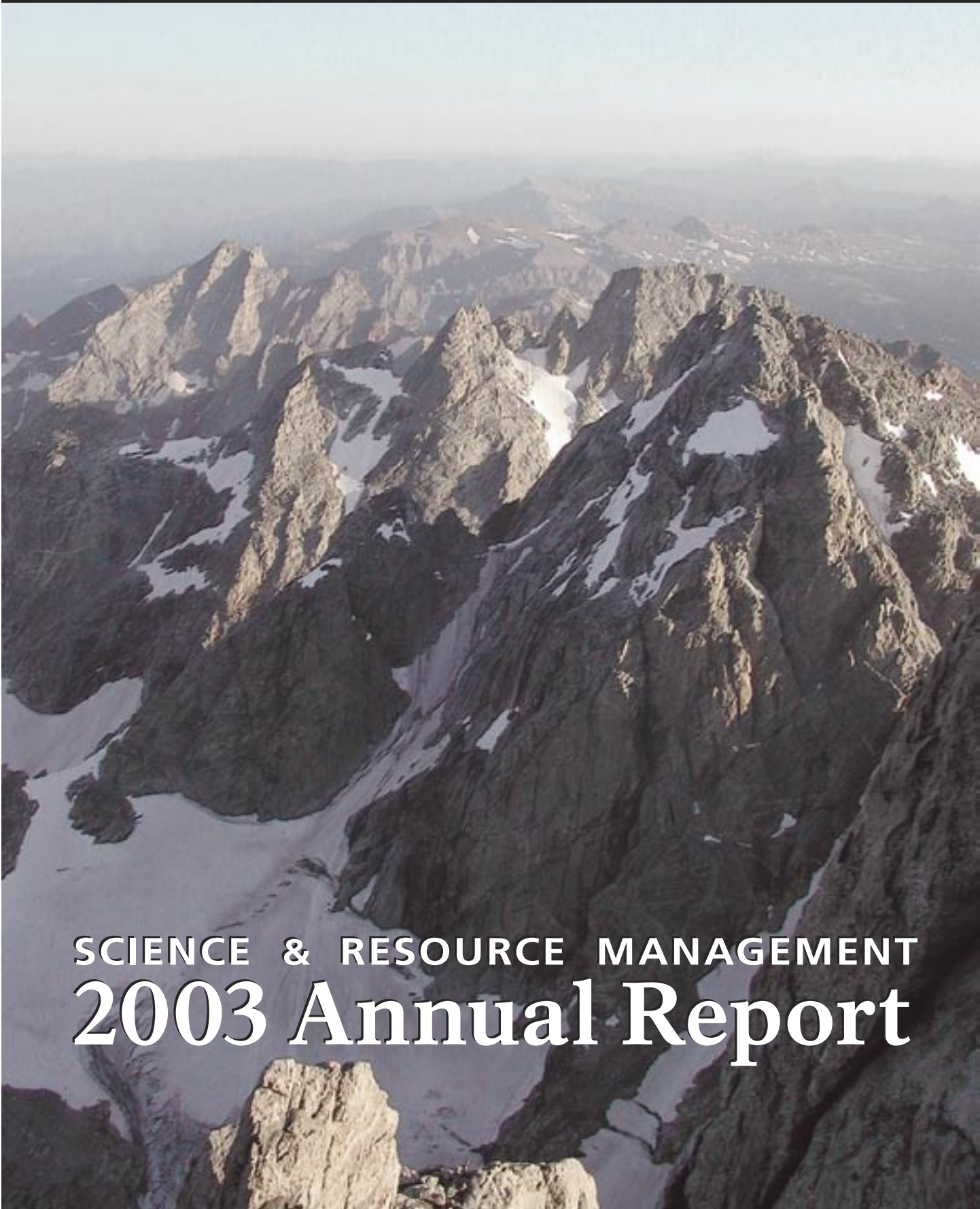


Grand Teton

National Park

National Park Service
U.S. Department of the Interior

An aerial photograph of the Grand Teton mountain range. The image shows rugged, dark brown and grey mountain peaks with patches of white snow. The perspective is from a high altitude, looking down into the mountain valleys. The sky is a pale, hazy blue.

SCIENCE & RESOURCE MANAGEMENT 2003 Annual Report



Photo by Ansel Adams,
courtesy of the Library of
Congress.

Cover photo by Ranger Chris
Harder, Friction Pitch Search
and Rescue, July 2003.

Mission Statement

Grand Teton National Park is dedicated to the preservation and protection of the Teton Range and its surrounding landscapes, ecosystems, and cultural and historic resources. The singular geologic setting makes the area and its features unique on our planet. Human interaction with the landscape and ecosystem has resulted in an area rich in natural, prehistoric, and historic resources that represents the natural processes of the Rocky Mountains and the cultures of the American West.



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Mt. Moran.

Foreword

Grand Teton National Park conducts research and conservation activities to help fulfill a mandate to conserve natural and cultural resources for the enjoyment, education, and inspiration of this and future generations.

The cultural and natural resource specialists of Grand Teton National Park devote themselves to monitoring and managing a fascinating array of resources and issues. For most of 2002 and 2003, they were absent a permanent division chief, after the retirement of Dr. Robert (Bob) Schiller, who capably served in that capacity for nine years. All of the science and resource management staff deserve thanks for continuing ably on in his absence; wildlife biologist Steve Cain deserves special mention for serving as acting chief of science and resource management during that time.

Employees in all of the park's administrative divisions share this common goal of resource conservation, and they contribute daily toward its achievement in a variety of ways—planning, regulating, informing, maintaining, monitoring, and managing, to name a few. This report provides an overview of selected recent and ongoing activities and programs of the park's Division of Science & Resource Management (SRM), and partners that share similar goals and are located within the park. Prior to the latter half of 2003, the cultural resource programs of the park were assigned to the Division of Interpretation; since then, they have rejoined the science and resource management staff, and we proudly include their reports in this volume.

This report is available on the park's website at <http://www.nps.gov/grte> or by calling (307) 734-3480. We invite your questions, comments, and suggestions for improving the park's research and resource conservation programs.

Sue Consolo-Murphy
Chief, Science & Resource Management

The Chapel of Transfiguration
in Moose.



Introduction

Grand Teton National Park was established to protect the area's native plant and animal life, its vast historical and cultural resources, and its spectacular scenic values, as characterized by the geologic features of the Teton Range and Jackson Hole.

The National Park Service defines two types of resources and their management goals as follows:

Natural resources (plants, animals, water, air, soils, natural soundscapes, topographic features, paleontologic resources, and esthetic values such as scenic vistas and clear night skies) are managed to maintain, rehabilitate, and perpetuate their inherent integrity.

Cultural resources (prehistoric and historic structures, cultural landscapes, archaeological resources, ethnographic resources, and museum collections) are preserved unimpaired.

Research projects are conducted within the park to help managers make better decisions on conservation of park resources and to advance the state of knowledge about topics and issues relevant to broader societal interests. Research and conservation programs in the park are sometimes challenged by a complex mosaic of private and federal land ownerships and jurisdictions within and surrounding the park. However, we appreciate and benefit by maintaining close working relationships with many other organizations and individuals in the area who share our goals and support our projects in a variety of ways, as described in this report.

In this report, projects are subjectively assigned to one of the two categories above (natural or cultural). In practice, research and resource conservation activities in Grand Teton National Park are often closely interwoven, frequently conducted cooperatively with park staff of other divisions, and may involve researchers and managers of other organizations, partnerships, or working groups.



Natural Resources

Grand Teton National Park conserves an array of natural resources that attract visitors from around the world. Geologists regard the Teton Range as one of Earth's most impressive examples of fault-block mountains. The peaks dominate the park landscape, towering 3,000 to 7,000 feet above the sagebrush flats of Jackson Hole and culminating in the Grand Teton (13,770 feet). The Tetons are the youngest mountains of the Rocky Mountain chain and began to rise about nine million years ago. Several piedmont lakes rimmed by moraines from the last glaciation are adjacent to the range and form part of the scenic foreground. The park also includes 25.5 miles of the Snake River. In addition to being an outstanding recreational resource, the Snake River is one of the last remaining natural habitats of the Snake River cutthroat trout.

Flora and fauna are typical of the Central Rocky Mountain region. Forests are a mixture of limber pine, lodgepole pine, whitebark pine, Engelmann spruce, subalpine fir, and Douglas-fir. Scattered patches of aspen are found at lower elevations. Cottonwood, willow, and Colorado blue spruce line the Snake River and its tributaries, and sagebrush dominates the valley floor.

Approximately 61 species of mammals have been documented in the park. Elk, moose, pronghorn, mule deer, and bison are common. Bighorn sheep can be found in the higher mountains. Other mammals include beavers, muskrats, coyotes, wolverine, red foxes, pikas, and Uinta ground squirrels. Black bears are common in forested areas. Grizzly bears, listed as a threatened species in 1975, were considered rare in the park 20 years ago, but are now common in all but the southernmost reaches of the Tetons.

Bird life is varied. Threatened bald eagles and peregrine falcons, once listed as endangered but delisted since 1999, nest in the park. Other prominent species are the white pelican, great blue heron, trumpeter swan, Canada goose, sandhill crane, sage grouse, golden eagle, common raven, several species of woodpeckers, and a variety of songbirds.

These resources are affected not only by the natural processes that occur within ecosystems, but also by the human influences upon them. Examples include visitor use of popular backcountry areas, boating on lakes and rivers, livestock grazing, and sound and visual effects from having the busiest airport in Wyoming located within the park.

Air Resources

Since the late 1970s, the NPS has maintained a nationwide network to monitor air quality. Ozone is the most pervasive air pollutant in the United States. At high levels ozone may cause significant human health effects and is poisonous to plants.

Air Quality Monitoring

In GRTE, ozone has been monitored weekly during summer months since 1995. Weekly averages of ozone concentrations during the first five years of monitoring have shown that the park is in the mid-range among other parks being monitored, and has ozone concentrations below the EPA standards that indicate areas of high ozone pollution. Nationwide results of ozone monitoring are available on the Internet at <http://www2.nature.nps.gov/ard/gas/assives.htm>.

Aquatic Resources

In 2000, aquatic resource biologist Susan O’Ney joined Grand Teton’s staff half-time; the other half of her time is devoted to the Greater Yellow-stone Inventory and Monitoring Network. She led monitoring efforts, initiated a number of cooperative research projects with partners, and served as liaison with outside researchers on studies related to water, air, and geologic resources.

Water Quality Monitoring

Baseline Water Quality Assessment

To assist park staff in making sound resource decisions, a two-year baseline water quality assessment and land-use characterization was completed for five tributary basins feeding the Snake River headwaters within GRTE—Pilgrim Creek, Pacific Creek, the Buffalo Fork of the Snake River, Spread Creek, and Ditch Creek. Results indicated that variations in dissolved solids probably were caused by differences in the geology of the tributary basins. Concentrations of nitrogen and phosphorous for some tributaries exceeded ambient levels for forested mountain streams in the Middle Rockies ecoregion; since those tributaries have limited development, the excesses are probably from natural sources. Trace metals and pesticide levels were low at all collection sites and suspended-sediment concentrations varied in response to seasonal variations in stream flow. Concentrations of fecal coliform in samples were generally matched to wildlife sources—avian, bovine, deer, or elk. Human sources were positively identified in six percent or fewer of the samples from each of the tributary basins.

Monitoring Water Quality in the Backcountry

The goal of this project is to help park staff determine the effects that increased backcountry use may be having on the quality of park surface waters. This information can then be used to guide decision-making related to the location of camping zones,

limitations on backcountry use, and directing educational efforts for park visitors.

In 2003, water samples were collected from Taggart and Bradley Lakes; Cascade, Granite, Open, Death, Avalanche, Leigh and Paintbrush Canyons; and Cottonwood Creek, Glacier Gulch, and Stewarts Draw. Samples were filtered and incubated for fecal coliforms analysis. Positive fecal coliform colonies were selected and sent to the University of Washington for genetic fingerprinting, which will determine the mammalian source of the coliforms. In this way the level of human presence can be compared with baseline data collected since 1996. The results of the genetic analyses are expected in May 2004.

The genetic analyses will be reviewed and used to guide the 2004 sampling plans. In addition, 2004 sampling efforts will include the use of a multiparameter water-quality monitoring probe to measure the pH, specific conductance, dissolved oxygen, and temperature of each stream sampled. Flow or discharge of each stream will also be measured. These measurements are being added to provide information required by the NPS Vital Signs Monitoring Program.

Aquatic Insects of the Snake River

Spring, summer, and fall collections of aquatic insects were completed along the Snake River above and below Jackson Lake. Also completed were habitat-typing of the collection sites, including data on water temperature, dissolved oxygen, conductivity, acidity, velocity, and depth.

Reference specimens have been collected and insect identifications are underway.

Snowpack Chemistry Monitoring

Monitoring snowpack chemistry at two sites in GRTE continued for the eleventh year. March 2003 analyses for major acids showed similar to moderately higher levels compared to the 11-year averages for Garnet Canyon and Rendezvous Peak. Concentrations of ammonium (NH₄⁺) were 50% to 90% higher than average. Mercury concentrations were moderate to low, compared to sites sampled elsewhere in the Rocky Mountain region.

Amoebae in Hot Springs

Investigators surveyed for the presence of *Naegleria fowleri* in Kelly Warm Springs, Huckleberry Hot Springs, and Polecat Creek, where people soak and swim, either legally or illegally. Positive matches were found in Huckleberry Hot Springs and Polecat Creek. These organisms are pathogens of humans and may cause amoebic meningitis, which can be a serious illness, perhaps even fatal.

Projects Involving Lakes

Acidification of High-Elevation Lakes

An ongoing master's thesis research project, to be completed in 2004, is investigating whether long term trends in atmospheric deposition rates are affecting water quality in the park's high-elevation lakes.

Coloration of Alpine Lakes

Two hypotheses were tested regarding the causes of coloration in alpine lakes—chemical components or biological components. In a 2002 study of Marion Lake, the investigator found neither a purely chemical nor a purely biological basis for the water's color. However, some evidence was found to support the possibility that spontaneously-formed ferrous chlorides combined with light attenuation and al-

pine lake water clarity to produce at least some of the coloration.

Hydrocarbons in Lake Water and Sediments

Water and sediment samples were collected in summer from Jackson, Jenny, and Taggart Lakes. Additional water samples were collected from water near a running four-stroke boat engine and from Jackson and Taggart Lakes soon after the ice on the lakes had melted. Snow samples were collected from Jackson and Taggart Lakes and from snow near a running snowmobile. Trout samples were preserved for analyses of organics and metals. Taggart Lake served as a reference site for this study because of its pristine conditions and lack of internal combustion engine use.

Analyses of water samples suggest trace levels of organics, naphthalene, alkylated naphthalenes, and acenaphthylene in Jenny and Jackson Lakes. No polycyclic aromatic hydrocarbons were found in summer water samples from Taggart Lake (the reference site). Data compilation and interpretations are ongoing.

Fish in Alpine Lakes

Continuing the second field season of a three-year inventory of fish in the alpine lakes of GRTE, eleven lakes were sampled using a gill net or minnow trap—Cirque Lake, Forget-Me-Not Lake, Grizzly Bear Lake, Icefloe Lake, Kitlake, Lake Taminah, Marion Lake, Mink Lake, Pass Lake, Rimrock Lake, and Timberline Lake. Of the 11 lakes surveyed, only Grizzly Bear Lake contained fish. The fish had spotting patterns closely resembling Yellowstone cutthroat trout. Dudley Lake and Talus Lake will be sampled in 2004, to complete the project. Information on basic water chemistry, plankton, Universal Transverse Mercator (UTM) net locations, and digital photos will be included in the 2004 annual report.

Cooperative Conservation Initiative Funded Projects

The Cooperative Conservation Initiative (CCI) was a new NPS funding source in 2003. The purpose of the program is to achieve the actual restoration of natural resources and/or the establishment of or expansion of habitat for wildlife. The projects funded in this category must seek local partners and use innovative practices that embody Secretary of the Interior Gale Norton's "Four C's" of cooperation, communication and consultation, all in the service of conservation.

Five subprojects were approved for CCI funding including Bar BC Spring restoration, Two Ocean Creek fish passage enhancement, Snake River bank stabilization and stream restoration workshop at Moose, Snake River Ranch irrigation ditch fish screen design, and preliminary evaluation of the effects of Jackson Lake Dam.

Accomplishments included:

■ Bar BC Spring

Spawning habitat for native cutthroat trout had been disturbed on this spring creek by the presence of an abandoned fish hatchery. This project removed the remaining dam structures, removed accumulated sediments, narrowed the channel to normal width and placed commercially washed spawning gravels and overhead cover to protect spawning fish and provide escape cover for fry. This project was completed in October 2003.

■ Two Ocean Creek

Fisheries biologists from the Wyoming Game and Fish Department identified a culvert on Two Ocean Creek that is a barrier to native fish migration. By modifying the downstream approach to this culvert, the upstream migration of spawning cutthroat trout could be restored. Plans for this project were engineered in 2003.

Implementation is planned for the week of April 19, 2004.

■ Snake River at Moose

The west bank of the Snake River at Moose has eroded as much as five feet during the last seven years. This project will use state-of-the-art bioengineering techniques to restore riparian vegetation and fish habitat. In addition, this project will serve as a demonstration project for restoration techniques. The bank stabilization project is still in the design phase. A Riparian Ecology and Restoration Workshop was held at Moose in October 2003, cooperatively sponsored with the Natural Resource Conservation Service and the Teton Conservation District.

