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 2018

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Grand Teton National Park Foundation and Grand Teton Association.
It shares natural and cultural resource data collected
during the calendar year 2018 and compiled in 2019.

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Cover painting: Geraldine's Cabin by Bill Sawczuk. Painted 2014. 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.

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Grand Teton National Park supports a wide variety of habitats and species.

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 that may change or affect native species have been introduced both accidentally and intentionally. 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, rivers, and water quality) are primarily the result of natural processes that operate on a distinctly larger scale than the park, but can be affected by human activities both within and outside the park.
- **Natural Resources:** selected plants and animals that
  - are or have been listed under the federal Endangered Species Act (bald eagle, gray wolf, grizzly bear, and peregrine falcon).
  - have experienced declines in the park and surrounding areas or are of special concern (golden eagle, great blue heron, great gray owl, 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, harlequin, pronghorn, and red fox).
  - 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, 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, livestock grazing, park visitation, plant and habitat restoration, wildlife collisions, 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 2018 (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)	24°F, 55°F 22.16” 2,733 days (2012)	22°F, 53°F (1959–2018 average) 21.73” (1959–2018 average) 2,366 (1959–2012 average)
Fire	Acres burned per year by wildfire	3.8 acres	1–19,211 (1999–2018 range)
Glaciers	Extent of 10 named glaciers	1.5 km² (2016)	Long-term decline
Water Quality	Basic water quality parameters- 2 river sites	Iron exceeds state standards	State water quality standards
Natural Resources			
Amphibians	% of potential sites suitable for breeding	85%	TBD
Bald Eagle	Breeding pairs	13 pairs	11.8 pairs (2009–2018 average)
Bighorn Sheep	Teton Range herd estimate	≈80 sheep	100–125 sheep (1970–2000 estimate)
Bison	Jackson herd winter count (includes areas outside park)	567 bison	500 bison
Common Loon	Breeding pairs	no pairs	TBD
Elk	Jackson herd winter count (includes areas outside park) Summer count (portion of park herd)	10,877 elk ≥1329 elk	11,000 elk ≤1600
Gray Wolves	Wolves in Wyoming (outside of Yellowstone) Breeding pairs in WY (outside of Yellowstone)	196 wolves (32 in park) 13 pairs (4 in park)	≥100 wolves ≥10 pairs
Great Blue Heron	Active nests	36 nests	22.5 nests (2009–2018 average)
Greater Sage-grouse	Active lek	7 leks (6 in park)	9 occupied leks (8 in park)
Grizzly Bears	GYE population estimate Distribution of females with cubs Mortality: Independent females (≥ 2 yrs old) • Independent males (≥ 2 years old) • Dependent young (human-caused only)	709 18 bear management units 6.1% 14.7% 5.0%	≥500 grizzly bears ≥16 bear management units of 18 not > 9% not > 20% not > 9%
Moose	Jackson herd winter count	≥276 (78 in park)	TBD
Osprey	Breeding pairs	14 pairs	12.3 pairs (2009–2018 average)
Peregrine Falcon	Breeding pairs	2 pairs	3.6 pairs (2009–2018 average)
Pronghorn	Jackson Hole/Gros Ventre herd estimate	492 pronghorn	350–900 (modeled range)
Trumpeter Swans	Occupying breeding territories (includes areas outside park) Pairs producing young	2 pairs (in park) 2 pairs (3 cygnets fledged)	18 historic territories (13 in park) TBD
Whitebark Pine	Blister rust infection (% of trees in park)	57% of trees	TBD
Cultural Resources			
Archaeological Sites	Percentage of park inventoried Percentage of documented sites in good condition	4.5% of the park (2017) 42% (2017)	75–100% TBD
Historic Structures	Percentage assessed in good condition	73% (2017)	100%
Museum Collections	Percentage that has been cataloged	86%	100%
Challenges			
Aquatic Invasive Species	Presence of non-native species	13	0 (limit spread & effects on native sp.)
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	8 in park	9.5 (2009–2019 average)
Invasive Plants	Species present Acres treated	27 invasive species 2260 acres	0 (limit spread & effects on native sp.)
Mountain Goats	Estimated number in park	≈100 goats	0 (limit spread & effects on native sp)
Plant Restoration	Restoring native plant communities in former agricultural fields (Kelly hayfields)	1484 acres under restoration treatment	100% of 4500 acres in the former Kelly hayfields area

Reference condition specified by government regulation or management plan.

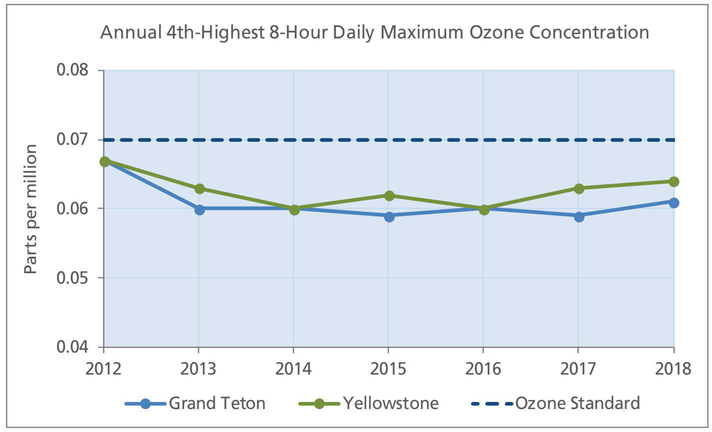
Air Quality

Grand Teton National Park experiences good air quality; however, both distant and local sources of air pollution affect the park. As a federally designated Class I airshed, Grand Teton is required to meet high standards for air quality. The park conducts monitoring to evaluate the potential for air pollution to affect park resources.

Air pollutants of concern include sulfur and nitrogen compounds deposited by precipitation and by settling out of the atmosphere. These compounds can harm surface waters, soils, and vegetation. High-elevation lakes are especially 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. Research suggests that deposition of nitrogen above 1.4 kilograms per hectare per year affected the diversity of diatoms (single-celled algae) found in high-elevation lakes in the Greater Yellowstone Ecosystem, an area that includes Grand Teton National Park.

