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 2015

This report is made possible through generous support from
Grand Teton National Park Foundation and Grand Teton Association.

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Acknowledgments

To supplement the work done by the Grand Teton Resource Management staff, the following organizations provided data and/or analysis that were used in preparing this report:

- Biodiversity Research Institute
- Craighead Beringia South
- Colorado State University, Federal Land Manager Environmental Database
- Grand Teton Fire Management Program
- Grand Teton Jenny Lake Rangers
- Greater Yellowstone Inventory and Monitoring Network
- Greater Yellowstone Whitebark Pine Monitoring Working Group
- Interagency Grizzly Bear Study Team (U.S. Geological Survey–Biological Resources Division, National Park Service, U.S. Forest Service, and the states of Idaho, Montana, and Wyoming)
- National Park Service Air Resources Division
- National Park Service Northern Rockies Exotic Plant Management Team
- Sky Aviation
- U.S. Fish and Wildlife Service, National Elk Refuge
- U.S. Forest Service, Bridger Teton National Forest
- U.S. Geological Survey, Northern Rocky Mountain Science Center and Columbia Environmental Research Center
- Western Regional Climate Data Center
- Wyoming Game and Fish Department
- Wyoming State Climate Office
- Yellowstone Center for Resources

To supplement funding from the National Park Service, funds from the following organizations supported the monitoring of vital signs included in this report:

- Charles Engelhard Foundation
- Grand Teton Association
- Grand Teton National Park Foundation
- Greater Yellowstone Coalition
- Greater Yellowstone Coordinating Committee
- National Park Service Air Resources Division
- Upper Snake River Basin Sage Grouse Working Group
- U.S. Forest Service, Forest Health Protection
- Wildlife Conservation Society

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Suggested citation: U.S. Department of Interior, National Park Service, *Grand Teton National Park & John D. Rockefeller, Jr. Memorial Parkway: Resource Report 2015*, Moose, Wyoming, USA, 2016.

Cover painting: The Sound of Taggert (sic) Creek by Dave Santillanes. Painted 2013. 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.

A moose pair during the fall rut.

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. 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 air, water resources, and many of the animals' seasonal migrations cross the boundaries of the park where other factors influence their condition. 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 affect 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) 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, elk, and mule deer).
  - are considered important indicators of ecosystem health because they are especially sensitive to environmental pollutants, habitat alteration, and climate change (sagebrush steppe, amphibians, fish, 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

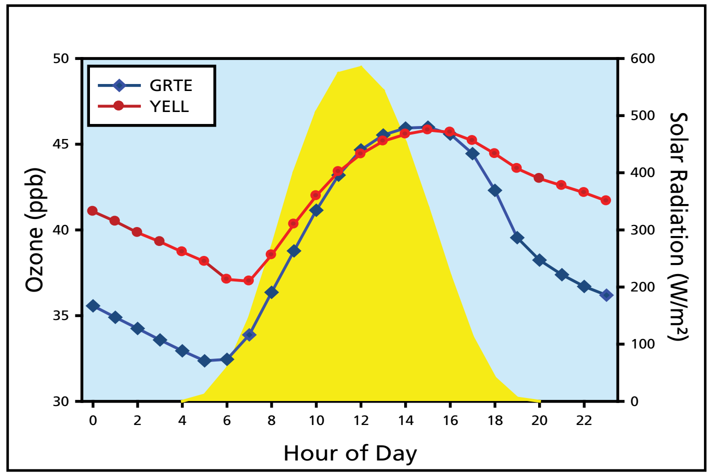
Resource	Indicators	Current Condition 2015 (or latest available)	Reference Condition
Climate and Environment			
Air Quality	Basic air quality parameters at 1 site	Class I Airshed	Clean Air Act
Climate	Average min., max. daily temp. (Moose) Annual precipitation (Moose) Growing degree days (Moose)	26°F, 57°F 25.12” 2,733 days (2012)	22°F, 52°F (1958–2012 average) 21.41” (1958–2012 average) 2,366 (1958–2012 average)
Fire	Acres burned per year by wildfire	7 acres	1–9,660 (1996–2015 range)
Glaciers	Extent of 10 named glaciers	1.5 km²	Long-term decline
Water Quality	Basic water quality parameters- 2 river sites Basic water quality parameters- 3 alpine lakes	Iron meets state standards 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	72%	TBD
Bald Eagles	Breeding pairs	17 pairs	13 pairs (2006–2015 average)
Bighorn Sheep	Teton Range herd estimate	100-125 sheep	TBD
Bison	Jackson herd winter count (includes areas outside park)	691 bison	500 bison
Common Loon	Breeding pairs	1 pair	TBD
Elk	Jackson herd winter count (includes areas outside park) Summer count (portion of park herd)	11,200 elk ≥672 elk	11,000 elk ≤1600
Gray Wolves	Wolves in Wyoming (outside of Yellowstone) Breeding pairs in WY (outside of Yellowstone)	283 wolves (44 use park) 25 pairs (2 uses park)	≥100 wolves ≥10 pairs
Great Blue Heron	Active nests	14 nests	23 nests (1991–2015 average)
Greater Sage-grouse	Active leks	7 leks (6 in park)	10 occupied 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)	717 17 bear management units 8.9% 11.7% 5.8%	≥500 grizzly bears ≥16 bear management units not > 7.6% not >15% not > 7.6%
Moose	Jackson herd winter count	≥241 (59 in park)	TBD
Osprey	Breeding pairs	16 pairs	16 pairs (2006–2015 average)
Peregrine Falcon	Breeding pairs	5 pairs	3 pairs (2006–2015 average)
Pronghorn	Jackson Hole/Gros Ventre herd estimate	578 pronghorn	Increasing trend
Trumpeter Swans	Occupying breeding territories (includes areas outside park) Pairs producing young	3 pairs (1 pair in park) 2 pair (3 cygnets fledged)	16 historic territories (11 in park) TBD
Whitebark Pine	Blister rust infection (% of trees in park)	59% of trees	TBD
Cultural Resources			
Archeological Sites	Percentage of park inventoried Percentage of documented sites in good condition	4.5% of the park 42%	TBD TBD
Historic Structures	Percentage assessed in good condition	72%	TBD
Museum Collections	Percentage that has been catalogued	61%	100%
Challenges			
Aquatic Invasive Species	Presence of non-native species	1 widespread 6 Kelly Warm Spring area	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	15 in park	13 (2008–2015 annual average)
Invasive Plants	Species present Acres treated	28 invasive species 1491 acres	0 (limit spread & effects on native sp.)
Mountain Goats	Estimated number in park	40–60 goats (in the park)	0 (limit spread & effects on native sp.)
Plant Restoration	Restoring native plant communities in former agricultural fields (Kelly hayfields)	1235 acres under restoration treatment	100% of 4500 acres in the former Kelly hayfields area

Reference condition specified by government regulation or management plan. (shaded rows: Air Quality, Water Quality, Bison, Elk, Gray Wolves, Grizzly Bears, Plant Restoration)

Air Quality

While Grand Teton National Park 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. Since 2011, Grand Teton operates an air quality monitoring station that measures wet deposition, primarily nitrogen, metrological data, ozone, ammonia, and visibility. The link for real-time results from this station, including a webcam is http://www2.nature.nps.gov/air/WebCams/parks/grtecam/grtecam.cfm. 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.



The average hourly ozone levels at Grand Teton NP (blue) and Yellowstone NP (red) compared with solar radiation (yellow).

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.

Ozone, a criteria pollutant regulated under the National Ambient Air Quality Standards, varies by hour of the day and by season. Grand Teton has generally lower levels than nearby Yellowstone, but patterns in the data suggest that local sources of pollutants affect the daily levels.

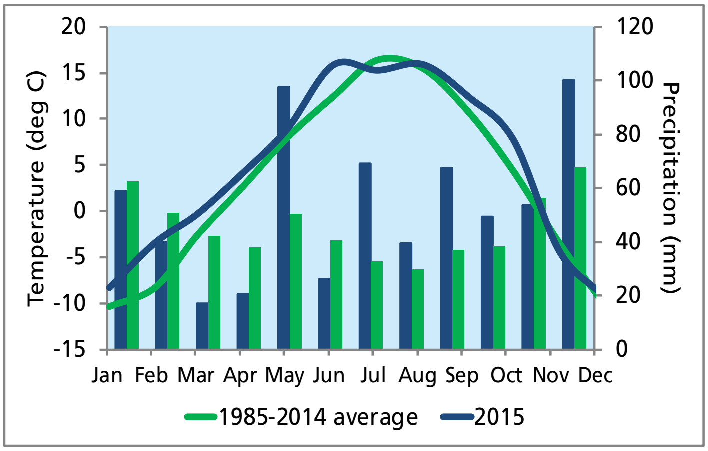
Visitors come to Grand Teton to enjoy spectacular views of the Teton Range and the Jackson Hole valley. Sometimes the park's scenic vistas are obscured by haze caused by fine particles in the air. Many of the same pollutants that ultimately fall out as nitrogen and sulfur deposition contribute to this 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.

While ground-level ozone concentrations are generally low in Grand Teton NP, there are a few ozone-sensitive species present in the park, such as quaking aspen (*Populus tremuloides*), and Scouler's willow (*Salix scouleriana*), and this spreading dogbane (*Apocynum androsaemifolium*).

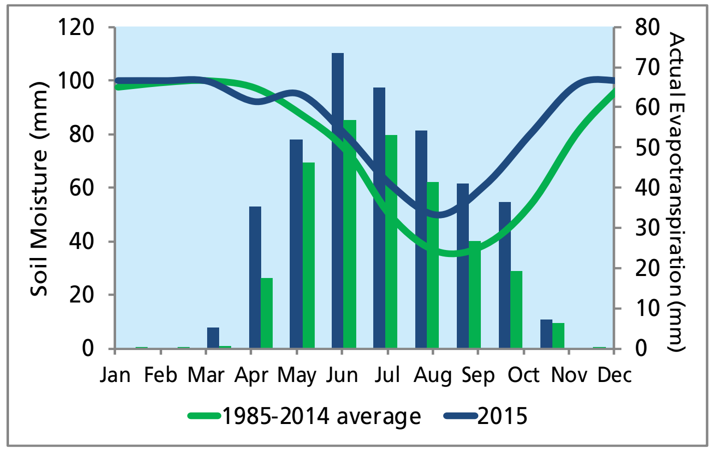
Climate

The year 2015 was the warmest year on record globally. In Grand Teton National Park at Moose, WY, 2015 was the second warmest year recorded since 1985. In 2015, weather station records show a mean annual temperature 1.5°C warmer than average for the period between 1985 and 2014. However, 2015 was wet with 98 mm more precipitation than average which made it the ninth wettest year since 1985.

The spring snow pack was 86% of average and it melted rapidly due to high spring temperatures that were 2.9°C warmer than average for the months February through March. This set the stage for a dry growing season, but during April continuing on through October rain was 160% of average. This kept soil moisture at 126% and evapotranspiration (water use by plants) at 148%, well above average for the growing season. Higher than average soil moisture in May through October held the soil moisture deficits to 67% of average.



Monthly comparison of 2015 temperature (lines) and precipitation (bars) in Grand Teton NP compared to the 1985-2014 average.



Monthly comparison of 2015 soil moisture (lines) and evapotranspiration (bars) in Grand Teton NP compared to the 1985-2014 average.

Fire

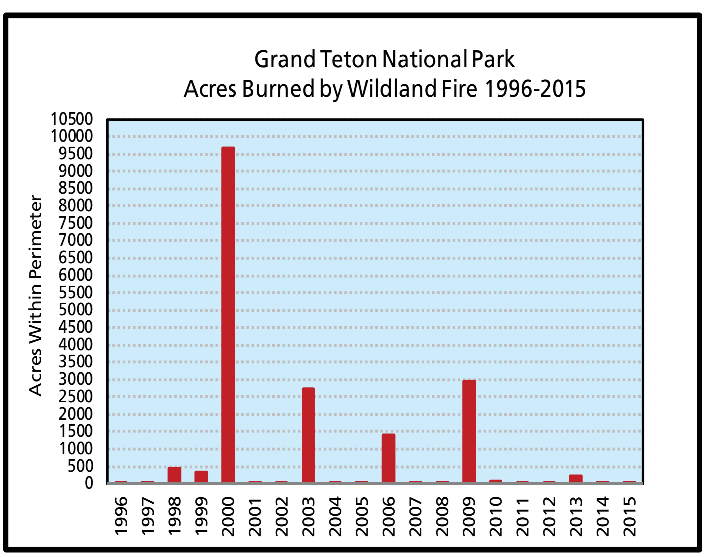
Grand Teton National Park's ecosystem evolved with periodic fire disturbances, and the plant communities adapted to recover through successional stages over time, creating a diverse array of habitats for wildlife species. Depending on severity, vegetation type, and post-fire climate conditions, fire contributes to different patterns of ecological change. Climate change is likely to further influence fire ecology in the coming decades. Fire managers at Grand Teton are charged with using science to keep the role of fire on the landscape as ecologically sound as possible while protecting important values like visitor safety, developed areas, and cultural resources.

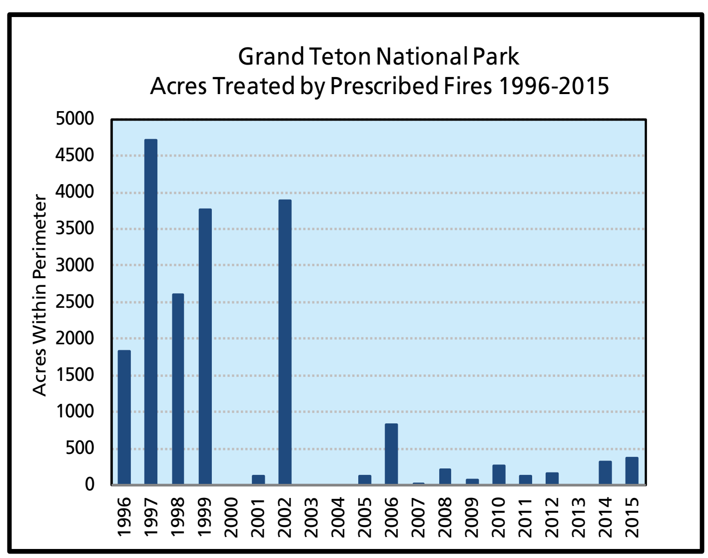
Park managers examine past fire patterns in order to better manage fire now. While park fire history from the 1940s–present is well documented and mapped, earlier fire history is more difficult to pinpoint. In 2014, the NPS Fire Program funded a research project to investigate fire history in Jackson Hole using a combination of tree ring core samples, fire scarred trunks, and a historical map made in 1898. This Brandegee timber survey map indicated large areas of Jackson Hole burned in the late 1800s. Fire ecologists from the Teton Science School and Colorado State University translated that map into a geospatial format. Field crews then worked to verify burned areas in addition to sampling adjacent green forest sites indicated on the Brandegee map. For the burned areas, the historic map proved highly accurate; however, most of the plots located in supposedly unburned areas also had seen stand-replacing fire since the 1600s. Fire history from plots located in Douglas-fir vegetation was more difficult to decipher. Fire-scarred trees indicated multiple ground fires occurred without killing the overstory in some stands, while other Douglas-fir stands were completely replaced after a more severe burn. In 2015, the research team focused specifically on understanding Douglas-fir fire ecology. This research partnership will help inform fire management decisions for managing lightning-ignited fires and using prescribed burns to maintain natural processes that influence the health of park vegetation.

