Science and Resource Management
Grand Teton National Park
& John D. Rockefeller, Jr. Memorial Parkway

National Park Service
U.S. Department of the Interior

GRAND TETON NATIONAL PARK
& John D. Rockefeller, Jr. Memorial Parkway

Natural and Cultural Resources

VITAL SIGNS 2013

Science and Resource Managment
Grand Teton National Park
& John D. Rockefeller, Jr. Memorial Parkway
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Cover painting: Teton Glacier by Leland Curtis. Painted 1965. Gift from the Grand Teton Association to Grand Teton National Park.

Where not otherwise indicated, photos in this report are courtesy of the National Park Service.

Female moose and calf feed along the banks of the Snake River.

Why We Monitor the Park's Resources

The National Park Service was established in 1916 with the mission of protecting the resources of the parks and providing for the public enjoyment of those same resources in such manner that the resources will remain unimpaired for future generations. While Grand Teton National Park was not created until 1929 (and expanded in 1950), the mission remains the same. In order to protect and manage the wide variety of natural and cultural resources held within the park, resource management staff monitor and study individual resources and ecological processes — vital signs—to better inform decisions made in the park. Systematic monitoring is complicated by the fact that many of the animals' seasonal migrations take them beyond the boundaries of the park where other factors influence populations. Inside the park, plant and animal species have been introduced both accidentally and intentionally that may change or affect native species. Pressure from humans, both within Grand Teton National Park and outside, may also impact conditions in the park. Data collected on some resources may be too limited to predict significant trends, but hopefully will provide a baseline for future study. Resources summarized in this report are monitored because of their significance to or influence on this ecosystem.

Vital Signs Summaries

Grand Teton's vital signs summaries are grouped into four categories for purposes of this report. They include:

- **Climate and Environment** (air quality, climate, fire, glaciers, soundscape, and water quality) are primarily the result of natural processes that operate on a distinctly larger scale than the park, but can be affected by human activities both within and outside the park.
- **Natural Resources:** selected plants and animals that
  - are or have been listed under the federal Endangered Species Act (bald eagle, gray wolf, grizzly bear, and peregrine falcon).
  - have experienced declines in the park and surrounding areas or are of special concern due to the lack of data (golden eagle, great blue heron, greater sage-grouse, moose, trumpeter swan, and whitebark pine).
  - have relatively small populations in the park and are considered vulnerable (bighorn sheep, Columbia sharp-tailed grouse, common loon, and pronghorn).
  - have a significant impact on the ecosystem and park management based on such factors as their large number, size, and movement outside the park, or where they are harvested (bison and elk).
  - are considered important indicators of ecosystem health because they are especially sensitive to environmental pollutants, habitat alteration, and climate change (amphibians and osprey).
- **Cultural Resources** (archeological sites, historic structures, and museum collections) are significant representations of the human evidence in or on the park and are inventoried, protected, and monitored to ensure that these resources and the information associated with them are passed along to future generations.
- **Challenges** (nonnative plants and animals, grazing, park visitation, plant restoration, and the human-bear interface) are generally caused or largely influenced by human activity.

Comparison to Reference Conditions

The table on the following page summarizes the current status of selected resources. In most cases, a reference condition is indicated that can be used for comparison purposes. Because conditions may fluctuate widely over time in response to natural factors, the reference condition is not considered the "desired" condition unless it is one that has been specified by government regulation or a plan. In other cases, the reference condition simply provides a measure for understanding the current condition, e.g., a historical range or scientific opinion as to the level needed to maintain biological viability.

Vital Signs Summary

TBD = to be determined

Resource	Indicators	Current Condition 2013 (or latest available)	Reference Condition
Climate and Environment			
Air Quality	Basic air quality parameters at 1 site	Class I Airshed	Clean Air Act
Climate	Average min., max. daily temp. (Moose) Annual precipitation (Moose) Growing degree days (Moose)	20°F, 53°F 16.97" 2,733 days (2012)	21°F, 52°F (1958–2012 average) 21.33" (1958–2012 average) 2,366 (1958–2012 average)
Fire	Acres burned per year	258 acres	1–9660 (1993–2013 range)
Glaciers	Extent of 12 named glaciers	1.15 km² (1994)	TBD
Water Quality	Basic water quality parameters- 2 river sites Basic water quality parameters- 3 alpine lakes	Iron exceeds state standards naturally during spring Nitrogen in Delta Lake exceeds federal reference	State water quality standards Federal ambient water quality reference conditions
Natural Resources			
Amphibians	% of potential sites suitable for breeding	75%	TBD
Bald Eagles	Breeding pairs	14 pairs	13 pairs (2003–2012 average)
Bighorn Sheep	Teton Range herd estimate	100-125 sheep	TBD
Bison	Jackson herd winter count (includes areas outside park)	852 bison	500 bison
Common Loon	Breeding pairs	2 pairs	TBD
Elk	Jackson herd winter count (includes areas outside park) Summer count (in park)	11,051 ≥1207 elk	11,000 elk 1600 (in park)
Gray Wolves	Wolves in Wyoming Breeding pairs in Wyoming	243 (53 use park) 19 pairs (4 use park)	≥150 wolves ≥15 pairs
Great Blue Heron	Active nests	27 nests	23 nests (1991–2012 average)
Greater Sage-grouse	Active leks	5 leks (4 in park)	10 historic leks (9 in park)
Grizzly Bears	GYE minimum population estimate Distribution of females with cubs Annual mortality: Adult female • Adult male • Dependent young (human-caused only)	610 18 bear management units 13%, 6% (2011, 2012) 29%, 15%, 21% (2010–2012) 4%, 4%, 3% (2010–12)	≥500 grizzly bears ≥16 bear management units not > 9% for 2 consecutive years not >15% for 3 consecutive years not > 9% for 3 consecutive years
Moose	Jackson herd winter count	≥237 (45 in park)	TBD
Osprey	Breeding pairs	14 pairs	13 pairs (2003–2012 average)
Peregrine Falcon	Breeding pairs	4 pairs	3 pairs (2003–2012 average)
Pronghorn	Jackson Hole/Gros Ventre herd estimate	244 pronghorn (2012)	TBD
Trumpeter Swans	Occupying breeding territories (includes areas outside park) Pairs producing young	5 pairs (2 pairs in park) 1 pair (4 cygnets fledged)	12 historic territories (8 in park) TBD
Whitebark Pine	Blister rust infection (% of trees in park)	37% of trees	TBD
Cultural Resources			
Archeological Sites	Percentage of park inventoried Percentage of documented sites in good condition	4% of the park 43%	TBD TBD
Historic Structures	Percentage assessed in good condition	72%	TBD
Museum Collections	Percentage that has been catalogued	43%	100%
Challenges			
Aquatic Nuisance Species	Presence of non-native species	1 widespread 10 thermally limited	0 (limit spread & effects on native species)
Fish	Species present	12 native 9 non-native	12 native 0 (limit spread & effects on native sp.)
Human-Bear Conflicts	Injuries, food obtained, or property damaged	11 in park	13 (2009–2013 annual average)
Invasive Plants	Species present Acres treated	22 invasive species 1190 acres	0 (limit spread & effects on native sp.)
Mountain Goats	Estimated number in park	10-15 goats	0 (limit spread & effects on native sp.)
Plant Restoration	Seeding native plants in old agricultural fields	100 acres (422 acres since 2009)	100% of 4500 acre project area

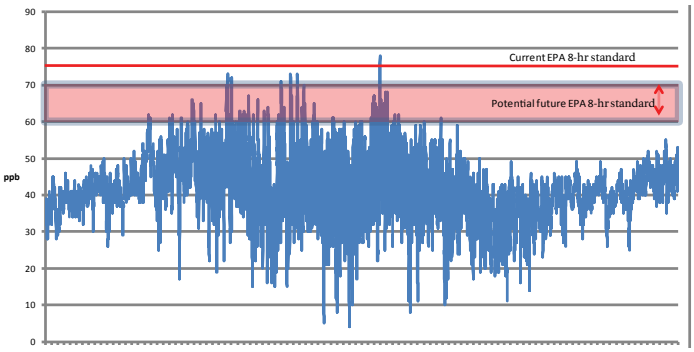
Reference condition specified by government regulation or management plan.

Air Quality

While Grand Teton National Park, Wyoming, experiences relatively good air quality, the park is downwind of significant pollutant sources including power plants, agricultural areas, industry, and oil and gas development. Pollutants emitted from these sources can harm the park's natural and scenic resources such as surface waters, vegetation, fish, and visibility.

As a federally designated Class I airshed, Grand Teton is required to meet high standards for air quality. Grand Teton in cooperation with the our partner, Teton Science School, operates an air quality monitoring station that measures wet and dry deposition, metrological data, ozone, and visibility. Data from this station, and other scientific research, indicate that the park is in compliance with federal standards for human health for ozone, sulfur dioxide, and particulate matter. However, air quality trends may be affecting other aspects of the ecosystem.

Nitrogen and sulfur compounds deposited from air pollution can harm surface waters, soils, and vegetation. High-elevation ecosystems in the park are particularly sensitive to sulfur and nitrogen deposition. Not only do these systems receive more deposition than lower elevation areas because of greater amounts of snow and rain, but short growing seasons and shallow soils limit the capacity of soils and plants to buffer or absorb sulfur and nitrogen. High-elevation lakes, especially, are sensitive to acidification from sulfur and nitrogen deposition and excess nitrogen enrichment. Acidification may cause loss of sensitive macroinvertebrates and fish, while enrichment may alter lake diversity. Alpine plant communities are also vulnerable to nitrogen enrichment, which may favor some species at the expense of others. Measurements indicate higher atmospheric nitrogen inputs to the north of the park and lower levels to the south—a gradient reflected in nitrogen concentrations in rain and snow, soils, and plants. Concentrations of ammonium in wet deposition from regional agricultural sources are elevated and increasing at sites in or near to the park. There are elevated concentrations of current-use pesticides found in park air and vegetation samples while mercury, pesticides, and other contaminants are found in high-altitude park lakes. Recent studies indicate mercury levels in high-elevation lake fish are below human and wildlife health thresholds.



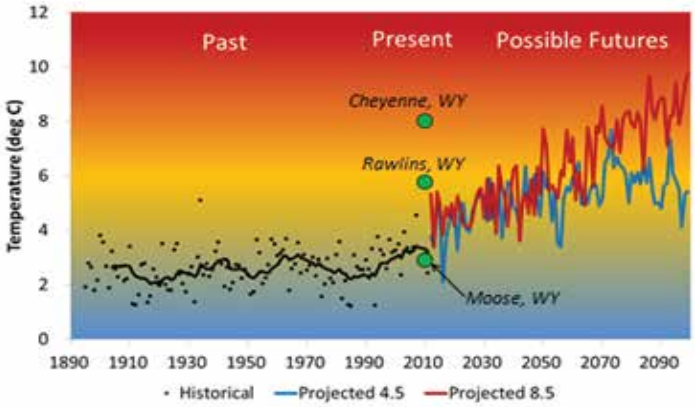
Ozone Hourly Levels (parts per billion) at Grand Teton Air Quality Station Jan. 2012 to Feb. 2012. Showing the difference between current EPA 8-hour standards (red line) and proposed standards (red shaded area).

Visitors come to Grand Teton to enjoy spectacular views of the Teton Range and the Jackson Hole valley. Sometimes the park's scenic vistas are obscured by haze caused by fine particles in the air. Many of the same pollutants that ultimately fall out as nitrogen and sulfur deposition contribute to this haze and visibility impairment. Additionally, organic compounds, soot, and dust reduce visibility. In the region, average natural visual range is reduced from about 180 miles (without the effects of pollution) to about 120 miles because of pollution. The visual range is reduced to below 70 miles on high pollution days and can be even less on days with smoke. While natural fire is recognized for its ecological benefits, smoke from forest fires significantly contributes to particulate matter in the region. Periods of reduced visibility from forest fire smoke is typical in late summer and was a factor even prior to human occupation.

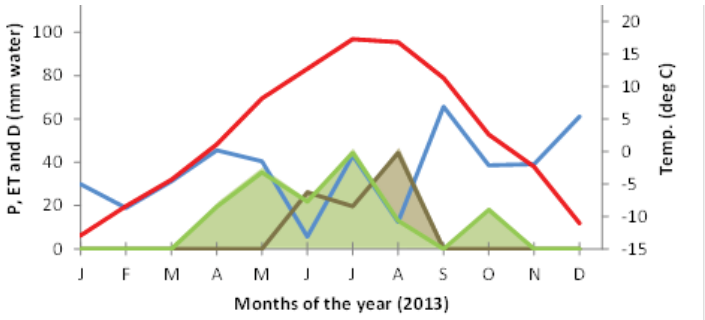
Moose Fire, September 2013

Climate

There are many gaps in the data records for climate in Grand Teton National Park, making it hard to complete long term analyses. Annual data summaries, using data from years with nearly complete data records for Jackson, WY, suggest that between 1950 and 2013 precipitation has increased slightly, but 2013 was 41 mm below the 1981–2010 average. Since 1950, average annual temperatures have increased, but 2013 was about 1 degree C cooler than the long-term average. It is clear from the data that increasing minimum temperatures influence the average more than maximum temperatures. In 2013, the growing degree days—a measure of heat that is suitable for plant growth—were about 5 percent below the long-term average.



Projected temperatures for Moose, WY based on historical data using low and high emission scenarios. (Source: PRISM climate data, Tabor and Williams 2010.)



