YELLOWSTONE
CENTER FOR RESOURCES

2006 ANNUAL REPORT

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

YCR–2007–03

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

Cover photos: *center,* boreal toad at High Lake (NPS); *clockwise from top,* Matt Metz (foreground) and Rick McIntrye observe a wolf–wolf clash (NPS); a pygmy owl (Terry McEneaney); wagon and mules on Slough Creek (NPS); Nez Perce drummer at the 3rd annual Nez Perce pipe ceremony along the Firehole River (NPS).

Contents

Centaurea repens.

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 (YCR) works to fulfill these responsibilities for the resources we are mandated to manage and protect. The biggest change in the YCR during 2006 was the February retirement of Director John D. Varley, who had lead the division since 1993. In May, I was selected as the new YCR chief—big shoes to fill, indeed.

During 2006, bison and grizzly bear population numbers in the park were similar to 2005, the wolf population rebounded from a decline as a result of disease in 2005, and the northern Yellowstone elk population continued to decrease in number. More than 59,000 non-native lake trout were removed from Yellowstone Lake, bringing the total number removed to almost 200,000 during 1994–2006. The *Servicewide Benefits-Sharing Draft Environmental Impact Statement* was released for public comment to examine the issue of whether the NPS should share in potential scientific and economic benefits when researchers studying park resources discover or invent something commercially valuable from their research involving NPS specimens.

Almost 3,000 people used the Heritage and Research Center in 2006. Park archeological staff made two discoveries of stone used in prehistoric tools and their associated workshops that are changing how we view the movements of prehistoric peoples in the park. The Greater Yellowstone Science Learning Center was accepted into the national NPS Research Learning Center program, and YCR staff continued to develop the learning center website in cooperation with partners.

YCR's partnerships and agreements with other federal and state agencies, academia, and public organizations continued to be critical to our successes in stewardship. In 2006, the Yellowstone Volcano Observatory (a partnership between the park, the U.S. Geological Survey, and the University of Utah) published a 10-year monitoring plan for the Yellowstone Volcano. The YCR also continued to benefit from the hard work of many volunteers. Research Permit Office (RPO) staff authorized more than 200 research permits to investigators from across the U.S. and foreign countries.

For more information, 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

Nez Perce drummer at the 3rd annual Nez Perce pipe ceremony along the Firehole River.

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

Archeology

Archeology in Yellowstone National Park (YNP) 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. 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.

Inventory

To prevent inadvertent damage to archeological resources, we worked with the Fire Cache to complete inventories in sites where hazard fuel reduction projects were planned near Norris Junction and Madison Junction.

As part of ongoing assessment efforts, we revisited 257 documented sites during the summer to obtain information about their current condition. We completed the fieldwork for the inventory of the south shore of Yellowstone Lake which is being funded by the Yellowstone Park Foundation and made progress on the report to be completed in 2007. Nearly 100 sites have been recorded between West Thumb and Trail Creek at the Yellowstone River delta. We also continue to add documented sites to the park's Archeological Sites Management Information System database, which now includes 1,467 sites.

Stone Raw Materials

The park archeological staff made two discoveries of stone used in prehistoric tools and their associated workshops this summer that are enabling us to refine questions about the prehistoric use of stone resources in and around the park. The larger source is a 1.6-mile-long exposure of Absaroka Volcanics bedrock that contains seams, nodules, and pockets of cherts and chalcedonies. We distinguish between these two materials largely by whether the material is opaque or translucent. The areas with high silica concentrations show pounding to knock off usable pieces and shallow excavations to follow veins of this material. The activity could be considered mining, which had not been previously identified for non-obsidian materials in the park. The areas around the local sources contain stone that was discarded. This raw material source varies broadly in color, including shades of brown, grey, red to pink, white, blue, and green. Some have inclusions of crystals or bands of different colors. We recognize stone with several unique color combinations from this source as occurring as artifacts in archeological sites along the Yellowstone River.

The second source, located near the Northeast Entrance, represents a large stone workshop that used chert cobbles found in the local gravels and probably also obtained from local limestone cliff mountains. This possibility is suggested by several large rockfall sections that contained chert nodules that could have been worked. The color of this material ranges from grays to off-whites.

These raw material source areas and the expectation that we will find more of them in the park is changing how we view the movements of prehistoric peoples in the park. Now we know they did not have to leave the park in order to obtain quality non-obsidian stone for tools. Other cherts were brought into the park by early visitors and more work is needed to distinguish between local and non-local materials. Unfortunately, cherts and chalcedonies cannot be as easily and inexpensively fingerprinted as obsidian is. We do not know the time period(s) during which these stone sources were used, but examination of artifacts from several Yellowstone River Canyon excavations could provide data relevant to this question.

Analysis of Artifacts Recovered Near Frying Pan Springs

The final phase of analysis of the 50,000+ artifacts recovered from the excavation of a precontact campsite in the thermal area near Frying Pan Springs began in 2006. Physical, chemical, botanical, and geophysical analysis of the artifacts and geological data from the site was coordinated by the Office of the Wyoming State Archaeologist. Statistical analysis of the flake stone debris and some additional chemical analysis of the thermal soils will be completed in 2007 prior to drafting the final report. A highlight of the 2006 analysis was the protein residue analysis of selected artifacts conducted by the Laboratory of Archaeological Sciences, California State University, which revealed that people camped at this site 2,200 years ago had a varied diet of plants and meat and were using tools to process a variety of substances. Antiserum tests of the residues identified mountain sheep, bear, mountain lion (or bobcat), gallinaceous fowl (such as quail or grouse), deer, bison, beaver or porcupine, rabbit, and rats. Plant food residue included amaranth or pigweed, cactus, camas, wild onion, beeplant, stinkweed, goosefoot, greasewood, pickleweed, and grasses. Pine and cedar residues were also identified on the tools, indicating that the people were using flaked stone tools to work wood and likely hafting stone points onto dart throwers (atlatls) using pine tar. Cultural resource staff presented information about the archeological data recovered from this site at the Plains Anthropological Conference in Topeka, Kansas.

Bannock Trail Clarification

Volunteers Bob Flather and Mike Robinson, who have been researching early roads in the park for several years, have traced the 1879 Cooke City Mining Road from Mammoth to the Northeast Entrance. Their extensive research in the park archives turned up a 1906 map of the newly constructed highway and the nearby miners' road between Mammoth and Blacktail Deer Creek by the University of Illinois Civil Engineering Department. Comparing this map with the 1956 description of the Bannock Trail by Wayne Replogle's 1956 map shows that Replogle misidentified the Cooke City Mining Road as the trail. Further examination of where the trail is believed to be shows road cuts and other evidence that are incompatible with identification of an aboriginal trail. Investigations in 2000 on the west side of the park and in 2006 in the Gallatin Mountains also failed to identify traces of this trail. Archeologists agree Indians were using trails (perhaps game trails) in the park, but no evidence of aboriginal trails have been identified yet. Although the mythology associated with a Bannock Trail across the park is strong, it seems unlikely that there will be physical evidence to associate an aboriginal trail with the Bannock Indians. Consultation with the Shoshone-Bannock Tribes (see Ethnography section) may shed some additional light on this matter.

Nez Perce Trail

With funding from the Yellowstone Park Foundation, we examined five locations where the Nez Perce were believed to have encountered tourists or to have camped during their flight across the park in 1877 (see Ethnography section). We were able to identify artifacts from that time period at four of the locations; however, only one area could be confidently associated with the Nez Perce. At other

These rosettes were designed for an Army officer's bridle and were found where General O. O. Howard's horse herd probably grazed on the Yellowstone River in 1877.

Volunteer Robin Szamuhel on the large quarry site.

locations we believe we found evidence of a camp of General O. O. Howard (who was chasing the Nez Perce) and of dude pack trips (Valley Ranch, Camp Trails, and maybe others) that were popular from the 1920s to 1940s. We gained valuable experience in getting to know the Nez Perce who participated in the inventory, becoming more familiar with the historical literature about their 1877 flight, and in clarifying the kinds of evidence and artifacts that the early sites could contain. This was a pilot project that will help us plan for a three-year inventory of the entire Nez Perce trail across the park beginning in FY08.

Development of an Archeological Field School

Cultural resource staff worked with University of Montana professors to explore the possibility of an on-going archeological field school to inventory and document precontact and historical sites in the Montana portion of the park. The Rocky Mountains Cooperative Ecosystem Studies Unit in Missoula and the University of Montana provided the seed money to begin the survey in field season 2006. Cultural resource staff reviewed the research proposal and submitted funding requests to continue the field work during the 2008 season.

Public Involvement and Volunteer Support

In addition to Bob Flather and Mike Robinson, five other volunteers greatly aided in the archeology program. Diane Hargreaves (Bozeman) cataloged artifacts and entered them into the NPS Re-discovery program. Robin Szamuhel (Alberta, Canada), John Reynolds (Virginia), and Stanford intern Brian Quinn worked in the lab when not in the field helping with field condition assessments and site documentation. Mary Meagher shared her knowledge of the park and assisted with backcountry inventories.

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 NPS. 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, while the library contains more than 20,000 volumes related to Yellowstone's history, past and present.

View of the rare book storage in the HRC.

The goal of the archives and museum program is to properly preserve and document the park's cultural and natural history, 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. Because of this affiliation, the park retains permanent federal records on-site rather than transferring records to NARA records centers and facilities. In addition to federal records, the archives also includes donated historical records

and collections, records of park concessioners, and an extensive oral history collection. The archives and museum collections are heavily used by park staff and outside researchers studying all aspects of park history.

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. Through the Wyoming Library Database (WYLD) of the Wyoming Library Consortium, 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.

Collection Conservation

Through the Yellowstone Park Foundation, the Mercer Endowment provided funding for a photograph conservator from Harpers Ferry Center to spend two weeks in Yellowstone assessing the condition of the park's photograph and film collection. Theresa Voellinger examined an extensive sample of the 90,000-item collection, including the archives film collection, and provided hands-on training for staff in humidifying and flattening photographs and oversized maps and documents. To help ensure that the pieces most at risk receive the proper conservation treatment with minimum loss of historic fabric, her report included recommendations on treatment proposals for the more at-risk items and storage improvement.

Assisting Researchers

The archives served 251 on-site researchers (including 118 NPS employees) during 2006 as well as responded to 321 telephone, e-mail, and written research requests. The library assisted 1,065 on-site patrons and answered almost 250 reference requests by phone and e-mail. Of the on-site researchers, 239 were NPS staff, which represented a 70% increase in use by park personnel over 2005, the year the library was closed for an extended period during the move to its new location in the HRC. Museum staff assisted approximately 100 researchers with photograph requests, which resulted in the scanning of more than 800 images. A researcher with Ken Burns's Florentine Films returned in 2006 and requested 350 images in addition to the almost 500 requested during 2005 for Burns's upcoming documentary on the National Park Service.

Internships and Volunteer Support

The internship program with Montana State University (MSU) and Stanford University continued for its second year, with eight interns completing 4,810 hours of project work with the history, museum, archeology, and ethnography programs during summer 2006. Interns working with the museum program assisted with the planning and installation of a temporary exhibit at the HRC entitled "Yellowstone Through the Decades: 1890s–1960s." Plans were finalized to enlarge the program in 2007 by bringing in MSU students to work during the winter season on critical projects such as backlog cataloging and object rehousing.

Theresa Voellinger, photograph conservator from Harpers Ferry Center, teaches HRC staff how to create a hydration chamber to assist with flattening rolled photographs and documents.

View of the HRC main lobby and part of the temporary exhibit, "Yellowstone Through the Decades: 1890s–1960s," installed during the summer of 2006 by MSU and Stanford interns.

The Community Docent Program was enlarged from 3 to 21 volunteers who donated 926 hours, providing full-time coverage at the HRC reception desk and working on important projects for the archeology, archives, library, and museum programs. The Volunteer Professional Program was instituted to bring current and retired professionals to the HRC to complete project work for these programs.

Volunteer Jay Antle worked more than 200 hours inventorying the archives' 1988 fire records. Volunteers also assisted the library staff by identifying which microfiche corresponds to which scrapbook in the library holdings. Long-time volunteer Robert Flather inventoried and identified photographs in a set of 40 albums created by park personnel between the 1920s and 1960s; he also assisted the park archeologist and archivist with research projects.

Projects of Note

The archives has approximately 175 16mm films that document various aspects of park history, including Civilian Conservation Corps (CCC) activities, wildlife management, and tourism. Volunteers viewed some 100 titles of 16mm motion picture film, noting information that assisted temporary film cataloger Tara Cross in August. She created a catalog record for 68 of the films, which will now be accessible to all researchers, and compiled a prioritized list for future digitization projects.

The archivist updated information on the park's archives website and revised 10 online finding aids to provide a more systematic and standardized description of the park's holdings.

The most frequently sought information in the archives and library is about former Yellowstone employees. As envisioned by the archivist and librarians, Roger Whiteside of Computer Support Services developed an Access database that incorporates the payroll records of former employees, personnel rosters, staff listings, and organizational charts. Volunteers have so far entered 4,000 records, including the names of former Park Service and concessioner employees and where they worked in the park, which are proving to be a useful tool for genealogical researchers.

Shaffner's Bindery in Missoula, Montana, bound 218 theses and dissertations as well as 48 journals for the library and created 130 custom archival clamshell boxes to house rare books.

Outreach and Assistance to Other Divisions and Parks

Almost 3,000 people used the HRC during 2006 for public and special tours, meetings in the conference rooms, appointments with collections personnel, and library patronage. In 2006 public tours of the facility were offered for the first time—61 tours for 595 people from June 14 to September 5. These tours were well received and helped to raise public awareness of the HRC and its mission.

Archives, library, and museum staff assisted the Division of Planning, Compliance and Landscape Architecture with the Lake Charrette project by aiding MSU architecture graduate students in conducting research and photographing plans and drawings. Archives staff also assisted the Division of Interpretation's Branch of Planning and Media by providing historic film footage for use in online video content.

In an effort to reach more volunteers and NPS and Yellowstone Association employees in the park's interior, the librarians created a bookmobile system that enables users to obtain library cards, delivers and picks up library books, and provides direct access to a lending library without having to come to the HRC. The librarians made nine trips into the park, with extended stops at the Old Faithful and Lake areas, and served more than 50 employees.

Museum staff continued to assist the Division of Interpretation with exhibit planning for the Old Faithful Visitor Education Center, and the Divisions of Business Management and Maintenance in planning for the Gardiner Transportation Complex. Staff also worked closely with the park ethnographer on the repatriation of several sets of human remains and associated funerary objects to the Eastern Shoshone and Shoshone-Bannock tribes.

Nine works of art from the park's collection were returned after being 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 traveled to the Buffalo Bill Historical Center in Cody, Wyoming, the Northwest Museum of Arts and Crafts in Spokane, Washington, and ended at the Museum of the Rockies in Bozeman, Montana, in August 2006. Moran watercolors, chromolithographs, and other Moran and William Henry Jackson items were also loaned for the "Thomas Moran: Painting the Parks" exhibit on display at the National Museum of Wildlife Art in Jackson, Wyoming, from May through October 2006 and a simultaneous exhibit at the Art Association in Jackson.

Noteworthy Accessions

A Collections Advisory Committee was formed in 2006 to monitor possible acquisitions with the goal of ensuring that, given the rising cost of curation and preservation, only items that fit the park's Scope of Collections Statement (SOCS) and are in at least fair or good condition are accepted into the collections. The committee consists of the curator, the acting registrar, the archivist, a librarian, and the historian, as well as subject matter experts who may be called upon depending on the item under consideration. Items not accepted for the collections may, with the donor's approval, be offered to another museum such as the Yellowstone Gateway Museum (Livingston, MT), the Yellowstone Historic Center (West Yellowstone, MT), or Buffalo Bill Historical Center (Cody, WY). In the future, the committee will also consider possible deaccession of items currently in the collections that do not fit the SOCS or are in such a poor condition as to be of no use to researchers or exhibits. For both acquisitions and deaccessions, the committee makes recommendations to the park superintendent, who is responsible for the final decision.

Museum. The museum staff complied with a servicewide "Corrective Action Plan for Museum Collections" during 2006 which stipulated that parks must process all existing backlog accessions. Staff successfully completed this by adding 134 accessions to the collections and culling numerous "potential" accessions from the backlog. Noteworthy accessions included the donation by the National Park Foundation of a bronze bust of Harry Yount, considered Yellowstone's first park ranger, that was sculpted by Susan Vertel in 1995 and is currently exhibited at the Museum of the National Park Ranger; 28 lantern slides made by Adolph Murie for his report "Ecology of the Coyote in the Yellowstone" (1940); 23 more wolf skulls from the Wolf Project Office; rare travertine-coated specimens and sand sculptures; and numerous images of the park, including family photographs and a CCC photograph album. With museum staff contributing greatly to the cataloging numbers requested by the Intermountain Region to compete for much-needed servicewide cataloging funds in 2007, the Intermountain Region completed more cataloging than any other region.

Archives. The archives accessioned 45 linear feet of permanent federal records into the NARA affiliated archives, including records from the park's central files, as well as records from various park offices (superintendent, public affairs, research permits, and bear management). Non-federal records accessioned into the park archives included a collection of historical research materials compiled by long-time seasonal employee Robert Flather on snowshoe and patrol cabins, the Soda Butte area, roads, and bridges.

Library. The library accessioned 547 items, including microfilmed historical newspapers such as the *Livingston Herald* (1891–1898), the *Wonderland* (1902–1905) of Gardiner, and the *Gardiner Gateway Gazette* (1940–1941).

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 may be affected by park activities.

Intergovernmental Meeting

Twenty representatives from the tribes associated with Yellowstone National Park and Grand Teton National Park attended an intertribal and intergovernmental information exchange held in Grand Teton National Park on May 31. The 11 tribes represented were: the Confederated Salish and Kootenai, Confederated Tribes of the Colville Indian Reservation, Crow, Eastern Shoshone, Assiniboine and Sioux, Nez Perce, Northern Arapaho, Northern Cheyenne, Oglala Sioux, Rosebud Sioux, and Shoshone-Bannock. Yellowstone National Park was represented by Deputy Superintendent Frank Walker, Grand Teton National Park by Deputy Superintendent Jim Bellamy, and the National Elk Refuge by Refuge Manager Barry Reiswig. Other participants included park staff from Colter Bay museum collections, planning and compliance, wildlife, and cultural resources in both parks.

Discussion at the meeting focused on bison management in Yellowstone, Grand Teton, and the National Elk Refuge, but also touched on tribal-Park Service resource management partnerships and compliance efforts.

Ethnographic Research and Management

Scholars' Meeting. With funding awarded to the Yellowstone Park Foundation by the National Endowment for the Humanities, ethnography 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 two-day meeting at Yellowstone in April. The meeting provided a rare opportunity for scholars from different disciplines and experiences to converge at Yellowstone and provide information that will be used in a variety of ways to interpret the 1877 Nez Perce war as it relates to events that occurred in the park. Participants visited some of the key sites in the park and provided information regarding particular events that helped tie the Yellowstone segment of the Nez Perce National Historic Trail (NPNHT) to broader contexts and historical perspectives. Scholars engaged in extensive and lively discussions about the meaning and significance of the 1877 war, including prewar Nez Perce use of lands that are now part of the park, why the Nez Perce came to Yellowstone as they fled east, and the legacy of post-war pain and suffering, often referred to as "historical trauma." The discussions provided park managers with ideas on how to most effectively convey that information to the public. The proceedings of the meeting will be used on Yellowstone's official website, for developing outdoor exhibits, and a brochure. Information generated from the meeting will also be used in interpretive services created by the NPNHT staff.

Inventory of NPNHT Sites in Yellowstone. With funding from the Yellowstone Park Foundation, archeology and ethnography staff of Yellowstone National Park examined five locations in the park where the Nez Perce are thought to have encountered tourists or to have camped in the summer of 1877. Archeologists and other representatives from the Nez Perce Tribe, the Chief Joseph Band of the Confederated Tribes of the Colville Indian Reservation, and the Confederated Tribes of the Umatilla Indian Reservation participated in the inventory. Nez Perce tribal elders also visited the park to provide information about the artifacts that were found and the encampment sites that were inventoried. The documentation of artifacts found along the NPNHT in Yellowstone will help park managers protect these sites and improve interpretation of the trail for park visitors. This was a pilot project whose results will inform the larger inventory scheduled to begin in 2008 that will cover the entire trail segment in Yellowstone.

Nez Perce Commemoration. Members of the Nez Perce Tribe visited Yellowstone National Park for three summer events that commemorated the 1877 war and the Nez Perce passage through Yellowstone National Park. Ethnography staff, as well as staff from park law enforcement and the Division of Interpretation, facilitated these traditional and educational events.

On the morning of August 26, several dozen Nez Perce tribal members, together with park staff and passing tourists gathered at the confluence of the Firehole River and the Nez Perce Creek, where the Nez Perce forded the river in 1877. The ceremony was meant to honor veterans of all wars and to create understanding and build friendships between the Nez Perce and other peoples. Horace Axtell, leader of the Nez Perce traditional Seven Drum Religion, and Wilfred Scott, a Nez Perce elder, conducted the traditional pipe ceremony. The ceremony included singing, drumming, and speeches in English and Nez Perce about the war, memories, and forgiveness. In his last official act as deputy superintendent, Frank Walker joined other park staff and tourists in smoking traditional pipes with the Nez Perce.

Frank Walker, Horace Axtell (spiritual leader of the Seven Drum Religion), and Wilfred Scott (former Nez Perce councilman) conduct 3rd annual Nez Perce pipe ceremony honoring ancestors who participated in the 1877 war.

On September 2, members of the Appaloosa Horse Club shared the history and culture of the Nez Perce with an audience of more than 100 at the Canyon amphitheater. Commencing with a parade of 12 horses and riders in full regalia, the evening continued with an hour-long presentation by club members. Descendents of 1877 war leaders and warriors shared their ancestors' stories of the war and what those stories meant for them today, bringing Nez Perce history alive with horses, traditional dress, and maps.

On the following day, 10 Nez Perce tribal members were joined by ethnography and law enforcement staff for an 18-mile trail ride on horseback along the Pelican Valley segment of the NPNHT. Aaron Penny was excited to be "tracing the route on our horses and going into the backcountry, to see what our ancestors saw." This was the third time the Nez Perce Appaloosa Horse Club has ridden through the park in memory of the 1877 war.

Nez Perce tribal members in Pelican Valley on their annual trail ride of the Nez Perce National Historic Trail.

Human Remains Re-interred. The Native American Graves Protection and Repatriation Act requires a federal agency in possession of American Indian human remains to try to determine their cultural affiliation or relationship with a contemporary tribe. Yellowstone had 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 they are the remains of Late Prehistoric ancestors of the Eastern Shoshone and the Shoshone-Bannock tribes. The tribes requested that the remains be re-interred near where they were exhumed. In October, ethnography and law enforcement staff facilitated the tribes' re-interment of their ancestors' remains. The tribes were grateful for the assistance from and the respect shown by the National Park Service.

Wickiup Documentation. Cultural anthropologist David White was contracted to prepare a report on the historical and ethnographic literature pertaining to the tribal use of wickiups (conical timber

structures) in what is now Bridger-Teton National Forest, Shoshone National Forest, Grand Teton National Park, and Yellowstone National Park. The completed report will be made available to the public in 2007 as the next phase of the study begins. Federal agencies will consult with tribes to learn who might be associated with the structures, their uses, and their cultural significance. To facilitate that consultation between the federal government and the tribes, ethnography staff worked with staff from the two national parks and the two national forests to video-document known and potential wickiups in these federal land jurisdictions.

The Bannock Trail. The Shoshone-Bannock Tribes are seeking national historic trail status for a route across the park that became known as the Bannock Trail. To respond to requests for information about the trail, archival research and limited fieldwork continued. Historical information from early park maps, traveler's journals, and park naturalists' logs were culled from the Yellowstone Research Library and archives. Ethnography staff completed limited fieldwork in an attempt to find evidence of any segments of the trail. However, recent research (see Archeology section) has identified the widespread presence of old wagon and freight roads, many in the general area where the Bannock Trail was believed to be, making identification of aboriginal presence difficult. The results of both historical and field research have been compiled into a report that is being circulated internally for review before being made available to the public. The Shoshone-Bannock tribes are planning a trip to the park in 2007 to visit segments of the trail and relay oral histories about it.