After several years of planning and waiting for appropriate conditions, firefighters ignited the 371 acre Matilda Prescribed Fire in September of 2015 to improve wildlife forage opportunities and protect homes in the Pacific Creek Subdivision.

In the past 20 years, 214 wildland fires burned a total of 17,997 acres. During this period in the park, the biggest fire year was 2000, when nearly 10,000 acres burned in five large lightning-caused fires north and west of Jackson Lake. Since 1996, a total of 19,421 acres were included in prescribed fire treatments.

Regular and abundant rainfall kept fires small in Grand Teton National Park during 2015. Lightning ignited three fires, the largest grew to seven acres. Heavy rain extinguished the River Bottom Fire, burning in the base of a tree, a few days after it was discovered. The other two lightning fires were suppressed because they were near private homes and developments. Park staff also suppressed two human-caused fires. In September, the Matilda prescribed burn was completed in the area of Pacific Creek to create a defensible space in the forest near private homes, identified in the Teton County Community Wildfire Protection Plan as a "community at risk."





Glaciers

Grand Teton National Park is home to 10 named glaciers formed during a recent cold period known as the Little Ice Age from about 1300 to 1850. The existing glaciers are *not* remnants of the much larger Ice Age glaciers that shaped the Tetons' canyons and frontcountry lakes before disappearing about 10,000 years ago. Glaciers provide long term water storage and are critical contributors to aquatic systems, particularly in low flow seasons, by providing steady baseflow 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.

Mapping the surface of Middle Teton Glacier, Sept. 2015.

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 using remote sensing and historic aerial photography 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). 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.

In 2015, park staff held interagency meetings on glacier monitoring and research to discuss creating general monitoring protocols and standards for the entire northern Rocky Mountain area, in collaboration with North Cascades monitoring program. Standardizing methods on the regional scale as well as sharing information will help scientists understand and address changes in glaciers, future water supply, and stream temperatures.

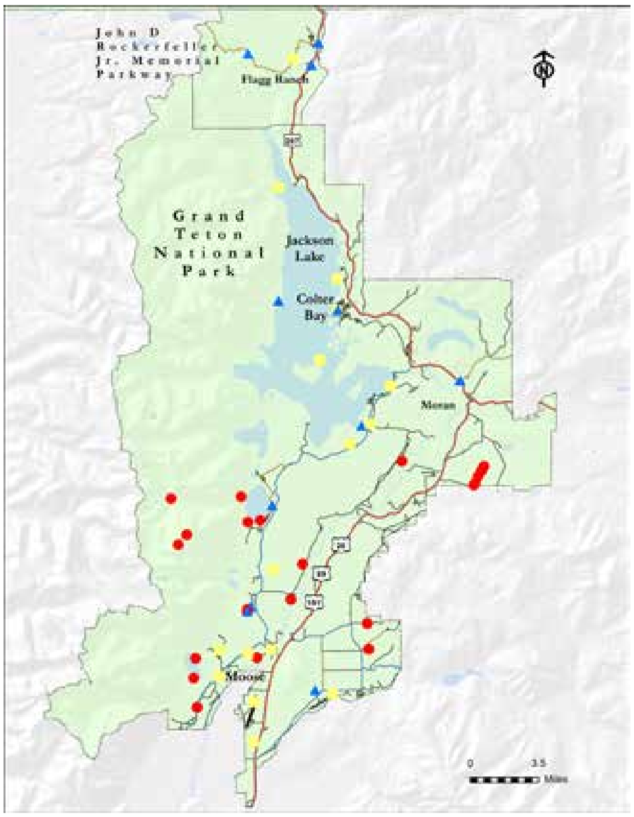
During the 2015 field season, park staff installed a temperature sensor network (to compare local data with the nearest climate stations), time lapse cameras (to monitor glacier movement and changes over the melt season), and a pyranometer (to measure solar radiation and compare to valley data). Comparisons of aerial photography, ground photography, surface elevation, GPS surveys, and LiDAR images help researchers assess changes in glacier perimeters, surface areas, and volumes. Researchers also use time lapse cameras to image glaciers that are too difficult or hazardous to monitor directly like Petersen and Falling Ice Glaciers.

In September 2015, a team of park GIS and hydrology staff working with park climbing rangers trained to assist with the dangerous on-glacier work completed an elevation survey of the upper lobe of the Middle Teton Glacier, with vertical accuracies to 10 centimeters or less. Researchers compared resulting survey data with the 2014 high accuracy LiDAR topographic imagery and determined volume loss from the previous year. Because of differences in the sampling years (the snowpack didn't completely melt in 2014 while in addition to annual snow pack melt there was significant loss of glacial ice in 2015), the comparison cannot define glacier ice lost during the period, but did show volume loss of almost 51,000 cubic meters. In the long term, these comparisons with additional surveys will assess glacier loss or gain. Using local climate data, researchers will evaluate glacier response to annual temperature, cloudiness, and precipitation factors with initial accuracy estimates of +/- 10 centimeters—appropriate for long term monitoring of ice elevations and volumes in the glaciers. Field methods developed by the team can be applied to the other Teton glaciers. These glacier elevation surveys in conjunction with future ablation stake installations and the use of remotely sensed imagery for mapping glacier margins (assisted by ground photo monitoring) will enable park staff to track mass balance and volume trends over time, providing an accurate history of the loss (or gain) in glacier ice in response to climate variability and trends.

Area surveyed on the Middle Teton Glacier during Sept. 2015.

Soundscape

Since 2003, a bioacoustic ecologist has monitored and researched 58 locations throughout the park in various management zones, ecological habitats, and elevations from the Snake River to the summit of Grand Teton. Throughout the year, he collects digital recordings and sound levels that characterize and quantify the park's soundscape and acoustic resources. 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.

This roadside real-time noise level display is part of the Motorcycle Ride Respectfully Campaign to educate all visitors about the importance of the park's natural soundscape.

The soundscape of Grand Teton is composed of natural and human-caused sounds. Natural sounds include intentional sounds (singing and bugling), 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 most prominent 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 changing park protocols.

Water

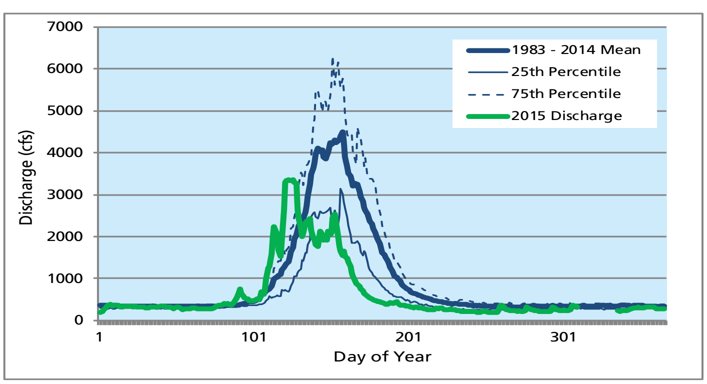
Collecting water samples in the Snake River at Flagg Ranch, Grand Teton NP.

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 feet 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.

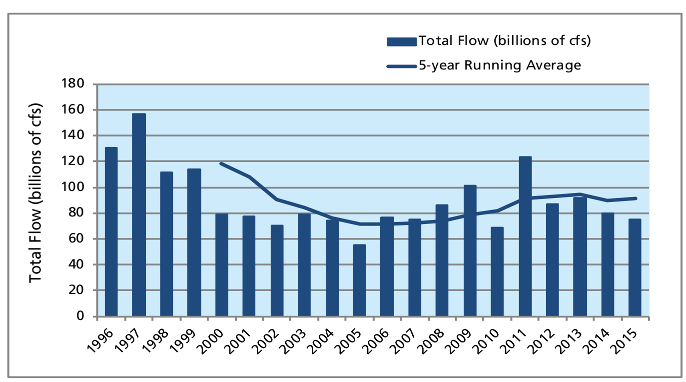
The uppermost reaches of the Snake River in Wyoming are characterized by good water quality with relatively low levels of dissolved nutrients and other anthropogenic compounds (e.g., pesticides). Good water quality and the presence of native fish, including cutthroat trout, are not surprising given that the headwaters of the Snake River include 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 the park 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 Wild and Scenic River designation by Congress (Snake River Headwaters Legacy Act, 2009), designed to preserve the Snake River headwaters' outstanding natural, cultural, and recreational values for the enjoyment of present and future generations.

The U.S. Geologic Survey monitors flow levels of the Snake River at two locations—Flagg Ranch and Moose, Wyoming. Overall discharge in 2015 was relatively low and peak flows at Flagg Ranch, Wyoming, ranked as the 2nd lowest in the 32-year monitoring record. Additionally, peak flows occurred three weeks earlier than the average for the Flagg Ranch site. Snake River flows at Moose were close to 25% of record of flows for that site (1995–2015) but are strongly modified by Jackson Lake Dam. Total volume of annual flow at the Moose monitoring location ranked 16th out of the 20-year record and the date of half discharge (when half of the annual volume of water occurs; June 16, 2015) occurred 12 days earlier than the average for this location. NPS resource staff have monitored water quality in the Snake River at these same locations for over a decade. Results from 2015 confirm that concentrations of primary nutrients (nitrogen and phosphorus) remained low or below detection. Trace metals (i.e., arsenic, copper, and selenium) are found in the watershed and are often naturally present in measurable concentrations, but below the State of Wyoming's aquatic life criteria. In 2015, copper and selenium were generally low and below detection levels, while total arsenic concentrations increased to measureable amounts during low flow at both sites. Conversely, total iron concentrations are highest in the Snake River during spring runoff. After several years of registering above the State of Wyoming's aquatic life criterion, iron concentrations in 2015 did not exceed the criterion. Because most of the watershed in the upper Snake River is undeveloped, scientists believe that iron and other trace metals are naturally occurring and that natural fluctuations in iron levels are driven by elevated spring discharge.

In 2006, Grand Teton park staff began a monitoring study of three alpine lakes (Amphitheater, Delta, and Surprise Lakes). The 2015 sampling events in July and October showed that water quality varied between sampling dates. Delta Lake has consistently had the highest levels of nitrogen compared with the other monitored lakes. The presence of glacier ice in alpine watersheds of the American Rocky Mountains has been shown to strongly influence nitrogen concentrations. Therefore, glacial contributions may help explain elevated nutrient levels documented in Delta Lake.



Summary of the average daily discharge in the Snake River near Flagg Ranch, Wyoming. River flows are presented by day of year.



Graph of annual river flow totals (in billions of cfs) for the Snake River at Moose, WY. A 5-year moving average is included to smooth annual variations for a clearer examination of trends.

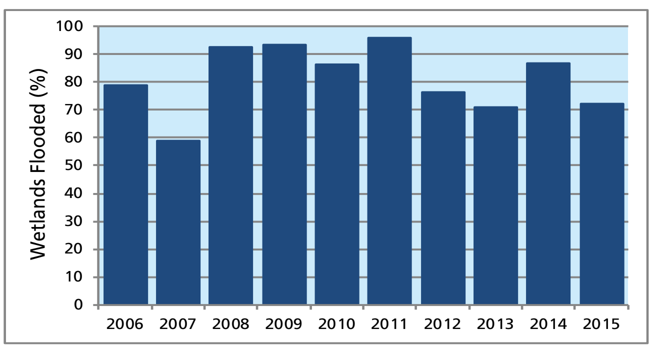
Amphibians

A western toad using a rodent burrow.

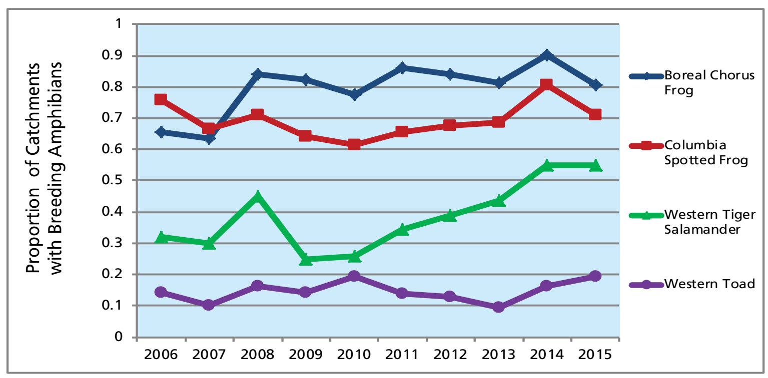
Biologists recognize four species of native amphibians in Grand Teton and Yellowstone National Parks: western tiger salamander (*Ambystoma mavortium*), boreal chorus frog (*Pseudacris maculata*), western toad (*Anaxyrus boreas*), and Columbia spotted frog (*Rana luteiventris*). The boreal chorus frog and the Columbia spotted frog are the most widely distributed species while the distribution of the western tiger salamander and western toad is more restricted. The northern leopard frog was historically documented in Grand Teton National Park, but there has been only one confirmed sighting since the 1950s. Plains spadefoot toads (*Spea bombifrons*) were recently documented in Yellowstone's Lower Geyser Basin, but their presence in Grand Teton has not been documented.