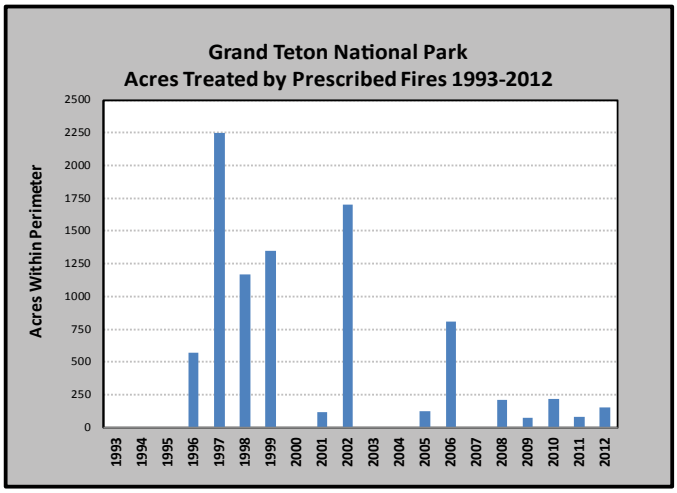
2013 seasonal climate water balance at Moose weather station in Grand Teton NP. Right axis shows monthly mean temperature (red line); left axis shows millimeters (mm) of water for accumulated monthly precipitation 'P' (blue line), evapotranspiration 'ET' (green line and shading) and water deficit 'D' (brown line). The brown shaded area shows the period dominated by a climate water deficit.

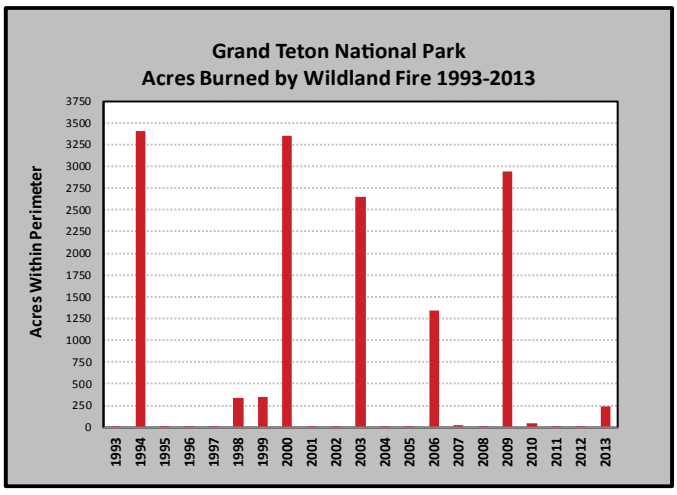
Fire

Grand Teton National Park's landscape evolved with fire disturbances. The plant communities adapted to recover from fire, regenerating or reseeding to provide diverse habitats. In pre-settlement times, fire severity and frequency varied with different forest and shrub vegetation types. For example, sagebrush in the valley burned more often and less intensely than spruce-fir forests in the high mountains. Aspen and Douglas-fir forests had mixed severity burns, while lodgepole pine fires tended to be more uniform and stand-replacing.

Precipitation received during May and June is the strongest predictor of how active the fire season will be in Grand Teton National Park. Most fires occur in July, August, and September. Each year there is an average of 12 fire starts. In the past 20 years, 249 wildland fires started with 62% caused by lightning. Most of these fires were small, either suppressed by firefighters or dying out on their own before they were located. In that same time period, the park fire staff ignited 31 prescribed fires in the park. The fire management goal is to allow natural fires given the right conditions to burn to meet ecological objectives. Fire managers use prescribed fires to reduce hazardous fuels and create the desired fire effects in developed or other high risk areas where it is deemed too dangerous to allow natural fire starts to burn.

In 2013, there were 10 wildland fires—lightning strikes ignited five and humans caused five. The Moose Fire, located high in Webb Canyon, accounted for 240 of the 243 total acres burned by wildland fire for the year. Firefighters monitored the Moose Fire and prepared to defend the Moose Basin Patrol Cabin, but rainy weather extinguished the fire before it approached the cabin. Nine other wildland fires burned three acres. Prescribed fires, including the winter burning of scattered slash piles created by fuels reduction projects near Colter Bay, totaled fifteen acres treated in 2013.

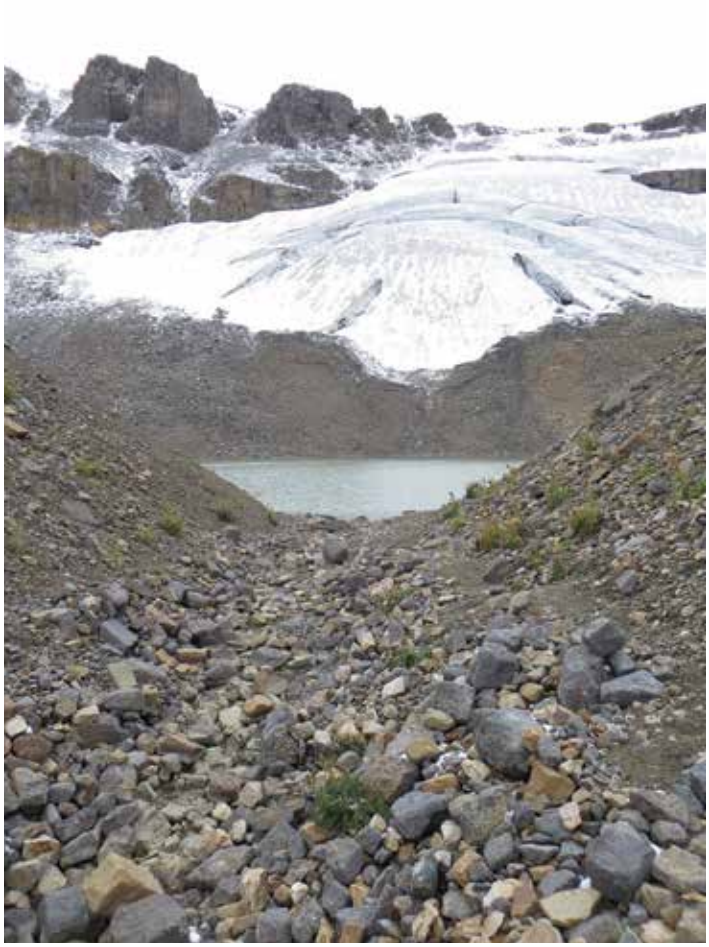




Glaciers

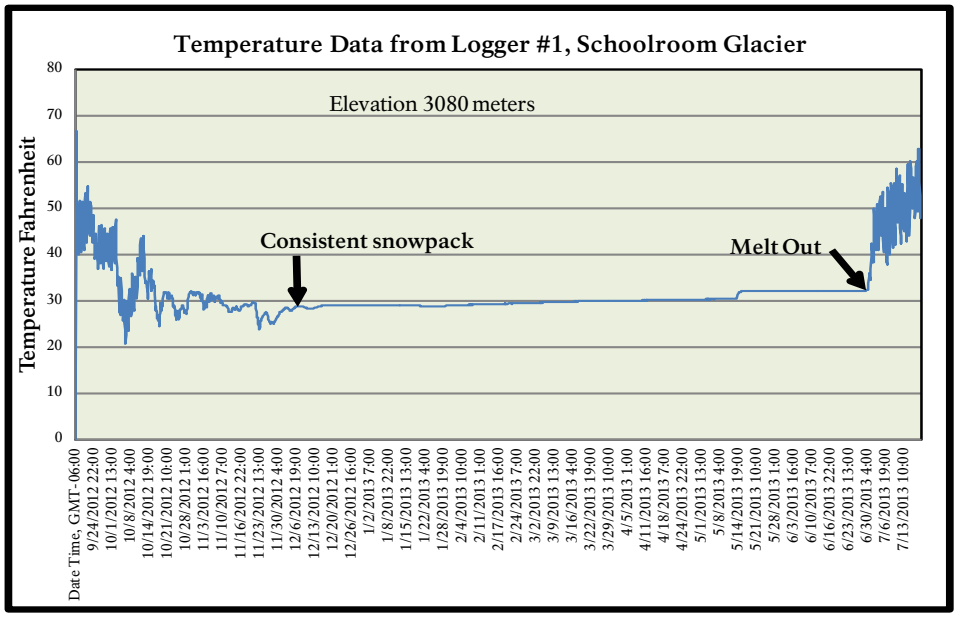
Grand Teton National Park is home to 12 named glaciers, small remnants of those left during the last glacial retreat about 20,000 years ago. Glaciers provide long term water storage and are critical contributors to aquatic systems, particularly in low flow seasons, by providing steady baseflow contributions and cold water inputs. Changes in glacial extent and volume are also significant indicators of changing climate. Recent studies show significant and rapid retreat of the glaciers in all areas of the Greater Yellowstone Ecosystem. Additionally, climate change studies indicate that high-elevation areas of the Rocky Mountains are experiencing rising temperatures, shrinking snowpacks, and earlier meltouts at a more rapid rate than the region overall. Because of these dramatic changes, the Teton glaciers are under increasing surveillance for the relationship between changing climate and the accretion/ablation cycles that respond to changes in temperature and snowpack.

Early studies of changes in glacier volume and extent in the Teton Range showed that despite short-term advances, significant glacier retreat occurred from 1929 to 1963. In 1993, researchers conducted a winter mass balance study of the Teton Glacier to provide a baseline for future comparisons. A 2010 study documented surface area declines in three Teton glaciers ranging from 25% (Middle Teton Glacier) to 60% (Teepe Glacier). Identifying accretion and ablation cycles in Teton Range glaciers includes use of remote sensing and historic aerial photography. Researchers are unable to connect periods of growth and retreat in glaciers and their permanent snowfields to climate trends because of a lack of high-elevation climate data. In order to create climate models that reflect the parameters around these glaciers, additional field measurements are needed.



Schoolroom Glacier, September 17,2013

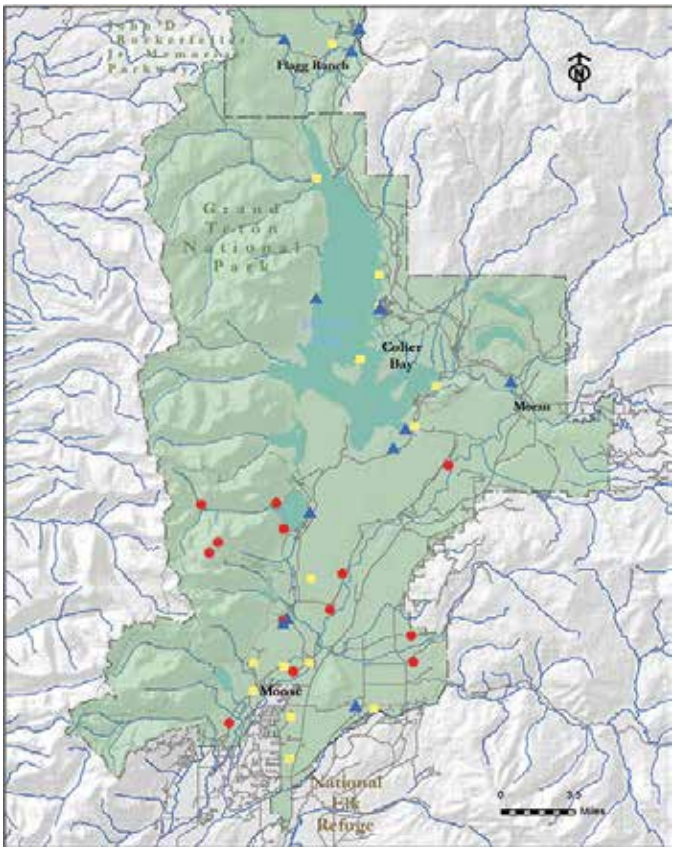
In 2013, using techniques tested in Glacier and North Cascades National Parks, Grand Teton staff developed a protocol and conducted initial field tests for baseline monitoring of temperature and extent on three Teton Range glaciers. Staff retrieved temperature loggers originally placed around the terminus of these glaciers in 2012. They downloaded data and replaced the sensors for continued monitoring. In addition, Grand Teton Jenny Lake Rangers assisted resource management staff in establishing photo monitoring sites for glacier surfaces, margins, and other landmarks of glacier depth and extent. This photo-monitoring will aid in mapping glaciers from aerial and satellite photography, which is especially difficult due to the extreme topography and resulting shadowed and/or blocked areas of view. Other sites were identified for the 2014 construction of digital elevation models (DEM) of the glacier surfaces. Repeated surveys and DEM construction will allow annual comparison of the changes in surface elevations. The 2013 pilot studies provided critical information and a foundation for effective long term monitoring.



Temperature data from a sensor at the base of Schoolroom Glacier.

Soundscape

Since 2003, a bioacoustic ecologist monitored and researched 44 locations throughout the park in various management zones, ecological habitats, and elevations from the Snake River to the summit of Grand Teton. He collected over 105,000 hours of digital recordings and sound levels that characterize and quantify the park's soundscape. Park managers use this information to aid in park planning and management decisions.



Sound monitoring sites in Grand Teton National Park. 2003-present. Yellow squares indicate monitoring in multiple seasons, blue triangles winter monitoring only, and red circles summer monitoring only.

The bioacoustic ecologist setting up a sound monitoring site on the west shore of Jackson Lake, Grand Teton National Park.