NPS interns Hannah Larkin and Mollie Chapman measure the width of the possible vestige of a historic trail in the Tower area.

Historic Road Rehabilitation

Yellowstone National Park's historic roads are a nationally significant example of early public road construction. Cultural staff make every effort to ensure that rehabilitation of these roads retains their integrity of materials, workmanship, feeling, and association through the use of natural materials and a continuing design philosophy, including preservation of historic curves and blending with the natural landscape.

National Award for the Dunraven Segment of the Grand Loop Road

The first phase of the reconstruction of the Canyon Junction to Tower Junction segment of the Grand Loop Road was chosen as the winner of the prestigious "Excellence in Highway Design" for 2006 by the Federal Highway Administration. The Western Federal Lands Highway Division took the top prize in the Highway Improvements on Publicly Owned Lands category. The runner-up in this category was the recently completed final segment of the Natchez Trace Parkway, a 444-mile parkway that has taken 67 years to complete, making Yellowstone's road program appear to be moving along at a rapid clip.

Reconstruction Progress on East Entrance Road

Work progressed smoothly on the reconstruction of the Sylvan Pass to East Entrance Station segment. The historic cut stone masonry guard walls were reconstructed, new stone masonry retaining walls finished, and numerous rockery retaining walls installed to decrease road construction impact on the cut slopes and rock faces of the Langford Formation. Masonry work was completed on the improved parking areas and the newly constructed Corkscrew Bridge Parking Area is near completion, with minor alterations planned for 2007 to improve the views of this unique historic structure. The simulated stone retaining wall on the cut side of the road along this section was completed and blends well with the terrain. Work on the two-mile segment of road approaching the East Entrance Station began in 2006 and progressed well. The road construction is expected to be completed by the end of the 2007 season.

Slough Creek Wagon Road Documentation

The Slough Creek Wagon Road is the only non-motorized, horse drawn wagon road still in operation in YNP today. The road, which originates as a spur off the Northeast Entrance Road, passes through the northern portion of the park and provides access to the Silvertip Guest Ranch and the Gallatin National Forest north of the park boundary. A Gallatin National Forest project to remove a small portion of the road from the flood plains and water-inundated banks of Slough Creek provided the opportunity for U.S. Forest Service archeologists and park staff to work together during the summer of 2006 to document the road and the constructed features associated with it. Field documentation has been completed and Montana and Wyoming cultural site forms for the Slough Creek Wagon Road will be finalized in 2007 and submitted for review by the Montana and Wyoming Historic Preservation Offices to comment on National Register eligibility. Documentation included recording of a previously unidentified precontact archeological site bisected by the wagon road in the Montana portion of the park. The tools and large quantity of chert flakes indicate the site represents a campsite where lithic reduction activities were taking place. The Montana State Historic Preservation Office concurred with YNP's determination that this site is eligible for listing on the National Register of Historic Places.

National Register Nomination for the Beartooth Highway

Previously YNP entered into a Memorandum of Agreement with the Wyoming State Historic Preservation Office, the Shoshone National Forest, and the Federal Highway Administration to nominate the Beartooth Highway to the National Register of Historic Places as a mitigation of the adverse effects of the reconstruction of this historic and scenic roadway. In 2006, cultural resource staff reviewed the nomination papers, drafted by Historic Research Associates, Inc., and found them to be well researched and well written. YNP will, on behalf of the Beartooth Highway's owners and managers, initiate the National Register review process.

Assessments for Roads and Road Features

To comply with a new List of Classified Structures (LCS) requirement, a great amount of effort was expended during 2006 to take digital photographs of and assess the condition of previously documented road features. Many of Yellowstone's historic roads were entered into the LCS system but do not have current condition assessments. Over half of the field assessments for the road structures were completed in 2006 including condition assessments for 11 bridges, 3 entrance roads and their associated features, and 3 segments of the Grand Loop Road and associated features.

Wagon and mules on Slough Creek Wagon Road.

Historic Preservation Compliance for the North Rim Drive/Inspiration Point Roads

Throughout 2006, park staff spent much time working with Federal Highway Administration staff to refine the plans and designs for the repair of the roadway and various historic features of the North Rim Drive/Inspiration Point road as well as the Artist Point parking and viewing areas. The designs are complicated by thermally altered soils throughout the Grand Canyon of the Yellowstone roadways and viewing areas and the intensive visitor use and confined spaces located within this constructed landscape. In August 2006 the Wyoming Historic Preservation Officer and the Advisory Council on Historic Preservation concluded their final consultation on the effect of the repair and repaving of the North Rim Drive/Inspiration Point Road, concurring that no historic properties will be adversely affected. Road and parking area design sheets were provided to both agencies along with a summary statement describing the planned rehabilitation of the roads and the historic properties found within

the area of potential effect. Rehabilitation of the canyon rim roads is expected to begin early in the 2007 construction season.

Historic Structures

In the past four years, more than 5,000 participants in the Tauck Guest Volunteer Program (sponsored by Tauck World Discovery) have donated almost 15,000 hours of labor to help maintain the appearance of the park's public areas and preserve historic structures in the West Thumb, Grant Village, and Old Faithful areas. The total value of this work and a donation of approximately $100,000 from Tauck World Discovery and the Tauck Foundation, amounts to almost $400,000. It was one of four volunteer programs to receive the "Preserve America" Presidential Award from President George W. Bush and First Lady Laura Bush in a ceremony at the White House in May of 2006.

In addition to the cleaning of amphitheaters, picnic and campground areas, guardrails, parking lots, and winter debris that frees up trained NPS staff for more technical maintenance work, this year the program participated in several large projects, including staining of the quarter-mile long Fishing Bridge, stabilization of employee cabins at Old Faithful, and prepping and staining or painting seven additional structures, bringing the total number of buildings brought up to good condition from fair to poor condition to 27.

Other historic structures projects that were underway during 2006:

- Second-phase stabilization of Fort Yellowstone NHL District's 1891 Cavalry Stable
- Structural stabilization of the 1895 Mail Carrier's Cabin in Mammoth Hot Springs
- Exterior stabilization of two of four Soap Suds Row NCO Quarters
- Stabilization work on the Lake Fish Hatchery buildings done with Cultural Cyclic Maintenance funding
- Development of a historic structures formal condition assessment form
- Completion of a historic structures report on the ca. 1927 Old Haynes Photo Shop at Old Faithful
- Completion of Historic American Building Survey photographs of Mission 66 structures including the Old Faithful Visitor Center and Theaters, the Tower Falls Store, and the Tower Junction Gas Station
- List of Classified Structures (LCS) survey work, including completion of most of the front country structures and trips into the backcountry to evaluate and record cabins and barns

The historic architect continued to collaborate with the Virginia City, Montana, historic preservation team as on-site grant coordinator and technical representative for the National Park Service, and assisted staff from the park's Divisions of Interpretation, Maintenance, Business Management, and Planning, Compliance, and Landscape Architecture on various projects. The Historic Structures Program was successful in competing for both Cultural Cyclic Maintenance projects and Historic Structures Stabilization projects, scoring well enough in the latter to obtain funding for two of four projects awarded funds for 2007.

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New Lake fish hatchery, 1928.

Yellowstone History

The park historian completed the research and writing of these projects during 2006:

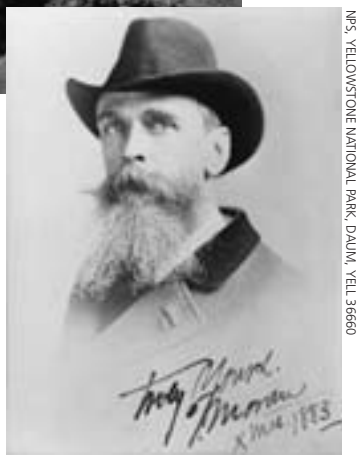
- a long study for park planning efforts, "A History of the Old Faithful Area, with Chronology, Maps, and Executive Summary";
- a book manuscript, "Storytelling in Yellowstone: Horse and Buggy Tour Guides," to be published by the University of New Mexico Press in February 2007;
- "A History of Parcels 'L' and 'M' in the Northern Addition to Yellowstone National Park, Formerly Known as the Stermitz Ranch," for the park's Gardiner Basin Restoration project; and
- "A Brief Look at Moran Point and Artist Point and Their Association with Thomas Moran and William Henry Jackson," which pertains to the park's ongoing planning for the Artist Point area and was published in *Yellowstone Science* 14:4 (Fall, 2006).

He hosted and oversaw the work of three interns from Montana State University: Rachelle Schrader (undergraduate) and Michael Fox (graduate student) in the spring and Bradley Snow (graduate student) in summer. The interns, along with longtime VIP Mary Anne Bellingham, provided the valuable service of reading and summarizing dozens of newspaper and other published historical accounts of trips to Yellowstone that are part of a growing database used constantly in the history program. The historian worked with Computer Support Services to arrange access to "Newspaper Archive Dot Com," an internet website that enables park staff to search hundreds of newspapers nationwide for historical accounts describing trips to Yellowstone.

Also during 2006, the park historian:

- wrote the foreword to the new edition of *The Geysers of Yellowstone* (2007) by T. Scott Bryan;
- advised the Division of Interpretation on exhibits to be placed in the new Old Faithful Visitor Center;
- taught an undergraduate class at MSU on the "History of Yellowstone and the Northern Rockies" and classes for the Yellowstone Institute on "Southern Roadside History of Yellowstone" and "Military History of Yellowstone;"
- supervised the work of VIP Tom Carter, who is preparing an article for *Yellowstone Science* about the history of the park's backcountry trails;
- spoke with the editor of the *Yellowstone Journal* to provide information for an article about Yellowstone's top 10 historic events that was published in the Fall 2006 issue;
- provided advice on place names for the ongoing project to catalog the park's thermal features; and
- accompanied the Brigham Young University Special Collections Librarian to Bozeman, Montana, to catalog rare Yellowstone items in the private collection of Ron Lerner for an upcoming co-authored bibliography of 13,000 Yellowstone items.

Lower Falls of the Yellowstone, William H. Jackson, 1871. NPS photo.



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Thomas Moran in 1883.

Pygmy owl.

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

Air, Land, and Water

Air Resources

GYA Clean Air Partnership. The Greater Yellowstone Area (GYA) Clean Air Partnership began in 1997 as a cooperative effort by the National Park Service and the U.S. Forest Service to advise the Greater Yellowstone Coordinating Committee and facilitate air program coordination and the implementation of consistent air quality management strategies. Current membership 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, the Bureau of Land Management in Wyoming, and the Montana, Idaho, and Wyoming Departments of Environmental Quality. The group focuses on addressing the four primary GYA air quality threats: 1) urban and industrial emissions, 2) oil and gas development in southwest Wyoming, 3) prescribed and wildfire smoke, and 4) snowmobile emissions.

The 10th annual meeting was held in Bozeman, Montana, in October 2006. Park staff gave updates on the park's greening program and wildland and prescribed fire programs. Discussions focused on smoke from prescribed and wild fires. Public concerns about visibility, nuisance smoke, greenhouse gasses, together with the Environmental Protection Agency's proposed revisions on particulate matter criteria (the 24-hour standard would change from 65ug/m^3 to 35ug/m^3) all have implications for prescribed burning. In high wildland fire years, the opportunities for prescribed fires could be restricted in order to minimize smoke.

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. Park rangers collect samples and data on atmospheric deposition and wet (acid rain) and dry atmospheric deposition at Tower Ranger Station, visibility (fine particulates, $PM_{2.5}$) and gaseous pollutants (ozone and sulfur dioxides) at the Lake water tank, and carbon monoxide and fine particulates at Old Faithful and at the West Entrance. 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 (available at www2.nature.nps.gov/air) noted that no measured Clean Air Act standards were exceeded in Yellowstone; the park's air quality, including visibility, is generally considered excellent. The NPS continues to work with the Environmental Protection Agency and with state air quality agencies to deal with the external sources of air pollution, such as oil and gas development and coal-fired power plants. Results of the 2006 Annual Performance and Progress Report will be available in 2007.

Most of Yellowstone's efforts in regard to air quality involve monitoring winter use at the West Entrance and Old Faithful. Air quality has been stable or improving over the last three winters when the Best Available Technology (BAT) requirement has been in affect. The highest hourly carbon monoxide (CO) concentrations at both locations occur during the winter even though summer traffic volumes are nearly 60 times higher, but the combination of reduced emissions by the snowmobiles using BAT and fewer winter vehicles entering the park has greatly reduced CO concentrations to be less than twice as high as the summer concentrations. Data for the winter of 2005–2006 showed a direct correlation between the decrease in total oversnow traffic and a decrease in air pollutants. Air quality at both locations was good during the winter and well below the National Ambient Air Quality Standards. The CO concentrations were about the same as the previous winter year despite an increase in the total number of winter vehicles entering at West Yellowstone. Even though summer traffic volumes are nearly 60 times higher, the highest hourly CO concentrations at both locations occur during the winter. However, the mean CO concentrations in winter have decreased over the last several years to be less than twice as high as the summer concentrations. Concentrations of fine particulate matter (2.5 micrometers or less) now correlate only weakly to traffic counts at the West Entrance and not at all at Old Faithful. The question of how much CO concentrations will increase if snowmobile traffic is allowed to increase up to the winter use plan limit is unresolved. (Source: Ray, J.D. 2007. Winter Air Quality in Yellowstone National Park: 2005–2006. Air Resources Technical Report NPS/ARD-2007/D-1207, National Park Service, Denver, CO.)

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 and 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), YNP has 10 NRCS SNOTEL (SNOpack TELemetry) stations and 5 manual snow course sites.

In addition to collecting data on long-term snow water equivalent, precipitation, and temperature, 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 areas 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.

A major goal of the Yellowstone Fens Project is to understand how different landscape-scale environmental variables affect the distribution of plant species in fens. With a grant from Canon U.S.A., researchers from Colorado State University led by Dr. David Cooper, spent the summers of 2004 and 2005 mapping and describing 170 fens in watersheds across the park to study the influence of different geologic formations near the road network and in

remote backcountry locations. Geology, including geothermal activity, is a key variable because it has a strong influence on groundwater chemistry, which has a strong influence on the plant species found in fens. Groundwater in a predominantly sedimentary watershed will have high pH and high ionic concentrations, volcanic watersheds will have lower pH values, and geothermal activity can create very acidic, low pH groundwater.

In addition to geology, the main environmental variables of interest are elevation and mean annual precipitation. While values for elevation and mean annual precipitation can be easily obtained for each fen site from GIS (geographic information system) maps provided by the park's Spatial Analysis Center, isolating the influence of geologic formations is complicated by a long history of volcanism and uplift, and fens are often located in valley bottoms and depressions that have been covered by glacial or fluvial deposits. Groundwater within a fen travels through different formations and more recent deposits before entering the fen. The researchers identified six main geologic types in the locations where fens were sampled: 1) glacial till containing sedimentary rocks in the Northern Range and below the Gallatin Mountains, 2) volcanic rhyolite in the central core of the park, 3) volcanic basalt in the southwest Bechler River drainage, 4) volcanic andesite in portions of the Gallatin and Absaroka mountains, 5) acidic geothermal water, and 6) neutral high chloride geothermal water. From the original 170 fen water chemistry samples, a subset of samples was selected from sites that were clearly dominated by one of the six geologic types. Statistical analysis of these samples provided a water chemistry signature of each geologic type. The relationship between water chemistry parameters and plant species diversity can be linked to these water chemistry signatures.

Through statistical analysis of the more than 500 stands of vegetation that were surveyed during the two-summer field effort, the researchers have built a classification system using the hierarchical agglomerative clustering technique. They identified 31 different vegetation communities in seven major groups defined by gross physical characteristics, such as small sedge-dominated community types or willow-dominated community types. In the final part of the analysis, which will be completed in 2007, they are examining how important the variables of elevation, mean annual precipitation, and groundwater chemistry are in determining which plant species grow in which fen.

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). Known as the Boundary Line or Gardiner Basin area, it is dominated by exotic vegetation introduced through homesteading, railroading, and gravel mining activities, but it is still an important feeding ground, especially for Yellowstone's dwindling pronghorn population. Yellowstone's initial experiments in reestablishing native vegetation to improve winter forage there 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.

With funding obtained from Canon U.S.A., Inc., through the Yellowstone Park Foundation, the Greater Yellowstone Coordinating Committee, and the Rocky Mountains Cooperative Ecosystem Studies Unit, a workshop was held in April 2005 with 10 arid land restoration specialists and 20 park and Gallatin National Forest staff. The workshop report, which included recommendations for both agencies applicable to specific sites, was presented during field trips for the 2006 Billings Land Reclamation Symposium, held in June, and the 28th annual conference of the National Association of Abandoned Mine Land Programs, held in Billings, Montana, in September. Park staff continue to seek funding for an initial pilot program that could begin in 2008.

Turbid Lake Road Restoration. When the East Entrance Road was reconstructed in the 1930s, a 6.5-mile segment known as the Turbid Lake Road was abandoned. Lack of funding put off removal of the road and restoration of the area to its natural state (especially wetlands and grizzly bear habitat) until wetlands impacts resulting from the recent reconstruction of the Dunraven and East Entrance roads required mitigation. The Army Corps of Engineers' Clean Water Act Section 404 project permits require that such projects result in

no net loss of wetlands; wetlands that are impacted or destroyed in the process of reconstructing the roads must be compensated for through the restoration of disturbed wetlands elsewhere in the park. A grant from Canon U.S.A. in 1997 provided the seed money for a multi-funding source project to remove culverts, de-compact the roadbed, and re-establish the original contours and natural drainage patterns, salvage and replace topsoil and plant material to speed revegetation, transplant grasses, forbs, and small trees, and re-route part of the Turbid Lake Trail to avoid the restored wetlands.

The heavy equipment phase of the Turbid Lake Road restoration project was completed in 2005 with gratifying results. On the oldest restoration segments, it is already difficult to see where the road was. The native plants have re-established and grizzly bear, elk, bison, and even wolves are frequent visitors. In keeping with the requirements of the 404 permit, vegetation staff continued to document the revegetation progress with groundwater monitoring wells, revegetation monitoring plots, and repeat photography.

Mining Impacts. Park staff continued to monitor proposed and ongoing reclamation projects associated with two historic mining sites outside the park: the New World Mining District and the McLaren mine tailings. 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.

Discussions about cleaning up the McLaren tailings site continued. The Montana Department of Environmental Quality is seeking funding and is monitoring groundwater in the proposed repository site. Three groundwater monitoring wells were installed in 2005 with funding from the NPS Water Resources Division 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 Cutthroat Trout Preservation

Upper Yellowstone River Basin. In spring of 2006, Mountain and Howell creeks were surveyed to determine the timing of Yellowstone cutthroat trout (*Onchorhynchus clarkii bouvieri*, YCT) spawning runs, location of spawning grounds, and upstream extent of spawning migration. Visual surveys were conducted throughout the Mountain Creek drainage in mid-June to determine the distribution and habitat use of spawning cutthroat in the system; fish were seen spawning throughout. In September, our focus switched to determining cutthroat trout distribution and habitat use in the Mountain Creek drainage and the main stem of the Yellowstone River. One-hundred meters per kilometer of stream in Mountain and Howell creeks and their tributaries were sampled using a backpack electrofishing unit and habitat assessments were conducted using the U.S. Forest Service R1/R4 fisheries habitat assessment method.

Snorkel surveys were conducted in conjunction with electrofishing surveys in early September in the main stem of the Yellowstone River from the park's southern boundary to the mouth of the river at Yellowstone Lake. By conducting both electrofishing and snorkel surveys, we were able to get a clearer picture of fish distribution and habitat use. Juvenile cutthroat trout were collected throughout the river, while adult cutthroat trout were found concentrated in a few sections of the river often associated with deep pools. Analysis of electrofishing data shows distinct size differences between the main stem of the Yellowstone River and tributaries to the river. Age analysis must be completed to determine if tributaries are used simply for spawning or if a difference in growth rates is causing the size differences.

Lake Trout Removal. Preservation of cutthroat trout in Yellowstone Lake continued to be a top priority in 2006. More than 59,000 non-native lake trout (*Salvelinus namaycush*) were removed, bringing the total number removed to almost 200,000 during 1994–2006 (Figure 1). The removal effort has undoubtedly saved hundreds of thousands of YCT from predation, changed the size and age structure of the lake trout population and slowed its rate of increase, but it remains questionable whether current levels of effort will suffice to collapse the lake trout population. We removed the largest lake trout yet (22.25 pounds) in 2006, and the catch of younger lake trout has slowly increased over the last five years. We have countered the recent increase in

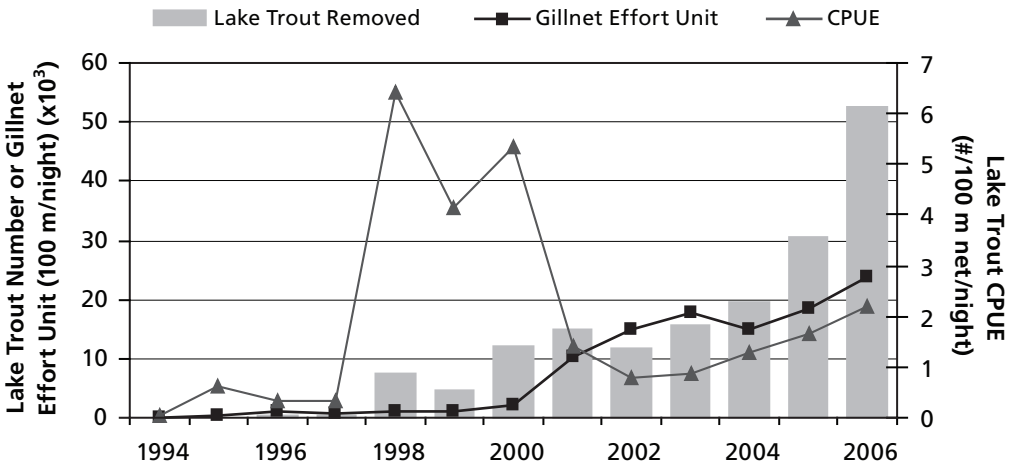


Figure 1. Number of lake trout removed, gillnet units of effort used, and lake trout catch per unit of effort (CPUE) obtained by the lake trout removal program on Yellowstone Lake during the entire gillnetting season, 1994–2006.

the catch of mature lake trout on spawning grounds (three times as many as in earlier years) by specifically targeting those fish through increased netting and electrofishing. The cutthroat trout population has yet to demonstrate a strong positive response. Although we have seen an increase in numbers of juvenile cutthroat trout recruiting to the population in recent years, it will take several more years for these fish to replace the lost reproductive potential caused by lake trout predation, whirling disease, and drought.

Population Monitoring at Clear Creek. Annual monitoring of spawning Yellowstone cutthroat trout was conducted at Clear Creek for the 18th consecutive season. Between May 1st and July 4th, aquatics personnel counted and sampled 471 mature trout, making 2006 the second consecutive year that fewer than 500 spawning trout were recorded migrating past the trap near the mouth of the stream. Fewer than 20 fish were counted on most days and the peak of the migration appeared to be in mid-May (Figure 2). All of the captured trout were longer than 400 mm and 56% were greater than 500 mm in length, suggesting that the trend of record lengths of spawning fish continues.

Native Trout Restoration

Westslope Cutthroat Trout. The East Fork Specimen Creek (EFSC) westslope cutthroat trout (*Onchorhynchus clarkii lewisi*, WCT) restoration project moved ahead in 2006 with completion of the National Environmental Policy Act (NEPA) process and the initial phases of project implementation. In August, YCT that had contributed to the degradation of WCT within the EFSC watershed were removed from High Lake using the piscicide rotenone, and initial observations indicated that the treatments were successful. In 2007, restocking of WCT in High Lake will begin, and the barrier in lower EFSC will be completed in anticipation of chemical removal of fish from the stream in 2008.

The way was cleared for the WCT discovered in an unnamed tributary of Grayling Creek to be used in WCT restoration projects in 2006 when genetic analyses confirmed that the population has not hybridized with rainbow trout or Yellowstone cutthroat trout and a complete health screen detected no pathogens. A second potential source of genetically pure WCT within Yellowstone's boundaries for utilization in WCT restoration efforts was identified in 2006 in the Oxbow/Geode Creek complex in the Yellowstone River drainage.