Annually since 2006, biologists in the Greater Yellowstone Ecosystem have monitored and documented amphibian breeding activity in 31 catchments. Encompassing about 500 acres each, these catchments or watersheds are defined by topography and vary in amounts of seasonal and permanent water. Within these 31 catchments, researchers visited 332 individual wetland sites in 2015, and surveyed 237 that had standing water present. Biologists documented breeding activity using visual surveys to detect eggs, larvae (e.g. tadpoles), and metamorphs. Of these sites, 57% were occupied by at least one species of breeding amphibian. In 2015, only two of the 31 catchments contained breeding evidence of all four species. These two catchments are referred to as amphibian "hotspots."

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; in 2015, nearly 72% of visited wetlands were flooded. 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). Increasing temperatures are predicted for this region and could therefore alter wetland habitats and influence amphibian breeding.



Percentage of surveyed wetlands with standing water suitable for breeding.



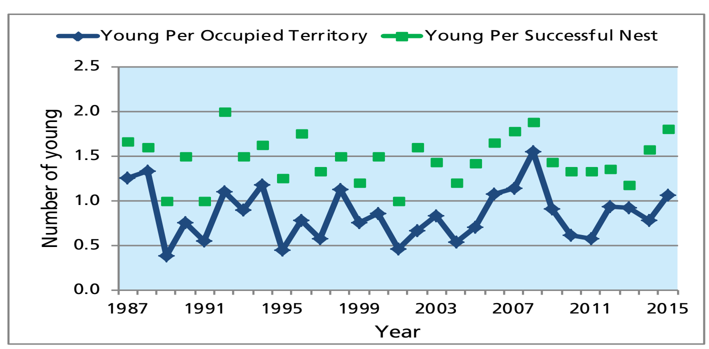
Proportion of surveyed catchments where breeding was observed for each species.

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 18 bald eagle territories monitored in 2015, 17 pairs occupied territories. Eleven pairs nested and fledged 18 eaglets, marking another year of high production. While the number of occupied territories, productive nests, and fledglings exceeded the 10-year average, the number of nesting pairs was slightly below average.

Bald eagles, once listed as endangered under the Endangered Species Act, were delisted in 2007. Over the past few decades, bald eagles experienced a dramatic recovery in Grand Teton, mirroring their recovery throughout the Greater Yellowstone Ecosystem. The number of territorial pairs in the park has almost doubled over the past 25 years. In accordance with the Greater Yellowstone Bald Eagle Management Plan (1987), park managers implement temporary closures around active bald eagle nest sites to minimize disturbances. In 2015, closures were established at nest sites along the Snake River and at one site near Two Ocean Lake.



Counts of bald eagle pairs occupying territories and successfully producing young in Grand Teton NP, 1987-2015.

Bighorn Sheep

Bighorn sheep (*Ovis canadensis*) were once widely distributed throughout the mountains and foothills of the Rocky Mountain west. They persist today in small, fragmented populations that remain at risk of further decline and extirpation. 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 Teton Range 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 information. Based on the number of sheep counted during the 2015 ground survey, biologist estimated herd ratios of 55 lambs, 31 yearlings, and 41 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.

Research conducted in the mid-1990s found that avalanches and falls accounted for the majority of known mortalities, while predation and starvation caused a small percentage of deaths. More recent studies determined that the north and south segments of the herd are genetically distinct, increasing concerns for the health of the population. 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 reduce the potential for disturbance and stress, the park closes crucial sheep winter range to human entry. No incursions into sheep winter range were reported in 2015.

Researcher scanning the high country of the Teton Range as part of the annual bighorn summer count, 2015.

Columbian Sharp-tailed Grouse

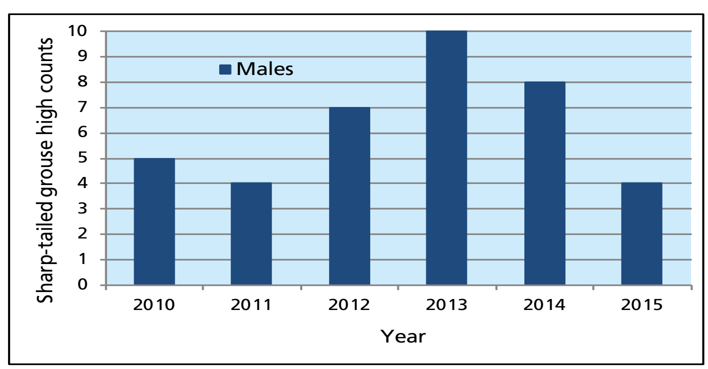
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) are endemic to sagebrush, shrub-steppe, mountain shrub, and riparian shrub communities. Once found in nine states and British Columbia, Canada, this subspecies now occupies less than 10 percent of its historic range. Excessive hunting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

Similar to 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, and the nearest known lek was in Idaho along the western 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 2015, biologists observed a maximum of 4 adult males strutting at the lek, but did not see any females.

B. Schiess

A male Columbian sharp-tailed grouse's courtship display.



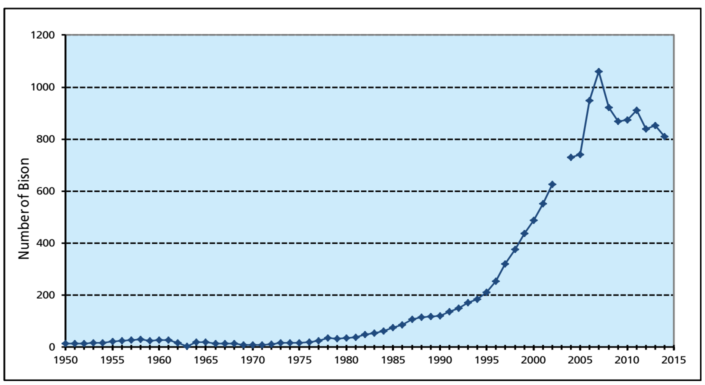
Annual counts of male Columbian sharp-tailed grouse displaying at the lek in Grand Teton National Park, 2010-2015.

Bison

Mature bull bison with the classic thick forehead fur and beard.

Bison (*Bison bison*), native to Jackson Hole, were extirpated from the area by the mid-1800s. In 1948, twenty animals from Yellowstone National Park were introduced to the fenced 1,500-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. During the winter of 1980, bison moved onto the National Elk Refuge and began using supplemental feed intended for elk. Since then bison have returned annually to exploit this food source.

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. The herd is now the second largest unfenced bison herd in the United States. 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. Bison summer primarily in Grand Teton National Park, and 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 annual winter count of 2015, biologists counted 674 bison using the National Elk Refuge feedlines and adjacent areas. Seventeen bison foraged on native winter range in the Elk Ranch area of the park. The herd-wide total of 691 is a significant decrease from the 794 counted in 2014 and continues the downward trend from the population high of 2007.



Population size of the Jackson bison herd, 1950-2015.

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 207 known bison mortalities in 2015, 206 resulted from legal harvest outside the park. In 2015, four bison were struck by vehicles, but only one was confirmed dead.

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 2015, one loon pair nested on Arizona Lake (just outside the park boundary), and a lone adult was observed on Emma Matilda Lake. The individual on Emma Matilda exhibited territorial behavior early in the breeding season but was never observed with a mate. No loons were observed during surveys of Leigh or Jenny Lakes. The Arizona Lake pair fledged two loonlets.

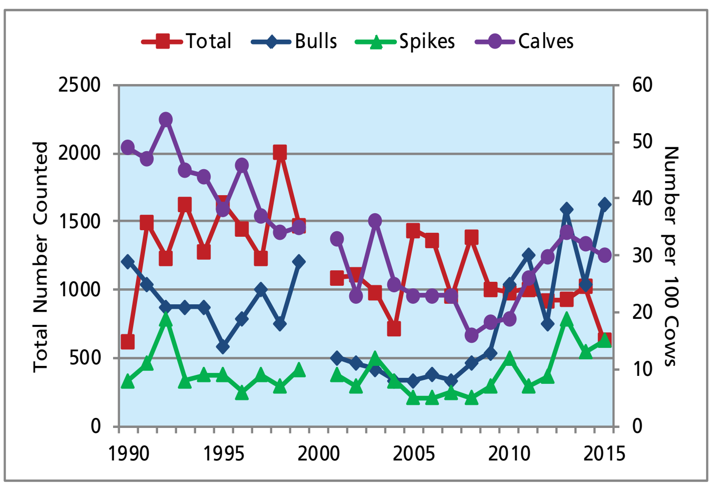
V. Spagnuolo

Elk

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway support a migratory Rocky Mountain elk (*Cervus canadensis*) population that is part of the larger Jackson elk herd. Elk summer throughout these parklands 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 one of 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, their grazing and browsing affect plant productivity and, as prey and carrion, elk provide sustenance to carnivores and scavengers. They are also popular with park visitors.

Park biologists counted and classified 628 elk in 2015 during the annual summer survey. The total number of elk counted was almost 400 fewer than in 2014. Herd ratios and composition in the standard survey area were 39 mature bulls, 15 spike bulls, and 30 calves per 100 cow elk. Fewer mature bulls were counted than in 2014, but bull ratios increased, primarily because significantly fewer cows were counted. Calf ratios decreased slightly from 2014, but remain well above the low documented in 2008. In general, calf ratios were lower in areas north of Moose and in the Willow Flats. No elk were counted in Snake River area south of Moose. In total, biologists counted 672 elk in the open sagebrush and willow habitats in the park.


A bull elk bugles in the middle of his harem during the fall rut.



Grand Teton mid-summer elk count and classification, 1990–2015.

In the spring of 2015, park biologists deployed two remote cameras along a known migration route on the west side of Jackson Lake, near Moran Bay, to assess the effectiveness of using cameras to monitor elk numbers in a portion of the park not covered by the summer helicopter survey. Fifty-three groups of elk passed the cameras. The cameras captured 87 unique individuals: 20 bulls, 64 cows, 1 spike, and 2 unclassified elk. Wyoming Game and Fish biologists used a plane equipped with forward-looking infrared cameras to survey the Snake River corridor south of Moose, including areas in and outside the park, in late October: 840 elk were counted. Four groups, totaling 46 elk, were located within the park.

In mid-winter 2015, the Jackson herd numbered 11,200 elk, meeting the 11,000 objective set by the Wyoming Game and Fish Department in the 2007 Bison–Elk Management Plan for Grand Teton National Park and the National Elk Refuge. 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 2015 numbered 1,183 elk, 9% of the Jackson herd. The park reduction program accounted for 13% of that total and numbered 149 elk.

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.

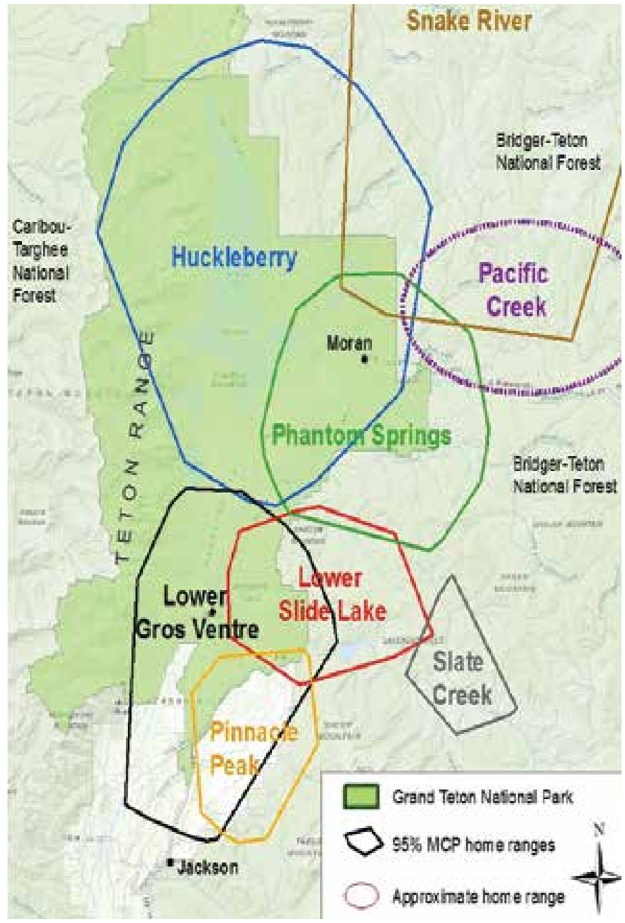
In 2015, park biologists partnered with Craighead Beringia South to conduct ground surveys for golden eagles. Biologists found and documented one occupied territory in Avalanche Canyon with a 5–6 week old eaglet in the nest. Data on area golden eagles is limited. Biologists want to develop more baseline 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 predator-prey relationships absent since humans eradicated wolves from the ecosystem in the early 20th century.

At the end of 2015, a minimum of 44 wolves in 7 packs resided in the Jackson Hole area. (The Slate Creek pack is considered outside of Jackson Hole.) These seven packs have persisted since 2012. The known wolf population grew from 6 to 76 wolves between 1999 and 2009, but declined to 48 animals in 2012. Pack size in 2015 ranged from 2 (Lower Slide Lake) to 13 (Pinnacle Peak) wolves and 3 of the Jackson Hole packs produced 16 pups that survived at least until the end of the year: Lower Gros Ventre (2), Pinnacle Peak (7), and Huckleberry (7). The Huckleberry and Lower Gros Ventre packs denned within the park. To minimize human disturbance of wolves raising young, park managers implemented closures around den and rendezvous sites for the Phantom Springs, Lower Gros Ventre, and Huckleberry packs. Two wolves dispersed from their packs in 2015; two males from Pinnacle Peak joined with wolves of unknown origin to form the Slate Creek pack. The Slate Creek pack denned in the Gros Ventre River drainage and consisted of 13 wolves including 7 pups at year end.

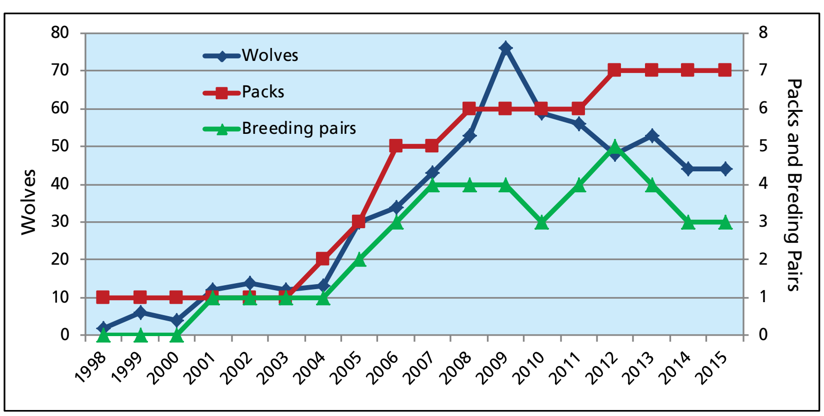
At least 3 adult wolves from the Jackson Hole area died in 2015. Two Phantom Springs wolves died in July: one yearling male was struck by a vehicle and a 2-year-old female died of injuries likely sustained from other wolves. The breeding male from the Lower Gros Ventre pack died in October, but cause of death could not be determined.



