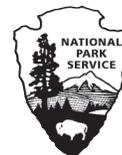


Yellowstone Center *for* Resources



2005 Annual Report

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2005 Annual Report

(October 1, 2004, to December 31, 2005)

Yellowstone Center for Resources
National Park Service
Yellowstone National Park, Wyoming

YCR-2006-08



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Photographs not otherwise marked are courtesy of the National Park Service.

Cover photos: *center*, spider web (NPS); *clockwise from top*, Swan Lake wolf #295M (by Bill Campbell); a researcher sampling at Angel Terrace (NPS); Nez Perce Tribe members after a ceremony (NPS); *Antennaria monocephala* CD. (by Jennifer Whipple); a yellow bus in front of the Heritage and Research Center (NPS).

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Introduction

Yellowstone's unique geological and biological resources inspired its creation as the world's first national park in 1872. The National Park Service (NPS) is legally responsible for preserving, unimpaired, the park's natural and cultural resources and values for the enjoyment, education, and inspiration of this and future generations. The Yellowstone Center for Resources works to fulfill these responsibilities for the resources we are mandated to manage and protect by providing outreach, contributing to literature, promoting interpretation, and striving to learn more about them. This report covers calendar year 2005, and also the period October 1 through December 31, 2004.

This year marked the opening of the Heritage and Research Center to the public, the initiation of a large-scale wolverine study, the discovery of a genetically pure population of westslope cutthroat trout in the park, and the first stage of development for a Greater Yellowstone Science Learning Center website. Also in 2005, the U.S. Fish and Wildlife Service proposed to remove grizzly bears in the Greater Yellowstone Ecosystem from the list of threatened species. The bison population summer count was estimated to be 4,900 animals, and an independent study of bison ecology and movements concluded that winter road grooming is not the major factor influencing bison distribution and range expansion. The northern Yellowstone elk population, which has decreased substantially over the past decade, numbered 9,545 in 2005. At the tenth anniversary of wolf restoration to the park, wolves numbered 118, showing the largest annual population decline since restoration began, due to poor pup survival caused by disease.

Highlights of the year included the Eighth Biennial Scientific Conference on the Greater Yellowstone Ecosystem, *Greater Yellowstone Public Lands: A Century of Discovery, Hard Lessons, and Bright Prospects*, which broke all previous conference attendance records and featured keynote speakers including U.S. Forest Service Chief Dale Bosworth and former NPS Intermountain Region Director Karen Wade. The Ethnography Program hosted a cross-cultural exchange with members of the Crow Tribe that allowed participants an opportunity to reconnect with their heritage. A workshop on arid lands reclamation was convened to discuss and recommend strategies for reclamation and long-term management of the Gardiner Basin area on both park and U.S. Forest Service lands which are dominated by exotic vegetation introduced by past homesteading, railroad, and gravel mining activities. Steamboat Geyser erupted again in 2005.

YCR's partnerships and agreements with other federal and state agencies, academia, and public organizations continued to be critical to our successes in stewardship. The YCR also benefitted from the hard work of many volunteers, one of whom, archeology volunteer John Reynolds, was selected as the Intermountain Region's 2005 representative for the national George B. Hartzog, Jr., Award for Outstanding Volunteer Service. The Historic Structures Program was again assisted by the Tauck Guest Volunteer Program, which received the Department of the Interior's "Take Pride in America" award in the corporate sponsorship category. Research Permit Office (RPO) staff authorized 221 research permits to investigators from across the U.S. and foreign countries, highlighting the park's value as a scientific laboratory as well as a pleasuring ground.

For more information about specific topics of interest, readers may contact us at (307) 344-2203, visit the park's web site at www.nps.gov/yell, or visit the Greater Yellowstone Science Learning Center website at www.greateryellowstonescience.org.



Tom Olliff
Chief, Yellowstone Center for Resources

PART I.

Cultural Resource Programs

The Branch of Cultural Resources helps preserve and increase knowledge of Yellowstone's resources in these areas:

- Archeology
- Archives, Library, and Museum Collections
- Ethnography
- Historic Road Rehabilitation
- Historic Structures
- Yellowstone History



Former park ranger Bob Murphy shares buffalo stories at the Research Library.

Archeology

Yellowstone's archeology is critical to understanding the precontact and historical record of the greater Yellowstone area. By studying the types of stone that were used and discarded, staff can track the early human residents as they lived and traveled in the park and beyond it. Although less than 2% of the park has been adequately inventoried, 1,204 sites have been documented into the Archeological Sites Management Information System (ASMIS). These sites demonstrate that people have been using the area's natural resources for some 12,000 years.

Some raw materials in the form of tools were brought into the park and left here; other tools manufactured from stone were found in the park and left with people traveling on seasonal routes. The most significant of many sources of tool stone in the park, Obsidian Cliff, provided unlimited quantities of raw materials and was used both by family parties traveling through the park during the warmer months and by work parties who came specifically to replenish their obsidian supply and returned to live outside the park.

Information obtained from historical archeology supplements the written records of the U.S. Army, early National Park Service, and park concessions development. Because the intensity of use varies through time as environmental conditions become more or less favorable, the archeological sites and their contents also provide a means for interdisciplinary investigations of past climate and biotic change.

Yellowstone's archeology program inventories, evaluates, interprets, and protects the precontact and historic archeological information, artifacts, and resources of the park. Staff work with other park divisions, the public, and volunteers to protect archeological sites and to increase understanding of and appreciation for the park's rich archeological record. Staff also strive to mentor, coordinate, and encourage other archeology programs in the Rocky Mountain Cluster parks.

2005 Highlights

During 2005, staff inventoried approximately 35 miles of Yellowstone Lake shoreline, adjacent terraces, and portions of the Promontory, resulting in the documentation of 100 new precontact sites. As part of ongoing assessment efforts, staff revisited 400 documented sites to obtain information about their current condition. The summer archeological staff was the largest the park has ever had, with one seasonal employee, one student intern (funded by the Yellowstone Park Foundation), and two volunteers helping the park's two full-time archeologists.

Yellowstone's senior archeologist, Ann Johnson, serves as Archeological Coordinator for the 15 national parks in the Rocky Mountain Cluster, Intermountain Region of the National Park Service. In this capacity she helped these parks prepare their contributions for the draft condition assessment plan that the region submitted to Washington, D.C.

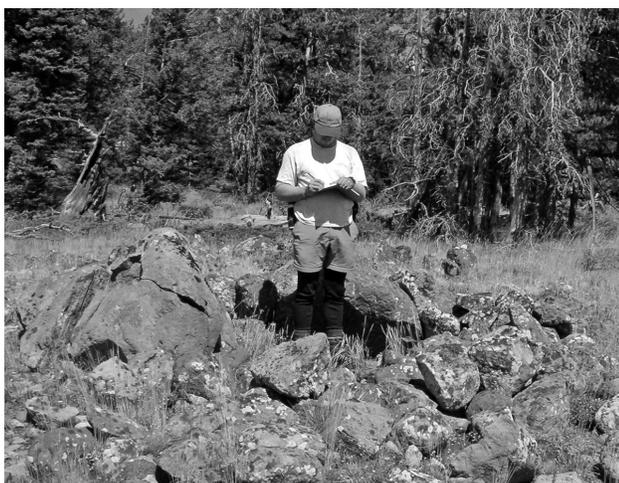
Inventory of Yellowstone Lakeshore

In 2005, with funding provided by the William H. Donner Foundation to the Yellowstone Park Foundation, staff began a pedestrian inventory of the shoreline from West Thumb to Trail Creek that is expected to be completed in 2006. During the 2005 field season, staff documented 106 new precontact sites along the beach and the immediately adjacent terraces. Staff also revisited five previously known sites, including 48YE252, which continues to erode and expose many tools. The richest site that has been identified on the south lakeshore, it has been named after the Donner Foundation. The primary use of this site occurred between A.D. 200 and ca. 4000 B.C.

The first evidence of Lusk use of the park was found in an isolated Lusk point and an apparent Lusk campsite. Lusk is a Paleoindian culture that elsewhere dates between 7500–8000 B.C. and is one of a group of cultural complexes of the same general period that display similar technology (parallel diagonal flaking) on the points. The Lusk Complex is poorly understood and rarely identified, and an intact site would help increase understanding of this group in the western U.S. and Canada.

Inventory on the Promontory

The crew working on the shoreline inventory also carried out a small inventory of the Promontory that was funded by Yellowstone. A well preserved hunting blind (probably for deer) was identified that is a unique site type and structure among the sites so far recorded in the park.



Remains of hunting blind identified on the Promontory. Photo by Brian Vivian.

Excavations at 2,200-Year-Old Campsite

When important archeological sites cannot be avoided during reconstruction of the park's roads, excavations are undertaken to recover the archeological data that would otherwise be lost. A National Register-eligible, Pelican Lake culture campsite with buried components and an association with the procurement of obsidian by various peoples during precontact times is located in a thermally active area south of Obsidian Cliff through which the Grand Loop Road passes. As plans began for reconstruction of this road section, Yellowstone and the Wyoming State Historical Preservation Office reached an agreement to excavate those portions of a 2,200-year-old site where geophysical and shovel tests conducted in 2004 indicated that cultural material was buried.

The Park Service rarely has the opportunity to excavate buried precontact campsites associated with Obsidian Cliff, and this was the first excavation of a buried precontact campsite on thermally active ground. It was also the first excavation of a lithic workshop area associated with Obsidian Cliff that yielded grey obsidian in a variety of forms (naturally grey and patinated grey) and associated with two sources, Obsidian Cliff (160,000 years old) and the Huckleberry Ridge Tuff (1.8 million years old).

Some artifacts and artifact types (several large flakes with a notch, the reduction of small cobbles, and high quality knapping debris located near poorly produced flake debris) from the lithic workshop suggest people were teaching their young how to make stone tools, possibly a small family group, not a specialized group of hunters. They used large and small water-worked cobbles as well as obsidian with little cortex excavated from the cliff, making statistical analysis of the flaked debris an interesting challenge. Domestic activities rather than a hunting camp were also indicated by the buried hearth, the large quantity of fire-cracked rock, many scraping tools (large and small, and exotic in size and form, mainly obsidian but also some chert and quartzite materials), and the number of large, transportable bifacially flaked tools compared to the small number of projectile points. Most of these tools were diagnostic to the Pelican Lake morphological type. Perhaps Yellowstone has always been a family park, with this excavation revealing over 2,000 years of cultural continuity within the thermal landscape.

Condition Assessments

Yellowstone is participating in a servicewide effort to document the current condition of all known archeological sites and include information about all documented sites in ASMIS. During the summer of 2005 staff assessed and photographed 400 documented sites, and entered the information into the ASMIS database. Staff could not have gotten to this large number of sites without dedicated summer personnel and volunteers.

Hazard Fuel Reduction

To prevent inadvertent damage to archeological resources, the archeology staff works with the fire cache to complete site inventories near developed areas where wildland-urban interface hazard fuel reduction projects are planned. In 2005, 14 acres were inventoried for this purpose in the Norris Developed Area (Johnson 2005).

Volunteer Support

Three volunteers greatly aided the archeology program: Mary Meagher (Cinnabar Basin, Montana) was active in the field condition assessments; Diane Hargreaves (Bozeman, Montana) cataloged artifacts and entered them into the NPS Re-discovery program; and John Reynolds (Virginia) worked in the lab when not helping with field condition assessments and site documentation. John was chosen as the Intermountain Region's 2005 representative for the national George B. Hartzog, Jr., Award for Outstanding Volunteer Service.



Superintendent Suzanne Lewis presents volunteer John Reynolds with his Intermountain Region award.

Archives, Library, and Museum Collections

Yellowstone National Park's archives, library, and museum collections comprise more than 5.3 million items that document the cultural and natural history of the park, making them the second largest group of collections in the National Park Service. They include some of the first photographs taken of the park by William Henry Jackson; Thomas Moran's original field sketches from the 1871 Hayden Expedition; one of the most comprehensive collections of postcards, souvenirs, and ephemera of Yellowstone; and a rare book collection. The archives collection consists of nearly 3,000 linear feet of historic records that document the history of Yellowstone since its establishment in 1872.

The goal of the archives and museum program is to properly preserve and document the park's cultural and natural history collections, and to make them available to as wide an audience as possible through on-site research, the Internet, facility tours, and temporary exhibits. The archival collection is one of nine affiliates of the National Archives and Records Administration (NARA), and the only one located in a national park.

The primary objectives of the Yellowstone Research Library are to document the history of Yellowstone National Park by preserving all relevant books and papers and to select, organize, and make accessible books and related materials that will assist park staff in the performance of their duties. The library also makes its resources available to the public; independent researchers; students; concessions employees; the local community in Gardiner, Montana; residents of the state of Wyoming; and park visitors through the Wyoming Library Database (WYLD) of the Wyoming Library Consortium.

Opening of Heritage and Research Center

With the opening of the Heritage and Research Center (HRC) this year, the collections now meet the standards for care, storage, and use required by the NPS and under a 1978 Memorandum of Agreement between NARA and the park, which grants the park custody of its archival records. The 32,000-square-foot facilities provide a 500% increase in the office, researcher, processing, and storage spaces of the

archives and library, and a 700% increase in those spaces relating to the museum collection. In addition to making the park's collections much more accessible, the new facilities have vastly improved environmental controls, security systems, and custom storage units.

Staff worked to prepare the HRC spaces for researchers and accommodated many park staff and contract researchers prior to the official opening on May 18. On that day, a community open house drew more than 500 visitors, all storage areas and researcher rooms were opened, and visitors were able to tour the HRC and view collections not normally on display. Several hundred visitors attended a second open house on August 25.

The park received almost \$300,000 in special projects funding for the design and installation of two large high-density mobile storage units in the museum storage room, and a five-carriage addition to the mobile unit in archives storage. These storage units provide state-of-the-art specimen and art cabinets, art racks, rolled textile storage, and visual storage cabinets for natural history specimens. This

special funding also provided storage units to properly house large scrapbooks and rare books.

New Internships

In 2005, staff established partnerships with Stanford University's Bill Lane Center for the Study of the North American West and with Montana State University's (MSU) Department of History and Philosophy to provide internships that would allow students to learn about curation and archives management while assisting the program in completing much needed work. With training provided by Tasha Felton, the six interns (two from Stanford and four from MSU) assisted park staff with cataloging 2,268 objects as well as exhibit design and fabrication, including the HRC's first temporary exhibit, which showcased the Susan and Jack Davis Collection. The interns also helped out at the HRC reception desk, answering visitor questions about the facility, interpreting the temporary exhibit, assisting researchers, checking IDs, and signing in visitors. The interns staffed the reception desk about 50% of the time, volunteers 10%, and HRC personnel 40%.



The Heritage and Research Center lobby during the grand opening, May 2005.

Collection Conservation

Through the Yellowstone Park Foundation, the Mercer Endowment provided funding for two conservators from Harpers Ferry Center to spend two weeks in the park this summer assessing the condition of the park's furniture and paper collections. Al Levitan examined almost all of the 300 items in the furniture collection, including those still in use in the park's hotels. Nancy Purinton examined works on paper, rare books, and oversized maps and blueprints. To help ensure that the pieces most at risk receive the proper conservation treatment with minimal loss of historic fabric, the conservators' reports included recommendations on treatment proposals for the more at-risk items and storage improvement.

Funding from the Yellowstone Association enabled the park to have James Everett Stuart's oil painting, "Constant Geyser," conserved by the Western Center for the Conservation of Fine Arts.

Assisting Researchers

Archives and museum staff handled research requests from 460 researchers since opening in May 2005, and the Yellowstone Research Library assisted 881 patrons. Included in this number were requests from many private individuals, organizations such as the White House Historical Society, and commercial enterprises including the Walt Disney Company, Yellowstone concessioners, and news and entertainment media. Accommodating Ken Burns's Florentine Films took the most staff time, approximately 120 hours, as staff provided almost 600 historic images in digital format for an upcoming documentary on the National Park Service.

Save America's Treasures Project

Save America's Treasures is a national effort to protect the nation's threatened cultural assets, including historic structures, collections, works of art, maps, and journals that document United States history and culture. Through a Cooperative Ecosystem Studies Unit agreement, students from the University of Colorado worked with Yellowstone and Xanterra staff to preserve, catalog, digitize, and re-house more than 5,000 drawings and blueprints that document the planning, construction, and renovation of park hotels, lodges, campgrounds, and restaurants, and

provide a visual history of concessions development in the park. The work was completed in two consecutive summer sessions with financial support provided by Canon U.S.A. and the Mercer Endowment (through the Yellowstone Park Foundation).

Digitization of Audiotapes and Films

The archives include 72 audiotapes in reel-to-reel format that contain interviews with former park employees and longtime local residents that were inaccessible because of the equipment needed to play them. So that these tapes will be readily accessible to researchers at the HRC, the Cutting Corporation created CD disc masters and access copies of each tape. Likewise, the archives and research library collections include many films in 16-mm format that have historical footage of wildlife, thermal features, and ranger activities. Another vendor, Scene Savers, provided digital Beta masters and DVD access copies of 15 films from the archives and 15 from the research library.

Research Library

With the installation of Workflows Database Software and the implementation of scannable library cards, the library's circulation system became fully automated in 2005. Patrons who wish to check out books are issued a library card and books are scanned to their account. Registered users can also request interlibrary loans from their own computers and are notified by e-mail when the material has arrived at the Research Library. Overdue notices are issued automatically through e-mail. In addition to tracking how many and which books have been checked out, the software enables staff to track which books are being used in the library; patrons are therefore asked to leave books they have taken off the shelf on a cart so that their bar codes can be scanned.

The Research Library circulation policy was revised to enable Yellowstone Association members as well as NPS employees in Yellowstone to borrow items from the collection.

Shaffner's Bindery in Missoula, Montana, bound 171 theses and journals for the library collection and created 32 clamshell boxes for storage and preservation of rare books.

Accessions

Museum. Among the museum's 88 acquisitions in 2005 were 67 wolf skulls, including those from wolves that were relocated to the park from Canada in 1995 and 1996, a 1910 Estey Reed organ that had been given to the Mammoth Chapel by the Woman's Army & Navy League, approximately 1,000 original printing blocks (ca. 1920s–1930s) from the Haynes Picture Shops, and a rare lantern slide from the 1920s showing the Wylie Camp at Swan Lake Flats.

Archives. In addition to the thousands of blueprints and drawings of park concessioner buildings, the archives also received an important collection of Horace Albright materials from his daughter, Marian Albright Schenck.

Library. More than 400 books and other items obtained through purchase or donation were accessioned into the library collection. Many of the books were part of the Susan and Jack Davis Collection and a significant number were donated by the Bob Jonas estate.

Assistance to Other Divisions and Parks

Archives and museum staff assisted the Division of Planning, Compliance, and Landscape Architecture by meeting with Shapins and Associates, the contractors working on the Lake Cultural Landscape Inventory, assisting with research in the archives and historic photograph collection, and providing digital images of selected photographs.

Museum staff provided historic photographs for the Division of Interpretation in planning numerous wayside exhibits and assisted with the removal and transport of two large dioramas from the Fishing Bridge Museum to the HRC. Staff also participated in exhibit and security planning meetings for the new Old Faithful Visitor Education Center.

Staff provided advice to Chaco Culture National Historical Park's curatorial staff on moving their collection, surplus acid-free packing supplies for Grand Teton National Park and Arlington House (the Robert E. Lee Memorial), and hands-on assistance to Grand Teton in packing and moving items from the Vernon Collection of Native American Artifacts at the Colter Bay Visitor Center.



Visitors looking at rare books displayed in the Research Library during the HRC grand opening, May 2005.

Nine works of art from the park's collection are on loan to the "Drawn to Yellowstone: Artists in America's First National Park" exhibit, which opened at the Autry National Center in Los Angeles, California, in 2004 and has traveled to the Buffalo Bill Historical Center in Cody, Wyoming, and the Northwest Museum of Arts and Crafts in Spokane, Washington. It will be at the Museum of the Rockies during spring and summer 2006. Staff also arranged for the loan of eight of Thomas Moran's original field sketches from the 1871 Hayden Expedition to the Washington County Museum of Fine Arts in Hagerstown, Maryland, for an exhibit entitled "The Moran Family of Artists" during summer 2005.

Ethnography Program

The goals of the Ethnography Program are to develop the programs, guidelines, and information needed to help management identify and protect culturally significant resources of peoples traditionally associated with the park, and to support relationships between the park and the peoples whose customary ways of life affect, and are affected by, Yellowstone's resource management activities.

Consultation Meeting with Tribes

Eight representatives from five of the park's associated tribes (Cheyenne River Sioux, Kiowa of Oklahoma, Oglala Sioux, Sisseton-Wahpeton Sioux, and Shoshone-Bannock) and four representatives of

the InterTribal Bison Cooperative (ITBC) attended the government-to-government consultation held in Mammoth Hot Springs on May 19. Yellowstone National Park was represented by deputy superintendent Frank Walker as well as staff from the Public Affairs Office and law enforcement, and YCR wildlife biologists and cultural resources personnel. Other participants included Chief Ranger Andy Fisher from Grand Teton National Park and Robert Grosvenor and Patrick Hoppe from Gallatin National Forest. Following the meeting, a community potluck sponsored by Bear Creek Council and the NPS was held at the Gardiner Community Center in the tribes' honor. More than 100 people attended including students from De La Salle Blackfeet High School in Browning, Montana.

Issues discussed included a history and review of the Interagency Bison Management Plan (IBMP), bison management in the field, the park's relationship with the governors of Montana and Wyoming, science-based bison management, the history and role of the ITBC, and management of bison and elk at the National Elk Refuge and Grand Teton. During the meeting, tribal representatives commended Yellowstone staff for their hard work and dedication to the resource, but continued to voice frustration about the IBMP test and slaughter program.

Ethnographic Research and Management

Nez Perce (Nee-Mee-Poo) Trail. Continuing work with the Division of Interpretation to develop media for the Yellowstone segment of this National Historic Trail, staff applied for a grant to host a meeting of tribal representatives and scholars to identify interpretive themes. With funding awarded to the Yellowstone Park Foundation by the National Endowment for the Humanities in August 2005, staff were able to invite historians, anthropologists, and representatives from the Nez Perce, the Joseph Band of the Confederated Tribes of the Colville Indian Reservation, and the Confederated Tribes of the Umatilla Indian Reservation to a meeting scheduled for April

2006. The goal is to provide a historical context for the 1877 trek through the park that reflects both scholarly perspectives and those of Nez Perce descendants.

Late Prehistoric Human Remains Documented.

The Native American Graves Protection and Repatriation Act (NAGPRA) requires a federal agency in possession of American Indian human remains to determine, if possible, their cultural affiliation or relationship with a contemporary tribe. YNP has three sets of human remains that were disinterred from the Fishing Bridge area during construction projects in the 1940s and 1950s. The preponderance of evidence obtained using the techniques of archeology, physical anthropology, historical documentation, and consultation with tribes indicates that these are the remains of Late Prehistoric ancestors of the Eastern Shoshone and the Shoshone-Bannock tribes. At Yellowstone, the Late Prehistoric Period ranges from 400 A.D. to approximately 1803, when the Lewis and Clark expedition arrived in the region. The Federal Register notice that announced this decision and provides additional details regarding the evidence used is available upon request. The tribes have requested that the remains be re-interred near where they were exhumed and staff are working to make arrangements for this.

Cross-Cultural Exchange with the Crow

With funding provided by the Yellowstone Park Foundation, staff arranged for six youth, four elders,



Crow Tribe youth viewing wildlife at Blacktail Plateau.

two chaperones, and one teacher from the Crow Reservation to come to Yellowstone for a three-day visit in August to reconnect with their heritage. With the guidance of Yellowstone Association Institute instructors Sandy Nykerk and Jim Garry, the group visited sites that highlighted both Crow perspectives and natural wonders and provided opportunities to share stories, describe plant processing techniques, teach Crow history, and learn the Crow language.

Nez Perce Commemorative Ceremony

Staff coordinated Yellowstone's second annual Nez Perce commemorative ceremony, which was held on August 27. Members of the Nez Perce (or Nimiipuu, meaning "we the people" or the "real people") gathered again to commemorate their ancestors' hardships during the arduous 1,170-mile journey of the 1877 Nez Perce War. The memorial and traditional pipe ceremony honoring those ancestors was held at the Nez Perce Ford, one mile south of Dragon's Mouth and Mud Volcano, where 800 Nez Perce and 2,000 horses crossed the Yellowstone River during their flight from the U.S. Army en route to the Canadian border.

The event was attended by about 50 park staff and visitors, including Nez Perce National Historic Park Superintendent Doug Eury and YCR Director John Varley. Nez Perce spiritual leaders and tribal members conducted a traditional pipe ceremony, sang songs, and gave prayers to honor their ancestors for their courage and the hardships they endured on the trek. Many tribal members expressed gratitude for being at the Yellowstone River, where over a century ago their ancestors had passed. Many audience members conveyed sentiments of unity and understanding as they experienced the Nez Perce commemorative ceremony for the first time.

The ceremony in Yellowstone, which is one of many that the Nez Perce tribe perform each year along the trail of their ancestors, was especially important to all those involved. The honoring of ancestors helps the Nez Perce to further connect with land that is culturally significant to them. Park staff invested more than 100 hours in their efforts to make this event a success. Thanks go to other divisions for their hard work and cooperation, especially Michael Keator, Supervisory Park Ranger, and Boone Vandzura, Park Ranger, of the Lake District,



Members of the Nez Perce Tribe after a private ceremony at Nez Perce Ford.

as well as to Nysa Dickey, supervisory interpretive ranger, of the Canyon District.

Volunteer Support

Staff couldn't have accomplished this year's work without 18 volunteers: B. J. Earle, Monica Mathis, Sandra Nykerk, Susan Kraft, Joe Cox, Katie White, Dan McNulty, Sabrina Hanan, Birdie Real Bird, Allen Pinkham, Phyllis Plain Bull, Clara Big Lake, Jim Garry, Gordon Plain Bull, George Reed, Paloma Hill, Wacey Dahle, and Albert Andrew Redstar. Their 1,747 hours of work was equivalent to having one and a half more people on staff. They helped organize and carry out events, transcribe oral history interviews, conduct research, and enter data for the Ethnographic Resources Inventory.

Historic Road Rehabilitation

As one of the first large-scale national road systems constructed, the Grand Loop Road is listed on the National Register of Historic Places. Yellowstone's remote and difficult terrain required the U.S. Army Corps of Engineers to address new logistical challenges and develop new techniques. The park's

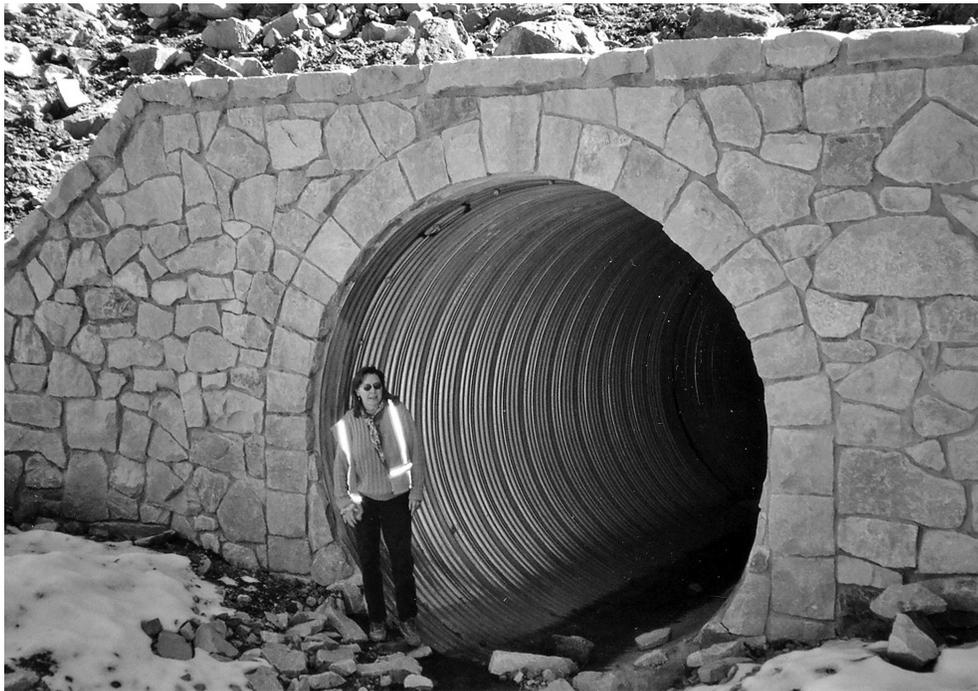
five entrance roads are also listed or eligible for listing. The evolution of the park's roads represents a continuing design philosophy that recognizes the roads as an integral part of the visitor experience and blends the road with the natural setting through the use of natural materials and by lying lightly on the land and not overpowering the landscape. The challenge in the current program is to preserve the character of the roads as distinguished from the surrounding modern highways, while repairing and rehabilitating them for today's greater traffic volume. During 2005, YCR staff were involved with the Canyon-to-Dunraven Pass and Sylvan Pass-to-East Entrance road rehabilitation projects by conducting archeological survey work and ensuring that the roads retain their historical integrity of materials and workmanship.