Yellowstone Cutthroat Trout. Resource surveys began on streams identified as high priority for YCT restoration: Rose Creek, Blacktail Deer Creek, and the Elk Creek complex. However, data collection on other streams throughout Yellowstone's northern range also continued in 2006. Genetic samples from Amphitheater, Antelope, Crystal, Pebble, and Rose creeks were delivered to the Idaho Fish Genetics Laboratory for analysis; the results will lend further insight into the genetic status of YCT on Yellowstone's northern range.

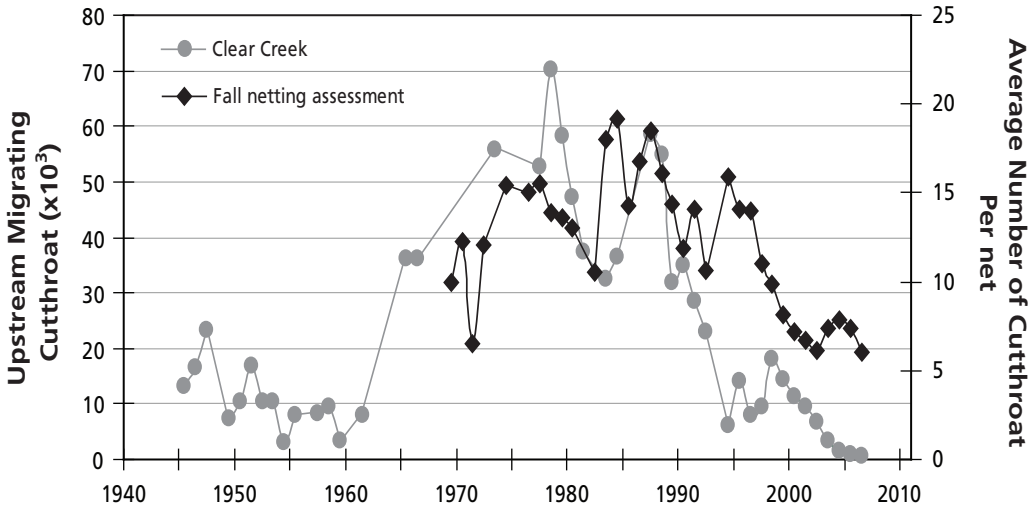


Figure 2. Upstream-migrating cutthroat trout counted at Clear Creek spawning trap (1945–2006), and mean number collected per net on Yellowstone Lake during the fall (1969–2006).

Amphibian Surveys

A critical element of the native fish restoration initiative is to better understand how piscicide use affects non-target wildlife including amphibians and aquatic invertebrates. The park's four native amphibian species are the Columbia spotted frog (CSF), *Rana pretiosa*; the boreal chorus frog (BCF), *Pseudacris triseriata maculate*; the boreal toad (BT), *Bufo boreas boreas*; and the blotched tiger salamander (BTS), *Ambystoma tigrinum melanostictum*. During the summer of 2006, fisheries and aquatic sciences staff surveyed current and proposed restoration sites (i.e., westslope cutthroat trout in the Specimen Creek drainage and Yellowstone cutthroat trout in the Yellowstone River drainage) to document the resident amphibian breeding populations and aquatic invertebrate distribution and community structure, and to assess the effects of piscicides on these species. For a complete synopsis of survey results, refer to the *Yellowstone Fisheries and Aquatic Sciences 2006 Annual Report*.

East Fork Specimen Creek. Surveys from 1997–1999 found all four amphibian species in the northwest portion of the park but only CSF in the Specimen Creek watershed. Within the East Fork Specimen Creek drainage in July 2006 we observed amphibians at 12 of the 40 sites sampled, including CSF (11 sites), BCF (3 sites), and BT (2 sites). Breeding populations (identified by the presence of eggs or larvae) were recorded at six sites, including three within the vicinity of High Lake at the headwaters of the drainage: one breeding population of CSF in the High Lake outlet with 100–200 tadpoles, and two breeding sites for both CSF and BCF in wetland areas approximately 200 m from the lake that are not being treated with piscicide. One of the latter sites is connected intermittently to High Lake via a wet meadow that may serve as a dispersion corridor to High Lake for newly emerged frogs.

The piscicide (1 ppm) applied to High Lake in August to eliminate the YCT proved lethal to larval (gill-breathing) amphibians, while adults (non-gill breathers) did not appear to be affected. Immediately after application, tadpoles deviated from their normal cryptic behavior and were seen swimming in open water, followed by erratic swimming and passive floating. However, effects of the piscicide may be reversible. Tadpoles that had progressed to the "floating" stage were revived by placing them in a clean water source.

Northern Range. We documented CSF, BCF, and BTS at 11 of the 40 wetland sites sampled within the Elk Creek drainage, including seven sites with a total of eight breeding populations, although two of the four BTS sites dried out before the larvae completed their metamorphosis. At the seven wetland

sites sampled within the Blacktail Deer Creek drainage, one adult CSF was found at each of two sites.

Aquatic Invertebrates

Monitoring aquatic invertebrate communities is important because they are relatively immobile, sensitive to environmental changes and can live from one to four years. The results of aquatic invertebrate sampling at six stream sites on East Fork Specimen Creek, three sites within the Elk Creek drainage, and at four sites within High Lake before and after the piscicide application are being processed at an independent laboratory. Cursory observation at East Fork Specimen Creek indicated that aquatic worms (annelids) and stonefly larvae (Plecoptera) were among the most impacted stream dwelling species. Both groups experienced some mortality and were seen accumulating within pooled areas of the stream. Effects of the piscicide on lake dwelling insects were more difficult to discern because of the abundant aquatic vegetation and the cryptic behavior of many species. Dead caddisfly larvae (Trichoptera) and fingernail clams (*Psidium compressum*) were observed during the days following treatment. Conversely, beetle species (*Coleoptera* sp.), dragonflies and damselflies (Odonata), and midges (Chironomidae) were abundant both before and after the piscicide application.

In addition to the 13 stream and lake sites sampled in areas targeted for native fish restoration, aquatic invertebrates were sampled at four sites associated with water quality monitoring stations and four sites near road construction projects.

Invasive Aquatic Species. Invertebrate settling plates were deployed on Yellowstone and Lewis lakes from June to October in boat launching areas to detect the presence of zebra mussels (*Driesenna polymorpha*). Watercraft are the most probable mode of transportation across watersheds for most aquatic nuisance species. Non-native species may be found attached to boat hulls and trailers and in bilge water. When retrieved in October, the settling plates had been colonized by many native invertebrates including snails (*Physa* sp.), fingernail clams (*Sphaerium* sp.), scuds (*Gammarus* sp.), leeches (*Glossiphonia* and *Erpobdella* spp.), and caddisflies (*Phryganea* and *Agraylea* spp.), but no zebra mussels were found.

Long-term Water Quality Monitoring

During 2006 we collected monthly physical and chemical water quality data at 12 sites on major rivers year-round and at seven sites on Yellowstone Lake during the ice-free period from May to October. A multiparameter probe was used to collect water temperature, dissolved oxygen, pH, specific conductance, and turbidity. Water samples were also collected for total suspended solid and volatile suspended solid analysis. In June we began a more comprehensive water quality monitoring effort as part of the Greater Yellowstone Network's Inventory and Monitoring Program. This sampling regime includes anions (sulfate, chloride, bicarbonate, and carbonate), cations (calcium, magnesium, sodium, and potassium) and nutrients (nitrate-N, nitrite-N, ammonia, total phosphorus, and ortho-phosphate). Dissolved and total metals (arsenic, copper, iron, and selenium) in the water and sediments are measured twice during high and low flow periods in Soda Butte Creek at the park boundary.

Fisheries volunteer Derek Rupert demonstrates electrofishing techniques to students in a Yellowstone Association Institute class.

Geology

Protection and monitoring of YNP's geothermal features is a focal point of the park's geology program. In 2006, the park's geologists provided assistance to law enforcement (describing and reporting on natural features taken by visitors), interpretation (seasonal, permanent, and winter guide training), and business management (fuel spill remediation efforts near the Snow Lodge at Old Faithful) staff. They also secured permission from maintenance staff to begin removal of a boardwalk near Palette Springs at Mammoth, and responded to requests for information from the media, general public, and other Yellowstone staff.

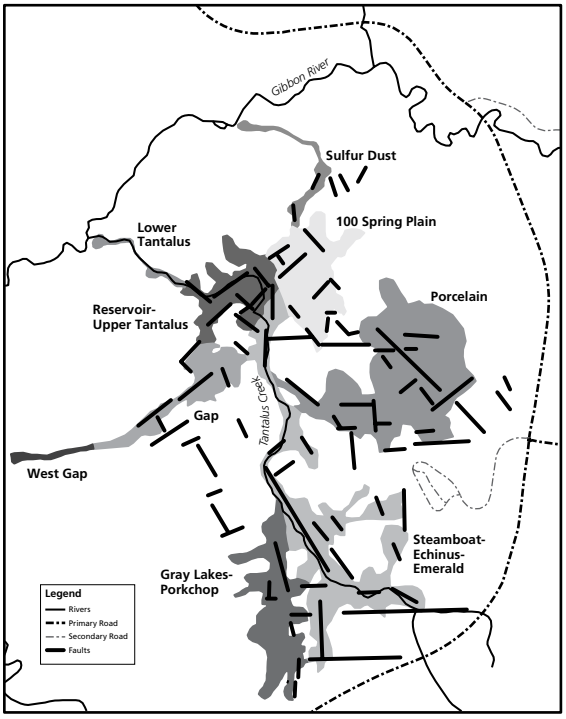
Montana Water Rights Compact

The Montana Water Rights Compact, established in 1994 between the state of Montana and Yellowstone National Park, protects geothermal features in the park by limiting groundwater withdrawal in a designated area north of the park. This Controlled Groundwater Area was to be monitored by the state of Montana with funding provided by the federal government. In 2005, YNP received a base increase from Congress to implement a comprehensive geothermal monitoring plan for the park, including $141,000 that was to be paid annually to the Montana Bureau of Mines for monitoring the Controlled Groundwater Area and $255,000 for geothermal monitoring in the park. In 2005 and 2006, $145,000 from the latter sum was paid to the University of Montana, Utah State University, and Montana State University for collaborative efforts to monitor the park's geothermal features using remote sensing techniques. In 2006, an additional $43,000 ($22,000 from Yellowstone National Park funds and $21,000 from the NPS Water Resources Division) was paid to the Montana Bureau of Mines and Geology to begin an assessment of plugging a geothermal well drilled by the Church Universal and Triumphant near LaDuke Hot Springs in 1986.

Geothermal Monitoring Program

Protecting the park's unique geothermal features is primary to its enabling legislation. The Geothermal Steam Act of 1970, as amended in 1988, also requires that the park's geothermal features be protected and monitored. In March 2003, park staff and partner scientists prepared a geothermal monitoring proposal to initiate a comprehensive, scientifically-based geothermal monitoring program within Yellowstone. The proposal included groundwater and surface water monitoring, remote sensing of thermal features, chloride flux monitoring, and geochemical monitoring. The park's Technical Oversight Committee and the Yellowstone Volcano Observatory (YVO) have peer reviewed and support the proposed program as a critical component of monitoring the Controlled Groundwater Area, monitoring volcanic and seismic hazards, and protecting the park's irreplaceable geothermal features. The work is estimated to cost $989,000 per year.

In 2006, geothermal monitoring in the park continued with the acquisition of airborne remotely sensed, thermal infrared images obtained over the Old Faithful, Norris, Mud Volcano, and Mammoth areas, and the Sour Creek resurgent dome. Additional effort was expended to improve the chloride flux component of the geothermal monitoring program. A $100,000 study funded by the Water Resources Division was begun that will improve our understanding of shallow groundwater movement in the Norris area.



Map showing major faults and fractures among the hydrothermal sub-basins within Norris Geyser Basin, determined by examination of airborne remotely sensed, thermal infrared images.

Yellowstone Volcano Observatory

The Yellowstone Volcano Observatory (a partnership set up by the park with the U.S. Geological Survey and the University of Utah) monitors volcano and earthquake hazards within the park using a network of 26 seismic and 13 GPS leveling stations. There were 1,202 earthquakes in Yellowstone in 2006, with rapid uplift continuing along the axis of the Yellowstone caldera. Near White Lake in the upper Pelican Valley area, the ground has risen about 16 cm in the last two years. In 2006, YVO published a 10-year monitoring plan for the Yellowstone Volcano and is in the process of finishing a report on volcanic hazards in Yellowstone.

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, in some situations, such as with hazard trees or fire, park visitors and staff must be protected from risks associated with the natural processes operating on vegetation communities.

YCR's vegetation staff has diverse responsibilities and functions related to the 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 1,375 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 into the NPSpecies biodiversity database.

Native Species. Two native species were found during summer 2006 for the first time in the park:

- A very small population of common oakleaf fern (*Gymnocarpium dryopteris*) was located in a rock crevice during rare plant inventories in the Norris area for the Fire Cache's wildland-urban interface project. Common oak fern occurs across the boreal north and reaches south at scattered locations in the Rocky Mountains and Black Hills. It is considered a plant species of concern in Wyoming due to its rarity in the state.

Common oakleaf fern (Gymnocarpium dryopteris).

- Jointed rush (*Juncus articulatus*) was located during the wetland delineation at Old Faithful, where it is part of the extensive wetland along Zipper Creek near the Old Faithful Ranger Station. Although widespread across the northern portion of the United States, the species is relatively uncommon in Wyoming and has been identified in only two counties, Teton and Platte.

Non-native Species. Two additional non-native species were documented for the first time in 2006:

- Several years ago an odd-looking Potentilla was collected in the Midway Geyser Basin area. Barbara Ertter, the North American expert on the genus Potentilla who examined the specimen last fall, identified it as ashy cinquefoil (*Potentilla inclinata*), a European species which had not previously been reported in the Rocky Mountains.
- During the rare plant inventory in the Old Faithful development, a single plant of bird's-foot trefoil (*Lotus corniculatus*) was found. The plant, which had both blooms and mature fruits, was destroyed. This species has become well-established in the Bozeman area.

Bird's-foot trefoil (Lotus corniculatus).

Rare Plant Surveys. To prevent inadvertent negative impacts to rare plant populations in the park, surveys are conducted prior to construction projects, 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 257 additional sites for the GIS layer of "species of special concern" or rare plants in the park. Summer fieldwork for Federal Highway projects took place primarily in the Old Faithful area, a fascinating amalgam of various plant communities where "species of special concern" occupy thermally warm sites and wetlands as well as barren black obsidian sand. Other frontcountry construction sites that were investigated for wetlands or rare plants include the route for the powerline burial near the Lake housing area, the Norris and Madison developed areas for the wildland-urban interface project, and the road realignment near the new fire dorm by the YACC camp. Surveys were also initiated for ground-disturbing activities resulting from the re-routing of the West Thumb Overlook trail and of trails near Outlet Lake and Fairy Falls, the construction of the proposed fish barrier on Specimen Creek, and the Shoshone/Bannock repatriation site.

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 are finally making significant inroads on the backlog of specimens to be added to the ANCS+ database. Several hundred specimens are in the process of labeling, mounting, and cataloging.

During the 2006 field season, 77 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.

Bryophyte Survey

Bryophytes (mosses, liverworts, and hornworts) represent an under-sampled and relatively poorly understood component of the park's ecosystem. Judy Harpel was funded by Canon U.S.A. through the Yellowstone Park Foundation to gather information on the bryophytes present in the park in 2006. This extensive survey, to be conducted over two field seasons, will culminate in a comprehensive bryophyte species list for the park.

The dry sagebrush steppe and dry grasslands were surveyed during the spring, when the small cryptic mosses and liverworts are visible, although some species are so inconspicuous that they look like little black dots on the soil surface. During the summer, the surveys focused on various forest types, alpine meadows and tundra, talus slopes, forested wetlands, peatlands, and riverine systems. The decrease in visitation in the fall allowed for surveys in geothermal areas, especially Norris Geyser Basin and the White Creek area.

One western North American endemic species found during the summer field season, Roell's moss (*Roellia roellii [Röll] Crum*), was the first record of this large, distinct moss in the park. When first found in a fishing area along the Madison River it was thought to have been introduced, but two additional locations were subsequently found in very different areas of the park. These additional locations suggest that this species may have previously had a broader distribution within the park. It occurs in higher elevations in the cool-climate forests of British Columbia, northern California, Idaho, Oregon, and Washington, reaches the eastern edge of its range in Colorado, Montana, and Wyoming, and is rare in Alaska, Nevada, and Utah. Because of its large size and distinct characteristics, it is surprising that it went unnoticed by previous bryophyte collectors.

Woody Vegetation on the Northern Range

The continuing controversies surrounding the status of woody vegetation (aspen, willow, and cottonwood) as it has been affected by historical and current elk population levels and wolf reintroduction, support many diverse research opportunities. The Vegetation Management Specialist supervised one seasonal employee, one Fulbright Scholar (J. Rubio, employed with the Ministry of the Environment, Spain), and two part-time volunteers. The primary emphasis of their work was the

resampling of 113 aspen transects that have been established throughout the northern range, 14 long-term established willow transects, and LANDSAT imaging of stream channel morphology and change. Sampling protocols called for measurement of current annual growth, proportion of browsed stems, pellet counts as an index of ungulate use, and tree/shrub mortality.

The Vegetation Management Specialist also oversaw woody vegetation research projects undertaken by visiting scientists during 2006:

- Drs. Tom Hobbs and David Cooper of Colorado State University and Drs. Linda Zeigenfuss and Robert Stottlemyer of the USGS-BRD in Fort Collins in the 4th year of a study of the effects of herbivory and hydrology on willow ecology;
- Dr. Andrew Hansen of Montana State University in the second of a three-year study of bird species diversity in willow communities of varying structure and size;
- Dr. Don Despain of the USGS-BRD at Montana State University and Dr. Rex Cates of Brigham Young University in the first of a two-year study of temperature influences on willow growth and phenolic production; and
- Initiation of a study with Dr. Stottlemyer to investigate the spatial and seasonal changes in soil and sediment microbial functional groups in natural and artificial beaver dams.

Alpine Vegetation

Ken Aho, from Montana State University, completed his dissertation entitled "Alpine and Cliff Ecosystems in the North-Central Rocky Mountains," the first alpine vegetation study of any volcanic mountains in the central or northern Rocky Mountains. In addition to quantitatively describing alpine plant communities on 10 peaks in and near Yellowstone's northeast boundary, Aho established permanent transects as a baseline from which we can monitor impacts from the non-native mountain goats that are increasingly moving into and using the area. Alpine plant diversity and cover have declined in Olympic National Park as a result of non-native mountain goats. While the net effects of global warming on terrestrial vegetation communities are difficult to gauge, alpine communities are likely to be particularly altered. In Greater Yellowstone, treelines are expected to move up in elevation, reducing the extent of alpine areas and alpine diversity. A three-year project beginning in FY08 will enable us to resample and expand upon Aho's transects and begin monitoring the abundance, distribution, and demographics of mountain goats so that we can evaluate management alternatives and develop an adaptive management plan to protect the alpine ecosystem.

Forest Insect Infestations

A partial aerial survey of the park conducted during 2006 by the U.S. Forest Service confirmed continuation of the insect-caused mortality of overstory trees that erupted early in the decade. The park had about 30,000 acres of whitebark pine mortality and 1,200 acres of lodgepole pine mortality, both caused by the mountain pine beetle. Other beetle species are causing mortality of subalpine fir (western balsam bark beetle), Douglas-fir (Douglas-fir beetle), and Engelmann spruce (Engelmann spruce beetle). Pockets of red needled trees resulting from these host-specific insects are evident throughout the different elevation and forested vegetation zones of the park.

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.

Another native defoliating insect, the spruce budworm, is also irrupting throughout the lower elevations of the Lamar and Yellowstone River valleys. Host trees are primarily Douglas-fir and secondarily Engelmann spruce. During the budworm's caterpillar life stage, the developing larva feed on the new needles of the year as they emerge, leaving behind a brown cast or "halo" on the outer portion of the tree crown as a result of dead, partially consumed needles. The spruce budworm usually does not feed on old growth needles or kill mature overstory trees except in severe outbreaks, but at high densities it can cause local pockets of mortality among under-

story seedlings and saplings. About 14,000 acres of spruce budworm activity is evident in the park with some seedling/sapling mortality; the most conspicuous defoliation is visible along Reese Creek, the Mammoth Terraces, Lava Creek, and near the Hellroaring trailhead.

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 can also be a driving force in diminishing insect outbreaks, as when extreme winter temperatures kill off overwintering broods, or wet 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.

Park staff have collaborated with scientists from Harvard University (Dr. Paul Moorecroft, Dr. Heather Lynch) and the non-profit Yellowstone Ecological Research Center (Dr. Robert Crabtree) to compile and analyze forest insect effects and trends since the 1960s. An important finding of this research, the results of which have been published in a scientific journal (see Appendix 2), is that mountain pine beetle outbreaks some 15 years previous to the 1988 Yellowstone fires acted to increase the odds of burning by 11%, primarily through the indirect height release of understory trees that flourished after beetles killed off the overstory canopy. More recent beetle activity did not influence fire risk.

An additional research effort was initiated in 2006 with the awarding of a Joint Fire Sciences proposal to investigate reciprocal interactions between forest fires and insect outbreaks, historical and recent. Rocky Mountain and Great Lakes Cooperative Ecosystem Studies Units agreements were established between Yellowstone National Park and three academic researchers: Dr. Dan Tinker at the University of Wyoming, Dr. Monica Turner at the University of Wisconsin–Madison, and Dr. William Romme at Colorado State University. The research team was provided with digital maps and datasets of historical and recent forest fires and insect activity to facilitate field research activities.

Vegetation Management

Fire Management. Daily tasks of the Vegetation Management Specialist during the 2006 fire season on the Magpie (>3,500 acres) and Stinky (>1,000 acres) fires included briefing management staff and field crews on expected fire behavior, making long-term fire behavior risk projections, and aerial reconnaissance/mapping of the fires. The Vegetation Management Specialist also served on Yellowstone's Fire Management Strategy Team and the Gallatin National Forest/Yellowstone National Park Fire Program Analysis Team that addressed fire program operational structure, fire management operations, prescribed burning issues, and logistics and implementation of hazard fuels reductions in the wildland-urban interface, and represented Yellowstone on an interagency team that is developing disturbance and succession regimes for various vegetation communities in the northern Rocky Mountains as part of the national LANDFIRE fire condition class assessment under the lead of The Nature Conservancy. Lead authorship was assumed in "Vegetation Dynamics Development Tool (VDDT)" model development for the aspen forest type.

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. In 2006, implementation of the newly approved Hazard Tree Management Plan was undertaken by staff from all park divisions. As part of this plan, the Vegetation Management Specialist trains resource management sawyer crews in hazard tree identification, assists with hazard tree assessments when called upon, and provides a centralized repository for records of hazard tree removal efforts throughout the park. During 2006, 1,063 hazardous trees were removed parkwide, including five that were identified within the Mammoth Historic District.

Vegetation Education

In addition to identifying plant species upon request for other park staff, outside researchers, and the public, the vegetation staff participated in more formal education efforts during 2006, including:

- weed identification for the Northern Rocky Mountain Exotic Plant Management Team, Yellowstone resource management personnel, Montana Conservation Corp, and Gallatin National Forest;

- 14 field seminars for various university, international, and media groups on topics including northern range/woody vegetation issues, fire ecology, forest insect activity, and disturbed lands restoration;
- rare plant and vegetation overviews for the Division of Interpretation, the Montana Native Plant Society, and the Bozeman chapter of American Association of Retired People (AARP); and
- a course on Yellowstone wildflowers was taught through the Yellowstone Association Institute.

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.

Road-Killed Wildlife

Bear Management Office staff maintain a database of large (>30 lbs.) and mid-size (badger, *Taxidea taxus*; porcupine, *Erethizon dorsatum*; red fox, *Vulpes vulpes*; and pine marten, *Martes americana*) mammals killed on park roads each year. A total of 99 large and mid-size mammals were hit and killed by vehicles on park roads in 2006. Elk (*Cervus elaphus,* 31) and mule deer (*Odocoileus hemionus,* 31) were the species most often killed in collisions with vehicles. Other species hit and killed by vehicles on park roads included bison (*Bison bison,* 12), coyote (*Canis latrans,* 8), red fox (5), pronghorn (*Antilocapra americana,* 3), moose (*Alces alces*, 2), pine martin (2), bighorn sheep (*Ovis canadensis,* 1), grizzly bear (*Ursus arctos,* 1), black bear (*Ursus americanus,* 1), river otter (*Lontra canadensis,* 1), and badger (1). The average rate of vehicle strike mortality for all park roads combined was 0.2 large and mid-size mammal road-kills per mile of park road. The highest road-kill rate was on U.S. Highway 191 (1.9 road-kills per mile of road). U.S. Highway 191 is the only park road with a 55 mph posted speed limit: all other roads in YNP are posted at 45 mph or lower. Highway 191 comprises approximately 7% of the primary roads in YNP, but accounted for 39% of road-killed mammals in the park in 2006. Annual numbers of road-killed wildlife are variable from year to year and are related to wildlife population numbers, park visitation, weather conditions, and other factors.