Distribution of Jackson area wolf packs, 2015. 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 affect prey populations and behaviors. In a five-year study, biologists found that in the winter when elk densities were relatively low, wolves preyed primarily on elk (71%) and moose (26%) and fed on deer and bison infrequently (3%). In the summer, when elk densities in the park were high, wolves preyed almost exclusively on elk and yearlings represented more than half of the kills.

Wolves also prey on other species, including livestock, which bring wolves into conflict with humans outside the parks. 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 in September 2012. In 2013, the State of Wyoming implemented a wolf hunt in the trophy management area of northwest Wyoming outside national parks, parkway, refuge, and the Wind River Indian Reservation. On September 26, 2014, a court ruling suspended the hunt and again granted Wyoming wolves federal protection.



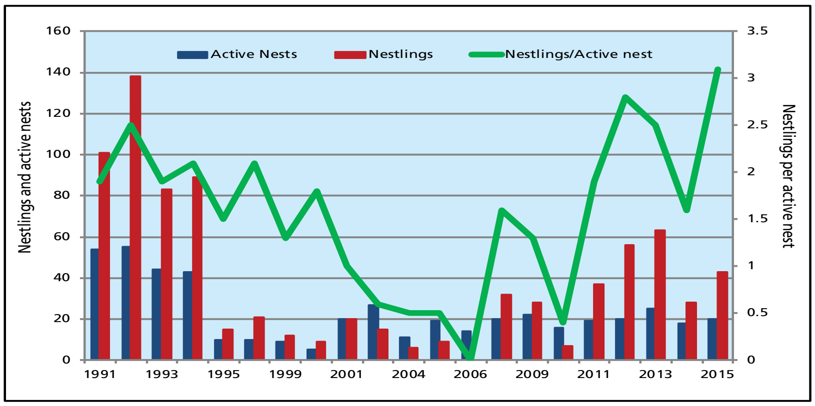
Population growth of Jackson area wolves, including those in Grand Teton NP, 1998-2015.

An older pup ventures out.

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. In addition, heronries are vulnerable to predation. 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, most recently two along the Buffalo Fork. Bald eagles in particular can have devastating impacts on the survival of young herons. Biologists do not know if bald eagles nesting near the Buffalo Fork led to the demise or displacement of heronries in that area.

Herons have nine known historic colonies located in or adjacent to the park plus a new site at Sawmill Ponds discovered in 2015. Of these sites, the Arizona Lake, Pinto Ranch, and Sawmill Ponds colonies were active in 2015. At Arizona Lake, herons produced 36 young from 11 active nests. Herons incubated four additional nests that failed to produce young. At Pinto Ranch, herons produced two young in one active nest. Biologists observed an adult incubating a second nest there early in the season but it failed to produce young. At the newly discovered Sawmill Ponds site, herons produced 5 young in 2 active nests. Similar to the other sites, an adult was observed incubating a third nest at Sawmill Ponds during initial site visits but the nest failed. Excluding one known nestling mortality at Arizona Lake, 43 nestlings from the three occupied colonies survived to 80% of fledging age. In 2015, biologists recorded the highest average number of nestlings per active nest (3.1) compared to all other years of heron monitoring in Grand Teton. However, the total number of 43 nestlings remained lower than the totals for 2012 or 2013, and considerably less than the average of 101 recorded from 1991-1994.

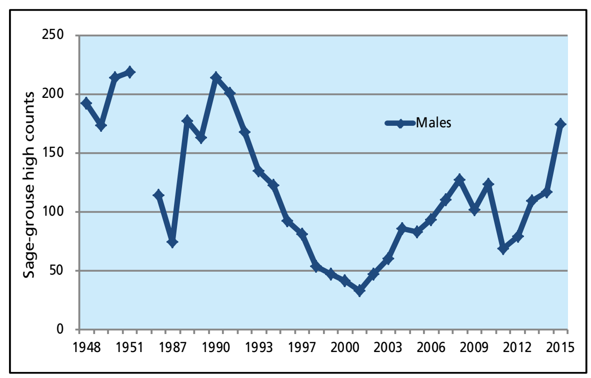


Great blue heron productivity in Grand Teton NP,1991-2015. Arizona Lake heronry, discovered in 2007, is located just outside the park's boundary and since 2009 is included in the park's monitoring program. Monitoring of heronries was not conducted in 1996, 1997, 2002, or 2008.

Greater Sage-grouse

Historically, the greater sage-grouse (*Centrocercus urophasianus*) occurred in sagebrush habitats across much of Wyoming and the American West. Sage-grouse populations declined throughout their range during the past 50 years, most likely due to 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 to attract females for breeding. Monitoring sage-grouse leks in Grand Teton National Park began in the 1940s to document population trends.



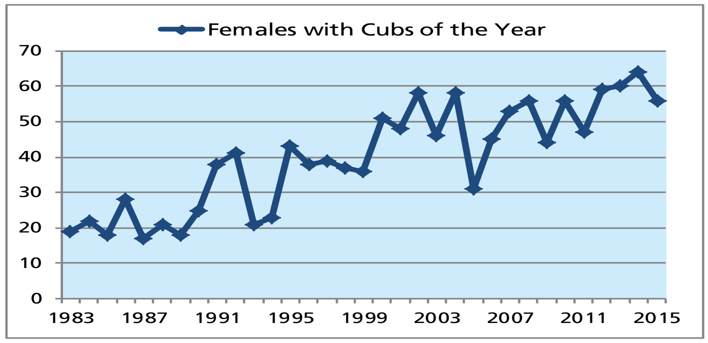
Counts of male sage-grouse on Grand Teton NP leks 1948-2014.

For 2015, of the 10 historically known leks (9 within the park boundaries and 1 outside), sage-grouse consistently occupied 6 park leks (Airport, Bark Corral, Moulton, RKO, Spread Creek, and Timbered Island) throughout the breeding season with at least 10 males in attendance. Biologists observed 10 males at North Gap lek on the National Elk Refuge early in the breeding season. Three other historically occupied leks (active in the last 10 years) were inactive in 2015 (Airport Pit, McBride, and Beacon). The location of the Spread Creek lek stabilized this year with an activity center on the southeast end of Wolff Ridge north of their historical display area on the flats.

The total count of 173 male sage-grouse in 2015 was well above the 10-year average of 100.5. Male counts at Moulton were exceptionally high at 103 males, with the next highest count at RKO with 21 males. Only Airport and Timbered Island leks were below the 10-year average. 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. In the first half of the 20th century, garbage became a significant food source for bears throughout the region. In an effort 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.



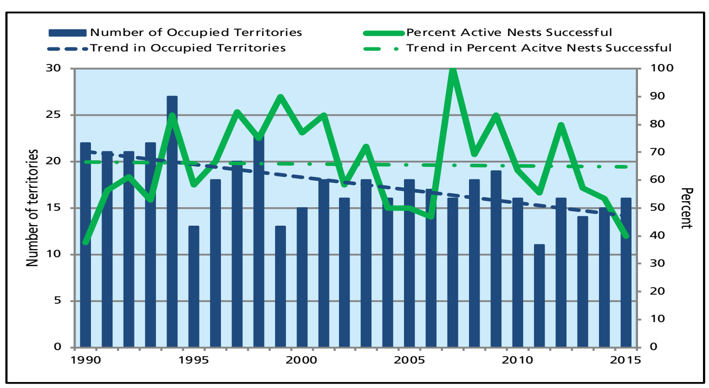
Estimates of grizzly bear females with cubs of the year, 1983–2015, are used to calulate the total grizzly population estimate within the USFWS-designated Yellowstone Ecosystem Suitable Habitat. One recovery criteria is a population of at least 48 grizzly bears females with cubs of the year.

Intensive conservation efforts over the next 40 years allowed grizzly bears to make a remarkable recovery. For 2015, the GYE grizzly bear population was estimated at 717 (95% Confidence interval = 639–794). 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. The high visibility of bears foraging on native foods in roadside meadows makes Grand Teton a popular bear viewing destination.

In addition to ungulates, spawning cutthroat trout, army cutworm moths, and whitebark pine, grizzly bears in the GYE consume a diversity of foods. Recent research identifies at least 266 known grizzly bear foods in the GYE, 39 of which are used frequently. The availability of these foods has certainly played a part in the recovery of grizzly bears throughout the GYE. However, the high mortality of whitebark pine trees from mountain pine beetles has caused concerns over the capability of grizzly bears to continue to use this high caloric food source. 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. For example, more ungulate meat, roots, and false truffles are consumed during years with poor whitebark pine seed production. The decline in whitebark pine appears to have abated since 2009, and research published in 2015 does not support the hypothesis that the recent slowed growth rate of grizzly bears since 2002 in the GYE was a product of the reduced availability of whitebark pine. On the contrary, the evidence suggests the slowed growth rate of the population is due to density dependence (i.e., population may be approaching carrying capacity). Thus, as their varied diet suggests, grizzly bears are well suited to adapt to changes in the abundance of individual foods. After careful consideration of the research from this and other studies, the U.S. Fish and Wildlife Service proposed to delist GYE grizzly bears from their federal status as a threatened species in the lower 48 states in March 2016.

Ospreys

Ospreys (*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 1968. From 1972–1981 only 6–9 nests were occupied each year. More recently, ospreys occupy 16 territories annually. Generally, nests are found near the low-elevation lakes in the park and along the Snake, Gros Ventre, and Buffalo Fork Rivers and their tributaries.



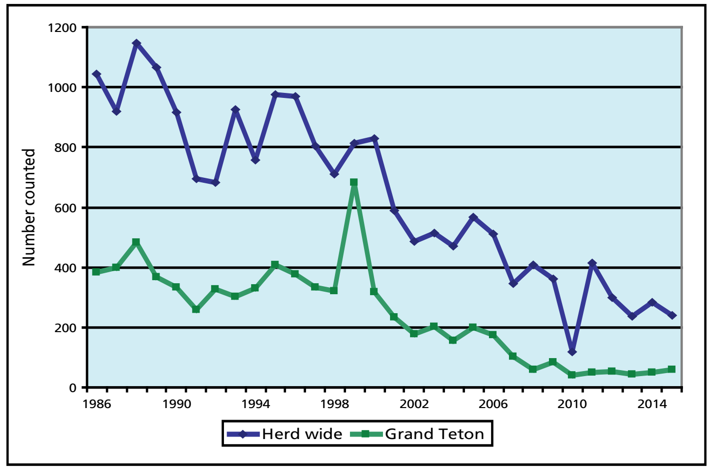
Territorial and successful osprey pairs, Grand Teton National Park, 1990-2015.

In 2015, ospreys occupied 16 (64%) of 25 monitored territories. Breeding activity occurred at 15 of these sites and 6 pairs successfully fledged a total of 8 young. The number of territorial pairs declined since 1990. 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.

Moose

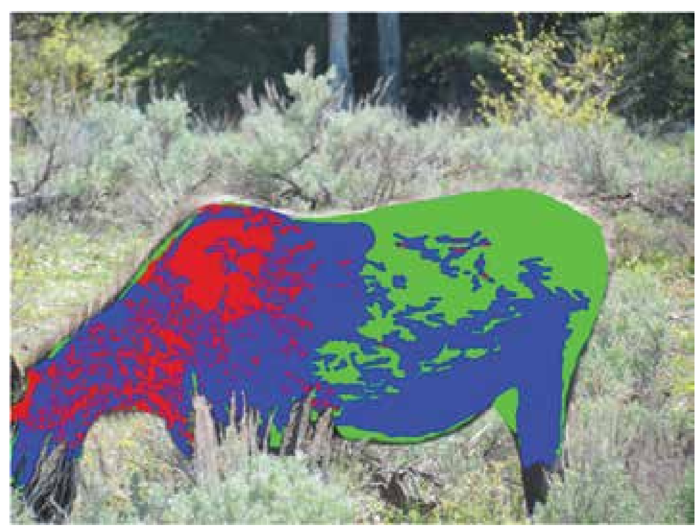
Moose (*Alces alces*) were rare or absent from Grand Teton National Park prior to 1912, but became numerous by 1950. They are well adapted to survive the deep snows of the Greater Yellowstone Ecosystem. Except during the rut, moose are usually found alone or in small family groups. Grand Teton moose 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 2015 totaled 241 moose (59 within Grand Teton), producing a Jackson herd estimate of 450 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 increased, 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. Temperatures above 57 degrees in the summer may 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.



Jackson moose herd mid-winter counts, 1986-2015 (data from Wyoming Game and Fish Department).

Biologists are also studying parasites, like ticks and carotid artery worms, to evaluate their effects on moose populations. Recent research indicates that carotid artery worm is found in 50% of the hunter-harvested moose in Wyoming. Using photographs for a study started in 2012, park biologists assess the extent of hair loss caused by winter ticks in moose. Hair loss leaves moose unable to properly thermoregulate. The average extent of hair loss is 23.2%. Males averaged 18.0% hair loss, while females averaged 28.4%. Average hair loss was highest in 2015, compared to the previous three years of monitoring. Earlier studies demonstrated that severe winter tick infestations can negatively impact calf survival. Tick reproductive success is positively affected by earlier springs and milder winters. While a direct correlation between parasites and the population decline is not demonstrated, it appears that these parasites may affect the overall health of the moose population.