Canyon to Dunraven Pass Rehabilitated

The final inspection tour of the road over Dunraven Pass, where reconstruction began almost two years before, took place on September 26, 2005. This segment of the Grand Loop Road was reconstructed with a minimum width of 24 feet (up to 27 feet on some curves) rather than the parkwide standard of 30 feet in order to lessen the road's impact in

the high mountain terrain and because of geologic concerns about the effect such a width would have in the Overhanging Cliff segment (to be reconstructed in a future phase). Rockeries (mechanically stacked boulder walls) were used on the cut-side slopes to lessen the impact on vegetated areas. All of the curves were left in the road, but they were engineered for safer driving. The vertical rock cuts were designed to look as natural as possible and similar to the previous rock cuts. The deeply buried masonry culverts were repaired in-kind, replacing missing stones by hand and re-mortaring energy dissipaters and spillways. Concrete was pumped into the bottom of several buried culverts to repair damage.

Several new parking and viewing areas were added, in some places formalizing existing pullouts. Major improvements were made at the Dunraven parking area and trailhead using roadside curb stone that was buried under layers of asphalt during previous re-paving projects. New stone retaining walls and walks were added to the trailhead using a new but compatible masonry design and stone from nearby road cuts. Natural materials were used to construct the log and stone benches, log railings, and stone curbs and spillways. Many of the masonry culvert headwalls were reconstructed with



Elaine Hale inspects the award-winning design of the culvert and retaining walls on the rehabilitated East Entrance road.

the same stone and masonry patterns that were used in their original construction. These headwalls are considered one of the features that made the Grand Loop Road eligible for the National Register. The reconstruction of some headwalls that were in poor condition provided an opportunity to reintroduce the high quality workmanship and headwall patterns with which these features were originally built.

Award for East Entrance Road Design

The current road construction project from Sylvan Pass to the East Entrance won the overall best project of the year award in 2005 from the Western Federal Lands Highway Administration. Despite the landslides that occurred on Sylvan Pass in 2004 after reconstruction began, the Wyoming State Historical Preservation Office's prompt response to the emergency consultation enabled the quickly drafted culvert designs to incorporate the historic characteristics of the road while accommodating new culverts constructed with historical materials.

Sylvan Pass to East Entrance Under Construction

Major progress was made in widening and reconstructing this very scenic segment of historic roadway. Much attention was paid to retaining the curvilinear road alignment and recreating the natural look of the vertical rock cuts, many of which have water flowing down the face. Material excavated from the rock faces provided base material for a new overlook viewing Corkscrew Bridge and expanded parking and viewing opportunities at several of the scenic water courses. In compliance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, 36 CFR 68.3 c (3), for reconstruction to be compatible with the historic roadway but not create a false sense of historical development, the new masonry headwalls contain design elements similar to those of the historic road features but not exactly replicating the historic headwalls.

Historic Structures

Yellowstone National Park has 993 historic properties listed on the List of Classified Structures (LCS). These structures range from world-renowned hotels like the Old Faithful Inn to simple backcountry patrol cabins. The Historic Structures Program protects

these resources, maintains and upgrades their condition to preserve significant architectural features, identifies significant historic buildings, and provides assistance when new structures are integrated into the park's historic districts. Yellowstone's historic architect also serves as a liaison between the park divisions responsible for Section 106 review and compliance under the National Historic Preservation Act and the Wyoming and Montana State Historic Preservation Offices.

The Historic Structures Program goals are to

- protect historically significant structures from modifications and alterations that have serious impacts on the historic and architectural character of the individual properties and of associated historic districts;
- enhance the management of historic park properties by park managers, maintenance personnel, contractors, and concessioners;
- develop a team approach to solving problems and accomplishing preservation work on historic buildings in the park.

In 2005, the Historic Structures Program benefited from several strengthened external partnerships and interdivisional collaborations that propelled the program toward achievement of its management goals. The successful funding of several projects enabled the Historic Structures Program to make significant progress in 2005. Because an all-inclusive approach was used to establish a team for each project, communications were improved between divisions and each project goal was shared by the divisions contributing to each project; credit goes to all involved.

Major Projects

Carpenter Shop Stabilization. The building in Mammoth now known as the carpenter shop was constructed in 1891 as a stable for U.S. Army horses and remains one of the oldest buildings extant in the park. As horseback patrols were replaced in large measure by motor vehicles, the stable was converted to a garage, doors were installed along the west elevation, and a carpenter shop was put in the south end of the building. Because its original columns had been altered, the building was moving downhill. The structural stabilization of this structure has been funded by \$150,000 in CRPP Base monies over

a two-year period beginning in 2005.

During the summer of 2005, a team of carpenters from the Maintenance Division worked to stabilize the northern third of the building, bury extensive concrete foundation footings below the dirt floor in the former stable, prevent the east wall from tilting further by shoring it with large timber trusses, and installing new columns and bracing. The preservation team doing the work was in direct contact with the job supervisors; their suggestions and concerns were addressed as part of the partnership between the divisions, consultants, and individual team members. The second phase of the structural stabilization project—structurally retrofitting the attic space above the carpenter shop—is underway; work will begin in spring 2006.

Mail Carrier's House. With funding obtained from the NPS Historic Structures Stabilization Fund, housing rehabilitation and structural stabilization of the Mail Carrier's House is being carried out with the assistance of the Montana Heritage Commission, and the Montana Preservation Alliance. The project will lift the three combined structures (the original 1895 log house, a 1903 kitchen and dining room addition, and the 1933 mudroom and bathroom addition) at one time so that a contiguous concrete foundation can be poured underneath them. Of the \$49,000 dollars allocated for this structural stabilization, about \$10,000 was used to compile a Historic Structures Report, which required testing of sample materials taken from the interior, composition of a mitigation plan, engineering and code analyses, and a license obtained from the state of Wyoming. The building contains some friable asbestos, primarily around an old wooden fuse box on the second floor. Asbestos had also been used to line the stovepipe openings in the two chimneys. Extensive photographs were taken, and historic materials and items were marked for salvage. Dating of the two additions was undertaken, including documentation of newspapers from 1903–1904 that had been glued onto interior walls to block drafts. The historic architect worked with consultant Ken Sievert to complete the report and submit it for review by management in the spring of 2005. The stabilization work is scheduled to begin in early 2006.

Old Faithful Haynes Photo Shop. This building, which was constructed in 1927 as a T-shaped structure, had a dormitory added to the back in 1951. It

was originally located adjacent to the Old Faithful Lodge, close to the geyser on a boulevard that ran south from the lodge to the Upper Hamilton Store. In 1971, when the road was re-aligned, both the store and dormitory were moved adjacent to the Upper Hamilton Store and old Snow Lodge, where they were positioned together as an L-shaped building, with a connecting section between the two. The main portion of the store has a one-and-one-half-story open interior; the rear portion contained storerooms, an accounting room, a men's dormitory, and an employee lounge and kitchen. The second floor of the addition was used as a women's dormitory.

In the spring of 2005, interest renewed in moving the structure from the Old Faithful Historic District to the Old Faithful Administrative Area (across the Grand Loop Road from its site near the Snow Lodge), and to place it on cribbing until a decision was made whether to make use of the building or demolish it. The historic architect, with VIP John Flanagan, measured, photographed, and researched the history of the structure in order to write a mitigation plan and conduct Section 106 review. A contract was awarded to Sievert and Sievert to complete a historic structures report on the building. At the superintendent's direction, relocating the structure was deferred pending the completion of Old Faithful foundation planning.

Lamar Buffalo Keeper's House. This project was funded through the Cultural Cyclic Maintenance fund and was coordinated with personnel from Maintenance; Planning, Compliance, and Landscape Architecture; and Telecommunications. The primary objective was to prevent water from coming into the basement on the east elevation of the Buffalo Keeper's Residence, which is also the office and home for the Lamar subdistrict ranger. The park's landscape architects surveyed the landscape elevations and grades and designed swales with the assistance of the historic architect. The plumbing shop provided a tractor and personnel, and the carpentry shop removed and rebuilt the building's historic windows. Telecommunications personnel ran telephone and direct satellite link lines underground between the historic barn, bunkhouse, Assistant Buffalo Keeper's House, and Buffalo Keeper's House.

Fishing Bridge Museum West Wing. Late in 2005, the historic architect, HRC curatorial staff, the

Division of Interpretation, and Lake Maintenance staff undertook a project to remove the mid-1960s interior from the west wing of the Fishing Bridge Museum, which is one of the park's National Historic Landmark structures. This required removing two dioramas, investigating the interior wall structure, photographing the non-historic interior and then removing it. This exposed the original views of Yellowstone Lake from the windows of the west wing, the original stucco-



Herb Dawson at the Hellroaring patrol cabin. Photo by Mary Meagher.

finished walls, historic windows, and historic double doors on the end of the wing. There had been considerable damage to the stucco plaster finish, and the window, door, and baseboard trim were missing. The crew from the Virginia City/Montana Heritage Commission partnership was brought in to assist with repair and replacement of the stucco walls. Lake Maintenance staff then finished the preparatory work and painted the interior, completing restoration of the interior to its original appearance.

List of Classified Structures

During 2005, files were updated and condition reports added to the LCS for historic properties in the Bechler Ranger Station complex, Norris Museum area, Northeast Entrance Station, and Mammoth Hot Springs Historic District. The historic architect continued survey work, primarily on the Gardiner Transportation District (the primary concessioner administrative area, garage, and warehouse district). Other survey work was conducted at the Hellroaring patrol cabin and barn and the Upper Blacktail Deer Creek cabin and barn.

Tauck Guest Volunteer Program

Bruce Fladmark, a retired NPS ranger and former cultural resource manager at Glacier National Park, served as Tauck Volunteer Coordinator for the

third year, with funding provided by Tauck through the Yellowstone Park Foundation. In 2005 he had an assistant, volunteer Dave Holmstrom. Tauck projects extended as far north as the Madison subdistrict, where the Madison Campground Amphitheater was prepared and stained. Projects were also accomplished in the West Thumb Geyser Basin and Grant Village subdistrict on a regular basis. Work on stabilizing the cabins in the lower loop of the Old Faithful Lodge cabins continued, with an additional eight structures prepped and stained or painted.

During the summer, Fladmark and the historic architect escorted David Cogswell, senior editor of *Travel Weekly*, to various sites and arranged for his participation in several volunteer groups, and the Tauck Program was subsequently featured in the magazine. In September, the program received the Department of the Interior's "Take Pride in America" award in the corporate sponsorship category.

In the three years since the program began, Tauck volunteers have donated approximately 10,000 hours of labor to help preserve historic structures suffering from deferred maintenance and to conduct cleanup and other routine maintenance activities. Volunteers have worked with park personnel from Resource Management, Maintenance,

Structural Fire, and YCR, as well as Xanterra concessions staff. This effort has benefited more than 25 buildings, 4 amphitheatres, thousands of feet of sit rail and fence, bumper logs, and public areas such as campgrounds and picnic areas. The total direct and in-kind contributions, including the approximately \$70,000 of funding donated by Tauck World Discovery and the Tauck Foundation, have been worth well over a quarter-million dollars.

Assistance to Other Divisions and NPS Units

The historic architect assisted the Division of Interpretation on the Old Faithful Visitor Education Center and the Section 106 review with the Wyoming State Historic Preservation Office; the Business Management Division on 25 projects involving rehabilitation, remodeling, lighting, design, installation, structural repair, restoration, structural additions, maintenance, and documentation; and Planning, Compliance, and Landscape Architecture on cultural landscape foundation planning for the Old Faithful and Tower–Roosevelt areas; consultation on historic structures, Section 106, and National Register eligibility; and four design and planning projects for lighting and parking lots.

The historic architect also served as the on-site grant coordinator and technical representative for review of projects that are being undertaken with a \$1.7 million NPS grant to the Montana Heritage Commission for the stabilization of more than 250 structures in Virginia City, including the restoration and rehabilitation of properties that are one of the most intact groups of mid-nineteenth-century mining town structures extant in the United States.

Yellowstone History

The mission of the History Program is to protect cultural resources and to increase knowledge and appreciation of Yellowstone's history by educating and collaborating with park managers and staff, the public, partners and contractors, and other constituents about the park's historical resources. Important considerations for the park historian, Lee Whittlesey, include inventory, research, evaluation, and documentation of historic properties and resources as well as important events, individuals, and themes. The program consists of

- researching and preparing historic contexts by

integrating the best of current historical methodology and scholarship into park research, education, and planning activities;

- reviewing for correctness and appropriateness dozens of books, articles, and manuscripts each year;
- outreach/information to other National Park Service divisions and the public.

Historical Research and Publications

During 2005, the park historian completed one long research paper, "A Post-1872 History of the Norris Area: Cultural Sites Past and Present," and three shorter papers: "‘You Only Count One Here!': Larry Mathews and Democracy in Yellowstone, 1887–1904"; "A Brief History of Moran Point and Artist Point and Their Association with Thomas Moran and William Henry Jackson"; and "Of Fairies' Wings and Fish: Fishery Operations and the Lake Fish Hatchery in Yellowstone." These papers were written in connection with Federal Highways and NPS projects at Norris and with the division of Planning, Compliance, and Landscape Architecture projects at Canyon and Lake. They will be published in *Yellowstone Science* and *Montana: The Magazine of Western History*. He co-authored two papers with Paul Schullery, "Greater Yellowstone Bison Distribution and Abundance in the Early Historical Period" and "Greater Yellowstone Pronghorn: A Nineteenth Century Historical Context."

The historian continued work on the manuscript for a book to be entitled "Storytelling in Yellowstone: Horse and Buggy Tour Guides in the Grand Old Park" and scheduled for publication in late 2006 or early 2007 by the University of New Mexico Press.

The historian published the following journal articles in 2005: a book review of *After the Fires: The Ecology of Change in Yellowstone National Park* (Linda L. Wallace, editor), for *Montana: The Magazine of Western History* (Autumn 2005); "G.L. Henderson: Interpreter and Innovator" and "The Henderson Family Today," for *Yellowstone Science* (Spring 2005); an article with Hank Heasler, park geologist, "A Guide to Making Proposals for Place Names of Thermal Features in Yellowstone National Park, Wyoming-Montana-Idaho (a National Park Service Document)," *GOSA Transactions* (January 2005).

The historian met frequently with Kiki Rydell regarding the historic resources study begun by Mary Shivers Culpin, the manuscript for which is entitled “Managing the Matchless Wonders: A History of Administrative Development in Yellowstone National Park, 1872–1965.”

The historian also went to Yale University’s Beinecke Library, where he found dozens of rare items pertaining to Yellowstone history and copied many of them for park collections. Some will be exhibited at the new Old Faithful Visitor Education Center.

Presentations

At the Yellowstone Association Institute the historian taught “History of Wildlife” with Dr. James Pritchard of Iowa State University; a “Flight of the Nez Perce” backcountry trip; and “Northern Roadside Yellowstone History.” Other presentations included: a tour of the new HRC, the Cinnabar area, and the Gardiner cemetery for Yellowstone Park Foundation board members; a

talk on G.L. Henderson at the Buffalo Bill Historical Center; a workshop and symposium with historian Jeremy Johnston for the American History Cowboy Coalition (history teachers); a bus tour for new NPS employees; an on-camera appearance for Ken Burns’s National Park Service documentary; presentations at the Northwest Museum of Cultural Arts in Spokane and the National Association of Interpreters; and a tour of the HRC with several workshops for Dr. Mary Murphy’s graduate history class from Montana State University.

Assistance to Other Divisions

For the Public Affairs Office, the historian fielded numerous reporters’ requests for interviews. He worked with Tom Cawley to write and record sound vignettes of the Fort Yellowstone walking tour. He helped Lindsay Robb write Yellowstone history vignettes for park management “Focus Days.” He met with the Division of Interpretation and contractors regarding the new Old Faithful Visitor Education Center.



Display of Yellowstone museum items at the Heritage and Research Center.

PART II.

Natural Resource Programs

The Branch of Natural Resources helps preserve and increase knowledge of Yellowstone's resources in these areas:

- Air, Land, and Water
- Aquatic Resources
- Geology
- Vegetation
- Wildlife



Travis Wyman and Tyler Coleman during the spring carcass survey.

Air, Land, and Water

Air Resources

GYA Clean Air Partnership. YCR hosted the partnership's 9th annual meeting in October. Mary Hektner, who continued to serve as Yellowstone's representative, provided an update on the park's air quality monitoring and "greening" initiatives and co-authored a major update of the 1999 GYA Air Quality Assessment. Other discussion topics at the meeting included snow chemistry monitoring in the GYA, Yellowstone's Greening Program, air quality issues related to oil and gas development activities in southwest Wyoming, Wyoming's air resource management update, regional NO₂ Increment Modeling Analysis and Existing & Planned Monitoring, and the Environmental Protection Agency's Regional Haze Regulations and Guidelines for Best Available Control Technology (BART) Determinations.

The partnership serves as an advisory group to the Greater Yellowstone Coordinating Committee and a forum to facilitate air program coordination and the implementation of consistent air quality management strategies. It includes Yellowstone and Grand Teton national parks, Gallatin, Custer, Beaverhead, Shoshone, Bridger-Teton, and Targhee national forests, Red Rock Lakes National Wildlife Refuge, the Idaho National Environmental and Energy Laboratory (INEEL), the Bureau of Land Management, and the Montana, Idaho, and Wyoming Departments of Environmental Quality.

Air Quality Monitoring. Yellowstone participates in a nationwide interagency air quality monitoring network designed to determine levels of air pollutants, trends in air quality, and compliance with National Ambient Air Quality Standards. Atmospheric deposition and wet (acid rain) and dry atmospheric deposition are monitored at Tower Ranger Station. Visibility (fine particulates, PM_{2.5}) and gaseous pollutants (ozone and sulfur dioxides) are monitored at the Lake Water Tank. Carbon monoxide and fine particulates are monitored at Old Faithful and at the West Entrance. Ranger staffs at Tower, Lake, Old Faithful, and West Entrance operate the stations; the samples and raw data are sent to various national programs for analysis.

The NPS Air Quality Division's 2005 Annual Performance and Progress Report noted that no measured Clean Air standards have been exceeded in Yellowstone and the park's air quality, including visibility, is generally considered excellent. However, four (ozone, and sulfate, nitrate, and ammonium in precipitation) of six measures of air quality showed a statistically significant decline in Yellowstone from 1995 to 2004. Visibility on clear days significantly improved during that period and visibility on the haziest days improved slightly, but the trend in declining air quality is of concern. The National Park Service has no control over external sources of air pollution, such as oil and gas development or coal-fired power plants, but continues to work with the Environmental Protection Agency and with state air quality agencies to deal with the external sources.

The NPS report is available on the web at www2.nature.nps.gov/air/.

Most of Yellowstone's efforts in regard to air quality concern winter use monitoring at the West Entrance and Old Faithful. Data for the winter of 2004–2005 showed a direct correlation between the decrease in total oversnow traffic and a decrease in air pollutants. Data analysis is still underway by the Air Quality Division.

Snow Survey

More than 75% of the surface water supply in the West is derived from snowmelt in the region's higher mountainous areas. Conditions from year to year and region to region can range from extreme drought to severe flooding, putting hundreds of millions of dollars at risk annually in agriculture, hydropower, dam operation, flood control, drought mitigation, and recreation. To help manage this resource for public safety, health, and economic viability, the Natural Resource Conservation Service (NRCS), under the federally mandated Snow Survey & Water Supply Forecasting Program, maintains an extensive monitoring system to collect snow pack and related climate information. As the headwater areas for two major river systems—the Yellowstone River east of the Continental Divide that feeds into the Mississippi River system, and the Snake River on the west that flows into the Columbia River—Yellowstone has 10 NRCS SNOTEL stations and 5 manual snow course sites.

In addition to the long-term snow water equivalent, precipitation, and temperature data that has been collected, NRCS has been adding snow depth sensors at the SNOTEL stations over the past three years. This information will provide a more accurate assessment of hydrologic and climate conditions relating to water supply conditions. The data is used to assess avalanche potentials and winter severity and range conditions for wildlife. Plans call for adding soil moisture and soil temperature sensors to the SNOTEL network over the next few years to better forecast both the quantity and timing of spring and summer stream flows.

Fens Study

Fens are wetland habitats in which a constant supply of surface or ground water maintains permanently saturated soils and, over thousands of years,

causes thick layers of partially decomposed organic matter to accumulate. This organic soil, called peat, is common in far northern climates. In Yellowstone National Park, although fens occupy little land area, they include a diverse range of fens occupied by plant and animal species that rely on permanently moist environments, and they serve as examples of how complex fen ecosystems function in a pristine state. Many of the major wildlife species of the park spend at least some of their time in fens, which provide both forage and a cool, moist place to go in the heat of the summer. Until recently, little was known about the park's fens. Through a grant from Canon U.S.A., researchers from Colorado State University led by Dr. David Cooper have spent the past two summers mapping and describing fens throughout the park.

Sampling during 2004 focused on 65 sites located along the road network for easy access. In 2005, the field team sampled more than 100 fens in more remote areas such as Mirror Plateau, Shoshone Lake, Heart Lake, the South Arm of Yellowstone Lake, the Gallatin Mountains, and the Bechler area. Perhaps the most unique type found in Yellowstone has been the acid fen complexes located where the chemistry of the waters feeding the fens is influenced by geothermal activity. Although the waters are not necessarily hot, they are strongly acidic, sometimes less than 3.0 pH, and contain high sulfur content. *Carex aquatilis* (water sedge) is the most common vascular plant at these sites, but a thick mat of mosses and liverworts that can survive in such acidic waters is often present at the edges.

Searching for fens at higher elevations, the field team found several sites close to 9,000 feet in the Gallatin Mountains. These sites contain a set of species typically found in the subalpine, such as *Carex illota* (sheep sedge) and *Caltha leptosepala* (white marsh marigold), along with highly diverse forested fens.

Bechler Meadows is the wettest area in the park and filled with peatlands. To sample the floating mats located in lakes there, the field team waded out into the lake and climbed on top of the mat. The peat soil that forms the mats is often much deeper than the eight-foot sampling probe, which indicates that dead plant matter has been accumulating for thousands and thousands of years. Several rare plant species grow on the floating mat at Robinson

Lake, including *Dulichium arundinaceum* (three-way sedge), *Lycopodium inundatum* (marsh clubmoss), *Scheuchzeria palustris* (rannoch-rush), and *Schoenoplectus subterminalis* (swaying bulrush).

In the Heart Lake area, the team found the rare dwarf shrub *Rubus acaulis* (dwarf raspberry) in several new locations. The team also found two samples of the moss *Meesia triquetrum*, one near the Continental Divide in the southern half of the park and the other in the Bechler area.

The two-year study has produced species lists with absolute cover of each species for 518 distinct stands of vegetation from 169 different fens. The data will be analyzed to look for recurring patterns that can be considered vegetation communities. Variables such as soil and water chemistry, elevation, annual precipitation, bedrock geology, and proximity to geothermal features will be examined to determine why certain types of vegetation communities occur in certain locations. The project's final report is expected to be completed within a year.

Restoration Projects

Gardiner Basin Restoration Workshop. In 1926, Congress added several thousand acres to the northern part of the park to "provide the winter range and winter feed facilities indispensable for the adequate and proper protection, preservation, and propagation of the elk, antelope, and other game animals of Yellowstone National Park" (Game Ranch Addition Act of May 26, 1926). Although this area, known as the Boundary Line or Gardiner Basin area, is dominated by exotic vegetation introduced through homesteading, railroading, and gravel mining activities, it is still a crucial feeding ground, especially for Yellowstone's dwindling pronghorn population. Yellowstone's previous experiments to reestablish native vegetation to improve winter forage have been largely unsuccessful, partly because of the staff's limited experience with the semi-desert environment found in the rain shadow of the Gardiner Basin.

Funding was therefore obtained from Canon U.S.A., Inc., through the Yellowstone Park Foundation; Greater Yellowstone Coordinating Committee; and Rocky Mountains Cooperative Ecosystem Studies Unit to convene a workshop on arid lands reclamation. Ten invited arid land restoration specialists and 20 park and Gallatin National

Forest staff participated in the facilitated meeting held in Gardiner on April 19–21. A summary report was produced that gives recommendations applicable to both agencies and also site specific recommendations. Staff have begun the next steps of NEPA compliance and are seeking funding for a 50-acre pilot project that could begin in 2008.

Information about the workshop and resulting recommendations were presented in talks at the George Wright Society Biennial Conference on Parks, Protected Areas, and Cultural Sites, (Philadelphia, PA), and the 8th Biennial Scientific Conference on the Greater Yellowstone Ecosystem (Mammoth Hot Springs, WY), and in a poster at the World Conference on Ecological Restoration (Zaragoza, Spain).

Turbid Lake Road Restoration. Restoration work from Turbid Lake to Pelican Creek began in 1997 as compensatory mitigation for wetland impacts incurred in the reconstruction of the Dunraven road. As required by the terms of the park's permits for the Dunraven and East Entrance Segment C road reconstruction, the hydrophytic vegetative cover must be restored before road reconstruction is completed.

The heavy equipment phase of the restoration project was completed this year with gratifying results. To document conditions at wetland restoration sites, groundwater monitoring wells were installed, checked, and repaired as necessary at 27 sites, 36 revegetation plots were set up, and more than 240 existing plots were checked and photographed.

Mining Impacts. Park staff continued to monitor proposed and ongoing reclamation projects associated with three mining sites outside the park: the New World Mining District, the McLaren Mill mine tailings, and the Great Republic Smelter. Environmental cleanup of historical mining impacts in the New World Mining District adjacent to the park's Northeast Entrance is proceeding. The U.S. Forest Service continues to identify sources of pollution and conduct site investigations to refine cleanup activities.

Significant progress was made on the cleanup of the McLaren Mill and tailings sites and the Republic Smelter site, all of which are located upstream and just outside the park's northeast boundary. The U.S. Forest Service (USFS) and Environmental

Protection Agency joined forces to completely clean up the Republic site, and the USFS reclaimed the portion of the McLaren Mill site that was on USFS property. All of the contaminated soils were placed in the Forest Service’s New World waste repository near Cooke City and the sites were recontoured and revegetated.

For the McLaren tailings site, the Montana Department of Environmental Quality received funding from the NPS Water Resources Division to install three groundwater monitoring wells to determine whether there is adequate separation between the groundwater and the bottom of the proposed repository—one of the criteria necessary to determine whether the site is suitable.

Aquatic Resources

Yellowstone National Park is home to the most ecologically and economically important inland cutthroat trout fisheries remaining in North America. However, over the past decade, these resources and the ecosystems that they support have become seriously threatened by introductions of non-native and exotic species. Aquatics Section activities are almost entirely aimed at reducing these threats and improving the overall condition of native aquatic communities in the park, with a primary focus on activities that support

- preservation of Yellowstone Lake cutthroat trout, the largest remaining concentration of genetically pure inland cutthroat trout in the world;
- restoration of fluvial populations of native trout,

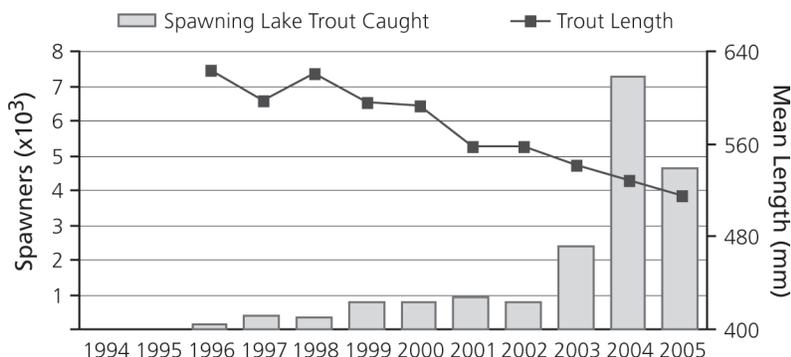
many of which have been lost due to introductions of non-native species.

Yellowstone Cutthroat Trout Preservation

Lake Trout Suppression. Preservation of Yellowstone Lake cutthroat trout continued to be a top priority in 2005, as a total of 36,426 non-native lake trout were killed, bringing the overall total killed to more than 136,000 during 1994–2005. Because each lake trout is capable of consuming at least 41 cutthroat trout each year, the gillnetting effort has saved a tremendous number of cutthroat trout. The result is a lake trout population that is beginning to show signs of suppression. Catch per unit of effort for lake trout remains low, and the average length of spawning adult lake trout continued to decline (Fig. 1). However, the cutthroat trout population has yet to demonstrate a significant positive response. Because no means of completely eliminating lake trout from Yellowstone Lake is currently feasible, the labor-intensive removal program will be necessary for the foreseeable future

Population Monitoring. The number of upstream-migrating Yellowstone cutthroat trout (*Onchorhynchus clarki bouvieri*, YCT) counted at Clear Creek, one of the cutthroats’ largest spawning tributaries, was only 917 during 2005 (having declined from 6,613 in 2002), the lowest since annual counts began at Clear Creek in 1945 (Fig. 2). However, the fall netting assessment in Yellowstone Lake during 2003–2005 has provided some of the first indications that the cutthroat trout may be responding positively to efforts to remove lake trout,

Figure 1. Number and mean length of mature lake trout removed near spawning locations on Yellowstone Lake during late August–early October, 1996–2005.



as suggested by a modest increase in the abundance of smaller, juvenile fish. An average of 7.4, 7.9, and 7.4 fish were caught per net in 2003, 2004, and 2005, respectively, whereas previously the catch had declined 11% per year on average since 1994. Critical to the cutthroat now will be the ability of these juvenile fish to recruit to the spawning population and appear within the spawning tributaries of Yellowstone Lake; that is the only means by which the population can be expected to rebound and return to the higher densities seen in the past.