Integrated Pest Management

As the park's Integrated Pest Management (IPM) Coordinator, the Vegetation Management Specialist maintains Commercial Pesticide Applicator certification, submits Pesticide Use Requests (27 in 2006) to the NPS Washington Office for approval to use specific pesticides in the park, and completes Pesticide Use Logs (22 from 2005) that detail the amount of pesticides used each year. During 2006, he responded to 29 different pest complaints involving insects (11), small mammals (12), spiders (5), and fungi (1) by working with park employee and concessions staff to determine the source of each problem and ways to minimize or eliminate it according to IPM protocols. He also worked with the park's fisheries biologists to secure permission from the Washington and Intermountain Regional Offices to use piscicides as part of the restoration plan for westslope cutthroat trout in the High Lake drainage.

Bears

Grizzly Bear Recovery Status

The grizzly bear was listed as a threatened species under the Endangered Species Act (ESA) in 1975 due to a high incidence of human-caused mortality that had caused a significant population decline. Since 1975, the Greater Yellowstone Ecosystem (GYE) grizzly bear population has increased from an estimated 136 bears to 549 bears in 2006. In recent years, the population has been increasing at 4–7% per year. GYE grizzly bears have expanded their range by more than 48% in the last two decades.

On November 17, 2005, the U.S. Fish and Wildlife Service (USFWS) published a proposal in the Federal Register to remove the distinct population segment of grizzly bears in the GYE from the list of species protected under the ESA (50 CFR, part 17). The USFWS held meetings for public comment on the proposal in Bozeman, Montana; Cody and Jackson, Wyoming; and Idaho Falls, Idaho, in January and February 2006, and accepted written and e-mail comments through February 15, 2006. More than 200,000 comments

were received. The USFWS is expected to publish its record of decision on the proposal in March 2007.

If GYE grizzly bears are removed from threatened species status, they will be monitored and managed under the guidance of the *Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area* (www.r6.fws.gov/species/mammals/grizzly/yellowstone.htm). The *Conservation Strategy* was written by all the agencies that manage grizzly bears and their habitat in the GYE. In YNP, grizzly bear management will not change drastically after delisting. The park 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 food and garbage storage regulations.

Population Monitoring

Reproduction. At least 15 distinct females with home ranges either wholly or partially within YNP produced at least 29 cubs in 2006 (Figure 1). Average litter size was 1.9 cubs per litter. Five one-cub litters, 6 two-cub litters, and 4 three-cub litters were observed. The annual number of females producing cubs in YNP has remained relatively stable in recent years, suggesting that the park may be at or near carrying capacity for grizzly bears.

Mortality. Due to the grizzly bear's low reproductive rate and vulnerability to human-caused mortality, it is important for bear conservation to keep mortalities at a sustainable level. In 2006, there was one known grizzly bear mortality in YNP. On May 25, the carcass of a 192-lb. adult female grizzly bear estimated to be 10 years old (from tooth wear) was found floating in Yellowstone Lake between Storm Point and the mouth of Pelican Creek. Necropsy of the carcass indicated that the bear had died from severe blunt trauma, most likely caused by a collision with a vehicle.

Bear Foods Monitoring

Elk, bison, cutthroat trout (*Onchorynchus clarkii*), and whitebark pine (*Pinus albicaulis*) seeds are four of the highest sources of energy available to grizzly bears in YNP. Due to the importance of these foods to bears, YNP staff monitor their annual availability within 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 75 elk, 1 pronghorn, and 39 bison carcasses were documented along the 285.4 km of survey routes, for an average of 0.4 carcasses/km surveyed. Twenty-five (33%) of the elk carcasses and 15 (38%) of the bison carcasses had conclusive evidence of scavenging by bears. Grizzly bears or their tracks were observed on 18 (62%) of the 29 survey routes.

Spawning Cutthroat Trout. Five spawning streams on the north shore and four spawning streams in the West Thumb of Yellowstone Lake

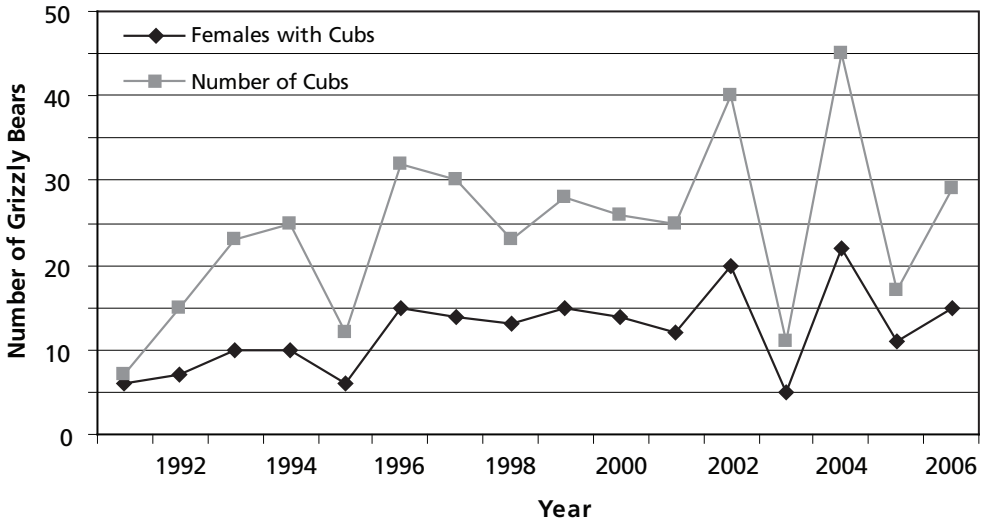


Figure 1. Female grizzly bears with cubs and total cubs counted in Yellowstone National Park, 1991–2006.

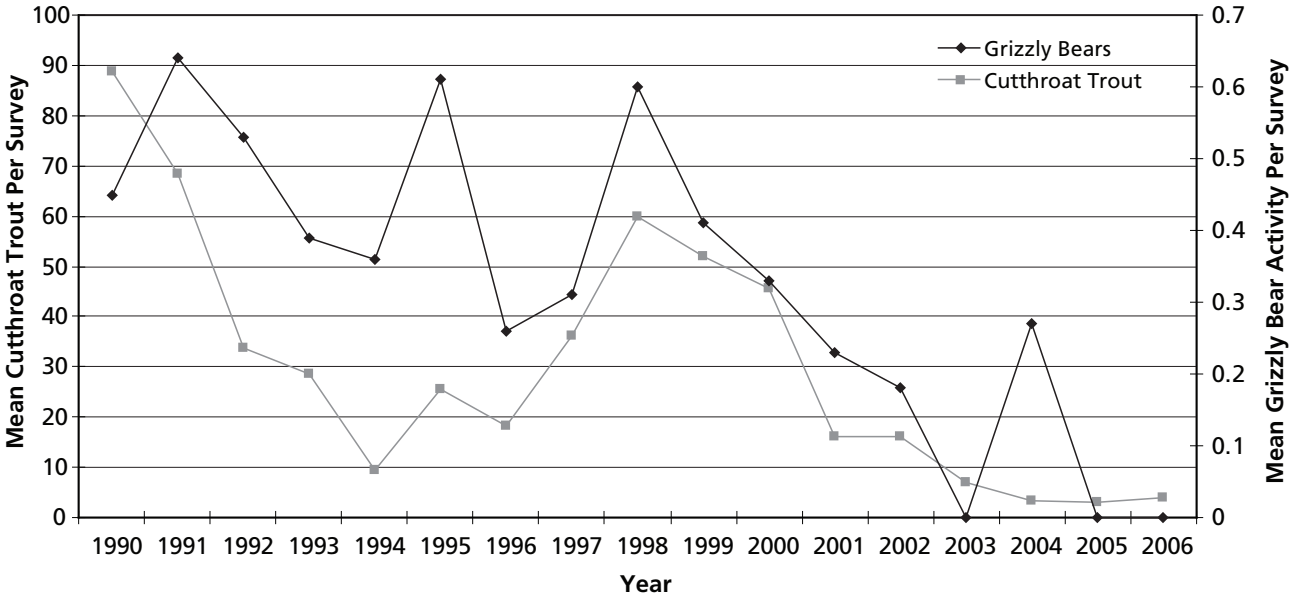


Figure 2. Mean number of spawning cutthroat trout and activity by grizzly bears observed during weekly surveys of nine streams tributary to Yellowstone Lake, 1989–2006.

were surveyed to document the presence and abundance of spawning cutthroat trout and predation of trout by bears (Figure 2). Only four of the nine streams contained spawning cutthroat trout. A total of only 27 spawning cutthroat trout were counted in these four streams. No evidence of grizzly bears fishing on any of these nine streams was observed.

Whitebark Pine Seeds. Whitebark pine surveys were conducted on 10 transects in YNP. The cone counts at these 10 transects averaged 42.4 (SD = 49.7) cones per tree in 2006, approximately three times more than the long-term (1987–2005) average of 14.4 (SD = 32.0) cones per tree, per year, for all transects located in YNP.

Bear Confrontations and Conflicts

Bear–Human Confrontations. We define confrontations as incidents where bears approach or follow people, charge or otherwise act aggressively toward people (posture, slap ground, pop jaws, etc.) enter frontcountry developments, or enter occupied backcountry campsites without inflicting human injury. Incidents where bears enter developments or occupied backcountry campsites are listed as confrontations, even if the bears involved did not behave aggressively, due to the potential threat to human safety. Incidents where bears injure or kill people are listed in the *Bear–Human Conflicts* section below.

In 2006, there were 174 reported incidents of bear–human confrontations (Table 1). Grizzly bears were involved in 120 of the confrontations and black bears in 49. The species of bear involved could not be determined for five confrontations.

Bear–Human Conflicts. We define bear–human conflicts as incidents where bears damage property,

Species	Type of confrontation				
	Bear in development[a]	Bear in occupied backcountry campsite	Bear approached or followed people	Charge or aggressive behavior	Total
Grizzly bear	89	8	9	14	120
Black bear	31	7	8	3	49
Unidentified bear species	1	2	2	0	5
Total	**121**	**17**	**19**	**17**	**174**

[a]Listed as a confrontation due to the potential threat posed to human safety, even if the bears involved did not behave aggressively.

Table 1. Number of incidents of bear–human confrontations reported in Yellowstone National Park, 2006.

Species	Type of conflict			
	Property damage No food reward	Anthropogenic foods	Human injury	Total conflicts
Grizzly bear	8	2	0	10
Black bear	3	4	0	7
Unidentified bear species	2	0	0	2
Total	**13**	**6**	**0**	**19**

Table 2. Number of incidents of bear–human conflict reported in Yellowstone National Park, 2006.

obtain anthropogenic foods, or injure people. In most incidents where bears damage property, they are attempting to obtain human foods, garbage, or other attractants. In most incidents where bears obtain anthropogenic foods they damage property in the process. In 2006, there were 19 bear–human conflicts reported (Table 2). Ten of these incidents involved grizzly bears and seven involved black bears. The species of bear involved could not be identified in two incidents.

Bear Management Actions

In 2006, there were 816 bear-related incidents where management action was taken (Table 3), including:

- 706 incidents where 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;
- 78 incidents where bears were hazed out of developments or away from roadsides due to concern for visitor safety;
- 18 incidents where trails, campsites, or other areas were closed to the public due to safety concerns related to bear activity;
- 12 incidents where bear warnings were posted at trails, campsites, or other areas due to bear activity;
- 1 incident where a grizzly bear that damaged property in the Lake Village employee trailer court was captured and relocated in an effort to prevent further conflicts; and
- 1 incident where a black bear that charged people, damaged property, and obtained anthropogenic foods at the Canyon campground was captured and euthanized.

Grizzly Bear Captures/Relocations/Removals. One grizzly bear was captured and relocated in a management action in 2006. On August 29, Bear Management Office staff trapped a two-year-old female grizzly bear that had been involved in five incidents of property damage in the Lake Village employee trailer court. The bear had also entered the Lake Village development on numerous occasions to forage for natural food. Park rangers and Bear Management Office staff had attempted to haze the bear out of the Lake Village area on numerous occasions by yelling and using horns, sirens, cracker shells, and bean-bag rounds. Hazing was successful only on a short-term basis; the bear kept returning to the Lake Village area throughout the summer. After being captured, the bear was ear-tagged and radio collared, given identification number 539, then relocated by boat to Charcoal Bay at the South Arm of Yellowstone Lake. The relocation was unsuccessful. Bear #539 returned to the Lake Village area three days after being released at Charcoal Bay. After returning to the Lake Village

Species	Bear warnings posted	Temporary area closures	Bear-jam Management	Management hazing	Attempt to trap, unsuccessful	Capture, mark and release on site	Capture and relocate	Capture and remove
Grizzly bear	8	8	242	48	0	0	1	0
Black bear	2	6	452	30	0	0	0	1
Unidentified bear species	2	4	12	0	0	0	0	0
Total	**12**	**18**	**706**	**78**	**0**	**0**	**1**	**1**

Table 3. Number of bear management actions taken in Yellowstone National Park, 2006.

Bear #539's transport on Warwood *to Charcoal Bay.*

area, park staff closely monitored #539's movements and hazed it out of the Lake Village development 15 times between September 1 and October 17. Bear #539 denned for the winter within a few miles of Lake Village and is expected to return to the development in spring 2007.

Black Bear Captures/Relocations/Removals. No black bears were captured and relocated in 2006. One black bear was captured and euthanized. On June 17, at approximately 9:00 a.m., an adult, 144-lb. black bear entered the Canyon campground and began chasing people out of their campsites and eating whatever food was left behind. The bear also caused multiple property damages while attempting to break into vehicles and campers. Hazing and bear spray were not successful in getting the bear to leave the campground. Due to the bear's very aggressive behavior and the fact that it had obtained multiple food rewards, Bear Management Office staff trapped the bear and euthanized it.

Bear–Human Conflict Prevention. An important component of the park's Bear Management Program is to prevent bears from obtaining anthropogenic foods. By preventing bears from obtaining human foods, the likelihood of bears damaging property or injuring people as well as the need to remove bears in management actions is reduced. As part of this program, the Bear Management Office purchased and installed three, 30-cubic-foot, bear-proof food storage boxes in the park in 2006. Two food storage boxes were installed at Indian Creek campground and one at Norris campground.

Public Education and Outreach

The long-term survival of bears in the Yellowstone ecosystem depends on park visitors and surrounding communities having an understanding of bears and bear management practices. As part of this goal, the Bear Management Office presented 38 bear-related educational talks, field trips, and slide shows to state and federal employees, and elementary school, high school, college, and university groups, and at teacher training seminars and Yellowstone Association Institute classes in 2006. Presentations covered topics including safety in bear country, history of bear management in YNP, grizzly bear food habits, grizzly bear conservation, and grizzly bear recovery.

Birds

Rusty blackbird (Euphagus carolinus).

Two species were added to the Field Checklist of Birds of Yellowstone National Park in 2006. A rusty blackbird (*Euphagus carolinus*) was observed in the Mud Volcano area by James Hancock and many others on January 14; and three least tern (*Sterna antillarum*) were seen on the north shore of Yellowstone Lake on May 20–21 by visitors and a park wildlife biologist. This brings the total number of bird species documented in the park to 323. An updated Field Checklist, available on the park website at www.nps.gov/yell, is scheduled to be available in spring 2007.

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 population gains made over the last three decades. Although certain populations are not completely recovered due to heavy metal contamination problems in the Great Lakes region, and habitat encroachment and development problems associated with riparian zones in the desert southwest, the bald eagle is expected to be delisted in 2007.

In Yellowstone, 33 active nests in 2006 produced only 10 fledglings (Figure 1), the lowest since the early 1990s. The large number of nest failures were primarily due to the weather—wet snows, rain, and strong winds.

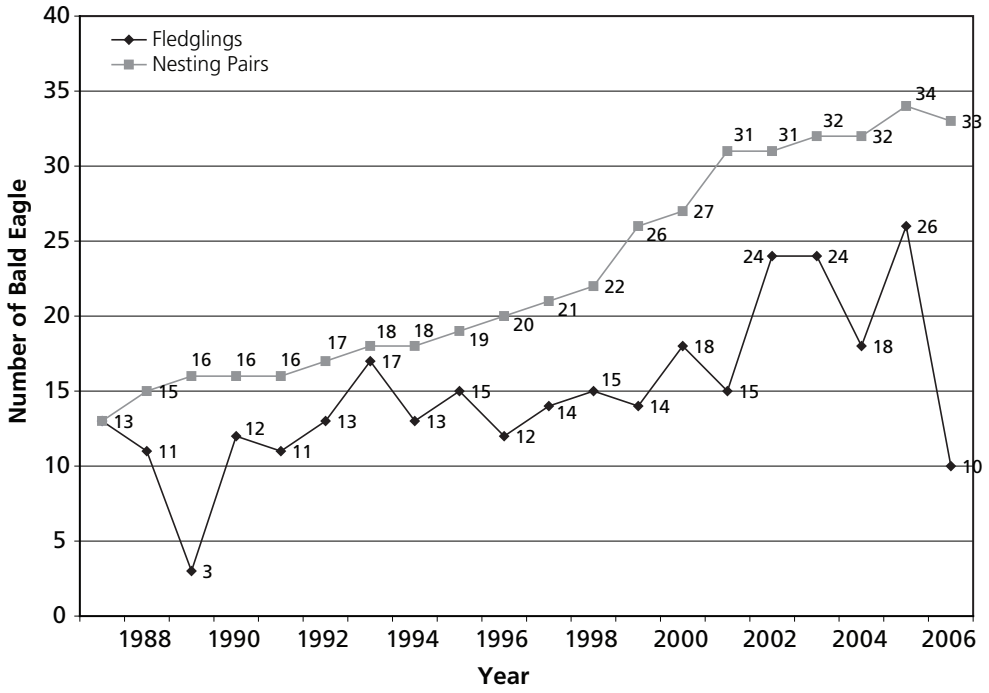


Figure 1. Bald eagle productivity in Yellowstone National Park, 1987–2006.

For the fifth consecutive year, a pair of bald eagles occupied a nest in a large tree located about 150 feet off the Madison-to-West Yellowstone road from mid-February through early July. To allow the eagles to obtain nest material and food without human disturbance, park staff again set up a temporary closure in the immediate vicinity of the nest where visitors were not allowed to stop. As in 2005, two eaglets fledged from the nest.

Peregine Falcon. The peregrine falcon was removed from the federal list of threatened and 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. One new eyrie was found in 2006, bringing the total number of peregrine eyries in YNP to 31, from which 50 peregrines fledged, the largest number ever recorded in Yellowstone (Figure 2).

Trumpeter Swan. The park's resident trumpeter swan count declined to 14 in 2006, the lowest since the 1930s. Recruitment from outside the park, especially Montana's Centennial Valley, has traditionally been a critical factor in maintaining the park's population, but swan numbers west of the park have declined substantially in the last two decades. Recruitment was observed on the west side of the park in 2006 for the third consecutive year, but these gains have been offset by predation.

Documented trumpeter swan nest attempts have ranged from 2 to 10 per year since 1986, but have averaged only three per year since 2001. In 2006, the three nest attempts resulted in four cygnets hatching from one brood, but no fledglings. As in 2005, one of the newly hatched cygnets was seen being preyed upon by an adult bald eagle, and egg clutches from two swan territories were destroyed by grizzly bears. During January and February, a bobcat was observed hunting along the banks of the Madison River, where he preyed upon a juvenile or cygnet trumpeter swan as well as a mallard duck and two Canada geese. In April, two trumpeter swans were preyed upon by three wolves in the Gibbon Meadow area; the birds were forced into soft snow where they were easily killed. In May, a lone wolf came upon a pair of adult swans sleeping in the Gibbon Meadow area, and killed one of them in the water.

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 2006. This was an average year for colonial nesting bird production, with fledglings from the nests of American white pelicans, double-

crested cormorants, and California gulls, but no Caspian tern nests.

Osprey. The park's osprey population has been on a downward trend for the last six years. Only 23 young fledged from 41 nests in 2006, compared to 96 fledglings from 64 nests in 2000, most of them on Yellowstone Lake. On 600-acre Frank Island, which had as many as 25 nesting pairs in 1994, a wildfire burned nearly all of the trees in 2003 and a severe windstorm blew down most of the remaining potential nest sites in 2005. Another possible factor in the osprey decline on Yellowstone Lake could be the decrease in young cutthroat trout, a major food source for ospreys.

Harlequin Duck. The park's harlequin duck population fluctuates slightly from year to year, with generally 22–26 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 the ducks time-consuming and difficult.

Common Loon. The count of adult common loons in the park was 39 in 2006, within the range of between 34 and 51 during the last 18 years. Of the nine nest attempts in 2006, only six loonlets fledged.

Other Population Monitoring

North American Bird Migration Count. Yellowstone National Park participated in the North American Bird Migration Count for the 14th consecutive year in 2006. Traditionally scheduled on the second Saturday in May, this year the count was done on May 13. Four observers recorded a total of 89 bird species and 2,446 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. Sixty-eight of the bird species were observed within the park.

Breeding Bird Surveys. Three Breeding Bird Surveys were conducted in the park in 2006. This data, which is sent to the Patuxent Wildlife Research Center in Laurel, Maryland, is used to develop population trends for North American songbirds and is available online at www.mp2-pwrc.usgs.gov/bbs.

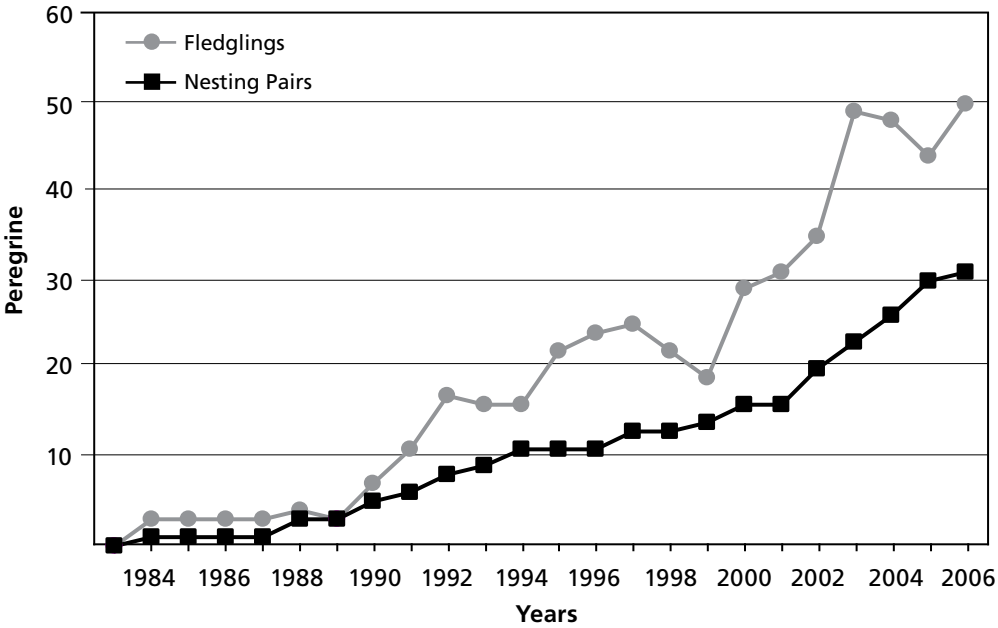


Figure 2. Peregrine falcon productivity in Yellowstone National Park, 1983–2006.

Christmas Bird Count. The six participants in the annual Yellowstone Christmas Bird Count observed a total of 35 bird species and 1,602 individual birds on December 17. These results were slightly above the long-term averages. The weather was somewhat mild by Yellowstone standards, with clear skies and temperatures ranging from -6 to 19° F, and 0–5 inches of snow on the ground depending on the elevation. New abundance records were set for northern pygmy-owls (2), northern flickers (12), and cedar waxwings (72).