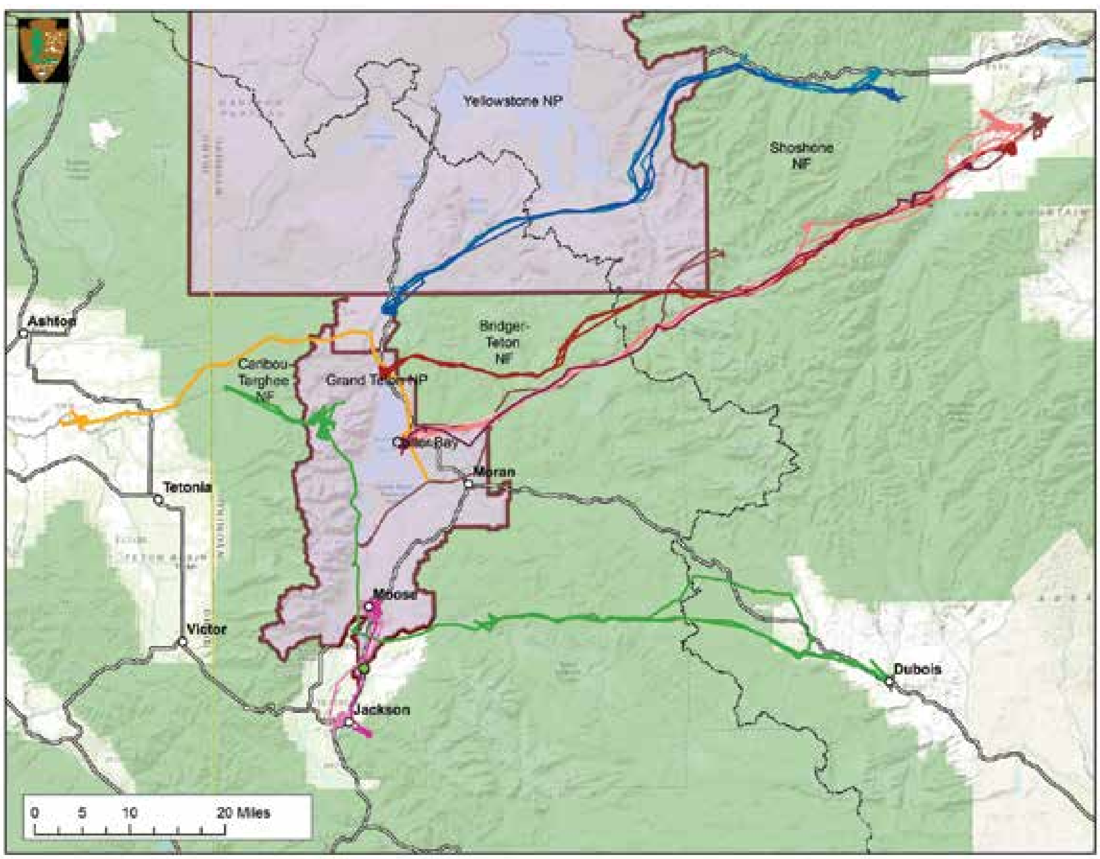
Park moose with hair loss from tick infestation are photographed. A color histogram is made from the photo distinguishing intact, bare, and broken hair areas is aid researchers in evaluating the extent of hair loss.

Mule Deer

Mule deer (*Odocoileus hemionus*), one of the many park animals that are seasonal residents, undertake annual migrations to distant wintering areas to meet their biological needs. Migrations showcase the behavioral strategies species use to exploit seasonal resources in otherwise inhospitable environments. Despite their intrinsic and ecological value, animal migrations have received little conservation attention until recently. Documenting animal movements is an essential first step to meaningful conservation actions.

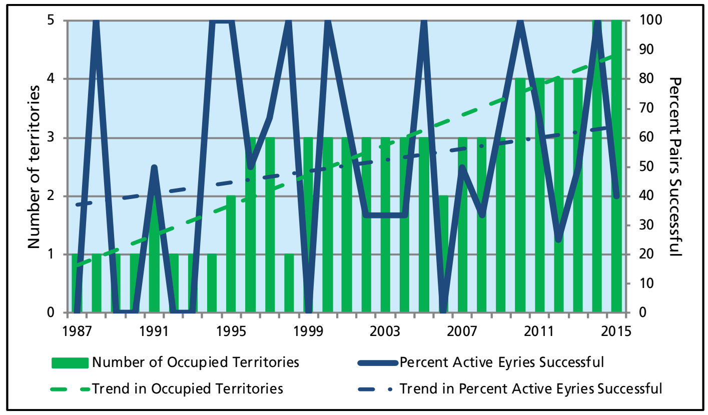
In 2013, park biologists initiated a pilot study aimed at documenting migration patterns of the mule deer that summer within Grand Teton National Park. Previous studies of mule deer movements documented both long and short-distance migrations for deer that summered in the southern portion of the park. Earlier research by Idaho Fish and Game biologists confirmed that mule deer migrate from Idaho winter ranges to summer in the Tetons, but did not delineate these routes. Park biologists focused their research on filling this data gap as part of a continuing broader migration initiative begun in the early 1990s. Specific objectives for the mule deer migration research include: identifying important migration routes and seasonal use areas both inside and outside the park; determining the timing of migrations and assessing the variations in mule deer movements; evaluating human land use patterns along migration routes to identify potential movement barriers and conservation needs; and working with partners to facilitate conservation of migration routes and important seasonal habitats.

In 2015, park biologists captured and radio collared four deer, two near Colter Bay and two near Moose. These deer migrated to 3 different wintering areas. Based on their movements, biologists identified a new long-distance migration route that spans two states and navigates a mix of land ownership to winter range along the Teton River in Idaho plus two short-distance routes to winter ranges around the Town of Jackson. The fourth deer travelled east over the mountains to winter along the South Fork of the Shoshone River near Cody. Half of the 12 deer collared since 2013 migrated east to winter in the South Fork drainage. To date, park biologists documented four long distance migration routes: three of which go east and cross the Continental Divide and one route that traverses the Tetons to Idaho. Wintering areas used by Grand Teton mule deer include the North and South Forks of the Shoshone River outside Cody, the Horse Creek drainage near Dubois, the Teton River Corridor in Idaho, and the foothills surrounding Jackson.



Fall and Spring migrations of twelve adult mule deer captured during summer in Grand Teton NP, 2013-2015.

Peregrine Falcons



Territorial and successful peregrine falcon pairs, Grand Teton NP, 1987-2015.

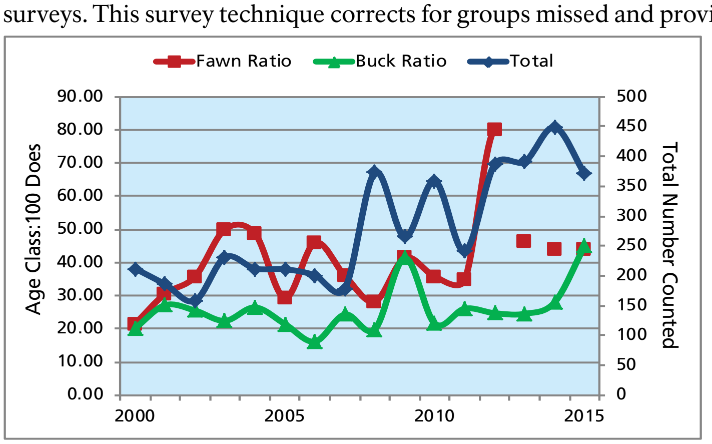
Peregrines (*Falco peregrinus*) are cliff-nesting falcons that mainly eat other birds. The lower elevations of the major Teton Range canyons provide peregrines with excellent cliff-nesting and diverse foraging opportunities. Decimated by DDT, peregrine falcons were extirpated from the Greater Yellowstone 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 Blacktail Butte.

In 2015, five peregrine falcon eyries were occupied and nesting was confirmed at all five locations. Three young peregrines fledged from the Garnet Canyon eyrie and one fledged from the Webb Canyon eyrie. With the addition of the Blacktail Butte site in 2014, the number of peregrine falcon pairs occupying territories in Grand Teton and the parkway remained at five for a second year (up from 4 pairs during 2010–2013). The percent of successful pairs is highly variable and appears to be influenced by breeding season weather events. Over the past decades 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. In 2015, after adult peregrines were observed near Baxter's Pinnacle, park managers established a temporary area closure on the popular climbing route to protect the nesting pair from disturbance. The closure was lifted after biologists confirmed that the nest had failed.

Pronghorn

The pronghorn (*Antilocapra americana*) that summer in Grand Teton National Park are a segment of the Sublette herd that undertakes one of the longest terrestrial mammal migrations in the Western Hemisphere. 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 upper 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. Concern for this migratory segment of the pronghorn herd exists because development (residential and energy) impacts the southern portion of the route and the winter range.

Park biologists track the number of pronghorn summering in the Jackson Hole and the Gros Ventre River drainage by conducting aerial line transect surveys. This survey technique corrects for groups missed and provides an estimate of pronghorn abundance with a level of precision. During the 2015 survey, biologists counted 185 pronghorn (134 in the central valley of Jackson Hole and 51 in the Gros Ventre River drainage). Based on this count, biologists estimated the herd size at 578, although this estimate had a high degree of uncertainty. Wyoming Game and Fish Department personnel conduct ground surveys to count and classify pronghorn in late summer after fawns are born. A total of 371 pronghorn were counted during the 2015 survey. Ratios were estimated at 44 fawns and 45 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 good recruitment for the population.



Pronghorn count and age/sex ratios during late summer classification counts, 2000-2015 (data from Wyoming Game and Fish Department).

Sagebrush Steppe

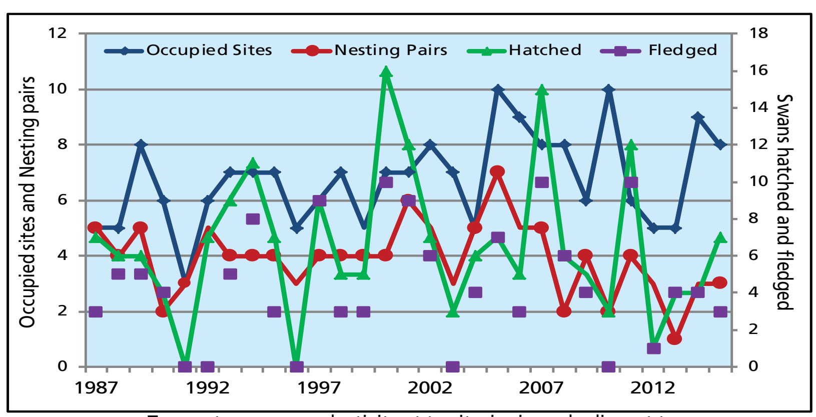
Sagebrush steppe is a sensitive vegetation type occupying much of the valley floor in Grand Teton National Park. Incredibly diverse, the sagebrush steppe has a greater variety of plant species than any other plant community in the park except for wetlands. Home to sage-grouse, a species of concern, as well as a myriad of other wildlife species, the health of sagebrush ecosystems is likely to be impacted by the direct and indirect effects of climate change. Approximately 15% of the park's sagebrush steppe acreage has been impacted by the effects of human habitation and agriculture over the past two hundred years. Biologists are studying the overall health of this plant community to understand and aid in conservation efforts where there is disturbance.

This year was the third year that vegetation biologists conducted monitoring studies of intact sagebrush communities, as well as some areas that are undergoing restoration activities. Park biologists examine changes in vegetation composition on intact sites and use the data as reference conditions for the eventual full restoration of former agricultural sites. In 2015, biologists sampled a total of 650 micro-plots in native sagebrush steppe communities. They compared these plots to earlier study results to examine the types and rates of change that are occurring in the sagebrush steppe community. In 2009, park managers initiated the long-term restoration project of the Kelly Hayfields—sagebrush steppe lands that were converted to agricultural use then abandoned. Today seven different units totaling 1,184 acres are now in various stages of restoration including 722 acres seeded with native plant species. Monitoring efforts in 2015 revealed that the species composition on sites seeded prior to 2013 shows a clear trend of increasing native plants, though portions of the six sites retain significant populations of non-native grasses mixed in with the native grasses, forbs, and shrubs that were seeded into the sites.

Trumpeter Swans

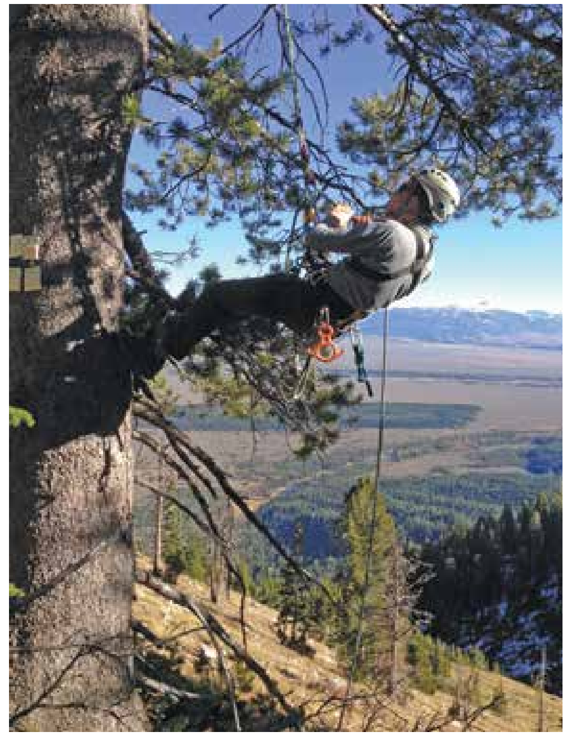
Nearly exterminated in the contiguous 48 states by the turn of the 20th century, trumpeter swans (*Cygnus buccinator*) made a comeback after intensive captive breeding programs, habitat conservation measures, and protection from hunting. Despite these efforts, swan population growth is low in the tri-state 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 16 historic nesting territories: 11 within the park and parkway plus 5 outside but adjacent to park boundaries. In 2015, swan pairs exhibited breeding behavior at 3 territories, but only produced young at Pinto Pond (4 cygnets) and Glade Creek Slough (3 cygnets). Only the cygnets from Glade Creek Slough fledged. The number of occupied swan sites, nesting pairs, and young hatched and fledged fluctuated widely over the 29 years since monitoring began. In 2015, occupied territories and cygnets hatched were above the historic average, while the number of nesting pairs and cygnets fledged were 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, 1987-2015.