Whirling Disease. Understanding the factors that affect whirling disease (WD) infections and YCT population declines requires knowledge of the spatial variation in *Myxobolus cerebralis* (*Mc*), the parasite that causes WD, in the upper reaches of the Pelican Creek watershed. In 2005, the park continued its partnership with Montana State University's Department of Ecology in the Pelican Creek backcountry. Goals included quantifying *Mc* infection risk in Pelican Creek using *Tubifex tubifex* worms (which serve as a host for *Mc*), comparing results to those obtained by sentinel fish exposures, and measuring variation among tubificids and habitat.

In 2005, a uniform (100%) infection prevalence and similar, high grades of infection severity were found in sentinel fish among six sites where fry were exposed. In contrast, patchy patterns of *Mc* infection were observed in tubificids at the 25 sites examined for worms in the watershed. The highly variable patterns of infected tubificid abundance

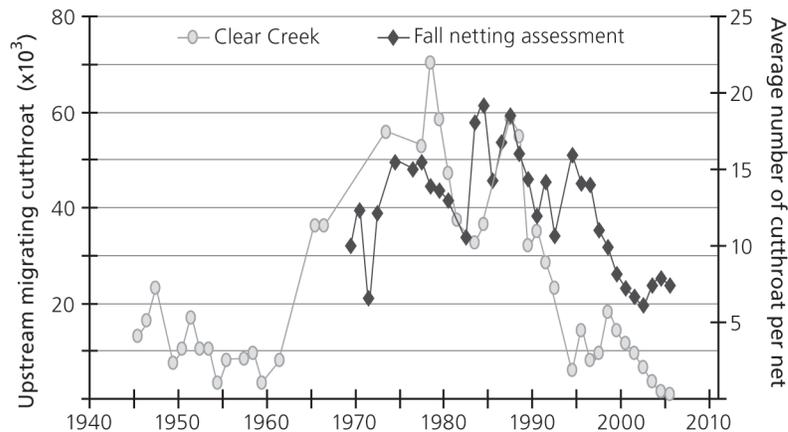
relative to habitat type warrants investigation. The next steps will be to monitor uninfected sites for colonization by the parasite, examine variation in the relative abundances of worm species, and evaluate any potential vectors of dissemination.

Native Trout Restoration

Westslope Cutthroat Trout. NPS mandates require that the park ensure the persistence of native species and restore them when appropriate. The westslope cutthroat trout (*O. c. lewisi*, WCT) has substantially declined in the park and elsewhere within its range in the upper Missouri River drainage. Losses within the park are primarily due to interbreeding (hybridization) with other trout, particularly introduced YCT and non-native rainbow trout. With generous support by the Yellowstone Park Foundation and its Fisheries Initiative that was developed in 2005, restoration of fluvial populations of native trout in the park is moving forward.

Although introgression of the North Fork Fan Creek westslope cutthroat trout was reported, a pure population of more than 700 westslope cutthroat was found in an unnamed tributary to Grayling Creek in June. Aquatics Section staff documented the population's extent during July and August and state of Idaho geneticists determined that they are the only pure westslope cutthroat trout known in the park, and one of only three populations remaining in the Gallatin and Madison river drainages of southwest Montana.

Figure 2. Upstream-migrating cutthroat trout counted at Clear Creek spawning trap (1945–2005), and mean number collected per net on Yellowstone Lake during the fall (1969–2005).



The Aquatics Section is proposing to restore westslope cutthroat to the East Fork Specimen Creek watershed by restocking it with genetically pure WCT from the few other, remaining native WCT populations within the Madison and Gallatin drainages. National Environmental Policy Act (NEPA) compliance was initiated in July for this purpose.

Yellowstone Cutthroat Trout. Work was completed to prioritize watersheds in the park's northern range based on probability of success for YCT stream restoration. Reese Creek, Rose Creek, the Elk Creek complex of streams, and Blacktail Deer Creek all provide excellent opportunities for re-establishment of genetically pure YCT populations. Rose Creek, given its proximity to the Lamar Buffalo Ranch, would provide opportunities for public education regarding native trout issues in the park.

Aquatic Invasive Species

Yellowstone's fisheries are threatened by aquatic invasive species (AIS) that displace native fish and the macroinvertebrates upon which they depend for survival. AIS may also impact trout consumers such as eagles, ospreys, and grizzly bears. Exotic AIS that are present in park waters include the New Zealand mud snail (*Potamopyrgus antipodarum*) and *M. cerebralis*, which causes whirling disease in trout. Once established in park waters, AIS are virtually impossible to get rid of. These measures have been taken to prevent additional AIS introductions in the park:



Jeff Arnold sampling macroinvertebrates at Mammoth Crystal Spring.

- A brochure has been developed to provide information on how to conduct boat inspections and clean angling gear (available online at www.nps.gov/yell/planvisit/todo/fishing/exotics.htm).
- Signs have been developed and installed at Yellowstone Lake and Lewis Lake boat ramps.
- Anyone purchasing a boating permit in the park is now informed about AIS and how to conduct boat inspections.
- Collaboration with partner agencies and non-governmental organizations, and development of an Aquatic Nuisance Species Management Plan for the Greater Yellowstone Area.

Yellowstone National Park also participates in the "Stop Aquatic Hitchhikers" campaign sponsored by the U.S. Fish and Wildlife Service and U.S. Coast Guard.

Fish Monitoring

Monitoring of fish communities occurred in many front- and backcountry streams during 2005, including research on the status and life history strategies of Yellowstone cutthroat trout in the Yellowstone River and its tributaries upstream of Yellowstone Lake. An inventory of fishes in the remote reaches of the Snake River and its tributaries also continued. These are among the first surveys of fishes in these regions of the park, even though fisheries investigations have been occurring in Yellowstone since the late 1800s. The waters of the upper Yellowstone River support significant numbers of spawning cutthroat trout from Yellowstone Lake. It is unknown to what extent the Snake River supports migrating cutthroat trout. Results will help managers understand the status and dynamics of cutthroat trout in these wilderness areas and the contribution of these systems to the overall cutthroat trout populations in the Greater Yellowstone Ecosystem.

The ecological health of the park's aquatic systems continues to be monitored intensively:

- The quality of surface waters is monitored biweekly at 12 fixed sites located near the confluences of major streams and rivers.
- The physical and chemical characteristics of Yellowstone Lake are monitored seasonally to assist in eliminating lake trout.
- Macroinvertebrates are sampled using regionally standardized methods to allow for data compari-

son among agencies. Results are being used in the development of NPS Vital Signs Monitoring protocols for the Greater Yellowstone Network.

- A study was completed on the effects of road operations at Sylvan Pass on the water quality and macroinvertebrate communities of Mammoth Crystal Spring.

Angler Participation

Anglers caught an estimated 520,218 fish in the park during the 2005 fishing season. Native cutthroat trout remained the most caught fish species, comprising 52% of the total catch, followed distantly by rainbow trout (20%), brown trout (13%), brook trout (6%), lake trout (4%), grayling (3%), and mountain whitefish (2%). Overall, native species comprised 57% of the total catch.

Yellowstone Lake remained the most popular destination for anglers; an estimated 10,271 anglers fished the lake this year, representing one-quarter of all fishing effort in the park. Anglers fishing Yellowstone Lake reported catching 0.70 cutthroat trout per hour of fishing. This catch rate continues a six-year downward trend following a record high catch rate in 1998. The angler-reported catch rate for lake trout in Yellowstone Lake decreased for the second consecutive year, to 0.05 fish per hour. This is a positive sign that lake trout suppression efforts are having some effect. The park encourages anglers to fish for lake trout on Yellowstone Lake and killing them is required by law; an estimated 5,530 lake trout were removed by anglers from Yellowstone Lake during the 2005 angling season.

Changes in Fishing Regulations

Public scoping took place for proposed changes in fishing regulations, including a possible requirement to use barbless hooks as a way to reduce fish injuries in catch-and-release fishing, especially in heavily fished waters such as the Yellowstone River and Soda Butte Creek. Five public meetings were held in gateway communities and a period for written public comments remained open for more than five months. Of the 506 correspondence records received, 352 (70%) were in favor of the proposed changes and 18 (4%) were opposed. A slightly higher percentage (74%) favored a parkwide requirement for barbless hooks and 2% were opposed.

Given the strong public support for the proposed

changes, the park plans to implement them in 2006. The framework for the new policy is based on the presence or absence of native sport fish species in different park waters. Most of the park will be designated a "Native Trout Conservation Area," where catch-and-release applies to native species but non-native fish may be taken within certain limits. The west-central part of the park will be considered a "Wild Trout Enhancement Area," where catch-and-release applies to rainbow trout and most brown trout as well as to all native species. Pelican Creek and part of the Yellowstone River drainage above the Upper Falls is closed to fishing because of the presence of whirling disease.

Assistance and Support

Aquatics Section staff continued to provide a variety of short-term educational programs with an emphasis on native fish conservation for visiting schools and other interested groups. The staff also provided American Red Cross certification in First Aid and CPR for employees of Yellowstone National Park as well as other agencies.

Public Involvement and Volunteer Support

Public involvement with the Aquatics Section increased, primarily through the assistance of many volunteers. The Yellowstone Volunteer Flyfishing Program, in which anglers from across the United States participated in specific fisheries projects in the park, was a highlight again this year. Information provided by volunteers is being used to assess the status of fisheries in many waters of Yellowstone.



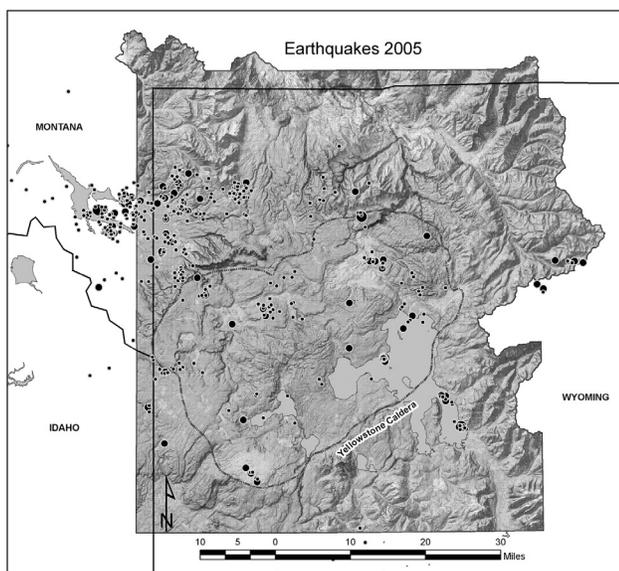
Non-lethal sampling of fin tissue for genetic analysis.

Geology

Yellowstone's geologic resources include its thermal features, landscape, rocks, minerals, and fossils as well as the geologic processes that continually form these resources and affect road projects, water sources for developed areas, boardwalks, visitors, and the distribution of plants and animals. Yellowstone became the world's first national park because of the many spectacular hydrothermal features, and their protection was a primary goal of the park's enabling legislation. The Geothermal Steam Act of 1970, as amended in 1988, also requires that the park's geothermal features be protected.

The primary mission of Yellowstone's geology program is to provide park managers with the information needed to protect the park's geologic resources from human activities and to protect the public from the dangers posed by geothermal activity. To carry out this mission, the park geologists collaborate with outside groups to ensure that the park's geologic resources are scientifically inventoried and monitored, and they work with other park divisions to help staff understand geologic processes and their impact on the park's geologic resources.

Protection and monitoring of the park's geothermal features is accomplished by the geologists in conjunction with the Montana Water Rights Compact and partner scientists from other government agen-



The seismic network detected 872 earthquakes in the Yellowstone area during 2005, the fewest since 1994.

cies and academic institutions. The Yellowstone Volcano Observatory (YVO, the park's partnership with the USGS and the University of Utah), monitors volcano and earthquake hazards within the park using a network of seismic and GPS leveling stations. The Montana Water Rights Compact, which YNP established in 1994 with the state of Montana, protects geothermal features by limiting groundwater withdrawal in a designated area north of the park. This Controlled Groundwater Area was intended to be monitored by the state of Montana with funding provided by the federal government. During 2005, the geology staff worked with the NPS Water Resources Division of the National Park Service to review groundwater use applications for the Controlled Groundwater Area.

Geothermal Monitoring Program

In March 2003, Yellowstone staff and partner scientists prepared a proposal for a comprehensive geothermal monitoring program that would include groundwater, surface water, chloride flux, geochemical monitoring, and remote sensing of thermal features for a total annual cost of \$989,000. The YVO and the Technical Oversight Committee for the Montana Water Rights Compact have peer reviewed and support the proposed program as a critical component of monitoring the Controlled Groundwater Area, volcanic and seismic hazards, and protecting Yellowstone's irreplaceable geothermal features.

As a result of successful lobbying by the Montana Water Rights Compact Technical Oversight Committee to implement a comprehensive geothermal monitoring plan for the park, in 2005 YNP received a \$646,000 base increase from Congress of which \$141,000 is to be paid annually to the Montana Bureau of Mines for monitoring the Controlled Groundwater Area, and \$250,000 will be used to relieve park budget shortfalls. The remaining \$255,000 a year is to be applied toward geothermal monitoring in the park, of which \$145,000 will fund three Cooperative Ecosystem Studies Unit (CESU) agreements for the use of remote sensing techniques to monitor the park's geothermal features:

- Montana State University—Drs. Steve Custer (Earth Sciences) and Rick Lawrence (Land Resources) will use current and historical satellite imagery to map active thermal features in the park.

- University of Montana National Center for Landscape Fire Analysis—Dr. Lloyd Queen, Dr. Carl Seielstad, and Josh Rodriguez worked with the USDA Forest Service Rocky Mountain Research Station Fire Sciences Lab (Dr. Colin Hardy and Jim Reardon), a Minnesota flight crew, and the park geologists to acquire day- and nighttime thermal infrared images over Norris Geyser Basin in October 2005, with the goal of generating a thermal map that shows changes in active thermal features since the last airborne data was collected in October 2002.
- Utah State University—graduate students (Deepak Lal, Miguel Augel Moreno Hidalgo, Sarvanan Sivarajan, and Raghuvier Vinukollu) from Dr. Christopher Neale’s Irrigation Engineering–Remote Sensing Services Lab acquired day- and nighttime images over the Upper, Midway, and Lower geyser basins.

Yellowstone Volcano Observatory

Scientists improved the YVO monitoring network by installing a new seismic station at Parker Peak and five new GPS stations for continuous data collection at the Northeast Entrance, Slough Creek, the Promontory, Madison Junction, and Canyon. These network enhancements increase the YVO’s ability to monitor seismic and volcanic hazards with a total of 27 seismic and 11 GPS leveling stations in the park. The network makes it possible to provide real-time data over the Internet, including live seismograms, an earthquake catalog of the Yellowstone area, GPS station velocities, stream discharge and temperature at Tantalus Creek, stream flow for several major rivers in Yellowstone, and temperature logs for Steamboat Geyser.

In November 2005, the geologists met in Salt Lake City with scientists from all five U.S. volcano observatories to discuss a 10-year plan for volcano and earthquake monitoring for YVO.

The park’s geologists and other scientists associated with the YVO provided technical information for the British Broadcasting Company’s production of “Supervolcano,” a two-hour docudrama about a catastrophic eruption of the Yellowstone volcano and its regional and worldwide impacts. Accompanying the drama was a one-hour documentary, “The Science Behind the Supervolcano Story” for which geology personnel were interviewed.

Monitoring at Sylvan Pass

Nearly one third of the geologists’ time during 2005 was taken up by intensive study and monitoring at Sylvan Pass in order to determine the possible impact of the East Entrance Road reconstruction on the hydrology of the area. The analysis began in August 2004 after a plume of milky turbidity was observed in 8 km of Middle Creek below Sylvan Pass. To investigate how the water flows underground, in June 2005, the geology staff worked with USGS scientists to inject fluorescein dye on the west side of the pass where a stream disappears into the talus. Activated charcoal samplers were deployed on both sides of the pass, and an auto sampler was set up at Mammoth Crystal Spring about 1.5 km east of the pass. About 22½ hours after the injection, dye was observed 2.25 km away in Mammoth Crystal Spring. Geology staff prepared four internal reports concerning the geohydrology of Sylvan Pass, including data on water flow, turbidity, pre-



Steamboat Geyser, the tallest in the world, erupted in 2000 for the first time in nine years, five times in 2002 and 2003, and once in 2005.

precipitation, and temperature that park managers are using to determine what changes the U.S. Federal Highways Program needs to make in how the road work is done.

Boreholes on the Mammoth Terraces

On a bitterly cold January day, park geologists logged three boreholes at the planned site of the Justice Center on the Mammoth Terraces and measured gases and temperatures within the boreholes. All three boreholes exposed decomposed, altered, porous travertine and produced temperatures near 8°C in moist, gray-brown, clay-rich layers. In borehole 1, explosive levels and concentrations of carbon dioxide and carbon monoxide gases were greater than those measured in boreholes 2 and 3. This information was used by the engineers of the Justice Center to make changes in its design.

Thermal Areas at Canary Spring

Three times during 2005, rapidly advancing deposits of travertine and flowing thermal water at Canary Spring prompted Yellowstone's boardwalk crew to remove segments of boardwalk. Law enforcement ranger Joe Bueter assisted the geology staff in each effort to restore the thermal areas affected by these removals.

Assistance and Support

The geology staff assisted other park divisions by providing information and conducting on-site investigations followed up by written reports (see Appendix II). For the Division of Interpretation, the geology staff edited publications and electronic field trips for scientific accuracy and provided a scientific review of exhibits for the Canyon Visitor Education Center and the Old Faithful Visitor Education Center.

During 2005, eight volunteers contributed 2,964 hours (370 eight-hour days) to clean thermal features, manage temperature loggers, and assist with protection and restoration of thermal resources. Patrice Barlow, a geology student at Stephen F. Austin State University, contributed 400 hours developing a geologic database for thermal features as a GeoCorps America volunteer paid by the Geological Society of America.

Vegetation

The vegetation found in Yellowstone reflects the physical environment—climate, geology, soils, elevation, and aspect—as influenced by natural disturbances and human activities. Preserving native vegetation communities and associated processes while minimizing human influences has great value for wildlife habitat, wilderness, cultural landscapes, and scientific research. However, there are situations, such as in the case of hazard trees or fire, in which park visitors and staff must be protected from hazards associated with the natural processes operating on vegetation communities.

YCR's vegetation group has diverse responsibilities and functions related to the protection, perpetuation, or restoration of vegetation communities, management of threatened or endangered species, safety and enjoyment of the public, mitigation of human-induced effects, assessing threats from external sources, and general management and compliance needs.

Plant Inventories

The park's vascular plant list includes more than 1,370 taxa. Yellowstone has met the goal of the servicewide inventory and monitoring initiative that requires documenting at least 90% of the vascular plant species in each park and incorporating the information in the NPSpecies biodiversity database. During 2005, Yellowstone's database was updated with new records, synonymy, park status, abundance, residency, nativity, and cultivation data, and several hundred specimens were labeled and mounted for addition to the herbarium.

Native Species. The vegetation zone believed most likely to have species not yet in Yellowstone's database is the alpine zone, especially in the Gallatin Mountains. Field work for the Gallatin Mountains alpine plant survey, which began in 2003, was completed in 2005, including surveys of limestone areas in the vicinity of Fawn Pass and revisits of the Quadrant, north cirque of Bannock Peak, and the slopes of Gray Peak with the help of corral operations. As a result of this fieldwork, the presence of grayish draba (*Draba cana* Rydb.) in the park was confirmed, and an unusual mustard was located that may be a new *Draba* species, pending verification at regional herbaria. Additional searches of the

Yellowstone portion of Cutoff resulted in the location of a population of dwarf buttercup (*Ranunculus pygmaeus* Wahlenb.) in the park that was previously reported erroneously in the annual report for 2001. The visit also located a site of one-head pussytoes (*Antennaria monocephala* DC.), a new record for the park. Three additional native species were found last summer for the first time in the park: scarlet gaura or butterfly-weed (*Gaura coccinea* [Nutt.] Pursh); rush-like skeletonweed (*Lygodesmia juncea* [Pursh] D. Don ex Hook.); and cup-shaped western stickseed (*Lappula redowskii* [Hornem.] Greene var. *cupulata* [Gray] Jones).

Non-native Species. Four additional non-native species were documented for the first time in 2005:

- The NPS Mountain Exotic Plant Management Team located spotted cats-ear (*Hypochaeris radicata* L.), also known as hairy cats-ear or gosmore, at the entrance to the Norris Geyser Basin. Although the infestation was small and completely dug up and eradicated, seed is probably present in the soil and the area will have to be monitored for several years.
- During wetland inventory in the Old Faithful development, the delineation team located common velvetgrass or Yorkshire-fog (*Holcus lanatus* L.), a highly invasive grass that is common on the West Coast. Eradication will be difficult because the species has apparently been present in the park for years and spread into wetlands on the edge of the Firehole River.
- An infestation of water speedwell or water pimpernel (*Veronica anagallis-aquatica* L.) along the spring within the NPS corrals at Tower could be eradicated through aggressive management over the next few years, but other introductions are possible since this species is well-established in areas adjacent to the park, such as Jackson Hole.
- Lamb's quarter or goosefoot (*Chenopodium strictum* Roth var. *glaucophyllum* [Allen] Wahl) is present in Gardiner, so its discovery in front of the HRC building was not unexpected. The solitary individual was eradicated, but it was late enough in the summer that some seed may have matured and dispersed.

Rare Plant Surveys. To prevent inadvertent negative impacts to rare plant populations in the park, surveys are conducted prior to construction proj-

ects, trail re-routes, and other disturbance activities. One benefit of these required compliance activities is the data gathered: the summer field season resulted in documenting 27 additional sites for the GIS layer of "species of special concern" or rare plants in the park.

Summer fieldwork for Federal Highways projects took place primarily in the Old Faithful area and at the Lamar River bridge. Rare plant sites that were potentially vulnerable were visited when advantageous or necessary during various stages of road construction. Staff worked with the park's landscape architects to coordinate salvage soil activities necessary as a result of impacts to the annual hairgrass (*Deschampsia danthonioides*) site on the East Entrance road. The revegetation plan that the landscape architects are developing for the section of the Gibbon Canyon where the Grand Loop Road will be removed from the river corridor will include specific recommendations for species of special concern such as warm springs spikerush (*Eleocharis flavescens* [Poiret] Urban var. *thermalis* [Rydb.] Cronq).

Front country construction sites that were investigated for wetlands or rare plants include the waterline for the expansion/upgrade of the Madison wastewater treatment plant, the Norris developed area for the Wildland-Urban Interface (WUI) project of the fire cache, the Tower Junction area and Yancey's, and the water system at Lake in the vicinity of the spring boxes. Surveys were also initiated for ground-disturbing activities resulting from the re-route of the Winter Creek trail, the expansion of the seismograph and GPS base station sites at Parker Peak, Slough Creek, Northeast Entrance, Canyon, Grant Village, the Promontory, and Madison Junction, and the Nez Perce event by the Nez Perce picnic area.

Yellowstone Herbarium

The Yellowstone National Park Herbarium houses approximately 9,000 specimens that have been curated and entered into a database. The specimens are used by NPS personnel and outside researchers to identify vascular plant taxa as well as the bryophytes, fungi, and lichens that occur in the park, and to document the presence, variation, and distribution of native species, and the arrival and spread of exotic species.

With the new herbarium facility at the HRC, staff finally have the space needed to process specimens.

During the fall and winter of 2005, strides were made in organizing all of the unmounted specimens and establishing protocols for identifying, mounting, and entering the specimens into the NPS museum catalog database (ANCS+). Labels were generated for some of the backlog collections, and these specimens are being added to the collection.

During the 2005 field season, 166 vascular plant specimens were collected and will eventually be mounted and catalogued into the herbarium. These new specimens were needed to document the native flora in under-collected portions of Yellowstone, and the arrival and spread of exotic species.

The oldest specimens in the collection are four specimens of western groundsel (*Senecio integerrimus*) and woolly groundsel (*Senecio canus*) that were collected in the park in 1899 and donated by the Booth Herbarium at Montana State University (MSU) in Bozeman in 2005.

Browse History of Aspen

Although aspen occupy a very small proportion of the northern Yellowstone landscape, the species has been the source of controversy regarding the cause of its decline over the past century, with some researchers attributing the decline largely or entirely to elk browsing. To look for evidence of browsing while the trees were seedlings and saplings, staff have examined 279 overstory trees that had died and fallen or were protected from browsing by range exclosures. Paired cross sections were obtained from each tree at 0.2 and 1.5 m above ground level for age estimation to determine whether previous browsing influenced growth rates. Most of the trees in the sample originated between 1850 and 1900. The terminal stem of 85% of the trees were browsed from 1 to 7 times. The trees reached breast height after an average of 6.8 years (range = 1 to 17 years). The median time it took to achieve breast height increased with the frequency of browsing. A subset of trees ($n = 28$) with a known death year showed that browsing on these aspen trees took place from the early 1860s through 1900. Data are being prepared for publication in a scientific journal.

Forest Insect Infestations

Aerial detection surveys conducted during 2005 showed that the insect-caused mortality of overstory trees that erupted early in the decade continues.

Although the number of infected acres for some tree species declined somewhat from previous years, mountain pine beetle activity increased in lodgepole pine and, more alarmingly, in whitebark pine. Small, isolated pockets of lodgepole pine infestation remain in the center of the park, and new areas were mapped in the Thorofare/Two Ocean region and in the northwest corner along U.S. Highway 191 between Dailey and Fan creeks. Epidemic levels of whitebark pine infestation persist in all high-elevation mountain ranges except on the Pitchstone Plateau. Large tracts of beetle-killed whitebark pine can be found in the Gallatin, Washburn, and Absaroka ranges. Mortality of up to 80 trees per acre has been reported on the slopes of Avalanche Peak. An estimated 365,000 whitebark pine trees died in the park during 2005, and the adjacent Gallatin National Forest has also experienced substantial losses.

Most of the insects responsible for the mortality are small (1/8" long) native bark beetles in the Scolytidae family. They are often referred to as "primary" beetles because through sheer numbers their feeding activity can girdle a tree and be directly responsible for its death. A tree attacked during the summer will have a red crown the following summer, and the red needles usually drop within the next year, leaving a bare, standing dead tree. Secondary beetles, like the native wood-boring and longhorn beetles, are larger (3/4" or more) and attack trees that are already dying or dead.

Landscape-scale drought and the availability of suitable host trees are the primary forces in the initiation and persistence of insect outbreaks. Healthy trees can successfully defend themselves from beetle attack by "pitching out" adult females as they try to bore their way into the tree. Climate is also a driving force in diminishing insect outbreaks, as when extreme winter temperatures kill off overwintering broods, or wet, rainy summer weather impedes the insects from invading additional trees. Insect activity also decreases as the older, more preferred and susceptible trees are killed off. All of these insects remain active in local areas between outbreaks, but the resulting tree mortality is negligible.

The recent surge in mountain pine beetle, western balsam bark beetle, and spruce budworm activity seems to coincide with recent drought conditions. The Douglas-fir beetle activity that began in the early 1990s and the Engelmann spruce beetle activity that

dates from the mid-1990s may be tapering off.

Vegetation Management

Fire Management. Management of fire activity in 2005 was limited to aerial reconnaissance, mapping, and fire behavior forecasting of the Chickadee and Elk Tongue fires. The YCR management specialist continued to serve on the YNP Fire Management Strategy Team to discuss logistics and implementation of hazard fuels reductions in the wildland-urban interface, revision of the fire management plan (completed), and prescribed burning to meet fuel reduction targets. Other interagency fire planning efforts involved participation in: 1) the Fire Program Analysis process, which is part of a national directive to optimize resources, personnel, and budget; 2) a three-day fire management workshop in Bozeman, Montana, to discuss landscape-level fuel treatments for units throughout the GYA; 3) a four-day vegetation modeling workshop in Missoula, Montana, to help The Nature Conservancy meet contractual obligations with the federal government to produce the nationwide LANDFIRE wildland fuels mapping database and delineate Fire Regime Condition Class for vegetation types specific to the GYA.

Hazard Tree Management. To protect people and property, it is necessary to identify, and remove potentially hazardous trees in areas of high visitor and employee use. Representatives from YCR, Resource Management Operations, and the fire cache met at the U.S. Attorney's Office in Cheyenne, Wyoming, with lawyers from the NPS Solicitors Office in Denver, Colorado, to review a draft of the park's Hazard Tree Management Plan. Comments were incorporated into a final version that was signed by Superintendent Lewis.

To assist field personnel in implementing the plan, the management specialist evaluated the condition of a culturally-significant hazard tree at the Artist Point Overlook and suggested mitigation alternatives to the Canyon District Ranger. The management specialist also evaluated hazard trees in the Mammoth Historic District with resource management and fire cache personnel and landscape architects, and identified five trees for removal.

Vegetation Education

Training provided by the vegetation staff during 2005 included: weed identification for the Northern

Rocky Mountain Exotic Plant Management Team, Yellowstone resource management personnel, and Bighorn Basin Master Gardeners; identification seminars in difficult groups, such as willows, primarily for outside researchers; plant and vegetation overviews for the Division of Interpretation and Xanterra bus drivers. Two courses on Yellowstone wildflowers were taught through the Yellowstone Association Institute. Staff also identified unknown plant species for all divisions of the park, outside researchers, and the public on request.

Bryophyte Workshop. Although bryophytes (mosses and liverworts) are increasingly included on regional rare plant lists, relatively little research has been done on these plants in the park. Funding from Canon U.S.A. through the Yellowstone Park Foundation made possible a three-day workshop on bryophyte identification for interested NPS personnel, outside researchers, and other federal agency personnel. The workshop was presented by Judy Harpel, a USFS bryologist, and Wilf Schofield, curator of bryophytes at the University of British



Visiting bryophyte expert Dr. Judy Harpel (left) and park botanist Jennifer Whipple (right).