■ Effects of Jackson Lake Dam

In 2003, University of Utah researcher Jack Schmidt analyzed hydrologic and photographic data. The analyses revealed three distinct periods of flow regimes on the Snake River in response to the Jackson Lake Dam:

1) 1906-1916: The early log-crib dam resulted in decreased stream flow during the rise of the annual snowmelt flood in May, and increased stream flow between mid-July and mid-September;

2) 1917-1956: The years following the construction of a permanent dam and establishment of the present maximum full pool elevation resulted in a delay of the annual flood for approximately two months. The magnitude of this flood was about the same as the estimated unregulated flow would have been; and

1957-2002: Representing years following construction of the Palisades Reservoir. The timing of the annual peak flow is now nearly the same as the estimated unregulated flow, but the magnitude of the annual flood has been greatly reduced and stream flow remains nearly steady (and much

Channel in Bar BC Spring Creek restored to natural width.



higher than estimated unregulated flows) between about July 1 and September 15.

Plans for additional work include:

■ Snake River at Moose

An additional workshop is planned for fall 2004, when the bank stabilization work is scheduled to be implemented. The workshop will be a one-day classroom exercise, followed by a field day that will call upon attendees and other volunteers from the community, neighboring agencies, sister parks, and others, to complete the bank stabilization work.

■ Snake River Ranch Fish Screen

A large diversion located near the JY Ranch is removing a significant cutthroat trout population from the Snake River. While many of these trout are providing a supply of fish to creeks located further down the watershed, Wyoming Game and Fish biologists feel that many fish are also being lost (trapped) when the ditch is shut down in the fall. This project has funded a consultant to design a fish screen that would redirect the cutthroats back into

the Snake River. The design is expected to be complete in summer 2004.

■ Effects of Jackson Lake Dam

Beginning in 2004, a two-year study will begin to summarize the state of understanding of Snake River hydrology and geomorphology as it relates to the operation of the dam, and to develop a set of river management objectives for guidance of NPS in future negotiations with the Bureau of Reclamation. The study will include field studies to survey, map, excavate, and analyze the hydrologic processes that contribute to areas of channel change. This study will also provide GRTE with maps of the Snake River that illustrate areas of channel stability and instability, for use in planning efforts.

Geologic Resources

Grand Teton National Park has no geologist on staff, but benefits from research and monitoring efforts provided by several cooperators, such as the U.S. Geological Survey, the University of Utah (who operates a seismic monitoring network throughout the region), and university scientists.

Seismic Monitoring Efforts

The Teton Fault runs along the base of the Teton Range. It is a zone of active but, in recent years, relatively quiescent seismic activity. GRTE has cooperated with the U.S. Geological Survey, the Bureau of Reclamation, and the University of Utah to operate a seismic monitoring network in the park as part of larger regional effort. In 2003, old but functioning stations long operated by the Bureau of Reclamation to monitor the safety of the Jackson Lake Dam were removed, surprising area partners. Subsequent efforts by agencies and elected officials from local, state, and national governments resulted in new funding to replace the stations in future years.

Evolution of Gneiss Layers in the Northern Teton Range

Webb Canyon gneiss and layered gneiss are two of the four rock types that form the base of the Tetons. This year, a field party of four in the Moose Basin area collected rock samples that are being analyzed to help determine the timing of their formation.

Glacial Geology, Neotectonics, and Geo-Archaeology of the Jackson Hole Area

Research continued on the geo-archaeology of Jackson Hole. Investigators found that three glacial lobes along the southern margin of the Greater Yellowstone glacial system fed into northern Jackson Hole during the last (Pinedale) glaciation. Within the Pinedale glaciation, the dominant lobe changed from the Buffalo Fork Lobe from the northeast, to the Snake River lobe from the Yellowstone Plateau to the north. Two huge outwash fans were built—first on the east side of the Snake River on Antelope Flats, and next on the west side of the Snake River heading near Spalding Bay.

Paleontological Resources Survey

Fossils were collected from several Grand Teton National Park localities and voucher specimens are being identified to assist park staff in conservation, research, protection, and interpretation of these resources.

Grand Teton National Park Fossil Specimens	
Madison Formation	Darby Formation
Corals:	Echinodermata
Bothrophyllum	Bryozoa
Axosmilia	Theodossia
Syringopora	Spirifida
Bothrophyllum	
Michelinia	Sundance Formation
Rugosa	Astartacea packardi
Menophyllum	Mytilus
Bothrophyllum	Pleuromya subcompressa
Rugosa	Unio
Brachiopoda:	Pleuromya subcompressa
Martinia rostrata	Belemnopsis
Martinia rostrata/Orthothetes inflatus	Rigauxia
Unispirifer/Martinia rostrata	Pleuromya subcompressa
Martinia rostrata	Pleuromya subcompressa
Spiriferida/Echinodermata	Meretrix
Echinodermata:	Pleuromya subcompressa
Echinodermata	Trigonia
Echinodermata	Anatina punctata
Echinodermata	Unio felchi
Pachylocrinus (NC)*	Gryphaea calceola/Pleuromya
Reticularia peculiaris	Gryphaea planoconvexa
* NC refers to specimens photographed but not collected.	Pleuromya subcompressa/Gastropoda
	Bivalvia
Phosphoria Formation	
Trace Fossils:	Frontier Formation
Thalassinoides	Trochodendroides
Molluscsa	Dryophyllum
Molluscsa	Protophyllocados
Brachiopoda	Anemia
Palaeoniscida or Acanthodian	Aralia
Gros Ventre Formation	
Bivalvia	
Trace Fossil:	
Zoophycos ?	

Greater Yellowstone I&M Network

As an integral part of its Natural Resource Challenge initiative, the NPS has established 32 networks of parks, linked by biogeographic region and commonality of resources. Grand Teton is part of the Greater Yellowstone Inventory and Monitoring Network, along with Yellowstone National Park and Bighorn Canyon National Recreation Area.

The goal of the Greater Yellowstone Inventory and Monitoring (GRYN) Program is to document the occurrence and distribution of vertebrates and vascular plants currently found in the GRYN parks. The goals of the program are to plan and conduct long-term natural resource monitoring and to provide staff with scientifically sound information needed to safeguard the health and integrity of these areas.

2003 Accomplishments

Inventories

The network helped support several inventory projects in GRTE. These projects included a non-native vascular plant inventory conducted by SRM staff, an amphibian inventory conducted by Idaho State University, an alpine lakes fish inventory conducted by the Wyoming Game and Fish Department, sage grouse and bald eagle surveys conducted by park staff, and a bat inventory conducted by personnel from the Wyoming Natural Diversity Database. Inventory results are detailed in the following reports:

■ *Bat and Terrestrial Mammal Inventories in the Greater Yellowstone Network.* 2003 annual report by D.A. Keinath, Zoology Program Manager, Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

■ *Bald Eagle and Sage Grouse Surveys in Grand Teton National Park.* Final report by Sue Wolff, Grand Teton National Park, 2003. On file at the SRM Office in Moose, Wyoming.

■ *Amphibian and Reptile Inventory and Monitoring Grand Teton and Yellowstone National Parks, 2000-2003.* Final report by Debra A. Patla and Charles R. Peterson. Herpetology Laboratory, Department of Biological Sciences, Idaho State University.

■ *2003 Weeds Inventory Report for the Non-Native Plant Management Program, Grand Teton National Park.* By Chad Jost, Grand Teton National Park, October 2003, on file at the SRM Office in Moose, Wyoming.

Monitoring

In 2003, GRYN identified and selected vital signs (also called ecological indicators) that form the basis of a long-term monitoring program. This was accomplished through an iterative process that identified candidate vital signs through an internet-based questionnaire, park workshops, and conceptual models. These were later ranked against a set of criteria by a group of subject-area experts. The final list of vital signs was eventually selected by the technical committee comprised of representatives from each park, and approved by the GRYN board of directors.

The introduction, background, conceptual models, and process used to select vital signs can be found in the *Greater Yellowstone Inventory and Monitoring Network Vital Signs Monitoring Plan: Phase II Report, September 30, 2003*, which is on file at the GRYN Office in Bozeman, Montana.

Plans for 2004

■ Continuation of inventories of vascular plants and vertebrates. SRM staff will

conclude the exotic plant inventory by filling data gaps in the valley floor zone. The inventory will focus on homesteads and sensitive habitats such as potholes, grazing allotments, and other disturbed sites.

■ Surveys for bats and amphibians will continue.

■ Bridger-Teton National Forest will conduct fish inventories in the main stem and tributaries of the upper Snake River.

■ In 2004, the monitoring program will also work on detailed monitoring protocols for several high-priority vital signs. These include biological indicators such as land birds, whitebark pine, amphibians, and aquatic invertebrates, as well as physical indicators such as water chemistry, climate, and land use.

■ In early fall, the program plans to start working on monitoring protocols for exotic plants and exotic aquatic assemblages.

For more information about the Greater Yellowstone Network and its many activities, visit <http://www.nature.nps.gov/im/units/gryn/index.html>.

Boreal toad being measured as part of the Greater Yellowstone Inventory and Monitoring Program.



Species: Bubo Date: 8/2/03
Sex: ♂ SVL: 61.7
Location: 538789 4853183 6m x 1m
UTM: Snake River 480-103
Observer: P. Barry, D. Patla

Integrated Pest Management

The goal of the Integrated Pest Management (IPM) program is to coordinate knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment. Pests are living organisms that interfere with the purposes or management objectives of a specific site, or that jeopardize human health or safety.

2003 Accomplishments

In 2003, IPM coordinator Brian Villalobos:

- Researched, prepared, and submitted 33 pesticide treatment proposals from Grand Teton National Park, Teton County Weed and Pest District, Signal Mountain Lodge, and Grand Teton Lodge Company to the Intermountain Region of the NPS, and also reported and submitted pesticide use logs at the end of the treatment season.
- Surveyed structures, mitigated, and gave information for prevention of pest issues at Signal Mountain Lodge for rodents, insects, and cliff swallows; at Grand Teton Lodge Company for cliff swallows, insects, and turf and upland weeds; at the Murie Center and historic Reimer Cabin for carpenter ants; at Jenny Lake and Gros Ventre Campgrounds for paper wasps; at Chapel of Transfiguration for chipmunks and paper wasps; at Colter Bay employee housing for skunks and campground weeds; at Highland residences, helped exclude bats and chemically treated for bat bugs.
- Updated safety program for pesticide spill management, personnel safety, and risk assessment for Safety, Health, and Environmental Awareness Committee.
- Modified IPM site plan for pests at Colter Bay Visitor Center and Indian Arts Museum.
- Contacted potential contractors, helped write contract specifications and budgets, and coordinated with contractor on successful chemical treatment of 726 acres of musk thistle on the Kelly Hayfields.
- Wrote annual work plan for weed management program.
- Wrote proposals for renewal of weed program, IPM technician position and coauthored proposal for cliff swallow eave netting, (latter two proposals were funded).
- Developed study plan for monitoring bio-control release sites and helped monitor sites.
- Wrote research study plan for chemical treatment of yellow toadflax test plots and pre-sampled test plot sites.
- Researched and wrote West Nile Virus (WNV) report for park employees, emphasizing prevention and safety, purchased DEET insect repellent for 350 employees, and submitted birds for WNV antibody analysis. All birds tested were antibody-negative for WNV.
- Complied with *Environmental Compliance Audit Report* on pesticides and coauthored proposal to correct deficiencies in pesticide storage building.
- Complied with cliff swallow nest depredation protocols and the *Migratory Bird Treaty Act* and completed annual report to the FWS.
- Helped train new employees on pesticide application and preparation for state exams and licenses.
- Presented lab on pesticide labels to attendees of our Annual Interagency Weed Training.
- Released 2,000 biocontrol insects on noxious weeds (i.e. dalmation toadflax).

and spotted knapweed) in five locations in GRTE.

■ Acted as division representative on Safety, Health, and Environmental Awareness Committee and served as safety officer for Vegetation Branch personnel. Served as member of Jackson Hole Weed Management Association and served on its education and training committees.

■ The IPM program will continue to coordinate the activities described above on park lands, including concessions and leased properties, in keeping with the *Presidential Directive of 1979*.

Natural Soundscapes

In 2003, term sound ecologist Shan Burson came from Alaska, where he had developed an acoustical research program for Denali National Park, to begin a similar effort for Grand Teton and Yellowstone national parks.

Sound Monitoring and Acoustical Research

The goal of this program is to provide current acoustical information to park staff in order to protect the natural soundscape and mitigate the human-caused impacts. GRTE initiated an acoustical research program in 2003 to collect baseline and current conditions of the park's soundscape, with special emphasis on over-snow vehicles and aircraft overflights.

The natural soundscape is a vital component of the park's natural resources. The natural soundscape includes all sounds intrinsic to ecological functioning, such as animal communication (e.g., bird songs), as well as physical sounds such as avalanches, wind blowing through trees,

and flowing water. Many visitors are attracted to the park to experience natural sounds such as bugling elk, or the serenity of backcountry areas having no human-made sounds.

Human-made sounds are evident in and adjacent to the park. GRTE is the only park unit in the NPS with a full-scale commercial airport operating within its boundary, and each year the number of flights, along with their noise impact, increases. GRTE and the FAA are required by the *National Parks Air Tour Management Act of 2000* to prepare an *Air Tour Management Plan* to address the impact of commercial air tours on the park; this effort may begin within several years.

The Winter Use Plan for Yellowstone and Grand Teton National Parks and the John

Skip Ambrose, NPS Natural Sounds Program, and Shan Burson, GRTE Soundscape Program, collect acoustical data near Timbered Island. Photo by Linda Franklin.



Skip Ambrose, Chris Florian, and Shan Burson, collecting acoustical data near Timbered Island. Photo by Linda Franklin



D. Rockefeller, Jr. Memorial Parkway provides noise thresholds for over-snow vehicles. To determine whether these mandated noise standards are being exceeded, the soundscape must be measured and described. Legislation and NPS policy, at the local, regional, and national levels, mandate an understanding of the natural soundscape at GRTE.

In 2003, the park hired an NPS acoustical ecologist, Shan Burson, to oversee the program. He purchased sound monitoring instrumentation, developed and implemented detailed work plans, obtained research permits, and began data collection and analysis. The acoustical ecologist was shared with Yellowstone for winter-use data collection.

The acoustical ecologist will continue to collect sound levels and digital recordings, identify sound sources, and calculate standard metrics of natural and human-caused sounds. These data will be collected by au-

tomated sound monitoring systems placed in representative management zones and habitats throughout the park.

The winter data will establish whether the noise thresholds in the *Winter Use Plan* are being met. Data to determine the impact of aircraft on the park's natural soundscape will be collected during all seasons. This information will provide comprehensive baseline and current conditions of both natural soundscapes and human-made intrusions.

Vegetation Management

Primary components of this program, supervised by biologist Steve Haynes, include monitoring and mapping native vegetation, controlling the spread of exotic plants, revegetation of disturbed sites, and management of legislatively permitted livestock grazing in GRTE.

Weed Inventory

The year 2003 was the fourth year of a weed inventory project using GPS/GIS technology to map the distribution and abundance of invasive species in GRTE and JODR. It was the first year that we had sufficient data to begin using this database to develop park-wide species strategies. Strategies range from eradication to containment within known distribution while naturalizing the weed through the use of biological controls, when available. It was also the first year that we generated maps and coordinates so weed control personnel could use a GPS unit to navigate to the location and apply control measures. There are currently more than 12,000 records in this database.

The focus of the 2003 weed inventory field season was on park road rights-of-way, utility corridors, and the east shoreline of Jackson Lake. In addition, several other weed inventory surveys were conducted. We surveyed both sides of all paved and unpaved roads within the park, as well as several closed roads. Survey lines for park road rights-of-way totaled 460 miles.

Park utility corridors selected for the survey were located in high-probability weed areas and were mostly above ground power lines. Survey lines for park utility corridors totaled 29 miles, from Deadman's Point in the south, up the east shoreline, to two miles north of Fonda Point. A total of 4,600 weed location points were collected during the 2003 season.

Exotic thistles in Grand Teton National Park.



Invasive Weed Control

There are approximately 20,000 acres in GRTE and JODR that are infested with 22 species of noxious weeds. These are species that have potential to replace native plant communities if left unchecked.

Containment strategies are used on larger infestations while eradication is the goal for several newly found species that still have limited distribution.

In 2003, chemical, mechanical, and biological treatments were used to eliminate or control noxious weeds. A total of 2,242 person-hours were spent treating 1,054 acres of weed infestations. Biological controls were applied to spotted knapweed (*Centaurea maculosa*) and dalmatian toadflax (*Linaria dalmatica*). The Gros Ventre riparian corridor received a concentrated effort to reduce spotted knapweed infestations. A total of 443 person-hours were spent treating 56 acres along the river corridor and surrounding areas. Much of this work was carried out using a horse-pack sprayer in the riparian corridor.

Work also focused on high human-use areas in the Gros Ventre Campground and the town of Kelly. At the Jackson Lake Dam complex, members of the Montana Conservation Corps spent 76 person-hours mechanically treating five acres of noxious weeds. In addition, approximately 1/3-acre of common tansy (*Tanacetum vulgare*) was chemically treated.