Whitebark Pine



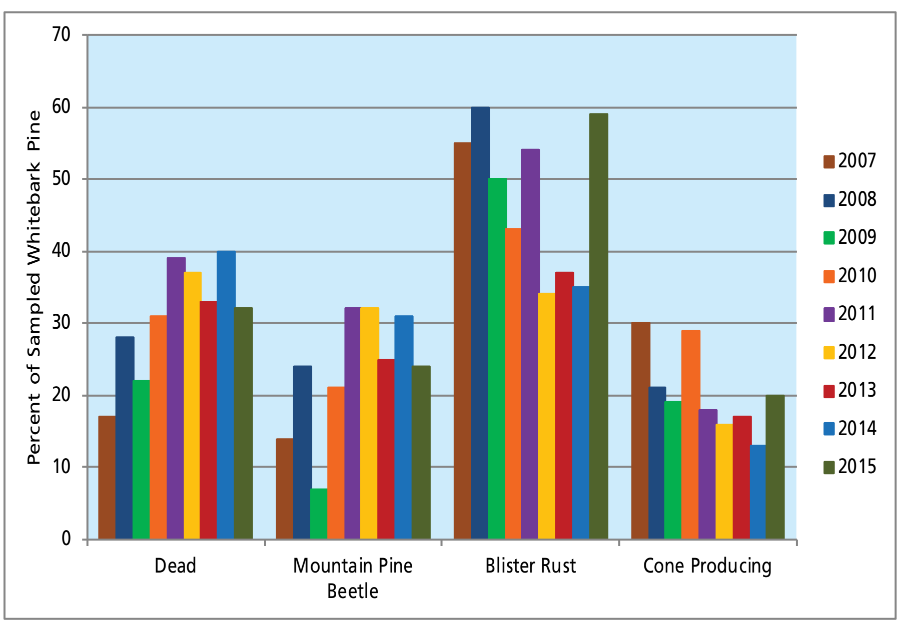
Park staff climb whitebark pines to gather cones and assess their condition.

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 significantly higher 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 also producing seeds that are an important food source for wildlife including Clark's nutcrackers, grizzly and black bears, squirrels, and other species.

During the past two decades, whitebark pine stands in Grand Teton National Park and throughout the Greater Yellowstone Ecosystem (GYE) have experienced unprecedented mortality due to the combined effects of native mountain pine beetle, the nonnative white pine blister rust, and changing climate conditions. Overflights by the US Forest Service in 2015 indicate that there are remaining areas of mountain pine beetle activity in Grand Teton and the GYE. Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway include a total of 28,500 acres of whitebark pine forests. Of these, 9,726 acres are dominated by whitebark pine and 18,775 acres are stands in which whitebark is co-dominant with other conifer species. White pine blister rust, found throughout the park and parkway, is causing extensive damage to cone-bearing branches, seedlings, and saplings.

In 2001, the US Forest Service initiated the Whitebark Pine Genetic Restoration Program to determine the degree of blister rust resistance found in whitebark pine in six western states. Since 2006, park staff identified and collected seeds from 10 trees that grow in blister rust infected stands, yet appear resistant to blister rust infection. Rust resistance screening of 657 trees from the GYE shows that two of the Grand Teton trees rank 1st and 4th for rust resistance in the seed zone. These trees, found in areas with heavy blister rust infection rates, have been exposed to blister rust for many years. Consistent with predictions, uninfected trees in areas with high infection rates have high levels of resistance. The presence of genetically resistant trees on the landscape could result in resistance in future seedlings as well.

Grand Teton began annual whitebark pine monitoring in 2007 using 26 permanent transects. Park staff monitor five of these transects annually and the remainder in a three year rotation. The annual data summary graph depicts the transects monitored in a specific year which accounts for some of the variability, but does not mask the trends. Overstory mortality associated with the mountain pine beetle epidemic from 2007–2015 has decreased slightly since 2011; although areas of intense beetle activity remain in Grand Teton. Blister rust is present in 92% of the sampled transects. The severity of rust infection is increasing, indicated by the number of rust cankers counted on each sampled whitebark. The proportion of live whitebark that produce cones is decreasing with occasional high cone crop, or "masting" years. Overall seed quantity has decreased with increased overstory mortality. Among whitebark sampled in 2015, 32% were dead, 24% attacked by beetles, 59% were infected with blister rust, and 20% produced cones. Whitebark regeneration was present on all transects. Regeneration was 98% rust-free with a seedling density ranging from 100 to 2,000 whitebark <1.4 meters tall per hectare. Beetle activity and blister rust severity were greater at elevations less than 9,500 feet and on transects with a south aspect; blister rust severity was greatest on larger diameter trees. Individual whitebark with greater rust severity had a higher incidence of mountain pine beetle attack.



Distribution by status of individual whitebark sampled in Grand Teton National Park 2007-2015.

Archeological Sites

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway contain 495 identified archeological sites. These sites range from prehistoric base camps, lithic quarries, and scatters, which date to as early as 9,000 years before present, to historic homesteads, roads, trails, irrigation ditches, and trash dumps dating from the late 19th century and early 20th century. Since archaeological work began in 1970, cultural resource staff surveyed approximately 4.5%, or 14,980 acres, of the 334,000 acres within Grand Teton and the parkway. Archeologists continue to find and record new sites every year.

The majority of sites within Grand Teton are identified and recorded when archeologists survey an area for cultural resources before construction activities begin. In 2015, the park completed field surveys before hayfield restoration, water and wastewater infrastructure improvement, and several large planning projects. If significant sites are located within a project area, archeologists assess the extent and integrity of the site to determine if the project will cause any damage. Throughout the process of recording, testing, and mitigating, Grand Teton consults with 24 traditionally associated American Indian tribes. These consultations aid collaboration and inform decision-making. In 2015, Grand Teton conducted one consultation in person, four in writing, and one via teleconference.

In June 2015, NPS archeologists completed an intensive survey of the proposed pathway and road realignment sections outlined in the draft Moose-Wilson Corridor Comprehensive Management Plan. They discovered two new prehistoric sites and documented a previously known site, all three considered eligible for listing in the National Register of Historic Places (NRHP). These sites are changing the understanding of past human occupation in Grand Teton National Park. Archeologists previously assumed that American Indians did not live in the park during the long and cold winters; however, the double stone circles at one site indicate a double layer or insulated layer around the tipi for colder temperatures. Through consultation with the Shoshone-Bannock, Eastern Shoshone, Crow, Northern Arapaho, Northern Cheyenne, and Umitilla, cultural resource managers understand the additional significance of these longer-termed occupation sites.

Volunteers working the excavation at Jenny Lake, Grand Teton NP, 2015.

The large Jenny Lake Renewal Project impacts a prehistoric site eligible for the NRHP. In October 2015, the staff from the Wyoming State Archaeologist office conducted an archaeological excavation at the site to mitigate the unavoidable construction disturbance. In their three week data recovery effort, the archaeologists and volunteers collected stone tools, soil samples, lithics, and floatation samples to analyze.

Park Service archeologists also assess the condition of previously discovered sites. By the end of 2015, archeologists determined 206 sites are in good condition; 124 sites are in fair condition; 77 sites are in poor condition; 1 site has been destroyed; and a total of 87 sites are lacking data or the site condition is unknown. Of the 495 archeological sites within Grand Teton and the parkway, 182 sites are listed on or eligible for the NRHP, 255 sites are considered ineligible for the National Register, and 58 sites remain unevaluated.

Historic Structures

Grand Teton National Park has 695 historic resources listed in or determined eligible for the National Register of Historic Places. The majority of these buildings, linear resources (trails, roads, ditches), and cultural landscape features (vegetation, fences, wells, trash dumps, etc.) are within one of the 44 historic districts of Grand Teton National Park. These districts exemplify the historic character of Jackson Hole which is defined by homesteading, agriculture, 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, the first example of modern architecture within a national park. All 695 structures have been assessed based on historic integrity and not functionality. These assessments show that 72% of the park's historic structures are in good condition, 16% are in fair condition, and 12% are in poor condition.

Many of these historic buildings are in usable condition and currently serve park and visitor's needs. Functioning as hotels, residences, and storage, these buildings receive routine maintenance. The Colter Bay Historic District includes more than 200 historic structures in good to fair condition. Because of the unique character of the district, park staff developed a detailed preservation maintenance plan for Colter Bay in 2015, to guide planning, scheduling, and execution of regular maintenance treatments for structures used primarily for lodging. This plan specifies how to proactively maintain historic fabric and slow the deterioration process.

One of the most significant challenges to the preservation and use of historic structures is the cost of deferred maintenance. Historic buildings often cost more to rehabilitate and maintain than modern buildings. Due to limited resources, the park can complete only a portion of recommended preservation maintenance. In addition to deterioration caused by exposure to the harsh Jackson Hole climate, Grand Teton's historic buildings are threatened by vandalism, ranging from graffiti to structural damage. In 2015, park staff removed spray painted graffiti from a log wall of the Luther Taylor homestead cabin. They tested various products to determine the effectiveness of removing paint without disturbing the aged wood patina. The team applied two graffiti removal products, agitating them with rough brushes before rinsing and repeating the process. With most of the paint removed, the clean logs weathered over the winter and the shadow is barely visible.

Volunteers replacing the fence at the Chambers homestead on Mormon Row.

Other preservation projects completed during 2015 took place in the Mormon Row Historic District. The T.A. Moulton and John Moulton barns received new shingle roofs with support from partners and volunteers. A preservation crew from the Western Center for Historic Preservation (WCHP) and volunteers completed additional stabilization work on other buildings on Mormon Row with the assistance of a Student Conservation Association crew. WHCP preservation carpenters also made repairs at the Lucas Fabian Homestead including applying UV inhibitor to prevent log degradation. The University of Pennsylvania Preservation Field School returned to the park, leading students in stabilizing two more sleeping cabins at the historic Bar BC Dude Ranch. Throughout the year, concessionaires who manage many of the historic properties complete annual preservation maintenance. Partnerships with these organizations are crucial to addressing preservation needs as funding is limited.

Grand Teton, in accordance with the National Historic Preservation Act of 1966, evaluates park properties for historic significance and integrity and assesses how park activities will affect historic properties. Currently being finalized, the Historic Properties Management Plan will assist the park in future management decisions. Although more than half of the park's historic properties are in good condition and three-quarters are actively used with an assigned purpose, the comprehensive plan will provide more direction for treatment and use of key properties.

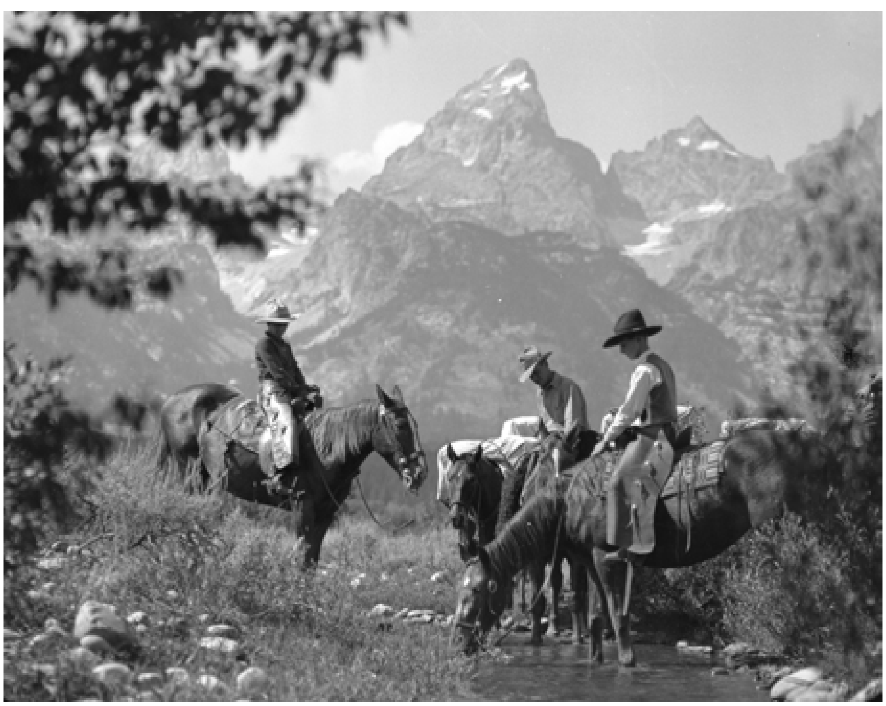
Museum Collection and Archives


Harrison Crandall, Grand Teton National Park's only official photographer.

Grand Teton's archival collection documents the complex history of Grand Teton National Park. The archives—the two-dimensional paper based unpublished materials—include reports, photographs, and maps documenting subjects ranging from land management, park history, and natural resources to the Tetons' extensive climbing history. The park collection of early summit registers is comprised of traditional ledgers and a variety of unique items, such as library cards and candy wrappers which were left atop peaks documenting the first ascents of numerous climbers over time. In July of 2015 after a decade of planning and preparation, the park curator, with support from the Intermountain regional archivist and staff, moved Grand Teton's entire archival collection to the park under one roof. With finding aids to assist with research, the archives are a well-organized resource available to park staff and the public, by appointment.

Grand Teton's museum collection preserves objects that represent the human historical record, such as archeological materials (projectile point and scrapers), historic vehicles, a significant fine art collection, regional handmade furnishings, and the renowned David T. Vernon Collection of ethnographic materials. While Grand Teton National Park does not currently have a museum facility that adequately meets the storage, research, and conservation needs of the collection, 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. The majority of the Vernon Collection is also currently housed off site at the National Park Service's Western Archaeological and Conservation Center located in Tucson, Arizona, to ensure the preservation of the materials; 89 pieces from the Vernon Collection are displayed in two of the park's visitor centers. A few other items from the museum collection are on exhibit outside of the park in local museums such as the National Museum of Wildlife Art and the Teton Valley Museum.

The museum received a noteworthy acquisition during 2015, three cameras used by Harrison Crandall, Grand Teton National Park's first official photographer and a Jenny Lake homesteader. Donated by his family, the items include a Kodak Retina II folding camera (manufactured 1963-1969), a No. 3a Autographic Kodak folding "postcard" camera with a range finder in the original leather case (produced from 1916-1934), and a Graflex Series C camera with one original film holder (produced from 1926-1935). The Graflex equipped with an immense F/2.5 Taylor-Hobson-Cook lens is rare and was the most desirable camera of the time. Along with nearly 1,200 Crandall images previously donated, the National Park Service received these cameras and remaining negatives that survived a mid-1950s fire at the former Crandall Studio on Antelope Flats.


One of Harrison Crandall's classic cowboy images, Grand Teton NP.

In partnership with Idaho State University's History Department, Grand Teton's museum program is working to document the history of recreational use of the Snake River. Research in 2015 focused on collecting oral histories from park concessionaires and their guides operating river trips on the Snake River since the mid-1950s.