Columbia Herbarium. In addition to identifying several new liverwort species and relocating the type locality for an endemic moss, the workshop led to an even more ambitious project wherein Canon has agreed to fund a complete inventory of the park's bryophytes that will result in an annotated checklist.

Wildlife

In YCR wildlife programs, staff with expertise in wildlife biology work individually and in small groups to apply National Park Service policy in the management, research, and monitoring of individual species and groups of species and their encounters with people.

Endangered Species Consultation

The National Park Service is committed to promoting the recovery of federally listed species. Section 7 of the 1973 Endangered Species Act requires federal agencies to consult with the U.S. Fish and Wildlife Service whenever agency projects (e.g., road improvements and fire management) may affect listed species or their habitats. The Canada lynx, grizzly bear, gray wolf, and bald eagle are federally protected as threatened in Yellowstone; the Arctic grayling is a candidate species.

YCR biologists consulted with the Division of Planning, Compliance, and Landscape Architecture on improvement of a wastewater treatment plant at Madison Junction and a modification of the East Entrance road improvement project. YCR biologists serve as resource experts on the effects of park projects on listed species during consultations with the U.S. Fish and Wildlife Service. They also attend Level One Streamlining meetings that technically review and expedite projects proposed by federal land management agencies in northwest Wyoming.

Road-killed Wildlife

A database of wildlife killed on the park roads is maintained by the Bear Management Office. In 2005, a total of 90 large mammals (those that can attain weights of >30 pounds) are known to have been hit and killed by vehicles. This is less than the average of 103 for the period 1989–2004. Variations in annual numbers of road-killed wildlife are related to wildlife population numbers, park visitation,

weather conditions, and other factors.

The species most often killed in 2005 were elk (29) and mule deer (26). Other large mammals killed by vehicles included 14 bison, 14 coyotes, 2 moose, 2 pronghorn, 2 bighorn sheep, 1 black bear, and 1 beaver. The highest kill rate was on U.S. Highway 191 (1.5 road-kills per mile of road), which has a 55 mph posted speed limit, compared to no more than 45 mph on other roads in YNP. Highway 191 comprises approximately 7% of the primary roads in YNP, but accounted for 32% of the road-killed large mammals in the park in 2005.

Integrated Pest Management

During 2005, YCR's management specialist Roy Renkin responded to complaints involving insects (7), small mammals (5), spiders (3), and birds (1). He worked with park concessions staff to determine the source of each problem and ways to minimize or eliminate it according to IPM protocols. He also participated in an inspection of concessions facilities with the NPS Chief of Business Management, NPS Sanitarian, and managers from Xanterra for sanitation/food storage issues at the Lake Hotel, Old Faithful Inn, and Mammoth Hotel that resulted in specific exclusion/removal efforts being undertaken by concessions employees and long-term recommendations in a report submitted by the sanitarian.

As the park's IPM Coordinator, the management specialist maintains Commercial Pesticide Applicator certification, submits Pesticide Use Requests to the Washington Office for approval to use specific pesticides in the park, and completes Pesticide Use Logs that detail the amount of pesticides used each year.



Bears

The grizzly bear was added to the list of threatened species protected under the Endangered Species Act in 1975 as a result of high human-caused bear mortality. Since then, the GYE grizzly bear population has increased from an estimated 136 bears to more than 600 bears. The area occupied by grizzly bears has increased by more than 48% in the last two decades. Less is known about the number and area used by black bears.

In addition to being part of the GYE-wide effort to maintain the grizzly bear, Yellowstone's Bear Management Office works to prevent bear-human conflicts in the park through public education and the appropriate management of individual bears when necessary.

Grizzly Bear Recovery Status

On November 17, 2005, the USFWS published a proposal in the Federal Register to remove grizzly bears in the GYE from the list of threatened species. After reviewing public comments, the USFWS will likely publish its decision by the end of 2006. The states of Montana, Idaho, and Wyoming have all completed state management plans and a multi-agency team has completed a *Final Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area*, outlining how grizzlies will be managed if they are delisted. This plan will protect the core of the population in a designated primary conservation area (PCA), while state plans will provide man-

agement direction outside the PCA. Delisting will not significantly affect grizzly bear management in Yellowstone. Staff will continue to protect bear habitat and emphasize prevention of bear-caused property damages, bear-inflicted human injuries, and human-caused bear mortalities through public education, sanitation, storage of human foods and garbage in a bear-proof manner, and enforcement of bear management storage regulations.

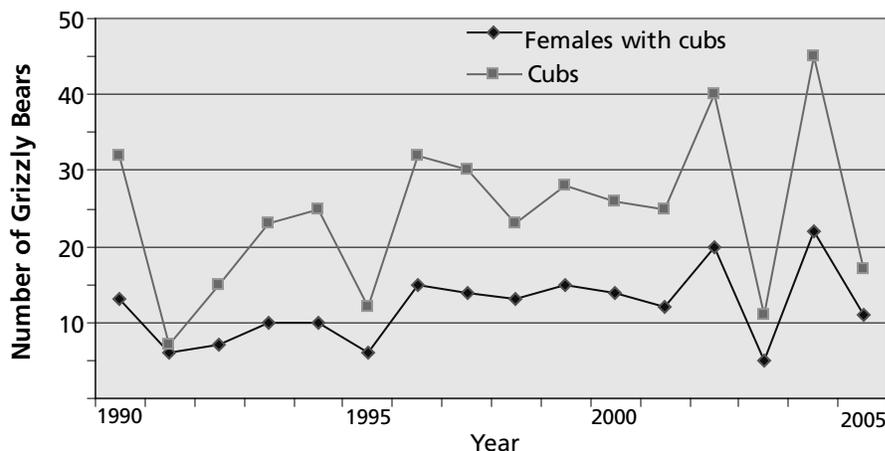
At least 11 grizzly females whose home ranges are wholly or partially within the park produced litters in 2005: 5 one-cub litters and 6 two-cub litters for a total of at least 17 cubs (Fig. 1). The grizzly bear's low reproductive rate and vulnerability to human-caused mortality make it important to keep mortalities at a sustainable level. In recent years the number of grizzly bear cubs produced in the park has exceeded the number of known human-caused grizzly bear mortalities in the park. No human-caused mortalities or natural grizzly bear mortalities were detected in the park in 2005.

Bear Foods Monitoring

Summary of Seasonal Bear Foods. Based on data collected along 29 routes in the park, the availability of ungulate carcasses in both thermally influenced ungulate winter ranges and on the northern ungulate winter range was below average in 2005. From den emergence until mid-May, staff observed bears scavenging wolf-killed ungulates and digging up pocket gophers and their food caches in localized areas where they were abundant.

During the season that bears are in estrus (May 16–July 15), the numbers of spawning cutthroat trout observed in tributary streams of Yellowstone Lake were very low in 2005; the predominant activities observed were predation on newborn elk calves, scavenging wolf-killed ungulates, digging biscuit root, and activities associated with reproduction (travel, leisure, and

Figure 1. Female grizzly bears with cubs and total cubs counted in Yellowstone National Park, 1990–2005.



play). Wet conditions during the spring and summer resulted in abundant vegetal foods for bears during estrus and early hyperphagia (July 16–August 31). Grazing clover, digging yampa roots, and scavenging the remains of wolf-killed ungulates were the predominant activities observed during this period. Whitebark pine seeds were abundant during late hyperphagia (September 1 until den entrance). The abundance of whitebark pine seeds kept bears at high elevations away from human activities during the fall, and likely contributed to the low numbers of bear–human conflicts that occurred in the park.

Winter-killed Ungulate Carcasses. Twenty-nine routes in ungulate winter range were surveyed to monitor the relative abundance of winter-killed ungulate carcasses available for bears to scavenge after den emergence in spring. A total of 11 bison and 9 elk carcasses were documented along the 258.2 km of survey routes for an average of 0.08 carcasses/km surveyed.

Thirteen routes totaling 137.5 km were surveyed on the Northern Winter Range. Four bison and nine elk carcasses were observed for an average of 0.10 ungulate carcasses per km of survey route. Grizzly bear sign was observed on 6 of the 13 routes. Black bear sign was observed on 2 of the 13 routes. Bear sign that could not be identified to species was observed on 7 of the 12 surveyed routes.

Eight routes totaling 81.4 km were surveyed in the Firehole River area. Seven bison carcasses were observed for an average of 0.09 carcasses per km. No elk carcasses were observed. Grizzly bear sign was observed along six of the eight routes. No black bear sign was observed on the Firehole area transects. Bear sign that could not be identified to species was observed along one of the routes surveyed in the Firehole area.

Four routes totaling 19.4 km were surveyed in the Norris Geyser Basin. No carcasses were found. Grizzly bear sign was observed on all four routes. No sign from

black bears or unidentified species of bear was found.

Three routes totaling 16.0 km were surveyed in the Heart Lake area. No carcasses were found. Grizzly bear activity was observed on all three survey routes. No black bear activity was observed. Sign from an unidentified species of bear was observed on two of the three survey routes.

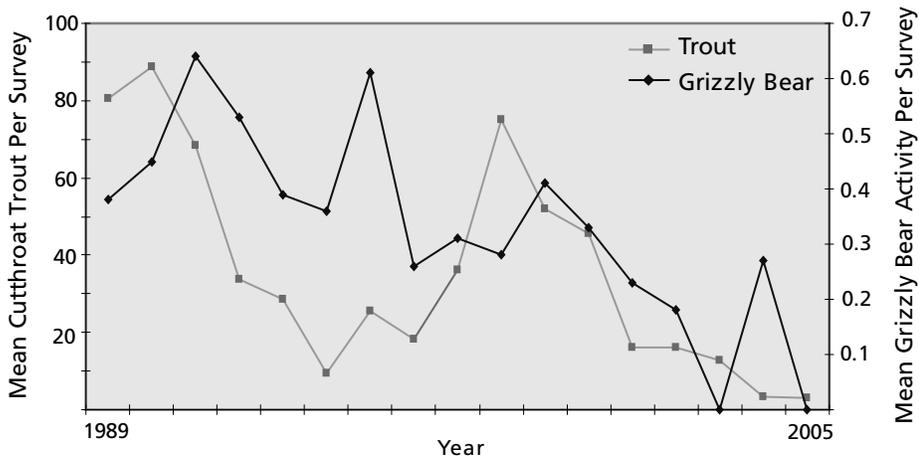
One route totaling 3.9 km was surveyed in the Mud Volcano area. No carcasses were found. Grizzly bear sign was observed on the survey route.

Spawning Cutthroat Trout. To monitor the timing and relative magnitude of cutthroat trout spawning runs and associated bear activity, park staff conduct surveys along eight streams within or near the Lake developed area and four streams within or near the Grant Village developed area. The survey data are used to set the opening dates for recreational facilities in these areas and to manage visitor use so as to prevent conflicts with bear use.

The spawning cutthroat trout count in the North Shore and West Thumb streams has decreased noticeably since 1989 (Fig. 2). This data is consistent with the decline in spawning cutthroat trout documented at fish traps operated on Clear and Bridge creeks (see the “Aquatic Resources” section).

Spawning surveys are also conducted on the Trout Lake inlet to determine the potential of this stream for fishing activity by bears. In 2005, the first movement of spawning cutthroat was observed on June 22 and the last on July 13. The average count per weekly visit was 46, well below the high of 131

Figure 2. Mean number of spawning cutthroat trout and activity by grizzly bears observed during weekly surveys of 12 streams tributary to Yellowstone Lake, 1989–2005.





Lisa Coleman and Kerry Gunther doing whitebark cone counts.

observed in 1999. No evidence of grizzly or black bear fishing or activity was observed along the inlet creek during the surveys.

Whitebark Pine Seeds. Whitebark pine seeds are an important fall food for bears due to their high fat content and their potential abundance as a pre-hibernation food source. As part of an ecosystem-wide whitebark pine survey conducted by the Interagency Grizzly Bear Study Team, cone counts are conducted at 19 whitebark pine transects within the GYE, 10 of them in YNP. Cone counts at the YNP transects averaged 14.6 (SD = 27.4) cones per tree in 2005, close to the 1987–2004 average of 14.4 (SD = 32.8). The abundance of whitebark pine seeds available to bears during late hyperphagia likely contributed to the low number of bear–human conflicts that occurred in the park during the fall.

A high level of mountain pine beetle-caused tree mortality has been observed in the YNP transects in recent years. Of the 100 transect trees that were alive in 2002, 42 were dead by 2005.

Confrontations and Conflicts With Humans

Bear–human conflicts are defined as incidents in which bears damage property, obtain anthropogenic foods, or injure people. Most property damage occurs when bears are trying to obtain human foods or garbage. Two of the 11 conflicts reported in 2005 resulted in human injury, both by a grizzly bear.

Confrontations are defined as incidents in which bears approach or follow people, bluff charge or otherwise act aggressively toward people, or enter front country developments or occupied backcountry campsites without inflicting injury. Of the 99 confrontations reported in 2005, 66 involved bears in developed areas and 19 involved a bluff charge or other aggressive behavior by a bear.

Bear Management Actions

In 2005, management action was taken in 658 bear-related incidents, including

- 581 in which park personnel responded to roadside bear-jams to provide traffic control, answer visitors' questions, and ensure that visitors did not approach or throw food to bears;
- 40 in which bears were hazed away from developed areas or roadsides for the safety of visitors;
- 22 in which trails, campsites, or other areas were closed to the public because of bear activity;
- 12 in which bear warnings were posted because of bear activity;
- 1 in which two grizzly bears on Stevenson Island were relocated to the mainland to increase their chances of survival.

The decrease in the number of bear-jams from 2004 to 2005 (Fig. 3) was likely related to the increased abundance of whitebark pine seeds, which drew bears to high elevation whitebark pine sites not visible from park roads.

Grizzly Bear Captures. On June 4, staff received a report that an adult grizzly bear with two yearlings had been observed on Stevenson Island, which covers approximately 105 acres. The next day staff investigated the shore around the island and found tracks of an adult grizzly bear and at least two yearlings. The numerous bear tracks and scats indicated that the bears had been feeding on the island's vegetation and had likely been there since before the ice broke up on Yellowstone Lake on May 23, 2005.

The island was closed to the public and on June

6, staff placed a bait station on the island. The tracks of two yearlings but no adults were found there the next day, suggesting that the adult bear, presumably the yearlings' mother, may have swum to the mainland. (The nearest shore is 1.4 miles away at the Gull Point/Sand Point area.) Although the island provided the bears with plenty of succulent vegetation, the types and quantity of late summer and fall bear foods were rather scarce, and the bears seemed likely to starve if they remained on the island. In 1984, a female grizzly bear with three cubs-of-the-year was found starving on Frank Island. One of the cubs died of malnutrition, the adult female and remaining two cubs were captured and relocated to the mainland. In 2001, a yearling grizzly was found on Dot Island and evidence indicated that the yearling's mother had swum to the mainland. The yearling was captured and relocated to the mainland. In 2005, the NPS again chose not to "let nature take its course" because of the grizzly bear's status as a threatened species. The yearlings' chances for survival were thought to be higher if the bears were captured and returned to the mainland.

With help from Lake Maintenance staff and the NPS Landing Craft, three aluminum culvert traps were placed on the island on June 8. The traps were baited and opened but not set, so that the bears could become accustomed to feeding in the traps and to increase the likelihood that all bears would be caught at once. If the yearlings' mother was still present, catching them without her would create a significant risk for personnel checking the traps.

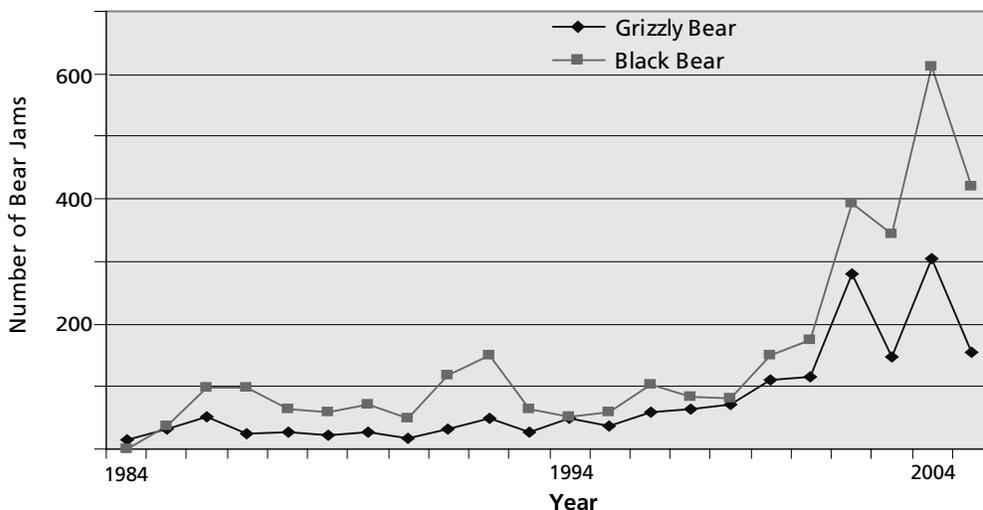
To obtain evidence as to how many bears were on the island, staff placed digital remote sensor cameras in several locations. On June 25, these cameras confirmed the presence of two yearlings. The re-baited and set traps captured the yearlings that evening. The trap with the bears in it was moved to a secure, well-shaded location

on the island and left for another night, surrounded by cameras. The periodic bawling of the yearlings was certain to attract their mother if she was on the island, but she did not appear. Interagency Grizzly Bear Study Team members helped immobilize the yearlings, weigh them, and fit them with ear tag transmitters to monitor their survival. The bears, both females, were underweight (71 lbs. and 76 lbs.) for their age, but otherwise healthy. After recovering from the immobilizing drug, the bears were transported to the south arm of Yellowstone Lake for release. They were last seen grazing together just above the beach. They were monitored by telemetry flights for the rest of the summer and are believed to have survived the summer and fall.

Bear-Human Conflict Prevention. To reduce the likelihood that obtaining anthropogenic food would result in bears damaging property or injuring people, in 2005 staff installed 30-cubic-foot bear-proof storage boxes at the Pebble Creek, Indian Creek, and Norris campgrounds, and at the Elk Tongue patrol cabin to store horse grain. In May 2005, a grizzly bear broke into the steel reinforced wooden grain shed that had previously been used at the cabin.

The long-term survival of bears in the GYE also depends on park visitors and surrounding communities understanding bear management practices. As part of this education effort, staff presented 33 bear-related talks, fieldtrips, and slide shows to various groups in 2005.

Figure 3. Number of grizzly bear and black bear-jams reported in Yellowstone National Park, 1984–2005.



Beaver

The number of active beaver colonies found in bi-annual survey areas increased from 49 in 1996 to 85 in 2003. The 2005 aerial survey was incomplete because poor weather required ending it before 12 riparian areas had been censused, but 65 colonies were tallied in the 16 areas that were surveyed, and most showed increases over the 2003 survey.

Beaver colonies increased significantly during the last two years in the northwest section of the park (from 26 to 41) and along Slough Creek (from 6 to 9), probably because of favorable water conditions (continued drought along mountain streams creates colonization opportunities) and continued re-growth of willows (especially along Slough Creek). The beavers' expansion was also probably intensified by the reintroduction of beavers into the Gallatin National Forest not long before wolves were reintroduced. Some of those beavers migrated downstream into Yellowstone. Where willow has been historically stable, so too have the beaver colonies.

Beaver colonies in the Bechler area declined from 14 to 8. This is difficult to explain, but it is not prime beaver habitat: willow and aspen are not abundant, and forests are primarily unburned and in a climax state. A colony at Harlequin Lake persists despite the absence of deciduous vegetation and a food cache entirely comprised of lodgepole pine, a poor beaver food. This colony likely relies on aquatic vegetation to some degree.

The Yellowstone River area south of Yellowstone Lake as well as the Snake River, Heart Lake, and associated tributary streams were not surveyed, nor were some streams on the northern range due to early ice and snow. A new colony along the Yellowstone River on the northern range was discovered near a recently established but small patch of willow.



Even though the Lamar and Glen Creek areas were not aerially censused, ground observations have indicated the persistence of two colonies that were established there in the last five years, representing beaver range expansion similar to that along Slough Creek and the northwest area of the park.

Birds

A total of 320 bird species have been documented in Yellowstone National Park since its founding. Although no species were added to the list in 2005, the most unusual sighting reported by the park ornithologist was a juvenile ruddy turnstone in Mary Bay on September 15.

Snowstorm Turns Flyovers into Stopovers

Early in the morning on April 27, large amounts of snow fell on the Yellowstone Plateau, particularly in the Canyon area. Many grebes, coots, and waterfowl that were migrating at night tried to escape to openings in the dark that turned out to be the lights of the Canyon development. By daybreak, birds had crashed into buildings, landed on roofs and wet pavement, and become stranded in a snow-covered meadow. Many were unable to take off again and fed upon by common ravens, pine martens, coyotes, bald eagles, and red-tailed hawks. More than 100 dead birds, mostly eared grebes, were counted, but many more birds survived their brief stay in Yellowstone. The park ornithologist observed 100 times more birds than have been recorded at that time of year in the past two decades. It is estimated that the storm blew 6,000 grebes, 1,000 avocets, and 40,000 ducks into Hayden Valley alone.

Great Horned Owl Takes Lake Trout

Although one reason the non-native lake trout do not belong in Yellowstone is that they are not as accessible a food source for many species as is the Yellowstone cutthroat trout, a great horned owl was observed capturing a lake trout on a September night while park staff were electroshocking the fish around Carrington Island in the West Thumb.

Species of Special Interest

Bald Eagle. The U.S. Fish and Wildlife Service downlisted the bald eagle from endangered to threatened in 1995 as a result of significant popula-

tions gains made over the last three decades. The species is considered to have ecologically recovered in the GYA and the Greater Yellowstone Bald Eagle Working Group believes it should be delisted here. Despite a decline in the number of fledglings at Yellowstone Lake, one of the species' strongholds for nesting in the park, 2005 saw the largest total number of fledglings on record: 26 eaglets from 34 active nests during 2005.

For the fourth consecutive year, a pair of bald eagles took up residence in a large tree nest located 55 meters from the Madison-to-West Yellowstone road from mid-February through early July. To enable the eagles to obtain nest material and food without human disturbance, park staff set up a temporary closure in the immediate vicinity of the nest. Visitors could stop and observe the eagles from a distance, then travel by the nest without stopping. The chicks were hatched and fledged, and the adult pair continued to add material to the nest throughout the year.

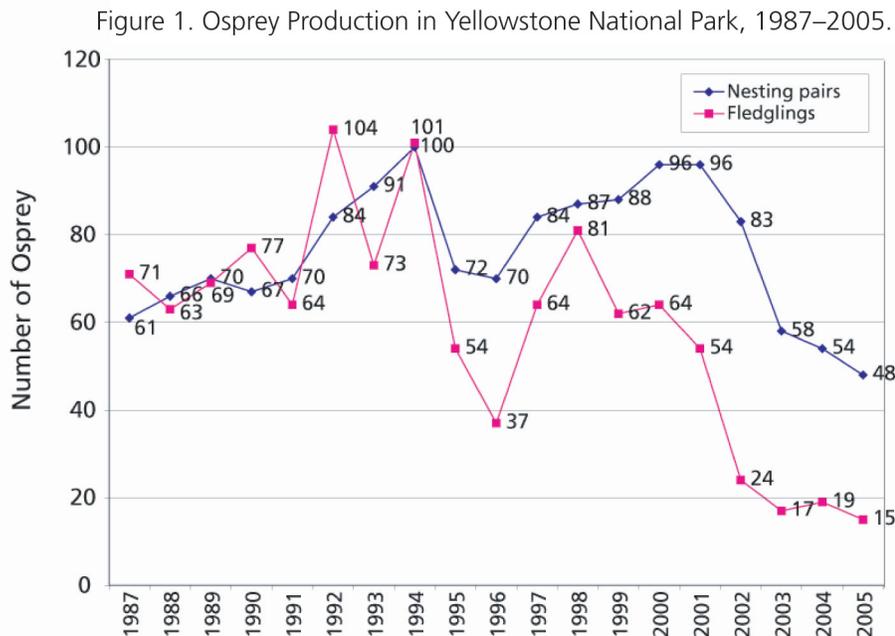
Peregrine Falcon. The peregrine falcon was removed from the federal list of endangered species in 1999 and is now managed as a species of special concern. Yellowstone National Park continues to be a stronghold for peregrines in the Northern Rockies. Four new eyries were found in 2005, bringing the total number of known eyries in the park to 30, and 44 fledglings were counted.

Trumpeter Swan. The park's resident trumpeter swan population, which has shown an overall decline since 1961, numbered only 19 in 2005, including one cygnet that fledged. Swan numbers in Montana's Centennial Valley, previously a major source of recruitment for the park, have declined substantially, but adult recruits from Montana's Paradise Valley have helped maintain the Yellowstone swan population. Adult recruitment was observed on the west side of the park for the second consecutive year.

Documented trumpeter swan nest attempts have ranged from 2 to 10 per year, including three in 2003, four in 2004, and three in 2005, which resulted in one brood of four cygnets. One of the newly hatched cygnets was seen being preyed upon by an adult bald eagle. Egg clutches from two swan territories were destroyed by grizzly bears, and two swans were apparently killed by wolves in separate incidents in May and July. In December, there was one report of a bobcat feeding on an adult swan whose cause of death was unknown, and a subsequent report of a bobcat seen killing a swan.

Molly Islands Colonial Nesting Birds. Aerial and boat surveys were used to census birds at the two Molly Islands in mid-May, early June, early August, and mid-September 2005. This was an average year for colonial nesting bird production, and fledglings left the nests of American white pelicans, double-crested cormorants, and California gulls. Three nests were initiated by Caspian terns, but none produced cygnets.

Osprey. The park's osprey population has been on a downward trend, with 17 fledglings from 58 nests in 2003, 19 from 54 nests in 2004, and 15 from 48 nests in 2005, which was the worst production since detailed data collection began 19 years ago (Fig. 1). A series of strong winds and wet summer weather caused some nests and/or nest trees to fall, resulting in high failure rates again this year.



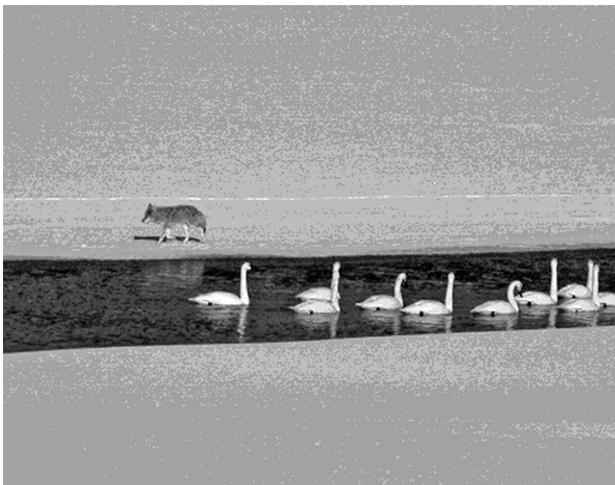
As recently as 2001, 59 nesting pairs and 26 fledglings were documented on Yellowstone Lake; in 2005, only 26 pairs and 2 fledglings were counted. The Frank Island wildfire of 2003 and a severe windstorm in 2005 that blew down most of the potential remaining osprey nest sites are believed to be responsible for the decline. Bald eagles have occasionally been documented taking over previously occupied osprey nests, and the incidence of takeover appears to be gradually increasing due to competition for nest sites. Another factor could be the decline in cutthroat trout, caused in part by predation by non-native lake trout.

Harlequin Duck. The park's harlequin duck population fluctuates from year to year, with generally 16–24 pairs residing in the park. More precise information is not known because the remoteness of many of the areas in which the ducks are found makes monitoring time-consuming and difficult.

Common Loon. The park's common loon population also fluctuates from year to year; adult numbers have ranged from 34 to 51 during the last 17 years. A total of 42 adults, 8 nest attempts, and four fledglings were documented in 2005. As in 2004, many of the nesting loons had to deal with variable water levels and shorelines as a result of weather conditions.

Other Population Monitoring

North American Bird Migration Count. Yellowstone National Park participated in the North American Bird Migration Count for the 30th con-



Coyote and trumpeter swans. Photo by Terry McEneaney.

secutive year in 2005. Traditionally scheduled on the second Saturday in May, this year the count was done on May 14. Three observers recorded a total of 96 bird species and 3,109 individual birds between Yellowstone Lake and Shields Valley, Montana, 70 miles north of the park. These results were above average due to the wet spring conditions.

Mid-Winter Eagle Survey. The bald eagle/golden eagle survey, which was conducted on January 7 for the 19th consecutive year, documented 27 bald eagles, and 9 golden eagles. Most of the eagles were sighted in the Jardine/Gardiner/Mammoth area. Wintering eagles continued to be most abundant on the northern range outside the park because of the waterfowl, trapper discards, and carrion from elk hunting present there. Carrion left by hunters and wildlife predators is also a winter food source.

Breeding Bird Surveys. Breeding Bird Surveys (BBS), which have been conducted in Yellowstone since 1982, are point counts at 50 stations located at half-mile intervals along a 25-mile transect through varied habitats. Data from the three BBS conducted in 2005 were sent to the database at the Patuxent Wildlife Research Center in Laurel, Maryland, and are available at www.mbr-pwrc.usgs.gov/bbs.

