forest

By Lisa Matlock

IT IS APRIL 2006 AND THE INDIAN RIVER IN SITKA, Alaska, is filled with students splashing and scrambling among cold and slippery rocks to collect water, algae, insects, and other samples. These third and seventh grade science students, along with Sheldon Jackson College students working toward resource-related careers, are involved in an educational aquatic monitoring program within Sitka National Historical Park.

In 2004 the National Park Service and the USDA Forest Service worked together with Dan Bogan, a University of Alaska–Anchorage aquatic biologist, to train local educators in the "Alaska Stream Team" water quality inventory and monitoring program. Since that time the national park's education specialist, Lisa Matlock, and biologist Geoffrey Smith have partnered

The USDA Forest Service and the National Park Service use this innovative program to teach Sitka's students about the importance of watershed protection. These agencies manage the upper and lower sections of the Indian River separately, but now work in partnership to manage this resource for the larger benefit of the public through education. The Alaska Stream Team program is a natural outgrowth of the historical connection of the park and forest that harkens back to the 1890s, when Congress set aside the first Alaskan forest reserve to protect watersheds and established Sitka National Historical Park, with the Indian River as the primary resource mentioned in the legislation.

The stream monitoring program in Sitka provides regional benefits as the data collected by the seventh grade and Sheldon Jackson College students are added to the Alaska Stream Team database for larger use by scientists and by other students throughout the state to monitor the general health of Alaska streams. If the data gathered by students suddenly show anomalies unrelated to seasonal or other natural fluctuations, then aquatic biologists are alerted to investigate the situation. The student-gathered data can be an early indicator of stream problems that can be corrected before serious negative effects occur. This is particularly important in a huge state where the number of aquatic biologists is limited and they are unable to monitor every watershed in the region.

Through the Alaska Stream Team program and the hard work of agency staff, students now provide a service to the National Park Service and USDA Forest Service. At the same time, they experience standards-based, hands-on science in an exciting and engaging environment that allows them to connect the importance of protecting their backyard watersheds to their own lives. ■

lisa_matlock@nps.gov

Education Specialist, Sitka National Historical Park, Alaska

This program advances the quality of science programming for area students while providing ongoing biological and chemical monitoring of the Indian River.

with Jim Case, the education and information technician for the Sitka District of the Tongass National Forest, to bring the Alaska Stream Team program to schools in Sitka.

This program advances the quality of science programming for area

students while providing ongoing biological and chemical monitoring of the Indian River. Students sample populations of mayflies, stoneflies, and caddisflies, which are sensitive to environmental changes like increased siltation and pollution, to determine the health of the ecosystem. Chemical testing includes temperature, flow rate, pH levels, and dissolved oxygen content, with samples taken in spring and fall every year. Park and forest educators use three monitoring sites: two in the park's lower reach of the river near the estuary and one upstream just below the forest boundary above human habitation. Between these monitoring sites is city land with growing residential and commercial development that could potentially impact water quality in the river, which is also Sitka's alternate drinking water source.



(Top) Seventh graders Maddie Stanley, Christopher Bowman, and Claire West sample aquatic insect populations along the Indian River in Sitka National Historical Park. (Bottom) Sheldon Jackson College chemistry students Yee Vue and Tasha Folsom investigate a sample of stream-bottom debris under the supervision of park education specialist Lisa Matlock.

Wildcam Grizzlies: Real-time bear viewing fosters cooperation, collaboration, conservation, and public participation

By Mary McBurney and Diana Maxwell

DURING THE SUMMER OF 2006 (FROM 23 JUNE TO 25 August), nearly 500 hours of live video of brown bears (*Ursus arctos*) from the McNeil River State Game Sanctuary in south-central Alaska were presented for public viewing at the Pratt Museum in Homer, Alaska. As a result of the *Wildcam Grizzlies* Webcam project, 16,000 museum visitors and more than 1.25 million Internet users were able to remotely watch brown bears in real time and interact with an NPS interpreter, who operated the camera from a museum viewing gallery and provided interpretive programs on brown bear behavior and natural history.

The McNeil River State Game Sanctuary is a national natural landmark (NNL) and is located between Lake Clark National Park and Preserve and Katmai National Park. In addition to its NNL status, the McNeil Sanctuary is significant to the National Park Service (NPS) because it shares both a boundary with Katmai and the same population of brown bears. Most of the bears that frequent McNeil River in the summer use Katmai during other times of the year. This movement of bears between Katmai and the sanctuary makes it incumbent on NPS resource managers to promote the

well-being of bears at McNeil River as they do in the national parks.

The *Wildcam Grizzlies* Webcam project has been phenomenally effective in connecting the public with the McNeil/Katmai brown bears and fostering greater collaboration among the National Park Service, the Pratt Museum (a nonprofit partner), and the Alaska Department of Fish and Game. Although the camera is physically located on state land and the video is publicly displayed at the museum, the project has provided managers at Katmai and Lake Clark with a powerful tool for educating people about brown bears and communicating the importance of their conservation and stewardship. It has also allowed the National Park Service to reach out to people who may otherwise never have an opportunity to view brown bears in the wild and to provide them with a live, real-time bear viewing experience.

Wildcam Grizzlies would not have been possible without the participation of National Geographic Media and their partner, RealNetworks. National Geographic Media was a key partner in bringing the project to the Internet. They helped support the cost of physically setting up and maintaining the Webcam and also created the *Wildcam Grizzlies* Web page on their Web site to allow the public to access the live video via the Internet. In addition they hosted a blog where people could post questions and comments. RealNetworks provided critical hardware and software to transmit near-broadcast-quality video over the Internet and hosted the Web site on their server.

Streaming live video from McNeil River to the Pratt Museum and National Geographic Media, the *Wildcam Grizzlies* Web site has created new opportunities for people to interact with national parks and other public lands through virtual visitation. It has also helped build public appreciation for brown bears and promote a constituency to support their conservation by allowing people to watch wild bears in real time via the Internet. Evidence for this can be found at the *Wildcam Grizzlies* blog, hosted by National Geographic, where an online community has developed around



Wildlife viewers watch brown bears at the McNeil River Falls. The Webcam is housed just below the viewing platform.

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An attentive brown bear sow attends her three young cubs at the McNeil River State Game Sanctuary and National Natural Landmark.

the McNeil River video feed. The blog provides an open forum for public participation where people interested in wildlife conservation and brown bears can ask questions, exchange information, and share their observations and thoughts with others. Many bloggers have even been moved beyond the blog to become bear advocates by supporting groups such as Friends of McNeil River and the National Parks Conservation Association.

This project exemplifies everything the National Park Service is trying to accomplish through its Education Renaissance and the Centennial Initiative. It has provided an opportunity for a variety of public and private partners to cooperate and collaborate on a project with a shared mission. It has allowed staff at Katmai and

Lake Clark to communicate with national and international audiences using state-of-the-art technologies. It has given the public a new way to connect emotionally and intellectually with these national parks, allowing them to develop a virtual sense of stewardship. And finally, it has created a new group of park advocates who can help support these parks in their efforts to protect brown bears and their habitats. ■

mary_mcburney@nps.gov

Subsistence Program Manager, Lake Clark National Park and Preserve, Katmai National Park and Preserve, Alaska Region

diana_maxwell@nps.gov

Partnership Program Manager, Natural Resource Program Center, Denver, Colorado