As of 2015, 61% of the one million item collection is processed and cataloged. While the park curator completed a full inventory of the collection, updates to the collections management database are still in progress to document Grand Teton's natural and cultural history.

Aquatic Invasive Species

Aquatic Invasive Species (AIS) are aquatic organisms that are introduced (or not native) to waters in an area. These species vary in size and phylum and are most often moved from one watershed to another via water craft. Once introduced to a waterway these species can thrive without the presence of their natural competitors and/or predators. Non-native species can result in major alterations to the native ecosystem, and adversely affect recreation, water utilization, and economics. A few examples of species that have recently seen expansion outside their native ranges near Grand Teton National Park include curly leaf pondweed (*Potamogeton cripus*), Eurasian milfoil (*Myriopyhyllum spicatum*), as well as fish species such as burbot (*Lota lota*). Quagga mussels (*Dreissena bugensis*), another species of concern, dramatically expanded their range in the western US during the past ten years.

Park waters are a major recreational draw for many visitors. The advent of increased personnel to prevent AIS introductions into the park's waters in 2015 was a tremendous asset in protecting park water resources and recreational opportunities. The park established a boat inspection station in Moran to screen watercraft entering the park and prevent unintentional introductions of AIS. While the boat inspection station didn't run for the full duration of the boating season, rangers screened 4,948 boats at the station and decontaminated several boats that came from suspect waters; however, no AIS were positively identified on the boats inspected in 2015.

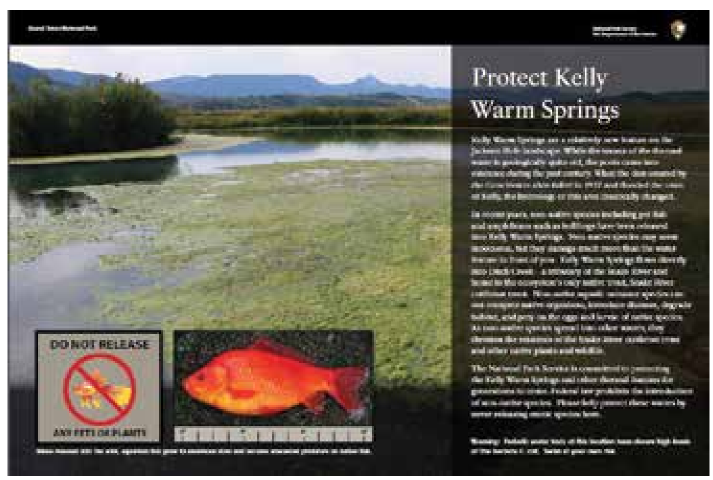
Only a few AIS have been documented in park or parkway waters, including New Zealand mudsnails (*Potamopyrgus antipodarum*), which invaded geothermally warmed waters in Greater Yellowstone as early as 1994. Their current distribution includes Polecat Creek and the Snake River near Flagg Ranch. In 2001, 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 14 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. Park staff hope to avert any other AIS infestations with the cooperation of park visitors and partners.

Kelly Warm Spring

Kelly Warm Spring is an ecologically sensitive thermal feature that has a long history of aquarium dumping leading to the proliferation of non-native species in the spring. Efforts to gain a better understanding of the ecology and potential threats in Kelly Warm Spring and its effluent continued in 2015 with the National Park Service, United States Geological Survey, and Wyoming Game and Fish Department partnering to gather data on fish abundance, distribution, and disease; distribution and diet of the American bullfrog (*Lithobates catesbeianus*); composition and relative abundance of aquatic invertebrates; and temperature data in waters influenced by the warm spring.

Non-native fishes dominated the warm spring, representing 93% of the fish found, and native macroinvertebrate abundance was low. Depending on the time of year, the water temperature generally ranged from 17–30°C. The warm spring flows into antiquated irrigation ditches that pass through historic hayfields. The abundance of invasive species and the thermal influence of the spring declined linearly with increased distance from the warm water source throughout this ditch system. However, non-natives persisted throughout the warm spring effluent as some warm water species were found in Ditch Creek, a tributary to the Snake River. Starting in 2012, goldfish (*Carassius auratus*) and tadpole madtoms (*Notorus gyrinus*), a warm water fish whose native range includes much of the eastern United States and portions of Canada, were found in Ditch Creek.

A bullfrog captured in Kelly Warm Spring.



Educational wayside exhibit erected in the parking area at Kelly Warm Spring in the autumn of 2014.

Biologists found American bullfrogs, another warm water species, to be more numerous in the warm spring than previously realized. 225 post metamorphic (four legs, no tail) individuals were captured during surveys in 2015. During three sample periods, diet information was obtained from 98 post metamorphic bullfrogs: 100% of the samples contained native species and only 20% of the frogs had non-native species in their stomachs. Non-native species made up 6.5%, 2.3% and 6.6% of the total prey mass in the bullfrogs' stomachs during the 3 sample periods. Bullfrogs aren't currently established in suitable habitats in nearby areas but post metamorphic bullfrogs were found as far as three miles from the warm spring. Park staff initiated planning to address restoration.

Fisheries

Utah suckers spawning in Phelps Lake, Grand Teton NP, 2015.

One priority of Grand Teton's fisheries program is to understand the life history requirements of the native species that inhabit the park's lakes. Cold water lakes may act as refuge for native cold-water reliant species, such as Snake River fine spotted cutthroat trout (*Oncorynchus clarkia*), if climatic shifts continue to alter hydrologic and thermal regimes of river systems. Surveys of the species indicate that spawning of lake-dwelling cutthroat trout differs significantly from river-dwelling cutthroat. Additionally, cutthroat runs are smaller than expected given the size of the aquatic system and amount of available habitat; this is likely a consequence of predation and competition from non-native species, such as lake (*Salvelinus namaycush*), brook (*Salvelinus fontinalis*) and brown (*Salmo trutta*) trout—species historically stocked in park lakes by the Wyoming Game and Fish Department (WGFD) prior to 2006.

Utah suckers, native to many of the park's waters, exhibit a variety of life histories. They typically congregate to spawn at predictable locations each year in the shallow water of park lakes and streams. Since 2012, eleven Utah sucker (*Catastomus ardens*) spawning sites were documented in six different lakes in the park. These spawning locations are targeted by predators such as pelicans. Some evidence suggests that bears may be using spawning suckers as an annual food source.

Fish populations depend on healthy habitat. Fragmentation and degradation are major concerns for fisheries managers. Grand Teton National Park is working on increasing habitat connectivity. Projects completed to accomplish this include removing obstructions to fish passage like the Newbold Dam on the Gros Ventre River and the diversion dam on Spread Creek. These projects opened more than 100 and 50 miles of habitat respectively. Another obstruction removal project was along Ditch Creek, where culverts prevented fish such as the Snake River fine spotted cutthroat trout, and bluehead (listed by the WGFD as a species of concern), Utah, and mountain suckers from reaching preferred spawning habitats. In the fall of 2014, baffles were retrofitted in the two culverts that prevented these fish migrations for over 50 years. Unfortunately, an unnatural channel course in Antelope Flats has led to an avulsed channel that is preventing fish from utilizing over 23 miles of fish habitat upstream of the obstruction. Resource managers are currently working to find viable long-term solutions to this problem and others as they preserve wild waterways for native species and processes.

Livestock Grazing

Cowboys moving cattle to grazing pasture in the park, Grand Teton NP, 2015.

Grand Teton National Park, like several other National Park Service units, allows livestock grazing due to traditional land use that existed prior to the park's establishment. When Grand Teton National Park (created in 1929) expanded in 1950, ranches on inholdings were allowed to retain their grazing allotments indefinitely while another 26 ranches were granted grazing privileges for the lifetime of immediate family members. Collectively, these provisions allowed livestock grazing and trailing on about 69,000 acres (22% of the park). Over time, these grazing allotments were substantially reduced through attrition and the park's acquisition of inholdings through purchase or donation.

In 2009, to address concerns about grazing impacts on riparian vegetation and to minimize the potential for cattle depredation, park managers moved the largest remaining cattle allotment from open range on split National Park Service/US Forest Service lands to the park's fenced and irrigated Elk Ranch pasture which predates the park's establishment.

In 2015, four ranches used a total of approximately 5,000 acres within park boundaries for livestock grazing and trailing. These included two park inholdings with grazing permits: the Moosehead Ranch grazed 64 horses and the Pinto Ranch grazed 290 yearling steers; Triangle X Ranch, a concessionaire operating a historic dude ranch within the park, grazed 120 horses; and Teton Valley Ranch, operating on an agricultural lease that dates back to the 1940s, grazed approximately 34 longhorn steers. Grand Teton National Park maintained another 33 horses and mules to support backcountry operations in the park and the State of Wyoming owns a 640-acre inholding that is leased for grazing.

Current livestock grazing in the park has been reduced by approximately 89% from historic grazing use. Park staff manage the remaining horse and cattle grazing with the goals of minimizing conflicts between stock and park wildlife, maintaining sufficient irrigation while balancing park aquatic resources, and reducing the spread of invasive nonnative plant species.

Human-Bear Interface


L. Clark

Black bear mother and cub looking for food in a backcountry campsite, GTNP.

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway provide ideal habitat for free-ranging black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears. Grand Teton receives over 4 million visitors per year, most of whom visit during the peak summer season. 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 have bear-resistant garbage receptacles. The park emphasizes “Be Bear Aware” public educational messages and provides annual bear safety training to park and concession employees. The primary focus is to keep human foods away from bears. Since 2008, the park, with generous support from Grand Teton National Park Foundation, installed a total of 547 bear-resistant food storage lockers in park campsites and picnic areas toward that goal.

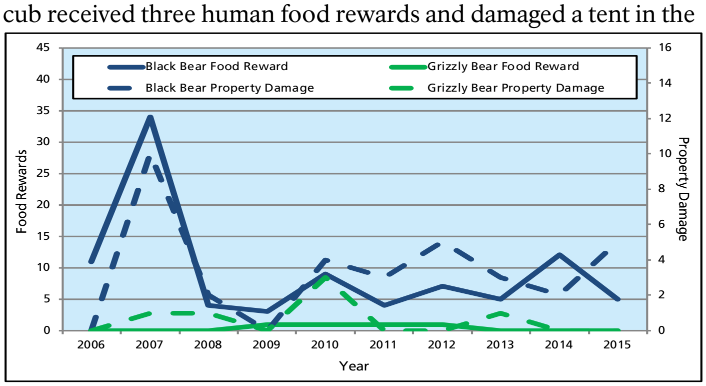
Human-bear confrontations are incidents when bears approach, follow, charge, or act aggressively toward people, enter front-country developments, or enter occupied backcountry campsites without inflicting human injury. Human-bear conflicts are incidents when bears damage property, obtain human foods, injure or kill humans, or are injured or killed by humans. In 2015, park staff recorded 182 human-bear confrontations and 15 human-bear conflicts. Ten of the conflicts involved black bears—five incidents in which a black bear received a food reward and five incidents in which a black bear damaged personal property (e.g., ripped tent, caused building damage). The other five conflicts involved grizzlies or unidentified bear species hit in motor-vehicle collisions. The extent of injuries or deaths from these collisions is unknown as the animals left the roadside.

Sixty percent of the food reward and property damage conflicts in 2015 involved three black bears and occurred in the park’s frontcountry. Early in the summer, a black bear was reported several times sniffing tents, fire pits, and bear boxes in the Jenny Lake Campground. Unfazed by hazing attempts, it ripped open an unoccupied tent. The black bear then obtained a food reward from a visitor’s open trunk at Jenny Lake Lodge, put paws on several cabin windows, and took a purse from an unattended cleaning cart. Biologists darted and euthanized this approximately 3-year old female for exhibiting repeated nuisance and food-conditioned behavior. Another adult female black bear and her cub received three human food rewards and damaged a tent in the backcountry over a 5-day period in August. Due to the female’s lengthy nuisance history, she and her cub were trapped. Given the likelihood that her cub would not survive without her, both bears were permanently removed from the ecosystem and placed in the Great Plains Zoo of Sioux Falls, SD.

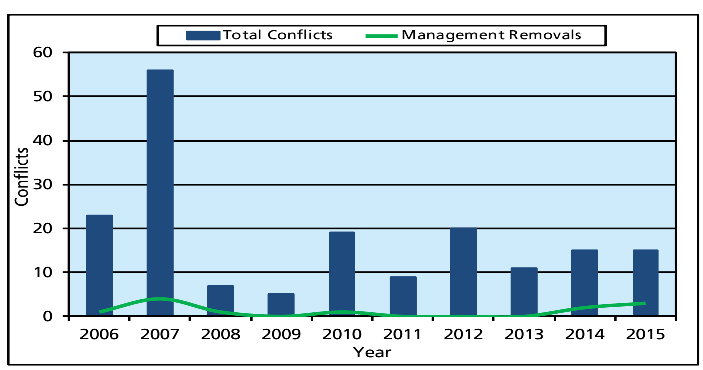
Park staff work diligently to prevent bears from developing nuisance behaviors. When humans fail to secure their food, bears can develop unwanted behaviors. In an effort to discourage bears from frequenting developed areas and roadways, trained staff follow an established protocol of hazing. Using noise (yelling, horns, sirens, or cracker shells), throwing rocks, using a sling shot, and/or firing bean bags or rubber bullets at the bears, Grand Teton staff hazed bears 86 times in 2015.

Park managers also implement seasonal closures to protect bear habitat and to address human safety concerns. In 2015, bear managers enacted two annual closures (Grassy Lake Road closed to motorized use from April 1–May 31 and Willow Flats closed to public entry from May 15– July 15 to protect grizzly bear foraging opportunities) and one special management area closure (Moose-Wilson Road to protect fall foraging opportunities beside the narrow road), along with eight temporary closures (around carcasses and foraging areas).

Since 2007, Grand Teton employs the Wildlife Brigade, a corps of paid and volunteer staff, to manage traffic and visitors at roadside wildlife jams, promote ethical wildlife viewing, patrol developed areas to secure bear attractants, and provide bear information and education. In 2015, they recorded 675 wildlife jams including 84 grizzly bear jams, 234 black bear jams, 48 unknown species bear jams, 207 moose jams, and 102 jams for other species such as bison, elk, and coyotes.