While not definitive, BBS data are the best long-term data available on northern range songbirds. These data points suggest that overall, songbird populations on the northern range are flat-to-some-what declining. The two BBS points in willow habitat show mixed results, very slight declines, and very slight increases, depending on the site.

Glacier Boulder Route Songbird Survey. The Glacier Boulder survey, which began in 1986, documents birdlife in lodgepole pine habitats in Yellowstone. The point count census is conducted at 30 stations along a transect that begins at the Glacier Boulder trailhead near Inspiration Point. Census routes are being developed away from established roads because traffic noise during the summer is beginning to affect BBS routes.

Christmas Bird Count. On December 18, 2005, the Yellowstone Christmas Bird Count was conducted for the 33rd time in the Gardiner, Montana, and Mammoth, Wyoming, areas. Weather conditions were among the coldest on record for the count, with temperatures ranging from –10 to 15°F, and strong winds, but experience has shown that colder temperatures and above-average snow depth

are the optimum conditions for finding the greatest bird richness and abundance during this count. Slightly above average results were obtained: 40 bird species and 1,749 individual birds were tallied. One abundance record was broken: 34 black-capped chickadees were recorded.

Bison

Yellowstone is the only place in the United States where bison have lived continuously since before Euro-American settlement. When the decision was made to manage bison intensively in Yellowstone at the beginning of the nineteenth century in order to ensure growth of the small herd, it was the first federal program to preserve a wildlife species threatened with extinction. Today, the park's Bison Ecology and Management Office uses very different techniques and draws on a much larger body of scientific expertise in addressing very different challenges: a large bison population, some of which are inclined to seek winter range outside the park and some of which are infected with brucellosis.

In 2000, the National Park Service agreed to an Interagency Bison Management Plan (IBMP) with the Montana Department of Livestock; Montana Fish, Wildlife and Parks; the USDA Animal and Plant Health Inspection Service (APHIS); and the USFS. The Bison Ecology and Management Office continues to work with these agencies and other park divisions to carry out Yellowstone's responsibilities under this plan, a primary goal of which is conservation of the free-ranging bison population. Spatial and temporal separation of bison and cattle minimize any risk that bison may transmit brucellosis to livestock by shedding *Brucella abortus* bacteria outside the park that will survive until cattle return to range they use during the summer.

Population Monitoring

To arrive at population estimates, staff use aerial surveys to count the bison twice a year, mid-summer and mid-winter. The population has increased each year since the severe winter of 1996–97, when more than a third of the herd died as a result of boundary control operations or natural winterkill. Since implementation of the IBMP in 2000, the population has grown about 10.3% per year on average.

After the 2005 summer count, the population was estimated at about 4,900 bison. During the winter, staff also do ground surveys in the west and north boundary management zones to assess how many bison are close to the boundary and determine when and where hazing may be required.

Long-term monitoring of bison demographics and population dynamics provides park managers with data that enables them to make more informed decisions and address the uncertainties of how brucellosis affects the bison population. Monitoring 29 bison cows during 2004 and 2005 revealed that 83% of the cows who were more than two years old became pregnant during the summer rut, and 75% of the pregnant cows gave birth to calves that lived for more than two days. While some two-year-old cows become pregnant in Yellowstone, very few are rearing calves the following summer.

Boundary Control

Under the IBMP, the National Park Service has primary responsibility for boundary control operations on the north side of the park near Gardiner, while decisions about bison that cross the west boundary near West Yellowstone are made by the Montana Department of Livestock. Hazing events were common at the west boundary starting in late fall of 2004, and began on the north boundary in early winter. Until February, hazing in both management zones involved only adult bulls, except for one adult cow that was shot after repeated attempts to haze her back across the north boundary proved futile. However, that was the only bison removed at the north boundary during the winter of 2004–2005. Outside the west boundary, where bison movements out of the park increased in March, the state of Montana captured and tested 171 bison, sent 98 seropositive bison to slaughter, released 78 that tested seronegative, including nine young bison that were vaccinated, and sent 17 seronegative bison to an experimental quarantine program north of the park that the state of Montana has initiated with APHIS.

For the first time in 15 years, in 2005 the state of Montana authorized the hunting of bison in certain areas outside the park boundary. A total of 50 permits were issued for two periods that spanned from November 15 to February 15.

Bison Management Plan Review

During 2005, staff participated on an interagency team that conducted a five-year status review of bison management operations since the IBMP was implemented. The resulting report, issued in September, confirmed that the agencies are working effectively together to prevent commingling of bison and cattle and noted that the state of Montana has retained its brucellosis-free status. The status review also noted that the northern boundary operations, which were expected to be focused on the northern range bison sub-population, are encountering many bison from the interior sub-population that move to the Gardiner Basin winter range.

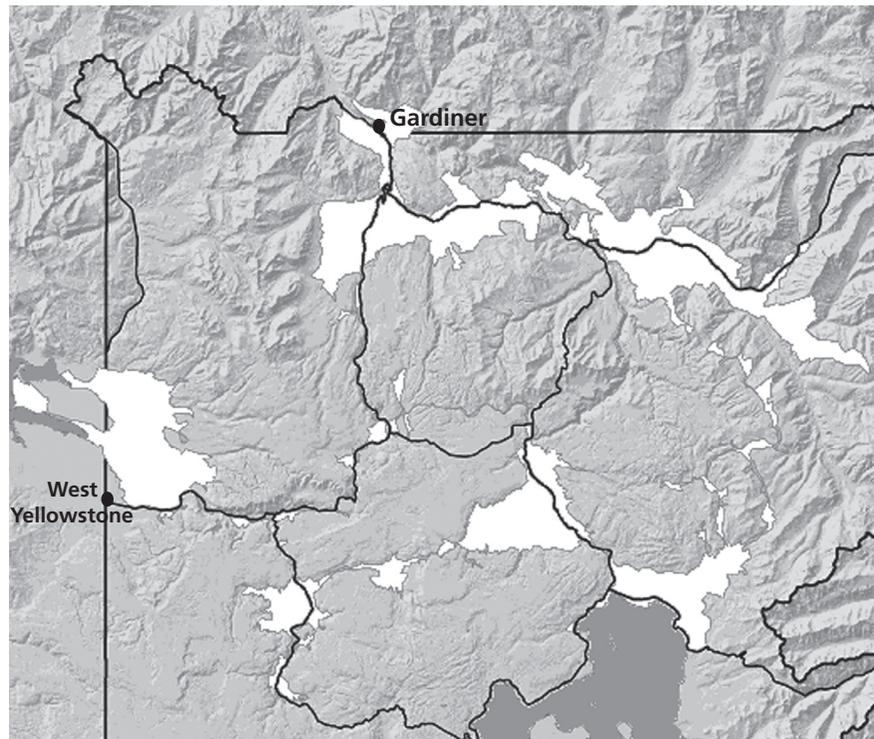
The RB51 vaccine has met safety criteria for vaccination of eligible bison, has been determined to be reasonably effective at conveying some immunity against brucellosis, and vaccination of bison captured at the boundary has begun. However, the review determined that the agencies will not be ready to move to the next phase of the IBMP, which will permit greater tolerance for bison on low eleva-

tion winter range outside the park, until a safe and effective remote delivery mechanism is available and a bison management plan has been developed in cooperation with the Royal Teton Ranch, which owns land adjacent to the park's north boundary.

Remote Vaccination Program

Bison Vaccination EIS. By reducing the number of brucellosis-induced abortions that shed the bacteria into the environment, the vaccination of bison could, over time, further minimize any risk of brucellosis transmission to cattle. In addition to vaccination of certain seronegative bison captured at the park boundary, the IBMP committed the NPS to developing a program to vaccinate bison in the park without handling the animals. Calves and yearlings are to be the focus of the initial effort, contingent on National Environmental Policy Act evaluation of the delivery system. Subsequent research and development on remote delivery systems and vaccine safety and effectiveness now make such a program appear feasible. During 2005, staff continued work on an

Figure 1. White areas indicate habitat occupied by bison over the course of a year based on aerial surveys and radio telemetry of marked bison, 1998–2004.



environmental impact statement that evaluates the feasibility of implementing a program to remotely deliver brucellosis vaccine to free-roaming bison throughout the park. The final EIS is expected to be released around the end of 2006.

Vaccine Delivery. While vaccines for use in protecting wildlife against brucellosis are limited in number and the currently feasible methods for delivering vaccines are limited to syringes and ballistic powered remote delivery equipment, understanding group dynamics and movement patterns helps staff develop potential methods for implementing a park-wide vaccination program. A project staff have initiated to randomly mark some bison and periodically relocate them is providing insight into the ecological parameters that may make such a program successful.

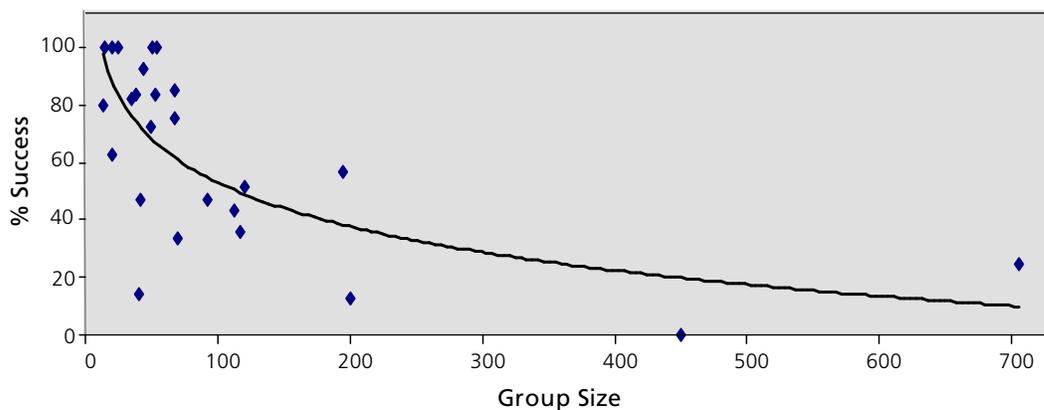
Based on relocation of marked bison and information about distribution collected during aerial population counts, staff have estimated that over the course of a year the park's bison range across 220,000 acres of habitat (including about 10% of the park) located in six distinct ranges (Fig. 1) that are connected by travel corridors. Marked bison that have been located in Hayden Valley during the summer rut use winter ranges in Hayden Valley as well as Pelican Valley, Firehole Geyser Basin, the west boundary, the Gardiner Basin and the upper northern range. Group composition changes throughout the course of the annual cycle. Bison are the most concentrated when they coalesce into very large groups in the summer. By September they begin to redistribute on the landscape and spread out

over a much larger area. Group size continues to decrease during the winter, from an average of 62 in December to 24 in April.

Our field studies have shown that trained crew members on foot, horseback, or vehicle could safely and successfully approach a bison group in order to deliver a vaccine biobullet to target animals (calves and yearlings). For purposes of field testing, a “successful” approach is one in which staff can stand within 30 meters of a stationary or traveling bison and make a popping noise to simulate a shot from an air-powered rifle without having the group move to an extent that would thwart the next shot. However, the ability to work around a group of bison and approach each calf and yearling depends on the size of the group; the larger the group, the smaller the percentage of target animals in the group that can be successfully approached (Fig. 2). The lower success rate in large groups is partly because they occur most often during the breeding season, which is an inopportune time to try to work closely around bison for any reason.

The uncertainties of vaccination go beyond the feasibility and logistics of delivering vaccine to individual bison throughout the park. Staff have partnered with the University of Kentucky to develop a model that can quantitatively assess the environmental consequences of three alternatives for implementing an in-park vaccination program. The modeling process has identified that the number of additional brucellosis naïve bison that are exposed to any bacteria shed by infected animals is a primary driver that allows the disease to persist in the

Figure 2. Relationship between bison group size and percent of successful approaches to within 30 meters of all calves and yearlings in the group.



population. One unknown is the probability of latent infected bison (those that developed an immunity after a previous infection) exhibiting a stress mediated re-infection response years later. These knowledge gaps point to the need for better understanding of the pregnancy cycle and the probability of shedding bacteria, regardless of whether individuals are newly infected or carry a latent infection.

Bison Movements and Distribution Study

In June 2004, the NPS arranged for Dr. Cormack Gates of the Faculty of Environmental Design at the University of Calgary to lead an independent study that would advance understanding of how groomed roads may influence winter bison movements. To prepare the resulting report that was delivered to Yellowstone managers a year later, "The Ecology of Bison Movements and Distribution in and beyond Yellowstone National Park," Gates and his colleagues met with more than 30 scientists, biologists, and current and retired park staff, as well as interested non-government organizations. The study confirmed that bison are fulfilling their functional role within the ecosystem and that their movements are explained by density of bison on suitable habitats within their range. When a threshold of about four bison per square kilometer is exceeded, the population response is to occupy a larger area. The study also concluded that road grooming is not the major factor influencing bison distribution and range expansion, and that the available evidence strongly suggests that groomed roads aligned with natural movement corridors have not changed bison population growth rates relative to what would have happened in the absence of road grooming. The study did identify a road segment through Gibbon Canyon that may facilitate bison movement from the park interior to the northern range; the possibility of conducting an experimental road closure there will be considered in winter use planning.

Brucellosis Symposium

Staff worked with other members of the Greater Yellowstone Interagency Brucellosis Committee



and the United States Animal Health Association to organize a Brucellosis Vaccine and Diagnosis Workshop facilitated by the Ruckelshaus Institute of Environment and Natural Resources at the University of Wyoming in Laramie, August 16–18. With funding provided by the U.S. Departments of the Interior and Agriculture, experts from government, academic, and private institutions around the world were invited to discuss strategies for improving diagnostic capabilities, brucellosis vaccines, and delivery methods for wild bison and elk.

Public Outreach

In addition to presenting programs about bison ecology and management to a variety of audiences, staff replied to requests for information from congressmen, congressional staffers, other agency staff members, and organizations such as the American Prairie Foundation, Grasslands and Waterton national parks in Canada, and staff responded to FOIA requests from The Fund for Animals and the Buffalo Field Campaign. Staff held a workshop for Lake district staff responsible for managing visitor interactions with bison during road construction work in the Hayden Valley. Staff also provided technical assistance and logistical support for a collaboration with University of California hydrology staff who were collecting snow dynamics data (depth and water content) to validate a management and interpretive model, and helped capture relevant information for their use in preparing two films for the Division of Interpretation.



Elk and Other Ungulates

Yellowstone National Park supports one of the most diverse complexes of migratory ungulates in North America, including bighorn sheep (*Ovis canadensis*), bison (*Bison bison*), elk (*Cervus elaphus*), moose (*Alces alces*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and white-tailed deer (*Odocoileus virginianus*). The park has also been colonized by descendents of mountain goats (*Oreamnos americanus*) that were introduced in Montana in the 1940s and 1950s.

Elk

Elk Calf Mortality Study. Staff completed a three-year study to: 1) estimate the relative causes and timing of deaths in northern Yellowstone elk calves; 2) estimate calf survival rates; and 3) evaluate factors that may predispose calves to death. Calves <6 days old were captured and fit with ear tag transmitters during May and June, 2003–2005. The calves' radio signals were monitored each day at dawn from mid-May through mid-July, when the risk of mortality to calves is relatively high, and less frequently thereafter. Ground crews investigated mortality sites and conducted necropsies to evaluate causes of death.

Of the 151 calves in the study, approximately 67% died within the first year of life. More than 90% of these deaths were the result of predation. More than 70% of this predation occurred within the first 15 days of life. During the first 30 days of life, approximately 55–60% of all mortality was the result of predation by bears; coyotes and wolves each accounted for approximately 10–15%. The causes of death did not vary significantly among the summers during the study period. Some form of compensatory

mortality is likely occurring because overall summer predation has increased, while winter malnutrition may have decreased since wolf restoration. A similar study conducted in the park by Frank Singer for the period 1987–1990 found that 53% of 127 calves died during the first year of life (32% during the summer and 21% during the winter), and although nearly all summer mortality was the result of predation, winter mortality was primarily related to malnutrition. The current study was a collaborative effort of YNP, the USGS-Biological Resources Discipline, the University of Minnesota, the Yellowstone Park Foundation, Annie and Bob Graham, and Montana Fish, Wildlife and Parks.

Winter Count of Northern Yellowstone Elk. On January 5, 2005, the Northern Yellowstone Cooperative Wildlife Working Group conducted its annual winter survey of the northern Yellowstone elk population, which winters between the park's Northeast Entrance and Dome Mountain/Dailey Lake in Montana's Paradise Valley. Biologists used four fixed-wing aircraft to count elk on the entire northern range that day.

Compared to survey days in the last several mild winters, a significant snowstorm on December 31 created good survey conditions by covering the landscape, which caused elk to concentrate in relatively open areas at lower elevations where they were more likely to be detected. Approximately two-thirds of the elk observed during the 2005 survey were located within Yellowstone National Park; the rest were north of the park. The fact that this year's count of 9,545 elk was 15% higher than the 8,335 counted the previous winter, and slightly higher than the 9,215 counted two years before is considered to be more likely a result of better survey conditions than an actual increase in elk numbers. The overall trend still suggests that elk numbers have decreased substantially over the past decade as a result of predation by wolves and other large carnivores and human harvests during the Gardiner late elk hunt. Other factors that have contributed to decreased elk numbers include a substantial winterkill caused by severe snow pack during 1997.

Elk After Wolf Restoration. To evaluate predictions that ungulate numbers would move to a lower equilibrium point with corresponding density-related changes, staff have analyzed elk counts, vital rates, and limiting factors for ungulates wintering

on the northern portion of the park before and after wolf (*Canis lupus*) reintroduction in 1995–96. Elk counts decreased from approximately 17,000 in 1995 to 9,545 in 2005. From 2000–2005, pregnancy rates for prime-age females (3–15 years) during 2000–2005 were high (0.90) and similar to those during 1950–1967 when elk density was 30% lower (5–9 elk/km²), yet indices of recruitment were among the lowest (12–14 calves/100 cows) recorded during the past several decades. The survival rate for prime-age females was 0.83 (95% CI = 0.77–0.89) compared to 0.99 when harvests were low and wolves absent.

Elk migration to lower elevation areas outside the park, and consequently, vulnerability to hunting, is strongly correlated with snow pack. The Gardiner late elk hunt was designed to limit elk numbers outside the park so that the elk do not decrease the quality of their winter range or cause long-term changes in forage productivity or diversity. During 1990–2002, a relatively constant proportion (27 ± 5%) of the elk that migrated out of the park were removed each year, primarily prime-age females with high reproductive value. As the size of the elk herd declined, a large number continued to migrate out of the park and the percentage of the herd that was harvested each year increased.

By 2003, annual wolf off-take (more than 1,000 elk even by conservative estimates) was exceeding hunter harvests, with wolves primarily selecting calves and older elk with lower reproductive value. As the ratio of wolves to elk increased, elk recruitment decreased and wolves maintained high kill rates and rapid population growth despite a 50% decrease in elk counts. In response, the state of Montana adjusted antlerless permit quotas to population size in a density-dependent manner so that harvests do not accelerate the decrease in elk numbers, and a much lower proportion of females were harvested during 2003–2005.

Other Ungulate Monitoring

Analyses suggest that the demography of bighorn sheep, mule deer, and pronghorn in northern Yellowstone has not been substantially influenced by wolf reintroduction. Pronghorn counts have remained between 204–252. With relatively high recruitment in recent years, the growth rate of the mule deer population appears to be increasing; the 2005 count was 2,366 compared to an average count

of 2,032 during 1986–2005 (range = 1,616–2,544).

Bighorn sheep counts in northern Yellowstone have been relatively stable to slightly increasing since 1995, with an average count of 189 (range = 134–244). These counts remain well below the record high count of 487 sheep prior to the outbreak of infectious keratoconjunctivitis (i.e., “pinkeye”) during the winter 1981–1982, which led directly or indirectly to the death of at least 60% of the population.

The current abundance of moose in and near the park is unknown because of the difficulty of conducting surveys and obtaining rigorous population estimates for this species at low densities. The abundance of moose decreased after the fires of 1988 burned important winter habitat (i.e., mature spruce/fir forests) in the north portion of the park.

Non-native mountain goats have clearly established a breeding population in the park and are at relatively high abundance in the northeastern and northwestern portions, raising concerns about adverse effects to native bighorn sheep, rare plants, and alpine habitats.

Pronghorn Migration and Seasonal Distribution. Yellowstone pronghorn retain one of only two pronghorn migrations left in the GYA. Staff used 5,750 telemetry locations of 44 adult female pronghorn obtained from June 1999 to August 2005 to determine migration patterns and seasonal distributions. Seventy percent of the pronghorn population migrated 15–50 km to four contiguous summering areas, while the remainder stayed year-round on the winter range. Migrations occurred during April 19 ± 9 (SD) days and October 18 ± 7 days, with individual migrations typically lasting 3–5 days. Most radio-collared pronghorn showed fidelity across years to their migration strategy and summer use area, but approximately 20% migrated in some years but not others. To travel the 10 km over Mount Everts, a topographic bottleneck separating the winter and summer ranges, the migrating pronghorn used three to four grassland and sagebrush pathways that are less than 300 m wide in places. Mt. Everts also served as a migration corridor for thousands of bison, elk, and mule deer, and as a destination wintering area for migratory bighorn sheep. Preserving this corridor is critical for the persistence of Yellowstone pronghorn and would aid in conserving one of the most diverse complexes of migratory ungulates in

North America.

Conservation of the Pronghorn Population. Staff initiated a three-year study to 1) establish a monitoring program of abundance and key vital rates for pronghorn; 2) conduct a study of the ecological interactions among wolves, coyotes (*Canis latrans*), and pronghorn to determine if there is differential recruitment among pronghorn fawning areas in relation to wolf and coyote densities and use areas; 3) determine the migration patterns and summer use areas of pronghorn to ensure they are not adversely affected by future infrastructure projects; 4) map habitat characteristics among fawning areas and migration routes of pronghorn; and 5) produce an electronic field trip focused on the conservation of Yellowstone pronghorn. In 2005 the electronic field trip premiered on the Windows into Wonderland website, and staff also helped convene experts to develop restoration recommendations for sites on pronghorn winter range that were once tilled for agriculture and now support invasive alien species. The study is a collaborative effort among YNP, the Yellowstone Ecological Research Center, the University of Idaho, the Bernice Barbour Foundation, and the Yellowstone Park Foundation.

Wildlife Responses to Motorized Winter Recreation. In an analysis of more than 6,500 interactions between bison and elk groups and oversnow vehicles that occurred during five winters (1999–2000, 2002–2004), staff found that elk responded with increased vigilance in 44% of the interactions and bison in 10% of the interactions. However, the frequency of higher-intensity movement responses was similar for elk and bison: 6–7% travel, 1–2% flight, less than 1% defense. These rates of movement response were relatively low compared to that found in other studies of ungulates and snowmobile disturbance. Active responses by bison were less likely during the winters that had the largest visitation, suggesting some habituation to oversnow vehicles may have occurred. There was no evidence that snowmobile or coach use during the past 35 years has affected the demography of bison or elk.

From December 2004 through March 2005, staff again monitored the behavioral responses of bison, elk, and trumpeter swans (*Olor buccinator*) to snowmobiles and coaches by surveying groomed road

segments. Staff sampled more than 2,100 interactions between vehicles and wildlife groups and used multinomial logits models to identify conditions leading to behavioral responses. In 90% of the interactions, these wildlife species reacted to oversnow vehicles and associated human activities with no apparent movement or response beyond increased vigilance, in 7% they moved away from the vehicles, and in 3% they showed a flight or defense response. As in previous years, the likelihood of active responses increased significantly when the animals were on or near roads, groups of animals were smaller, or humans approached the animals. The survey results suggest that wildlife responses can be diminished by 1) restricting travel to predictable routes and times, 2) reducing the number of vehicles in groups, 3) reducing the number and length of stops to observe wildlife, 4) stopping vehicles at distances >100 m, and 5) deterring humans from engaging in disturbing activities when not in vehicles.

Public Outreach and Assistance to Other Divisions and Agencies

The Ungulate Program assisted several divisions in Yellowstone as well as other parks and refuges in complying with the Endangered Species Act and National Environmental Policy Act. Staff also assisted the Superintendent's Office with winter use planning analyses pertaining to wildlife and provided vital signs evaluations for the Greater Yellowstone Inventory and Monitoring Network. In addition, staff responded to requests from park staff for assistance in dealing with aggressive, habituated, or injured ungulates. Staff shared program results with other agencies in the Greater Yellowstone Area, including Montana Fish, Wildlife and Parks; USFWS; USGS; USFS; and Wyoming Game and Fish Department. Also, staff provided dozens of informational talks to visitors, natural resource managers, educational specialists, and students, both at the park and elsewhere. Staff participated on the graduate committees of several students and collected information or samples requested by non-governmental researchers. In addition, staff conducted a symposium on "Integrated Science in Central Yellowstone" at the Wildlife Society conference in Madison, Wisconsin.



A large-scale wolverine study was initiated in 2005.

Mid-sized Carnivores

Yellowstone supports its original diversity of mid-sized carnivores such as Canada lynx, bobcat, wolverine (*Gulo gulo*), American marten, river otter, badger, and red fox. Although little is known about the presence of these species in the park, they play an important ecological role as predators of small and mid-sized mammals and as scavengers. Due to their rareness and affinity for boreal forests or alpine habitats, the Canada lynx and wolverine are rarely seen, but they carry strong aesthetic and existence values. The Canada lynx is federally protected as a threatened species. The red fox, American marten, and long-tailed weasel are common in the park.

The mission for the mid-sized carnivore program is to improve the information available for resource management, planning, and interpretation staff in the park, as well as agency partners, such as the USFWS, that have joint conservation responsibilities for listed species under the Endangered Species Act. Inventories, monitoring, and basic research are vital to identifying and managing human effects, conservation planning, and efforts at public education.

2005 Highlights

The primary focus of the mid-sized carnivore program during 2005 was on initiating a large-scale wolverine study and preparing publications related to the Canada lynx survey in Yellowstone that was completed in 2004. A summary of the survey appeared in *Yellowstone Science*, and a manuscript intended for *Northwest Science* was submit-

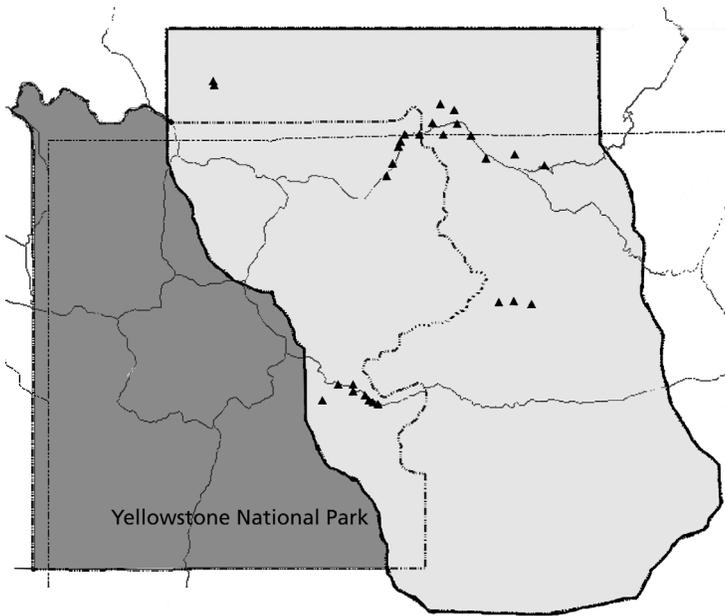
ted for publication. Staff also provided field assistance to outside researchers studying river otters on Yellowstone Lake and red fox on the northern range, and administrative assistance to Wildlife Conservation Society biologists conducting wolverine research along the west and south boundaries of the park.

Absaroka-Beartooth Wolverine Ecology

The wolverine, which is the largest terrestrial member of the weasel family, recently emerged as a concern in the northern Rockies because the species may be particularly vulnerable to extirpation due to low numbers, a low reproductive rate, and large spatial requirements. Anthropogenic influences, such as winter recreation and road development, may compound unfavorable life history attributes by causing disturbance during postnatal periods and creating barriers to movement within the wolverine's native habitat and among different populations. Two petitions to list the wolverine under the Endangered Species Act have been rejected by the U.S. Fish and Wildlife Service. Conservation of this species may depend on having more information about its ecology and threats to its survival.

Lacking even basic knowledge of this elusive animal, park and national forest managers have identified the need for field studies that provide life history information and gauge the effects of humans on wolverine at a landscape scale. Such studies are essential in developing long-range strategies that help ensure wolverine persistence and the biological integrity of high-elevation environments. During 2005, YNP and the USFS Rocky Mountain Research Station began a five-year study to evaluate wolverine status, ecology, and interactions with humans in the eastern portion of the park and the Shoshone and Gallatin national forests. Other cooperators include the Wyoming Game and Fish Department, the Rocky Mountains Cooperative Ecosystem Studies Unit, the USFS Region 1 Carnivore Program, and the Yellowstone Park Foundation.

The study is specifically designed to remedy the information shortfalls that currently impede wolverine conservation planning and management in this region. The goal is to improve existing data on wolverines and their environmental requirements, particularly in regard to the anthropogenic effects of park and national forest management. A second goal



Map of wolverine study area indicating trap locations.