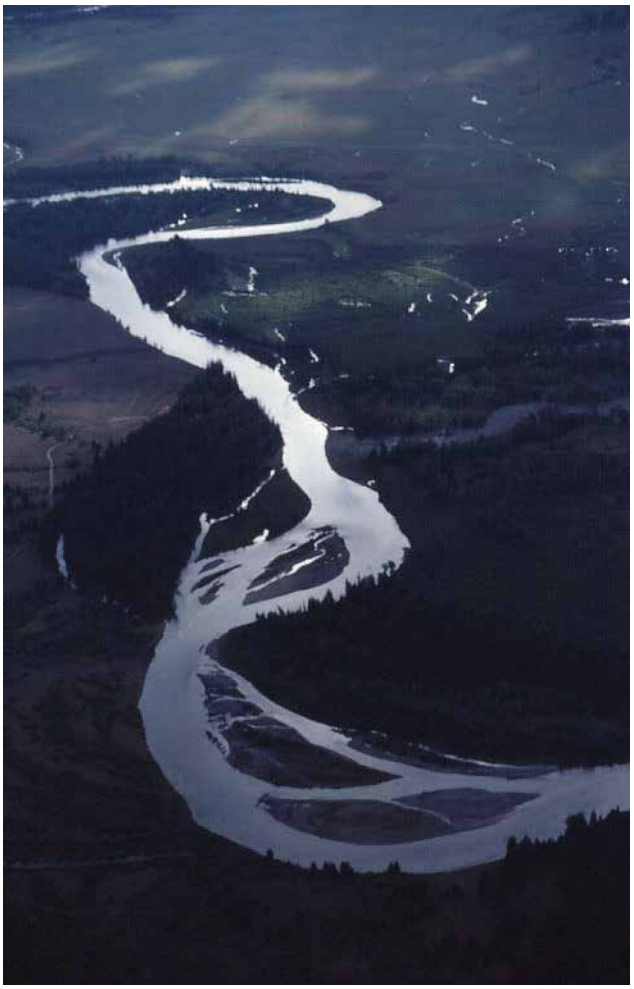
The soundscape of Grand Teton is composed of natural sounds and human-caused sounds. Natural sounds include intentional sounds (singing and bugling) and adventitious sounds (footsteps and wingbeats) of animals and sounds created by physical processes (raindrops, thunder, flowing water, rockfalls, avalanches, and wind). The most widespread and numerous human-caused sounds are from surface, air, and water transportation activities. Airplanes and road vehicles are present all year; motorboats operate in the non-winter months.

The natural soundscape of Grand Teton is fully intact and functioning. However, noise from human-caused sounds affects the natural soundscape and can interfere with ecological functioning. Noise impacts on the natural soundscape tend to increase with higher visitation and administrative activity. Noise is highest nearest transportation corridors, but can propagate for long distances, especially when the ambient sound levels are very low. Seventy-five percent of the park is within two miles of a road or lake that allows motorboats. The National Park Service works to mitigate these impacts through education, quiet technology, and altered behaviors.

Water Quality

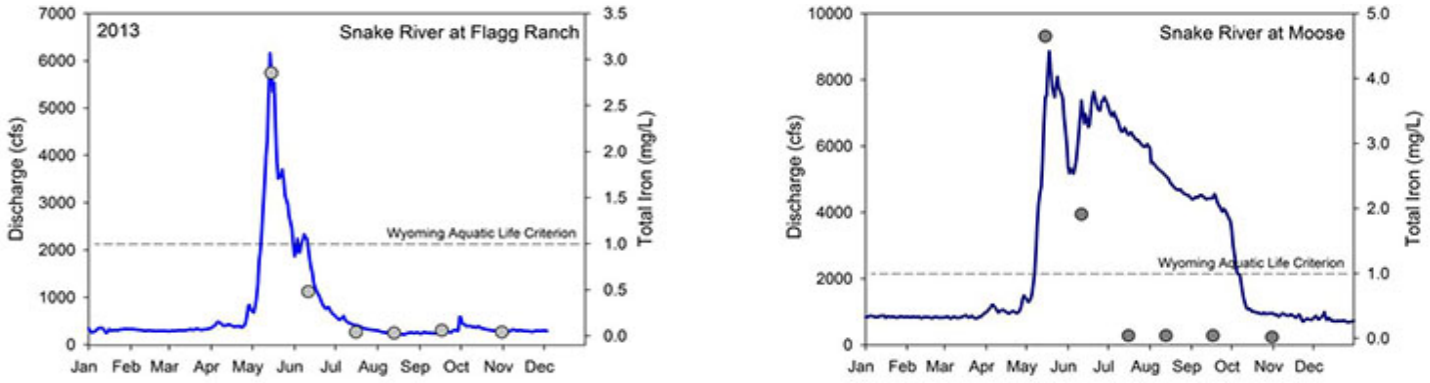
Approximately 10% of Grand Teton National Park is covered by surface water. The park contains more than 100 alpine lakes, with surface areas ranging from 1 to 60 acres, and many above 9,000 ft in elevation. All surface and groundwater in the park drains to the Snake River. The Snake River is of considerable significance to the biological diversity and functioning of not only Grand Teton NP and the Greater Yellowstone Ecosystem, but also to the health and vitality of gateway and downstream communities.

These uppermost reaches of the Snake River in Wyoming are characterized by good water quality with relatively low levels of dissolved nutrients and other anthropogenic compounds (e.g., pesticides). Good water quality and the presence of native fish, including cutthroat trout, are not surprising given that the headwaters of the Snake River includes parts of Grand Teton and Yellowstone National Parks. Maintenance of high quality waters and continued support of native freshwater assemblages are among the highest management objectives for Grand Teton National Park. The State of Wyoming also recognizes and values this important resource and has designated the upper Snake River and all surface waters within GRTE as Outstanding or Class 1 waters—recognized for their exceptional quality and therefore "no further water quality degradation by point source discharges other than from dams will be allowed" (WYDEQ 2001). The Snake River headwaters also received a Wild and Scenic River designation by Congress (Snake River Headwaters Legacy Act, 2009), designed to preserve the quality of the Snake River headwaters' outstanding natural, cultural, and recreational values for the enjoyment of present and future generations (Wild and Scenic Rivers Act, October 2 1968).



Aerial view of the Snake River in Grand Teton NP.

NPS resource staff have monitored water quality in the Snake River for nearly a decade. Results confirm that concentrations of primary nutrients (nitrogen and phosphorus) have been low or below detection over this period. Trace metals (i.e., arsenic, copper, and selenium) have been sampled in the watershed and are often naturally present at measurable concentrations but below the State of Wyoming's aquatic life criteria. Total iron concentrations are highest in the Snake River during spring runoff and in 2013 concentrations exceeding State of Wyoming's aquatic life criterion (1.0 mg/L) were documented at two Snake River locations. However, because most of the watershed in the upper Snake River is undeveloped it is believed that iron and other trace metals are naturally occurring and that natural fluctuations in iron levels are driven by elevated spring discharge.

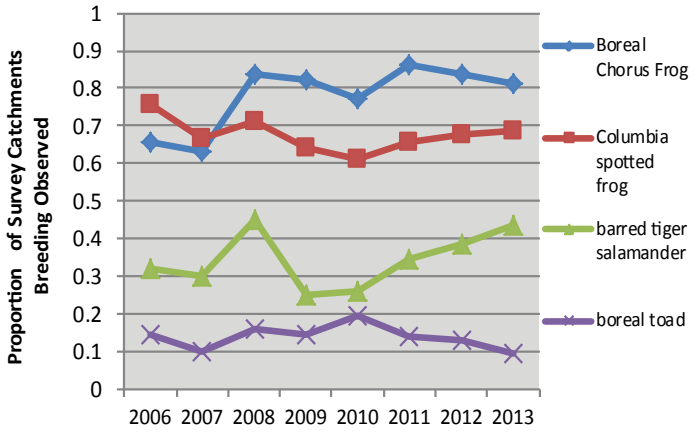


Natural iron concentrations (gray dots) and river discharge (blue line) for the Snake River at Flagg Ranch and Moose during 2013.

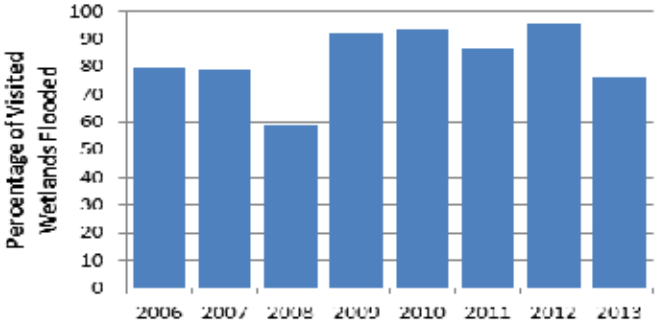
Amphibians

In annual surveys since 2002, biologists identified four species of native amphibians in Grand Teton and Yellowstone national parks: barred tiger salamander (*Ambystoma mavortium*), boreal chorus frog (*Pseudacris maculata*), boreal toad (*Anaxyrus boreas boreas*), and Columbia spotted frog (*Rana luteiventris*). The boreal chorus frog and the Columbia spotted frog are the most widely distributed species each year. The barred tiger salamander and boreal toad appear to be less widespread. The northern leopard frog was historically documented in Grand Teton National Park, but there was only one confirmed sighting since the 1950s. Spadefoot toads were documented a few times in Yellowstone's history, but their presence in Grand Teton has not been documented.

Biologists document the proportion of observed amphibian breeding in catchments. Annual variations in breeding may be tied to hydrologic fluctuations that are driven by unique meteorological conditions each year. Such annual variations alter the extent and mosaic of wetland breeding sites, which can affect amphibian reproduction. The percentage of visited wetlands that supported surface water suitable for breeding varied between 59% in 2007 and 96% in 2011. All amphibians in Grand Teton and Yellowstone National Parks require wetlands for breeding, but individual habitat needs differ and may leave some species more vulnerable to changes in wetland condition (e.g., cumulative loss of seasonal water bodies or shrinkage of year-round ponds).



Proportion of catchments where breeding was observed for each species.



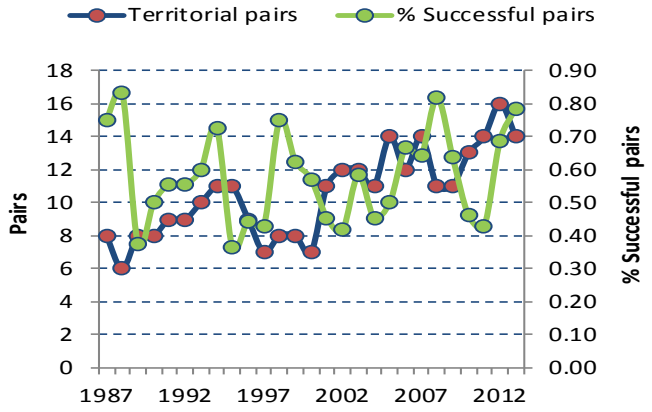
Percentage of wetlands 2006-2013 that had standing water suitable for breeding.

Barred tiger salamander, boreal chorus frog, Columbia spotted frog, and boreal toad.

Bald Eagles

Bald eagles (*Haliaeetus leucocephalus*) are large, primarily fish-eating predators that generally nest in trees, close to water bodies. They also feed on small mammals, waterfowl, and carrion. Within Grand Teton breeding sites are found along the shores of Jackson Lake, the Snake River, Two Ocean Lake, and the Gros Ventre River.

Of 17 bald eagle territories monitored in 2013, 14 pairs occupied territories and 11 nested and fledged 13 eaglets, marking another year of high production. Both the percent of occupied territories (64%) and successful nests (82%) were above the long-term average. Bald eagles experienced a dramatic recovery in Grand Teton over the last few decades, mirroring the recovery throughout the Greater Yellowstone Ecosystem. The number of territorial pairs in the park has almost doubled over the past 25 years. However, the average number of young produced per occupied territory has not changed appreciably.

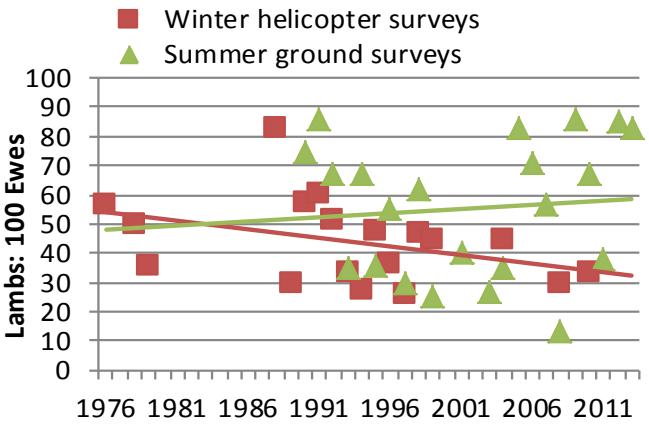


Counts of bald eagle pairs defending territories and successfully producing young in Grand Teton NP, 1987-2013.

Bighorn Sheep

Bighorn sheep (*Ovis canadensis*), once widely distributed throughout the mountains and foothills of the Rocky Mountain west, persist today in small, fragmented populations that remain at risk of further decline and extripation. The Teton Range herd is Wyoming's smallest and potentially most isolated native sheep herd. The herd now lives year-round at high elevation along the Teton crest and in the steep canyon areas on the east and west slopes of the range. Sheep in this herd endure harsh winter weather in windblown areas above 9,500 feet due to the loss of low-elevation winter ranges to residential and recreational encroachment.

Biologists estimate the Grand Teton bighorn population contains 100–125 individuals, distributed in two segments at the north and the south ends of the range. Annual ground classification surveys started in 1990 provide composition, distribution, and trend



Ratios of lambs per 100 ewes based on ground and helicopter surveys of bighorn sheep in the Teton Range, 1976-2013.