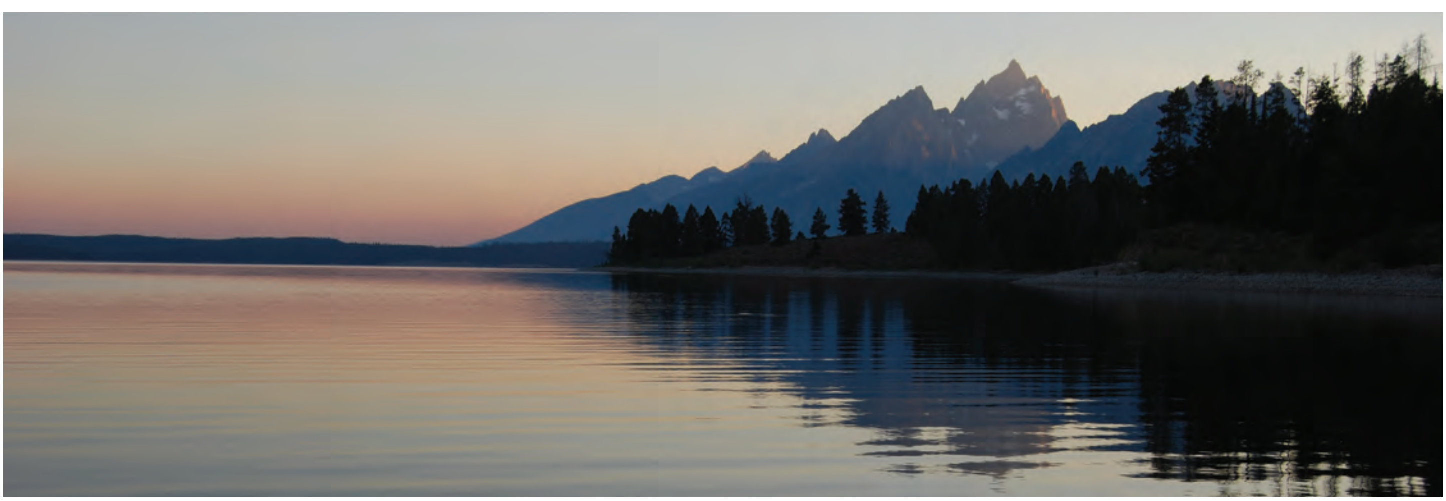
The park operates an air quality monitoring station, established in 2011, to track the deposition of these compounds in precipitation. This station is part of the National Atmospheric Deposition Program, which measures precipitation chemistry at over 200 locations across the country. The link for real-time results from this station, including a webcam is http://www.nature.nps.gov/air/WebCams/parks/grtecam/grtecam.cfm. Annual wet deposition of nitrogen measured at the Grand Teton station from 2012 through 2017 varied from 1.1 to 1.9 kilograms per hectare per year. The Grand Teton deposition monitor is located at an elevation of 6,900 feet; higher elevation areas of the park are likely experiencing higher levels of deposition as a result of higher annual precipitation.

Some air pollutants while still in the atmosphere react in the presence of sunlight to form ozone. Ozone is harmful to humans as well as vegetation and is regulated under the Clean Air Act. Ozone monitoring in Grand Teton begin in 2012. The Environmental Protection Agency has established a standard for ozone that is based upon the three-year average of the fourth-highest eight-hour average concentration that occurs during the year. Data collected by the park ozone monitor from 2012 through 2018 indicate that the park meets the ozone standard. Due to the short span of time that the Grand Teton monitor has collected data, it is not possible to determine whether or not there is a trend.



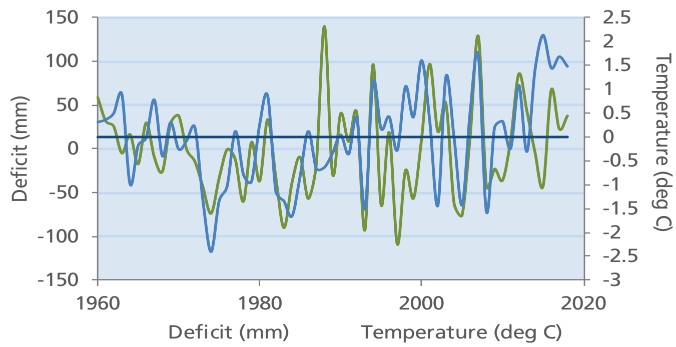
A comparison of the maximum ozone levels annually on the fourth-highest day in Grand Teton and Yellowstone National Parks. The fourth-highest day of the year is identified and reported in order to minimize the impact of short-term variations in weather conditions in any given year.

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 about 70 miles on the haziest 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 are typical in late summer and were a factor even prior to human occupation.



Climate

Weather records at Moose, WY collected since 1960 show that in 2018 the temperature was 1.5°C above average, making it the fifth warmest year since 1960. In 2018, precipitation was near average; however, the 2018 water deficit (drought stress) was 38 mm above average placing it in the 79th percentile of dryness. This relatively high drought stress in a year with normal precipitation indicates the strong influence that temperature plays in determining water availability for vegetation.



Temperature and water deficit (drought stress) anomaly at Moose, WY in Grand Teton NP compared to the 1960–2018 long-term average conditions, shown as the navy horizontal line. Data from Climateanalyzer.org.

Fire

Once again in 2018 there were many "megafires" in the northern Rocky Mountains. While no large fires burned in Grand Teton National Park or the John D. Rockefeller Parkway, fire managers observed the continued trend of increasing fire size and more extreme behavior on the landscape. With stark predictions for hotter temperatures and longer fire seasons in the future, fire managers are shifting their approach from restoring historic fire regimes toward facilitating a fire environment that preserves the ecosystem's most important characteristics like wildlife habitat, water resources, scenic beauty and safety for human communities. The US National Cohesive Wildland Fire Management Strategy calls this "resilience" for wildland areas and "fire adaptation" for the developed areas, but the two goals are interdependent.

Researchers use plots to study plant germination and survival in the 2016 Berry Fire. Concerned about seedling failure under the hotter and drier conditions associated with climate change, they monitor weather data in the area using a temporary station mounted on a tripod.

While the overall trend of larger, faster-spreading fires is consistent, there remains a great deal of variability between fire seasons. Some years are still too moist to support large fires. During the lifetime of a specific fire, some days may be cool and wet, causing fire growth to pause for several days or more. Fire events are therefore very episodic on both a daily and an annual basis because fire spread is so dependent on fuel and weather conditions. Even when there is a dense forest or continuous sagebrush-grassland, two other major factors also drive fire behavior in the Rocky Mountain west; fuel moisture content and wind velocity.