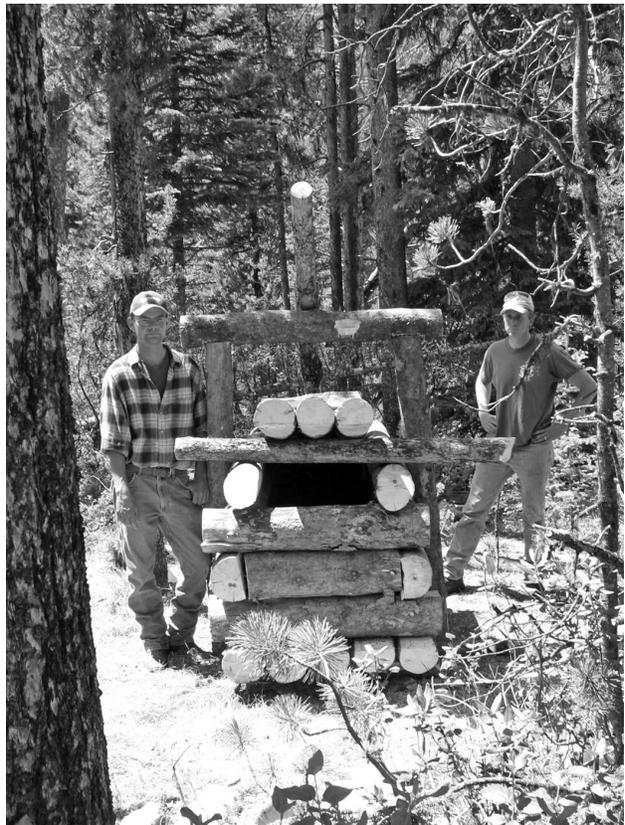
is to foster appreciation and support for wolverine conservation through public education. The objectives are to collect basic data on the residency and breeding status of wolverines; document aspects of their population, including sources of death, genetic characteristics, and extent of connectivity with other wolverine populations in the northern Rockies; document habitat requirements related to birthing dens and potential human disturbance; and describe interactions with other carnivores, such as wolves and grizzly bears.

During summer and fall 2005, staff constructed 28 wolverine live traps at sites distributed in four geographic areas across the 3,500-mi² study area. In Yellowstone, the traps were constructed using logs cut from lodgepole pine trees cleared at Canyon Village during construction of the new contractor camp. The logs were hand-carried to trap sites along the East and Northeast Entrance roads. On the national forests, logs for traps were obtained from dead trees found at the trap site.

Beginning in January 2006, the traps will be baited, set, and remotely monitored. When a trap has been entered, the nearest available of the four crews will go to the site. The captured wolverines will be radio-marked with GPS technology that provides location

and movement information at a broad range of temporal and spatial scales. For the safety of both the crews and bears, the trapping season will end when bears begin to emerge from hibernation each spring.

Staff have obtained the necessary research permits from YNP, Montana Department of Fish, Wildlife and Parks; the Wyoming Game and Fish Department; and the University of Montana Institutional Animal Use and Care Committee. Staff completed a peer-reviewed study plan and aviation safety plan, and assisted the Yellowstone Park Foundation in preparing several funding proposals. Yellowstone and Grand Teton interpretation staff and project biologists made seven presentations to lay and professional audiences concerning the study, wolverine life history, and conservation needs.



Wolverines enter through the gap under the lid and, when they pull on a food bait connected to a trigger, the lid falls. Photo by Kerry Murphy.

Wolves

As part of the effort to restore a viable wolf population to the Greater Yellowstone Area that began in 1995, YCR Wolf Project staff monitor population dispersal, distribution, reproduction, mortality, and predation on ungulates within YNP.

Population Monitoring

Population Status. At least 118 wolves occupied ranges located primarily in the park at the end of 2005. That was 53 (31%) fewer wolves than were known to be present at the end of 2004 (Fig. 1), the largest annual population decline since wolf restoration began. It was largely attributable to poor pup survival, for which disease is suspected as the major cause. The decline was offset by the continued growth in the wolf population outside the park, bringing the total Greater Yellowstone population to 325 in 2005.

The number of packs residing primarily in the park declined from 15 to 13 during 2005. One new pack formed (Hellroaring Creek) when part of the Leopold pack split off, but three packs that were in the park at the end of 2004 are gone: the Biscuit Basin pack moved to Idaho, and the Specimen Ridge and Geode Creek packs dissolved. Two other packs, Nez Perce and Swan Lake, declined substantially and are likely to disband in 2006 if they have not already.

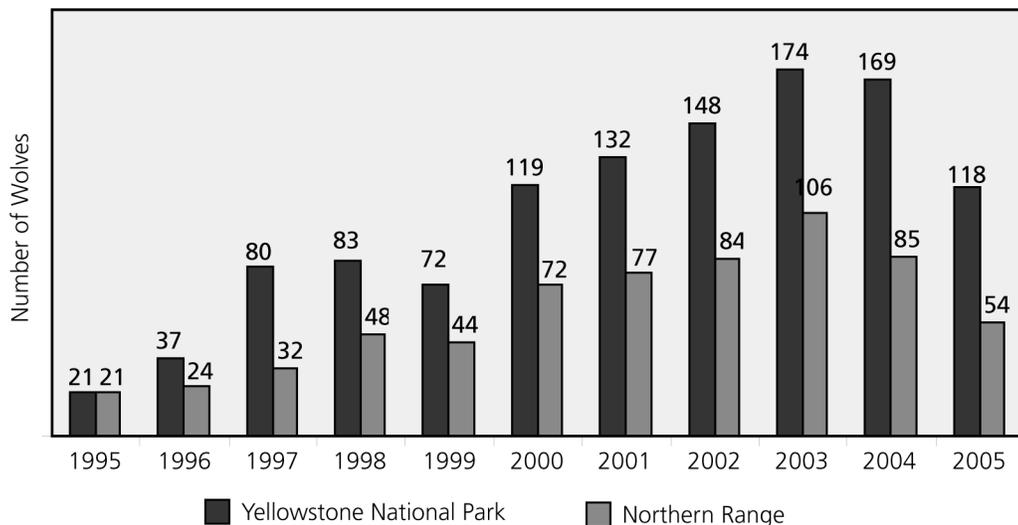
In late December the alpha female of the Nez Perce pack was killed by the Gibbon Meadows pack and the surviving Nez Perce members dispersed.

Despite the significant population decline, wolf distribution remained largely the same in the park. Wolf territories continue to include the northern range, Pelican Valley, Hayden Valley, the Madison-Firehole, north of the Madison River, Thorofare, and Bechler. The six packs that occupied the northern range had a total of 54 members at the end of 2005, 30 (36%) less than a year earlier. The count for the other seven packs was 64 (down 26%). Pack size ranged from 4 (Druid Peak) to 17 (Yellowstone Delta) and averaged nine wolves. Seven packs had breeding pairs.

Reproduction. Eleven of the packs exhibited denning activity, and seven used a previous den (Swan Lake, Leopold, Delta, Bechler, Gibbon Meadows, Cougar Creek, and Nez Perce). Wolf Project staff visited den sites and collected scats to analyze the wolves' summer diets.

Ten of the packs produced at least 13 litters and a total of 69 pups, but only 22 pups (32%) were still alive at year end. Pup survival was especially poor on the northern range, where only 8 (16%) of 49 pups survived. None of the pups born to the Druid Peak, Swan Lake, and Nez Perce packs survived. Mollie's pack had no pups, probably because the alpha female died shortly before the breeding season

Figure 1. Number of wolves in Yellowstone National Park, 1995–2005, comparing the northern range to the total park population.



began and had not been replaced. Two packs had multiple litters: the Slough Creek pack produced four litters with a total of 15 pups, of which three survived; the Leopold pack had at least three and possibly four breeding females who gave birth to a total of 19 pups, of which two survived.

Mortalities. Twenty-five radio-collared wolves died in 2005. Intraspecific killing was the leading cause of death, but mange was a factor for the first time, resulting in three deaths. However, the 2005 mortality rate (not including pup mortality prior to September) was 15%, less than the 10-year average of 20%.

Wolf–Prey Relationships

Wolf–prey relationships were documented by observing wolf predation directly and by recording the characteristics of prey at kill sites. Staff added to the database of information about behavioral interactions between wolves and prey, predation rates, the total time wolves fed on their kills, percent consumption of kills by wolves and scavengers, and characteristics of wolf prey (e.g., sex, species, nutritional condition), and kill sites. Similar data were also collected opportunistically throughout the year during weekly monitoring flights and ground observations.

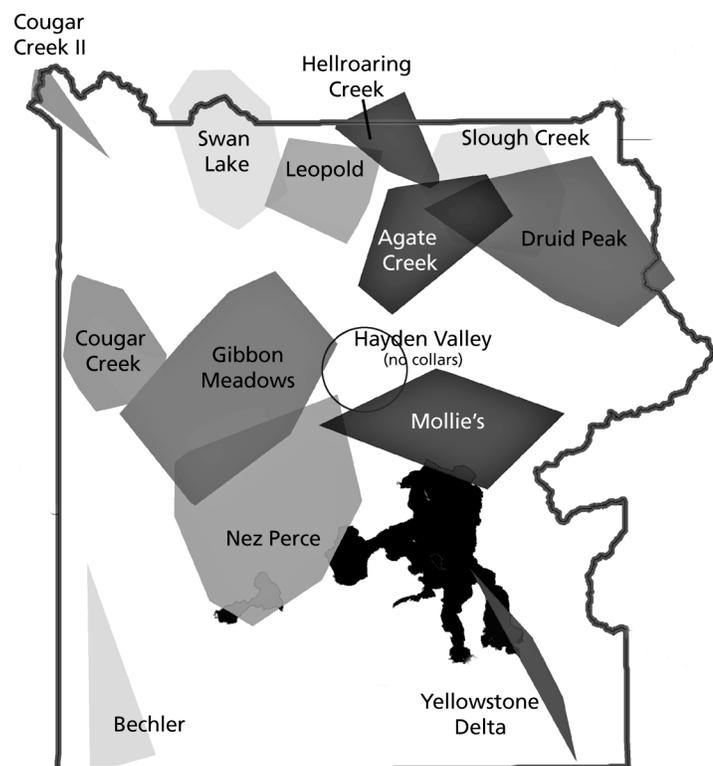
Composition of Wolf Kills. Including definite, probable, and possible kills, staff detected a total of 316 wolf kills during 2005: 244 elk (77%), 29 bison (9%), 9 wolves (3%), 6 deer (2%), 4 moose (1%), 4 coyotes (1%), 2 skunk (1%), 2 ravens (1%), 1 pronghorn (<1%), 1 badger (<1%), and 14 unknown prey (4%). The composition of elk kills was 18% calves (0–12 months), 11% cows (1–9 years), 12% older cows (>10 years), 43% bulls, and 16% elk of unknown sex and/or age. Bison kills included 9 calves (unknown sex), 10 cows, 6 bulls, and 4 bison of unknown sex and age.

Winter Studies. During two 30-day periods in March and November–December, the wolves were intensively radio-tracked. Two-person teams on the ground monitored the Leopold, Geode Creek, and Slough Creek packs during the March study period, and the Slough Creek and Hellroaring packs during the November–

December period. Aerial monitoring during both study periods was done of all four of these packs as well as the Swan Lake, Agate Creek, Mollie’s, Gibbon Meadows, Nez Perce, and Cougar Creek packs. The Yellowstone Delta, Bechler, and Biscuit Basin packs were rarely located, largely because of poor conditions for aerial monitoring in the southern part of the park or because they were outside the park.

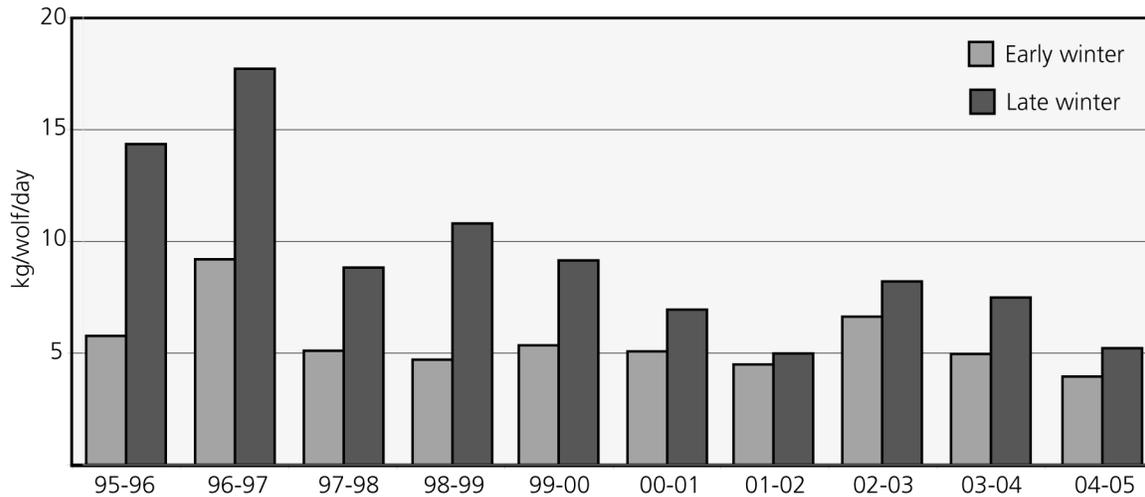
During the March study period, staff detected 69 definite or probable kills. Wolves were also observed scavenging on nine bison and seven elk that had died from other natural causes (e.g., winterkill, cougar kill, stuck in mud). During the November–December period, staff detected 55 definite or probable wolf kills.

On the northern range, winter predation rates for 1995–2000, which were calculated using the double count method, showed an average of 1.8 elk/wolf/30-day study period. In the last two winters, a slightly different method (minimum kill rate) showed an average of 0.9 ungulates/wolf/30-day study period. Although the two methods of calculation are not directly comparable, this decrease suggests changing



Territories occupied by the 13 wolf packs residing primarily in YNP, plus that of the Nez Perce pack, whose status was unknown at the end of 2005.

Figure 2. Food consumption by wolves during early and late winter study periods from the winter of 1995-1996 to the winter of 2004-2005.



ecological conditions on the northern range. Food consumption by wolves in early winter compared to late winter has varied less in recent years than it did during the first years after wolf reintroduction, which suggests that wolves are now killing at a rate that more closely approximates their daily food requirement throughout the winter (Fig. 2). Recent findings also indicate that compared to the first eight years after restoration, the use of calves has declined while the use of bulls has increased.

Summer Predation. Documenting the predatory habits of wolves is more difficult in summer because nighttime activity increases, pack cohesion decreases, the prey tends to be smaller and more quickly consumed with less evidence left, and tracking the wolves is harder without snow. The best data concerning wolf summer food habits have come from analysis of scat collected at den and rendezvous sites. In 2005, staff also deployed GPS collars on some wolves to enhance understanding of 1) seasonal predation patterns; 2) spatial and temporal interactions with other wolf packs and other carnivores; 3) movements with respect to dens during pup rearing season; and 4) territory size, use, and overlap. Using GPS radio collars with downloadable data acquisition technology, weekly data gathering on collars was attempted. Collars programmed to collect location data every 30 minutes provided high resolution data on wolf movements and enabled researchers to find more wolf kills, even newborn

elk calves.

However, malfunctioning collars and wolf mortality in 2005 made summer predation patterns difficult to document. The collared alpha male in the Geode pack was killed by the Leopold pack in March. A Geode wolf pup also had a GPS collar, but he became a lone wolf after the death of the alpha male and strife with the Leopold pack led to the disbanding of the Geode pack. The GPS data showed that he survived for more than three months by scavenging more than 10 carcasses of animals ranging from two weeks to four months old, most of which consisted of only bone and hide. He died of starvation in late summer. After the GPS collar on a Leopold pack female began malfunctioning in early summer, data could not be downloaded. Summer predation studies will continue with newer collars in 2006.

Summer Scavenging. Research on wolf and scavenger interactions, mostly done in the winter, has been conducted since 1998 with support from Canon U.S.A. and YCR. This research has monitored how wolves influence the abundance and distribution of carrion, spatially and temporally, and how they facilitate food acquisition by other carnivores. Although staff have learned a great deal about the magnitude and relative importance of wolf-killed carcasses to the winter scavenger communities, little is known about the impact on summer scavengers. In the summer of 2005, Dr. Chris Wilmers of the

University of California–Davis began collaborating with project staff to document invertebrate diversity and abundance at summer carcasses. This effort will continue in 2006 with increased monitoring efforts.

Population Genetics

A collaborative effort with the University of California–Los Angeles was initiated in 2005 to use genetics techniques to construct a pedigree for all handled Yellowstone wolves and understand gene flow between the three Rocky Mountain wolf recovery areas. Blood samples from more than 500 wolves from Idaho, Montana, and Wyoming were sent to Robert Wayne at UCLA for genotyping and determination of heterozygosity (a measure of genetic diversity). Eventually a pedigree of all handled Yellowstone wolves will be constructed to help explain pack dynamics and social behavior.

The high level of heterozygosity (0.64) found in Yellowstone wolves indicates a genetically robust population. The three recovery areas can be distinguished from each other genetically and migration assessed. Movement of Yellowstone wolves to Idaho appears to be frequent, but there is no genetic evidence that any have moved to the northwest Montana recovery area. Immigration from Idaho and northwest Montana into Yellowstone appears to be rare, indicating some isolation of the wolves in the Yellowstone recovery area.

Wolf Management

Wolf Capture. Staff captured and handled a total of 36 wolves from 12 packs in 2005 (15 pups, 5 yearlings, and 16 adults). In addition to collaring the wolves, Wolf Project staff measured each captured wolf and took a blood sample for genetic and disease analysis. No wolves were ear tagged. Although the objective is to have at least one collared wolf in each pack, the Hayden Valley pack could not be located for aerial capture. At year end, 39 (33%) of the 118 known wolves were collared.

Area Closures. To prevent human disturbance of young pups, an area of about one square mile centered on the Slough Creek pack's den (southwest of the Slough Creek Campground) was closed to visitors until July 1. Shorter closures of one to two weeks were enforced around the Agate Creek and Hayden Valley dens until those packs moved to

more remote dens or rendezvous sites. Den sites for the Leopold, Mollie's, and Nez Perce packs were protected through Bear Management Area closures for Blacktail (March 15 to June 30), Pelican Valley (April 1 to July 3), and Firehole (March 15 to through Memorial Day Weekend). The areas around the other packs' den sites were not closed because of historically low visitor use in these areas.

Druid Road Management Project. YCR, Resource and Visitor Protection, and the Division of Interpretation launched the Druid Road Management Project in 2000 with private funds to manage wolf viewing in Lamar Valley. The project objectives are: 1) human safety—control parking and traffic along the road to protect motorists and those viewing wolves; 2) wolf safety—protect wolves from vehicle strikes, permit wolves to cross the road without human interference, and protect the den area from visitor intrusion; 3) visitor enjoyment—provide opportunities for people to view and learn about wolves and other wildlife ecology; and 4) wolf monitoring and research—maintain opportunities for scientists to study the denning behavior, predation activity, and interactions of wolves with other wildlife.

Previously, the Druid Peak pack, which has denned in Lamar Valley since 1997, has been the most easily observed by park visitors. However, in 2005 the Druid Peak pack did not return to their traditional den site near the road. Because vehicular traffic control in that area was not needed, staff focused on the Slough Creek pack denning area, which was visible from the Northeast Entrance Road and the Slough Creek Campground road. Two staff members from the Division of Interpretation who were assigned to the northern range to help educate the public about wolves spent most of their time in the Slough Creek area working with wolf project staff. Two accidents were reported at Slough Creek but no one was injured. Traffic overall was less of an issue, especially after the Slough Creek road reopened July 1, but before that parking space was insufficient. Hundreds of visitors were able to observe the wolves from a safe distance from early April through late July. This was the second largest number of visitors to see wolves in a single year (2002 was highest).

PART III.

Professional Support Programs

This section summarizes the 2005 accomplishments of YCR staff who provide services for other YCR branches and park divisions:

- Spatial Analysis Center
- Resource Information Team
- Research Permit Office
- Servicewide Benefits-Sharing EIS
- Funding and Personnel Support



Former Yellowstone Superintendent Bob Barbee at the 8th Greater Yellowstone Biennial Scientific Conference.

Spatial Analysis Center

The Spatial Analysis Center (SAC) is responsible for the park's geographic information systems (GIS), global positioning systems (GPS), image analysis systems, soil information support, and a resource database. The main tasks are the acquisition, analysis, organization, storage, maintenance, and presentation of data, especially concerning Yellowstone's cultural and natural resources. The goals are to maintain an up-to-date GIS lab, provide GPS equipment and expertise to park staff and improve their GPS and GIS skills, and repackage technology and technical data to meet internal and external needs.

In 2005, staff enhanced the role of service providers by participating on intra-divisional teams focused on specific priorities. This included working on the park's three major search and rescue efforts during the year; mapping water, sewer, and electric systems; contributing to the power line right-of-way; participating on the Tower ID team; and working with GYA partners to create fire history and fire fuel maps for the area.

The summer of 2005 was the eighth field season of digitally mapping the park's thermal features. With data collected from an additional 994 features, the database now contains information about approximately 9,900 thermal features in areas throughout the park. This database provides the only way for park staff and outside researchers to identify individual thermal features that have specific combinations of temperature and pH.

Research Permit Office

The Research Permit Office carries out four primary responsibilities consistent with National Park Service policies:

- responds to inquiries about and issues permits for research projects that include fieldwork in Yellowstone
- monitors the fieldwork associated with scientific studies in a variety of disciplines to ensure that it does not negatively affect park resources or conflict with other park goals or missions
- encourages research in Yellowstone and provides logistical support where possible
- collects and appropriately disseminates the results of park-related scientific studies to the widest possible audience

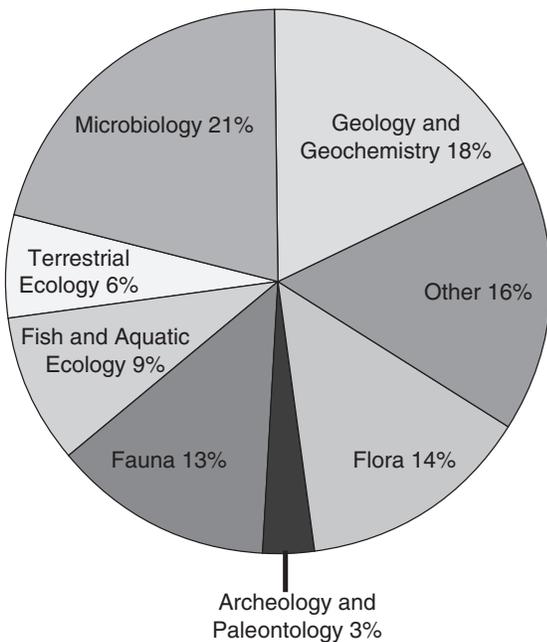
During 2005, staff issued 221 research permits to scientists from 40 of the United States and 9 foreign countries. In addition to permits issued as renewals of ongoing studies, 43 requests for new projects were approved by Yellowstone's Research Review Team, which was 30% more new projects than in 2004. An additional 30 scientists inquired about conducting research in Yellowstone but did not pursue obtaining a permit.

Staff accompanied approximately 10% of the researchers during their fieldwork, which not only helps prevent harm to park resources, but enhances understanding of the scientists' research needs. Working with the researchers, staff often discover

better ways to record data or collect samples, while minimizing any potential negative affects on resources. These ideas for “best practices” are documented and passed on to park staff and other researchers when applicable.

Although Yellowstone is widely known for its abundant wildlife and unique geothermal features, scientific research is conducted in a wide range of subject areas, as shown in the pie chart below.

Staff received reports from 42 investigators who had concluded their project and submitted their



research findings and publications to the park. To disseminate the results of research studies to research scientists, park employees and managers, and the public, during 2005 staff scheduled five presentations on research projects and distributed more than 500 journal articles, theses, and research reports to interested parties.

Here is a more detailed breakdown of topics addressed by research projects in 2005.

Air quality	1
Archeology	4
Climate/Weather	2
Ecology-Aquatic	5
Ecology-Terrestrial	13
Entomology	8
Exotic Plants and Animals	7
Fisheries	8
Forestry/Fire Ecology	9
Geochemistry	17
Geography/GIS	7
Geology	22
Herpetology	2
Mammalogy	25
Microbiology	49
Natural Soundscapes	1
Ornithology	1
Other	11
Paleontology	3
Plant communities	18
Sociology	5
Water Quality	3



Researcher Bruce Fouke sampling at Angel Terrace.

Benefits-Sharing EIS

Biological research associated with the development of commercial products that is undertaken in natural environments has become known as bioprospecting. In 1997, the NPS adopted a policy to manage bioprospecting as a defined subunit within the research permitting system that the parks have used for more than a century. The NPS also decided to manage bioprospecting with monetary and non-monetary benefits-sharing requirements if commercially viable products were anticipated. Opponents of this policy sued the NPS in federal court on the grounds that bioprospecting constituted a new commercial activity that was illegal and inappropriate in NPS units. In 1999, the court ordered the NPS to review the policy under NEPA. The resulting draft EIS analyzes the range of policy options deemed reasonable by the NPS.

With assistance from the DOI Office of the Solicitor and the Assistant U.S. Attorney's Office, the NPS responded successfully to ongoing litigation in Washington, D.C., federal court over an October 2002 FOIA. In August 2005, the plaintiff sent another large FOIA request asking for more than three years' worth of project records. The NPS contested the fee-waiver request for this FOIA and the case is under review by the Solicitor's Office.

Two drafts of the EIS were prepared and reviewed for adherence to NEPA. The final NPS internal review of the draft EIS was completed in the fall of 2005. Congressional briefings by the NPS are planned for spring 2006 and the final EIS is expected to be completed in 2007.

Resource Information Team

The mission of the Resource Information Team is to translate, produce, and synthesize scientific and technical information of all kinds into language and formats that are accessible to researchers, other agency scientists, self-selected members of the public, and park managers who need access to results from scientific research in order to make informed decisions about park issues. Through presentations, events, printed and electronic publications, and outreach efforts, staff strive to increase the informed discussion of park issues and policies by a variety of interested participants; contribute to

the scientific body of knowledge about the park; and promote resource conservation and visitor enjoyment through accessible dissemination of scientific knowledge about the park.

Despite a staffing reduction, personnel worked toward those goals in 2005 by producing four issues of *Yellowstone Science* magazine; planning a Research Learning Center website with support from the Yellowstone Park Foundation and Canon U.S.A., Inc.; organizing and hosting the 8th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, *Greater Yellowstone Public Lands: A Century of Discovery, Hard Lessons, and Bright Prospects*; and producing a variety of high quality materials in support of YCR and other divisions.

Yellowstone Science magazine

In 2005, the quarterly journal *Yellowstone Science* entered its thirteenth year with two full-color issues and articles on a wide range of topics highlighting many aspects of Yellowstone's natural and cultural resources.

Four issues were published and distributed to a subscription readership of nearly 2,500 individuals and institutions. Among the highlights this year was a very popular winter issue devoted to the tenth anniversary of wolf restoration, and a fall issue that explored the park's new Heritage and Research Center. Other feature stories this year included a look at art and conservation in Yellowstone; the history of the Canyon Hotel; a study of the presence and ecology of lynx and snowshoe hares in the park; an investigation of elk calf mortality that offered somewhat surprising results (cited in a November *USA Today* article on the same topic); a history of the park's first general store; an interview with the park botanist; and a story on the Yellowstone super-volcano and its portrayal in the media.

8th Biennial Scientific Conference

Greater Yellowstone Public Lands: A Century of Discovery, Hard Lessons, and Bright Prospects, possibly the most immediately pragmatic Biennial Scientific Conference to date, focused on the mandates, "cultures," relationships, and accomplishments of the numerous local, state, and federal management agencies responsible for Greater Yellowstone's public lands. Staff planned and organized the event with the help of other YCR staff



There were 20 posters displayed at the 8th conference.

and a program committee of independent scholars and non-Yellowstone federal agency personnel. It was sponsored by 11 local academic and non-profit institutions and federal agencies.

The conference, held October 17–19, 2005, at the Mammoth Hot Springs Hotel, set yet another attendance record, with 209 registered attendees. Featured speakers were USFS Chief Dale Bosworth, former chief Jack Ward Thomas, Canadian conservationist Harvey Locke, Sarah Boehme of the Buffalo Bill Historical Center’s Whitney Gallery of Western Art, landscape ecologist Dr. Monica Turner, former NPS Intermountain Region director Karen Wade, and wildlife conservation professor Dr. Richard Knight. There were also sessions on history, mammals, biocomplexity, water resources, fire, human values, native plants, trophic cascade questions, and the history and current challenges of the Greater Yellowstone Coordinating Committee, all with a cross-agency or cross-boundary perspective. More than 70 papers, panels, and posters were presented; major themes included interagency cooperation, community-based conservation, and the importance of training scientists and managers to express themselves clearly, and to perceive of their audience as consisting of far more than other scientists.

Other scientific publications

Other annual publications included four issues of the *Buffalo Chip* newsletter, the *2004 YCR Annual Report*, the *2004 Wolf Project Annual Report*, the *2004 Yellowstone Bird Report*, and the *2004 Yellowstone Fisheries and Aquatic Sciences Annual Report* all of which were edited and designed by resource information staff. Special publications included the production of “The Ecology of Bison Movements and Distribution in and Beyond Yellowstone National Park: A Critical Review with Implications for Winter Use and Transboundary Population Management,” by respected Canadian wildlife biologist and NPS contractor Cormack Gates.