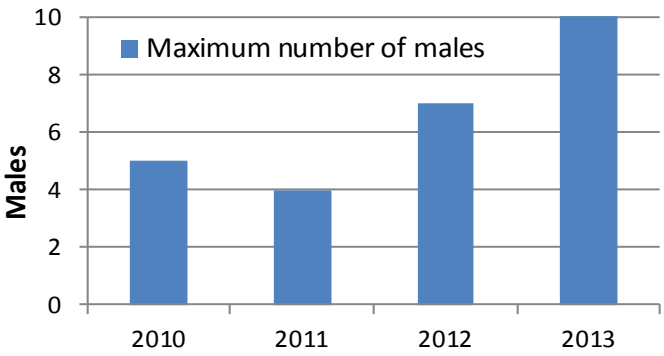
information. Based on the number of sheep counted during the 2013 ground survey, biologists estimated herd ratios of 83 lambs, 50 yearlings, and 83 rams per 100 ewes. Since ratios derived from summer ground counts are highly variable over time, the counts primarily provide a confirmation that the herd is still reproducing and that some of the lambs survive their first year to join the herd.

Recent studies determined that the north and south segments of the herd are genetically distinct, increasing concerns for the health of the population. Avalanches and falls caused the majority of known mortalities recorded for 16 radio-collared and 7 non-radio-collared bighorn sheep in the mid-1990s; predation and starvation caused a small percentage of deaths. The herd does not migrate and is isolated from neighboring populations. While small population size, high lamb mortality, possible reduction in genetic fitness due to inbreeding, and extremely limited winter range all jeopardize the long-term sustainability of this herd, managers recognize limited winter range in avalanche-prone, high-elevation areas as the greatest potential threat. To decrease disturbance, Grand Teton closes crucial Teton Range bighorn sheep wintering areas to recreationists. No incursions into sheep winter range were reported in 2013.

Columbian Sharp-tailed Grouse

Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) is endemic to sagebrush, shrub-steppe, mountain shrub, and riparian shrub plant communities. Once found in nine states and British Columbia, Canada, this subspecies now occupies less than 10 percent of its historic range. Excessive hunting in the 19th century combined with habitat alteration and degradation contributed to local population declines and range reduction. Environmentalists petitioned twice for listing the Columbian sharp-tailed grouse under the Endangered Species Act, but each petition failed. Sharp-tailed grouse are considered a species of greatest conservation need in Wyoming.

Similar to the greater sage-grouse, sharp-tailed grouse males display in the spring to attract females to breeding grounds called leks. Leks are typically positioned on elevated sites with flat, open areas. Columbian sharp-tailed grouse leks tend to have taller vegetation and more shrub cover than leks of other subspecies of sharp-tailed grouse. Little is known about the sharp-tailed grouse population in Jackson Hole. Several incidental observations of small groups of sharp-tailed grouse were recorded in Grand Teton over the last several years but no leks were found prior to 2010. Previously the nearest known lek was in Idaho along the western



Annual counts of male Columbian sharp-tailed grouse at the lek in Grand Teton National Park, 2010-2013.

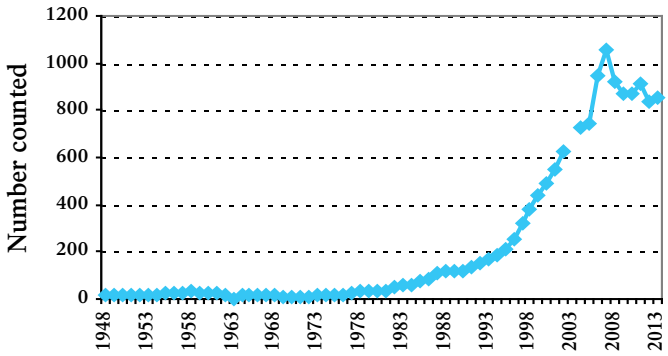
slope of the Tetons.

In the spring of 2010, biologists located a sharp-tailed grouse lek near the southeast boundary of the park, where they observed five males displaying. This marked the first known sharp-tailed grouse lek in the park in over 40 years. In 2013, biologists observed a maximum of 10 adult males strutting at the lek, but did not see any females present.

Bison

Bison (*Bison bison*) native to Jackson Hole, were extirpated from the area by the mid 1800s. In 1948, 20 animals from Yellowstone National Park were introduced to the fenced 1500-acre Jackson Hole Wildlife Park near Moran. In 1963, after testing positive for brucellosis, all adult bison in the small herd were destroyed while nine vaccinated yearlings and calves remained. Twelve bison from Theodore Roosevelt National Park were added to the population. The herd escaped from the wildlife park in 1969 and was allowed to remain free. Present-day Jackson bison are descendants of those bison and some subsequent migrants from Yellowstone. The herd is now the second largest unfenced bison herd in the United States. During the winter of 1980, bison moved onto the National Elk Refuge and began using supplemental feed intended for elk. Returning annually to exploit this food source, the bison altered their natural population dynamics and distribution.

With unusually low winter mortality and no significant predation, the herd has grown steadily since the 1980s, reaching more than 1,000 by the winter of 2007. Although some bison began using areas east of the park and the refuge in the late 1990s, herd distribution has changed little in the past two decades. Jackson bison summer primarily in Grand Teton National Park. Depending on winter severity and native forage availability, nearly the entire herd moves to the refuge for the winter, where they remain until April or May. In some years, individuals or small groups remain in the park all winter. During the winter of 2013, 827 bison used the National Elk Refuge feedlines and adjacent areas. Twenty-five bison foraged on native winter range mainly in the Elk Ranch area of the park. The herd-wide total of 852 is a slight increase from the 840 counted in 2012.



Jackson bison herd numbers, 1947-2013.

A joint Bison–Elk Management Plan approved in 2007 allowed bison hunting on the National Elk Refuge in an effort to maintain the herd at about 500 animals. The refuge hunt also helps disperse the herd. While the expanded hunt area helped increase the number of legal harvests and brought the herd closer to a sustainable population given available forage, research suggests that only consistently high hunter harvests focused on cows will bring the population to the desired level. Of 253 known bison mortalities in 2013, 94% resulted from legal harvest outside the park, while other causes included 7 vehicle strikes, 3 winter kills, 2 possible wolf predations, and 2 unknown.

Common Loons

Common loons (*Gavia immer*) are long-lived birds with a prolonged period of maturation and low reproductive rates. Arriving shortly after lakes become ice free in the spring, loons breed on freshwater lakes throughout the northern U.S. and migrate to coastal areas for winter. Loons that nest in Grand Teton National Park reside at the southernmost extent of the species' range in the interior mountain west. The Wyoming population is small and appears isolated from other breeding populations. Long-term monitoring shows reductions in the number of territorial pairs and chicks fledging in the Greater Yellowstone population. The state of Wyoming lists loons as a species of greatest conservation need primarily because of the small size of the nesting population and its restricted distribution.

In 2013, loon pairs established territories on Arizona Lake and Emma Matilda Lake while a lone adult was observed on Bradley Lake in June. No loons were observed during surveys of Leigh or Jenny Lakes. The Emma Matilda pair nested producing one loonlet. Despite observations of the adults in June, biologists do not know if the Arizona Lake pair nested or produced chicks.

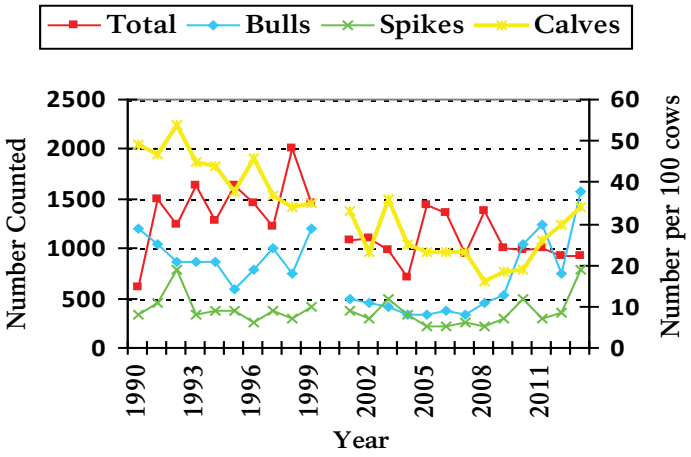
V. Spagnuolo

Elk

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway support a migratory Rocky Mountain elk (*Cervus elaphus*) population that is part of the larger Jackson elk herd. Elk summer throughout the parks and occur at relatively high densities in low elevation open sagebrush, willow, and forested habitats. Most of the elk migrate to winter range on the National Elk Refuge near Jackson, but a small number winter in the eastern portion of the park. Other portions of the herd migrate through the park/parkway between the National Elk Refuge and summer ranges in Yellowstone and the Bridger-Teton National Forest. The Jackson elk herd is the largest in North America. Its migratory routes cross multiple jurisdictional boundaries as elk travel between seasonal ranges. As Grand Teton's most abundant ungulate, elk have significant effects on park ecology. Their grazing and browsing may affect plant productivity and, as prey and carrion, elk provide sustenance to carnivores and scavengers. They are also popular with park visitors.

Park biologists surveyed and classified 926 elk in 2013 during the annual summer survey, when slightly more elk were counted compared to 2012. Overall numbers have been remarkably consistent the last 5 years. Herd ratios and composition in the standard survey area were 38 mature bulls, 19 spike bulls, and 34 calves per 100 cow elk. More mature bulls were counted than in 2012 and bull ratios increased to the highest levels seen since the counts were initiated in 1990. Calf ratios continued to increase for the fifth consecutive year and matched levels seen in the mid-2000s. In general, calf ratios were lower in areas north of Moose and in the Willow Flats and highest in the Snake River bottoms south of Moose and around Lupine Meadows. The Snake River area south of Moose had remarkable calf ratios with 60 calves per 100 cows, almost twice the number observed in Willow Flats. The distribution of elk among count blocks remained similar to that observed in 2012. In total, biologists counted at least 1207 elk in the park.

Bull elk bugling to attract mates and announce his territory during the fall rut.



Grand Teton mid-summer elk count and classification, 1990–2013.

In 2013, the Jackson herd numbered 11,051 elk, very close to the 11,000 objective set by the Wyoming Game and Fish Department. Estimated at above 19,000 during the early-mid 1990s, the Jackson herd is reduced by annual harvest on the national forest and the refuge, in addition to an elk reduction program in the park (authorized by Congress in 1950 to help manage herd size when necessary). Non-harvest mortality (e.g. from winterkill) averages an unusually low 1–2% of the herd. The total annual harvest for 2013 numbered 1500 elk, 12% of the Jackson herd. The park reduction program accounted for 14% of that total and numbered 204 elk. About 1,600 Jackson elk occupy summer range in Grand Teton, close to the objective described in the 2007 Bison–Elk Management Plan for Grand Teton National Park and the National Elk Refuge.

Golden Eagles

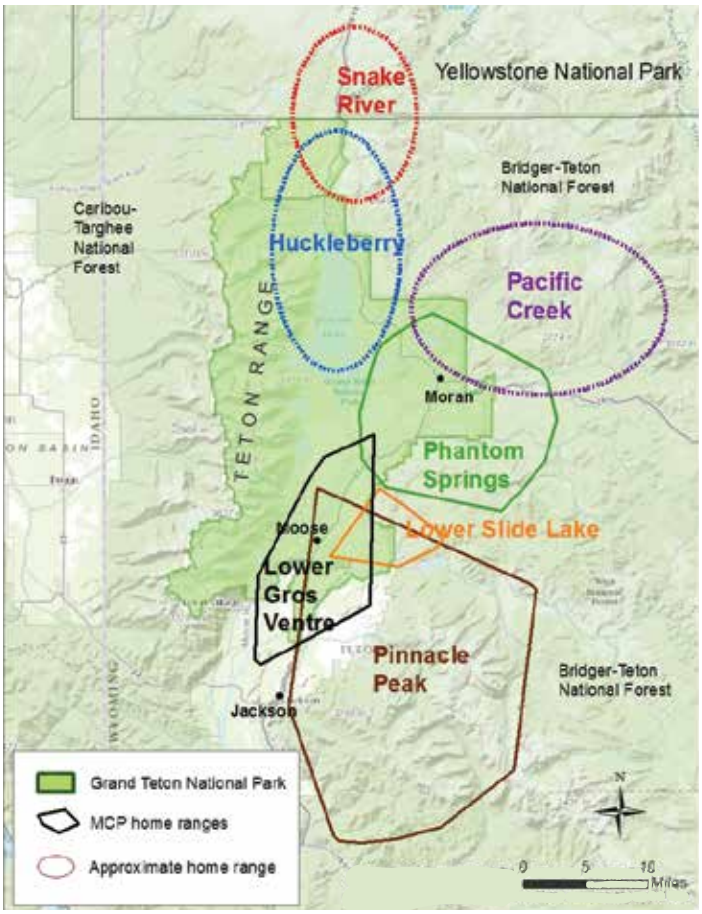
Golden eagles (*Aquila chrysaetos*) are large aerial predators well suited to the Teton Range, with its abundance of cliff faces for nest sites and diversity of prey found in the canyons. In the 1980s, biologists located golden eagle nests in Death, Avalanche, Cascade, and Webb Canyons. Concerns about golden eagle populations throughout the western U.S. have arisen, primarily because of loss and alternation of their native habitats. Like many raptors, golden eagles are sensitive to disturbance around their nest sites.

In 2013, an active nest in Avalanche Canyon produced at least one eaglet. Data on area golden eagles is limited. Biologists want to develop more baseline information to better assess the population.

Gray Wolves

After the U.S. Fish and Wildlife Service and National Park Service reintroduced gray wolves (*Canis lupus*) into Yellowstone National Park in 1995–96, wolves dispersed to Grand Teton National Park and surrounding areas. In 1999, a wolf pack denned in Grand Teton and produced a litter of pups—the first in the park in over 70 years. Since then, wolves continue to live and reproduce in the Jackson Hole area, including Grand Teton and the John D. Rockefeller, Jr. Memorial Parkway. The reintroduction of wolves restored natural predator-prey relationships absent since humans eradicated wolves from the ecosystem in the early 20th century.