New invasive weeds were given high priority in 2003. Salt cedar (*Tamarix ramosissima*) and perennial pepperweed (*Lepidium latifolium*) were identified and treated in addition to the species identified in 2002. A total of 176 person-hours were dedicated to treating 3.9 acres of new or recent infestations. Boom spraying was largely carried out by a contract with Simplot. In two days they were able to treat 726 acres of musk

thistle (*Carduus nutans*) in the Kelly Hayfields. In addition, 67 acres were treated at the Elk Ranch, Aspen/Hunter Ranch, Barker/Ewing Meadow, and an old JY Ranch pasture. The Snake River Pit Restoration Area also received an initial treatment for Canada thistle (*Cirsium arvense*) in 2003. Our crew spent several days treating Canada thistle to encourage restoration of native plants.

Monitoring of biological control releases was also conducted in 2003. Sixteen sites were sampled and compared to data gathered in 2000. Early analysis shows that *Trichosirocalus horridus* released in 1995 is starting to have an impact on musk thistle infestations. It also appears that *Ceutorhynchus litura* released on Canada thistle in 2000 is starting to show effects. The results of releases on spotted knapweed are very ambiguous. Additional time is needed to determine whether these controls will be effective.

Revegetation Program

Components of the revegetation program include site identification and inventory, monitoring sites seeded in past years, seed collection, site revegetation, and a seed-overseeing increase contact with the Meeker Plant Materials Center (MPMC).

Nine sites totaling more than 51,000 square feet were seeded by park crews during 2003. In addition, contractors seeded the Murie Center and the Colter Bay housing area, and planted wetland seedlings and willow cuttings on the Snake River Pit 60-acre wetland restoration project.

Eleven sites seeded in 2001 and 2002 were monitored for success and exotics. With the exception of the Menor's Ferry site, native plant density appears to be sufficient to ensure success. Low plant density at Menor's Ferry may be due to human

foot traffic or site conditions and will be reevaluated in 2004.

Crews collected seed from 11 species of native plants including enough showy goldeneye to put into our seed increase program at MPMC. Most of the seed was used in reseeding projects during the year, supplemented with native plant seeds from commercial sources.

We have five species in the increase program at Meeker. This seed is dedicated to federal highways projects, but surplus amounts can be used elsewhere.

Much of the work accomplished in 2003 was done with the assistance of the Montana Conservation Corp (MCC) crew which spent four two-week periods in the park. Unfortunately, funding for MCC is not available for 2004, severely limiting site rehabilitation and seed collection activities.

Aspen Growth Rates

Growth rates of aspens during the last 20 years were determined by examining 617 increment cores collected from 107 sites throughout the Greater Yellowstone Area, including nine sites in GRTE. Variations in growth rates were analyzed across gradients in climate, soils, and topography. No single variable of climate, soils, or topography was found to explain more than 26% of variations in growth rates. When all the biophysical variables were combined, the model explained only 53% of variations in aspen growth rates. The investigators suggest that aspen distribution may have been constricted by conifers or fire, thus limiting the range of potential variations in growth patterns.

Vegetation Mapping

In GRTE, science and resource management and wildland fire management are cooperating to produce a new vegetation

and fuels map of the park. This mapping program is largely funded by the fire program with additional funding from the Inventory and Monitoring program and the NPS Fee Demonstration program.

During the second year of a three-year study to create new or improved maps and vascular plant associations in GRTE, 166 plots were sampled and about 5,400 plant specimens were collected. Vegetation types were assigned an association name from the *National Vegetation Classification System* list of associations. Ninety vegetation types were assigned an association name with confidence, 36 were assigned an association with uncertainty, and 441 could not be assigned an association. At sampling locations, additional measurements were made on fuels; this information will be analyzed by personnel in the park's fire program.

Field work for the final summer will include on-the-ground accuracy assessment of the preliminary vegetation map of over-story plant species, created by air-photo interpreters.

Grazing Management

In 2003, legislatively permitted cattle grazers did not exercise their option to use pastures in the south-central areas of the park. One permittee from the Pinto Ranch grazed cattle in the Pacific Creek area on park and adjacent national forest land. The Triangle X concession and the Moosehead Ranch private inholding grazed horses on park land south of Spread Creek.

Wildlife

The division maintains an active wildlife inventory and monitoring program, annually targeting selected sensitive species with the goal of detecting changes in their status and distribution. Other objectives of the program are to map species' distribution, identify critical habitats, and determine numbers of individuals, threats to species, and population trends. In addition, biologists Steve Cain, Sue Wolff, newly hired Sarah Dewey, and other staff and/or cooperators from other agencies, universities, and private research institutions contribute information from studies permitted in the park or surrounding areas, and manage human interactions with wildlife and their habitats.

Amphibians

Although declining amphibian populations have been documented worldwide, additional knowledge is needed about species distribution, numbers, and causes of disappearance. Amphibian declines have been most evident in western North America among species occupying both montane and low-elevation desert habitats and in relatively undisturbed habitats, including national parks. Long-term data sets document changes in amphibian numbers and distributions, and may reveal reasons for these changes.

In 2002, researcher Debra Patla completed amphibian surveys of 53 wetland sites in three GRTE/JODR watershed units. Twenty-three of these sites (43%) were occupied by amphibians. She documented breeding by tiger salamanders at three sites, boreal toads at three sites, boreal chorus frogs at five sites, and Columbia spotted frogs at eight sites. At one monitoring site, beaver dam-building had considerably enlarged and improved habitats for toads and spotted frogs.

Boreal toads are the rarest of the widespread amphibian species in the Greater Yellowstone Ecosystem, now perhaps facing a new threat from invading New Zealand mud snails. Wandering garter snakes

were documented at nine sites, and the rare valley garter snake was found at one site.

Annual amphibian surveys are conducted in the park to monitor species distribution, demography, and population trends. Over the last ten years, two to three sites have been visited during these surveys.

In 2003, two amphibian breeding sites were monitored—Snake River Quarry and Schwabacher Landing (Table 1). Spotted frogs and boreal toads were found at both of these sites. Above average numbers of spotted frog egg masses were found at Schwabacher Landing (Table 2). Numbers of tadpoles and metamorphs were similar or higher than those found in the recent past, but were lower than the ten-year average. At Snake River Quarry, numbers of boreal toad tadpoles and metamorphs increased from previous years (Table 3).

SRM received few amphibian observation cards in 2003 (Table 4). Leopard frogs were reported near Taggart Lake, but follow-up surveys conducted by SRM personnel did not locate leopard frogs in the area. One dead tiger salamander was observed by SRM staff in early June, near Harem Hill.

Although the boreal toad is the most commonly reported herpetile, few toad breeding sites have been confirmed in the park. SRM staff reported an adult toad and

Table 1. Adult spotted frogs, chorus frogs, and boreal toads located at two survey areas in GRTE during 2003.

Site	Adult/juvenile spotted frogs*	Adult chorus frogs	Adult boreal toads
Schwabacher Landing	30	2	8
Snake River Quarry	4	0	0
Total	34	2	8
*Number of adult and juvenile spotted frogs were combined.			
** Chorus frogs were heard singing during the survey but numbers were not estimated			

Table 2. Spotted frog productivity at Schwabacher Landing in GRTE, 1993-2003.

Year	Egg Masses	Tadpoles	Metamorphs
1993	3	5000	18
1994	2	1300	78
1995	7	2600	46
1996	0	1	0
1997	0	1	159
1998	0	319	128
1999	0	0	16
2000	15	40	26
2001	0	70	29
2002	<20	>500	<200
2003	>10	>500	>100
Mean/yr	5.2	939.2	72.3

Table 3. Boreal toad productivity at the Snake River Quarry in GRTE, 1999-2003.

Year	Egg Masses	Tadpoles	Metamorphs
1999	0	>1000	0
2000	2	100	50
2001	2	<2000	45
2002	0	<200	>300
2003	0	>1000	>800
Mean/yr	0.8	860	239

Table 4. Visitor-reported herpetile observations in GRTE, 1998-2003.

Species	1998	1999	2000	2001	2002	2003
<i>R. luteiventris</i>	1	0	3	0	0	0
<i>R. pipiens</i>	13	2	0	4	2	2
<i>P. triseriata</i>	3	0	0	0	several hundred	0
<i>B. boreas</i>	19	6	2	7-10	0	4
<i>C. bottae</i>	1	1	0	3	1	2
<i>T. elegans</i>	3	0	0	4	6	0
<i>A. tigrinum</i>	1	0	0	3	0	1

several juvenile toads, tadpoles, and metamorphs along irrigation ditches at Elk Ranch. Surveys will be conducted at Elk Ranch in 2004 to locate specific breeding areas and to monitor productivity.

Snake River Quarry Reclamation Project

In 2002, the Snake River Quarry underwent major construction to reclaim the ponds to their natural state, after years of gravel mining at the site. In addition, the quarry was revegetated in 2003 with native vegetation. Boreal toads historically bred and produced young at the quarry's northeast pond. It is uncertain what effects the construction may have on this breeding site in the future, but toads returned in 2003 and counts were higher than average for tadpoles and metamorphs. Monitoring of this site by park personnel will continue in 2004 to determine whether the historical breeding sites are used, and to determine whether other reclaimed areas are used by boreal toads for breeding and for producing young.

Chytrid Fungus in Toads

There is growing interest in infectious diseases and their role in global amphibian declines. In particular, chytrid fungus, an introduced contagious disease found in various frogs, toads, and salamanders, is thought to be the cause of heightened mortality, leading to mass amphibian die-offs in six continents, including North America.

Montane and pristine areas in the western United States have not been immune to the fungus; in fact, two toad species once common in the Rocky Mountains, including boreal toads in Rocky Mountain National Park, have likely been decimated by the disease. Cases of chytrid-infected amphibians in Wyoming, Montana, and Colorado indicates that this disease occurs throughout the Rocky Mountains

and has the potential to be detrimental to amphibian populations in these areas.

A complete understanding of how chytrid affects animals and its role in amphibian declines is lacking. Baseline information on the distribution of chytrid, the susceptibility of populations to the disease, and the role it plays in amphibian population declines is critically needed in the GYE. Although amphibians in GRTE have not been sampled for chytrid, the fungus is predicted to be present because of its occurrence in areas adjacent to the park.

In 2003, chytrid was found in boreal toads near the Black Rock Ranger station on the BTNF at a pond only several miles from the park's Moran entrance station. Additionally, research on the National Elk Refuge in 2001 and 2003 identified chytrid in spotted frogs and boreal toads captured there, only a few miles from the park's most southern border.

Although the fungus is considered extremely pathogenic in other toad populations, evidence suggests that it may not be killing infected toads on the NER (D. Patla, personal conversation). If so, this would be the first report of a chytrid infection that is not accompanied by a population decline.

Further study is needed to determine the effects of the disease on GYE amphibian populations. In addition, no studies have been conducted to determine if this anomaly is widespread in the GYE or unique to the NER; therefore, it is important to determine the effects this fungus on toads in the GYE, and how it may be affecting their survival.

Birds

Breeding Bird Surveys

Populations of many species of birds that breed in North America but winter from Mexico south are declining. The causes of these declines are complex and baseline data on habitat use, seasonal distributions, productivity, and the effects of management practices are lacking. To identify and understand breeding bird population trends, the collection of long-term data sets is needed.

Annual monitoring of birds breeding in relatively undisturbed habitats, such as national parks, can provide reliable information that can be used in assessing population trends. In the late 1960s, Dr. M. L. Cody of UCLA established a long-term monitoring plan for breeding birds in GRTE; goals were to evaluate local, regional, and, to some extent, continental population trends of birds that breed in a variety of vegetation types in the northern Rocky Mountains. Intermittent surveys were conducted between the 1960s and 1990s, but between 1995 and 1998, all established sites were monitored. Since 1999, park personnel, volunteers, Dr. Cody, and WYGF staff have collectively been able to survey some sites each year. This survey is now called the Cody survey.

In addition to continuing the Cody surveys, a survey for the Northern America Breeding Bird Survey (BBS) program, the

primary source of standardized population data for breeding birds in North America, was completed in the park during 2003. A survey route called Colter Bay has been surveyed intermittently since the late 1960s. In the 1990s, WYGF surveyed it, and in 2001 park staff became responsible for the survey.

The original Cody survey plan established 30 monitoring sites within and adjacent to GRTE, spanning elevations between 6,000 to 11,000 feet and covering an array of habitat types. Although the monitoring program intended to cover the widest possible range of breeding bird species, it proved best to census small, terrestrial-foraging species with small territories, rather than birds with large territories (e.g., owls and raptors).

The BBS roadside survey is a 24.5-mile route that requires stops at half-mile intervals, for 50 stops. The BBS route was surveyed in mid-June, beginning near Lizard Creek and ending on the River Road. Survey data were submitted electronically to Patuxent Wildlife Research Laboratory, the federal laboratory responsible for data analysis.

Park personnel surveyed eight sites and documented 56 bird species during the 2003 Cody surveys (Table 5). In addition, Dr. Cody surveyed numerous sites; his results will be summarized in his annual report. Most sites had similar numbers of

Table 5. Number of visits and species and average number of breeding birds at 11 sites in GRTE, summer 2003.

Site	Number of visits	Number of species	Average number of birds
Wolff Ranch	3	11	24
Antelope Flats	3	9	37
Elk Ranch West	3	23	59
Elk Ranch East	3	25	43
Schwabacher Landing	3	18	73
Spread Creek	3	27	70
Granite Canyon	3	21	64
Taggart Lake	3	23	35

species and average number of individuals, although Taggart Lake and Schwabacher Landing had some notable yearly variations. These differences could be due to weather, timing of surveys, observer variance, or some combination of these factors.

During the 15 years that the Colter Bay BBS survey route has been conducted, an average of 51 bird species and more than 500 birds have been recorded. This year 450 birds were documented, including 58 species. Birds that are usually seen during this survey, but were not seen this year, include mallard, horned lark, common nighthawk, great blue heron, and pine grosbeak. Species observed this year, but not often seen in the past, include Wilson's warbler and American crow. Because regional and local long-term trends in breeding bird densities can be determined from projects such as the BBS, GRTE and other NPS units recognize this survey as a high priority for continued monitoring.

Wyoming Partners in Flight Breeding Bird Program, a program documenting the status of breeding birds from all habitat types throughout the state, has identified high alpine communities as lacking in long-term breeding bird information. Impacts of global warming, pollution, and increased human activity in high alpine areas are beginning to be documented throughout North America, but few areas have baseline information to indicate trends and changes in flora and fauna. Likewise, in GRTE little is known about the number of breeding birds using areas above treeline. Although Dr. Cody has one site established in a high alpine community (Cody Bowl), it has been surveyed only since the mid-1990s and has no other site for comparison of patterns or trends. To address this important data gap, park personnel are investigating the feasibility of conducting WYPF surveys in high alpine areas in the future.

The GRYN I&M program has identified neotropical migratory birds as a vital sign to be monitored in the park. Currently, a long-term study plan is being developed, which is likely to be implemented in 2005. Meantime, park personnel plan to continue the Cody surveys. Visitors and park staff are encouraged to report rare birds to SRM staff for incorporation into the state's rare bird database.

Effects of Human Residential Development on Songbird Habitats

In a study of the effects of suburban development on songbird breeding habitats in Jackson Hole, conducted by University of Wyoming graduate student Court Smith, research in 56 cottonwood forest patches showed that neotropical migrant bird species were the most negatively impacted. Bird species that were short-distance migrants, food generalists, ground gleaners, or avian nest predators all increased with increasing human development. A critical threshold of human development was found to be between 1.27 to 3.18 houses per hectare along the Snake River riparian corridor. Study sites in GRTE with little or no development provided critical "control" areas for comparisons in this work, while also providing the park with useful information.

Great Blue Herons

Colonial waterbirds depend on wetlands for feeding, nesting, and security. Where increasing human recreation occurs, colonial nesters are highly vulnerable to human disturbance. Human intrusions on heron nesting areas (heronries) may influence heron occupancy, disrupt nesting behaviors, increase predation, and result in abandonment of these areas. Human activities near heronries may also affect foraging behaviors by displacing herons to areas of lower prey availability. Environmental factors, such as water levels

near heronries or at feeding sites, may also affect heron productivity. Changes in turbidity, water depth, or temperature may influence the prey base at feeding grounds and, in turn, affect feeding behavior. Colonial waterbirds that feed in wetlands are attuned to seasonal patterns of hydrological fluctuations, and disruption of these patterns may lead to lowered nesting success and population decreases.

As a species of special concern, great blue herons in GRTE have been monitored annually since 1987. Reproductive success and occupancy of heronries in the park have varied widely, with overall productivity declining, and many heronries becoming inactive over time. Documenting the distribution and reproductive success of great blue herons is especially critical, given these downward trends.

Beginning in late May, historical heronries were visited to determine occupancy, nesting status, and productivity. Of the seven historic heronries known in the park, two were active in 2003—the Buffalo #2 and Glade Creek sites. At Buffalo #2, 17 nests were occupied and 15 young survived to fledge. At Glade Creek, ten nests were occupied but number of fledglings was not determined.

Low occupancy and low success of heronries has been documented in GRTE in recent years (Figure 3). In addition, the number of active heronries has declined from nine to two. It is uncertain why nest occupancy and number of nests have declined so drastically during the last ten years, but because most of the heronries are located in the popular Snake River corridor, impacts associated with human activity are among suspected factors. Boating, the primary recreational activity on the Snake River, has steadily increased in the park, and river use for rafting and fishing may continue to rise.