Greater Yellowstone Science Learning Center

The primary focus of the Greater Yellowstone Science Learning Center (GYSLC), a partnership between the Yellowstone Center for Resources, the Yellowstone Park Foundation, and Canon U.S.A., Inc., and part of the *Eyes on Yellowstone* is made possible by Canon program, is to promote mission-oriented research in the Greater Yellowstone Inventory and Monitoring Network (Yellowstone and Grand Teton national parks and Bighorn Canyon National Recreation Area), explain the need for and results of research in the network to park managers, researchers, students, and interested public, and to help develop the network’s Vital Signs monitoring plan.

A proposal was developed and funding secured for this extensive web-based project. Planning meetings were held, web pages were designed, and staff began to develop content for the website prototype in the form of resource almanacs and overviews, reference lists, and lists of laws and other management documents. The site can be visited at www.greateryellowstonescience.org.

Assistance and Support

During 2005, staff drafted letters and remarks for the park superintendent; made resource-related presentations at the park’s seasonal orientation; read and commented on more than 20 manuscripts for Yellowstone-related books and articles (in addition to *Yellowstone Science* and *Buffalo Chip* submissions); designed a brochure and a series of aquatic invasive warning signs for the Aquatics Section; created informational handouts on research permitting and

the benefits-sharing EIS; reviewed publications for the Division of Interpretation as requested; drafted updates on the park's status as a World Heritage site; provided technical assistance and Government Printing Office guidance to other divisions; edited the park's Historic Resource Study, volume III (History of Administrative Structures); compiled and submitted the park's submission for the NPS *Natural Resource Year in Review*; edited the interagency paleontology report, *Cretaceous Complexities: The Stratigraphic Intricacies of Mount Everts*; edited and designed a pamphlet detailing the archeology program's activities at Osprey Beach; attended a planning workshop for the *Atlas of Yellowstone* project; re-designed a conference poster for vegetation staff; and maintained the YCR scanning station for use by park staff.

Public Involvement and Volunteer Support

Resource information staff were grateful for the help of Lia Lawson, who volunteered approximately 160 hours to RIT projects, including the design for a series of signs for the Aquatics Section, and creating flyers for the 8th Biennial Scientific Conference and the Heritage and Research Center open house.

Funding and Personnel

Base Operating Budget

Superintendent Suzanne Lewis and Deputy Superintendent Frank Walker approved a base operating budget of \$4,364,100 for the Yellowstone Center for Resources on February 4, 2005, for FY05. The increase of \$375,700 over FY04 funding levels that was included in this budget was specifically earmarked for implementing and maintaining a geothermal monitoring program. The base operating budget accounted for 63% of YCR's total for FY05. This compares to an average of 60% for the period FY95–FY04.

Additional Funding

Recreation Fee Demonstration Funds. Although the fee demo program did not provide funds for any new resource management projects in FY05, it did make \$167,700 available to continue some ongoing projects: rare books restoration, northern range

riparian studies, a geothermal features inventory, a whirling disease survey, and two fisheries conservation projects. Since YCR began receiving fee demo money in 1997, this program has allocated about \$1.7 million for 18 different projects.

Fishing Fee Program. The YCR received authorization to use \$342,300 from fishing permit fee revenue to cover part of the estimated \$942,000 cost of the aquatic resources program in FY05.

Federal Lands Highway Program. Federal Highways funded \$495,900 for natural resource inventories, archeological surveys, and resource compliance along the road corridors in the park scheduled for major repair or reconstruction in the near future.

Special Emphasis Program Allocation System. The Branch of Cultural Resources successfully competed for a total of \$696,900 in special emphasis program funding that was used to procure and install specialized storage units for the museum, archives, and library collections in the Heritage and Research Center facility; stabilize three historic buildings (Fort Yellowstone and Lamar); maintain the historic vehicles collection; continue ethnographic resource inventory, traditional use, and research studies; and undertake two cataloging projects.

The special emphasis program also provided \$218,000 for the Branch of Natural Resources to conclude the elk calf mortality study begun in FY03, finalize the survey results for Canada lynx, and begin a three-year study of the declining pronghorn antelope population.

Other Park Service Funds. YCR continued work on two planning projects in FY05 that were supported with funds from the servicewide level of the National Park Service: the Benefits-Sharing EIS (\$287,000) and the Brucellosis Vaccine EIS (\$80,000).

Other Federal Funds. Most of these funds were provided by the Greater Yellowstone Coordinating Committee (\$22,000). The GYCC elected to fund three Yellowstone projects in FY05: two aquatic resources projects relating to native cutthroat trout conservation and a trumpeter swan assessment. Yellowstone also received GYCC funds for participation in two Greater Yellowstone Area projects: development of a fire history and fuel model mapping project for wildland fire applications, and pro-

duction of a summary report of GYCC projects.

Private Funds. A total of \$181,300 was donated to the park by private organizations or individuals in support of various YCR projects, including whirling disease surveys, restoration of westslope cutthroat trout, Yellowstone cutthroat trout conservation efforts, wolf recovery program operations, an experimental electronic data collection project (Eyes on Hayden), the Tauck World Discovery volunteer program for historic structures conservation, a collection condition survey, and a feasibility proposal for the Greater Yellowstone Science Learning Center. Most of this funding (\$133,500) came through the Yellowstone Park Foundation. The Montana Whirling Disease Initiative provided \$40,900.

Personnel

In an effort to control costs and channel diminishing funds to the highest priority position vacancies parkwide, Yellowstone's management team set up the Position Management Review Board (PMRB) in November 2003. The Board reviewed all requests to fill vacant permanent positions in the park through July 2005. Of the approximately 84 vacancies that were considered during this period, 27 were recommended for indefinite lapse. This process helped ensure that work was organized and assigned among positions in a manner serving the park's core mission most effectively and economically.

Of the 232 personnel actions processed by YCR in FY05, these were of special note:

- On January 3, 2005, Wayne Brewster, Deputy Director of the Yellowstone Center for Resources, retired after 35 years of federal service in the U.S. Army, USFWS, and NPS. Brewster came to work for Yellowstone in 1991 from Glacier National Park, where he had worked on wolf and grizzly recovery since 1988. In Yellowstone, Brewster was the regional lead for wolf recovery planning for all parks, then took on a laborious and frustrating multiple-agency Bison Management Plan and EIS. His influence and talents made an extraordi-

nary difference on some of North America's most popular wildlife. He and his wife, Lil, moved to Helena, Montana, where they plan to enjoy their horses and the beauty of the Montana landscape for many years to come.

- YCR's Senior Writer-Editor Roger Anderson was permanently assigned the responsibilities of the Chief of Cultural Resources (vice-Consolo Murphy) and promoted in October 2004 based on an accretion of duties.
- Administrative Support Assistant Colleen Watson accepted a promotion to the lead Budget Analyst position with the Division of Interpretation and left YCR at the end of November 2004.

As a result of PMRB decisions, three YCR positions were left vacant after these changes: the Deputy Director position, a Writer-Editor position, and an Administrative Support Assistant position.

Total employment on YCR activities was equivalent to 76 full-time employees for FY05 (Appendix 1, FTEs). This was slightly less than the FTE count for FY04, but more than for any other prior year. The average FTE for the period FY95–FY04 was 56.

Other Administrative Activities

Assistance Agreements. Staff processed 50 assistance agreements and task orders in FY05, totaling obligations of \$925,300, of which 54% was used for administration of the Montana Water Compact and geothermal monitoring plan. Other significant investments were made in archeological surveys and evaluations, research in support of winter use studies, aquatic resources studies, historic structures stabilization assistance, and research on the riparian habitats of Yellowstone's northern range.

Procurement Actions. Staff processed 783 procurement actions in FY05, totaling approximately \$1,143,900.

Clerical Support. Staff processed 954 pieces of correspondence and 345 travel authorizations in FY05.

Funding history (FY 1993-05), Center for Resources, Yellowstone National Park (new allocations only)

YCR Base Increase	FY	National Park Service Funds											Total
		Park Base	Nat Res Project Funds	Cult Res Project Funds	Fish Fee	FLHP	Fee Demo	Other NPS	Other Federal	Private			
	93	1,004,600	16,000	-	-	-	-	785,000	188,000	20,000		2,013,600	
245,400	94	1,250,000	260,000	33,200	65,000	43,300	-	320,600	79,600	10,000		2,061,700	
250,000	95	1,500,000	420,000	45,000	65,000	303,600	-	59,800	20,000	5,300		2,418,700	
44,100	96	1,544,100	404,000	201,100	274,500	626,700	-	157,800	65,000	31,500		3,304,700	
130,000	97	1,674,100	204,000	228,400	213,400	433,700	340,000	42,700	398,300	48,000		3,582,600	
571,500	98	2,245,600	130,500	242,100	284,800	330,800	31,000	24,000	65,300	37,700		3,391,800	
286,300	99	2,531,900	-	221,900	285,000	396,500	298,000	152,900	105,200	56,700		4,048,100	
36,700	00	2,568,600	237,500	101,000	280,000	214,900	631,000	1,418,000	41,300	52,700		5,545,000	
93,300	01	2,661,900	297,000	216,700	285,100	409,000	-	-	15,000	85,500		3,970,200	
772,900	02	3,434,800	293,000	198,700	261,900	293,200	6,000	-	11,700	126,400		4,625,700	
(16,100)	03	3,418,700	101,000	326,300	250,000	431,000	103,000	454,400	24,000	224,300		5,332,700	
569,700	04	3,988,400	92,600	470,400	332,600	623,500	133,000	855,000	22,400	229,200		6,747,100	
375,700	05	4,364,100	218,000	676,900	342,300	495,900	167,700	367,800	23,700	181,300		6,837,700	

YCR distribution of FY05 funds (including carryover)

Cultural Resources	796,100	1,000	-	-	35,100	33,200	287,800	3,000	24,300		1,180,500
Natural Resources	2,986,300	217,000	-	342,300	203,800	143,200	80,000	20,700	142,800		4,136,100
Professional Support	581,700	-	676,900	-	257,000	34,000	-	-	14,200		1,563,800
Total:	4,364,100	218,000	676,900	342,300	495,900	210,400	367,800	23,700	181,300		6,880,400

APPENDIX I.

Personnel Roster, 2005

Professional Support Branch			FTE	Borrowed FTE
Management and Administration				
1.	Brewster, Wayne	Deputy Director	0.26	
2.	Cline, Barbara	Division Secretary	1.00	
3.	Deutch, Ann	Environmental Protection Assistant	0.59	
4.	Hendrix, Christie	Environmental Protection Assistant	1.00	
5.	McAdam, Melissa	Sprv. Budget Analyst	1.00	
6.	Mills, Sue	Environmental Protection Specialist	1.00	
7.	Perius, Joy	Budget Analyst	1.00	
8.	Smith, Christine	Administrative Support Assistant	0.86	
9.	Varley, John	Director	1.00	
10.	Watson, Colleen	Administrative Support Assistant	0.15	
11.	Whiteside, Marlene	Maintenance Worker	-	0.02
		<i>subtotal Management & Admin:</i>	7.86	0.02
Resource Information Team				
1.	Blackford, Tami	Technical Writer-Editor	0.99	
2.	Franke, Mary Ann	Technical Writer-Editor	0.26	
3.	Schullery, Paul	Resource Naturalist	0.44	
4.	Stevenson, Sarah	Technical Writer-Editor	0.12	
5.	Warner, Virginia	Editorial Assistant	0.98	
6.	Wondrak Biel, Alice	Technical Writer-Editor	1.00	
		<i>subtotal Resource Information:</i>	3.79	-
Spatial Analysis Center				
1.	Bonzey, Nick	Cartographic Technician	0.29	
2.	Campbell, Erin	Cartographic Technician	0.15	
3.	Friedel, Rob	Cartographic Technician	0.23	
4.	Guiles, Carrie	Cartographic Technician	0.84	
5.	Jurak, Mike	Cartographic Technician	0.19	
6.	Miller, Steve	Physical Science Technician	0.28	
7.	Napoli, Jim	Cartographic Technician	0.38	
8.	Nock, Erin	Cartographic Technician	0.23	
9.	Rodman, Ann	Sprv. GIS Specialist	1.00	
10.	Santoro, Andrea	Cartographic Technician	0.23	
11.	Savage, Shannon	GIS Specialist	0.94	
		<i>subtotal Spatial Analysis:</i>	4.76	-
Professional Support Branch FTE:			16.41	0.02

			FTE	Borrowed FTE
Cultural Resources Branch				
1.	Anderson, Roger	Chief of Cultural Resources	1.00	
2.	Capozzi, Maria	Museum Technician	0.64	
3.	Case, Bridgette	Museum Technician	0.79	
4.	Curry, Colleen	Museum Curator	1.00	
5.	Dawson, Herb	Historic Architect	0.99	
6.	Edmiston, Sarah	Library Technician	0.25	
7.	Faggen, Peter	Museum Technician	0.27	
8.	Felton, Tasha	Cultural Resources Technician	0.95	
9.	Hale, Elaine	Archeologist	0.96	
10.	Hinckley-Cole, Maurine	Administrative Support Assistant	0.93	
11.	Housley, Harold	Archivist	1.00	
12.	Housley, Sara	Center Clerk	0.05	
13.	Johnson, Ann	Archeologist	0.99	
14.	Reid, Charissa	Cultural Anthropologist	0.14	
15.	Schumacher, Michael	Archeology Technician	0.19	
16.	Sucec, Rosemary	Cultural Anthropologist	0.96	
17.	Tustanowski-Marsh, Steve	Museum Technician	0.12	
18.	White, Katie	Cultural Resources Assistant	0.35	
19.	Whittlesey, Lee	Historian	1.00	
20.	Historic Structures	Preservation Projects Assistance (Maint.)	-	2.44
Cultural Resources Branch FTE			12.58	2.44

Natural Resources Branch

Natural Resources Administration

1.	Olliff, Tom	Chief of Natural Resources	1.00	
2.	Wyman, Becky	Administrative Support Assistant	1.01	
3.	Winter Use	Monitoring Assistance (RMVP & Maint.)		
<i>subtotal NR Admin FTE:</i>			2.01	0.97

Fisheries and Aquatic Resources

1.	Arnold, Jeff	Ecologist	0.99	
2.	Bigelow, Pat	Fishery Biologist	0.95	
3.	Bywater, Tim	Administrative Support Assistant	0.13	
4.	Doepke, Phil	Biological Science Technician	1.00	
5.	Erickson, Jeremy	Biological Science Technician	0.43	
6.	Ertel, Brian	Biological Science Technician	0.91	
7.	Facendola, Joe	Biological Science Technician	0.54	
8.	Hutchinson, Hunter	Biological Science Technician	0.26	
9.	Johnson, Krisinda	Biological Science Technician	0.08	
10.	Jones, Michael	Biological Science Technician	0.03	
11.	Kavanagh, Maureen	Biological Science Technician	0.06	

		FTE	Borrowed FTE	
12.	Keep, Shane	Biological Science Technician	0.06	
13.	Koel, Todd	Sprv. Fishery Biologist	1.00	
14.	Legere, Nicole	Biological Science Technician	1.00	
15.	Mahony, Dan	Fishery Biologist	1.00	
16.	McKinney, Mary	Administrative Support Assistant	0.31	
17.	Naughton, Joe	Biological Science Technician	0.42	
18.	Olson, Kevin	Biological Science Technician	0.44	
19.	Olszewski, Brad	Biological Science Technician	0.54	
20.	Romankiewicz, Chris	Biological Science Technician	0.42	
21.	Rowdon, Barb	Biological Science Technician	0.09	
22.	Schamberry, Nicole	Biological Science Technician	0.42	
23.	Sefton, Melinda	Maintenance Worker	-	0.08
24.	Sigler, Stacey	Biological Science Technician	0.50	
25.	Swanke, Denice	Administrative Support Assistant	0.58	
26.	Varian, Anna	Biological Science Technician	0.43	
27.	Wethington, Don	Small Craft Operator	0.59	
	<i>subtotal Aquatic Resources FTE:</i>	13.18	0.08	

Geology and Physical Sciences

1.	Brickl, Melissa	Physical Science Technician	0.18	
2.	Heasler, Hank	Geologist	1.00	
3.	Iobst, Ben	Physical Science Technician	0.15	
4.	Jaworowski, Cheryl	Geologist	0.96	
5.	Miller, Steve	Physical Science Technician	0.25	
6.	Ross, Tara	Sprv. Park Ranger	-	0.01
	<i>subtotal Geology FTE:</i>	2.54	0.01	

Vegetation Management

1.	Anderson, Heidi	Botanist	0.83
2.	Hektner, Mary	Resource Management Specialist	1.00
3.	Klaptosky, John	Biological Science Technician	0.76
4.	Pecha, Vicki	Biological Science Technician	0.84
5.	Renkin, Roy	Vegetation Management Specialist	1.00
6.	Whipple, Jennifer	Botanist	0.89
	<i>subtotal Vegetation FTE:</i>	5.32	-

Wildlife Resources Team

1.	Billman, Hillary	Biological Science Technician	0.04
2.	Blanton, Doug	Biological Science Technician	1.02
3.	Chalfant, Danielle	Biological Science Aid	0.22
4.	Coleman, Louise	Biological Science Technician	0.81
5.	Coleman, Tyler	Biological Science Technician	0.51
6.	Davis, Troy	Biological Science Technician	1.03
7.	Dixon, Chris	Biological Science Technician	0.07
8.	Geremia, Chris	Biological Science Technician	1.02
9.	Guernsey, Deb	Biological Science Technician	0.97

		<u>FTE</u>	<u>Borrowed FTE</u>
10.	Gunther, Kerry Wildlife Biologist	1.02	
11.	Jones, Jennifer Biological Science Technician	1.00	
12.	Jones, Tildon Biological Science Technician	0.97	
13.	McEneaney, Terry Wildlife Biologist	1.01	
14.	McIntyre, Rick Biological Science Technician	0.51	
15.	Miller, Steve Physical Science Technician	0.49	
16.	Murphy, Kerry Wildlife Biologist	0.97	
17.	Plumb, Glenn Sprv. Wildlife Biologist	1.00	
18.	Roberts, Lori Biological Science Technician	0.34	
19.	Simenson, Monty Horse Handler	-	0.47
20.	Smith, Doug Wildlife Biologist	1.01	
21.	Smith, Jeremiah Biological Science Technician	0.35	
22.	Stahler, Dan Biological Science Technician	0.97	
23.	Stroud, Janice Biological Science Technician	0.99	
24.	Thompson, Derek Biological Science Technician	0.27	
25.	Treanor, John Biological Science Technician	0.63	
26.	Wallen, Rick Wildlife Biologist	1.00	
27.	White, P.J. Wildlife Biologist	1.00	
28.	Wyman, Travis Biological Science Technician	1.05	
	<i>subtotal Wildlife FTE:</i>	20.27	0.47
Natural Resources Branch FTE:		43.32	1.53
TOTAL YCR FY05 FTE:		72.31	3.99



Bison management crew at the Mary Mountain cabin.

APPENDIX II.

Publications, Reports, and Papers

Professional Publications

- Bangs, E., M. Jimenez, C. Niemeyer, T. Meier, V. Asher, J. Fontaine, M. Collinge, L. Handegard, R. Krischke, D. Smith, and C. Mack. 2005. Livestock guarding dogs and wolves in the northern Rocky Mountains of the United States. *Carnivore Damage Prevention News* 8:32–39.
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- Haroldson, M. A., K. A. Gunther, D. P. Reinhart, S. R. Podruzny, C. Cegelski, L. Waits, T. Wyman, and J. Smith. 2005. Changing numbers of spawning cutthroat trout in tributary streams of Yellowstone Lake and estimates of grizzly bears visiting streams from DNA. *Ursus* 16(2):167–180.
- Herrero, S., T. Smith, T. D. DeBruyn, K. Gunther, and C. A. Matt. 2005. Brown bear habituation to people—safety, risks, and benefits. *Wildlife Society Bulletin* 33(1):362–373.

- Mao, J. S., M. S. Boyce, D. W. Smith, F. J. Singer, D. J. Vales, J. M. Vore, and E. M. Merrill. 2005. Habitat selection by elk before and after wolf reintroduction in Yellowstone National Park. *Journal of Wildlife Management* 69(4):1691–1707.
- McEneaney, T. 2004. A Whooper Swan (*Cygnus buccinator*) at Yellowstone National Park, Wyoming, with comments on North American reports of the species. *North American Birds* 58(2):301–308.
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APPENDIX III.

Partnerships

Standing Partnerships

YCR staff contribute to regional, national, and international stewardship efforts by participating in the following ongoing partnerships:

Absaroka Divide Cooperative Wildlife Working Group

Partners: Shoshone National Forest, Wyoming Game and Fish Commission

Mission: to increase knowledge of species and habitats in the Absaroka Mountains along the east boundary of Yellowstone National Park, promote resource management activities, and encourage an interagency approach to problem solving and data collection and sharing

Commitment: Member agencies collaborate on wildlife monitoring and other projects inside and outside the park.

YCR representatives: P.J. White

2005 highlights: The group developed a Memorandum of Understanding to facilitate collaboration and initiated cooperative monitoring of ungulates.

Consultation with American Indian Tribes

Partners: 26 park-affiliated American Indian tribes and an additional 50 tribes that are specifically interested in bison management issues

Mission: interagency consultation with the goal of enabling the park to manage its cultural and natural resources in a culturally informed manner

Commitment: Each spring, tribes are invited for a full day's meeting to hear about the most pressing management issues in natural and cultural resources. A welcoming potluck is held, and field trips are usually offered.

YCR representative: Rosemary Sucec

2005 highlights: The park hosted a consultation meeting on May 19.



Participants in food storage box test conducted at Grizzly Discovery Center, West Yellowstone.

Ethnographic Resources Inventory (ERI) National Data Standards and Implementation Committee

Partners: NPS members include the Chief Ethnographer; Archeology and Ethnography Program Manager; representatives from the Alaska, Midwest, Northeast, and Southeast regions; the Olympic National Park ethnographer

Mission: to assess use of the ERI system, identify any needed changes, consider interface with other servicewide data systems, and address operational and conceptual needs as they arise

Commitment: telephone conference calls every quarter and on an as-needed basis, attendance at NPS ethnographers' annual meeting

YCR representative: Rosemary Sucec

2005 highlights: We continued to try new beta versions of the software and worked with the contractor who developed it to make the necessary changes.

Federal Highways Road Team

Partner: Federal Highway Administration

Mission: to ensure context-sensitive design in the

reconstruction of the park's historic roads and compliance with the National Environmental Policy Act and Endangered Species Act

Commitment: weekly conference calls, two 4-day sessions walking the road corridor along each segment to be reconstructed, winter meetings

YCR representatives: Mary Hektner, Elaine Hale

2005 highlights: The road construction project from Sylvan Pass to the East Entrance won the 2005 overall best project award from the Western Federal Lands Highway Administration.

Greater Yellowstone Area Clean Air Partnership

Partners: Grand Teton National Park; Gallatin, Custer, Beaverhead, Shoshone, Bridger-Teton, and Targhee national forests; Red Rock Lakes National Wildlife Refuge; Idaho National Environmental and Energy Laboratory; Montana, Idaho, and Wyoming Departments of Environmental Quality

Mission: to advise the Greater Yellowstone Coordinating Committee on air quality issues and to facilitate air quality program coordination and the implementation of consistent air quality management strategies

Commitment: annual meeting

YCR representative: Mary Hektner

2005 highlights: The YCR hosted the 9th annual meeting and participated in a major update of the 1999 GYA Air Quality Assessment.

Greater Yellowstone Bald Eagle Working Group

Partners: GYA state and federal government agencies, and non-governmental organizations

Mission: Established in 1982, this group monitors bald eagle productivity and other information.

Commitment: communications via e-mail

YCR representative: Terry McEneaney

Greater Yellowstone Peregrine Falcon Working Group

Partners: two peregrine falcon groups, the states of Montana and Wyoming, and the Peregrine Fund

Mission: to continue to facilitate the recovery of the peregrine falcon in the GYA

Commitment: Wyoming has an informal working group, with coordination done over the telephone.

Montana has a more formalized working group with an annual meeting.

YCR representative: Terry McEneaney

Greater Yellowstone Interagency Brucellosis Committee (GYIBC)

Partners: USDA Animal and Plant Health Inspection Service; states of Montana, Wyoming, and Idaho; InterTribal Bison Cooperative

Mission: to facilitate the development and implementation of brucellosis management plans that will sustain the free-ranging elk and bison populations in the GYA and protect the public interests and economic viability of the livestock industry in Idaho, Wyoming, and Montana

Commitment: The NPS is represented on the executive committee by the Associate Regional Director for Natural Resources and Science. YCR provides a representative for the technical subcommittee. Meetings are typically held three times a year.

YCR representative: Wayne Brewster

2005 highlights: The InterTribal Bison Cooperative was invited to participate as a non-voting member of the Executive Committee. Discussions continued to update the MOU for another five-year period.

Greater Yellowstone Trumpeter Swan Working Group

Partner: Greater Yellowstone Area agencies

Mission: to collect annual population and production data on trumpeter swans in the Greater Yellowstone Area

Commitment: Management activities are communicated between agencies at meetings.

YCR representative: Terry McEneaney

Harlequin Duck Working Group

Partner: U.S. and Canadian state, federal, and provincial agencies

Mission: to share harlequin duck information

YCR representative: Terry McEneaney

Integrated Science in Central Yellowstone

Partners: Montana State University, California State University–Monterey Bay

Mission: to build an integrated and multidisciplinary research program with the goal of advancing our

knowledge of the central Yellowstone ecosystem, supporting sound natural resource management, and communicating our knowledge and discoveries to the visiting public to enhance their experience and enjoyment of the park

Commitment: YCR is a full partner and has committed resources and staff for the project duration.

YCR representative: P.J. White

2005 highlights: We conducted a one-day symposium “Integrated Science in Central Yellowstone” at The Wildlife Society conference in Madison, Wisconsin. The program attracted more than \$500,000 in matching funds for ungulate-related activities and analyses regarding Yellowstone during FY 2005.

Interagency Bison Management Plan

Partners: USDA Animal and Plant Health Inspection Service; state of Montana Fish, Wildlife and Parks and Department of Livestock

Mission: to carry out the provisions of the 2000 plan which is designed to maintaining a wild, free-ranging bison population while minimizing the risk of transmitting the disease Brucellosis from bison to domestic cattle on public and private lands in Montana adjacent to YNP

YCR representative: Rick Wallen, Glenn Plumb

2005 highlights: Five-year status review completed.

Interagency Grizzly Bear Study Team

Partners: USGS Biological Resources Discipline; USFS; states of Idaho, Montana, and Wyoming

Mission: to conduct research needed to provide information for immediate and long-term management of grizzly bears inhabiting the GYE

Commitment: two to six meetings annually, which typically range from one to two days each

YCR representative: Kerry Gunther

2005 highlights: IGBST members provided managers with pertinent information on grizzly bear survival, mortality, cub production, population estimates, key foods, habitat, and conflicts with humans.

McLaren Mill Mine Tailings and Great Republic Smelter Reclamation

Partner: Montana Department of Environmental Quality

Mission: to address the potential reclamation of the McLaren Mill and Mine tailings sites and other water quality issues in the Cooke City, Montana, area

Commitment: meeting participation

YCR representative: Mary Hektner

2005 highlights: The USFS and EPA completed clean-up of the Republic site, and the USFS reclaimed the portion of the McLaren Mill site on USFS property. The sites were recontoured and revegetated.

Mid-sized Carnivore Inventory and Research

Partner: U.S. Forest Service

Mission: to improve research and inventory-related studies on mid-sized carnivores in the Greater Yellowstone Ecosystem

Commitment: 20 workdays

YCR representative: Kerry Murphy

2005 highlights: We constructed 28 wolverine live traps at sites distributed across the 3,500-mi² study area that will be set beginning in January 2006.

Montana Bird Records Committee

Partners: various government agencies

Mission: to review new and rare bird records, and to keep current on advances in ornithology

YCR representative: Terry McEneaney

Montana Compact Technical Oversight Committee

Partners: Montana Water Rights Compact Commission, NPS Water Resources Division

Mission: to oversee administration of the Montana Water Rights Compact, which was established in 1994 to protect geothermal features by limiting groundwater withdrawal in a designated area north of the park

YCR representative: Hank Heasler

2005 Highlights: The committee successfully lobbied Congress for funding to implement a comprehensive geothermal monitoring plan for Yellowstone.

Montana Fluvial Arctic Grayling Workgroup

Partners: Montana Fish, Wildlife and Parks

Mission: This group develops short- and long-term goals and works toward the restoration of populations in the upper Missouri basin.

Commitment: a one-day meeting each year plus any

required field activities

YCR representative: Todd Koel

2005 highlights: Yellowstone National Park has initiated research to determine the status of fluvial arctic grayling within the Gibbon River system.

National Partnership for the Management of Wild and Native Coldwater Fisheries

Partners: federal and state agencies, professional associations, and private advocacy organizations concerned with the status of wild and native fisheries in the United States

Mission: to provide leadership and recommendations for the Whirling Disease Initiative and the Montana Water Center

Commitment: one 3-day meeting each year

YCR representative: Todd Koel

2005 highlights: The Whirling Disease Initiative will continue to fund research projects with a focus on the development of tools to mitigate the effects of the disease.

Natural Resources Advisory Group

Partners: The group includes representatives from each NPS region, the central office, and field resources, and a superintendent.