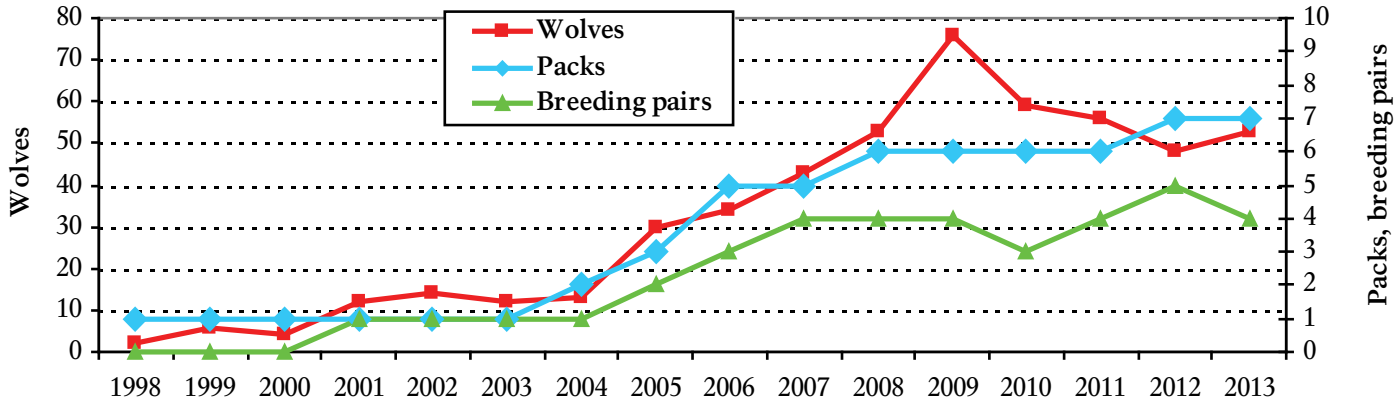
At the end of 2013, a minimum of 53 wolves in 7 packs were resident in the Jackson Hole area. The known Jackson area wolf population grew from 6 to 76 wolves between 1999 and 2009, but declined to 48 animals in 2012. Pack size in 2013 ranged from 2 (Lower Gros Ventre and Lower Slide Lake) to 12 (Pinnacle Peak) wolves. In 2013, four of the Jackson Hole packs produced 17 pups that survived at least until the end of the year: Huckleberry (6), Phantom Springs (5), Pinnacle Peak (2), and Snake River (4). Two packs denned and spent over 50% of their time in Grand Teton or the parkway (Huckleberry and Phantom Springs) producing 13 pups with 11 (85%) surviving at the end of the year. At least 2 adult wolves from Grand Teton died in 2013. Both were legally shot outside the park.



Distribution of Jackson area wolf packs, 2013. (MCP- Minimum convex polygons are home ranges based on locations of collared pack members.)

The return of wolves to Grand Teton and the surrounding area presents researchers with an opportunity to study the complex relationships of an ecosystem with an intact suite of carnivores and ungulates. Wolves and other predators have impacts on prey populations and behaviors. In a four-year study, biologists found that in the winter when elk densities are relatively low, wolves prey primarily on elk (70%) and moose (27%) while feeding on deer and bison infrequently (3%). In the summer, when elk densities in the park are high, wolves preyed almost exclusively on elk with yearlings representing more than half of the kills in 2013.

Wolves also prey on other species, including livestock, which bring wolves into conflict with humans. A long history of controversy surrounds wolf management and the effects of wolves on ungulates and livestock. Wolves in Wyoming were removed from the federal list of threatened and endangered species on September 30, 2012. Wyoming classifies wolves as trophy game (managed through regulated public harvest) in the northwest portion of the state outside the parks, parkway, National Elk Refuge, and Wind River Indian Reservation; and as predators (allowing unregulated take but requiring notification and information be provided) in the rest of the state. Although wolf hunting is prohibited inside Grand Teton National Park, most wolves with territories in Jackson Hole use substantial areas beyond park boundaries, and state management may influence the dynamics of the valley's wolf packs. Given adequate protection, wolf biologists generally consider the Northern Rocky Mountain wolf population to be at a sustainable level.

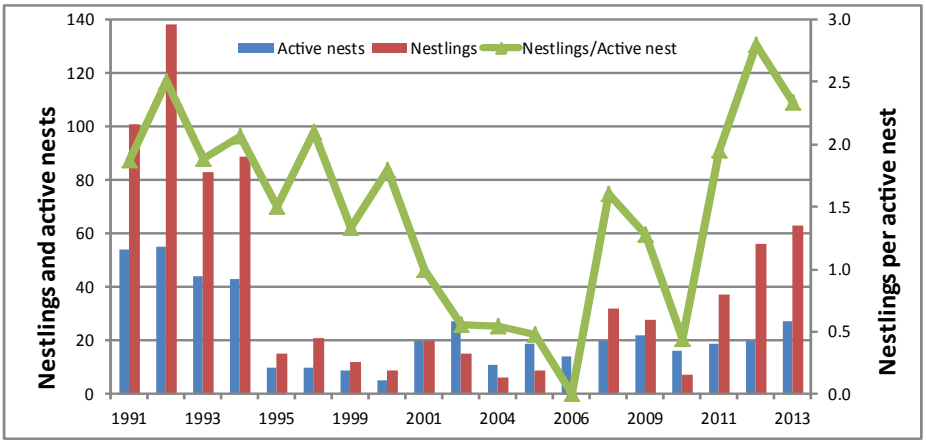


Population growth of Jackson area wolves, including those in and adjacent to Grand Teton National Park, 1999-2013.

Great Blue Herons

Great blue herons (*Ardea herodias*) are colonial water birds dependent on wetlands for feeding, nesting, and habitat security. Colonial nesters are highly vulnerable to human disturbance. Human activities near heron colonies (heronries) may influence heron occupancy, disrupt nesting behaviors, change foraging behavior, increase predation, or lead to heronry abandonment. Monitored since 1987 in Grand Teton National Park, heron occupancy and reproductive success varies widely with overall productivity declining. Over the last decade herons abandoned several historic heronries.

Herons have eight known historic colonies located in or adjacent to the park plus a new site on the Buffalo Fork. Of these sites, only three colonies were active in 2013. At Arizona Lake, herons produced 51 fledglings from 20 active nests. At the new Buffalo Fork site, herons occupied five nests and produced 12 fledglings. All 63 known nestlings survived to 80% of fledging age. Herons at the Glade Creek/Steamboat Mountain site had two active nests in mid-May, but both nests failed.



Great blue heron productivity in Grand Teton National Park,1991-2013. The Arizona Lake heronry, located just outside the park's boundary, was discovered in 2007 and has been included in the park's monitoring program since 2009. Monitoring of park heronries was not conducted in 1996, 1997, 2002, or 2008.

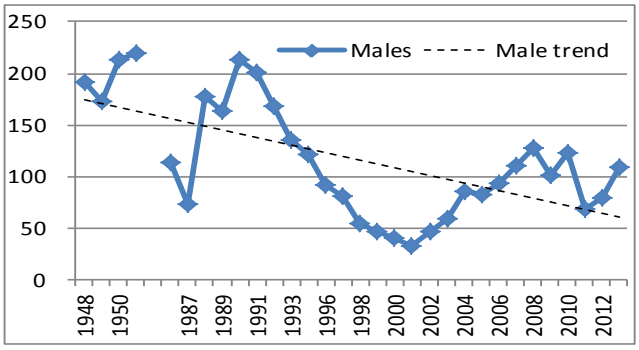
The new Buffalo Fork colony may be related to another historically known heronry on the Buffalo Fork that is now abandoned. Heronries are vulnerable to predation. Bald eagles in particular can have devastating impacts on the survival of young herons. Biologists do not know if bald eagles nesting nearby led to the demise or displacement of this heronry. The number of nests at the Arizona Lake heronry increased from 10 to 20 since 2009. In 2013, the average number of nestlings per active nest (2.3) matched levels seen in the early 1990s.

Greater Sage Grouse

Historically, the greater sage-grouse (*Centrocercus urophasianus*) ranged across nearly all of Wyoming and much of the American West using sagebrush habitat. Sage-grouse populations declined throughout their range during the past 50 years, most likely due to a combination of factors including increased livestock grazing, farming, residential development, invasive plants, and oil and gas development. The Jackson Hole sage-grouse population also declined, despite occurring in an area with a high density of public lands and protected habitat.

Sage-grouse congregate on display areas, or leks, during their breeding season each spring. Lek sites are usually open areas such as rocky slopes, burned areas, or gravel pits. Males perform a unique strutting display on these areas to attract females for breeding. Grand Teton National Park biologists began monitoring sage-grouse leks in the 1940s to document population trends.

Of the 11 historically known leks (10 within the park boundaries and 1 outside), sage-grouse consistently occupied 4 leks throughout the breeding season with substantial male attendance in 2013 (Airport, Moulton, RKO, and Timbered Island leks). Biologists observed sage-grouse at the Spread Creek lek on only one survey day early in the breeding season, suggesting it served as a staging area or a satellite lek. The North Gap lek on the National Elk Refuge was active with 77 individuals observed early in the breeding season. Five other historically occupied leks were inactive in 2013.



Total counts of male sage-grouse on Grand Teton National Park leks 1948–2013.

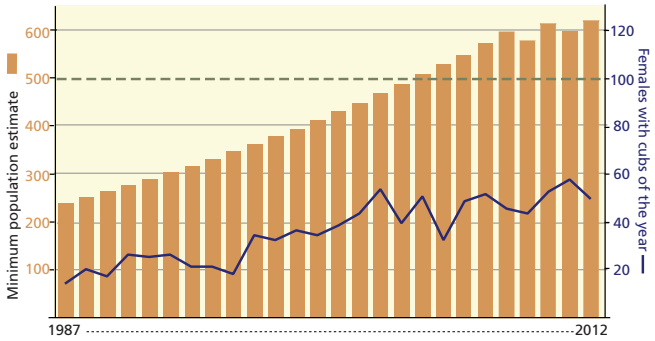
The total maximum count of 109 male sage-grouse in 2013 was slightly above the 10-year average. Male counts at Moulton and Airport leks were above the 10-year average while all other leks were below. While this data provides useful information on general trends of sage grouse attendance at leks, the relationship of these numbers to the local sage grouse population is not known.

Grizzly Bears

Predator eradication programs eliminated grizzly bears (*Ursus arctos*) from most of the western U.S. by the 1950s. Due to its isolation, the Greater Yellowstone Ecosystem (GYE) became one of the last refuges for grizzly bears south of the Canadian border. Throughout the region, garbage became a significant food source for bears in the first half of the 20th century. To return bears to a diet of native foods, garbage dumps in the GYE were closed in the 1960s and 1970s. Following the dump closures, human-caused mortality increased significantly and the population declined from an estimated 312 grizzly bears, prior to the dump closures, to 136 bears in 1975. That same year the grizzly bear was federally listed as a threatened species.

Intensive conservation efforts over the next 33 years allowed grizzly bears to make a remarkable recovery. As of December 2012, the GYE grizzly population was estimated at a minimum of 610 bears. There are more grizzly bears today, occupying a larger area (19,305 mi^2), than there were in the late 1960s prior to the closure of the garbage dumps (312 bears occupying 7,813 mi^2). Grizzly bears now occupy areas where they were absent for decades including all of Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway. Cub survival significantly exceeds human-caused mortality. Despite huge growth in area visitation, bear attacks on people and incidents of bears damaging property remain low. The high visibility of bears foraging on native foods in roadside meadows makes Grand Teton National Park a popular bear viewing destination.

Researchers place a tracking collar on a young grizzly.



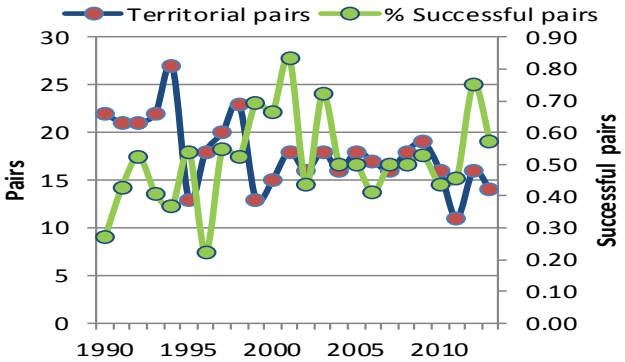
Counts of grizzly bear females with cubs of the year and total population estimate within the USFWS-designated Yellowstone Ecosystem Suitable Habitat, 1987–2012. One recovery criteria is a population of at least 500 grizzly bears.

Whitebark pine, a preferred fall food for grizzly bears, has declined over the last decade due to an increase of mountain pine beetle-caused tree mortality, raising concerns for the bears' future. Although no one can predict for certain how declines in whitebark pine will affect grizzly bear population demographics, grizzly bears are well suited to adapt to changes in the abundance of individual foods. Since whitebark pine is a masting species that does not produce a seed crop every year, past poor seed production years provide an indication of what bears might rely on in the fall if whitebark pine becomes functionally extinct. GYE grizzly bears currently consume more ungulate meat, roots, and false truffles during years with poor whitebark pine seed production. Studies are ongoing to determine how whitebark pine seed production influences grizzly bear reproduction and survival. Recent research documents at least 266 known grizzly bear foods in the GYE, 39 of which are used frequently. After careful consideration of the research from this and other studies, the U.S. Fish and Wildlife Service may propose to delist GYE grizzly bears from their federal status as a threatened species in the lower 48 states in 2014.