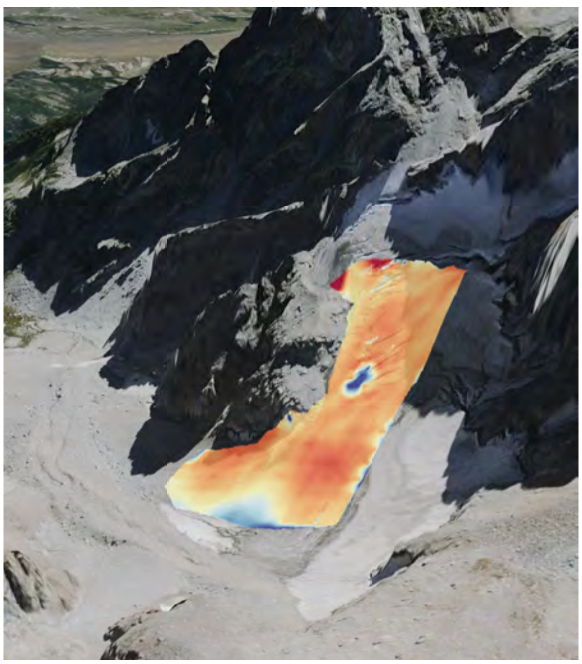
In Grand Teton National Park, fire managers partnered with fire ecology researchers to use the best available science to help understand this new fire paradigm. Dr. Monica Turner's research laboratory at the University of Wisconsin started working in the Greater Yellowstone firescape after 1988 fire events burned 36% of Yellowstone National Park and thousands more acres on the surrounding lands. This group of scientists is currently studying places where recent fires have re-burned forests that are still in the early stages of regeneration after crown fires that occurred within the last 30 years. Fire managers previously thought that fires would not actively spread in recently burned forests because of diminished fuels. Instead fire managers observed that fires are easily spreading in these areas when conditions are right, raising concerns for future forest recovery if trees are repeatedly burned and seed sources disappear.

Adding to the concern about seed sources is the changing climate's effect on seedling germination and survival in the post-fire environment. Dr. Turner's group is measuring soil and air temperature in recently burned forests to track how the warming environment is taking a toll on these seedlings, hoping to answer what implications this may have for future forests and future fire regimes in the Greater Yellowstone Ecosystem. While it appears that future fires will increase in challenges, park fire managers will continue to rely on science to inform their management responses and plans for protecting resources.

Glaciers

Grand Teton National Park has 11 known glaciers, formed during a short cold neo-glaciation period called the Little Ice Age (1400–1850). Some of these glaciers are active, while others are considered remnant because they have lost so much volume they have stopped flowing. Glaciers store water at high elevations that provide critical input to the landscape and to aquatic systems, particularly in years of below-average precipitation, where stream temperatures can be 3–4 degrees cooler than adjacent, glacier-less basins. Changes in glacial extent and volume are significant indicators of changing climate and, as in nearly all glaciated areas of the globe, recent studies show significant and rapid retreat and volume loss of glaciers in the Greater Yellowstone Ecosystem (GYE). High-elevation areas of the Rocky Mountains are experiencing changes such as rising temperatures and earlier meltouts at a more rapid rate than the region overall. The Teton glaciers are also iconic features of the park landscape, prompting efforts to monitor their fluctuations under current and future climate regimes.

Aerial view of the Teton Range showing three glaciers from left to right—Middle Teton, Teepe, and Teton Glaciers, 2018.



Comparison study of Middle Teton Glacier showing elevation loss (red) and gain (blue) for 2018 compared to the previous year.

Aerial view of Falling Ice Glacier on Mt. Moran, 2018.

Starting in 2013, NPS staff, with support of the USGS, created monitoring protocols and tested elevation survey methods on Middle Teton and Schoolroom Glaciers—both chosen for their relative safety and accessibility. Park staff also installed air temperature sensors to provide data for a GYE-wide sensor network, as well as time-lapse cameras to provide images and monitor seasonal snow pack on glaciers that are too difficult or hazardous to monitor directly. The park's objective is to monitor glacier movement, area and volume changes over time, and their influence on steamflow quantity and quality.

Despite some short-term advances, Teton Range glaciers have steadily decreased in volume since the 1850s. Over the last 50 years, analysis of aerial images indicates Middle Teton Glacier decreased in size by 25% and Teepe Glacier by greater than 60%. In fact, aerial photography from September 2018 indicates that Tepee has very little ice remaining at all, let alone enough to move under its own mass. Schoolroom Glacier, named for its textbook example of a glacial moraine and impounded, turquoise lake, decreased in size by over 30%.

Annually since 2015, physical science staff and climbing rangers conduct GPS elevation surveys of Middle Teton Glacier. Results from 2018 indicate a net volume increase of 18,000 cubic meters (the equivalent of an 9 cm increase in surface elevation across the glacier) compared to 2017—perhaps influenced by an above average winter (May 1st snow water equivalent was 118% compared to median), higher than average late spring precipitation, and additional large inputs of snow from the upper reaches of the mountain. During a site visit on June 1, 2018, staff observed debris from a large, wet avalanche that probably occurred sometime in late-May and persisted throughout the ablation (melt) season, likely contributing to the lower reaches of the glacier increasing in elevation when decreases are normally prevalent. Although 2017 measurements revealed a small volume decrease (-3,000 m^3) and 2018 presented a modest gain (+18,000 m^3), the overall trend from 2014-2018 demonstrated a significant decline in volume totaling 66,000 m^3.

In 2018, NPS staff returned to Schoolroom Glacier for the first time since 2014 to repeat the GPS surveys. Comparing the change over five years, results indicated a net volume decrease of 35,000 m^3.

Recent remote sensing analysis comparing high-resolution satellite imagery to old aerial photographs indicates an average annual loss of 16 cm of water equivalent across the surfaces of Teton glaciers each year. That equals a loss of 8 meters of water equivalent (and an even greater thickness of ice) over the course of 50 years, an important metric for demonstrating glacial shrinking.

Rivers

Spread Creek in small flood stage showing lateral bank migration, 2018.

The rivers and streams of the Upper Snake River Basin and Grand Teton National Park drain the Teton Range, Absaroka Mountains, and Yellowstone Plateau. Spring snowmelt released from the surrounding high elevation areas drive annual floods throughout the park. Depending on the watershed's elevation and aspect, annual peak flows can occur anytime from mid-May to mid-June.

The fluvial backbone of Grand Teton, the Snake River, alternates between a highly dynamic, multi-thread channel occurring where the alluvial valley is wide and a single-thread channel when it is narrow. The Snake River, similar to other braided rivers, has a high bed load, erodible banks, and changes course frequently through lateral migration and avulsion. Tributaries feeding the Snake River come from the Absaroka and Gros Ventre Ranges to the east, and the Teton Range to the west. The major tributaries are Pacific Creek, Buffalo Fork, and Spread Creek, each contributing large amounts of sediment to an otherwise naturally sediment-deficient system below Jackson Lake.

2018 was the 50th anniversary of the Wild and Scenic Rivers Act. Within Grand Teton National Park there are four waterways under that designation—the Snake River, Gros Ventre River, Pacific Creek, and Buffalo Fork. Totaling over 40 miles in length, these waterways are identified because of their regionally and nationally significant geology, scenery, cultural, fish, wildlife, and recreation values.

Jackson Lake Dam, originally built in 1906–07 and reconstructed in 1916, raised the height of the natural lake by 38 feet, and completely dictates the flow of the Snake River until the Pacific Creek confluence 4.5 miles downstream. Studies show that the dam significantly changes the hydrology immediately downstream, but those changes become more muted as downstream tributaries enter the Snake. Gage data from below the dam, as well as a historical record of natural inflows to Jackson Lake, provide a unique view of how the dam changes this system. In 2018, peak flows decreased by 50% compared to unregulated flows, and late season baseflow increased to above 300%.