Recently park staff, in conjunction with the University of Wyoming, have been seeking funding and investigator interest in developing a research program to explain recent heron declines. Monitoring of known heronries will continue and other potential nesting areas along the Snake River and its tributaries may be investigated for heron use in 2004.

Raptors

Many raptors experienced widespread population declines in the mid-twentieth century because of the DDT and habitat loss. However, with the banning of DDT, reintroduction programs, and habitat management and protection, raptors have recovered in many areas.

Low numbers of bald eagles, osprey, and peregrine falcons were observed in the park during the late 1960s and 1970s. With the listing of the peregrine falcon in 1970 and the bald eagle in 1978 as endangered under the Endangered Species Act, and in view of the low productivity of ospreys, GRTE implemented an annual monitoring program for these birds of prey. Over the last 20 years, these three species have shown steady increases in productivity. Continued monitoring will help us promote continued increases and long-term conservation.

Raptor Nesting Success

The abundance and diversity of raptors in a relatively undisturbed area of GRTE were documented from February through August 2002 by Beringia South, a local nonprofit research and educational institution. Forty-six nesting pairs consisting of nine raptor species were located; American kestrels and common ravens were the most abundant species. Six of the nine species fledged at least one young, although there was complete nesting failure for Swainson's hawks (four nests), bald eagle (one nest), and long-eared owl (one

nest). Cold and wet weather, and a high-wind storm during early incubation, may have negatively affected stick-nest breeders. This study replicated several others initiated by Frank Craighead in 1947, providing a rare and valuable long-term look into the park's raptor community.

Ospreys

Eighteen historic osprey territories were monitored at least once between June and August 2003. Out of these, 13 were occupied breeding sites and successfully nested

and produced young (Table 6). Two new nests were discovered this season—one on the south side of Emma Matilda Lake and the other northwest of the Buffalo Fork Junction. Although numbers of occupied territories, breeding pairs, productive pairs, and young fledged were all above average, the number of young per productive nest was lower than average.

Several osprey nests are located along Jackson Lake and are surveyed only once during the breeding season, making it difficult to determine whether unsuccessful

Table 6. Osprey productivity in GRTE, 1972-2003.

*Productivity prior to 1990 was not available.

Year	Occupied territories	Breeding pairs	Productive pairs*	Young fledged	Young/occupied territory	Young/productive nest
1972	8	2	-	-	-	-
1974	6	3	-	-	-	-
1975	9	5	-	-	-	-
1976	7	3	-	-	-	-
1978	9	7	-	-	-	-
1979	9	6	-	-	-	-
1980	8	2	-	-	-	-
1981	6	5	-	-	-	-
1982	11	5	-	-	-	-
1983	12	11	-	-	-	-
1984	12	6	-	-	-	-
1985	15	5	-	-	-	-
1986	9	7	-	-	-	-
1987	15	8	-	-	-	-
1988	16	13	-	-	-	-
1989	17	6	-	-	-	-
1990	22	16	6	6	0.27	1.00
1991	21	16	9	19	0.90	2.11
1992	21	18	11	19	0.90	1.73
1993	22	17	9	18	0.82	2.00
1994	27	12	10	18	0.67	1.80
1995	13	12	7	9	0.69	1.29
1996	18	6	4	5	0.28	1.25
1997	20	13	11	13	0.65	1.18
1998	23	16	12	17	0.74	1.42
1999	13	10	9	13	1.00	1.44
2000	15	13	10	19	1.46	1.90
2001	18	18	15	20	1.1	1.30
2002	16	12	7	13	0.81	1.86
2003	18	18	13	19	1.06	1.46
Mean	14.53	9.7	9.5	14.86	0.81	1.55

ful nests failed or were ever occupied. To ensure that occupancy has been accurately determined, Jackson Lake should be surveyed two or three times a year—once early enough in the nesting chronology to determine occupancy, and one other time during the nestling phase.

Bald Eagles

Monitoring of bald eagles began in early May and continued throughout July, when young fledged. Of 13 bald eagle territories monitored in 2003, 12 nests were occupied and seven successfully fledged young (Table 7). A new nest was located south of Moose on the west bank of the Snake River. Numbers of occupied territories, breeding and productive pairs, young fledged, and young per occupied territory were above the 17 year average.

GRTE is part of the Greater Yellowstone recovery area for bald eagles, and the park has a long record of working with the Greater Yellowstone Ecosystem Bald

Eagle Working Group to promote eagle recovery. To protect eagles from human disturbance, the park implements public closures of ½-mile radius around active nests between February 15 and August 15. SRM staff coordinates these closures with the ranger division each year.

In 2003, SRM staff developed a bald eagle pamphlet and distributed it to all river users when they acquired their seasonal permits. The pamphlet included information about the natural history of bald eagles, their status as a threatened species, and why closures are in effect during their breeding season.

Peregrine Falcons

Decimated by DDT in the first half of the 20th century, peregrine falcons were considered extirpated from the GYE by the 1960s. In 1980, efforts to reintroduce falcons were initiated and continued until 1986. The first verified nesting attempt in GRTE occurred in 1987. Since then, at least

Table 7. Bald eagle territories and productivity in GRTE, 1987-2003.

Year	Occupied territories	Breeding pairs	Productive pairs	Young fledged	Young/occupied territory	Young/productive nest
1987	8	8	6	10	1.25	1.67
1988	6	6	5	8	1.33	1.60
1989	8	6	3	3	0.38	1.00
1990	8	7	4	6	0.75	1.50
1991	9	8	5	5	0.55	1.00
1992	9	7	5	10	1.10	2.00
1993	10	8	6	9	0.90	1.50
1994	11	9	8	13	1.18	1.63
1995	11	9	4	5	0.45	1.25
1996	9	7	4	7	0.78	1.75
1997	7	6	3	4	0.57	1.33
1998	8	6	6	9	1.13	1.50
1999	8	6	5	6	0.75	1.20
2000	7	7	4	6	0.86	1.5
2001	11	10	5	5	0.46	1.0
2002	12	12	5	8	0.67	1.6
2003	12	12	7	10	0.83	1.43
Mean	8.88	7.88	5.00	7.29	0.82	1.44

four territories have been established in the park. Annual breeding surveys to document the distribution and productivity of nesting peregrines began in 1990. The species was removed from the endangered species list in 1999.

In 2003, falcon monitoring began in early May and continued through July. Biologists monitored three historical peregrine falcon nests in 2003. A new site located near the Teton Valley Ranch was discovered and monitored. Observations of peregrines at other locations were reported and follow-up surveys conducted; however, no other new occupied eyries were located. Only one site, Garnet Canyon, successfully fledged young in 2003.

Trumpeter Swans

Trumpeter swans were nearly exterminated in the lower 48 states by the turn of the century. After intensive captive breeding programs, habitat conservation measures, and protection from hunting, swans made a comeback in many areas of the country. However, in the GYE and surrounding areas, swan numbers have declined 38% during the last ten years. Many reasons may be responsible for this decline, including competition with migratory flocks of swans on marginal winter range, variable reproduction rates, or high rates of cygnet mortality. Concern has resulted in cooperative efforts between state and federal agencies to monitor swan distribution and productivity. Because GRTE provides important nesting habitat for trumpeter swans, SRM personnel participate in these efforts by monitoring swan occupancy, nesting status, and cygnet survival.

In 2003, park biologists monitored historical nesting territories for occupancy. Swans occupied seven of ten historic sites and attempted to nest at five sites (Table 8). Only one site, Two Ocean Lake, successfully hatched young; however, none of

these cygnets survived to fledge. SRM personnel were unable to locate any remains of the cygnets. The cause of mortality is unknown; however, observations were reported of boaters on the lake approaching the swans and their cygnets.

Trumpeter swans have attempted to nest at Hedrick Pond since 1990, but have failed to successfully produce young. A pair was successful at this site in 1988 and 1989 when biologists provided a secure, artificial nesting platform. This pond has natural features that attract nesting swans every year but appears to lack a secure, natural nest site that can protect swan eggs and young cygnets from predation. Because of the recent decline in trumpeter swan numbers, the park allowed the WYGF to place an artificial platform in Hedrick Pond in spring 2003 to provide the swans a place to nest and raise young (Figure 4). The platform was 4x8 feet and camouflaged with nesting material such as dried grasses and willow branches. A 90-pound anchor secured the platform in place. The pair occupied the pond early in the breeding season, but in mid-May both birds left the pond and only one returned in mid-July. This site will be closely monitored again in 2004 to assess nesting status.

Trumpeter swans have occupied Swan Lake each year since the mid-1980s. Although they have made several nesting attempts, the pair has never hatched young. Reasons for this have been uncertain. In summer 2000 and 2001, eggs collected at the site and analyzed by WYGF personnel were found not to be viable, the cause unknown. After repeated observations of swans reacting to hikers using the trail along the lake's shoreline, SRM personnel and trail staff developed a plan to reroute the trail to minimize human disturbance of the swans. The reroute was not completed until after the 2003 nesting season, therefore its effects are not known at this

Territory	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	Total young	Young per occupied territory	Young per productive nest
Cyngets Fledged*																			
Arizona Lake	?	0	**	**	0	1	-	**	-	-	-	-	-	-	-	-	1	0.14	1.00
Christian Pond	1	**	**	**	0	**	**	3	0	4	2	2	2	**	-	-	14	0.93	2.33
Elk Ranch	0	0	**	**	**	0	5	0	0	5	1	**	**	**	0	**	11	0.69	3.67
Glade Creek	?	4	4	0	0	3	3	**	**	**	**	1	**	2	0	0	17	1.13	2.83
Grassy Lake	?	?	?	?	?	-	**	-	-	-	-	-	-	-	-	-	0	0.00	0.00
Hedrick Pond	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.19	1.50
Pinto Pond	2	**	**	?	0	**	**	**	0	**	**	-	6	4	1	0	13	0.93	3.25
Spread Creek	?	?	-	*	*	1	*	-	-	-	-	-	-	-	-	-	1	0.25	1.00
Swan Lake	**	0	0	**	0	**	0	0	0	0	0	0	**	0	**	0	0	0.00	0.00
Two Ocean	**	?	-	-	-	?	-	-	-	-	-	-	2	3	2	0	7	0.71	2.33
Emma Matilda	-	-	-	-	-	-	-	-	-	-	-	-	-	0	**	-	0	0.00	0.00
Steamboat															3	0	3	0.67	1.00
OVERALL	5	5	4	0	0	5	8	3	0	9	3	3	10	9	6	0	70		

* Cyngets surviving greater than 93 days

0 Occupied but nesting attempt failed

? Occupancy unknown

** Occupied but no nest attempt

- Not occupied

Table 8. Trumpeter swan (*Cygnus buccinator*) productivity, GRTE/JODR, 1988-2003.

time. This site and other historical swan sites will be monitored in future years.

Sage Grouse

Sage grouse numbers have declined significantly throughout the West, with recorded declines of up to 51% of historical levels. Recently, several conservation groups petitioned the USFWS to list the sage grouse under the Endangered Species Act. The principal reasons for declines in both distribution and abundance of sage grouse include permanent loss, degradation and fragmentation of key habitats, and low nesting success.

Early park surveys date back to the late 1940s and since 1986 biologists have monitored the sage grouse population within GRTE on an annual basis. Historically, eight leks (strutting grounds) were active in the park. In recent years, only two have been occupied—the airport and Moulton leks. In spring 2000, a large-scale airport construction project expanded the runway at the location of the airport lek. Grouse continued to use the area after the project was completed; however, it is uncertain how the runway expansion may influence use of the lek in the future.

Leks are surveyed several times annually to document attendance by male and female sage grouse. In addition, helicopter flights to locate new leks were conducted in 2002 and 2003. Two historical leks were active in 2003—Moulton and the airport. During helicopter flights a new lek near Timbered Island was also discovered. Overall, total number of sage grouse in the park was slightly higher than in past years (Figure 5), but still is much lower than historical counts.

It is possible that active leks exist in the park but have not been found, and that the decline in number of grouse reflects a movement to unknown areas rather than a decline in the overall population. Small

movements in display areas have been documented since the 1990s (e.g. east and west Moulton leks). To accurately assess the sage grouse population, biologists will conduct ground and aerial surveys in the future to locate outlying or unknown leks.

Invertebrates

Stream Invertebrates Modeling

To help assess the degree to which human activities may be degrading stream ecosystems, invertebrates were collected from streams in and around GRTE in 2002. These data were used to build a model to predict the occurrence of invertebrate taxa, based upon easily measured physical stream characteristics such as slope, conductivity, and elevation. By comparing the number of taxa predicted with the number found to actually occur, a measure of stream degradation is inferred.

Parasitic Wasps

Parasitic wasps (*Braconidae*) were sampled in GRTE by trapping to develop a preliminary species inventory and to better understand the roles that these wasps may play in the restoration of rangeland ecosystems after fire.

Samples included 19 subfamilies, 71 genera, and at least 150 species of *Braconidae*. Of these, 100 species were new distribution records, and at least nine were new species.

New Zealand Mud Snail Impacts on Native Invertebrates

During summer 2002, Bar BC Spring Creek, Jenny Lake Outlet, Kelly Warm Springs, Ditch Creek, and Cottonwood Creek were sampled for these ¼-inch long snails. Low densities of mud snails were found in Polecat Creek. Variations in snail abundance and biomass will be used to estimate the potential responses of native invertebrate populations in streams not yet invaded by these non-native snails.

Mammals

Bears

Bear management in the park is a highly collaborative endeavor in which every park employee and resident plays an important role. It is guided by three primary goals and five program elements outlined in the park's *Human-Bear Management Plan*.

The program goals are 1) to restore and maintain natural integrity, distribution, and behavior of bears; 2) to provide for the understanding and appreciation of bears to visitors; and 3) provide for safety of visitors and bears by minimizing bear/human conflicts. Program elements include public information and education, removal of artificial food sources, enforcement of regulations, management and control of problem bears, and research.

On a day to day basis, we put the majority of the program's emphasis into the first two elements, public information and education and removal of artificial food sources, because these are the real keys to a successful program. When these two fail, enforcement of regulations becomes important. Entering the management and control of problem bears realm is a last resort, and usually a symptom of failure in the three higher elements. Management options range from simply correcting the source problem (usually an unsecured food source), to trapping and moving bears (often more than once), to destroying individual bears.

We know from decades of experience all over North America that by the time a bear has developed nuisance behavior we have lost most of the battle. Rarely are we successful in rehabilitating bears that have learned to seek human food. More often than not, these bears become more aggressive toward humans in their quest for calories and are destroyed because of the danger they represent to us. This is why

it is so important for each and every one of us to do our part to ensure that all bear attractants (e.g. food, garbage, pet and livestock food, petroleum products) are secure and unavailable at all times.

Current Research

There are currently two separate but related research projects being conducted on bears in the park. One project that involves both black and grizzly bears seeks to determine how grizzly bears, black bears, and humans share the park's landscape as grizzly bears continue to expand in distribution and density, and particularly how limited and variable food sources (e.g. whitebark pine nuts) affect this relationship. This study is utilizing GPS radio collar technology and is occurring in the northern half of the park where both grizzlies and black bears are common.

Another study is investigating these same factors in the south half of the park, where predominantly black bears reside. Both studies are being conducted by the USGS Interagency Grizzly Bear Study Team in based Bozeman, Montana in collaboration with GRTE. Results of these studies will provide information necessary to formulate long-term bear conservation plans in this dynamic system.

Grizzly Bear Monitoring

The Interagency Grizzly Bear Study Team monitors grizzly bears in the Yellowstone ecosystem and provides a wealth of information about the status of the population. For example, from their work we know that grizzly bears continue to expand in numbers and distribution throughout the ecosystem, particularly in the south, increasing at a rate of about 7% annually.

A recent distribution analysis revealed that grizzlies now occupy the northern 2/3 of the park. In the Teton Range proper, they are common from Leigh Canyon

north. While they still do not seem to have colonized the heavily human-traveled southern canyons of the Teton Range, we know that they frequently move through that area. That is why we warn that grizzlies could be encountered anywhere in the park.

The most recent minimum population estimate of grizzlies in the ecosystem is just over 400 bears. A very crude estimate of the number of grizzlies that might use GRTE annually ranges from a minimum of 20 to as many as 60 bears, recognizing that grizzly home ranges are large, and that most if not all bears use large areas outside the park as well.

In the most recent decade, site conflicts and self-defense incidents, occurring primarily on private and public lands, respectively, have been the principal cause of grizzly mortality. About 73% of adult grizzly mortalities are human-caused, 15% are natural, and 12% die of unknown causes. Subadult male bears are most likely to be involved in site conflicts because of the bold and curious phase they seem to go through as “teenagers”. As expected, adult females with cubs are most likely to be involved with human self-defense related bear mortalities, because of their aggressive protection of young. Adult males, on the other hand, are most likely to be associated with livestock depredation-related mortalities.

Like brown bears around the world, our grizzlies have a very low reproductive rate. Females do not reproduce until they are an average of 5.8 years old, average two cubs per litter, and breed on average only once every three years. Annually, reproduction is highly variable and is correlated with food abundance, particularly whitebark pine nuts. In fact, demographic models suggest that the abundance of whitebark pine cones directly influences cub produc-

tion. Since last year was a good whitebark pine year, we can expect to find grizzlies in these high-elevation stands again this year, foraging on any leftover whitebark pine nuts.