Osprey

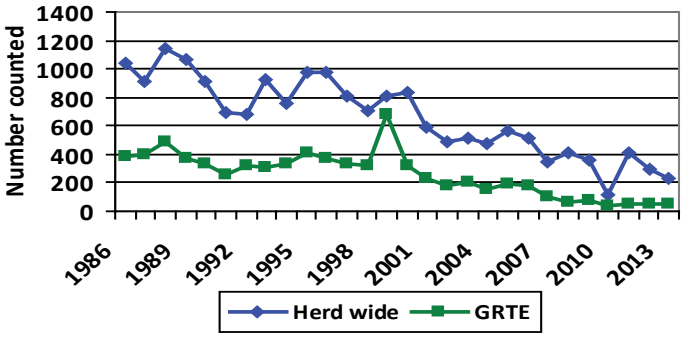
Osprey (*Pandion haliaetus*) are medium-sized hawks that prey almost exclusively on fish. The population of osprey in Grand Teton is migratory and research documents that osprey from the park migrate as far as the Mexican gulf coast and Cuba for the winter. Park monitoring of occupied osprey nests began in 1972. Initially only 6-8 nests were occupied on average each year. More recently, 16 territories have been occupied annually. Generally, nests are found near the low-elevation lakes in the park, along the Snake, Gros Ventre, and Buffalo Fork Rivers and their tributaries.

In 2013, osprey occupied 14 (74%) of 19 known territories. Breeding activity occurred at all 14 of these sites and 9 pairs successfully fledged a total of 15 young. The number of territorial pairs declined since 1990, while the number of young produced per occupied territory slightly increased. The decline in the number of occupied territories coincides with an increase in the number of territorial bald eagles. Compared to bald eagles, osprey populations recovered relatively quickly following the banning of DDT and now that eagles are more prevalent on the landscape, osprey populations may be responding by stabilizing at a lower level.



Territorial and successful osprey pairs, Grand Teton National Park, 1990-2013.

Moose

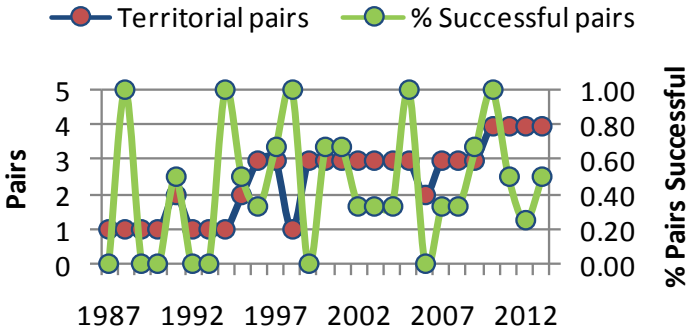


Jackson moose herd mid-winter counts, 1986-2013 (data from Wyoming Game and Fish Department).

Moose (*Alces alces*) were rare or absent from Grand Teton National Park prior to 1912, but became numerous by 1950. They are better adapted to survival in deep snow than other ungulates in the Greater Yellowstone Ecosystem. Except during the rut, moose are usually found alone or in small family groups. Grand Teton moose are part of the Jackson moose herd which encompasses animals in areas outside the park boundaries. The estimated size of the herd declined from a high of over 4,000 in 1990 to less than 1,000 since 2008. This partially migratory herd moves between distinct but overlapping summer and winter ranges. The Wyoming Game and Fish Department makes an annual winter estimate of herd size based on the number of moose counted in aerial surveys. The count for 2013 totaled 237 moose (45 within Grand Teton), producing a Jackson herd estimate of 500 animals. Ratios were estimated at 33 calves and 96 bulls per 100 cows.

The moose herd decline likely results from a combination of interacting factors. The ecological landscape of today is dramatically different than the turn of the 20th century when moose populations expanded. At that time, large-scale predator reduction programs were ongoing throughout the west, wildfire suppression was widespread, and restrictions on moose hunting were in effect. Today, grizzly and wolf populations have recovered, large-scale wildfires affected portions of the herd unit in 1988 and 2000, and hunting is currently at very low levels. Studies suggest that nutritional quality of moose forage in areas burned in 1988 is significantly lower than in unburned areas. Individuals summering in these areas have lower pregnancy and calf survival rates. Conversely, winter habitat availability does not appear to be limiting the growth of the Jackson moose population. Moose have narrow temperature tolerances. Temperatures above 57 degrees trigger moose to seek cooler locations. Many of the shady mature forests bordering the riparian forage areas preferred by moose remain absent after large fires. Additionally, warming temperatures associated with climate change may be affecting moose, by altering their feeding and other activities, potentially affecting food intake. Biologists are also studying parasites, like ticks and carotid artery worms, to evaluate their effects on moose populations.

Peregrine Falcons



Territorial and successful peregrine falcon pairs, Grand Teton National Park, 1987-2013.

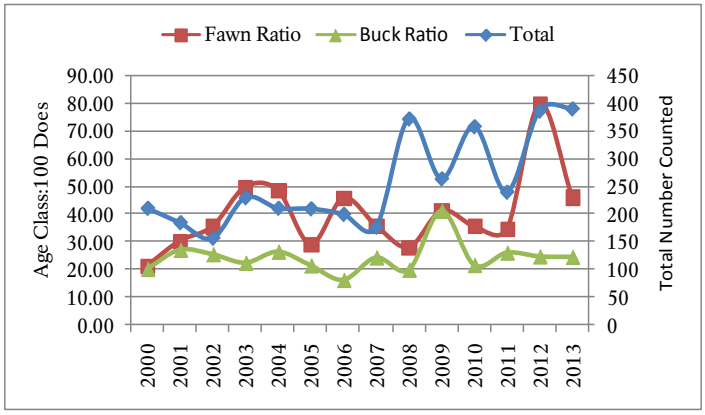
Peregrines (*Falco peregrinus*) are cliff-nesting falcons that mainly eat other birds. The lower elevations of the major Teton Range canyons provide peregrines with excellent cliff-nesting and diverse foraging opportunities. Decimated by DDT, peregrine falcons were extirpated from the Greater Yellowstone Ecosystem by the 1960s. Between 1980 and 1986, 52 fledgling falcons were released at several sites in Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway. Peregrine falcons first attempted nesting in 1987 at Glade Creek and successfully fledged young the next year. To date, peregrines use territories in Garnet Canyon, Cascade Canyon, Webb Canyon, near Glade Creek, and near Steamboat Mountain.

In 2013, four peregrine falcon eyries showed evidence of breeding activity, each occupied by two adult birds making a nest attempt. A single young peregrine fledged from the Cascde Canyon eyrie and two young fledged from the Garnet Canyon eyrie. The number of peregrine falcon pairs occupying territories in Grand Teton and the parkway appears to be stable, remaining at four for the last four years. The percent of successful pairs is highly variable and appears to be influenced by breeding season weather events. Over the past decade when at least three eyries were occupied consistently, there was only one year of complete reproductive failure (2006) and in most years, greater than 33% of nests were successful. Peregrines, once listed as threatened under the Endangered Species Act, were delisted in 1999.

Pronghorn

The pronghorn (*Antilocapra americana*) that summer in Grand Teton National Park are part of a herd that undertakes one of the longest terrestrial mammal migrations in the Western Hemisphere, second only to caribou. In the fall, these fleet-footed animals cover up to 30 miles a day on a roughly 150-mile route that follows the Gros Ventre River to its headwaters, and down to winter range in the Green River drainage. Pronghorn bones found at the Trappers' Point archeological site support that these animals have been using this narrow pathway for at least 6,000 years. Development around the southern end of their migration route has made it increasingly difficult for pronghorn to reach their winter grounds.

Using aerial line transects during June 2013, biologists counted 135 pronghorn (118 in the central valley of Jackson Hole and 17 in the Gros Ventre River drainage). Based on this count, biologists estimated the herd size at 368, an increase from 2012. Based on a late summer classification count by Wyoming Game and Fish Department personnel, ratios were estimated at 46 fawns and 24 bucks per 100 does. The reproduction rate in this herd segment is typically low, but varies widely. Low pronghorn fawn counts are often seen following a severe winter or a cool, wet spring. Fawn ratios returned to average after reaching the highest level seen in more than a decade in 2012. In general, a ratio of 25 bucks per 100 does is needed to maintain a good reproductive rate for the population.

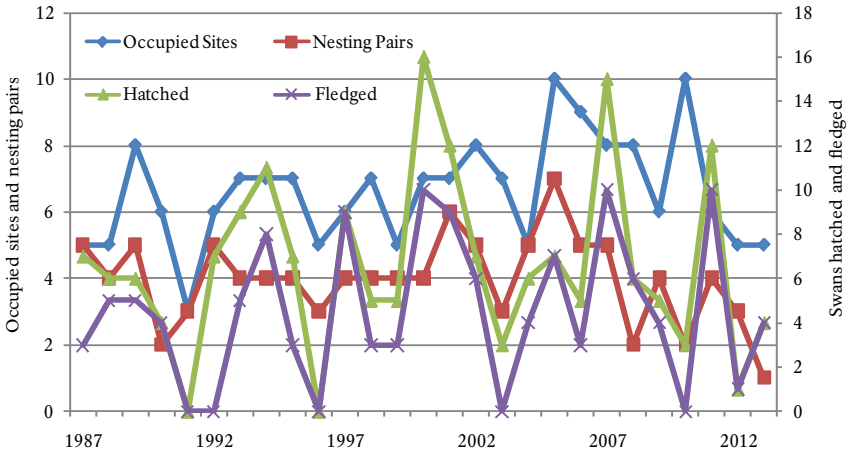


Pronghorn count and age/sex ratios during late summer classification counts, 2000-2013 (data from Wyoming Game and Fish Department).

Trumpeter Swans

Nearly exterminated in the contiguous 48 states by the turn of the 20th century, trumpeter swans (*Cygnus buccinator*) made a comeback after intensive captive breeding programs, habitat conservation measures, and protection from hunting. Despite these efforts, swan population growth is low in the tri-state region (the Greater Yellowstone Ecosystem and surrounding areas in MT, ID, and WY). Many factors likely inhibit recovery, including competition with migratory flocks of swans, marginal winter range, variable reproduction rates, limited and low quality nesting habitat, and high cygnet mortality. Monitored since 1987, Grand Teton provides important nesting habitat for swans.

Biologists monitor 12 historic nesting territories: 8 within the park and 4 outside but adjacent to park boundaries. In 2013, swan pairs exhibited breeding behavior at 5 territories, but only produced young at Pinto Pond where 4 cygnets fledged. The number of occupied swan sites, nesting pairs, and young hatched and fledged fluctuated widely over the last 26 years since monitoring began. In 2013, occupied territories, nesting pairs, and productivity were all below average. Swan pairs have disappeared from some traditional park nesting sites that were occupied for decades. Substantially decreased water levels due to drought and other undetermined causes likely led to abandonment of some sites while increased human activity and predation may affect occupancy and productivity at other sites.



Trumpeter swan productivity at territories in and adjacent to Grand Teton National Park, 1987-2013.

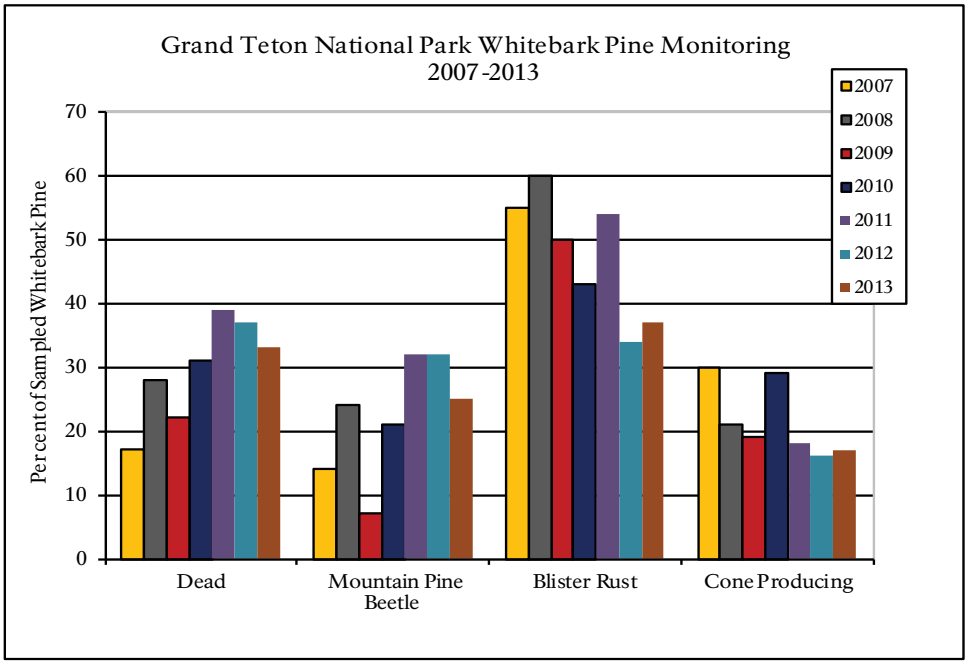
Whitebark Pine

One of the whitebark pines identified as being resistant to blister rust in the Stewart Draw area of Grand Teton National Park.