In 2018, river runoff and snowpack were well above average, and continued to drive changes to riverbanks and channels throughout the park. On May 1st, the snow water equivalent (SWE) in the Upper Snake River Headwaters was 146% of the 1981–2010 median, and the adjacent basin draining into the Gros Ventre River was at 136%. Following an above average snowpack at the beginning of the month, May was warmer and wetter than normal, driving earlier than typical peak flow timing. Mean monthly flows for May were the 2nd highest over the 22 year period of record, at 10,500 cfs . The runoff trend for 2018 did not lead to an abnormally high peak magnitude, being only equivalent to a 5-year event at 14,000 cfs, but it had a long duration at the "small flood" stage, which continue to drive channel avulsion and streambank migration, especially along the Snake River and its eastern tributaries, Pilgrim Creek and Spread Creek. The duration of the small flood stage was approximately 78 days at the Moose gaging station, only exceeded by 1997 and 2017 water years during the period of record.

This affected park infrastructure at Spread and Pilgrim Creeks, tributaries of the Snake River. Both creeks leave confined geomorphic settings spreading into open alluvial fans where water velocity decreases significantly, depositing large quantities of sediment which results in a high degree of channel braiding and avulsion. The long flood duration, in combination with geologic factors, caused both streams to avulse into new channels and migrate laterally, causing erosion and damage to adjacent road infrastructure. Much of Grand Teton's infrastructure continues to be adjacent to highly dynamic fluvial systems and because of unknown future changes in temperature and precipitation is likely to require continued management as waterways avulse and migrate.

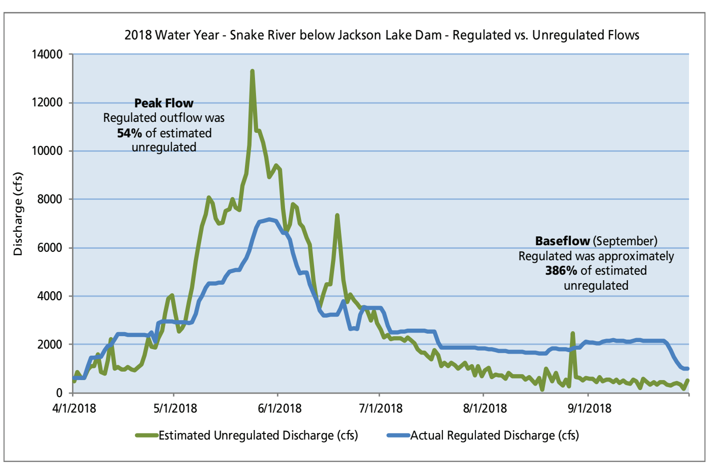


Chart comparing the Snake River's 2018 flow regulated by the dam (blue) compared to the estimated unregulated flow (green).

The River Road is no longer passable due to bank erosion along the Snake River, and was closed permanently as outlined in the Wild and Scenic River Plan.

Water Quality

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

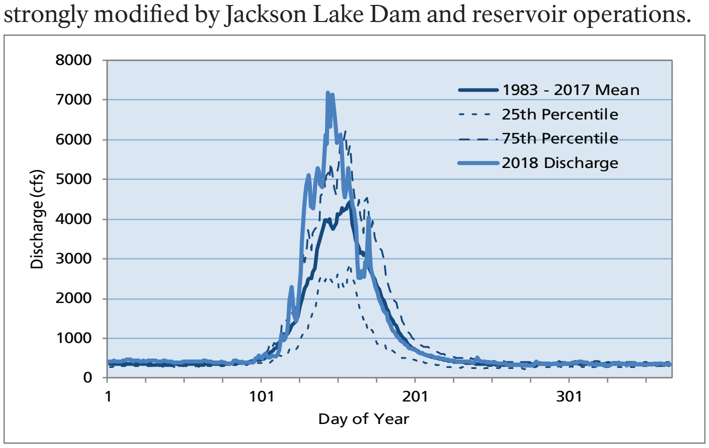
The uppermost reaches of the Snake River in Wyoming are characterized by good water quality with relatively low levels of dissolved nutrients and other anthropogenic compounds (e.g., pesticides). Good water quality and the presence of native fish, including cutthroat trout, are not surprising given that 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 where "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 US Geologic Survey monitors flow levels of the Snake River at two locations—Flagg Ranch and Moose, Wyoming. Discharge in 2018 was above average at the Flagg Ranch site (1983–2018) and peak flows at Flagg Ranch, Wyoming ranked as the 15th highest in the 35-year monitoring record. In addition, peak flows occurred just 2 days earlier than the average for this site. Snake River flows at Moose were above the 75th percentile record for flows at that site (1995–2018) early in the season but dropped precipitously as the season progressed. Flows at this site are strongly modified by Jackson Lake Dam and reservoir operations.

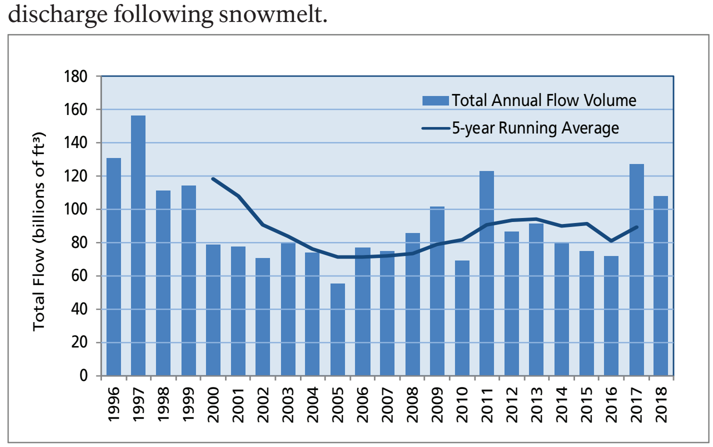
The Snake River is an extremely important park resource, Grand Teton NP.

Total volume of annual flow at the Moose monitoring location ranked 7th out of the 23-year record, but the date of half discharge (the day when half of the annual volume of water occurred June 8, 2018) was nearly 20 days earlier than the record for this location.

NPS resource staff also monitor water quality at these same Snake River locations. Results from 2018 confirm that concentrations of primary nutrients (nitrogen and phosphorus) consistently remain low or below detection and show little seasonal variation. Trace metals (i.e., arsenic, copper, and selenium) are found in the watershed and are often naturally present in measurable concentrations, but typically below the State of Wyoming's aquatic life criteria. In 2018, copper and selenium were below detection levels at both sites. Total arsenic concentrations increased to measurable amounts during low flow at both locations with higher concentrations found at the Flagg site; however, both sites were below the State of Wyoming's aquatic life criterion. Conversely, total iron concentrations are highest in the Snake River during spring runoff. Iron concentrations at both monitoring locations exceeded the State of Wyoming's aquatic life criterion in 2018. 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 following snowmelt.