Beaver Habitat Modeling

To evaluate the potential for using an existing habitat suitability model for beavers in the park, investigators from the University of Wyoming located seven beaver dens and lodges along the Snake River between Flagg Ranch and Moose. Using aerial photographs, they found another 16 locations of beaver activity in the same area. The model focused on vegetation characteristics, stream width, and stream gradient, and was found to be unsuitable for use in Grand Teton National Park without modifications that would better represent variations in park vegetation and hydrologic conditions, including variations that result from human regulation of Snake River water levels.

Bighorn Sheep

The Teton Range bighorn sheep population is approximately 100-125, and occurs as two distinct population segments—one at the north end and one at the south end of the Teton Range. Historically, these sheep wintered at lower elevations in the Jackson Hole and Teton Basin valley floors, but currently winter along the Teton Crest. These segments are small and are mostly isolated from other bighorn sheep in other populations

Park personnel conducted bighorn sheep classification surveys in the northern portion of the Teton Range during September 22-26, 2003. These annual surveys are intended to provide an index to the health of the bighorn sheep population in the park and a rough age distribution of animals in the population segments. Because of the large area covered and the abundant hiding cover available for sheep, the surveys

Table 9. Age and sex classification of bighorn sheep observed during 2003 surveys.

Class	Number
Ewe	11
Ram	0
Yearling male	1
Yearling female	4
Lamb	3
Unclassified	2
Total	21

are more opportunistic than scientifically rigorous, but, nevertheless, they provide important trend information over the long term.

Eight groups of sheep totaling 31 sightings were recorded over the five-day survey period (Table 2). These sightings likely represent 21 unique individuals (after accounting for repeat observations).

Park biologists plan to conduct concurrent sheep classification surveys throughout the entire Teton Range in summer 2004, to better assess the status of the northern and southern population segments and to evaluate the overall condition of the Teton herd.

Bison Monitoring

The park's bison herd, known as the Jackson bison herd, originated from a total of 32 animals reintroduced to Jackson Hole in the 1940s and 1960s. This population numbered less than 50 when, in 1980, it discovered supplemental food provided for elk on the NER during winter. The herd now migrates annually between its summer range in the park and winter range on the refuge, and has grown considerably in size. An official count in February 2004 pegged the herd at 729. With the spring arrival of this year's calves, the population will crest the 800 mark.

A long-term research project aimed at monitoring the demography of the herd, its movements, and several ecological factors associated with brucellosis, is on-

going. About 30 adult female bison in the herd are radio-collared so that field crews can document brucellosis infection rates, brucellosis-induced abortion rates, disease transmission risk, and several other reproductive parameters associated with epidemiology of the disease.

The information gained in this study has been critical in the development of alternatives considered in a draft long-term management plan, and has shed important new light on how brucellosis, a cattle-originated disease, is manifested in wild bison.

Bison and Elk Management Plan/Environmental Impact Statement

The preparation of an internal-review draft of the NER and GRTE bison and elk management planning document is nearing completion. The co-lead agencies (USFWS and NPS), USFS, Animal and Plant Health Inspection Service, BLM, and WYGF comprise an interagency working group formed to address this topic. This group is conducting an analysis of the problems associated with bison and elk management, formulating management objectives, and drafting alternatives to address the full range of issues identified by stakeholders, including the lead and cooperating agencies, tribes, and public. Completion of the draft document, agency reviews, and release of the draft plan and EIS to the public is planned in 2004, with public meetings and public comments to follow.

Cougar Ecology

The Teton Cougar Project that began in 1999 was originally designed by the Horner Wildlife Institute. In 2003, the project was reorganized under the auspices of Beringia South, a nonprofit research and educational organization based in Kelly, Wyoming. Cooperators are GRTE, WYGF, USFWS, USFS, NER, and Utah State University.

In an effort to quantify cougar ecology and ecological relationships among cougars and wolves in the southern Greater Yellowstone Ecosystem, researchers conducted weekly aerial monitoring of radio-collared cougars and ground monitoring of their activities every two to three days. Collared cougars included several from the BTNF and seven kittens captured in August 2002.

In November, three kitten carcasses and two kitten collars were found near an elk carcass on which they had been feeding with their mother. Fresh snow, tracks of an adult male cougar and a grizzly bear, and scavenging of two kitten carcasses by the bear, made it impossible to determine the cause of the kittens' deaths.

Twenty-five cougar kills were identified as 17 elk, three mule deer, two coyotes, a blue grouse, a bighorn ram, and a porcupine. Five of the 17 elk were males (one yearling), five were females (one calf), and seven were of unknown sex (three calves, three newborns).

In 2003, 20 cougars were captured and fitted with radio collars. Four cougar deaths were documented—two legally harvested, one killed by another cougar, and one kitten died of unknown causes. Average home range size of two adult males was about three times larger than the average home range of seven adult females. Two young sibling cougars raised in the park dispersed during 2003—one moved south and was killed in a legal hunt, the other established a home range near her mother, within the park. Thirteen cougar predations were examined in 2003, 85% were elk. In 2004, field activities will focus on monitoring movements and predation by radio-collared cougars.

Coyote Densities and Pronghorn Fawn Survival Rates

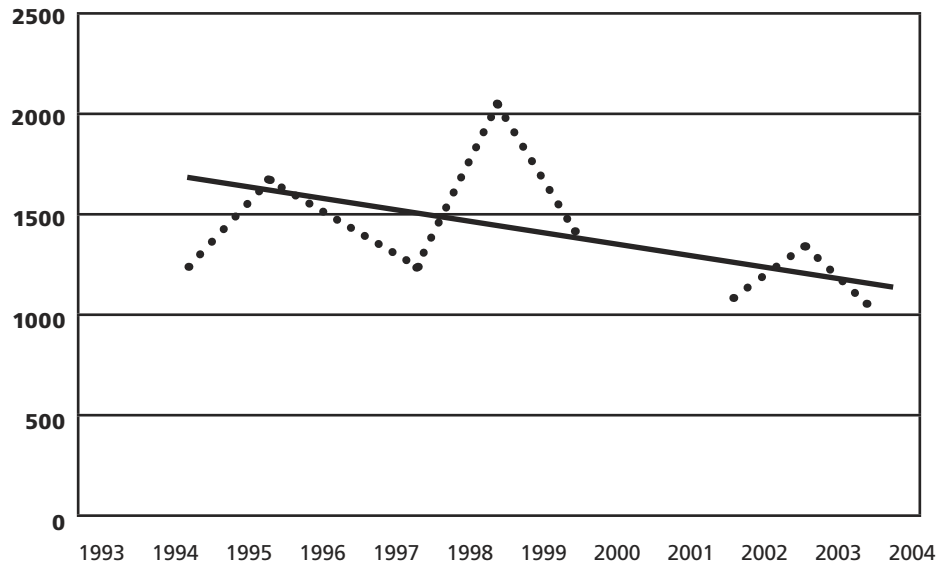
This research is investigating relationships between recolonizing wolves, coyotes, and pronghorn fawn mortality rates in the southern GYE. Coyote densities, spatial dynamics, and mortality factors will be contrasted in locations having high, moderate, and low levels of wolf activity. Pronghorn fawn mortality rates and causes will be compared across these locations to determine how differences in coyote densities may be affecting fawn survival rates. The results of this study will be evaluated using sensitivity analysis to address implications for conservation of pronghorns in GRTE.

Elk Management

Elk management in GRTE is complex and involves a variety of data collection programs, substantial interagency coordination, and an annual reduction that was provided for in the park's 1950 enabling legislation. Data collection includes tracking the status and annual migrations of the Jackson elk herd, of which the park's elk comprise perhaps one-quarter to one-third of total numbers. Estimates of herd status are obtained by conducting age and sex classifications by helicopter during summer in the park's central valley, roughly the area of the valley floor between Moose and Colter Bay, and by counting and classifying elk on their winter ranges in the park, national forests, and on four feedgrounds in the Gros Ventre River drainage and the NER complex. Additionally, censuses of the park's summering herd segment are completed every three to five years.

The last census was completed in 2000. The census is a major effort, involving seven to ten days of comprehensive helicopter surveys, and using a complex set of data analysis protocols that were developed es-

Figure 1. Annual Central Valley Elk Classification Counts.



pecially for GRTE. Migration timing and several demographic parameters are monitored by maintaining a sample of radio-collars in the herd. These elk are located on a regular basis through a combination of ground and aerial reconnaissance.

Information from these studies is relied upon to determine critical population and harvest goals, and to develop hunting seasons, both inside the park and out, that will help to achieve those goals.

GRTE and NER biologists conducted the annual summer survey of the central valley elk population in GRTE on August 4-5, 2003. The count of 1,101 elk was fewer than the 1,289 elk counted in August 2002. The long-term trend in counts of elk summering in the central valley shows a decrease of approximately 19% since 1994.

Jackson Interagency Habitat Initiative

GRTE participates in the Jackson Interagency Habitat Initiative, which is comprised of local interagency biologists. The team formed because of concerns related to loss and degradation of winter and transitional habitats for ungulates resulting from human settlement, competing land uses, and altered fire regimes. This group

has been working to identify opportunities for vegetation restoration that not only would manage vegetation communities for long-term sustainability and resiliency, but could benefit elk winter and transitional ranges. Currently, the team is evaluating possible opportunities within the Lower Buffalo Fork/Spread Creek area.

Elk Reduction Program

The park's elk reduction program, administered jointly by the SRM and Ranger Activities Divisions, ran from October 25 to December 7 during 2003, with 1,991 permits issued. The state-licensed and park-deputized hunters harvested 456 elk last year (Table 1). This is lower than the recent ten-year average harvest of 712 elk, primarily because of a late migration of elk that summer in YELL and in parts of the Teton Wilderness. This unique and somewhat controversial program is necessary to manage elk from the Jackson herd that summer in and migrate through the park.

Park hunt permits are issued for "any elk" and "antlerless elk". Most "any elk" permit holders harvest bulls; this has little impact on the long-term population trend. Conversely, the number of cow elk in the herd

Table 10. Elk Harvested in GRTE's 2003 Elk Reduction Program.

Class	Area75/76	Area79	Total
Bulls	52	65	117
Cows	192	60	252
Spikes	10	12	22
Male calves	19	8	27
Female calves	32	6	38
Total	305	151	456

and their reproductive rate has a significant impact on population growth. Therefore, over the last decade, the structure of the park permit quotas and harvests have been trending toward more “antlerless elk” permits and higher cow harvests. By skewing the harvests in favor of females, we can more effectively regulate the population and maintain appropriate sex ratios with less-intensive hunts, which is a primary goal of this elk management program.

Jackson Elk Herd Monitoring

Biologists have monitored a sample of 60-70 elk from the four herd segments of the Jackson Elk Herd (GRTE, YELL, Teton Wilderness, and Gros Ventre/Spread Creek) since 1990, to determine seasonal distribution, migrations, survival, and causes of mortality.

This was the second year of a three-year project focusing on the herd segment that winters in the Gros Ventre River drainage. Five elk, estimated to be three to ten years old, were captured there in March and fitted with Telonics radio collars. Blood samples showed two of the five (40%) were seropositive for brucellosis. At the end of winter 2003, a total of 20 radios were functioning on 15 animals captured in 2002 and the five captured in 2003. During the summer and fall, these elk moved in all directions from the Gros Ventre feedgrounds to occupy five summer range areas.

This year, aerial and ground telemetry counts on the NER showed that elk arrived about a week earlier than the

long-term average. Two of the 20 (10%) radio-collared elk were harvested during 2003. Over 2002 and 2003, harvest rate of the radioed elk captured on the Gros Ventre feedgrounds was four of 39 (10%). An 8-year-old female radio-collared elk died of unknown natural causes (not predation) in GRTE in May 2003. Harvest rates during fall 2003 were 11% (three of 28) for GRTE, 17% (one of six) for Yellowstone, and none of the three for Teton Wilderness.

In 2004, investigators plan to continue monitoring the remaining 18 radio-collared elk for distributions, fidelity, and survival, as well as to learn more about elk-wolf interactions in the Gros Ventre.

Management Alternatives for Ungulates in the Greater Teton Ecosystem

In 2003, researchers completed a final report on simulation modeling to predict forage utilization by ungulates during a range of climatic conditions in the Greater Teton Ecosystem and the NER (Hobbs, N.T., G. Wockner, and F.J. Singer, 2003. *Assessing management alternatives for ungulates in the Greater Teton Ecosystem using simulation modeling*. Natural Resources Ecology Lab, Colorado State University, Fort Collins, Colorado. 63 pp.) The report provides insight into the potential impacts of different levels of winter forage utilization on ecosystem processes, including net primary production and nutrient cycling. It addresses the potential consequences of forage deficits on elk mortality and aggregates the results of insights to draw general conclusions relevant to management

of local ungulates and the assumptions of alternatives developed in the *Jackson Bison and Elk Management Plan/Environmental Impact Statement*.

Pronghorn

In 2004, park biologists plan to conduct aerial surveys to count pronghorn antelope that summer in the park and adjacent national forest lands in the Gros Ventre River drainage. The pronghorn antelope that summer in GRTE and the surrounding Jackson Hole valley migrate between their summer and winter ranges along a traditional route that follows the Gros Ventre River drainage and then crosses the hydrographic divide into the Upper Green River drainage. There is concern that numbers of pronghorn antelope in this population segment have declined; however, population data have not been collected in a rigorous manner since aerial counts were discontinued in the mid-1990s.

The goal of this project is to reestablish the annual counts using the distance sampling technique, which will provide reliable estimates of the numbers of pronghorn summering in GRTE and the surrounding Jackson Hole valley. These data would be used to assess population trends over time, with the ultimate goal of maintaining this population segment.

Protecting a Critical Pronghorn Migration Corridor

Long distance migration is one of earth's most stunning, yet imperiled, ecological processes. In GRTE, at the center of the 18-million-acre Greater Yellowstone Ecosystem, a small summering population of pronghorn antelope migrates south, up to 342 miles roundtrip, to winter range outside the park in the upper Green River Basin. This the most extreme long distance migration of any mammal in the New World other than caribou.

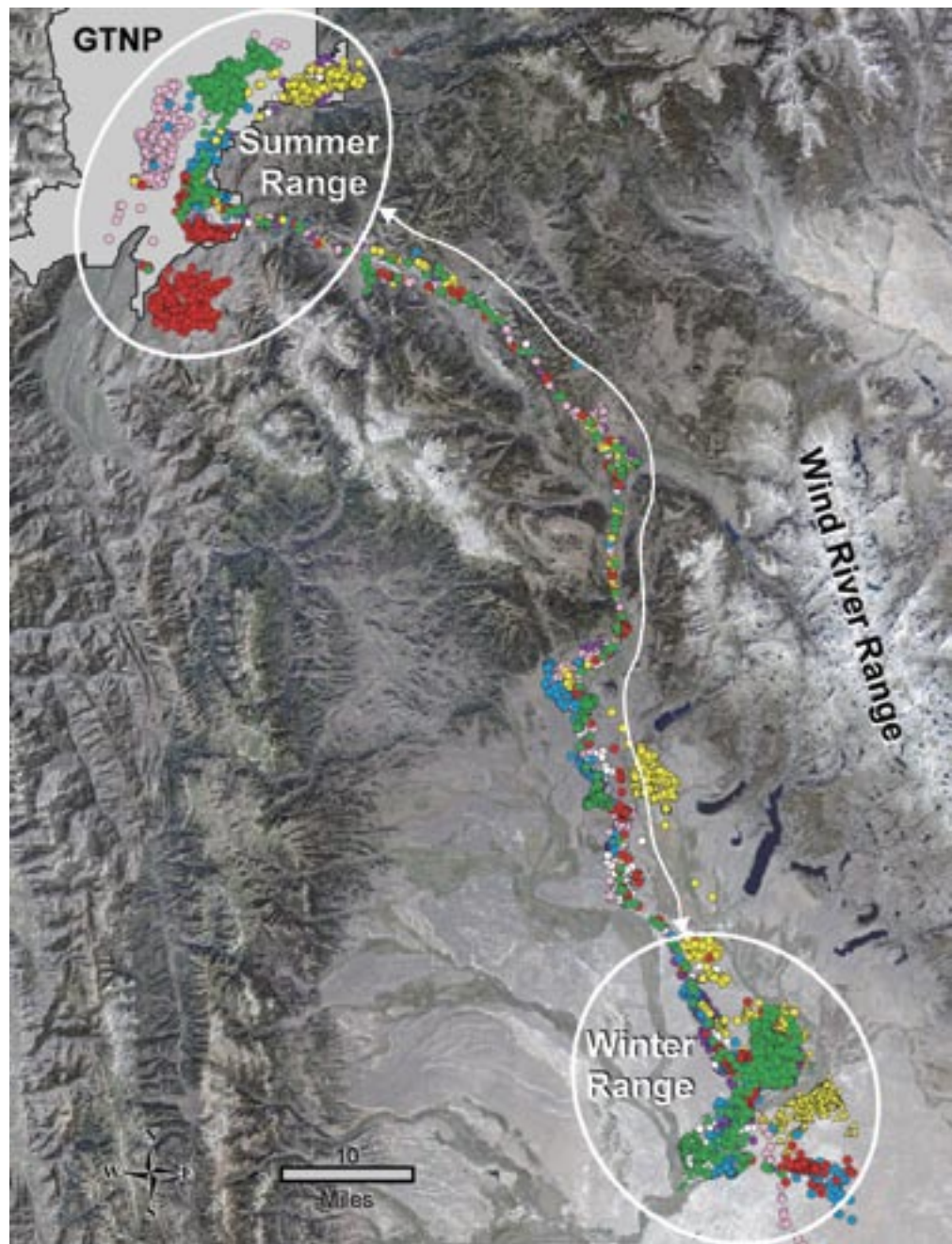
While four other species in the GYE (mule deer, elk, moose, and bison) also represent extreme long distance migrators in the New World, this pronghorn migration is known from archaeological evidence to have persisted for at least 6,000 years. As in the past, pronghorn still navigate historic, narrow (0.2- to 1.4-mile) corridors twice during annual migration cycles. However, the migration and hence the viability of pronghorn are jeopardized by large-scale energy development, increasing private land development, and other migration barriers in the Upper Green River Basin, an area of primarily federal lands some 50-75 miles south of the park.