Whitebark pine (*Pinus albicaulis*) is a slow growing, long-lived pine, often the only conifer species capable of establishing and surviving on high-elevation sites with poorly developed soil, high winds, and extreme temperatures. As a keystone species with a disproportionately large ecological role compared to its abundance, whitebark influences biodiversity and forest structure. These trees maintain water quality by trapping snow, regulating snowdrift retention and melt, and preventing erosion of steep sites while producing seeds that are an important food source for grizzly bears, Clark's nutcrackers, and other wildlife. Whitebark pine is experiencing unprecedented mortality due to the native mountain pine beetle, the nonnative white pine blister rust, and altered climated conditions. Overflights of the Greater Yellowstone Ecosystem in 2009 found visible beetle activity in 90% of all watersheds containing whitebark pine. Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway have a total of 28,500 acres of whitebark pine forests–18,775 acres mixed with other conifers and 9,726 acres dominated by whitebark pine. In addition, white pine blister rust is found throughout the park and parkway causing extensive damage to cone-bearing branches, seedlings, and saplings, which reduces the likelihood that seedlings will survive to maturity.

Grand Teton's annual whitebark pine monitoring study, initiated in 2007, indicates that whitebark mortality, beetle activity, blister rust severity, seedling regeneration, and cone production vary by location. Whitebark pine is a masting species, meaning that trees produce sporadic large cone crops (generally every 3 years, but not necessarily so) though they also produce a small number of cones nearly every year. The data from Grand Teton suggests that cone production is decreasing over time; however, longer studies are needed to determine if this is a significant trend or just normal variability.

Overall mountain pine beetle activity has decreased since 2011, although areas of intense activity remain. Rust is present in nearly all sampled areas; the number of trees affected and severity of infection appears to be increasing annually. Among whitebark sampled in 2013, 33% were dead, 25% attacked by beetles, 37% were infected with blister rust, and 17% produced cones. Blister rust was present in 87% of the sampled transects. Whitebark regeneration was 97.6% rust-free with a seedling density ranging from 0 to 4420 per hectare. Beetle activity and blister rust severity was significantly greater at elevations less than 9,500 feet and on south aspect transects; blister rust severity was also greatest on larger diameter whitebark pines. Individual whitebark with greater rust severity had significantly higher incidence of mountain pine beetle attack.

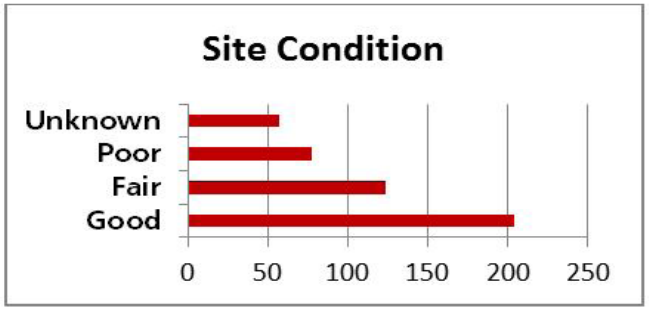


Distribution by status of individual whitebark sampled in Grand Teton National Park 2007-2013.

Archeological Sites

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway contain 479 identified archeological sites. The sites found in the valley of Jackson Hole and surrounding landscape range from prehistoric base camps to lithic quarries and scatters, which date to as early as 9,000 years before present. Archeological sites also include historic homesteads, roads, trails, irrigation ditches, and trash dumps dating from the late 19th century and early 20th century.

Official archeological work began in Grand Teton and the John D. Rockefeller, Jr. Memorial Parkway in the 1970s, and since that time archeologists surveyed approximately 4% of the 334,000 acres within Grand Teton and the Rockefeller Memorial Parkway, which equates to 13,900 acres of land.



Archeologists continue to discover and record new sites throughout the park and parkway; however, their work often focuses on assessing the condition of previously discovered sites. Currently archeologists have determined that 204 sites are in good condition; 124 sites are in fair condition; 77 sites are in poor condition; and a total of 57 sites lack data or the site condition is unknown. Of the 479 archeological sites within Grand Teton and the parkway, 179 sites are listed on or eligible for the National Register of Historic Places, 251 are considered ineligible for the National Register, and 49 sites are unevaluated.

Whenever possible, archeologists in the park and parkway will record and assess sites without collecting any artifacts, in order to leave these fragile cultural resources intact. However, staff will collect material when those resources are vulnerable to illegal collections or disturbance/loss through natural causes, such as erosion or flooding. These salvage efforts are made through surface collection, or if necessary, excavation.

Historic Structures

Grand Teton National Park has approximately 589 historic structures listed on or determined eligible for the National Register of Historic Places. The majority of these structures are within one of the 45 historic districts of Grand Teton National Park. These districts exemplify the historic character of Jackson Hole defined by homesteading, farming, dude ranching, conservation, recreation, and tourism. Two sites are designated National Historic Landmarks: Murie Ranch for its association with the conservation movement and Jackson Lake Lodge as the first example of modern architecture within a national park.

All of these structures have been assessed and documented in the NPS List of Classified Structures. These assessments, based on historic integrity and not functionality, show that 72% of the park's historic structures are in good condition, 14% in fair condition, and 14% in poor condition. The majority of the structures have been assessed within the last 3 years and all have been assessed within the last 10 years. Additionally cultural landscape inventories for seven historic districts are complete.

The cultural resources program at Grand Teton focuses on preservation planning as well as hands-on work to ensure that historic buildings are maintained and that historic fabric is not lost. Projects done in 2013 include the rehabilitation of three historic backcountry patrol cabins in Cascade, Death, and Upper Granite Canyons; a successful volunteer project at the Bar BC Dude Ranch repairing roofs, replacing rotting sill logs, and maintaining vegetation; and a week of preservation work on the T.A. Moulton Barn culminating in a centennial celebration.

To assist the park in future management decisions, cultural resources staff are working to complete a Historic Properties Management Plan—a comprehensive, strategic plan to provide management guidance and site-specific planning for historic properties. Although more than half of the park historic properties are in good condition and three-quarters are actively used with an assigned purpose, a comprehensive management plan will provide more direction for treatment and use of key properties in the foreseeable future.

Replacing the roof on the historic Cascade Canyon Patrol Cabin.

CULTURAL RESOURCES

Museum Collection and Archives

Jim Langford on top of the Grand in 1957.

Grand Teton's museum collections reflect the dynamic landscape for which the park was established and include an array of materials including archeological artifacts, ethnological materials, historical items, artwork, and natural history specimens. Three-dimensional artifacts such as the David T. Vernon Collection of American Indian Art, a stunning ethnographic collection and the most celebrated portion of the park's collection, comprise the majority of the museum collections. The collections also include archeological artifacts from various excavations throughout the park beginning in the 1970s; geological samples; historic vehicles; historic furnishings representative of regional furniture makers; and items that represent the regional history of homesteading, ranching, and climbing. Unique collections such as original Thomas Molesworth furniture, iconic western motif furniture, made by a Cody, Wyoming furniture maker beginning in the 1930s and a collection of Kranenberg Furniture, made by local Jackson residents Bob and Jack Kranenberg in the 1930-1950s, are some other collection highlights.

The museum also encompasses archival collections that document the complex history of Grand Teton National Park. The archives—the two-dimensional paper based materials—include reports, photographs and maps documenting subjects ranging from land management, natural & cultural resources including historic landscapes & structures, and the Teton's extensive climbing history. Grand Teton holds a unique collection of early summit registers that are comprised of original items left atop peaks documenting first ascents of climbers like Jim Langford's ascent of the southeast ridge of the Grand in 1957. In addition to the summit registers, Grand Teton also has a collection of mountaineering records that document climbing activities in the Teton Range beginning in 1898, which provides information including number of climbers in the party, climbers' names, climbing dates, and which peaks were to be climbed.

While Grand Teton National Park does not have one designated museum to exhibit the collections, 89 pieces from the David T. Vernon Collection are displayed in two of the park's visitor centers. Other items from the museum collections are on exhibit outside of the park in local museums such as the Jackson Hole Historical Society's Museum and the Teton Valley Museum. Some materials are held in repositories maintained by other institutions outside the park, such as the Midwest Archeological Center in Lincoln, Nebraska, where a large percentage of the park's archeological collection is stored. As of 2013, nearly 43% of the one million item collection is processed and cataloged. In 2013, a new curator completed a full 100% inventory of the collection; updates to the collections management database are still in progress. The Scope of Collections Statement defines what should be included in the museum collection as the best representation and documentation of Grand Teton's natural and cultural history, taking into consideration the expense of curation and preservation. Items that fall outside of that scope are deaccessioned and offered to other public institutions.

CHALLENGES

Livestock Grazing

Grand Teton National Park's organic legislation, along with several dozen other national park units, allows livestock grazing because of traditional land use prior to the park's establishment. When Grand Teton National Park (created in 1929) expanded in 1950, five ranches on inholdings in the park were allowed to retain their grazing allotments while another 26 ranches were granted grazing privileges for the lifetime of immediate family members. These regulations allowed livestock grazing and trailing on about 69,000 acres (22% of the park). Over time this acreage has been substantially reduced through attrition and the park's acquisition of inholdings through purchase or donation.

Today about 5,000 acres are still used for livestock grazing and trailing in the park by four ranches: two on park inholdings (the Pinto Ranch with 290 yearling steers and the Moosehead Ranch with 50 horses); one concessioner operating a historic dude ranch on park land (the Triangle X Ranch with up to 120 horses); and a ranch outside the park that operates under an agricultural use lease dating to the park's foundation (the Teton Valley Ranch with approximately 30 longhorn cattle). In addition, the state of Wyoming has a 614-acre inholding that is leased for grazing.

To address concerns about grazing impacts on riparian vegetation and minimize the potential for cattle depredation, park managers moved the largest remaining cattle allotment off open range and onto cultivated, irrigated Elk Ranch pasture lands in existence prior to creation of the park. This action benefits park resources, particularly in riparian areas.

CHALLENGES

Aquatic Nuisance Species

Federal, state, university, and private partners contribute to aquatic nuisance species prevention and monitoring efforts in Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway. Only a few aquatic nuisance species have been documented, including New Zealand mudsnails (*Potamopyrgus antipodarum*) in the northern region of the park and a suite of thermally limited, warm water species in Kelly Warm Springs including red-rimmed melania (*Melanoides tuberculata*), the American bullfrog (*Lithobates catesbeianus*), and multiple tropical and warm water fishes.

New Zealand mudsnails invaded geothermally warmed waters in Greater Yellowstone as early as 1994. Their current distribution includes Polecat Creek, Marmot Creek and the Snake River near Flagg Ranch. In 2001, University of Wyoming researchers found densities as high as 483,000 individuals per square meter in Polecat Creek, but densities have fluctuated greatly over the last 13 years. Studies indicate that the New Zealand mudsnail can alter stream nutrient cycling and outcompete the endemic Jackson Lake springsnail (*Pyrgulopsis robusta*). No population-level effects on fish were detected.

Didymo (*Didymosphenia geminata*), also referred to as "rock snot", is a microscopic algae that has been observed in the Leigh Lake Outlet, Phelps Lake Outlet and Inlet, Taggart Lake Outlet, Jenny Lake Outlet, Flat Creek, Fish Creek and Lake Creek. Even though this species is native, it can take on nuisance characteristics when certain environmental conditions allow for thick and explosive blooms. Didymo can form a mat greater than 20 cm thick that covers the rocky substrate and can shift the invertebrate community from large-bodied species to smaller species. The impacts of diymo on fish are not well understood.

Heavy growth of didymo in Lake Creek, Grand Teton National Park.

Grand Teton National Park is working with Wyoming's Aquatic Invasive Species Program to prevent further spread of these established aquatic nuisance species and to prevent the introduction of new aquatic nuisance species—especially zebra and quagga mussels (*Dreissena polymorpha* and *D. rostrifromis bugensis*, respectively), because these invaders have large ecological and economic impacts. Other aquatic nuisance species of concern that are now established in the Greater Yellowstone Ecosystem are Eurasian watermilfoil (*Myriophyllum spicatum*), curly pondweed (*Potamogeton crispus*), and the parasite that causes whirling disease (*Myxobolus cerebralis*). Primary tools for preventing the spread and introduction of aquatic nuisance species include (1) educating visitors to prevent spread, by decontaminating water crafts and fishing gear, (2) mandatory water craft inspection stations at state borders and high use areas, and (3)implementing an early detection monitoring program.

Mountain Goats

Mountain goats (*Oreamnos americanus*) are native to some rugged mountains of the American West, however not to the Greater Yellowstone Ecosystem. The closest native mountain goat population exists in the Lemhi Range of Idaho, roughly 125 miles northwest of Grand Teton National Park. From 1969 to 1971, the Idaho Department of Game and Fish released goats into the Snake River Range south of the park for the benefit of hunters. Presumably from this stock, mountain goats moved into the Tetons by 1977. Over the years, sightings became more frequent, with mixed-age and mixed-sex groups of mountain goats seen.

Since 2008, park managers confirmed consistent reports of mountain goats, including repeated sightings of nannies with kids which strongly suggest the establishment of a breeding population in the park. While a biologist spotted a single mountain goat in Webb Canyon at the northern end of the park, the majority of observations come from the vicinity of Cascade Canyon. In 2013, park managers received 12 reports of mountain goat sightings.

The main concern about establishment of a viable non-native mountain goat population in the Tetons is that it could displace, outcompete, or transmit diseases to the native bighorn sheep population. Park managers are already concerned about the long-term prospects of the bighorn sheep herd, due to its small size, isolation, and restriction to marginal winter habitats. As mountain goats and bighorn sheep share similar habitats and forage, the potential competition among the species in the park could pose additional threats to the precarious sheep population and the alpine community on which they depend.

In 2013, Grand Teton park managers and biologists began to develop a mountain goat management plan to address the park's goat population. This plan will examine several alternatives to mountain goat management in the park, including no action, monitoring, and a range of removal strategies.