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

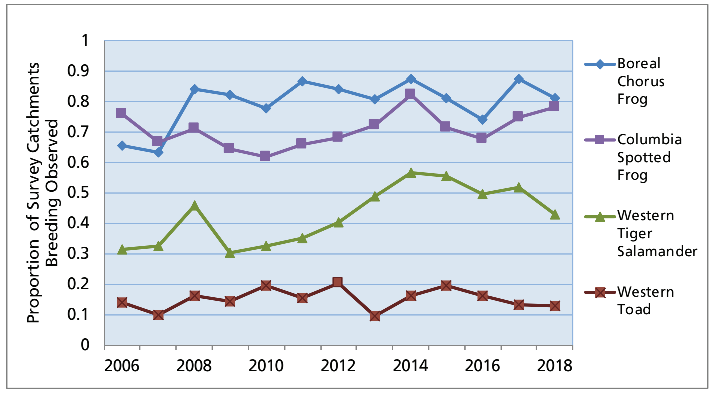


Annual Snake River flow totals (in billions of cfs) at Moose, WY. A 5-year average smooths annual variations for a clearer examination of trends.

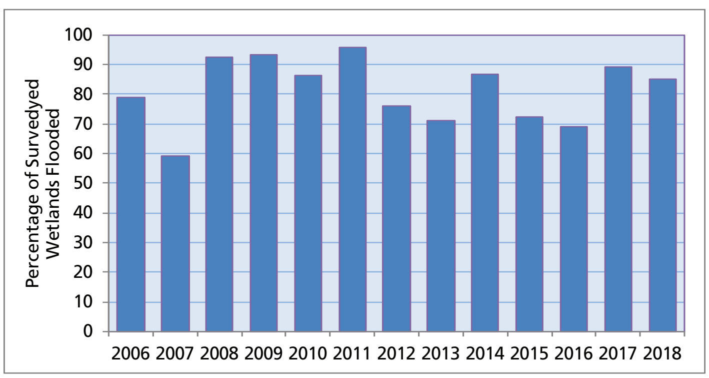
Amphibians

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 only one confirmed sighting occurred 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.

The National Park Service collaborates with the Northern Rockies Conservation Cooperative, US Geological Survey, and university scientists to monitor amphibians in the Greater Yellowstone Ecosystem (GYE). Annually since 2006, these biologists 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 336 individual wetland sites in 2018, and surveyed 280 that had standing water present. Biologists documented breeding activity using visual surveys to detect eggs, larvae (e.g. tadpoles), and metamorphic forms (i.e., transitional forms between aquatic and terrestrial life stages). Of these sites, 55% were occupied by at least one species of breeding amphibian. In 2018, two of the 31 catchments contained breeding evidence of all four species (referred to as amphibian "hotspots"). This was consistent with 2017 and up from 2016 when no catchments contained breeding evidence by all four species. For comparison, biologists found two hotspot catchments in 2015 and four in 2014, illustrating the breeding variability that takes place even in protected areas.



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



Percentage of surveyed wetlands with standing water suitable for breeding.

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 2018, 85% of visited wetlands were flooded. All amphibians in the GYE 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 alter wetland habitats and influence amphibian breeding which could disproportionately affect amphibians relying on shallow wetlands.

The extended vocal sac of the male chorus frog helps to resonate the sound of its mating call.

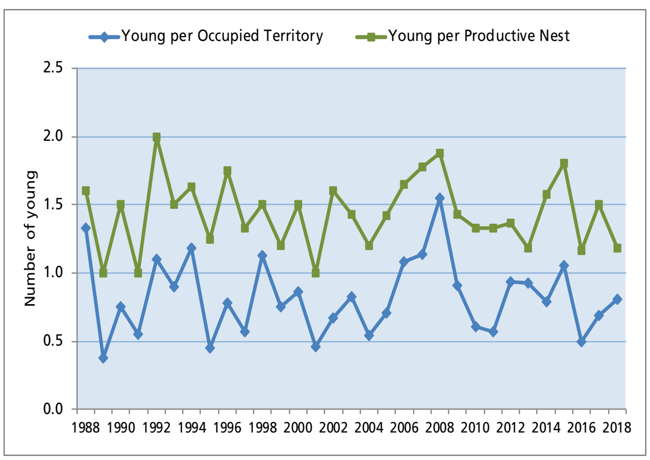
Bald Eagles

Eagles have four talons per foot, a hallux talon at the back of the foot that faces forward and three talons in front that face toward the back. The hallux talon, always longer than the other talons, is longer on females than on males. Hallux talons on large female eagles are almost 2 inches long and only about 1.25 inches on small males.

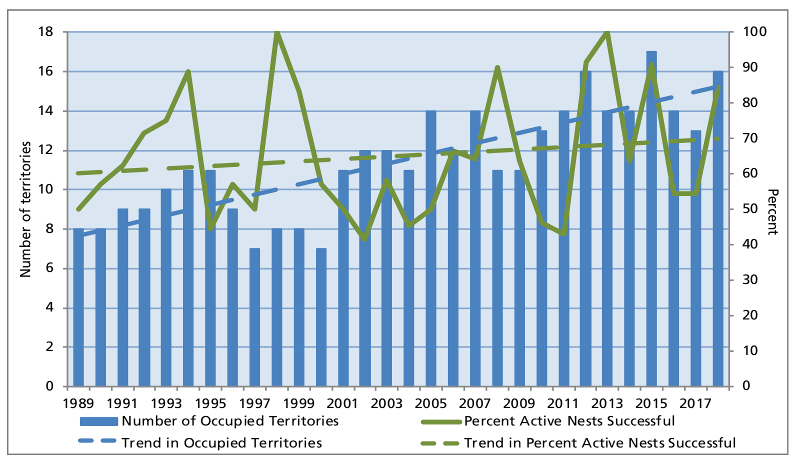
Bald eagles (*Haliaeetus leucocephalus*) are large, primarily fish-eating predators that generally nest in trees, close to water bodies. They also feed on small mammals, waterfowl, and carrion. Within Grand Teton, breeding sites are found along the shores of Jackson Lake and along the Snake River.

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 30 years. In accordance with the Greater Yellowstone Bald Eagle Management Plan (1995), park managers may implement temporary closures around active bald eagle nest sites to minimize disturbances. In 2018, closures were established at nest sites along the Snake River, as well as at the Wilcox Point campsite.