Migration impediments at lower elevations include highways, housing developments, and more than 80 fences. In addition, four bottlenecks along the migration route exist, including a 1.4-mile

Table 11. During the summer and fall, collared elk moved in all directions from the Gros Ventre feed grounds to occupy five summer range areas.

Summer Range	Geographic Description	Number of Elk	
		2002	2003
North Gros Ventre	Hunt Area 81: areas north of the Gros Ventre River, including the Spread Creek drainage	4	5
South Gros Ventre	Hunt Area 82: areas south of the Gros Ventre River	2	4
East Gros Ventre	Hunt Area 83	6	5
Wind River drainage	Hunt Area 68	3	4
Green River drainage	Hunt areas 93 and 95	4	2
TOTAL		19	20

Figure 2. The fall migration route of a collared pronghorn that died after falling through ice on the New Fork River, south of Pinedale, last winter. It completed the trek from GRTE to its wintering area there, a distance of more than 100 miles, in three days.



constriction between a subdivision and the Green River, a sagebrush gap narrowing to a strip only 90 to 360 yards wide, a high-altitude hydrographic divide, and a 90- to 180-yard constriction between sandstone cliffs, road, and the Gros Ventre River. Furthermore, given that an addi-

tional 5,000 or more gas wells are forecast in the Upper Green River during the next decade, the potential to sever the pronghorn migration route into GRTE is high. If the migration corridor is lost, pronghorn in the park will become extinct.

To learn more about how pronghorn navigate this route, park biologists teamed with scientists from the Wildlife Conservation Society (formerly New York Zoological Society) to deploy global positioning system radio collars on ten adult antelope during October 2003. These collars will record detailed movement information for about one year, capturing both spring and fall migrations, and then automatically drop off so researchers can retrieve and download data from them. This information will be used by the park, other agencies, and other organizations to develop long-term conservation plans and protective measures in an effort to safeguard this unique ungulate population.

Small and Medium-Sized Mammal Monitoring

To continue long-term monitoring of mammal community changes over time in relation to biotic and abiotic changes, especially the recolonization of the park by wolves, trapping of rodents continued in the park. This work is being conducted by several researchers and supported by non-NPS funds. Since 1999, abundances of some rodents have been less affected by rainfall in drier habitats (i.e., sage) than in wetter habitats.

Wolves

The USFWS first reintroduced wolves into Yellowstone in January 1995. The Soda Butte Pack, a group of wolves originating from the reintroduction program, began using northern parts of GRTE during winter 1997-1998. In fall 1998 and winter 1998-1999, additional wolves were found within the park, the NER, and adjacent Forest Service lands.

In spring 1999, two wolves comprising the Teton Pack denned within Grand Teton boundaries and produced five young, constituting the first wolf denning within the park in more than 70 years. The Teton

Pack did not den in 2000, but in 2001 and 2002, the pack had double litters producing nine and 11 pups, respectively.

Since winter 1998-1999, park personnel, in cooperation with USFWS biologists, have monitored wolves to determine denning activity, pack composition, areas of use, and prey composition.

Methods

Radio-collared wolves were located weekly throughout the year via aerial surveys. All locations were geo-referenced for GIS analysis and shared with USFWS. In addition, SRM personnel conducted ground observations of the Teton Pack near their den site from May until early September, when pups were old enough to hunt with the adults and the pack left the park.

Results & Discussion

During winter 2002-2003, the Teton Pack ranged primarily in the Gros Ventre mountains in BTNE, adjacent to the park. In late April, the pack localized in the eastern area of the park and appeared to be denning. Denning was confirmed in early May and six pups were observed in May.

At the end of April, USFWS recovered the body of wolf 200F, the alpha female of the Teton Pack, inside the park after her radio collar emitted a mortality signal. She appeared to have given birth to a litter of pups. Necropsy revealed that her death was most likely related to an infection of her mammary glands.

Livestock were not present at the Elk Ranch allotment and no observations were reported of wolves depredating cattle in the vicinity. However, four two-year-olds from the pack killed three calves near Union Pass. Two of these wolves were eventually removed by USFWS. A collared male wolf from the pack also was reported to have joined the Green River Pack near Pinedale, Wyoming. In September, this

wolf was removed by USFWS for depre-
dating livestock.

Funding sources for monitoring wolf ac-
tivities in 2004 are uncertain, but SRM
plans to submit proposals for future proj-
ect support in winter 2004. GRTE biolo-
gists will continue to monitor the pack in
spring 2004 if denning occurs within park
boundaries.



Cultural Resources

Grand Teton National Park has a long history of human occupancy. The park's archeological resources include over 350 prehistoric human-use sites that range from 300 to 10,000 years in age. These sites are the archaeological result of consistent, seasonal re-occupation of this area by aboriginal populations. Both the lowland and mountain regions were used for seasonal camps, tool procurement, and ceremonial purposes. Within Grand Teton National Park there are more than 300 historic structures listed in or eligible for listing in the National Register of Historic Places.

In 2003, the park initiated several planning efforts aimed at jointly improving the preservation of historic properties while meeting operational objectives. For example, the park proposed to rehabilitate and adaptively use abandoned historic structures for seasonal park housing and as the Western Center for Preservation Training and Technology. In these cultural resources preservation efforts, the park appreciates and benefits by partnering with several other organizations, groups, and individuals.

The goals of the cultural resource management program are to: (a) continue inventories, assessments, evaluations, documentation, and monitoring of cultural resource sites, in compliance with the National Historic Preservation Act (NHPA), and (b) continue research, field surveys and consultations with state and tribal governments on cultural resources aspects, when a federal project is proposed, in compliance with the National Environment Protection Act (NEPA).

Archaeological Resources

In 2001 the park hired its first full-time archaeologist, Jacquelin St. Clair, who documents and analyzes sites, oversees or conducts inventories in previously unsurveyed areas, and works with park rangers to protect artifacts from being looted. She also is liaison between the park and associated American Indian tribes, including the Eastern Shoshone, Shoshone-Bannock, Northern Cheyenne, Arapaho, and Crow Indians. Recent archaeological projects include inventories of over 200 acres resulting in the identification of seven previously undiscovered prehistoric sites and ten historic sites.

Alteration of Archaeological Resources by Wildfires

Experiments were conducted in GRTE in conjunction with prescribed burns in grasses and small willows near Jackson Lake Lodge, and in sagebrush near Kelly, in 2002. Experimental artifacts were placed on soil surfaces within burn plots, and soil-surface temperatures were recorded at one-second intervals during burns to produce time and temperature curves. Results showed that fires in grass and willow habitats do not generate enough heat to significantly alter most archaeological materials (except wood and other organics). However, fires in medium-large sagebrush/fine grasses habitats may produce thermal fractures in chert materials, glass, and bone located at the soil surface.

Survey of Archaeological Resources

Through contract and staff work, archaeologists surveyed, documented, and monitored several prehistorically used sites in 2003. The park archaeologist completed reports and compliance, as required under Section 106 of the National Historic Preservation Act, for a number of park projects ranging from prescribed burn plans and backcountry trail reconstruction efforts to proposed construction of the new Grand Teton Discovery and Visitor Center. She also coordinated with a University of Wyoming researcher investigating prehistoric quarry sites high in the Teton Range. Artifacts collected from sites were accessioned into the park's museum collection and used to help orient park interpreters and others to the park's archaeological history.

Ethnographic Resources

In 2002, Grand Teton National Park partnered with Yellowstone National Park and the National Elk Refuge to successfully compete for servicewide CRPP funds to facilitate an ethnographic overview and traditional use study which will help managers better understand how American Indians used the landscape and resources of Jackson Hole. Fire program funds have contributed to increased surveys which located new archeological sites, and universities have provided funding to research new topics, such as identifying the in-park sources of steatite (also known as soapstone) which was widely used to make pipes, bowls, and pots.

Plans for 2004

Archaeology and ethnography program plans for 2004 include continuing tribal consultations on park projects, coordinating with the Fire Management team on fuels reduction programs, preparing cultural inventory reports on 4 Lazy F and Hunter Barn projects, and inventorying the Lupine Meadows and Spring Gulch housing sites. Research will be conducted

to prepare inventory reports and condition assessments for historic and prehistoric archaeological sites. Cooperative cultural resource activities will continue with the National Elk Refuge (traditional use study), with Yellowstone and Bridger-Teton National Forest (wickiup study), and with the University of Wyoming (ethnobotanical research).

Steatite artifacts.



History

At the age of 101, Margaret (Mardy) Murie died at her home in Grand Teton National Park on October 19, 2003. Mardy, the wife of world-renowned biologist Olaus J. Murie, was famous in her own right for her long, strong advocacy for wilderness and other natural resources. Olaus and Mardy, along with Adolph (Olaus' brother) and Louise (Mardy's sister) Murie, purchased the old STS Dude Ranch in 1945, and the property quickly became known as the Murie Ranch. The Murie Ranch transferred to the park upon Mardy's death, and now it serves as the Murie Center, an organization that carries forward the values inherent in the Muries' teachings: respect for nature, the importance of wilderness, and responsible action. Jackson Hole residents, including Acting Superintendent Ralph Tingey and park staff, held a celebration of her life in November 2003.

Mardy Murie, photo by Chuck Manners, 1990.



Historic Structures and Cultural Landscapes

In May 2003, Pam Holtman was converted from student career employment program (SCEP) status to permanent park historian. She oversaw work assessing and monitoring historic structures for compliance with NPS standards and historic preservation laws. She also planned and sought funding for rehabilitation of several dozen structures, and interpreted park history for many audiences inside and outside the park.

Historic Structures Preservation

Treatment and Maintenance Plan

In 2003, Grand Teton National Park drafted the *Historic Structures Treatment and Maintenance Plan* which includes:

- 1) proposed use(s) for structures listed in or eligible for listing in the National Register of Historic Places,
- 2) the appropriate treatment needed to bring structures into fair or good condition using the Secretary of the Interior's *Standards for the Treatment of Historic Properties*,
- 3) a cyclic maintenance plan, and
- 4) estimated costs—initially thought to require \$5.4 million to bring the structures up to fair or good condition with a minimum of \$395,000 annually for cyclic maintenance.

2003 Historic Preservation Projects

Five cabins (HS-1369, HS-1370, HS-1372, HS-1373, HS-1374) at the Bar BC Dude Ranch were stabilized by a contractor using historic structure stabilization money. The Michigan Volunteers re-roofed the dance cabin (HS-1375) using red rolled roofing. Materials for the volunteers were paid for with fee demo money.

Several buildings in the Old Administrative Area Historic District (Beaver Creek) received new roofs. A contractor installed a brown metal roof on the trails office (carpenter shop HS-18) and green Eco-Shakes on the residences (HS-1, HS-2, HS-6, HS-7,

and HS-8) and resource management office building (old administration building HS-10). Both fee demo and housing money was used to fund the project. Also in 2003, the park and Wyoming State Historic Preservation Office determined that the CCC “barracks” next to the trails office did not have enough integrity to be included in the Old Administrative Area Historic District. The historic district boundary was changed back to what is shown in the 1990 National Register nomination for the area.

A contractor completed the interior rehabilitation of several seasonal employee cabins at the Highlands and Lupine Meadows.

The park started to write an environmental assessment that proposed moving the Hunter Hereford Ranch barn to the Teton Science School and adaptively using it for office, storage, and housing space.

The Michigan Volunteers reconstructed the chimney on Geraldine Lucas’ cabin (HS-747). Log expert, Harrison Goodall, replaced in kind half logs on the south elevation of the Russell cabin (HS-746). Fee demo money paid for the materials and Harrison Goodall’s time. Lastly, the park began to prepare an environmental assessment to rehabilitate and adaptively use the Lucas/Fabian property for an artist in residence (AIR) program. The Grand Teton Natural History Association would be the lead partner on this project and would ultimately run the AIR program.

The park started to write an environmental assessment that proposed rehabilitating and adaptively using the three

residential buildings at the McCollister Residential Complex for seasonal park housing. The EA also proposed moving five JY Ranch buildings to the property and also using them for seasonal park housing.

The Michigan Volunteers re-roofed (green rolled roofing) three outbuilding on the Reed Moulton property on Mormon Row. They were the outhouse (HS-1284A), shed (HS-1285), and garage/pumphouse (HS-1287). The volunteers stabilized and re-roofed (green rolled roofing) two out-houses (HS-1276A&B) on the John Moulton property, as well as reconstructed the back porch and stairs on his residence (HS-1276). Fee demo money paid for the materials.

Preservation work continued at the Murie Ranch using the Save America's Treasures grant that the park received in 2001 and donated funds. A contractor completed the rehabilitation of the garage, and now the Murie Center uses it as an office.

A contractor rehabilitated the Reimer/Hultman (aka Holy Ost) residence on Antelope Flats Road. The single family home is used for seasonal park housing. Fee demo money funded the project.

Other Accomplishments

On July 31, 2003, Secretary of the Interior Gale Norton designated Jackson Lake Lodge a National Historic Landmark. The historic district has thirty-nine contributing resources.

The park hired six architecture students from the University of Utah for the summer. The students conducted condition assessments on a majority of the historic buildings in the park, as well as some non-historic structures. This information was then entered into the FMSS database.

In October 2003, the Michigan Volunteers received the prestigious Honor Award

from the National Trust for Historic Preservation for all their hard work stabilizing historic structures in the park.

White Grass Ranch

The park started planning efforts to rehabilitate and adaptively use the thirteen buildings at White Grass for a Western Center for Preservation Training and Technology. The park submitted a line-item construction funding proposal for \$1.4 million to rehabilitate the buildings and construct new utilities on the property. On October 4, 2003, Secretary Gale Norton signed a general agreement with National Trust President Richard Moe that declared the NPS and National Trust project partners. The National Trust agreed to raise up to \$1 million for the rehabilitation of the buildings.

Museum Collections

By the end of fiscal year 2003, GRTE had 395,795 objects, from Indian artifacts to rock, fossil, and plant specimens, formally accessioned into its museum collection. Countless other objects undoubtedly deserve to be added to the collection—from uninventoried archival material distributed in park files to the oral histories and memorabilia of former park employees and others who have contributed significantly to the development and history of the park. In 2003, Christine Jacobs Landrum was converted from a SCEP position to being the park's first professional museum curator.

The David T. Vernon Collection

This renowned collection of American Indian artifacts, given to Grand Teton by Laurance Rockefeller in 1976, represents objects from more than 200 tribes, and is on display at the Colter Bay Visitor Center and Indian Arts Museum. Visitor demand has outpaced the facility's capacity to provide high-quality services. Exhibits are poorly lit and labeled, not universally accessible, and fail to do justice to the objects' significance—or to maximize the opportunity to educate researchers and millions of other park visitors about American Indian heritage. A recent donation from the Rockefeller family will allow park staff a synergistic opportunity to improve its overall museum management program and its most significant collection.

In December 2003, the park conducted its first value analysis and design charrette to begin developing alternatives for rehabilitation of the Colter Bay Visitor Center and Indian Arts Museum. Park partners and experts from other agencies participated and will continue to assist with ongoing efforts to improve existing museum storage. The 2003 *Intermountain Regional Museum Facilities Strategy* supported GRTE as one location to consolidate collections storage to meet the needs of the region's 86 parks.