CHALLENGES

Fish

Grand Teton National Park is home to 12 species of native fish along with 9 non-native fish (4 trout species and 5 warm or tropical species). Two distinct looking but genetically undifferentiated cutthroat trout (*Oncorhynchus clarkii*), the Snake River fine-spotted and Yellowstone cutthroat, are native to the park. Other native species include mountain whitefish; Utah chubs; redside shiners; northern leathersides; Paiute and mottled sculpins; bluehead, mountain and Utah suckers; and speckled and longnose dace. Historically the Wyoming Game and Fish Department stocked both the easily accessible valley lakes and the remote backcountry lakes with non-native game fish: lake, brook, brown and rainbow trout. With strong support from the park, the last fish stocking program ended in 2006. The state manages the recreational fishing licenses and catch limits of both native and non-native fish within the park, with input from the National Park Service.

Additional non-native aquarium species are found in Kelly Warm Spring, including swordtails, convict cichlids, tadpole madtoms, goldfish, guppies, bull frogs and red rimmed melania (snail). Park resource managers recently initiated efforts to curb the culture of aquarium dumping in the warm spring and are considering restoration efforts to bring the spring closer to its natural state.

The potential impacts of non-native trout species are not the only threats to native fish in Grand Teton National Park. Fish passage in three park waterways was impeded by irrigation diversion structures that acted as fish barriers. In recent years, two of the three were removed, reconnecting fragmented fish habitat. Removal of the Spread Creek diversion dam, in the fall of 2010,

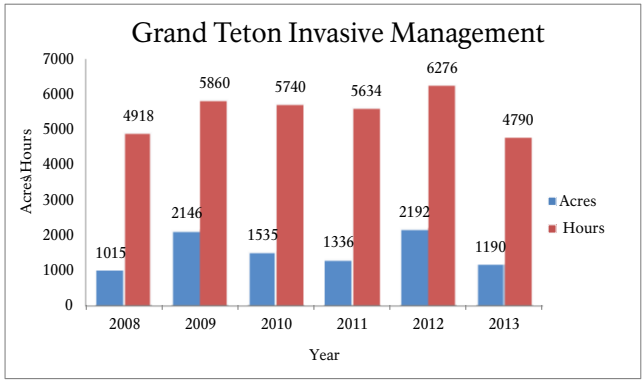
One of several Snake River fine-spotted cutthroat trout recovered from the Granite Supplemental Ditch on 10/28/13. The measuring board that the fish is lying on is 18" in length.

opened up more than 50 miles of stream habitat. The removal of the Newbold diversion dam, on the Gros Ventre River in 2013, opened over 100 miles of habitat for fish migration. The remaining barrier, Jackson Lake Dam, adds 40 vertical feet of water to the natural lake (equaling 847,000 acre feet of water) for irrigation purposes in Idaho's Snake River Plains. Managers of the dam's flow at the Bureau of Reclamation attempt to mimic natural flow regimes while still meeting water user needs downstream. Studies show that regulated systems can reduce habitat complexity and can affect cues used by fish for spawning events.

Irrigation ditches in the park have entrainment issues (trapping fish in ditches away from the natural waterway which typically leads to the fish's demise) and occasionally dewater natural streams. Historic water rights and prevailing attitudes about water usage make solutions to these issues complicated. While park managers face a variety of challenges, they continue working to maintain wild waterways for future generations.

Invasive Plants

Exotic plants displace native vegetation and may change animal distribution and foraging activities. Homesteaders planted exotic ornamentals and crops before the park was established and some of those species still persist. Today people inadvertently transport seeds on their vehicles, clothing, shoes, in livestock feed, and in construction sand and gravel. Areas particularly vulnerable to invasive plants include disturbed areas along roads, pathways, utility corridors, and building sites.



Annual record of the hours spent and acres treated for invasive plants.

Grand Teton biologists prioritize nonnative plant species according to the threats posed to park resources and the prospects for successful treatment. Some infestations can be eradicated if the species is treated when the outbreak is still small; other species are so common that stopping them from spreading is the primary goal. "Noxious weeds" are plants considered detrimental to agriculture, aquatic navigation, fish and wildlife, and/or public health. Park staff focus their efforts on finding and using the best treatments to address these most aggressive species. Listed with their primary exotic species, sites where park staff treated and managed noxious weeds successfully over the past five or more years include: Barker Meadow (musk thistle), Moran Cemetery (Dalmatian toadflax), Bradley-Taggart Trailhead and Meadow (yellow toadflax), and Kelly Hayfields (musk thistle).

Seasonal employees including a backpack spray crew; a backcountry horse crew; truck, tractor, and UTV sprayers; along with the Rocky Mountain Exotic Plant Management Team and volunteer groups treated 1,190 acres in 4,790 person hours in Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway during the summer of 2013. Areas treated include roadsides, developed areas, backcountry trails, horse trails, hayfields, and front country heavy use areas. Through a cooperative agreement Teton County Weed and Pest treated along the park's main highways, Teton Park Road and US 26/89/191. The park treats 15 major invasive species, which are listed on the Wyoming Noxious Weed List, as well as cheatgrass (*Bromus tectorum*) which is listed by Teton County, WY. This year, staff found one new invasive species (tall buttercup) that they treated and will monitor with the goal of eradication.

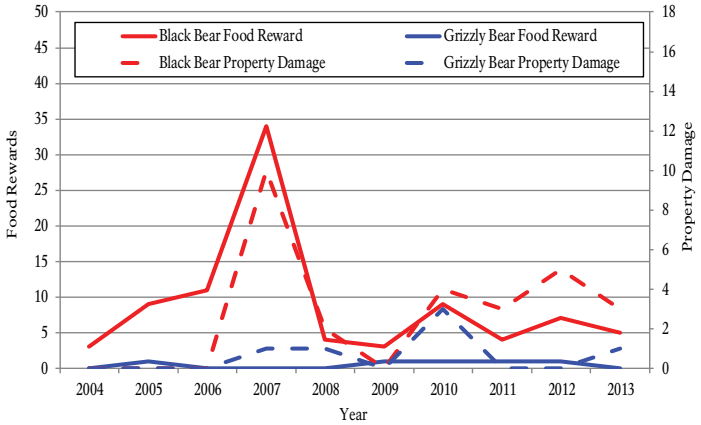
Human Bear Interface

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway provide habitat for healthy populations of black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears. Both bear populations are free ranging and naturally regulated. Grand Teton receives nearly 3 million visitors per year, most of whom visit during the peak summer season (June through September). Consistently high levels of human recreation in prime bear habitat create a high potential for human-bear interactions.

In an effort to decrease conflicts, park staff strictly enforce food storage regulations and all park facilities (including employee housing, concession areas, and visitor campgrounds) have bear-resistant garbage receptacles. The park delivers a "Be Bear Aware" message to the public through a variety of formats, in addition to providing annual bear management training to park and concession employees. The primary focus is to keep human foods away from bears. Since 2008, the park installed a total of 430 new bear-resistant food storage lockers in park campsites and picnic areas toward that goal.

Human-bear confrontations are incidents when bears approach or follow people, charge or otherwise act aggressively toward people, enter front-country developments, or enter occupied backcountry campsites without inflicting human injury. Human-bear conflicts are incidents when bears damage property, obtain anthropogenic foods, injure or kill humans, or are injured or killed by humans.

In 2013, park staff recorded 74 human-bear confrontations and 11 human-bear conflicts (respectively a 20% and 45% decrease from the previous year). Eight of the conflicts involved black bears, including five incidents in which a black bear received a food reward and three incidents in which a black bear damaged personal property (e.g., ripped tent, bit water bottle). Two incidents involved property damage caused by bears whose species could not be verified. In one human-bear conflict, a grizzly bear bit a camera bag left unattended by a photographer.



Documented cases of bears receiving human-food rewards or causing property damage in Grand Teton National Park.

A black bear checks a campground fire pit for food scraps, Grand Teton NP.

Seventy-three percent of the food reward and property damage conflicts in 2013 occurred in the park's frontcountry, the exact opposite of results observed in 2012. Almost 50% of these conflicts involved a black bear and her cub-of-the year. Between Lupine Meadows and Leigh Lake, they received three human food rewards and caused minor property damage on two occasions over a span of nine days in August. Attempts to trap the family group were unsuccessful. Later in August the pair moved to feeding on a mule deer carcass and did not exhibit nuisance behavior again. In July, a grizzly bear started foraging naturally within the Lizard Creek Campground. Park staff successfully hazed the bear out of the campground, but the bear returned the next day foraging close to visitor's tents and not responding to hazing this time. Bear managers trapped the approximately 3-year-old male bear and relocated it to Boone Creek. He was not observed within a developed area again.

Since 2007, Grand Teton employs the Wildlife Brigade, a corps of paid and volunteer staff, to manage traffic and visitor congestion that occurs at roadside wildlife jams, promote ethical wildlife viewing, patrol developed areas to secure bear attractants, and provide bear information and education material. In 2013, they recorded a minimum of 548 wildlife jams including at least 153 grizzly bear jams, 174 black bear jams, 42 jams for bears of unknown species, 117 moose jams, and 62 jams for other species such as bison, elk, and coyotes. The Wildlife Brigade has significantly decreased bear confrontations and conflicts in the park.

Plant Restoration

All revegetation and restoration that is conducted in Grand Teton National Park is accomplished with plant materials that originate within the boundaries of the park. Research confirms the benefits of using native locally occurring plant materials. Many plant species adapt to local environments. Using local genotypes can translate into greater success of restoration efforts while introduction of non-local genotypes can alter both genetic identity and physical traits of adjacent native populations. Park Service policy mandates using native species in revegetation efforts supporting the overall policy of leaving park resources unimpaired. In 2013, park staff supervised the hand collection of seed from 30 plant species. Park collection efforts totaled over 500 person hours and yielded approximately 1,333 pounds of bulk material. Contract crews gathered an additional 485 pounds of bulk material to use in future projects.

In 2013, crews worked on 22 separate projects (totaling 19 acres) associated with revegetating disturbances resulting from park infrastructure improvements such as replacement of waterlines, walking bridges, fiber optic lines, and building construction and repair. Overall plant ecologists worked to restore native plant communities to 131 acres of Grand Teton National Park in 2013. Restoration efforts included decommissioning social trails, restoring vegetation at a dam removal site, restoring native species on old agricultural fields, in addition to revegetation of facility improvements. Park crews applied 2,300 pounds of native seed in these projects.

Park staff remove social trails in important wildlife habitats to reduce habitat fragmentation, minimize the spread of non-native plant species, reduce soil erosion, and decrease negative impacts on water quality. In 2013, contractors and volunteers helped park crews remove and revegetate 28 miles of trails. Since compacted trails and roadbeds can be persistent barriers to plant establishment and root penetration, loosening soil in the trail tread prior to seeding increases success. Following soil decompaction, crews seed with a native seed mix by hand dispersal and with a rangeland seed drill. Crews also treat the project areas for noxious weeds that can outcompete native seed.

Park biologists taking measurements in a sagebrush monitoring plot.

Park revegetation crews continue the long term project to restore 4,500 acres of historic hayfields in the Antelope Flats area to the native sagebrush steppe community which provides important habitat for elk, bison, antelope, and sage grouse. Restoration of these lands can include: prescribed fire, herbicide applications, cereal grain cover crops, and finally native seeding. In 2013, crews sprayed herbicide to remove smooth brome on 343 acres, seeded 100 acres with a native seed mix, and treated weeds on 125 acres. Cumulatively in the last eight years, crews treated over 700 acres of the hayfields restoration area and seeded 422-acres with native plant species.

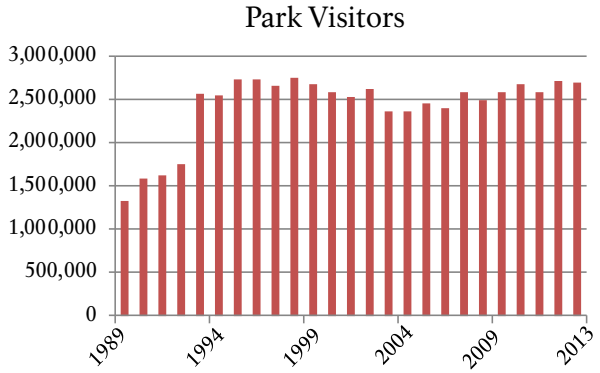
Since 2012, park staff collaborate with the Greater Yellowstone Inventory and Monitoring Network staff to monitor sagebrush steppe ecosystems. This monitoring provides information on the current condition of intact sagebrush communities and collects baseline data for evaluating long-term changes to these communities. Park revegetation crews establish and study vegetation plots to determine effectiveness of weed control and revegetation treatments. Grand Teton's revegetation efforts are crucial in reestablishing healthy, ecologically functioning plant communities.

Visitor Use

Use of the park by visitors is both a primary reason for establishment of Grand Teton National Park and a factor in the condition of some of the resources that the park is intended to protect. Visitor activities and associated infrastructure affects many park resources, including:

- air and water quality, and the natural soundscape;
- wildlife habitat, distribution, and habituation;
- the preservation of historic structures; and
- the spread of nonnative plants, diseases, and aquatic organisms.

Since 1993, recreational visits to the park have fluctuated between 2.4 and 2.8 million a year. In 2013, the park received over 2.69 million recreational visits with a total of 525,702 overnight stays. Frontcountry camping ranked first in visitor accommodations accounting for 55% of the overnight stays, followed by lodging with 39%. While almost half of the park (44%) is considered backcountry, only 5.7 % of the overnight stays were in backcountry campsites. Although there are no day-use limits, lodging and campgrounds in the park are limited by available space, and on some summer nights, one or more forms of accommodation are full. Daily visitation during July 2013 averaged 20,737 visitors. About 81% of the park visitation occurs in the warmer months, from June through September.



Annual Grand Teton visitation 1989–2013.