Red-tailed Hawks and Swainson's Hawks. Although the staff ornithologist has collected incidental data about red-tailed hawks and Swainson's hawks nesting in the park via ground reconnaissance and aerial surveys over the last 20 years, a more thorough effort to map nesting territories was made during 2003–2006. The results indicate that 126–139 red-tailed hawk pairs nest in the park each year and their territories remain fairly constant. Many of the nesting sites have been occupied for at least two decades.

Swainson's hawks are much fewer in number. Incidental field data collected via ground reconnaissance and aerial surveys indicate they ranged in abundance from 28–36 nesting pairs during 2003–2006. The park ornithologist attributes the slight reduction in numbers he has observed over the past two decades primarily to drought-like conditions or a shift toward a drier weather cycle.

Black-billed Magpies and Common Ravens. An estimated 73–120 pairs of black-billed magpies nest in the park each year. Magpie nesting habitat in the park appears to be slowly declining as a result of reduced, dying, or decadent substrates as a result of drought-like conditions or changes toward a drier weather cycle. Information collected by the park ornithologist during the last 20 years suggests the abundance of common raven nesting pairs (100–150) has not changed significantly, and most nest sites are traditional and have been occupied for decades. Since ravens are long-lived birds, there are also a large number of non-breeders in the population. The summer population in the park is estimated to vary between 300–500. The large whitebark pinenut production in 2005 and 2006 brought above-average numbers of common ravens as well as Clark's nutcrackers to the Mount Washburn area in the fall.

Bison

Bison are among the most intensively managed wildlife species occupying habitats in and around Yellowstone National Park. During the past 100 years, the population has grown from a few dozen animals to nearly 4,000. Some of these bison are infected with the bacterial disease brucellosis, and some of them migrate to low elevation winter ranges along and beyond the park boundary.

In 2000, as part of an interagency partnership, the National Park Service completed a lengthy planning process to develop a management strategy for the Yellowstone bison population. Their expansion in range necessitates cooperative management to ensure conservation across multiple jurisdictions. The Bison Ecology and Management Office (BEMO) continues to conduct a monitoring program to track vital rates of the population and understand the dynamic nature of how brucellosis infection affects bison.

Boundary Control

Boundary control operations were much more extensive along the north boundary than the west boundary during the winter of 2005–06. The large population size at the beginning of the winter and the slightly above-average snow pack conditions led to an earlier start on hazing and capture operations than in most years. A total of 1,308 bison were captured, nearly all of them at the north boundary,

where 304 were held at the Stephens Creek corral for approximately one month to mitigate brucellosis risk management needs. A total of 1,002 bison were culled from the population through management actions, including 87 calves that were consigned to Montana Department of Fish, Wildlife and Parks for the quarantine feasibility research program. An additional 46 bison were harvested on winter ranges adjacent to the park through hunting programs managed by Montana Fish, Wildlife and Parks and the Nez Perce tribe.

Population Monitoring

Three aerial counts were conducted in July and August of 2006. Population counting conditions were generally good except that the third flight experienced extensive early morning fog in the Hayden Valley and Canyon area. The population estimate based on these flight results is 3,905 (95% range 3,247–4,563). The daily counts varied less this year than in many past years. During the third flight, 491 calves were counted.

From 2000 to 2006, the annual rate of population growth has been 16% in the Northern Range subpopulation and 1% for the Central Interior subpopulation (Figure 1). The difference in growth rates appears to be the result of management actions that have had more impact on the Central Interior subpopulation during this period.

Classification of the population is done to assess the population status and demographic trends relative to boundary control operations and ecological processes occurring in the system.

The calf-to-adult cow ratios observed in both areas in mid-summer 2006 indicated good productivity (45 calves per 100 females on the northern range; 40 calves per 100 females in Hayden Valley). The ratio of yearlings in the population, which is an index of recruitment, was higher than during the past few years, and the trend is slightly greater in yearling females than in yearling males.

Eighteen female bison were captured during the fall and early winter to deploy or remove radio transmitting devices that are used to maintain a marked sample of individual animals. Of the 14 adult bison, 10 were pregnant, and 1 of 4 two-year-old bison was pregnant. This is consistent with previous monitoring results. All of the pregnant bison that survived the winter carried their pregnancies to full term and produced a surviving calf.

The primary mode of brucellosis transmission between bison is thought to be through oral ingestion of bacteria when susceptible bison investigate the reproductive tissues expelled during a parturition event (abortion or birth). In most of 11 observed parturition events in 2006, one to four bison from the same group came to investigate the newborn and/or the birth materials. Samples of birthing tissues were collected at 15 parturition sites and samples from two of the sites cultured positive for brucellosis.

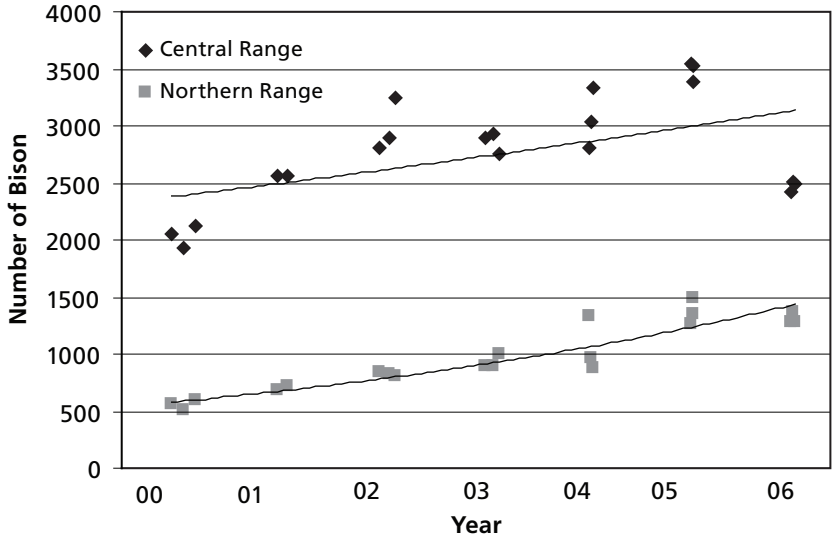


Figure 1. Annual bison counts during summer by breeding area, 2000–2006.

Mike O'Brien (University of Montana) collects bison fecal sample for genetics study.

Non-invasive Sampling to Detect Genetic Diversity

In 2005, the BEMO program initiated a pilot study to determine the feasibility of sampling bison fecal material for extracting DNA. Cells from the lining of the intestinal tract are sloughed off as pellets pass along the digestive track and are excreted with the pellets. By collecting the mucus substance found on the surface of the buffalo chip when it is very fresh, the DNA can be fixed in the field and prevented from deteriorating. This technique has been very successful in carnivore research and recently validated in research on elephants in Asia and India. The preliminary results show that this technique can be successful in bison as well. More than 40 microsatellite loci have been screened and a subset of 14 loci were determined to provide good to excellent amplification of DNA. Preliminary results showed amplification of mtDNA fragments of 100 to more than 800 base pairs long. Approximately 400 samples have been collected from throughout the summer and winter range distribution of Yellowstone bison. The project is also collecting samples from the Jackson bison population in the southern GYA. After many months of refining the extraction methods, we have found the appropriate quantity and type of template for use in maximizing the extraction of DNA. Early results show that proportions of known haplotypes differ between the two subpopulations.

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

We continued monitoring key vital rates and limiting factors of Yellowstone elk to evaluate the relative effects of disease, harvests, land use, predation, and environmental factors on elk demographics and population trends. We collaborated with the U.S. Geological Survey Northern Prairie Wildlife Research Center and University of Minnesota to estimate annual survival rates for 85 adult female elk radio-collared on the northern range during March 2000–February 2004. Annual survival rates averaged 0.83 for females 1–15 years old, with most deaths occurring from December through March. Eleven of 33 documented deaths were attributed to hunter harvest, 14 to predation (10 wolf, 2 unknown, 1 cougar, and 1 bear), 6 to unknown causes, and 2 to winter-kill. Wolf-killed elk were typically older (median = 12 years) than hunter-killed elk (median = 9 years), but elk known to winter outside the park, where they were exposed to hunting, were also younger (median = 7 years) than elk not observed outside the park (median = 9 years). Consequently, differences in ages of elk killed by wolves and hunters may reflect characteristics of elk exposed to various causes of mortality as well as differences in susceptibility.

We also collaborated with Dr. L. Lee Eberhardt to evaluate trends in annual counts and removals of northern Yellowstone elk. The population decreased during 1976–2004 in response to: 1) liberal harvests of antler-less elk outside the park; 2) substantial winterkill and reduced calf survival during 1989 and 1997; and 3) the rapid numerical response of wolves and their predation on elk following restoration in 1995–1996. No influential effects of snow pack or summer precipitation were

detected on the growth rate of the population. Estimated wolf kill of elk exceeded hunter harvest during 2003–2005, but wolves likely had a smaller effect on elk dynamics because they concentrated on calves and older females with lower reproductive value. Antler-less harvests were reduced 96% by Montana Fish, Wildlife and Parks during 2000–2006 to decrease removals of prime-aged animals with high reproductive value and increase adult female survival. Conservative harvests of females may be necessary for many years to avoid destabilizing elk dynamics given the abundant complex of predators.

We continued surveillance for chronic wasting disease (CWD), a contagious, fatal disease of deer, elk, and moose for which there is no vaccine or known treatment. It is transmitted by direct animal-to-animal contact or, indirectly, through the environment. Deer, elk, and moose of Yellowstone National Park are at near-term risk for infection by CWD because known infected cervids are approximately 130 miles from the park, the disease has recently spread across Wyoming toward the park, and large populations of deer and elk utilize park habitats. The staff has developed plans to implement management actions to reduce or stabilize the prevalence of the disease if it is detected in or near the park.

Pronghorn

Staff continued monitoring abundance and key vital rates for pronghorn. They collaborated with the Yellowstone Ecological Research Center, the University of Idaho, the Bernice Barbour Foundation, and the Yellowstone Park Foundation to continue a three-year study of differential recruitment among pronghorn fawning areas in relation to wolf and coyote densities and use areas. In addition, staff collaborated with Montana State University to analyze pronghorn counts during 1918–2006. Concerns about sagebrush (*Artemisia* spp.) degradation led to removals of more than 1,100 pronghorn during 1947–1966; counts decreased from approximately 700 to 150. Contrary to expectations, the population did not exhibit enhanced demographic vigor after the termination of the harvest program; counts remained between 100–190 during 1967–1981. However, the population irrupted to a peak abundance of approximately 600 during 1982–1991, with a slowing in growth rate as counts exceeded 500. Numbers crashed to 235 pronghorn during 1992–1995, perhaps because important food resources (e.g., sagebrush) on the winter range were severely diminished by high densities of browsing elk, mule deer, and pronghorn. Pronghorn numbers remained relatively constant during 1996–2006, at approximately 196–235.

Staff also collaborated with MSU to evaluate habitat use and diet composition by 37 radio-collared, adult females from December 1999 through March 2005. Attributes of vegetation type, elevation, solar radiation, and slope associated with 1,446 different groups containing radio-collared pronghorn were compared to 9,891 randomly selected points from the winter range. Pronghorn selected intermediate elevations and slopes, preferred greasewood (*Sarcobatus vermiculatus*), and avoided sagebrush in comparison to the grassland cover type. The avoidance of sagebrush, which is highly important to other wintering pronghorn populations, may stem from a substantial decrease in this plant type on the winter range by the 1960s due to intense browsing by congregated ungulates. The percent composition of sagebrush in the winter diets of pronghorn decreased from 67% during 1985–1988 to less than 10% during 2000–2001, while rabbitbrush (*Chrysothamnus* sp.) increased from 5% to 60%.

Bighorn Sheep

Staff collaborated with the Northern Yellowstone Cooperative Wildlife Working Group to evaluate if bighorn sheep numbers had decreased following wolf reintroduction because of lower survival and recruitment. Counts of bighorn sheep decreased following the severe winter of 1997, but then increased 7% annually during 1998–2005. Recruitment

followed a similar temporal pattern, decreasing to 7–11 lambs per 100 ewes during the severe winter of 1997 and the following winter, but then increasing to 21–34 lambs per 100 ewes during 1998–2005. Annual estimates of survival for 14 adult females and 4 males 1–3 years old were high (0.94) and indicative of an increasing or constant population. Thus, the presence of wolves did not prevent the bighorn sheep population from increasing slowly during the decade following reintroduction. However, sheep counts remain low compared to the 487 sheep observed before an outbreak of keratoconjunctivitis caused 60% mortality during 1982, which suggests that other factors have limited the recovery of this relatively isolated, high-elevation, native sheep population.

Wildlife Responses to Winter Recreation

Staff continued to monitor the behavioral responses of bald eagles (*Haliaeetus leucocephalus*), bison, elk, and trumpeter swans (*Olor buccinator*) to snowmobiles and coaches by repeatedly surveying groomed road segments from December 2005 through March 2006. They also collaborated with MSU to analyze 5,688 interactions between these species and groups of snowmobiles or coaches during 2003–2006. Bison responded less frequently (20%) to snowmobiles and coaches than swans (43%), elk (52%), or bald eagles (83%) due to fewer vigilance responses. However, the frequency of higher-intensity movement responses was similar among species (8–10%). The likelihood of vigilance and movement responses by these species increased significantly if animals were on or near roads, animal groups were smaller, humans approached animals on foot, interaction time increased, or the numbers of snowmobiles and coaches in a group increased. Human disturbance did not appear to be a primary factor influencing the distribution and movements of any of these species, nor was there evidence that snowmobile use during the past 35 years has significantly affected their demography or population dynamics.

Staff also collaborated with MSU to quantify temporal trends in the amount of bison road and off-road travel during 1997–2005 in the upper Madison River drainage. Bison were observed on the road less often from December to April when the roads are groomed than during the rest of the year, and there was no evidence that bison preferentially used groomed roads during winter. Bison travel on and off roads was positively correlated with snow pack, bison density, and the springtime melt period. Travel was only a small percentage (11%) of all bison activity, with foraging comprising 67% of observations. Also, only 7% of traveling bison and 30% of foraging bison were displacing snow. Thus, foraging rather than traveling appeared to be the major energetic cost to bison in winter. Bison generally used their own trail networks, connecting foraging areas with stream corridors, geothermal pathways, and self-groomed travel routes. These data indicate that changes in bison spatial dynamics during the past three decades have likely been the result of the natural phenomenon of density-dependent range expansion rather than caused by the anthropogenic influence of road grooming.

In addition, staff collaborated with MSU and California State University–Monterey Bay to evaluate 121,380 locations from 14 female bison with GPS collars in central Yellowstone. The probability of bison travel and spatial distribution of travel locations were affected by slope, landscape roughness, habitat type, elevation, and distances to streams, foraging areas, forested habitats, and roads. Streams were the most influential natural landscape feature affecting bison travel and their travel network was spatially defined by the presence of streams that connected foraging areas. Also, the probability of bison travel was higher in regions of variable topography that constrained movements, such as in canyons. Roads may facilitate bison travel in certain areas, but many road segments used as travel corridors appear to be overlaid upon natural travel pathways because road segments receiving high amounts of bison travel had similar landscape features as natural travel corridors.

Mid-sized Carnivores

Yellowstone supports a broad variety of mid-sized carnivores, including the American marten, river otter, and red fox, as well as two uncommon species, the wolverine (*Gulo gulo*) and the Canada lynx (*Lynx canadensis*). Although little is known about their presence in the park, mid-sized carnivores undoubtedly play an important ecological role as predators and scavengers of small and medium-sized prey.

The Canada lynx and wolverine are rarely seen because of their small numbers and affinity for boreal forests and alpine habitats, but they carry strong aesthetic and existence values for the public. The Canada lynx is federally protected as a threatened species. In 2007 and early 2008 the U.S. Fish and Wildlife Service (USFWS) will conduct a status review that may result in a decision to list the wolverine as endangered under the Endangered Species Act. Two previous petitions to list the wolverine were denied due to a dearth of information about the wolverine's life history and ecological requirements.

The mission of the mid-sized carnivore program in Yellowstone is to improve the information available to resource management, planning, and interpretation staff in the park. The program also provides data that supports the park's responsibility to consult with the USFWS concerning the effect of park management activities on endangered species.

2006 Highlights

In 2006, the mid-sized carnivore program completed its first winter field season for collaring wolverines to monitor their movements, and finalized the 2001–2004 Yellowstone lynx survey by publishing the findings in *Northwest Science* (vol. 80:199–206). Staff also provided administrative assistance to Wildlife Conservation Society biologists who are conducting a wolverine study in the western GYE, including some areas adjacent to the park's north and west boundary.

Absaroka-Beartooth Wolverine Study

The wolverine, the largest member of the weasel family, has recently emerged as a species of primary concern for federal land managers in the Rocky Mountains because of its low population density, infrequent reproduction, genetic fragmentation, and possible sensitivity to human disturbance. The goal of the Absaroka-Beartooth Wolverine Study is to collect basic ecological and mission-critical information on wolverines during a five-year study in the Absaroka and Beartooth Ranges, and to encourage wolverine conservation by building public knowledge and appreciation through education. Project cooperators with Yellowstone National Park include the Yellowstone Park Foundation (primary fund raiser), the U.S. Forest Service, the Rocky Mountain Research Station of the U.S. Department of Agriculture, Montana Fish, Wildlife and Parks, Wyoming Game and Fish, and the Rocky Mountains Cooperative Ecosystem Studies Unit.

Beginning in mid-January, project staff baited and maintained 29 live traps clustered in four trap lines in east Yellowstone (East Entrance Road, 8 traps; Northeast Entrance Road, 6 traps) and the Gallatin and Shoshone national forests. The total trapping effort through early April exceeded 1,800 trap nights. Two healthy, mature male wolverines, each weighing more than 25 pounds, were captured in March, including one along the East Entrance Road. Both were instrumented with GPS collars and VHF transmitters. The sizes of their annual home ranges were approximately 156 mi^2 and 155 mi^2, and mean elevations were 9,100 and 10,400 feet. One male moved 280 air miles over a 26-day period at an average rate of 1.4 kilometers/hour. During one particular two-hour period, he traveled more than nine kilometers. Project staff made several forays into the backcountry to monitor the two wolverines and document their food habits. Several new traps were built during the summer and fall, including one near Dunraven Pass.

Assisted by wolverine project staff, the Division of Interpretation taught five "wolverine" field camps during 2006 in gateway communities surrounding the park to expose grade-school children to wolverine life history, research techniques, and the social, ecological, and aesthetic values of the species. Project staff also taught two Yellowstone Association Institute courses on wolverines, gave nine public and professional presentations, and distributed an annual newsletter and several updates to private and governmental cooperators. The project is expected to continue through 2009.

Cooperators Dan Tyers and Jeff Copeland (USFS) with a wolverine.

Wolves

Population Monitoring

Population Status. At the end of 2006, at least 136 wolves in 13 packs occupied Yellowstone National Park (Figure 1). This represents a 15% rebound in wolf numbers after the population decline in 2005 (Figure 2). In 2006, there was no evidence of a disease outbreak, which was the cause of the population drop in 2005; adult and pup survival was very good. Unlike previous years, there was very little turnover in packs; of the 13 packs present in 2005, 12 were still together at the end of 2006, along with one new pack, the Oxbow Creek pack. Pack size ranged from 4 (Cougar Creek) to 19 (Leopold) and averaged 10.5 wolves.

Wolf distribution across the park has remained the same for several years, indicating that all available wolf habitat is settled. Pack turnover, when it occurs, is always within the occupied wolf range and new areas of settlement have not been recorded.

Although it includes only about 11% (1,000 km^2) of the park area, the northern range continues to support most of the park's wolves because of greater year-round prey density. The seven packs using the northern range had a total of 75 members; the six packs in the rest of the park, 61 members. However, recent analyses indicate that social strife (wolf–wolf

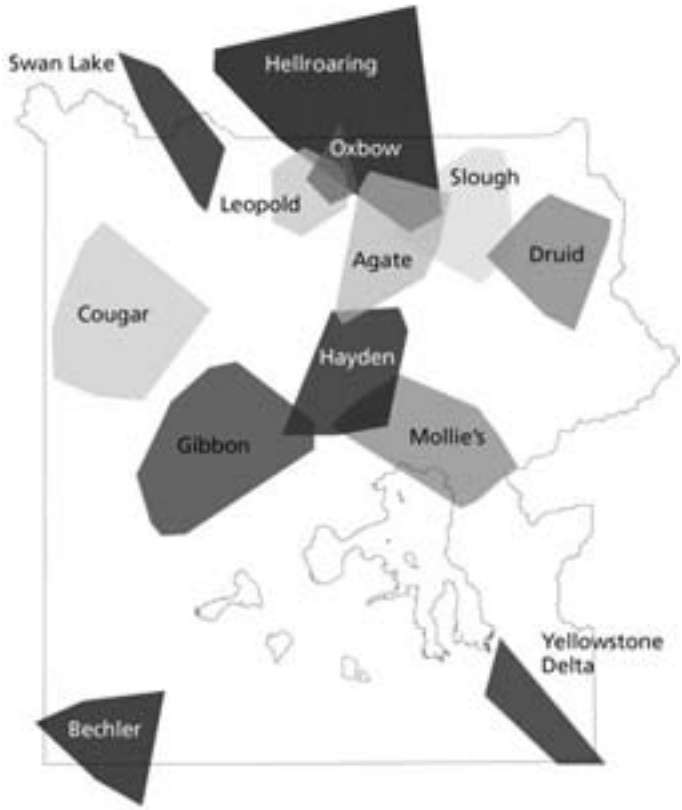


Figure 1. Territories occupied by the 13 wolf packs residing primarily in YNP.

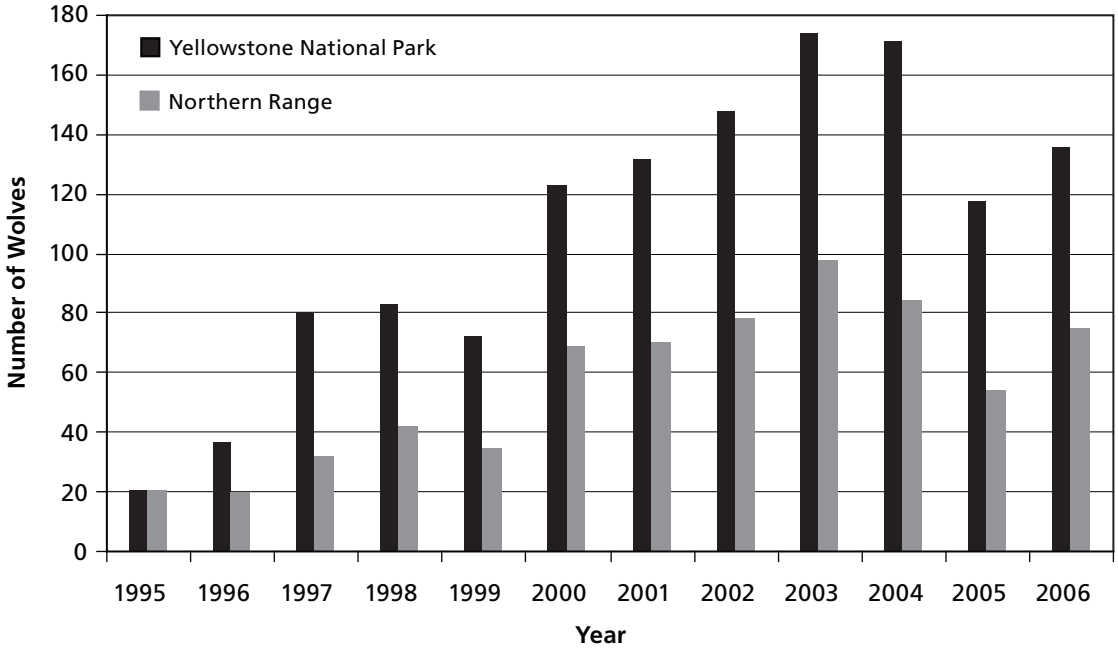


Figure 2. Number of wolves in Yellowstone National Park, 1995–2006, comparing the northern range to the total park population.

killing and territorial clashes) and probably disease were limiting wolf numbers on the northen range. Based on these observations, we expect wolf numbers to decline over the next several years despite the recent one-year increase in wolf numbers.