Museum Collections

Park museum and archival collections total 395,795 objects, classified as follows:

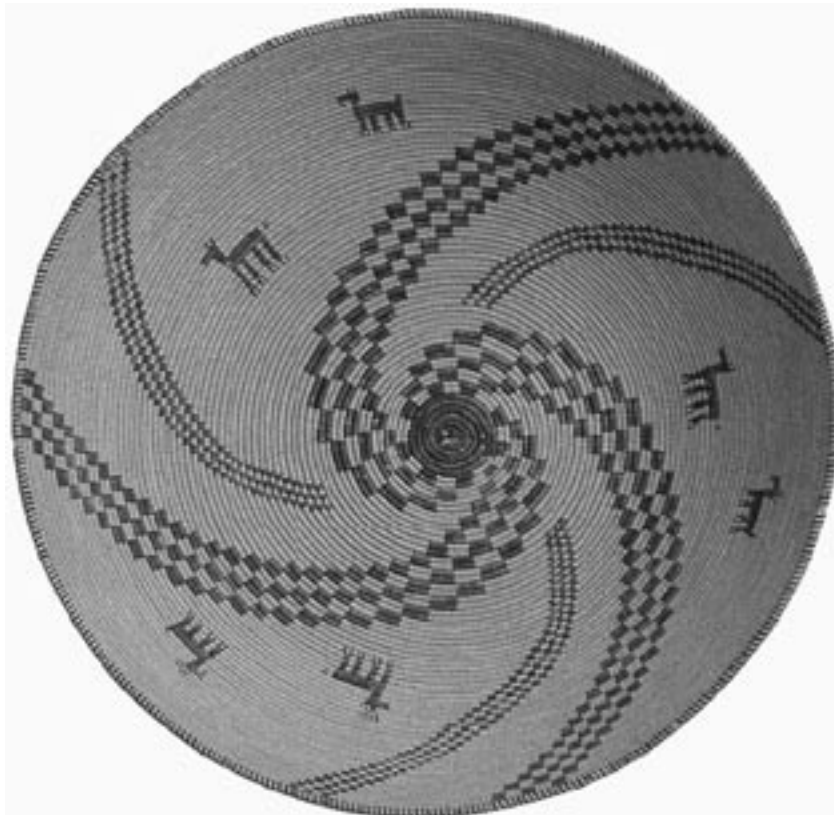
Archaeology	272,488
Archives	110,666
Biology	8,703
Ethnology	1,435
Geology	400
History	1,903
Paleontology	200
Total	395,795

These items are housed in five facilities: park headquarters, Moose Visitor Center, Beaver Creek Museum Collections Storage Area, Colter Bay Visitor Center, and Menor's Ferry Historic District. During 2003, regional curator Matt Wilson helped GRTE curator Christine Jacobs Landrum assess these facilities and address concerns related to the storage, preservation/conservation, and uses of these collections. In addition, the oil paintings and historic photographs in various staff offices in the Moose Visitor Center and headquarters facility were inventoried, cleaned, fitted with polyethylene plastic sheeting backerboards, assessed for additional preservation/conservation needs, and photographed. Three watercolor paintings by William H. Jackson that were stored at Beaver Creek were found to be in need of immediate attention by professional conservators, and were taken to

Denver for conservation treatment. Other activities completed in 2003 included:

- Updating all loan documentation folders.
- Improving key-control practices at Beaver Creek and Colter Bay.
- Reporting environmental conditions of collections at Colter Bay.
- Implementation of basic IPM programs for the Colter Bay and Beaver Creek collections.
- Assisting with Grand Teton Discovery & Visitor Center planning projects.
- Planning and participating in a value analysis study for the Colter Bay Visitor Center and Indian Arts Museum.

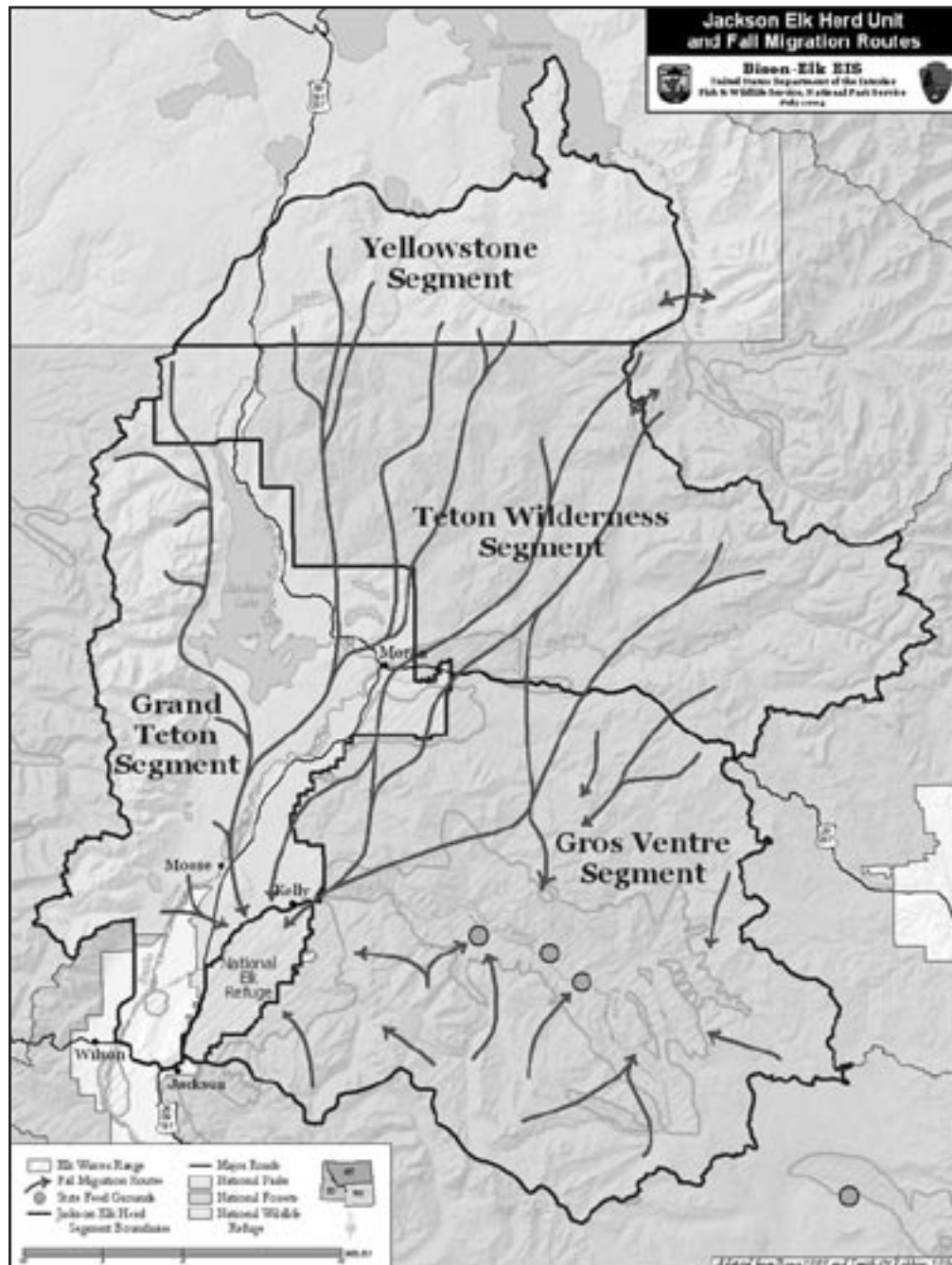
Basket from Vernon Collection.



Geographic Information Systems

The goal of the GIS program in Grand Teton National Park is to collect, edit, analyze, and display geo-spatial data to highlight spatial relationships that are used by park specialists to make informed management decisions.

Figure 3. Jackson Elk Herd Unit and Fall Migration Routes.



GIS Overview

Geographic Information Systems (GIS) is software that links geographic information with descriptive information. For example, the location of underground water or waste water utilities can be linked to attributes such as pipe diameter, pipe material, and flow direction; or the migratory patterns of mammals can be displayed with attributes describing date, time, species (such as bison, elk, and bear), age, and sex.

2003 Accomplishments

In 2003, Cartographic Technician Peter Lindstrom and a visiting GIS Specialist, Mark Adams from Cape Cod National Seashore, accomplished the following:

■ **Bison-Elk EIS** In cooperation with GRTE staff, the USFWS, and WYGF, the GIS Team produced draft cartographic products for the joint Grand Teton and National Elk Refuge *Bison and Elk Management Plan and EIS*. These maps illustrate variables such as calving and hunting areas, migration routes, species range, and live-stock allotments that were considered in the planning process.

■ **Adaptive Reuse of Lucas/Fabian Property** GIS Team assisted park staff with proposals for the reuse of the Lucas/Fabian property. Cartographic items were produced to illustrate the location of existing services such as water and electric utilities and sites for proposed development such as access roads and parking.

■ **Global Positioning System (GPS) Training** Training and support was provided to SRM staff and Jenny Lake rangers in GPS data collection. GPS is a worldwide radio-navigation system formed from a constellation of 24 satellites and their ground stations. GPS uses the satellites as reference points to calculate positions that are accurate to within meters.

■ **Lynx Analysis Units** The GIS Team worked with park staff, USFS, and WYGF to delineate Lynx Analysis Units (LAU) within GRTE. Identifying these helps managers analyze impacts to lynx habitat.

■ **Weeds Mapping** The cartographic technician supported SRM vegetation staff by mapping invasive exotic plants within GRTE and JODR.

■ **GIS Specialist Temporary Detail** The park hired a GIS specialist, Mark Adams from Cape Cod National Seashore on a temporary detail to review the park's GIS program, provide program direction, and organize the park's GIS data. His detail began in October 2002 and ended in March 2003.

■ **GIS Metadata** The park published Federal Geographic Data Committee metadata for the park's GIS data sets. Metadata collection is mandated for federal agencies by Executive Order 12906 of June 1994. Metadata describes who collected the data, dates of collection, reasons for data collection, accuracy and scale of data, units of data, and whom to contact to obtain the data.

■ **ArcView's GIS Theme Manager** Specialists installed ArcView GIS on computers of various park staff, complete with NPS GIS Theme Manager. Theme Manager adds ease of access to park GIS layers, thus increasing GIS awareness and accessibility to data sets.

■ **GIS Data Development** Created and updated GIS data layers for park buildings, road turnouts, and Blacktail Fire boundary.

2004 Plans

■ **GIS Specialist Vacancy** Fill GIS Specialist vacancy in SRM. This permanent position will provide consistency, direction, long-

GIS staff utilizing GPS data collection.



term goals, and foster cooperative relationships for the GIS program.

■ **National Hydrologic Dataset for GRYN**

Develop a network-wide, integrated and consistent GIS for managing and using water related feature and attribute data, using the latest GIS technology and data format, the geo-database. This is a cooperative venture between Yellowstone National Park, Grand Teton National Park, and Bighorn Canyon National Recreation Area, (all members of the Greater Yellowstone Inventory and Monitoring Network), which will integrate attributes of aquatic, fisheries, and water quality data sets with spatial features to provide the basis for explicit and exploratory analysis and reporting.

■ **White Grass Ranch Environmental Assessment (EA)** Collaborate with park and regional staff on the *White Grass Dude Ranch EA*. Provide coordinate pairs (latitude and longitude), and area and length

figures. Conduct related analyses (e.g., proximity to wilderness areas, existence of weeds, proximity to local and regional historic structures).

■ **McCollister Residential Complex Historic District** Provide park staff with maps, x and y coordinates, and area and length figures for the McCollister property, to be submitted to the State Historic Preservation Office.

■ **Digitize Water & Waste Facilities with GPS** Assist park staff with gathering institutional knowledge of water and waste water facilities. This will include the compilation of legacy facility information with conversion to GIS data sets, cooperation and planning with Yellowstone GIS, and technical assistance to seasonal GPS employees who will collect the utilities information.

■ **Weeds Mapping** Support NPS and Teton County Weed and Pest staff in the inventory and mapping of invasive exotic weeds

within GRTE, JODR, and Teton County. This will be the first year that the park's GIS program will support the GPS/GIS training and mapping needs of Teton County.

■ **NPS Burned Area Emergency Rehabilitation (BAER) Team** Continue to support the NPS BAER team. BAER teams are composed of multi-agency, multi-disciplined resource specialists who are assembled to assess fire damage, fire suppression effects, and prepare mitigation measures.

■ **Bison-Elk EIS** Finalize cartographic products for the *Bison and Elk Management Plan and EIS*.

■ **GRTE Planning Map** Develop a strategy for mapping all line-item (e.g., road/bridge construction) and related park projects (e.g., JY Ranch structure relocation). These cartographic products will illustrate where each project will occur and when, so park staff may foresee any potential conflicts between projects and help to alleviate any negative affects on visitor experience.

■ **GIS Plan** Initiate preparation of a *GIS Plan* for the park. This plan will provide insight into the types of information required to meet management goals. It also will outline long-term guidelines for GIS operation and will aid in refining short-term objectives for the program.

■ **GIS Data Organization** Organize GIS data sets into a new intuitive, theme-based (e.g., boundaries, natural resources, facility management) directory structure. Write Federal Geographic Data Committee (FGDC) compliant metadata for all legacy and future data sets. Author a GIS page on the GRTE intranet site to include information pertaining to available GIS layers, GIS/GPS frequently asked questions, and standard operating procedures.

■ **Global Positioning System (GPS) Training** Continue to train and support park staff in GPS data collection.

■ **GIS Software** Upgrade all GIS software in the park from Environmental Systems Research Institute ArcView to ArcGIS.

■ **GIS Data Development** Create data layers for land-tract ownership, lake bathymetry and precipitation.

Figure 4. Lucas-Fabian Project Components.

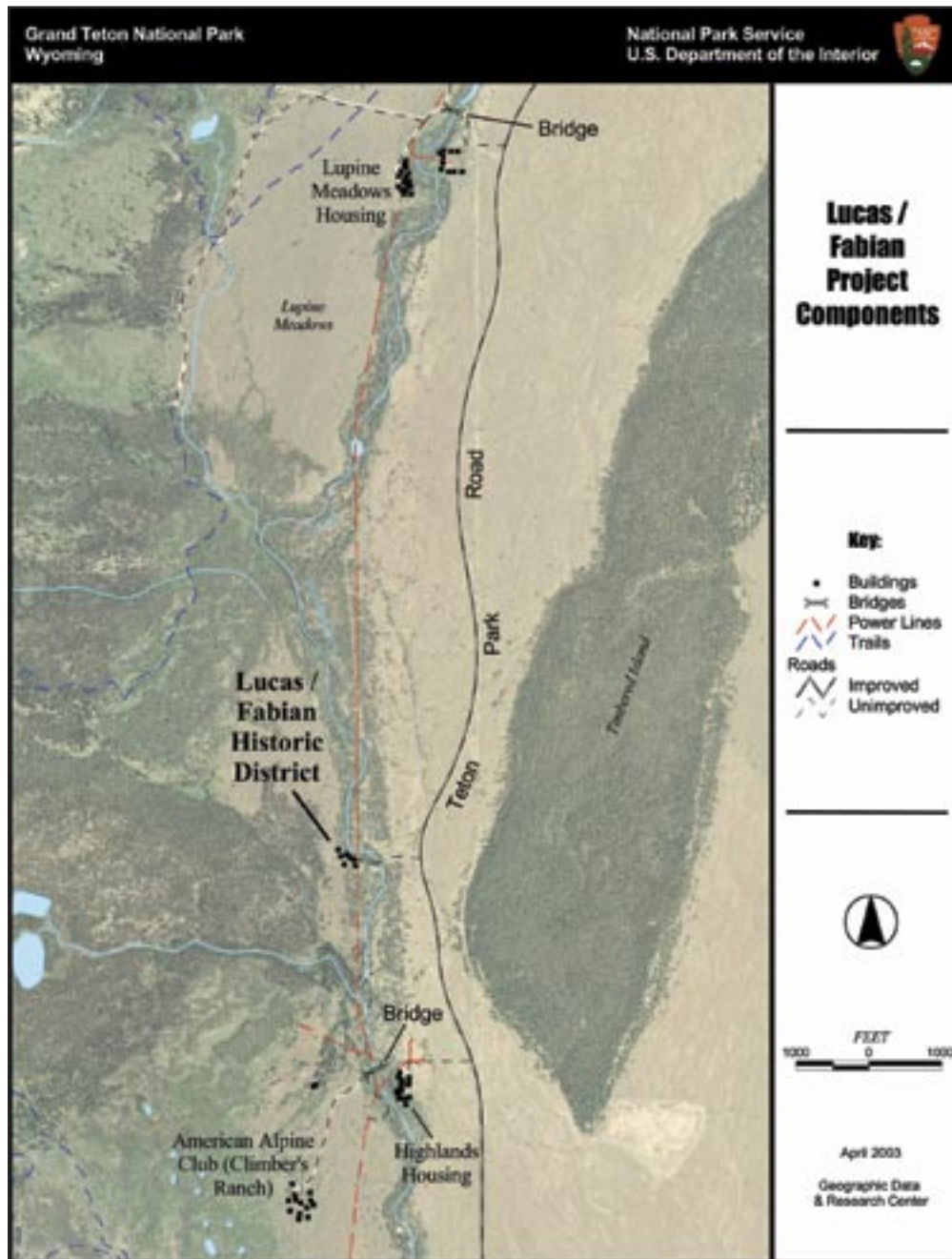
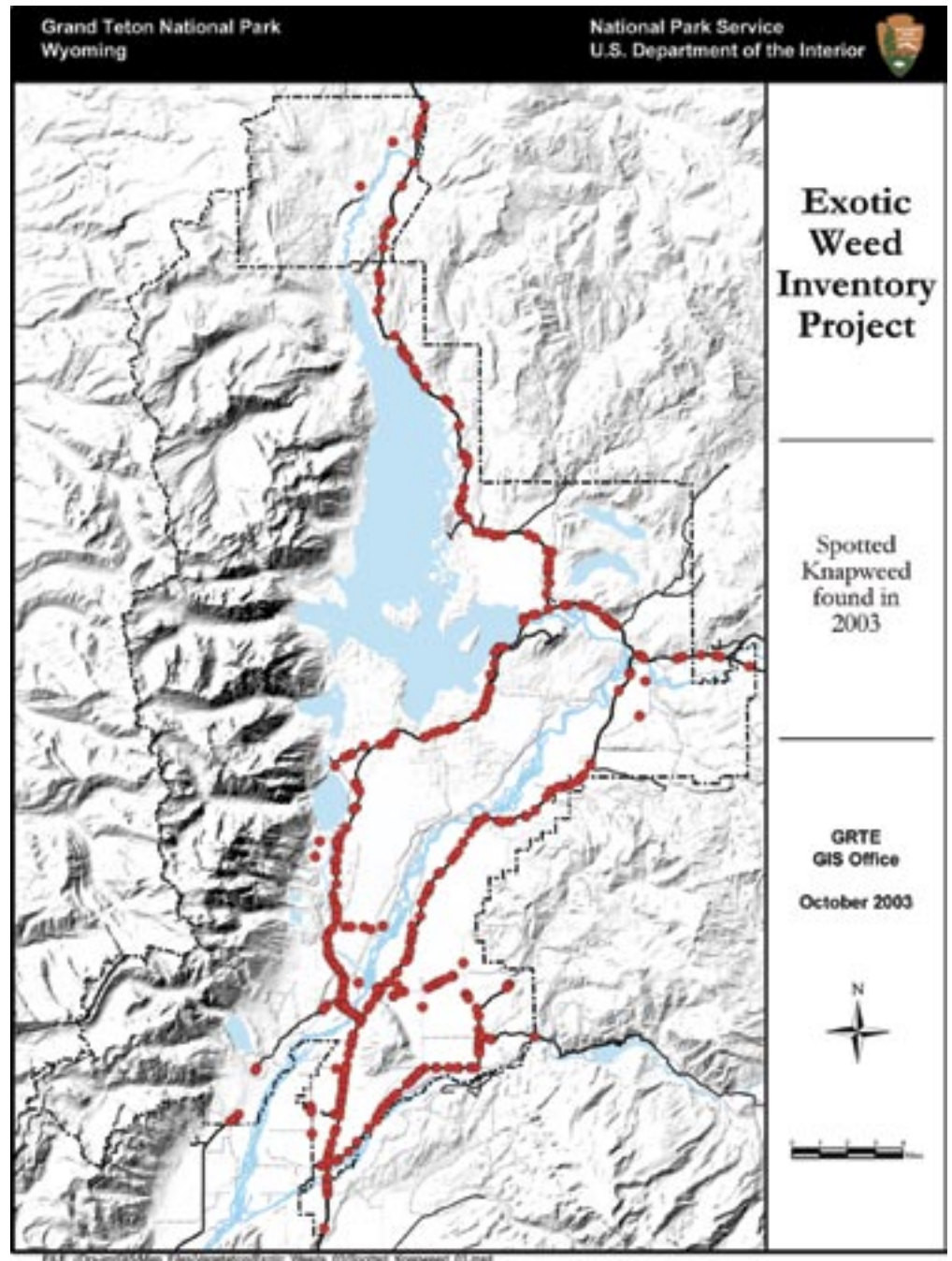