Mission: to advise the Associate Director for Natural Resources, Mike Soukup, on servicewide issues

Commitment: annual meeting and between-meeting assignments

YCR representative: Tom Olliff

2006 highlights: This group met March 14–16 at Timucuan Ecological and Historical Preserve, Jacksonville, Florida. The group welcomed Bert Frost in his new role as Deputy Associate Director for Natural Resources (vice Abby Miller), discussed budget and project funding sources, GPRA/Strategic Planning goals, resource reporting (including Score Cards), and resource databases.

Neotropical Migrant Working Groups

Partners: Partners in Flight of Montana, Partners in Flight of Wyoming, Western Working Group Partners in Flight

Mission: They are currently focused on priori-

tizing species and developing conservation plans.

YCR representative: Terry McEneaney

New World Mining District Response and Restoration Project

Partners: USFS, EPA

Mission: to develop and implement certain response and natural resource restoration activities in the New World Mining District in conjunction with the states of Montana and Wyoming and public participation

Commitment: public and agency meetings related to the ongoing restoration work and review of USFS quarterly progress reports to Congress

YCR representative: Mary Hektner

2005 highlights: Environmental cleanup of the mining impacts is proceeding

Northern Yellowstone Cooperative Wildlife Working Group

Partners: Montana Fish, Wildlife and Parks; Gallatin National Forest; USGS-Northern Rocky Mountain Science Center

Mission: to protect the long-term integrity of the northern Yellowstone winter range by increasing knowledge of its species and habitats, promoting prudent land management activities, and encouraging an interagency approach to solving problems

Commitment: bi-annual meetings and work assignments on wildlife surveys and reports. Members share costs and duties for monitoring ungulates on the northern range inside and outside YNP.

YCR representatives: Glenn Plumb, P.J. White

2005 highlights: We completed cooperative counts and/or classifications of bighorn sheep, elk, pronghorn, mule deer, and mountain goats, the results of which were summarized in an annual report.

Northwest Level 1 Streamlining Group

Partners: federal land management agencies in Northwest Wyoming; U.S. Fish and Wildlife Service

Mission: to provide an expedited technical review of the effects of proposed agency projects on listed, proposed, and candidate species that are protected under the 1973 Endangered Species Act. Attendance at meetings helps YCR biologists identify and mini-

mize potential adverse effects of park activities on listed species, and greatly facilitates consultation with the U.S. Fish and Wildlife Service.

Commitment: two to four meetings per year

YCR Representative: Kerry Murphy

2005 Highlights: Murphy attended a meeting in Lander, Wyoming, and assisted Grand Teton National Park in hosting a workshop with the Canada lynx biological team in Moose, Wyoming.

Rocky Mountain Cluster Natural Resource Managers Group

Partners: Rocky Mountain Cluster NPS units

Mission: to discuss cluster resource issues and funding initiatives and receive updates on servicewide issues

Commitment: a two-day annual meeting

YCR representative: Tom Olliff

Snow Survey

Partner: Natural Resources Conservation Service

Mission: to collect snowpack and related climate information in order to monitor and help manage surface water supply derived from snowmelt in the higher mountainous areas of the West

YCR representative: Mary Hektner

Commitment: Ranger staff collect monthly snow depth and water content data January–May at five manual snow courses and 7 of 10 automated SNOTEL sites. YCR conducts resource inventories when site modifications are needed to install additional equipment.

Tauck Volunteer Program

Partners: Tauck World Discovery/Tauck Bridges

Mission: to give Tauck guests an opportunity to provide volunteer help on infrastructure preservation and maintenance projects, and to enable the park to complete projects that otherwise would not be done

Commitment: approximately one week per month during spring through fall, plus several days each month during winter

YCR representative: Herb Dawson

2005 highlights: Volunteers prepared and stained

eight employee cabins on the lower loop of the Old Faithful Lodge Cabin complex; prepared and log-oiled the Nez Perce Patrol Cabin; painted 110 fire hydrants at the Grant Village and Old Faithful developed areas; helped Maintenance personnel from the Grant subdistrict replace and stain log guardrails; cleaned the parking lot and picnic area at West Thumb Geyser Basin; and prepped and stained 500 bumper logs at campsites in the Bridge Bay Campground.

Virginia City National Historic Landmark District Stabilization Partnership

Partner: Montana Heritage Commission (MHC)

Mission: to administer the expenditure of a \$1.7 million NPS grant to the MHC and provide technical assistance and coordination with the MHC, the National Park Service, private consultants, contractors, and the Montana State Historic Preservation Commission

Commitment: three days per month

YCR representative: Herb Dawson

2005 highlights: The YCR representative reviewed plans for stabilization of the Prasch Blacksmith Shop, one of the oldest buildings in Virginia City, and oversaw stabilization of the Gilbert Brewery. New, low-impact technology called micro-piling is being used to core holes through the building, both vertically and horizontally, and then fiberglass rods are epoxied into the holes.

Wyoming Important Bird Area Technical Review Committee (WIBATRC)

Partner: Wyoming Audubon

Mission: The WIBATRC is responsible for reviewing, designating, and implementing important land tracts in Wyoming for bird conservation.

Commitment: meetings via conference call

YCR representative: Terry McEneaney

Wyoming Rare Plant Technical Committee

Mission: to coordinate activities between government agencies with rare plant responsibilities, and promote awareness of rare plants statewide

Commitment: two days per year

YCR representative: Jennifer Whipple (chair)

Yellowstone Volcanic Observatory

Partners: U.S. Geological Survey, University of Utah

Mission: to monitor Yellowstone for volcanic hazards and earthquakes using a network of seismic and GPS stations and provide real-time data to scientists and other interested persons at <http://volcanoes.usgs.gov/yvo>

YCR representative: Hank Heasler

2005 Highlights: A seismic station at Parker Peak and five continuous GPS stations were added to the network. YVO held a meeting in Salt Lake City to discuss a 10-year volcano and earthquake monitoring plan for YVO with scientists from the other four U.S. volcano observatories.



One-head pussytoes (*Antennaria monocephala* DC.), one of the native species added to the park's vascular plant list in 2005.

Project-based Partnerships

YCR staff enlist a variety of external partners from universities, federal and state agencies, non-governmental organizations, and private groups on a short-term basis to meet some of the park’s specific resource stewardship objectives. These partnerships normally last one-to-three years, are formed to achieve specific objectives, and disband when the objectives are achieved. The following partnerships were active in 2005.

Note: A list of acronyms used in this table appears on page 79.

Benefitting Program	Cooperator/ Partner	Principal Investigator	Project	Fund Source	Amount
Air, Land, and Water Resources	State of Montana (Department of Environmental Quality)	John Koerth (YCR: Mary Hektner)	Groundwater investigation for mine waste repository at McLaren tailings site	NPS-Water Resources Division	\$14,600
Aquatic Resources and Fisheries	Greater Yellowstone I&M Network	Dr. Todd Koel and Jeff Arnold (YCR)	Water quality monitoring	NPS I&M	\$26,371
Aquatic Resources and Fisheries	Greater Yellowstone I&M Network	Dr. Todd Koel (YCR)	Upper Snake River cutthroat trout inventory	NPS I&M	\$12,612
Aquatic Resources and Fisheries	Montana State University (Big Sky Institute)	Dr. Lisa Graumlisch (YCR: Dr. Todd Koel)	Yellowstone cutthroat trout watershed priorities	Yellowstone Park Foundation	\$46,389
Aquatic Resources and Fisheries	Montana State University (Ecology)	Dr. Thomas McMahon (YCR: Dr. Todd Koel and Brian Ertel)	Assessment of cutthroat trout of the upper Yellowstone River	Fish Fee	\$8,000
Aquatic Resources and Fisheries	Montana State University (Ecology)	Drs. Alexander Zale (YCR: Dr. Todd Koel)	Spatial dynamics of Arctic grayling in the Gibbon River	Fish Fee	\$33,460
Aquatic Resources and Fisheries	Montana State University (Ecology)	Lynn Kaeding (YCR: Dr. Todd Koel)	Yellowstone cutthroat trout recruitment related to stream temperature and flow	In-kind	Support as needed
Aquatic Resources and Fisheries	Montana State University (Ecology)	Dr. Billie Kerans (YCR: Dr. Todd Koel)	Examination of Yellowstone cutthroat trout infection risk as part of the Yellowstone NP whirling disease study	Fee Demonstration, Fish Fee	\$33,839
Aquatic Resources and Fisheries	Montana State University (Ecology)	Drs. Todd Koel (YCR), Dr. Billie Kerans, Silvia Murcia	Development and testing of risk assessment tools for whirling disease infection	MT/USFWS Whirling Disease Initiative	\$49,690
Aquatic Resources and Fisheries	Montana State University	Dr. Todd Koel (YCR), Gretchen Rupp	Use of high-resolution thermal imagery to locate <i>Tubifex tubifex</i> in Pelican Creek	MT/USFWS Whirling Disease Initiative	\$36,925

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source	Amount
Aquatic Resources and Fisheries	Montana State University	Dr. Todd Koel (YCR), Gretchen Rupp	Role of birds as a dispersal vector for whirling disease	MT/USFWS Whirling Disease Initiative	\$ 17,599
Aquatic Resources and Fisheries	Montana State University	Crystal Hudson (YCR: Dr. Todd Koel)	Laboratory assessment of Yellowstone cutthroat trout whirling disease infection	MT/USFWS Whirling Disease Initiative	\$ 12,914
Aquatic Resources and Fisheries	Sun Ranch (Madison Valley, Montana)	Roger Lang, Buddy Drake (YCR: Dr. Todd Koel)	Westslope cutthroat trout broodstock development	Fish Fee	\$5,000
Aquatic Resources and Fisheries	State of Wyoming (Fish and Game)	Steve Yekei, Jason Burckhardt (YCR: Dr. Todd Koel, Brian Ertel)	Life history of Yellowstone cutthroat trout of the upper Yellowstone River	Fish Fee	\$ 11,040
Aquatic Resources and Fisheries	State of Wyoming (Fish and Game)	Jim Barner, Steve Sharon (YCR: Dr. Todd Koel)	Establishment of Yellowstone cutthroat trout broodstock in Wyoming	In-kind	Staff support as needed
Aquatic Resources and Fisheries	University of Wyoming (Wyoming Cooperative Fish and Wildlife Unit)	Dr. Wayne Hubert (YCR: Dr. Todd Koel and Pat Bigelow)	Predicting lake trout spawning areas in Yellowstone Lake	ONPS-Lake Trout	\$29,268
Aquatic Resources and Fisheries	University of Wyoming (Zoology and Physiology)	Dr. Bob Hall, Dr. Todd Koel (YCR), Lusha Tronstad	Trophic consequences of lake trout and whirling disease invasion of Yellowstone Lake	In-kind	logistic support as needed
Aquatic Resources and Fisheries	USFS, GYCC	Mary Maj (YCR: Dr. Todd Koel)	Fine-spotted cutthroat assessment	GYCC	\$ 1,500
Aquatic Resources and Fisheries	USGS-FCRU	Dr. Al Zale (YCR: Dr. Todd Koel and Dan Mahony)	Status of Arctic grayling in the Gibbon River system	Fish Fee	\$40,000
Archeology	University of Wyoming (OWSA)	David Eckles, Elaine Hale (YCR)	Data recovery at Frying Pan Spring	FHWA	\$ 122,000
Archives	University of Colorado at Boulder (Library Administration)	Colleen Curry and Harold Housley (YCR)	Save America's Treasures: consolidation, inventory, and re-housing of Yellowstone NP's architectural drawings	NPS, National Endowment for the Arts, National Endowment for the Humanities	\$60,000
Bears	University of Calgary (Environmental Science), USGS (Alaska Biological Science Center), NPS Alaska Support Office, Alaska Fish and Game	Dr. Stephen Herrero, Tom Smith, Terry DeBruyn, Colleen Matt (YCR: Kerry Gunther)	Brown bear habituation to people: safety, risks, and benefits	University of Calgary, ONPS, Alaska Fish and Game	Participant salaries
Bears	USGS-BRD (IGBST)	Dr. Charles Schwartz, Mark Haroldson (YCR: Kerry Gunther)	Black bear demographics in Yellowstone NP	USGS, ONPS Base	As time is available

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source	Amount
Bears	USGS-BRD (IGBST), Montana Fish, Wildlife and Parks, Grand Teton National Park, Idaho Fish and Game	Kerry Gunther (YCR), Mark Haroldson, Kevin Frey, Steve Cain, Jeff Copeland, Dr. Charles Schwartz	Grizzly bear-human conflicts in the Greater Yellowstone Ecosystem	ONPS, USGS-BRD, State of Montana, State of Idaho	Participant salaries
Bears	USGS-BRD (IGBST), University of Idaho	Mark Haroldson, Dan Reinhart, Shannon Podruzny, Chris Cegelski, Lisette Wait (YCR: Kerry Gunther, Travis Wyman, Jeremiah Smith)	Estimates of grizzly bear numbers visiting Yellowstone Lake spawning streams	USGS-BRD, ONPS, University of Idaho	Participant salaries
Bears	Washington State University, USGS-BRD (IGBST), University of Idaho	Laura Felicetti, Dr. Charles Schwartz, Robert Rye, James Crock, Mark Haroldson, Lisette Waits, Charles Robbins (YCR: Kerry Gunther)	Use of naturally occurring mercury to determine the importance of cutthroat trout to Yellowstone grizzly bears	University of Washington, USGS-BRD, ONPS, University of Idaho	Participant salaries
Bears	Washington State University, USGS-BRD (IGBST)	Charles Robbins, Dr. Charles Schwartz, Robert Rye (YCR: Kerry Gunther)	Use of stable isotopes and trace elements to understand effects of long-term changes in grizzly bear food resources	Yellowstone NP	\$6,500
Bison	Russian Federation Ministry of Health, USDA-ARS, Texas A&M University	Drs. Alexander Denisov, Glenn Plumb (YCR), Steven Olsen, and Gary Adams	Comparative studies of immunobiological characteristics of live brucellosis vaccines	U.S. State Department, Turner Foundation-Nuclear Threat Initiative	\$1,200,000
Bison	University of Calgary, University of Montana	Drs. Cormack Gates, Len Broberg, Glenn Plumb (YCR)	Bison movement and dispersal	NPS	\$339,212
Bison	U.S. Animal Health Association	Drs. Rick Willer, Bret Marsh, Glenn Plumb (YCR)	An initiative to enhance brucellosis vaccines, vaccine delivery, and surveillance diagnostics for bison and elk	NPS, USFWS, USGS-BRD, USDA-APHIS	\$150,000
Bison	Ballistic Technologies, Inc.	Rick Wallen (YCR), Dr. Rick Hansen	Accuracy of pneumatic remote delivery equipment	USGS-BRD (paid out in FY04), ONPS-Bison	\$96,000
Bison	Montana State University (Ecology)	Dr. Robert Garrott, Rick Wallen (YCR), Jason Bruggeman	Spatial dynamics of the central Yellowstone bison herd	Montana State University ONPS-Bison (paid in FY02)	\$92,000 \$72,000
Bison	Montana State University (Ecology)	Drs. Robert Garrott and P.J. White (YCR), Julie Fuller, Rick Wallen (YCR)	Bison demography in relation to groomed roads during winter	ONPS-Winter Use Monitoring (paid out in FY04)	\$49,000
Bison	USDA-APHIS	Rick Wallen (YCR), Dr. Ryan Clarke	Rate of brucellosis exposure in Yellowstone bison	USDA-APHIS, ONPS-Bison Management	\$26,000
Bison	University of Kentucky	Philip Crowley (YCR: John Treanor, Rick Wallen)	Effects of vaccination on brucellosis prevalence	University of Kentucky (paid out in FY04) ONPS-Bison	\$5,000 \$20,500

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source	Amount
Bison	University of Montana	Fred Allendor (YCR: Rick Wallen)	Conservation genetics of bison	University of Montana (paid out in FY04) ONPS-Bison	\$45,000 \$5,875
Ethnography	Bear Creek Council	Rosemary Sucec (YCR)	Support for the potluck welcoming American Indian tribes to Yellowstone	Bear Creek Council, Yellowstone NP	in-kind
Ethnography	Nez Perce National Historic Trail, Confederated Tribes of the Colville Indian Reservation, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe	Sandi McFarland (NPNHT), Linda Young (Division of Interpretation) (YCR: Rosemary Sucec)	Planning for 2006 meeting with tribal representatives and scholars to identify interpretive themes for Yellowstone segment of the trail	National Endowment for the Humanities via the Yellowstone Park Foundation	\$10,000
Ethnography	University of Montana	Greg Campbell (YCR: Rosemary Sucec)	Ethnographic Resources Inventory	CESU	\$5,000
Geographic Information Systems	Montana State University (Thermal Biology Institute), Western Oregon University, USGS, Portland State University, Idaho National Engineering & Environmental Laboratory, University of New Mexico	Drs. William Inskip, Sarah Boomer, Darrell Nordstrom, Anna-Louise Reyensbach, Frank Roberto, Cristina Takacs-Vesbach, Ann Rodman (YCR)	Create a research coordination network for geothermal biology and geochemistry in Yellowstone	National Science Foundation	\$100,000
Geographic Information Systems	University of New Mexico, Portland State University, USGS	Drs. Cristina Takacs-Vesbach, Anna-Louise Reyensbach, & Kirk Nordstrom, Ann Rodman (YCR)	A microbial inventory of Greater Yellowstone Ecosystem features	National Science Foundation	\$150,000
Geology	University of Utah (Geology and Geophysics)	Dr. Robert Smith (YCR: Dr. Henry Heasler)	Seismic and GPS monitoring of Yellowstone	ONPS-Geology	\$14,400
Geothermal	Montana State University	Dr. Rick Lawrence (YCR: Dr. Henry Heasler)	Detection of radiative thermal flux change	Montana State University	\$40,000
Geothermal	University of Montana	Carl Seielstad (YCR: Dr. Henry Heasler)	Thermal remote monitoring of Norris Geyser Basin	ONPS-Geology	\$40,000
Geothermal	USGS-Menlo Park, Yellowstone Volcano Observatory	Jake Lowenstern (YCR: Dr. Henry Heasler)	Geothermal gas monitoring	ONPS-Geology	\$14,500
Geothermal	Utah State University	Christopher Neale (YCR: Dr. Henry Heasler)	Mapping thermal springs in geyser basins	ONPS-Geology	\$64,954
Geothermal/ Montana Water Compact	State of Montana (Bureau of Mines and Geology)	Edmond Deal (YCR: Dr. Henry Heasler)	Controlled groundwater area <ul style="list-style-type: none"> Monitoring Database administration 	ONPS-Geology ONPS-Geology	\$25,534 \$141,000

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source	Amount
Geothermal/ Montana Water Compact	State of Montana (Natural Resources and Conservation)	Bud Clinch (YCR: Dr. Henry Heasler)	Yellowstone controlled groundwater area water rights administration	ONPS-Geology	\$23,000
Geothermal/ Montana Water Compact	USGS-WRD (Montana District)	Drs. Robert Davis (YCR: Dr. Henry Heasler)	Assess water discharge and selected chemical and physical parameters of waters in Yellowstone NP	USGS-WRD, ONPS-Geology	\$61,400
Geothermal/ Montana Water Compact	USGS-WRD (Utah District)	David Susong (YCR: Dr. Henry Heasler)	Hydrologic assistance in administering the compact and with other issues	USGS-WRD, ONPS-Geology	\$14,400
Historic Buildings	Montana Preservation Alliance	Chere Jiusto (YCR: Herb Dawson)	Stabilization of historic buildings in Yellowstone NP		\$88,151
Lynx Project	A Naturalist's World	Dr. Kerry Murphy (YCR), Dr. James Halpenny, Kerry Gunther (YCR)	Presence and distribution of lynx in Yellowstone	NPS, Yellowstone Park Foundation, National Fish and Wildlife Foundation	\$20,000
Museum	Montana State University Stanford University	Michael Cary (YCR: Colleen Curry)	Internship program for museum techs	Yellowstone Park Foundation	\$12,741 \$1,986
Natural Resources	Montana Conservation Corps	Mary Hektner (YCR)	Turbid Lake Road restoration	Canon U.S.A., Inc.	\$5,600
Research	University of Wyoming-NPS Research Center	Dr. Henry Harlow, Dr. Glenn Plumb (YCR)	Cooperative research program support	ONPS-Research	\$5,750
Spatial Analysis Center	Greater Yellowstone I&M Network	Ann Rodman (YCR)	NPSPECIES database: Invertebrates	NPS I&M	\$2,400
Vegetation	Colorado State University (Forest, Rangeland, and Watershed)	Dr. David Cooper (YCR: Mary Hektner)	Fens of YNP: identification, classification, geochemistry, floristics, and vegetation	Canon USA, Inc., ONPS-Vegetation	\$54,100 for 2-yr study; \$10,000 ONPS
Vegetation	Greater Yellowstone I&M Network	Rob Daley, Jennifer Whipple (YCR)	NPSPECIES database: Vascular Plant Certification	NPS I&M	\$5,440
Vegetation	Greater Yellowstone I&M Network	Jennifer Whipple (YCR)	Alpine plant inventory	NPS I&M	\$3,258
Vegetation	Montana State University (Biology)	Dr. Tad Weaver, Ken Aho (YCR: Mary Hektner)	Characterization of alpine vegetation on the northeast corner of YNP	ONPS-Vegetation	\$40,000 in FY99 ; \$6,500 in FY03
Vegetation	Montana State University (Center for Invasive Plant Management)	Janet Clark (YCR: Mary Hektner)	Conduct Gardiner Basin native vegetation/ungulate winter range restoration workshop	Yellowstone Park Foundation, GYCC, RM-CESU	\$17,500

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Vegetation	Oregon State University, University of Wisconsin at Stevens Point	Drs. William Ripple, Eric Larsen (YCR: Dr. Doug Smith, Roy Renkin)	Aspen regeneration on Yellowstone's northern range	ONPS	\$5,000
Vegetation	RM-CESU, Colorado State University	Drs. David Cooper, Tom Hobbs (YCR: Roy Renkin)	Persistence of willows on Yellowstone's northern range	ONPS-Vegetation, ONPS-Wildlife, Fee Demonstration	\$51,712
Vegetation	RM-CESU, Montana State University	Dr. Andrew Hansen, Lisa Baril (YCR: Roy Renkin, Terry McEneaney, Dr. Doug Smith)	Bird reponse to willow release on Yellowstone's northern range	Fee Demonstration	\$8,000
Vegetation	University of Montana (Flathead Biological Station), Yellowstone Ecological Research Center	Dr. Robert Crabtree (YCR: Roy Renkin)	Use of multispectral, remotely-sensed imagery to map willow distribution in northern Yellowstone	USGS-BRD, NRPP	\$20,000
Vegetation	USGS-BRD, Brigham Young University	Dr. Don Despain, Dr. Rex Cates (YCR: Roy Renkin)	Temperature influence on willow growth and phenolic production	ONPS-Vegetation, USGS Park-Oriented Biological Support, Fee Demonstration	\$44,250
Vegetation	USGS-BRD, University of Wisconsin-Stevens Point	Dr. Don Despain, Roy Renkin (YCR), John Klapotosky (YCR), Dr. Eric Larsen	Browse history of tree-sized aspen on Yellowstone's northern range	Fee Demonstration	\$19,134
Vegetation	USGS-BRD	Robert Stottlemeyer, Linda Zeigenfuss (YCR: Dr. P.J. White, Dr. Doug Smith, Roy Renkin)	Willow persistence and distribution following wolf reintroduction	USGS-BRD, NRPP	\$50,000
Vegetation/Wildlife	Natural Resources Conservation Service, Bridger Plant Center, Montana Conservation Corps	Mary Hektner (YCR)	Restore native vegetation/pronghorn habitat at HRC site	Yellowstone Park Foundation (Coin Fund), DOI Cooperative Conservation Initiative	\$108,000 (5-year project)
Wildlife	Idaho State University; USGS Amphibian Research and Monitoring Initiative	Dr. Chuck Peterson; Steve Corn	Amphibian Monitoring	NPS I&M	\$35,000
Wildlife	Montana State University (Ecology)	Dr. Robert Garrott (YCR: Dr. P.J. White)	Collaborative ungulate habitat and population monitoring	ONPS-Ungulates, Winter Use, Bison	\$31,400
Wildlife	University of Idaho	Drs. P.J. White (YCR), John Byers, Kerey Barnow-Meyer	Conservation of the declining Yellowstone pronghorn population	RM-CESU	\$15,000

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Wildlife	University of Minnesota (Fisheries and Wildlife), USGS-BRD	Dr. P.J. White (YCR), Dr. David Mech, Shannon Barber	Monitoring elk calf mortality	NRPP Natural Resources Management, USGS Park-Oriented Biological Support	\$58,000
Wildlife	University of Minnesota (Ecology)	Dr. Glenn Plumb (YCR), Dr. Craig Packer, Dan McNulty	Conduct wildlife research in conjunction with remote Canon cameras (Canon Eyes on Hayden Project)	Yellowstone Park Foundation/Canon, U.S.A., Inc.	\$96,000
Wildlife	University of Montana (Economics)	Dr. John Duffield (YCR: Dr. Glenn Plumb)	What price Yellowstone? The role of wolves in the regional economy	Yellowstone Park Foundation	\$144,000
Wildlife	University of Wyoming- Wyoming Natural Diversity Database	Gary Beauvais and Douglas Keinath	Ana Bat data analysis	NPS I&M	\$1,250
Wildlife	University of Wyoming- Wyoming Natural Diversity Database	Gary Beauvais and Douglas Keinath	NPSPECIES database: certification	NPS I&M	\$9,630
Wildlife	USGS-NPWRG	Jay Hestbeck (YCR: Dr. Glenn Plumb)	Trumpeter swan data analysis		\$7,000
Winter Use	Montana State University (Ecology)	Dr. P.J. White (YCR), Dr. John Borkowski, Dr. Scott Creel, Dr. Robert Garrott, Amanda Hardy	Motorized winter recreation and glucocorticoid stress responses in elk	ONPS-Winter Use Monitoring	\$4,500
Winter Use	Montana State University (Ecology)	Dr. Robert Garrott (YCR: Dr. P.J. White)	Evaluating the abundance, distribution, and stress hormones of ungulates in relation to winter human use in west-central Yellowstone NP	ONPS-Winter Use Monitoring	\$8,000
Winter Use	Montana State University (Mathematical Sciences)	Drs. John Borkowski, P.J. White (YCR), and Robert Garrott	Evaluating wildlife responses to motorized winter use in Yellowstone NP, 1998-2004	ONPS-Winter Use Monitoring	\$10,000
Winter Use	State of Montana (Department of Environmental Quality)	Elton Erp (YCR: Mary Hektner)	Air quality monitoring at West Entrance	ONPS-Winter Use Monitoring	\$2,890
Winter Use	USGS-WRD (Central Region, Denver)	George Ingersoll, Jeff Arnold (YCR)	Correlation of heavy metals deposition in snowpack and snowmachine use	ONPS-Winter Use Monitoring	\$15,000

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source	Amount
Wolverine Project	USFS-RMRS; Gallatin National Forest; Shoshone National Forest	Dr. Kerry Murphy (YCR)	Ecological assessment of wolverines in the Absaroka-Beartooths	YPF, USFS-RMRS, USFS Carnivore Program, RM-CESU, Gallatin National Forest, Shoshone National Forest	\$190,000
Yellowstone Center for Resources	California State University–Monterey Bay, Montana State University (Ecology)	Drs. Fred Watson, Robert Garrott, Susan Alexander (YCR); Dr. P.J. White and Rick Wallen)	Integrated natural science research program for the central Yellowstone ecosystem	NASA	\$2,500,000 (for 5 years)
Yellowstone Center for Resources	University of Oregon	Dr. Andrew Marcus, Jim Meacham, Ann Rodman (YCR)	Atlas of Yellowstone project	Yellowstone NP, University of Oregon	\$10,000
Yellowstone National Park	Montana State University (Big Sky Institute), U.S. Agency for International Development, Colorado State University, Montana Fish, Wildlife and Parks, Tanzania National Parks	Drs. Lisa Graumlich, Glenn Plumb (YCR), Robin Reid, Michael Coughenour, Kurt Alt, and Emmanuel Gereta	A proposal to strengthen collaborations between researchers and managers working in and around Yellowstone and Serengeti parks	U.S. Agency for International Development (Global Livestock Collaborative Research Program)	\$100,000

Acronyms

FHWA: Federal Highway Administration
GRYN: Greater Yellowstone Inventory and Monitoring Network
GYCC: Greater Yellowstone Coordinating Committee
IMR: Intermountain Region
NASA: National Aeronautics and Space Administration
NPS: National Park Service
ONPS: Operation of the National Park Service
ONPS-CRPP: Operation of the National Park Service-Cultural Resources Preservation Program
OWSA: Office of the Wyoming State Archaeologist
RM-CESU: Rocky Mountains Cooperative Ecosystem Studies Unit
USDA-APHIS: U.S. Department of Agriculture-Animal and Plant Health Inspection Service
USDA-ARS: U.S. Department of Agriculture-Agricultural Research Service
USFS: U.S. Forest Service
USFS-RMRS: U.S. Forest Service Rocky Mountain Research Station
USFWS: U.S. Fish and Wildlife Service
USGS: U.S. Geological Survey
USGS-BRD: U.S. Geological Survey Biological Resources Discipline
USGS-BRD (IGBST): U.S. Geological Survey Biological Resources Discipline, Interagency Grizzly Bear Study Team
USGS-FCRU: U.S. Geological Survey Fish Cooperative Research Unit
USGS-WRD: U.S. Geological Survey Water Resources Discipline
YCR: Yellowstone Center for Resources