Reproduction. After a poor year in 2005, there seemed to be some compensatory survival in 2006; of the 77 pups counted in the park, 60 (78%) survived compared to only 32% in 2005. The average number of pups in the 11 packs that had counted pups was 6.8. The average number of pups born to each breeding female was 5.4 because in three packs, two females bred. These multiple litters, like those previously documented in the park, occurred on the northern range.

The Slough Creek pack had a litter, but none of the pups survived, probably due to competitive interactions with another pack. The reason for the absence of pups in the Cougar Creek pack is not known, but could be the result of reproductive failure by the breeding female, who was eight years old.

Mortalities. Nine collared wolves, seven males and two females, died in 2006: four as a result of intraspecific strife, one from natural causes, one from a control action, one killed illegally outside the park, and two from unknown causes. The mortality rate among collared wolves in 2006 was 18%, compared to the 11-year average of 20%.

Wolf Predation

Including definite, probable, and possible kills, project staff detected a total of 218 wolf kills in 2006: 219 elk (80%), 30 bison (14%), 6 coyotes, 5 wolves, 3 deer, 2 bighorn sheep, 2 moose, 1 beaver, 1 golden eagle, and 12 unknown prey (4%). The composition of elk kills was 32% calves (0–12 months), 16% cows (1–9 years old), 14% old cows (≥10 years old), 31% bulls, and 7% elk of unknown sex and/or age. Bison kills included 12 calves, 11 cows, 3 bulls, and 2 of unknown sex and age.

Winter Studies. The kill rate per wolf was higher during the 2005–2006 winter than the preceding winter, probably because of deeper and more crusted snow that made elk and bison more vulnerable to wolf predation. However, the total number of elk killed declined because the wolf population was smaller (Figure 3). This was the first winter since 1996–1997 that the Wolf Project documented significant winter-kill of elk and bison.

Summer Studies. Project staff continued efforts to document the wolves' summer predation patterns using GPS telemetry and by collecting scats at dens and rendezvous sites. They also collected data on invertebrate diversity and abundance at summer carcasses in collaboration with Dr. Chris Wilmers (University of California–Davis). Members of the order Coleoptera (including beetles) dominated the

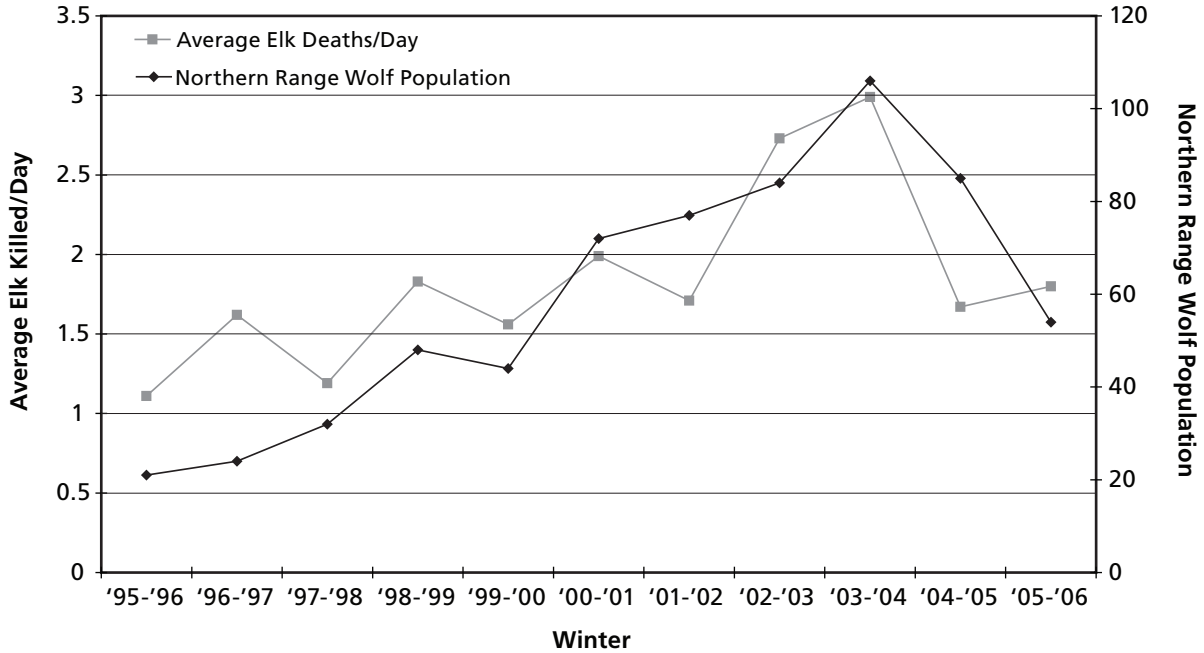


Figure 3. Average number of elk killed by wolves (November–March) and northern range wolf population (1995–2006).

sampling, particularly those in the family Silphidae (carrion beetles).

Other Wolf Management and Research

Wolf Capture and Collaring. Staff captured and handled 26 wolves from 12 packs in 2006. At year's end, 37 (27%) of the 136 known wolves were collared. In addition to deploying standard VHF and GPS collars, three ARGOS collars, which track wolves via satellites and are capable of emailing the locations to the wolf office, were used on the more remote packs (Delta, Bechler, and Mollie's) in 2006.

Population Genetics. A collaborative effort with the University of California–Los Angeles that began in 2005 continued to use genetic techniques to construct a population pedigree for all handled Yellowstone wolves and understand the gene flow among the three Rocky Mountain wolf recovery areas. In 2006, project staff made considerable efforts to get DNA samples from key breeders in the population that will allow for greater understanding of pack lineages, parentage, and relatedness among packs.

Disease. Serum from 222 wolves was sent to Cornell University and tested for exposure to three common canine diseases: infectious canine hepatitis, canine parvovirus, and canine distemper virus. All three were found to be present in Yellowstone wolves. Presence of sarcoptic mange, a disease detectable through the physical examination of a wolf (e.g., hair loss), is also being monitored.

Visitor Management. Area closures for wolves are minimized except in the case of denning wolves. Small areas around dens were temporarily closed at Slough Creek and Hayden Valley in 2006.

This was the seventh year that private funds were used to manage wolf viewing by park visitors. Project staff worked closely with the Division of Resource and Visitor Protection and the Division of Interpretation in wolf viewing areas in Slough Creek, Round Prairie, Antelope Creek, and Hayden Valley to ensure that objectives for wolf and human safety, education, and research were met. It is estimated that more than 13,000 visitors viewed wolves during the summer of 2006.

Public Involvement and Outreach

Nineteen volunteer field technicians worked a total of 6,200 hours in 2006. Wolf Project staff gave more than 100 talks at scientific conferences and to the general public. Douglas Smith was interviewed 60 times by media sources about park wolves. For the sixth straight year, Smith accompanied U.S. Forest Service personnel on horseback into outfitter camps adjacent to the park to discuss wolf issues. This year, three camps on the north boundary in Gallatin National Forest were visited with YCR Chief Tom Olliff.

Wolf Project staff weighing and processing.

Pelican Cone bear survey.

PART III

Professional Support Programs

This section summarizes the 2006 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

Spatial Analysis Center

The Spatial Analysis Center (SAC) provides a variety of GPS (global positioning system) and GIS (geographic information system) services to park staff and cooperators by "repackaging" technology and technical data to suit a variety of information needs.

Highlights for 2006

Improving GIS Data for Buildings, Roads, and Trails. The Maintenance Division has entered a large amount of information about park assets into a database called FMSS (Facilities Management Software System). To link that information to the spatial representation of those assets, the correct FMSS number must be added to nearly every one of the 1,975 building features, 1,490 road segments, and 1,657 trail segments in the GIS. During 2006 we assigned FMSS numbers to more than two-thirds of these assets, and the task will be completed during summer 2007. We have also linked 732 buildings with FMSS numbers to records within the LCS (List of Classified Structures) database.

Support for Planning Efforts. We created three-dimensional computer models of the Lake, Tower, and Old Faithful developed areas, complete with realistic buildings, trees, and terrain. Allowing users to view the consequences of different planning scenarios on the landscape increases the likelihood that everyone will understand the proposals and not be surprised by the results. We also support the environmental analysis process by participating on ID Teams and supplying planners with numerous map and analysis products.

Wildland Fire and Wildland-Urban Interface (WUI) Support. Every year the SAC staff dedicates a significant portion of the summer to mapping Yellowstone's wildland fires and creating information products for fire crews, the Public Affairs Office, and the public (via the park's website). We also participate throughout the year in the WUI planning efforts through analysis of data and creation of information products.

Thermal Inventory. Summer 2006 was the SAC's ninth field season of digitally mapping Yellowstone's thermal features. With temperature, pH, photos, and GPS locations collected from more than 500 additional thermal features, the database now contains information about approximately 10,400 thermal features throughout the park. This data enables park staff and outside researchers to identify individual

Three-dimensional computer model of Roosevelt Lodge and cabins.

thermal features with particular combinations of temperature, pH, and location.

Archeological Sites. Using the 155 reports provided by the park archeologist, every known archeological site was digitized and linked to an electronic site form, the source archeological report, and the Archeological Sites Management Information System (ASMIS) number. Approximately 2,000 polygons were created to represent every iteration of every site.

Computer and Software Support. One of the SAC's main functions is to help users solve computer, network, printer, and GIS questions, which range from 10 to 50 per week, depending on the season. Many of the problems are solved quickly, but more complicated issues can take half the day to resolve. In 2006 we responded to more than 1,100 of these requests for help. Dedicating SAC staff time to these problems in Mammoth allows the staff from Computer Support Services to provide more assistance to staff outside of the Mammoth area and to spend time on higher priority, more technical problems.

Mapping Support. Throughout the year, we respond to hundreds of requests for maps and data. About 60% of these requests are typically from park staff. The other 40% come from NPS staff from other locations; other federal, state, and local agencies; university faculty and students; and the general public.

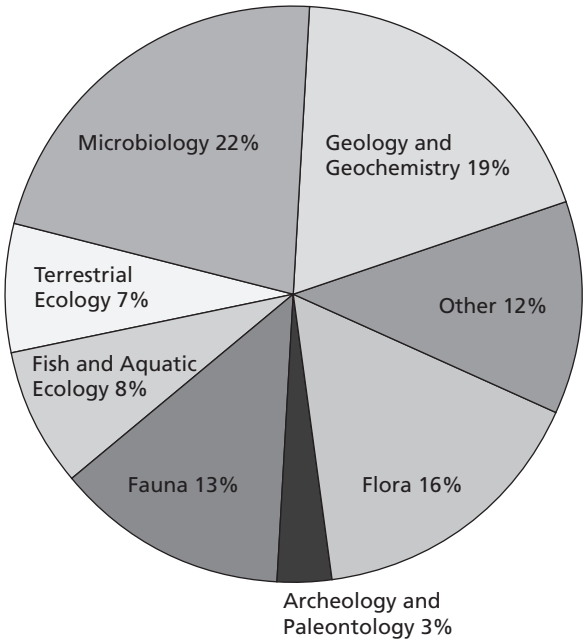
Research Permit Office

Yellowstone National Park is the proud host of more than 200 research studies each year. The Research Permit Office is tasked with issuing permits to researchers who conduct scientific studies in a variety of disciplines and monitoring their fieldwork to ensure that it does not negatively affect park resources or conflict with other park goals or missions. National Park Service policy also requires that we promote research in the park, and collect and appropriately disseminate the results of park-related scientific inquiry to the widest possible audience. Our stakeholders include research scientists, park staff, land managers, and the public. We do this through various means including scheduling research talks and disseminating journal articles, theses, and research reports to interested parties.

During 2006, Yellowstone's Research Permit Office issued 208 research permits to scientists from 35 U.S. states and 9 foreign countries. These permits included 25 new projects that had been approved by Yellowstone's Research Review Team as well as renewal permits for ongoing studies. The number of requests for new permits was down 40% from 2005. An additional 24 scientists inquired about conducting research in Yellowstone, but did not pursue obtaining a research permit. Twenty-seven investigators reported the conclusion of their studies and submitted their research findings and publications to the park.

We accompanied approximately 15% of the researchers in the field, enabling us to better understand their project's needs as well as ensure that no park resources were harmed. During these field outings our staff and the researchers usually discover better ways to record data or collect samples as well as minimize any potential negative affects on resources. These ideas for "best practices" are documented and transferred to our staff and other researchers when applicable.

Though Yellowstone is widely known for its abundant wildlife and unique geothermal features, scientific research is conducted in a variety of disciplines. A breakdown of research studies, by topic, is as follows:



In addition to the above-mentioned tasks, the Research Permit Office staff continues to provide general park information and logistical support to researchers throughout the year.

Benefits-Sharing EIS

A draft of the environmental impact statement (DEIS) was completed and released for public review September 22, 2006, through January 29, 2007. The key issue examined in the DEIS is whether the NPS should share in potential scientific and economic benefits when researchers studying park resources discover or invent something commercially valuable from their research involving NPS specimens. The DEIS proposed to clarify the rights and responsibilities of researchers and the NPS in these instances. Three alternatives for managing benefits-sharing with the scientific community were considered:

- The Preferred Alternative would require researchers who study park specimens to enter into benefits-sharing agreements with the NPS before using their research results for any commercial purpose. Engaging park researchers in benefits-sharing agreements could return scientific benefits, in-kind services, and sometimes royalties and other monetary benefits to parks for conservation-related purposes.
- Another alternative would prohibit scientific research involving NPS specimens if associated with the development of commercial products.
- The No-Action alternative would allow research that may lead to commercial products to continue in parks without any obligation to share any resulting benefits with the NPS.

Prior to public release, briefings on the EIS were presented to the Department of the Interior (DOI) Secretary's Office, the NPS Directorate, the Montana and Wyoming Governor's Office staff, and various NPS regional and central office staff groups, non-governmental organizations, and other external groups. Over 10,000 notifications were distributed in a variety of formats, including the Benefits-Sharing EIS website. The DEIS was available for download and comment via the NPS's web-based public involvement system, Planning, Environment and Public Comment (PEPC). Following analysis of public comments, the final EIS and decision document are expected to be released in 2007.

With assistance from the Assistant U.S. Attorney's Office and the DOI Office of the Solicitor, the NPS continued a successful response to ongoing litigation in Washington, D.C., federal court over documents withheld as part of an October 2002 Freedom of Information Act (FOIA) response. To date, nearly a dozen court filings and personal declarations have been prepared in response to the litigation. Late in the litigation, the plaintiff amended their filing to contest a fee-waiver denial for their August 2005 FOIA, which requested more than three years' worth of project records. In November 2006, the judge issued a ruling in favor of NPS on all counts except for the fee waiver denial, which was granted to the plaintiff. Efforts have begun to address filling the massive August 2005 FOIA request.

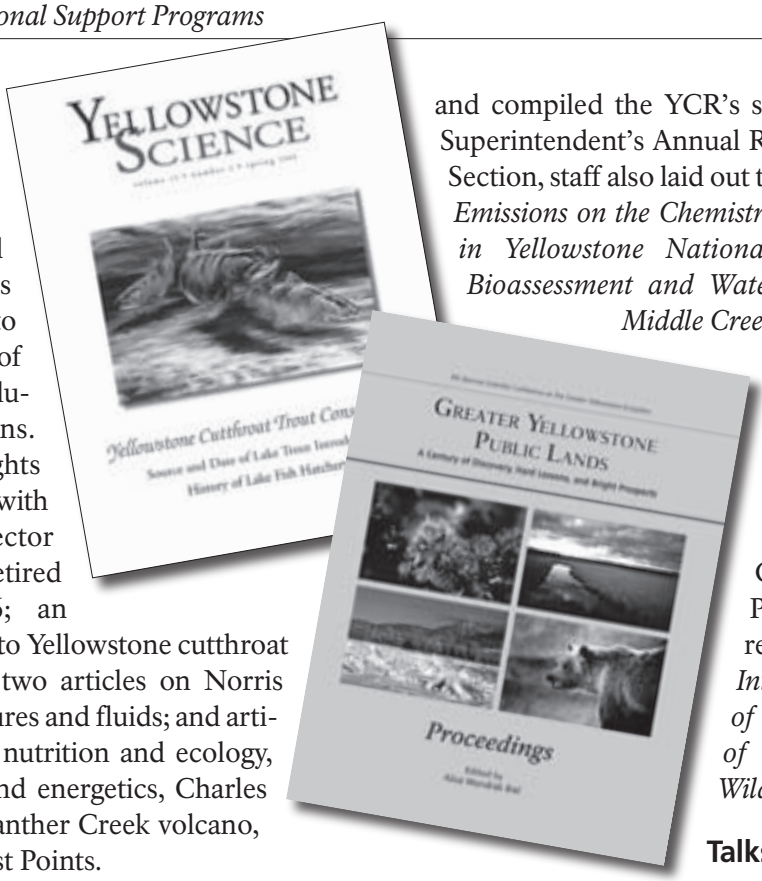
Resource Information Team

The mission of the Resource Information Team is to translate, produce, and synthesize scientific and technical information 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 research results in order to make informed decisions. Through presentations, events, printed and electronic publications, and outreach efforts, staff strive to promote 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.

Personnel worked toward those goals in 2006 by producing four issues of *Yellowstone Science* magazine; planning and producing content for the Greater Yellowstone Science Learning Center website with support from the Yellowstone Park Foundation and Canon U.S.A., Inc.; beginning plans for the 9th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, which will recognize the 20th anniversary of the 1988 Yellowstone area fires; and producing a variety of other materials in support of YCR and other divisions.

Yellowstone Science magazine

In 2006, the quarterly journal *Yellowstone Science* entered its fourteenth year with issues and articles



on a wide range of topics highlighting many aspects of Yellowstone's natural and cultural resources. Four issues were distributed to a subscription list of nearly 2,600 individuals and institutions. Among the highlights were an interview with former YCR Director John Varley, who retired in February 2006; an entire issue devoted to Yellowstone cutthroat trout conservation; two articles on Norris Geyser Basin's fractures and fluids; and articles on grizzly bear nutrition and ecology, microbial ecology and energetics, Charles Doolittle Walcott, Panther Creek volcano, and Moran and Artist Points.

Other scientific publications

Other annual publications included the *2005 YCR Annual Report*, *2005 Wolf Project Annual Report*, *2005 Yellowstone Bird Report*, *2005 Yellowstone Fisheries and Aquatic Sciences Annual Report, Pronghorn Distribution in Winter 2006*, and an issue of the *Buffalo Chip* newsletter, all of which were edited and designed by resource information staff. Special publications included the editing, design, layout, and printing of the proceedings of the 8th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, *Greater Yellowstone Public Lands: A Century of Discovery, Hard Lessons, and Bright Prospects*.

The Resource Information Team was also involved in the editing, layout, and printing of the *Servicewide Benefits-Sharing Draft Environmental Impact Statement*, released for public comment in September. The Historic Resource Study, Volume III, *Managing the "Matchless Wonders": A History of Administrative Development in Yellowstone National Park, 1872–1965*, which was edited, designed, and laid out by resource information staff, was also printed and distributed in 2006. Resource information staff edited *Cretaceous Complexities: The Stratigraphic Intricacies of Mt. Everts* for the cultural branch and compiled the YCR's submission for the 2005 Superintendent's Annual Report. For the Aquatics Section, staff also laid out the *Effects of Snowmobile Emissions on the Chemistry of Snowmobile Runoff in Yellowstone National Park—Final Report*; *Bioassessment and Water Quality Sampling of Middle Creek and Mammoth Crystal Spring, Yellowstone National Park, WY 2002–2005*; and produced a version of the aquatic nuisance species handout for use in Grand Teton National Park. Staff also continued research and writing on *An Interdisciplinary Analysis of the Ecological History of Greater Yellowstone Wildlife, 1790–1882*.

Talks and Presentations

Resource information staff gave talks at a winter guide training, a Yellowstone Association Institute grizzly bear class, an interagency forest carnivore class, and a keynote talk on the "narratives of Yellowstone" at the biennial resource management workshop in Grand Teton National Park, as well as talks on wildlife management history.

Greater Yellowstone Science Learning Center

The Greater Yellowstone Science Learning Center (GYSLC) is 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. Its primary purposes are 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.

In 2005, a proposal was developed and funding secured for this extensive web-based project. During 2006, resource information staff developed

content for 11 resource topics for the website prototype in the form of resource almanacs, overviews, and atlas pages, and lists of references, links, laws, and other management documents. In May, the GYSLC became the newest member of the NPS Research Learning Center program. In August, the GYSLC was adopted as the servicewide model for a website strategy for NPS Research Learning Centers and Inventory and Monitoring Networks. The site can be visited at www.greateryellowstonescience.org.

Assistance and Support

During 2006, resource information staff produced miscellaneous flyers, maps, and graphics for park staff; provided technical assistance and Government Printing Office guidance to park staff; reviewed publications for the Division of Interpretation; drafted updates on the park's status as a World Heritage site; and pulled together graphics and information as requested for the *Atlas of Yellowstone* project. Resource information staff also converted files from an outside contractor for the Division of Planning, Compliance, and Landscape Architecture (PCLA)'s booklet: *Access to Nature: The Evolution of Context-Sensitive Roadway Design in Yellowstone National Park*. The booklet was redesigned and rewritten into final draft form by the end of the year, and staff hope to get it printed in 2007. Also for PCLA, staff helped with the creation of a scoping map handout for Yellowstone's *Wireless Communication Services Plan Environmental Assessment*, and edited the *Restoration of Westslope Cutthroat Trout in the East Fork Specimen Creek Watershed Environmental Assessment*.

Staff edited, laid out, and printed the *Greater Yellowstone Coordinating Committee 2005 Annual Report* for the GYCC. Resource Information staff also laid out for print a booklet for a U.S. Animal Health Association (USAHA) convened Special Committee on Brucellosis in the Greater Yellowstone Area, *The USAHA Laramie Agenda: A Roadmap for Improved Vaccine Delivery, and Testing for Brucellosis in Elk and Bison in the Greater Yellowstone Area*.

Funding and Personnel

Base Operating Budget

The final base operating budget was $4,211,300 for the Yellowstone Center for Resources in FY06. The decrease of $152,800 over FY05 funding levels was due primarily to the newly instituted park policy of withdrawing salary for permanent and term positions that became vacant in the division and shifting the allocation to a parkwide lapse fund. The base operating budget accounted for 63% of YCR's total for FY06. This compares to an average of 60% for the period FY95–FY05.

Additional Funding

Recreation Fee Demonstration Funds. In FY06, the fee demo program provided $54,500 in funding for two new resource management projects: improving visitor access lighting at the Heritage and Research Center, and beginning the renovation of and improvements to interpretive exhibits along the Nez Perce trail. Visitor fees also provided $170,000 to continue some ongoing projects: northern range riparian studies, a geothermal features inventory, a whirling disease survey, and two fisheries conservation projects. Since the YCR began receiving fee demo money in 1997, this program has allocated about $1.925 million for 20 different projects.

Fishing Fee Program. The YCR received authorization to use $368,400 from fishing permit fee revenue to cover part of the estimated $925,000 cost of the aquatic resources program in FY06.

Federal Lands Highway Program. Federal Highways funded $427,700 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 $466,900 in special emphasis program funding that was used to stabilize historic buildings (Fort Yellowstone and Lake); continue ethnographic resource inventory, traditional use, and research studies; and undertake three cataloging projects. The special emphasis program also provided $193,800 for the Branch of Natural Resources for year two of a three-year study of the declining

pronghorn antelope population, year two of three for a trumpeter swan statistical analysis, and to begin a study of the Norris Geyser Basis groundwater system.

Other Park Service Funds. YCR continued work on the Benefits-Sharing Environmental Impact Statement in FY06 with funds provided by the servicewide planning office of the National Park Service ($249,000).

Other Federal Funds. Some of these funds were provided by the Greater Yellowstone Coordinating Committee ($11,800) to fund Yellowstone participation in four Greater Yellowstone Area projects in FY06: development of a fire history and fuel model mapping project for wildland fire applications, production of a summary report of GYCC projects, production and printing of the proceedings of the 8th Biennial Scientific Conference on the GYE, and an American Indian ethnographic resources survey. The bulk of the funding in this category, however, was provided by the U.S. Fish and Wildlife Service for increased monitoring of grizzly bears in preparation for their removal from the Endangered Species List ($120,000), and the Bureau of Land Management for a Joint Fire Sciences Program fire behavior study ($90,500).