Of the 21 bald eagle territories monitored in 2018, 16 were occupied by at least one adult. Thirteen pairs nested and 11 territories fledged a total of 13 eaglets. Most of the 2018 breeding statistics were slightly above both the previous year's numbers and the 10-year average. The number of occupied territories in 2018 was 16 (10-year average = 14.2), a total of 13 nesting pairs were observed (11.8), and 11 successful nests (8.1) fledged a total of 13 eaglets (11.2). Although there were more successful territories than the 10-year average and only twice have there been 11 successful nests in the past 30 years, the number of fledglings per nest (1.18) was lower than both the 10-year average (1.39) and the 30-year average (1.43).



Counts of bald eagle young produced by territories and nest.



Bald eagle pairs occupying territories and successfully producing young.

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 US and migrate to coastal areas for winter. Loons that nest in Grand Teton National Park reside near the southeasternmost 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 showed a reduction in the number of territorial pairs and chicks fledging in the Greater Yellowstone population around 2010, but the population is now experiencing an increasing trend. 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 the summer of 2018, researchers observed one unpaired loon within Grand Teton National Park on Jackson Lake, but they did not observe any breeding activity. No loons were observed on Leigh and Jenny Lakes.

On September 7, 2018, wildlife staff observed a family group of two adults and a juvenile on Snowdrift Lake (elev. 10,006'). Biologists speculate that these were either local birds moving around or birds moving south from more northern populations.

Bighorn Sheep

Both genders to bighorn sheep develop horns soon after birth, with horn growth continuing throughout life. Annual growth rings indicate age. The curling horns of older rams may weigh more than 30 lbs. and measure over 3 ft. Ewes' horns are much smaller and lighter and do not tend to curl.

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 core native sheep herd. The herd now lives year-round at high elevation along the Teton crest and in 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 80 individuals, distributed in two segments at the north and the south ends of the range. It appears that the herd has experienced a recent decline. In 2018, Wyoming Game and Fish Department (WGF) personnel counted a total of 76 sheep (30 in the south end of the range and 46 in the north end). This marked an increase from the low aerial counts the previous three years. Similar numbers of ewes were counted in the north and south, but significantly more adult males were observed in the north. In 2018, park biologists implemented a pilot study to assess the effectiveness of remote cameras to monitor the Teton Range bighorn sheep population during summer months. Biologists placed motion-triggered cameras at nine mineral licks scattered across the Teton Range that, collectively, are likely used by the entire bighorn sheep population. From June through September the cameras collected over 11,600 photos of bighorn sheep in 254 different groups on 94 different days. The cameras photographed 10 of the park's 11 radio-collared bighorn sheep on multiple occasions and confirmed that at least five of the eight radio-collared ewes produced a lamb in 2018. Biologists used the data from this pilot-study to estimate the number of adult (one year or older) bighorn sheep in the Teton Range at 106 individuals with an 80% confidence interval ranging from 82 to 139 individuals. Initial findings indicate that trail cameras can be an effective tool to monitor bighorn sheep in the Teton Range.

Annual ground classification surveys started in 1990 provide composition, distribution, and trend information. Biologists from the park, WGF, Bridger-Teton and Caribou-Targhee National Forests, Northern Rockies Conservation Cooperative, and Wyoming Wild Sheep Foundation, as well as several volunteers from the local community counted a total of 40 sheep during the late August ground surveys (26 in the south and 14 in the north). Herd ratios were estimated at 63 lambs, 19 yearlings, and 69 rams per 100 ewes. Since ratios derived from summer ground counts are highly variable over time, the counts primarily provide confirmation that the herd is still reproducing and that some of the lambs survive their first year.

Park personnel conducted captures in December of 2018. Weather conditions were not favorable, thus only two adult ewes were captured. Each animal was aged, weighed, sampled for pneumonia pathogens, and fitted with a GPS radio collar. The information collected will be used to track survival, better estimate population size, track habitat use, and assess the potential for disease transmission between bighorn sheep and nonnative mountain goats. Compared to surrounding bighorn sheep populations, relatively few pneumonia pathogens were found in Teton Range bighorn sheep. This result is surprising because historically domestic sheep (the typical source of pneumonia in wild sheep) grazed in the Tetons and may have mingled with bighorns.

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 but did not regularly monitor the Teton Range golden eagle population. Concerns about golden eagle populations throughout the western US have arisen recently, primarily because of habitat loss and alteration. Like many raptors, golden eagles are sensitive to disturbance around their nest sites.

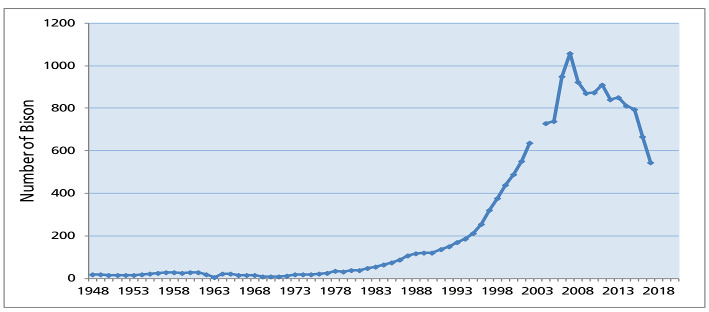
In 2018, park biologists partnered for the fourth year with Craighead Beringia South to conduct ground surveys for golden eagles and their nesting territories. Biologists surveyed for golden eagles throughout Granite, Death, Avalanche, Cascade, Paintbrush, and Leigh Canyons, as well as the Uhl Hill area. Biologists confirmed occupancy at three sites—Avalanche Canyon, Cascade Canyon, and Uhl Hill. At Uhl Hill, eagles built up a nest but other reproductive behaviors were never observed. Biologists could not find an initiated nest in Cascade Canyon. The Avalanche Canyon golden eagles successfully fledged one eaglet.

Bison

Bison (*Bison bison*), a species 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. This altered the herd's natural population dynamics, as they returned annually to feed on this easily obtainable 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. 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. 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.

Bison wallow, rolling in dirt, to deter biting flies and help shed fur. Male bison also wallow during the mating season to leave their scent and display strength.



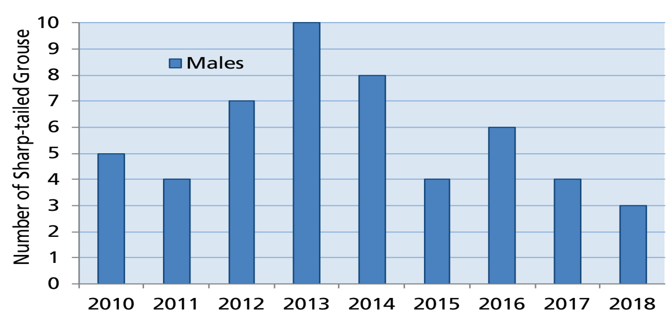
Population size of the Jackson bison herd, 1948-2018.

Due to mild conditions during the winter of 2017/2018, supplemental feeding did not occur on the National Elk Refuge. Consequently, biologists did not conduct a ground count. The joint Bison and 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 and 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, biologists suggest that only consistently high hunter harvests focused on cows will maintain the population at the desired level. Vehicles collided with nine bison, resulting in at least two (22%) bison deaths in 2018.