Figure 5. Exotic Weed Inventory Project.



Partnerships

University of Wyoming-NPS Research Center

The UW-NPS Research Center, located at the historic AMK Ranch in Grand Teton National Park, is a field-research facility that includes housing for up to fifty researchers, laboratories, library, computer facilities, herbarium, boats, and other research equipment. It is operated cooperatively to address biological, physical, and social sciences projects that are of importance to park management as well as those of a basic scientific nature. Most field work is conducted during summer months.

Project topics at the center in 2002 included:

- non-native plant invasions of riparian habitats along the Snake River.
- monitoring breeding land bird populations.
- mapping changes in position, mass, and volume of cirque glaciers (about a dozen), using GPS technology, satellite imagery, and photos.
- sampling small mammals in the park for plague and tularemia (none present in animals captured in 2000).
- use of the Snake River Quarry (near Flagg Ranch) by boreal toads, using radio telemetry.
- coyote habitat use and mortality in the park and on suburban-agricultural lands surrounding Jackson, Wyoming.
- long-term monitoring to assess abundance and densities of some small and medium-sized mammals in Grand Teton.
- whether environmental variables contribute to the fluctuations in vole densities known as “cycles”.
- lymph tissue in field mice, as related to “cycles” in vole population densities.
- history of archaeology in Grand Teton National Park.
- mating behavior of sagebrush crickets.
- habitat selection by elk, bison, and moose in Jackson Valley.
- using remote-sensed imagery to classify and model plant and animal communities in mountain meadows.
- how climate has varied over time in the Greater Yellowstone Ecosystem, as shown by tree-ring growth patterns.
- interactions of New Zealand snails and algae in Yellowstone rivers.

UW-NPS Research Center in Grand Teton National Park.



- satellite imagery to characterize the lodgepole pine forest of the Central Plateau region in Yellowstone.
- long-term effects of wild fires on carbon release and storage in lodgepole pine forests in Yellowstone.
- natural changes in landscape patterns between large wildfires in Yellowstone.
- how fire intervals affect initial revegetation patterns in Yellowstone.

In 2003, project topics at the center included:

- effects of El Niño cycles, vegetation types, and large predators on rodent population dynamics.
- river otter abundance and their effects on nutrient cycling near Yellowstone Lake.
- modeling to estimate the beaver population of Grand Teton National Park.
- bat inventories.
- mating behavior of sagebrush crickets.
- aspen regeneration.
- effects of organic matter and nitrogen on forest regeneration, as influenced by fire.
- nutrient enrichment effects on river productivity.
- non-native snail invasions of rivers and streams.
- songbird nesting success in willow habitats.
- monitoring of neotropical bird migrants.
- gene flow among salamander populations.
- archeological surveys in the park.

Grand Teton staff have developed a list of research topics that, if addressed by the research community, would be especially timely and helpful in reaching informed resource conservation decisions. Currently, the top three topics, in priority order, are:

- 1) Ecological and/or human factors associated with long-term decline of nesting great blue herons in Grand Teton National Park.
- 2) Evaluation and comparison of vegetation patterns on previously disturbed

historic home sites and on non-disturbed adjacent sites.

- 3) Status and distribution of beaver in the park.

Other topics of special interest at this time include:

- Documentation and history of GRTE's herbarium collection.
- Eligibility of cultural landscapes for National Register listing.
- Status, distribution, and ecological implications of mud snails.
- Effects of lake trout on cutthroat trout in park lakes.
- Effects of fluctuating lake levels on river otters and other shoreline-dependent species.
- Effects of regulated Snake River flows on river and riparian habitat ecology.
- Ecological changes associated with wolf colonization of Jackson Hole.
- Ecological consequences of Spread Creek water diversion and irrigation runoff into the Snake River.

During 2003, negotiations with the University of Wyoming neared completion to develop a memorandum of understanding (MOU) and expanded vision for the center, providing for the long-term continuance of this mutually beneficial arrangement. Finalization of the MOU is planned for early 2004.

Teton Science School

The campus of the Teton Science School is located in Grand Teton National Park in a cluster of log buildings, some of which are listed on the National Register of Historic Places. A non-profit educational organization, the Science School has been operating since 1967 to encourage experiential education in natural science and ecology, while fostering an appreciation for conservation ethics and practices.

Open year-round to provide programs for students of all ages, the school also offers

Students from the Teton Science School.



a one-year, graduate-level teaching practicum and academic program. Courses are registered as graduate courses through the University of Wyoming, Utah State University, the University of Idaho, and Prescott College.

Teton Science School's Kelly Campus is operated in cooperation with the GRTE and BTNF. Park staff interfaces with the school to provide environmental, science, and cultural education programs related to the park and the GYE. Details are available from the school's website at <http://www.tetonscience.org>.

FY2003 ONPS & Soft Money

Fee Demonstration Money (Multiple Year Projects)				
Natural Resource Management				
Project Name	Account	Project Date	Authorized	Spent
Develop Small Projects for NR Tactical Res & Univ Parts	1460-8065-R8Z	2003	\$60,000.00	
Water Rights Study	1460-8053-N8Z	2002	\$55,000.00	\$17,076.77
Provide Data & Mapping to Sup Veg Map	1460-8052-N8I	2002	\$96,800.00	\$12,753.95
Data Collection & Modeling/Fire Behavior	1460-8051-N8I	2002	\$98,200.00	\$16,209.25
2-Year Snake River Water Quality Sampling	1460-8050-N8Z	2003	\$78,600.00	\$31,744.00
Protocol Development for BC Water Quality Assessment	1460-8049-N8B	2003	\$78,000.00	\$16,458.89
4-Year Wildlife Monitor/Study	1460-8026-N8I	2002	\$225,000.00	\$35,439.31
Restoration of Rangeland	1460-8027-N8Z	2002	\$360,000.00	\$188,624.55
Water Quality	1460-8001-R8Z	2001	\$115,000.00	\$114,860.48
Backcountry Baseline	1460-8001-N8B	2001	\$30,000.00	\$11,780.50
Hydrocarbon Study	1460-8002-R8Z	2001	\$100,000.00	\$48,180.00
Noise Monitoring	1460-8003-R8Z	2001	\$100,000.00	\$11,524.98
Noxious Weed Program	1460-8019-N8Z	1999	\$400,000.00	\$306,253.70
Resource Inventory/Monitoring	1460-8012-N8I	1998	\$299,000.00	\$299,000.00
Wildlife Survey	1460-8009-P8N	1997	\$279,045.64	\$279,045.64
	1460-8109-P8N	1997	\$51,654.36	\$51,654.36
Potential Fire Breaks Using Aspen Regen.	1460-7015-R7Z	2003	\$72,000	
Backcountry Weed Treatment Enhancemt	1460-7016-R7Z	2003	\$65,000	
Integrated Pest Management Technician	1460-7017-R7Z	2003	\$79,761	\$1,536.50
			\$2,643,061	\$1,442,142.88

Donation Accounts, Reimbursable, and One-Year Money				
Biological Support USFWS	1465-2002-454	2003	\$3,057.35	\$3,057.35
Elk/ Bison EIS	1465-2003-454	2003	\$40,000.00	\$40,000.00
USGS Reimbursable/ Burcellosis	1465-9001-454	2003	\$4,861.09	\$4,861.09
Donation Account	1465-7001-600	2003	\$13,859.12	\$13,859.12
Bear Project Donation	1465-2003-600	2003	\$50,000.00	\$50,000.00
Resource Management Base	1465-1000-NZY	2003	\$409,460.00	\$409,460.00
Archeology Base	1465-1000-CYA	2003	\$29,800.00	\$29,800.00
Winter Use	1465-5000-NZZ	2003	\$50,000.00	\$50,000.00
Protect Pronghorn Mitigation	1465-2030-RYY	2003	\$10,000.00	\$10,000.00
SNAKE RIVER RESTORATION	1465-0390-SCC	2003	\$121,000.00	\$121,000.00
			\$732,037.56	\$732,037.56

Fee Demonstration Money (Multiple Year Projects)				
Cultural Resource Management				
Project Name	Account	Project Date	Authorized	Spent
Archivist/Curator to Assist Park Collection	1460-8032-C8C	2002	\$88,100.00	\$58,316.12
MWAC Archeo Cataloging	1460-8022-C8Z	2001	\$150,000.00	\$111,518.52
Develop Western Preservation Center	1460-8063-C8S	2003	\$99,799.00	\$3,054.59
Rehab & Stabilize 18 Historic Structures	1460-8029-M8L	2002	\$210,500.00	\$22,823.83
Conduct Hist Blds Condition Assessments	1460-8033-C8S	2002	\$95,000.00	\$79,362.23
Rehab Beaver Creek Historic District	1460-8020-C8S	1999	\$480,000.00	\$92,228.64
Cultural Resource Preservation Projects	1460-8008-U8C	1997	\$48,110.10	\$48,110.10
Cultural Resource Preservation Projects	1460-8008-C8S	1997	\$460,231.00	\$55,802.16
Cultural Resource Preservation Projects	1460-8008-P8A	1997	\$1,500.00	
Complete Historic Structures Mgmt Plan	1460-7006-C7Z	2003	\$98,500	\$3,582.03
Rehab of Historic Prop, McCollister #1152	1460-7008-M7Z	2003	\$35,000	
Rehab of Historic Prop, McCollister #1150	1460-7009-M7Z	2003	\$50,000	
Plan Rehab of Lucas/Fabian Historic Site	1460-7010-U7Z	2003	\$98,000	
Planning for Colter Bay VC Remodel	1460-7011-V7Z	2003	\$97,772	\$8,911.74
Relocate JY Ranch Buildings	1460-7012-U7Z	2003	\$275,000	\$6,048.80
Rehab of Hist Prop, McCollister #1150A	1460-7018-M7Z	2003	\$35,000	
Rehab of Hist Prop Reimer/Hultman #1359	1460-8019-U7Z	2003	\$48,000	\$48,000.00
			\$2,370,512.10	\$537,758.76

			AUTHORIZED	SPENT
TOTAL			\$5,745,610.66	\$2,711,939.20

Staff

In 2003, a museum curator was added to the staff to oversee collections management and, in October, the park hired Sue Consolo-Murphy to fill the position of Chief, Division of Science and Resource Management. The following list includes permanent full-time, subject-to-furlough, and term employees, but not the many seasonals and volunteers who also contribute significantly to park resources and programs.

Name	Title/Specialty	Telephone
Sue Consolo-Murphy	Division Chief	739-3481
Joanna Behrens	Resource Biologist	733-9212
Shan Burson	Ecologist (Sound)	739-3584
Steve Cain	Senior Wildlife Biologist	739-3485
Megan Callahan	Administrative Support Assistant	739-3480
Carol Cunningham	Technical Writer/Editor	733-9212
Sarah Dewey	Wildlife Biologist	739-3488
Mark Fain	Biological Science Technician	739-3489
Steve Haynes	Senior Vegetation Management Specialist	739-3486
Pam Holtman	Historian	739-3671
Eric Janssen	Biological Science Technician	739-3487
Christine Jacobs Landrum	Museum Curator	739-3678
Peter Lindstrom	Cartographic Technician	739-3482
Kathy McFarland	Biological Science Technician (Wildlife)	739-3484
Susan O'Ney	Resource Biologist (Hydrology, Soils)	739-3666
Jaquelin St. Clair	Archaeologist	739-3664
Brian Villalobos	Biological Science Technician (Plants)	739-3483
Sue Wolff	Wildlife Biologist	739-3464

Contributors

This report reflects the contributions of many people in Grand Teton National Park and beyond. Appreciation is extended to many other cooperating investigators who have NPS permits to conduct approved research projects in Grand Teton National Park, whose efforts have also been summarized in this report. Any omissions are purely accidental, please accept our apologies.

Kim Berger	Pam Holtman
Brent Buenger	George Ingersoll
Shan Burston	George Jones
Steve Cain	Christine Landrum
Megan Callahan	Brian Miller
Eddie Caslick	Brad Mueller
Jim Caslick	Sue Consolo Murphy
Melanie Clark	Deborah O'Neill
Derek Craighead	Susan O'Ney
Carol Cunningham	Charles Peterson
Sarah Dewey	Kenneth Pierce
Richard Easterbrook	Howard Quigley
Aida Farag	Scott Shaw
Ronald Frost	Kathy Sheehan
Rachel Gray	Bruce Smith
Andrew Gregory	Courtland Smith
Bill Gribb	Jacquelin St. Clair
Robert Hall	Tracy Stephens
Andrew Hansen	Brian Villalobos
Hank Harlow	Doug Wachob
Chuck Hawkins	Sue Wolff
Steve Haynes	Scott Woods

Acronyms/Abbreviations

BAER	Burned Area Emergency Rehabilitation
BBS	Breeding Bird Survey
BTNF	Bridger Teton National Forest
CCI	Cooperative Conservation Initiative
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FGDC	Federal Geographic Data Committee
GIS	Geographic Information Systems
GPS	Global Positioning System
GRTE	Grand Teton National Park
GRYN	Greater Yellowstone Network
GYE	Greater Yellowstone Ecosystem
I&M	Inventory & Monitoring
IPM	Integrated Pest Management
JODR	John D. Rockefeller, Jr. Memorial Parkway
LAU	Lynx Analysis Unit
MCC	Montana Conservation Corp
MOU	Memorandum of Understanding
MPMC	Meeker Plant Materials Center
NEPA	National Environment Protection Act
NER	National Elk Refuge
NHPA	National Historic Preservation Act
NPS	National Park Service
SRM	Science & Resource Management
USFWS	US Fish and Wildlife Service
USFS	US Forest Service
USGS	US Geological Service
UTM	Universal Transverse Mercator
VHF	Very High Frequency
WNV	West Nile Virus
WYGF	Wyoming Game and Fish Department
WYPF	Wyoming Partners in Flight
YELL	Yellowstone National Park

Message from the Compilers

In preparing this report, we have drawn freely from many documents, copying, abstracting, extracting, and sometimes editing items provided by others, as we attempted to represent here the variety and depth of the park's research projects and resource conservation programs. We doubtless have omitted many important points that those who do the work would have included here; for these omissions and any errors of interpretation, our apologies. This report and additional information about topics reported here may be obtained from the park's website at <http://www.nps.gov/grte>.

Progress in research and conservation activities is not neatly captured in annual reports; few of us would sit up late on New Year's Eve to write one. Therefore, calendar years in annual reports often overlap, as they do here. As well, the park's research investigators and resource conservation project leaders are increasingly pressed to write funding proposals, at the expense of preparing timely and highly detailed reports. We hope, however, that their dedication to resource conservation goals and their accomplishments in 2003 are fairly represented in this compilation of their activities.

**Jim and Eddie Caslick
Volunteers-in-Parks, 1988-2004**

Photo by Ansel Adams,
Courtesy of the Library of
Congress.