Private Funds. A total of $340,400 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, cultural resource preservation projects, an ethnographic survey, the *Atlas of Yellowstone* project, a wolverine survey, and to launch the Greater Yellowstone Science Learning Center project. Most of this funding ($265,500) came through the Yellowstone Park Foundation. The Montana Whirling Disease Initiative provided $44,100.

Personnel

Many staffing changes took place in YCR during FY06, driven in part by the retirement, reassignment, and resignation decisions of some key employees, but also by the implementation of recommendations based on the servicewide Core Operations Analysis process. YCR's management team began to incorporate position management strategies that would allow for long-term financial solvency, while refocusing human resources on the highest park priorities. 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 254 personnel actions processed by YCR in FY06, these were of special note:

- In November of 2005, Supervisory Interpretive Ranger (Lake) Carol Shively accepted a temporary reassignment to YCR's new Heritage and Research Center in Gardiner, Montana, to coordinate facility management and establish a public outreach and volunteer program.
- GIS Specialist Shannon Savage resigned from the National Park Service as of January 6, 2006, to pursue her doctorate degree in the field of spatial analysis at Montana State University–Bozeman. Her workload was later backfilled on a trial basis with two Cartographic Technicians on term appointments.
- On February 3, 2006, John D. Varley, Director of the Yellowstone Center for Resources, retired from the National Park Service. John's career in Yellowstone spanned more than 30 years, the last 13 of which he spent guiding the park division combining natural and cultural resource staff that he worked to create in 1993. A proven innovator and servicewide leader of resource stewardship within the National Park Service, John firmly established science and research as a foundation for resource management in Yellowstone. Upon retirement, John and his wife Anita moved to Bozeman, Montana, where John indulges his passion for gardening and continues his work with natural resources as the Director of Montana State University's Big Sky Institute.
- On February 5, 2006, Natural Resources Branch Chief Tom Olliff was appointed as the Acting Division Chief for YCR, then successfully competed for and accepted the position permanently as of May 14, 2006, vice-John Varley.
- Maurine Hinckley-Cole, Administrative Support Assistant for the Branch of Cultural Resources, accepted a promotion within Yellowstone and moved to the position of Secretary for the Division of Interpretation on February 19, 2006. Her posi-

tion with the YCR was discontinued as part of an internal downsizing exercise. The seasonal Administrative Support Assistant position for the Aquatic Resources group at Lake was also discontinued with the resignation of Mary McKinney in March, who accepted a full-time position in Cody, Wyoming, shortly after Maurine's departure.

- Glenn Plumb was offered a temporary promotion at the end of February 2006 to assume the duties of the vacant Natural Resources Branch Chief position, vice-Tom Olliff. He was the candidate selected and appointed to the position permanently on September 3, 2006. His former position as Supervisory Wildlife Biologist in charge of the Wildlife Resources Team was backfilled by senior staff biologists through a series of temporary promotions during the subsequent lapse and deferred recruiting process.
- The lead position for the Vegetation Management group was re-classified and established at a supervisory level on par with the other natural resources workgroups, and Resource Management Specialist Mary Hektner was selected for the promotion as of May 28, 2006, and her former position discontinued.
- Likewise, the lead position for YCR's Resource Information and Publications group, which had been vacant since October 2004, was restructured, reestablished, and filled by Technical Writer-Editor Tami Blackford on a temporary promotion from July 2 through the end of the fiscal year.
- Budget Analyst Joy Perius, who had been with YCR since 1993 in various capacities, accepted a promotion to the position of park Budget Officer and moved to the Division of Administration as of July 2006. Joy's position was backfilled for the remainder of the fiscal year by Montana Lindstrom, on detail from the Finance Office.
- Technical Writer-Editor Alice Wondrak-Biel, who had been working remotely from her husband's duty station at Bryce Canyon National Park, resigned her Yellowstone position on September 30, 2006, in conjunction with their relocation to Padre Island National Seashore in Texas and Alice's acceptance of a position with the NPS Intermountain Regional Office. The Technical Writer-Editor position was then discontinued beginning in FY07.

As of the end of FY06, the following YCR positions had been discontinued as result of Core Operations recommendations: a permanent full-time GIS Specialist, a permanent part-time Administrative Support Assistant, a seasonal administrative assistant position, and a permanent full-time Technical Writer-Editor. Also, YCR ended the year with the following positions either vacant or occupied through temporary detail assignments: Supervisory Wildlife Biologist, Senior Editor, and Budget Analyst.

Total employment on YCR activities was equivalent to 75 full-time employees for FY06 (Appendix 1). This was slightly less than the FTE count for FY05, but still above the average FTE for the period FY01–FY05 (71 FTE), mainly due to the number of hours contributed by employees from other divisions working on YCR projects.

Other Administrative Activities

Assistance Agreements. Staff processed 64 assistance agreements and task orders in FY06, totaling obligations of $1,337,300, of which 37% was used for administration of the Montana Water Compact and geothermal monitoring plan. Other significant investments were made in ethnographic use studies, aquatic resources studies, research in support of winter use studies, wildlife research, and research related to fire ecology and vegetation on Yellowstone's northern range.

Procurement Actions. Staff processed 702 procurement actions in FY06, totaling approximately $514,900.

Clerical Support. Staff processed 1,147 pieces of correspondence and 331 travel authorizations in FY06.

Funding history (FY 1993–06), Center for Resources, Yellowstone National Park (new allocations only).

		National Park Service Funds										
YCR Base Increase	FY	Park Base	Nat. Res. Project Funds	Cult. Res. Project Funds	Fish Fee	FLHP	Fee Demo	Other NPS	Other Federal	Private	Total	% Soft Funded
	93	1,004,600	16,000	—	—	—	—	785,000	188,000	20,000	2,013,600	50%
245,400	94	1,250,000	260,000	33,200	65,000	43,300	—	320,600	79,600	10,000	2,061,700	39%
250,000	95	1,500,000	420,000	45,000	65,000	303,600	—	59,800	20,000	5,300	2,418,700	38%
44,100	96	1,544,100	404,000	201,100	274,500	626,700	—	157,800	65,000	31,500	3,304,700	53%
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	53%
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	34%
286,300	99	2,531,900	—	221,900	285,000	396,500	298,000	152,900	105,200	56,700	4,048,100	37%
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	54%
93,300	01	2,661,900	297,000	216,700	285,100	409,000	—	—	15,000	85,500	3,970,200	33%
772,900	02	3,434,800	293,000	198,700	261,900	293,200	6,000	—	11,700	126,400	4,625,700	26%
(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	36%
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	41%
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	36%
(152,800)	06	4,211,300	193,800	466,890	368,400	427,700	224,500	249,000	224,200	340,400	6,706,190	37%
Draft Estimates	07	4,400,000	137,900	257,400	275,000	460,100	375,000	250,000	151,000	350,000	6,656,400	34%

YCR distribution of FY06 funds (includes carryover).

Cultural Resources	679,000	—	466,890	—	243,600	54,500	—	10,400	65,900	1,520,290	22.7%
Natural Resources	2,824,200	186,600	—	368,400	161,700	145,000	—	206,900	213,300	4,106,100	61.2%
Professional Support	708,100	7,200	—	—	22,400	25,000	249,000	6,900	61,200	1,079,800	16.1%
Total:	**4,211,300**	**193,800**	**466,890**	**368,400**	**427,700**	**224,500**	**249,000**	**224,200**	**340,400**	**6,706,190**	**100%**

Base:	**4,211,300**	**63%**
All other funding services:	**2,494,890**	**37%**

Other NPS:

Benefits Sharing EIS	**249,000**

Other Federal:

BLM–Joint Fire Sciences Program	90,500
USFS–Clearwater NF Nez Perce Trail	5,500
USFWS–Grizzly Conservation Strategy	116,400
GYCC–Ethnography Study	4,900
GYCC–Conference Proceedings	6,500
GYCC–Fire Mapping Project	400
Total:	**224,200**

Private:

Travel Reimbursements	10,600
General Donations	1,800
Archeology Donations	1,000
MT Whirling Disease Initiative	60,400
Yellowstone Park Foundation	266,600
Total:	**340,400**

Not Included:

USGS–BRD Bear Study Team (no YCR charges–pass through only)	**5,200**

APPENDIX I

Personnel Roster, 2006

Professional Support Branch

Management and Administration

		YCR FTE	Non-YCR FTE
1. Cline, Barbara	Division Secretary	1.00	
2. Deutch, Ann	Environmental Protection Assistant	0.55	
3. Hendrix, Christie	Environmental Protection Assistant	1.00	
4. Housley, Sara	Center Clerk	0.04	
5. Lindstrom, Montana	Budget Analyst	0.13	
6. McAdam, Melissa	Sprv. Budget Analyst	1.00	
7. Mills, Sue	Environmental Protection Specialist	1.00	
8. Olliff, Tom	Division Chief	0.38	
9. Perius, Joy	Budget Analyst	0.65	
10. Shively, Carol	Program Manager-HRC	0.85	
11. Smith, Christine	Environmental Protection Assistant	0.70	
12. Varley, John	Director	0.35	
Maintenance & custodial assistance (Lake Research Dorm)		-	0.02
	subtotal Management & Admin:	**7.65**	**0.02**

Resource Information Team

13. Blackford, Tami	Technical Writer-Editor	1.00	
14. Franke, Mary Ann	Technical Writer-Editor	0.43	
15. Lawson, Cecilia	Editorial Assistant	0.21	
16. Schullery, Paul	Resource Naturalist	0.40	
17. Stevenson, Sarah	Technical Writer-Editor	0.11	
18. Warner, Virginia	Editorial Assistant	0.94	
19. Wondrak Biel, Alice	Technical Writer-Editor	0.95	
	subtotal Resource Information:	**4.04**	**-**

Spatial Analysis Center

20. Bone, Sarah	Cartographic Technician	0.02	
21. Cater, Steve	Cartographic Technician	0.30	
22. Dale, Jeffrey	Cartographic Technician	0.32	
23. Friedel, Rob	Cartographic Technician	0.23	
24. Guiles, Carrie	Cartographic Technician	1.01	
25. Miller, Steve	Cartographic Technician	0.31	
26. Rodman, Ann	Sprv. GIS Specialist	1.00	
27. Savage, Shannon	GIS Specialist	0.27	
28. Zawistoski, Mark	Cartographic Technician	0.29	
	subtotal Spatial Analysis:	**3.75**	**-**
Professional Support Branch FTE:		**15.44**	**0.02**

Natural Resources Branch

Administration

			YCR FTE	Non-YCR FTE
1.	Cole, Stephanie	Administrative Support Assistant	0.28	
2.	Olliff, Tom	Chief of Natural Resources	0.62	
3.	Plumb, Glenn	Chief of Natural Resources	0.08	
4.	Wyman, Becky	Administrative Support Assistant	0.98	
	Horse handler & packer support (bison, fish, geology projects)		-	0.51
	Winter Use Monitoring Assistance (wildlife, air quality, acoustic)		-	1.26
		subtotal NR Admin FTE:	**1.96**	**1.77**

Wildlife Resources Team

5.	Blanton, Doug	Biological Science Technician	1.02	
6.	Coleman, Louise	Biological Science Technician	0.52	
7.	Coleman, Tyler	Biological Science Technician	0.35	
8.	Davis, Troy	Biological Science Technician	1.02	
9.	Geremia, Chris	Biological Science Technician	1.01	
10.	Guernsey, Deb	Biological Science Technician	0.97	
11.	Gunther, Kerry	Wildlife Biologist	1.02	
12.	Holcomb, Sarah	Clerk-Typist	0.20	
13.	Jones, Jennifer	Biological Science Technician	1.01	
14.	Jones, Tildon	Biological Science Technician	0.50	
15.	McEneaney, Terry	Wildlife Biologist	1.00	
16.	McIntyre, Rick	Biological Science Technician	0.46	
17.	Miller, Steve	Cartographic Technician	0.58	
18.	Murphy, Kerry	Wildlife Biologist	0.98	
19.	Playter, Amanda	Biological Science Technician	0.27	
20.	Plumb, Glenn	Sprv. Wildlife Biologist	0.95	
21.	Roberts, Lori	Biological Science Technician	0.19	
22.	Robison, Hillary	Biological Science Technician	0.14	
23.	Smith, Doug	Wildlife Biologist	1.00	
24.	Smith, Jeremiah	Biological Science Technician	0.35	
25.	Stahler, Dan	Biological Science Technician	0.76	
26.	Stroud, Janice	Biological Science Technician	0.15	
27.	Tallian, Aimee	Biological Science Technician	0.42	
28.	Thompson, Derek	Biological Science Technician	0.31	
29.	Treanor, John	Biological Science Technician	0.89	
30.	Tubbs, Noelle	Clerk-Typist	0.07	
31.	Wallen, Rick	Wildlife Biologist	1.00	
32.	Wells, Kimberly	Biological Science Technician	0.27	
33.	White, PJ	Wildlife Biologist	1.00	
34.	Wyman, Travis	Biological Science Technician	1.00	
	Wildlife Project Assistance (wolverine, bison, wolf, & grizzly bear monitoring)		-	2.36
		subtotal Wildlife FTE:	**19.41**	**2.36**

Fisheries and Aquatic Resources		YCR FTE	Non-YCR FTE
35. Arnold, Jeff	Ecologist	0.98	
36. Bigelow, Pat	Fishery Biologist	0.94	
37. Billman, Hilary	Biological Science Technician	0.17	
38. Bywater, Tim	Administrative Support Assistant	0.15	
39. Doepke, Phil	Biological Science Technician	1.00	
40. Erickson, Jeremy	Biological Science Technician	0.55	
41. Ertel, Brian	Biological Science Technician	0.89	
42. Facendola, Joe	Biological Science Technician	0.08	
43. Hutchinson, Hunter	Biological Science Technician	0.18	
44. Keep, Shane	Biological Science Technician	0.16	
45. Koel, Todd	Sprv. Fishery Biologist	1.00	
46. Kreiner, Ryan J.	Biological Science Technician	0.42	
47. Legere, Nicole	Biological Science Technician	0.90	
48. Mahony, Dan	Fishery Biologist	1.00	
49. McKinney, Mary	Administrative Support Assistant	0.17	
50. Olson, Kevin	Biological Science Technician	0.01	
51. Olszewski, Brad	Biological Science Technician	0.08	
52. Romankiewicz, Chris	Biological Science Technician	0.38	
53. Schamberry, Nicole	Biological Science Technician	0.08	
54. Sigler, Stacey	Biological Science Technician	0.54	
55. Varian, Anna	Biological Science Technician	0.08	
56. Wachter, Rebecca	Biological Science Technician	0.42	
57. Wethington, Don	Small Craft Operator	0.44	
58. Wiggins, Justin	Biological Science Technician	0.42	
Fisheries Projects Assistance (stream restoration)		-	0.07
	subtotal Aquatic Resources FTE:	**11.04**	**0.07**
Vegetation Management			
59. Anderson, Heidi	Botanist	0.88	
60. D'Imperio, Elizabeth	Biological Science Technician	0.26	
61. Hektner, Mary	Sprv. Vegetation Specialist	1.00	
62. Klaptosky, John	Biological Science Technician	0.46	
63. Pecha, Vicki	Biological Science Technician	0.23	
64. Renkin, Roy	Vegetation Management Specialist	1.00	
65. Whipple, Jennifer	Botanist	0.81	
	subtotal Vegetation FTE:	**4.64**	
Geology and Physical Sciences			
66. Eagan, Sean	Hydrologist	0.50	
67. Gardiner, William	Physical Science Technician	0.29	
68. Heasler, Hank	Geologist	1.00	
69. Jaworowski, Cheryl	Geologist	0.96	
70. Miller, Steve	Physical Science Technician	0.12	
Geothermal monitoring assistance		-	0.04
	subtotal Geology FTE:	**2.87**	**0.04**
Natural Resources Branch FTE:		**39.92**	**4.24**

Cultural Resources Branch

			YCR FTE	Non-YCR FTE
1.	Anderson, Roger	Chief of Cultural Resources	1.00	
2.	Case, Bridgette	Museum Technician	0.99	
3.	Curry, Colleen	Museum Curator	1.00	
4.	Dawson, Herb	Historic Architect	1.00	
5.	Felton, Tasha	Cultural Resources Technician	0.96	
6.	Hale, Elaine	Archeologist	0.96	
7.	Hinckley-Cole, Maurine	Administrative Support Assistant	0.35	0.03
8.	Housley, Harold	Archivist	0.96	
9.	Housley, Sara	Center Clerk	0.12	
10.	Johnson, Ann	Archeologist	1.00	
11.	Perkins, Jodine	Library Technician	0.23	
12.	Reid, Charissa	Cultural Anthropologist	0.10	
13.	Saba, Meredith	Archives Technician	0.21	
14.	Sucec, Rosemary	Cultural Anthropologist	0.92	
15.	White, Katie	Cultural Resources Technician	1.00	
16.	Whittlesey, Lee	Historian	1.00	
17.	Zirngibl, Wendy	Museum Technician	0.39	
	Historic Structures Preservation Projects Assistance		-	2.91
Cultural Resources Branch:			**12.19**	**2.94**
115	**YCR Employees**	**TOTAL YCR FY06 FTE:**	**67.55**	**7.20**

Wolf Project staff and November–December winter study volunteers. Standing, from left: Andy Shepard, Tim Hudson, Abby Nelson, Libby Williamson, Nicole Legere, Bill Bridgeland, Robin Rauch, Deb Guernsey, Douglas Smith (with Hawken and Sawyer Smith). Kneeling, from left: Erin Albers, Sarah Malick, Matt Metz.

APPENDIX II

Publications, Reports, and Papers

Professional Publications

Borkowski, J.J., P.J. White, R.A. Garrott, T.D. Davis, A.R. Hardy, and D.J. Reinhart. 2006. Wildlife responses to motorized winter recreation in Yellowstone National Park. *Ecological Applications* 16:1911–1925.

Bruggeman, J.E., R.A. Garrott, D.D. Bjornlie, P.J. White, F.G.R. Watson, and J.J. Borkowski. 2006. Temporal variability in winter travel patterns of Yellowstone bison: the effects of road grooming. *Ecological Applications* 16:1539–1554.

Evans, S.B., L.D. Mech, P.J. White, and G.A. Sargeant. 2006. Survival of adult female elk in Yellowstone following wolf restoration. *Journal of Wildlife Management* 70:1372–1378.

Gogan, P.J.P., T.O. Lemke, D.B. Tyers, and P.J. White. 2006. The northern Yellowstone elk herd—management actions and natural regulation. Pages 224–229 *in* D.R. McCullough, K. Kaji, and M. Yamanaka, editors. *Wildlife in Shiretoko and Yellowstone National Parks: Lessons in Wildlife Conservation from Two World Heritage Sites*. Shiretoko Nature Foundation and the Asahi Shimbun Company, Hokkaido, Japan.

Lynch, H.J., R.A. Renkin, R.L. Crabtree, and P.R. Moorecroft. 2006. The influence of previous mountain pine beetle (*Dendroctonus ponderosae*) activity on the 1988 Yellowstone fires. *Ecosystems* 9:1318–1327.

Murphy, K.M., T.M. Potter, J.C. Halfpenny, K.A. Gunther, M. Tildon Jones, P.A. Lundberg, and N.D. Berg. 2006. Distribution of Canada lynx in Yellowstone National Park. *Northwest Science* 80(3):199–206.

Schwartz, C.C., and K.A. Gunther. 2006. Grizzly bear management in Yellowstone National Park, the heart of recovery in the Yellowstone Ecosystem. Pages 232–238 *in:* D.R. McCullough, K. Kaji, and M. Yamanaka, editors. *Wildlife in Shiretoko and Yellowstone National Parks: Lessons in Wildlife Conservation from Two World Heritage Sites*. Shiretoko Nature Foundation and the Asahi Shimbun Company, Hokkaido, Japan.

Schwartz, C.C. M.A. Haroldson, K.A. Gunther, and D. Moody. 2006. Distribution of grizzly bears in the Greater Yellowstone Ecosystem in 2004. *Ursus* 17(1):63–66.

Smith, D.W. 2006. Coexisting with large carnivores: Lessons from Greater Yellowstone (book review). *BioScience* 56(10):848–849.

———. 2006. Re-introduction of gray wolves to Yellowstone National Park, USA. *Re-Introduction News* 25:29–31.

Smith, D.W., D.R. Stahler, D.S. Guernsey, and E. Bangs. 2006. Wolf restoration in Yellowstone National Park *in:* D.R. McCullough, K. Kaji, and M. Yamanaka, editors. *Wildlife in Shiretoko and Yellowstone National Parks: Lessons in Wildlife Conservation from Two World Heritage Sites*. Shiretoko Nature Foundation and the Asahi Shimbun Company, Hokkaido, Japan.

Stahler, D.R., D.W. Smith, and D.S. Guernsey. 2006. Foraging and feeding ecology of the gray wolf (*Canis lupus*): lessons from Yellowstone National Park, Wyoming, USA. *Journal of Nutrition* 136: 1923S–1926S.

Wright, G.J., R.O. Peterson, D.W. Smith, T.O. Lemke. 2006. Selection of northern Yellowstone elk by gray wolves and hunters. *Journal of Wildlife Management* 70(4):1070–1078.

Administrative Reports

Arnold, J.L., and T.M. Koel. 2006. *Bioassessment and Water Quality Sampling of Middle Creek and Mammoth Crystal Spring, Yellowstone National Park, WY, 2002–2005*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming, YCR-2006-06.

———. 2006. *Effects of Snowmobile Emissions on the Chemistry of Snowmelt Runoff in Yellowstone National Park, Final Report*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-1.

———. 2006. *Evaluation of Stream Quality in the Greater Yellowstone Network Parks using Benthic Macroinvertebrate Communities as Biological Indicators: Final Report to the Greater Yellowstone Network*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-07.

Caslick, J. and E. 2006. Pronghorn distribution in winter 2006. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-05.

Gunther, K.A. 2006. Yellowstone National Park recreational use. Page 47 *in* C.C. Schwartz, M.A. Haroldson, and K. West, editors. *Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2005*. U.S. Geological Survey, Bozeman, Mont., USA.

Gunther, K.A., M.T. Bruscino, S.L. Cain, K. Frey, Lauri Hanauska-Brown, M.A. Haroldson, and C.C. Schwartz. 2006. Grizzly bear–human conflicts in the Greater Yellowstone Ecosystem. Pages 55–59 in C.C. Schwartz, M.A. Haroldson, and K. West, editors. *Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2005*. U.S. Geological Survey, Bozeman, Mont., USA.

Gunther, K.A., and T.C. Wyman. 2006. Yellowstone National Park 2004 annual report of activities conducted under endangered species subpermit #87-1. U.S. Department of the Interior, National Park Service, Bear Management Office, Yellowstone National Park. 7pp.

Gunther, K.A., T. Wyman, T. Coleman, L. Coleman, K. Loveless, L. Roberts, and S. Sigler. 2006. Bear Management Office administrative annual report for calendar year 2005. U.S. Department of the Interior, National Park Service, Bear Management Office, Yellowstone National Park.

Gunther, K.A., T. Wyman, T.M. Koel, P. Perrotti, and E. Reinertson. 2006. Spawning cutthroat trout. Pages 34–38 *in* C.C. Schwartz, M.A. Haroldson, and K. West, editors. *Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2005*. U.S. Geological Survey, Bozeman, Mont., USA.

Koel, T.M., J.L. Arnold, P.E. Bigelow, P.D. Doepke, B.D. Ertel, D.L. Mahony, and M.E. Ruhl. 2006. *Yellowstone fisheries and aquatic sciences: annual report, 2005*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-09.

Maj, M. 2006. *Greater Yellowstone Coordinating Committee 2005 annual report*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming.

McEneaney, T. 2006. *Yellowstone bird report 2005*. Yellowstone National Park, Wyo.: National Park Service, Yellowstone Center for Resources, YCR-2006-02.

National Park Service. 2006. *Servicewide Benefits-Sharing Draft Environmental Impact Statement*. National Park Service, Yellowstone Center for

Resources, Yellowstone National Park, Wyo.

Podruzny S., and K. Gunther. 2006. Spring ungulate availability and use by grizzly bears in Yellowstone National Park. Pages 31–33 *in* C.C. Schwartz, M.A. Haroldson, and K. West, editors. *Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2005*. U.S. Geological Survey, Bozeman, Mont., USA.