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% 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 sharp-tailed grouse subspecies. 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 preceding years but no leks were found prior to 2010, and the nearest known lek was in Idaho along the western slope of the Tetons.



Male Columbian sharp-tailed grouse displaying at the Grand Teton lek, 2010-2018.

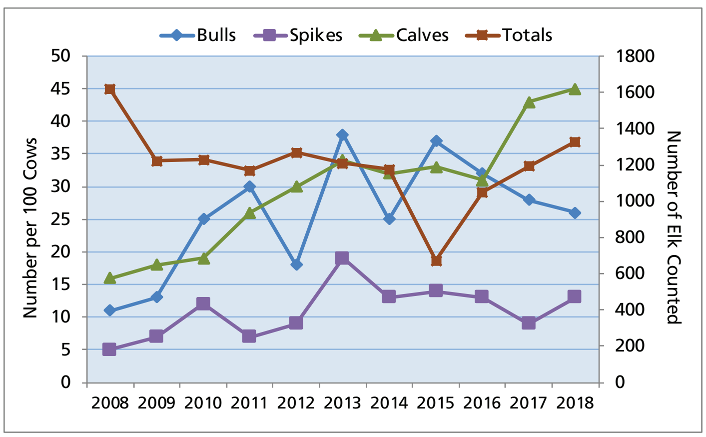
In the spring of 2010, biologists located a sharp-tailed grouse lek near the southeast boundary of the park, where they observed five males displaying. This marked the first known sharp-tailed grouse lek in the park in over 40 years. In 2018, biologists observed a maximum of three adult males strutting at the lek, but did not see any females at the lek. A maximum of ten males were observed on the lek in 2013. While staff never observed females on the lek during surveys, the longevity of lek activity as well as 2016 observations of a hen with chicks within two miles of the lek suggests that successful breeding occurs.

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, elk have significant effects on park ecology. Their grazing and browsing may affect plant productivity and, as prey and carrion, elk provide sustenance to carnivores and scavengers. They are also popular with park visitors.

Elk calves can stand within 30 minutes of birth but cannot keep up with the herd for another few weeks. Born spotted and with little scent, they are camouflaged from predators and sometimes left hidden as their mothers feed.

The mid-winter trend count objective for the Jackson elk herd set by the Wyoming Game and Fish Department (WGF) is a three-year average of 11,000 elk ± 20%. In the trend count conducted in February 2018, WGF found 10,877 elk yielding a three-year average of 10,770. 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. During the 2018 park reduction program a total of 185 elk were harvested.



Grand Teton mid-summer elk count and classification, 2008–2018.

During the summer, park biologists count and classify elk from a helicopter in a portion of the park with high elk density and visibility. The survey is not intended as a census of park elk, but provides a minimum count of elk within the area surveyed. In 2018, park biologists counted and classified 1,329 elk. The total number of elk counted was 137 more than in 2017. Overall numbers remained remarkably consistent from 2009–2014, but abruptly declined in 2015 and rebounded to near the previous level the last several years. Herd ratios and composition were 26 mature bulls, 13 spike bulls, and 45 calves per 100 cow elk. Calf ratios increased slightly compared to 2017 and were the highest level observed since 2008. The calf ratio was highest along the Snake River north of Moose and lowest in Willow Flats.

Great Gray Owls

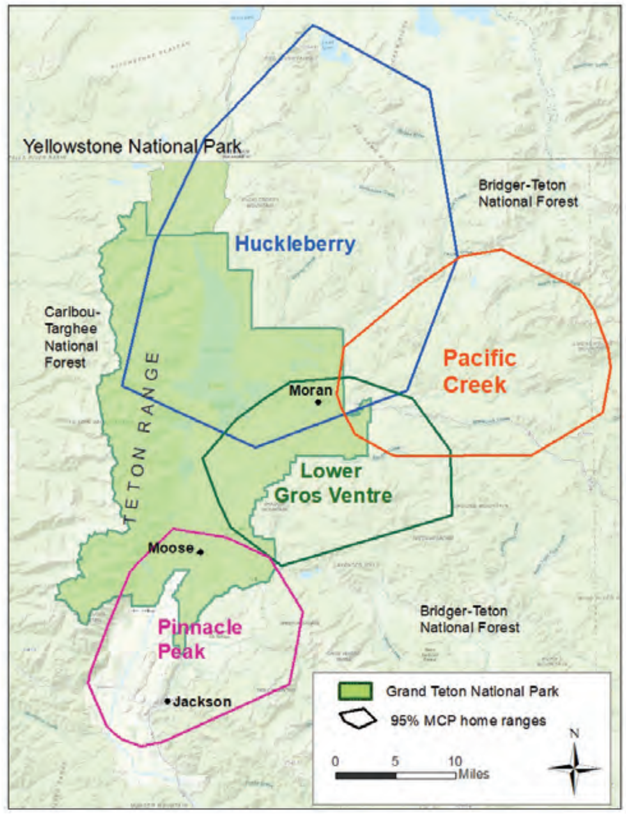
The great gray owl (*Strix nebulosa*) is associated with old-growth boreal forest habitats in western Wyoming and is considered a species of greatest conservation need in Wyoming. Little is known about their population status and tends. Since boreal forests in Wyoming are currently at risk due to drought, insect outbreaks, disease, and logging; concern for the status of great gray owls is growing.

Starting in 2013, Grand Teton National Park partnered with the Teton Raptor Center to collect baseline data on territorial occupancy, demographics, nest success, prey use, and year-round habitat use of the Jackson region great gray owl population. This data will aid area land managers in developing management plans.

In late winter–early spring of 2018, biologists deployed automated recorders near known nests. These recorders documented owl activity in seven of the eight great gray owl territories prior to nesting season, matching 2017 occupancy. In 2018, only one owl pair in Grand Teton initiated a nest. This nest successfully fledged a single owlet, one of only three fledged in the entire Jackson Hole valley. This was the second consecutive year with very low reproductive success for great gray owls in Jackson Hole. There were no nests initiated and no owlets fledged in 2017, which was down dramatically from 2016 when there were 21 active nests and 17 owlets fledged.

Biologists continued to track owls previously outfitted with VHF transmitters as well as capture and outfit additional owls to evaluate habitat selection and movement patterns. Additionally researchers surveyed pocket gophers to assess prey availability and measured snow monthly at several owl territories throughout the valley and park.

Gray Wolves



Distribution of Jackson area wolf packs, 2018. MCP (Minimum convex polygons) are home ranges based on collared pack members.

After the US 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 a predator-prey relationship absent since humans eradicated wolves from the ecosystem in the early 20th century.