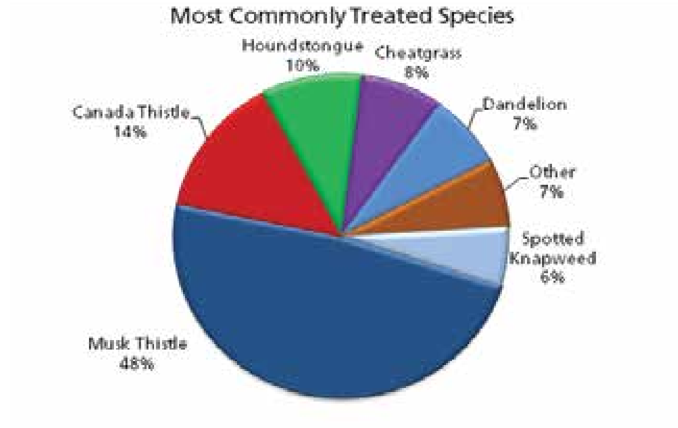


Bears receiving human-food rewards or causing property damage in Grand Teton.



Bear conflicts and removals in Grand Teton.

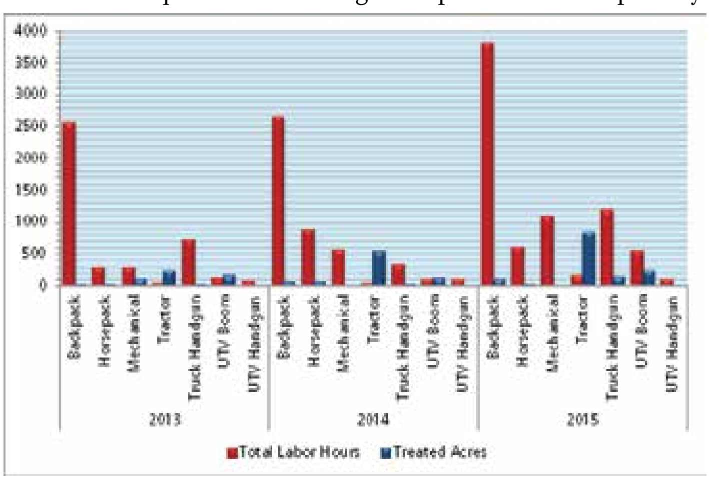
Invasive Plants



The survey and control of invasive nonnative plants remains a high priority for Grand Teton vegetation staff. Nonnative plants displace native vegetation communities, alter wildlife distribution, and negatively impact foraging opportunities. In 2015, vegetation management staff actively managed 9,582 infested acres, treating 1,491 acres, for 28 invasive nonnative plant species.

Invasive plants have multiple origins. In addition to accidental introductions from Eurasia, homesteaders planted nonnative crops and ornamentals before the park was established, and some species still persist. Today, humans contribute to the spread of invasive species by inadvertently transporting seeds on their vehicles, clothing, shoes, in livestock feed, and in construction sand and gravel. Wildlife and domestic stock also transport seeds. Areas particularly at risk to invasive plant infestations include disturbed areas along roads, levees, pathways, trails, utility corridors, and building sites. Formerly disturbed sites within the park such as old homesteads and gravel pits remain a management challenge.

Grand Teton biologists prioritize management control efforts by species and by site, based on threats posed to ecological processes and prospects for successful treatment. Some infestations can be eradicated if treated when the outbreak is still small and a seedbank not well established. Other species have become so ubiquitous that limiting their spread is now the primary goal. Listed "noxious weeds" are particularly aggressive plants legally deemed to be detrimental to agriculture, navigation on inland waterways, fish and wildlife, and/or public health. Grand Teton National Park vegetation staff focus efforts on locating and using the best treatment practices to address listed noxious species. Examples of sites where noxious weeds have been successfully managed 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). Salt cedar (Tamarisk), formerly infesting the Snake River corridor, was not found in 2015, and may be nearing eradication.



Annual comparison of treatments methods by hours spent and acres treated.

Management actions in 2015 included chemical treatments with pressurized backpack sprayers, horse-mounted pressurized sprayers, truck-mounted spray equipment, UTV-mounted boom and handgun spray systems, and a tractor-mounted boom sprayer. Vegetation staff and volunteer groups also implemented mechanical treatments, hand pulling and removal with shovels or cutting tools. The majority of labor hours were invested in the grassland-sage communities that dominate the lower elevations of the park. Preventing spread of invasive species into backcountry and other less degraded areas remains a high priority.

Partnerships with Teton County Weed and Pest District, Jackson Hole Weed Management Association, Montana Conservation Corps, and the Yellowstone Exotic Plant Management Team are very important to successful invasive plant management.

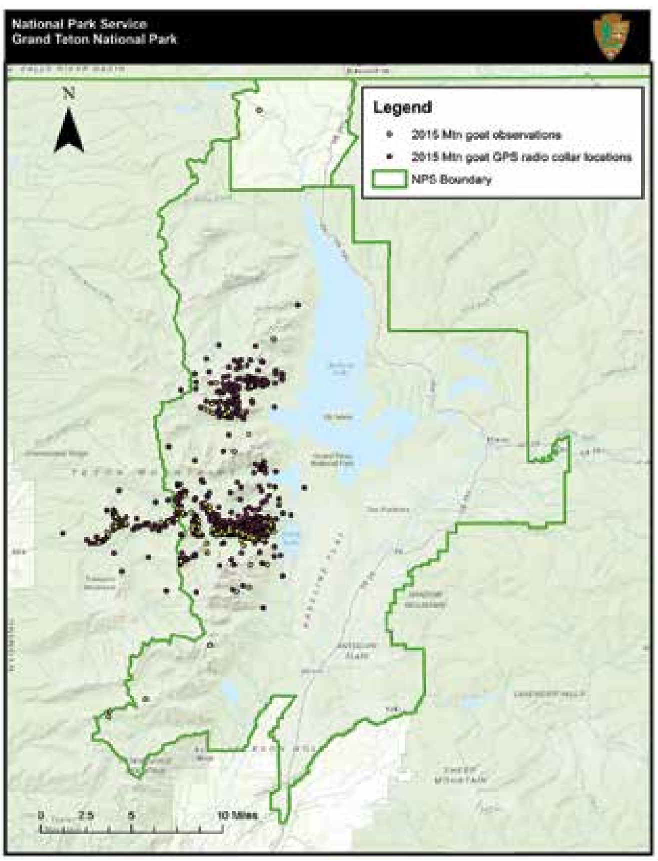
Mountain Goats

Mountain goats (*Oreamnos americanus*) are native to some rugged mountains of the American West, however not to the Greater Yellowstone Ecosystem. The nearest native mountain goat population occurs in the Lemhi Range of Idaho, approximately 125 miles northwest of Grand Teton National Park. From 1969 to 1971, the Idaho Department of Fish and Game released goats into the Snake River Range south of the park for the benefit of hunters. This transplanted population grew and dispersed to new areas. Reports of mountain goats in the Teton Range began in 1977, with the first sighting in the park by 1979. Until 2008, mountain goat observations were sporadic. Since then park biologists have documented adult female mountain goats (nannies) with young (kids) each year, indicating that a breeding population is now established.

The Teton Range is also home to a native bighorn sheep population, a species of concern because of its small size, isolation from neighboring herds, low genetic diversity, and loss of historic winter range. Teton bighorns live year-round at high elevation where conditions are harsh, especially in the winter. As mountain goats and bighorn sheep share similar habitats and forage, the potential for competition and the risk of disease transmission between the species pose additional threats to the already stressed sheep population.

In response to these concerns, park managers began preparation of a mountain goat management plan and environmental assessment in 2013. In December of 2014, park biologists captured and radio collared 4 mountain goats (4 nannies, one with a kid) to gather data about the number, distribution, movement, and reproduction of mountain goats in the Teton Range. Three goats spent the majority of the year in the vicinity of Cascade Canyon, including the area around Hanging Canyon, Mount St. John, and Paintbrush Divide. These goats also used the Caribou-Targhee National Forest near Table and Fred's Mountains. The nanny and kid, captured in Snowshoe Canyon, spent most of the year there and in Moran Canyon. Two of the 4 nannies tracked in summer 2015 produced one kid each. Although the other two collared individuals did not have kids in 2015, they did have kids the previous year.

Remote motion-sensing camera photo of several mountain goats, Grand Teton NP, 2015.



Map showing mountain goats observations and GPS radio collar locations in Grand Teton NP, 2015.

Park staff continued to solicit observations of mountain goats through the rare species observation reporting system. In 2015, park visitors and staff reported 126 mountain goat sightings within the park and John D. Rockefeller, Jr. Memorial Parkway. A report of a mountain goat in the parkway north of the park at the Glade Creek cliffs was noteworthy. The furthest south observation was reported along the trail to Static Peak Divide. Based on a review of verified sightings, remote camera images, and observations of collared and uncollared goats, biologists estimate that 40-60 goats reside in the Tetons: this includes 11-18 kids from 2015.

In December 2015, crews captured and radio collared 4 more mountain goats (3 nannies and 1 kid), bringing the total number of radio collared goats to 8. Disease testing on these goats resulted in two positive tests for the leukotoxin *Biberstenia trehalosi*. *Biberstenia* is the most common respiratory pathogen found in wild sheep and goat populations. Mountain goats in the Snake River Range, the presumed source from which the Teton goats originated, have tested positive for *Mannheimia haemolytica* and *Mycoplasma ovipneumonia*. In combination with leokotoxin *Biberstenia trehalosi,* these pathogens can present a serious risk to bighorn sheep, primarily through an increase in lamb mortality. Thus, the potential for disease transmission remains a serious concern.

Native Plant Restoration

Native plant restoration and revegetation are both processes of managing vegetation in disturbed areas in an effort to return degraded or damaged habitats to functioning ecological systems. A primary goal of vegetation management in Grand Teton National Park is to restore disturbed ecosystems to provide critical habitat for the diverse wildlife species that inhabit the park. A second goal is to support National Park Service policy which states that the service shall leave the natural landscape unimpaired for future generations. The propagation and planting of genetically local native plant species encourages the recovery of native plant communities and minimizes the establishment of invasive, nonnative plants. Revegetation seeks to rapidly establish native plants and initiate vegetation recovery, while restoration is intended to restore the native plant community and ecosystem that existed before disturbances occurred. In order to achieve park goals, all revegetation and restoration work conducted in Grand Teton National Park is accomplished by conserving local top soil and using plant materials that originate within the boundaries of the park and are suited to the natural ecotypes associated with a specific plant community. Research shows that using native locally occurring plant materials adapted to the environment translates into greater success of restoration and revegetation efforts.

In 2015, vegetation crews worked on 23 separate revegetation projects (22 total acres of disturbance) associated with park infrastructure improvements such as waterline replacements, building construction and repairs, multi-use pathway construction, and trail construction and rehabilitation. These areas were seeded with ecologically appropriate seed mixes consisting of 28 different species of grasses, forbs, and shrubs. Total native seed used on all projects combined was 392 lbs. All planted seed originated from materials hand collected and processed by vegetation management staff. In 2015, park seed collection efforts totaled 321 hours which amounted to 247 pounds of bulk material and 54 pounds of clean seed.

Native seed for restoration and revegetation projects is generated by one of two methods: seed collection or increase. Seed increase is the process where locally hand collected seed is planted and grown in a field or agricultural setting, to generate a greater quantity of seed that can be harvested directly off the fields. In this manner, large quantities of native seed can be produced in a controlled setting. The park has interagency agreements for seed increase/propagation with the Natural Resources Conservation Service's Plant Materials Centers in Aberdeen, ID; Bridger, MT; and Bismarck, ND. Additionally, park vegetation management staff initiated planting of a three-acre seed increase field in 2014 within the boundaries of the park. This relatively unique undertaking in the National Park Service has the potential to provide native seed that is both genetically appropriate and free of nonnative plant seed that can contaminate seed grown in fields located outside the park. While it will take time for these fields to establish and produce seed, they should eventually be a significant source for locally grown native seed that will help support the park's plant restoration and revegetation needs.

Park staff seeding an area disturbed by construction at park headquarters in Moose, 2015.

Park vegetation crews continue in the long-term effort to restore 4,500 acres of nonnative 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 may include prescribed fire, herbicide applications, and finally native seeding. Currently 1,235 acres of the 4,500 former Kelly Hayfields is under restoration treatment, including intensive invasive plant treatments for musk thistle, smooth brome, cheatgrass, and others. Approximately 275 acres are currently fenced to minimize wildlife pressure. Additional acres may be fenced as needed to promote successful restoration. As of December, 2015, 745 acres were seeded with native vegetation. Crews monitor treated acres for native plant establishment and possible cheatgrass or other invasive plant infestations. Park staff will adaptively adjust treatments of these areas to restore and maintain healthy native plant communities.

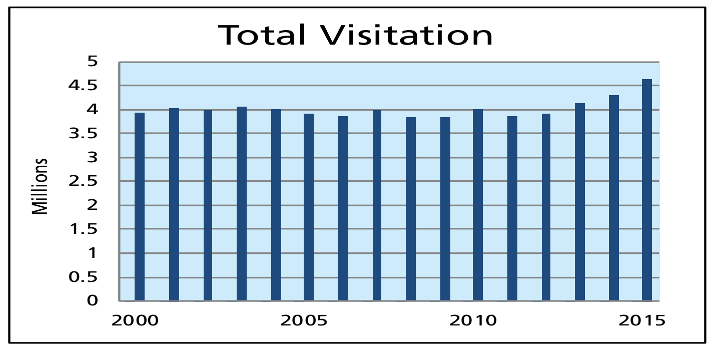
Visitor Use

Use of the park by visitors is both a primary reason for the establishment of Grand Teton National Park and a factor influencing resource condition. Visitor activities and associated infrastructure affect the park in many ways, including:

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

Since 2000, total visits to the park have fluctuated between 3.8 and 4.6 million a year. In 2015, the park received more than 4.6 million visitors with a total of 631,240 overnight stays. Frontcountry camping ranked first in visitor accommodations accounting for 61% of the overnight stays, followed by lodging with 33%. While almost half of the park (44%) is considered backcountry, only 5.4 % 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 2015 averaged 29,609 visitors. While about 66% of the park visitation occurs in the warmer months—from June through September— visitation during the cooler months has been growing. The climbing number of park visitors puts additional pressure on park staff and resources.



Annual Grand Teton NP total visitation 2000–2015.