Rydell, K.L., and M.S. Culpin. 2006. *Managing the "Matchless Wonders": A History of Administrative Development in Yellowstone National Park, 1872–1965*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-03.

Smith, D.W., D.R. Stahler, and D.S. Guernsey. 2006. *Yellowstone Wolf Project: annual report, 2005*. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyo., YCR-2006-04.

Wondrak Biel, A. ed. 2006. *Greater Yellowstone Public Lands: A Century of Discovery, Hard Lessons, and Bright Prospects*. Proceedings of the 8th Biennial Scientific Conference on the Greater Yellowstone Ecosystem. October 17–19, 2005, Mammoth Hot Springs Hotel, Yellowstone National Park. Yellowstone National Park, Wyo.: Yellowstone Center for Resources.

Wondrak Biel, A. and D.W. Smith. 2006. Diseases investigated as possible cause of wolf decline. *Yellowstone Discovery* 21:6–7.

Yellowstone Center for Resources. 2006. *Yellowstone Center for Resources annual report 2005*. National Park Service, Mammoth Hot Springs, Wyo., YCR-2006-08.

Sow and cub acquiring human foods at Sylvan Pass.

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

2006 highlights: The group collaborated on bighorn sheep, elk, moose, and wolverine surveys and projects.

Atmospheric Mercury Deposition Monitoring

Partners: Wyoming Department of Environmental Quality

Mission: to monitor and quantify mercury levels in wet deposition at YNP at the National Atmospheric Mercury Deposition Network site at Tower Ranger Station

Commitment: YCR provides staff to retrieve and ship the weekly wet deposition sample and precipitation records and deploy new glassware and rain gauge chart for the collection of the next week's sample. YCR staff also troubleshoots problems to ensure that the precipitation collector and rain gauge are working properly.

YCR representatives: Mary Hektner

2006 highlights: YCR took over the operation of the site from the Ranger staff. The NPS and Wyoming Department of Environmental Quality (WYDEQ) entered into a memorandum of understanding wherein WYDEQ agreed to pay for analytical, site support, data validation and network coordinating costs which had previously been paid for by the Environmental Protection Agency.

Consultation with American Indian Tribes

Partners: 26 park-affiliated American Indian tribes and an additional 54 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

2006 highlights: YNP hosted a consultation meeting in partnership with Grand Teton on May 19.

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
2006 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
2006 highlights: The first phase of the reconstruction of the Canyon Junction to Tower Junction segment of the Grand Loop Road was chosen as the winner of the prestigious "Excellence in Highway Design" by the Federal 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

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: Rick Wallen
2006 highlights: The InterTribal Bison Cooperative was confirmed 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
2006 highlights: The group assembled an integrated knowledge of large scale landscape dynamics, wildlife responses, and interactions in the central portion of YNP and delivered products to the NPS at their direction, including imagery, maps, field data, and simulation model runs. The group also provided this knowledge through novel visualization tools combining computer animation and digital video production in the form of an interactive DVD media for use by park management in general planning, management activities, and Visitor Education Center kiosks.

Interagency Bison Management Plan (IBMP)

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 IBMP, signed in 2000, that 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

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
2006 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

Partner: Montana Department of Environmental Quality
Mission: to address the potential reclamation of the McLaren Mill and Mine tailings sites in the Cooke City, Montana, area
Commitment: meeting participation
YCR representative: Mary Hektner
2006 highlights: The State is continuing to monitor groundwater lelvels in the proposed repository site.

Mid-sized Carnivore Inventory and Research

Partner: U.S. Forest Service, Rocky Mountain Research Station–Missoula
Mission: to improve basic and management-related information on mid-sized carnivores in the Greater Yellowstone Ecosystem
Commitment: 20 workdays
YCR representative: Kerry Murphy
2006 highlights: Two wolverines were captured and monitored as part of a 5-year study. The park is contributing DNA samples (hair) from red fox captured incidentally in wolverine live traps.

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
2006 Highlights: In 2005, the committee successfully lobbied Congress for funding to implement a comprehensive geothermal monitoring plan for Yellowstone and in 2006, the committee reviewed progress of the plan.

Montana Cutthroat Trout Steering Commitee
Partners: Montana Fish, Wildlife and Parks and several federal agencies, tribes, and private advocacy organizations concerned with cutthroat trout in Montana
Mission: to ensure the long term self-sustaining persistence of cutthroat trout across their respective historical ranges
Commitment: a two-day meeting each year and several days reviewing documents and/or updating databases
YCR representative: Todd Koel
2006 highlights: Completed draft Memorandum of Understanding and Conservation agreement.

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
2006 highlights: Yellowstone National Park continues 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
2006 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

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 prioritizing 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
2006 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 encourag-

ing 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
2006 highlights: The group completed cooperative counts and classifications of bighorn sheep, elk, and pronghorn, 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
Commitment: two to four meetings per year
YCR Representative: Kerry Murphy
2006 Highlights: Murphy attended four meetings in northwest 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
2006 highlights: Volunteers prepared and stained five vehicle bridges including Fishing Bridge; and hauled over 3,000 lbs. of broken asphalt paving for recycling. The Tauck Volunteer program received the Preserve America Presidential Award in May, 2006, "for exemplary accomplishment in the preservation and sustainable use of America's heritage assets, which has enhanced communtiy life while honoring the Nation's history."

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
2006 highlights: The YCR representative reviewed plans for structural stabilization and fire and electrical improvements for historic buildings in Virginia City.

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: three days per year
YCR representative: Jennifer Whipple (chair)
Highlights: A threatened and endangered plants of Wyoming poster for the four listed vascular plant species was produced by the BLM and the Wyoming National Diversity Database in cooperation with other organizations and agencies.

Yellowstone Cutthroat Trout Interstate Workgroup

Partners: Montana, Idaho, Wyoming, and several federal agencies and tribes
Mission: provide a framework for cooperation and collaboration between those concerned with the conservation of Yellowstone cutthroat trout
Commitment: a two-day meeting each year plus several days reviewing documents and/or updating databases
YCR representative: Todd Koel
2006 highlights: Completed 2006 Yellowstone cutthroat trout range-wide status assessment.

Yellowstone Wildlife Health Program

Partners: Yellowstone Park Foundation, Montana State University, University of California–Davis
Mission: The YWHP has been established to understand and address priority wildlife disease and ecosystem health problems at Yellowstone National Park by designing and implementing a long-term wildlife health assessment program to monitor and evaluate wildlife diseases and health indicators as a subcomponent of the Greater Yellowstone Network Vital Signs Monitoring Program.
Commitment: The YWHP will develop information and mechanisms to understand and address present or future diseases, including brucellosis in bison and elk, West Nile virus in birds, whirling disease in trout, and hantavirus in small mammals, because they have the potential to alter the outcome of YNP's mission.
YCR representative: Glenn Plumb
2006 Highlights: An exploratory meeting amongst the principal partners was held in July 2006, and a Memorandum of Understanding was signed in October 2006.

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
2006 Highlights: YVO published a ten year volcano and earthquake monitoring plan for the Yellowstone volcano (available online at http://pubs.usgs.gov/sir/2006/5276/). YVO scientists gathered data at Hot Springs Basin to document changes associated with rapid ground uplift (about 16 cm from 2004 to 2006).

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 partnerhips were active in 2005.

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

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
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
Aquatic Resources and Fisheries	Greater Yellowstone I&M Network, Colorado State University	Dr. William Clements (YCR: Dr. Todd Koel and Jeff Arnold)	Water quality monitoring	NPS I&M
Aquatic Resources and Fisheries	Greater Yellowstone I&M Network	Cathie Jean, Dr. Todd Koel (YCR)	Upper Snake River cutthroat trout inventory	NPS I&M
Aquatic Resources and Fisheries	Montana State University (Big Sky Institute)	Dr. Lisa Graumlich (YCR: Dr. Todd Koel)	Yellowstone cutthroat trout watershed priorities	Yellowstone Park Foundation
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
Aquatic Resources and Fisheries	Montana State University (Ecology)	Amber Steed, Dr. Alexander Zale (YCR: Dr. Todd Koel)	Spatial dynamics of Arctic grayling in the Gibbon River	Fish Fee
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
Aquatic Resources and Fisheries	Montana State University (Ecology)	Dr. Billie Kerans, Dr. Todd Koel (YCR), Silvia Murcia	Development and testing of risk assessment tools for whirling disease infection	MT/USFWS Whirling Disease Initiative
Aquatic Resources and Fisheries	Montana State University	Julie Alexander, Dr. Billie Kerans, Dr. Todd Koel (YCR)	Use of high-resolution thermal imagery to locate *Tubifex tubifex* in Pelican Creek	MT/USFWS Whirling Disease Initiative
Aquatic Resources and Fisheries	Montana State University	Dr. Billie Kerans, Dr. Todd Koel (YCR)	Role of birds as a dispersal vector for whirling disease	MT/USFWS Whirling Disease Initiative
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
Aquatic Resources and Fisheries	Sun Ranch (Madison Valley, Montana)	Roger Lang, Buddy Drake (YCR: Dr. Todd Koel)	Westslope cutthroat trout broodstock development	Fish Fee

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
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
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
Aquatic Resources and Fisheries	USFS, GYCC	Mary Maj (YCR: Dr. Todd Koel)	Fine-spotted cutthroat assessment	GYCC
Archeology	University of Wyoming (OWSA)	David Eckles, Elaine Hale (YCR)	Data recovery at Frying Pan Spring	FHWA
Archeology	Gallatin National Forest Service	Walt Allen (GNF), Elaine Hale (YCR)	Document historic Slough Creek wagon road	FHWA
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
Bear Management Office	USGS-BRD (IGBST)	Dr. Charles Schwartz, Mark Haroldson, (YCR: Kerry Gunther)	Grizzly Bear Demographics	USGS, ONPS Base, USFWS
Bear Management Office	USGS-BRD (IGBST)	Dr. Charles Schwartz, Mark Haroldson (YCR: Kerry Gunther)	Grizzly Bear/Black Bear Species Niche Separation	USGS, ONPS Base
Bear Management Office	USGS-BRD (IGBST)	Dr. Charles Schwartz, Mark Haroldson, (YCR: Kerry Gunther)	Whitebark Pine Cone Production	USGS, ONPS Base
Bear Management Office	USGS-BRD (IGBST)	Mark Haroldson, (YCR: Kerry Gunther)	Grizzly Bear Use of Roadside Habitats	USGS, ONPS Base
Bear Management Office	USGS-BRD (IGBST)	Shannon Podruzny, (YCR: Kerry Gunther)	Spring Ungulate Carcass Availability	USGS, ONPS Base, USFWS
Bear Management Office	Wyoming Game & Fish, Montana Fish Wildlife & Parks, Idaho Fish & Game, Grand Teton National Park, USGS-BRD	Kerry Gunther, Mark Bruscino, Kevin Frey, Lauri Hanauska-Brown, Steve Cain, Mark Harodson, and Dr. Charles Schwartz	Grizzly Bear-Human Conflicts in the Greater Yellowstone Ecosystem	YONPS Base, USFWS, WYGF, MTFWP, IDFG, GTNP, USGS-BRD
Bear Management Office	Washington State University, USGS-BRD (IGBST)	Dr. Charles Robbins, Dr. Charles Schwartz, Mark Haroldson, Jennifer Fortin, (YCR: Kerry Gunther)	Assesing habitat and diet selection for grizzly bears and American Black Bears in YNP	NRPP, USGS, ONPS Base
Bear Management Office	Washington State University, USGS-BRD (IGBST)	Dr. Charles Robbins, Dr. Charles Schwartz, Mark Haroldson, Justin Teisberg, (YCR: Kerry Gunther)	Estimating number of grizzly bears and American black bears preying on cutthroat trout in tributaries around Yellowstone Lake	NRPP, USGS, ONPS Base

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
Bear Management Office	Montana State University, USGS-BRD	Dr. Scott Creel, Dr. Charles Schwartz, Tyler Coleman, (YCR: Kerry Gunther)	Development of techniques to evaluate the effectiveness of grizzly bear management areas in YNP	NRPP, GYCC, Robert D. Kent, Jr. Trust, YPF, USGS, ONPS Base
Bear Management Office	USGS-BRD (IGBST), Montana State University	Dr. Kim Keating, Dr. Steve Cherry, Dr. Charles Schwartz, (YCR: Kerry Gunther)	Modeling habitat-specific probability of occurrence for grizzly bears in the GYE	POBS, USGS, ONPS Base
Bear Management Office/ Wolf Project Office	Beringia South, USGS-BRD (IGBST)	Dr. Howard Quigley, Dr. Charles Schwartz, Mark Haroldson, (YCR: Dr. Doug Smith, Kerry Gunther)	Mountain Lion, Wolf, Grizzly Bear, & Black Bear Interactions	Beringia South, YPF, USGS, ONPS Base
Bison Ecology and Management	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
Bison Ecology and Management	University of Calgary, University of Montana	Drs. Cormack Gates, Len Broberg, Glenn Plumb (YCR)	Bison movement and dispersal	NPS
Bison Ecology and Management	Montana State University (Ecology)	Dr. Robert Garrott, Dr. P.J. White (YCR), Rick Wallen (YCR), Jason Bruggeman	Spatial dynamics of the central Yellowstone bison herd	Montana State University ONPS-Bison (paid in FY02)
Bison Ecology and Management	Montana State University (Ecology)	Jason Bruggeman, Drs. Robert Garrott and P.J. White (YCR), Rick Wallen (YCR)	Bison demography in relation to groomed roads during winter	ONPS-Winter Use Monitoring (paid out in FY04)
Bison Ecology and Management	USDA-APHIS	Rick Wallen (YCR), Dr. Ryan Clarke	Rate of brucellosis exposure in Yellowstone bison	USDA-APHIS, ONPS-Bison Management
Bison Ecology and Management	University of Kentucky	Philip Crowley (YCR: John Treanor, Rick Wallen)	Affects of vaccination on brucellosis prevalence	University of Kentucky (paid out in FY04) ONPS-Bison
Bison Ecology and Management	University of Montana	Fred Allendorf, Flo Gardipee (YCR: Rick Wallen)	Conservation genetics of bison	University of Montana (paid out in FY04) ONPS-Bison
Ethnography	Bear Creek Council	Rosemary Sucec (YCR)	Support for the potluck welcoming American Indian tribes to Yellowstone	Bear Creek Council, Yellowstone NP
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 Intepretation) (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

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
Ethnography	University of Montana	Greg Campbell, (YCR: Rosemary Sucec)	Document the Buffalo Walk and its meaning for the Nez Perce and Lakota	RM-CESU
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 Inskeep, Sarah Boomer, Darrell Nordstrom, Anna-Louise Reyenbach, Frank Roberto, Cristina Takacs-Vesbach, Ann Rodman (YCR)	Create a research coordination network for geothermal biology and geochemistry in Yellowstone	National Science Foundation
Geographic Information Systems	University of New Mexico, Portland State University, USGS	Drs. Cristina Takacs-Vesbach, Anna-Louise Reysenbach, & Kirk Nordstrom, Ann Rodman (YCR)	A microbial inventory of Greater Yellowstone Ecosystem features	National Science Foundation
Geology	University of Utah (Geology and Geophysics)	Dr. Robert Smith (YCR: Dr. Henry Heasler)	Seismic and GPS monitoring of Yellowstone	ONPS-Geology
Geothermal	Montana State University	Dr. Rick Lawrence (YCR: Dr. Cheryl Jaworowski)	Detection of radiative thermal flux change	Montana State University
Geothermal	University of Montana	Carl Seielstad (YCR: Dr. Cheryl Jaworowski)	Thermal remote monitoring of Norris Geyser Basin	ONPS-Geology
Geothermal	USGS-Menlo Park, Yellowstone Volcano Observatory	Jake Lowenstern (YCR: Dr. Henry Heasler)	Geothermal gas monitoring	ONPS-Geology
Geothermal	Utah State University	Christopher Neale (YCR: Cheryl Jaworowski)	Mapping thermal springs in geyser basins	ONPS-Geology
Geothermal/Montana Water Compact	State of Montana (Bureau of Mines and Geology)	Edmond Deal (YCR: Dr. Henry Heasler)	Controlled groundwater area • Monitoring • Database administration	 ONPS-Geology ONPS-Geology
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
Geothermal/Montana Water Compact	USGS-WRD (Montana District)	Dr. Robert Davis (YCR: Dr. Henry Heasler)	Assess water discharge and selected chemical and physical parameters of waters in Yellowstone NP	USGS-WRD, ONPS-Geology
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

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
Historic Buildings	Montana Preservation Alliance	Chere Jiusto (YCR: Herb Dawson)	Stabilization of historic buildings in Yellowstone NP	Historic Structures Stabilization Funds, CRPP, Cultural Cyclic Maintenance
Mid-sized Carnivores	A Naturalist's World	Dr. Kerry Murphy (YCR), Dr. James Halfpenny, Kerry Gunther (YCR)	Distribution of Canada lynx in Yellowstone	YPF
Mid-sized Carnivores	Rocky Mountain Research Station, Gallatin and Shoshone National Forests, Montana Fish, Wildlife and Parks, Wyoming Game and Fish, Rocky Mountain Cooperative Ecosystems Studies Unit	Dr. Jeff Copeland, Dr. Kerry Murphy (YCR)	Conservation of Wolverine at YNP: answering mission-critical questions	YPF, Gallatin and Shoshone National Forests, Rocky Mountain Cooperative Ecosystems Studies Unit, Wyoming Game and Fish
Mid-sized Carnivores	University of British Columbia, University of Montana	Dr. Karen Hodges, Dr. Scott Mills, Dr. Kerry Murphy (YCR)	Abundance and distribution of snowshoe hares in Yellowstone NP	Rocky Mountain Cooperative Ecosystems Studies Unit, University of Montana
Museum	Montana State University Stanford University	Michael Cary (YCR: Colleen Curry)	Internship program for museum techs	Yellowstone Park Foundation
Research	University of Wyoming-NPS Research Center	Dr. Henry Harlow, Dr. Glenn Plumb (YCR)	Cooperative research program support	ONPS-Research
Spatial Analysis Center	Greater Yellowstone I&M Network	Ann Rodman (YCR)	NPSPECIES database: Invertebrates	NPS I&M
Vegetation	Greater Yellowstone Coordinating Committee, Interagency Grizzly Bear Study Team	Cathie Jean (GRYN), Dan Reinhart (YNP)	Interagency Whitebark Pine Monitoring	NPS I&M
Vegetation	Greater Yellowstone I&M Network	Jennifer Whipple (YCR)	Alpine plant inventory	NPS I&M
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
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

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
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
Vegetation	RM-CESU, Colorado State University	Dr. David Cooper, Josh Rose (YCR: Roy Renkin)	Herbivory and hydrology in cottonwood establishment and persistence	Fee Demonstration
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
Vegetation	University of WY, Colorado State University, University of WI - Madison	Drs. Dan Tinker, William Romme, Monica Turner	Reciprocal interactions between bark beetles and wildfire in subalpine forests	Joint fire sciences
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
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
Vegetation	Yellowstone Park Foundation, Canon USA	Dr. Judy Harpell (YCR: Jennifer Whipple)	Bryophyte Inventory	Yellowstone Park Foundation, Canon USA, Inc.
Wildlife	Idaho State University; USGS Amphibian Research and Monitoring Initiative	Dr. Chuck Peterson; Steve Corn	Amphibian Monitoring	NPS I&M
Wildlife	Montana State University (Ecology)	Dr. Robert Garrott (YCR: Dr. P.J. White)	Collaborative ungulate habitat and population monitoring	ONPS-Ungulates, Winter Use, Bison
Wildlife	University of Idaho YERC	Drs. P.J. White (YCR), John Byers, Kerey Barnowe-Meyer, Robert Crabtree, Jenny Sheldon	Conservation of the declining Yellowstone pronghorn population	RM-CESU
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
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.

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
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
Wildlife	University of Wyoming-Wyoming Natural Diversity Database	Gary Beauvais and Douglas Keinath	Ana Bat data analysis	NPS I&M
Wildlife	University of Wyoming-Wyoming Natural Diversity Database	Gary Beauvais and Douglas Keinath	NPSPECIES database: certification	NPS I&M
Wildlife	USGS-NPWRG	Jay Hestbeck (YCR: Dr. Glenn Plumb)	Trumpeter swan data analysis	NPS-NRPP, GYCC
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
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
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
Winter Use	State of Montana (Department of Environmental Quality)	Elton Erp (YCR: Mary Hektner)	Air quality monitoring at West Entrance	ONPS-Winter Use Monitoring
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
Wolf Project	Beringia South	Howard Quigley, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf–carnivore interactions	NPS, YPF, Beringia South
Wolf Project	Colorado State University, Oregon State University, University of Alberta, USGS	David Cooper, Don Despain, Tom Hobbs, Evelyn Merrill, Roy Renkin (YCR), William Ripple, Doug Smith (YCR)	Wolf effects on willow regeneration	NPS, YPF
Wolf Project	Michigan Technological University, University of Alberta, University of Minnesota, USGS	Mark Boyce, L. David Mech, Rolf Peterson, Dan MacNulty, Doug Smith (YCR), Daniel Stahler (YCR), Nathan Varley	Wolf effects on trophic cascades	NPS, YPF
Wolf Project	Michigan Technological University, University of Minnesota	Tom Drummer, Dan MacNulty, Rolf Peterson, Doug Smith (YCR), Daniel Stahler (YCR), John Vucetich	Wolf predation	NPS, YPF, Michigan Technological University, University of Minnesota

Benefitting Program	Cooperator/ Partner	Contact/ Principal Investigator	Project	Fund Source
Wolf Project	Montana State University	Matt Becker, Bob Garrott, Claire Gower, Doug Smith (YCR), Daniel Stahler (YCR), Dr. P.J. White (YCR)	Wolf–elk relationships, Madison-Firehole watershed	NPS, YPF, Montana State University
Wolf Project	Montana State University	Lisa Baril, Andy Hansen, Doug Smith (YCR)	Wolves, willows, and songbirds	NPS, YPF, Montana State University
Wolf Project	Oregon State University, University of Montana, University of Wisconsin at Stevens Point	Matt Kauffman, Eric Larsen, Roy Renkin (YCR), William Ripple, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf effects on aspen	NPS, YPF, Oregon State University, University of Montana, University of Wisconsin at Stevens Point
Wolf Project	Trent University	Dennis Murray, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf survival	NPS, YPF, Trent University
Wolf Project	University of California, Davis	Daniel Stahler (YCR), Chris Wilmers	Wolf–scavenger interactions	NPS, YPF, University of California, Davis
Wolf Project	University of California, Los Angeles	John Pollinger, Daniel Stahler (YCR), Bridgett vonHoldt, Robert Wayne	Wolf population genetics	NPS, YPF, University of California, Los Angeles
Wolf Project	University of Idaho	Kerey Barnowe-Meyer, John Byers, Doug Smith (YCR), Dr. P.J. White (YCR)	Wolf effects on coyote–pronghorn predation	NPS, YPF, University of Idaho
Wolf Project	University of Minnesota, USGS	Emily Almberg, L. David Mech, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf diseases and parasites	NPS, YPF, University of Minnesota, USGS
Wolf Project	USFWS, USGS, Wyoming Game and Fish	Mike Jimenez, Douglas McWhirter, L. David Mech, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf movements/dispersal	NPS, YPF, USFWS, USGS, Wyoming Game and Fish
Wolf Project	Wildlife Conservation Society	Toni Ruth, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf–cougar interactions	NPS, YPF, Wildlife Conservation Society
Wolf Project	Yellowstone Ecological Research Center	Robert Crabtree, Jennifer Sheldon, Doug Smith (YCR), Daniel Stahler (YCR)	Wolf–coyote interactions	NPS, YPF, Yellowstone Ecological Research Center
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
Yellowstone Center for Resources	University of Oregon	Dr. Andrew Marcus, Jim Meacham, Ann Rodman (YCR)	Atlas of Yellowstone project	Yellowstone NP, University of Oregon

Acronyms

CRPP: Cultural Resouce Preservation Program
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
NPWRC: North Prairie Wildlife Research Center
NRPP: National Resource Preservation Program
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
YERC: Yellowstone Ecological Research Center
YCR: Yellowstone Center for Resources
YPF: Yellowstone Park Foundation