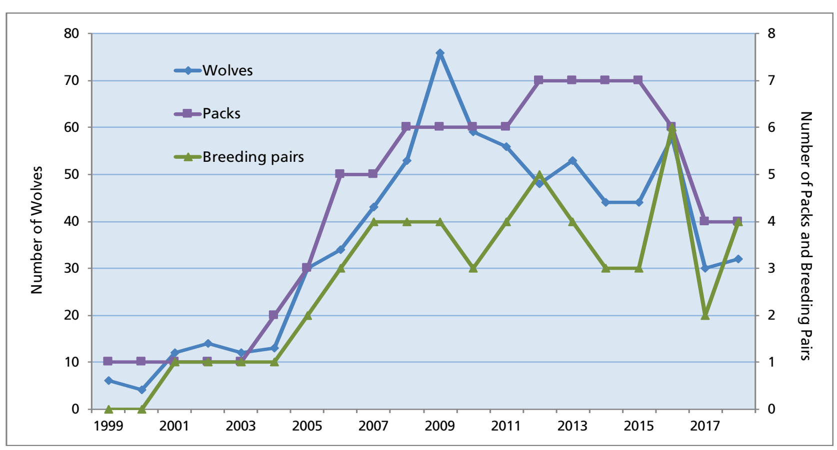
At the end of 2018, a minimum of 32 wolves in 4 packs resided in the Jackson Hole area with home ranges in Grand Teton National Park. The Lower Gros Ventre (8 wolves), Huckleberry (10), Pinnacle Peak (8), and Pacific Creek (6) packs used the park. All four packs produced pups in 2018: Lower Gros Ventre (4 pups), Huckleberry (6), Pinnacle Peak (4), and Pacific Creek (4), but only the Lower Gros Ventre pack denned in the park. To minimize human disturbance to wolves raising young, park managers implemented closures around den and rendezvous sites for the Lower Gros Ventre pack.

At least seven wolves dispersed from area packs in 2018: a Huckleberry male to Montana, two males separately to Idaho (one from Lower Gros Ventre and another from Togwotee), and four males joined other packs in Wyoming. Eight area wolves died in 2018. Three of the deaths occurred in the park: an adult female was hit by a vehicle in August, an adult male died of natural causes in October, and a female pup was illegally shot in December. In early January, the Lower Gros Ventre pack killed the lone remaining Phantom Springs female outside the park boundary and took over its territory. Four other wolves were legally harvested outside the park.

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 their calves, representing more than half of the kills in June and July.

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. However, on March 3, 2017, the US Court of Appeals for Washington DC ruled to reverse the 2014 decision and once again remove Wyoming wolves from the endangered species list, which became official April 25, 2017.

Trail camera captures a pack with young pups drinking from the river.



Population growth of Jackson area wolves, including those in Grand Teton, 1999-2018.

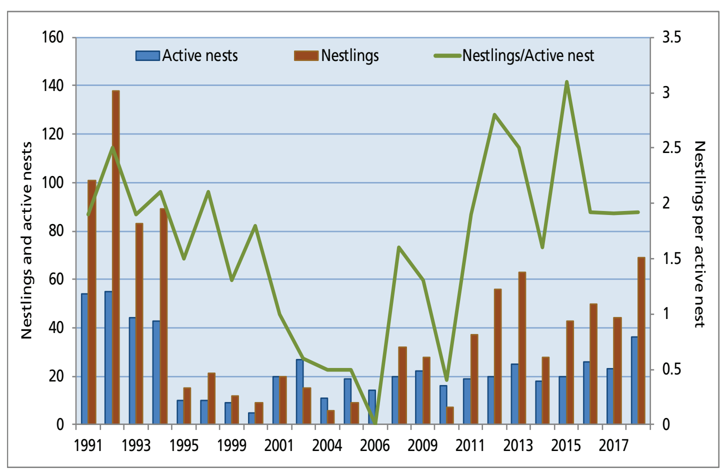
Great Blue Herons

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. Heronries are also vulnerable to predation. Monitored since 1987 in Grand Teton National Park, heron occupancy and reproductive success vary widely with overall productivity declining during 1995-2006 but slowly increasing since. 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 recently established site at Sawmill Ponds discovered in 2015 and two new nests at Oxbow Bend and Moran Junction, discovered in 2018. Biologists monitored the new nests and colonies at Arizona Lake, Pinto Ranch, and Sawmill Ponds in 2018. At Arizona Lake, herons produced 39 young from 14 active nests. At Pinto Ranch, there were 19 active nests which produced a total of 22 young. Only one active nest was observed at both Sawmill Ponds and Oxbow Bend, yielding 4 chicks each. The Moran Junction nest, active early in the season, produced no young.

The totals of 36 active nests and 69 nestlings observed in 2018 were higher than the 10-year averages of 22.5 nests and 42.5 nestlings. Overall numbers of active nests and nestlings remained fairly stable with a slight increase for the past 10 years. Despite fluctuations in the number of nests over the last three years, the number of nestlings per active nest remained stable. While heron numbers increased since their historic lows of 1995-2006, current numbers are still well below the historic highs of the early 1990s.

Great blue herons are distinctive in flight with their slow wingbeats , neck tightly curved to tuck their head between their shoulders, and trailing long legs.

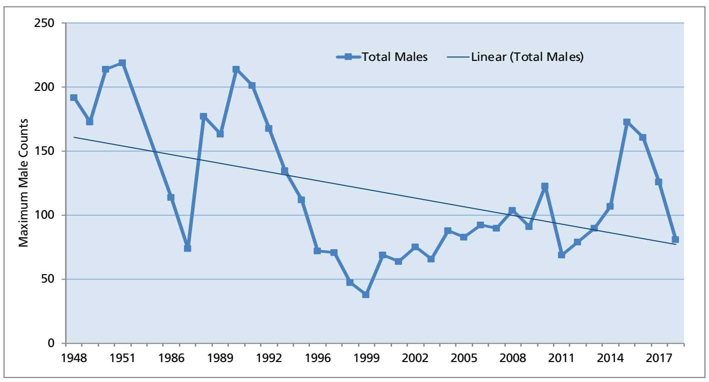


Great blue heron productivity in Grand Teton NP, 1991-2018. Arizona Lake heronry, discovered in 2007 just outside the park's boundary, is included in the park's monitoring program since 2009. Monitoring of heronries was not conducted in 1996, 1997, 2002, or 2008.

Greater Sage-grouse

Historically, greater sage-grouse (*Centrocercus urophasianus*) occurred in sagebrush habitats across much of Wyoming and the American West. Sage-grouse populations declined throughout their range over 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. Biologists began monitoring sage-grouse leks in Grand Teton National Park in the 1940s to document population trends.



Counts of male sage-grouse with a trend line on Grand Teton NP leks 1948-2018. No monitoring data for sage-grouse in 1952–1985 and 1993.

Male sage-grouse spread their tails, strut, and thrust their heads to inflate two air sacs that produce unique sounds as part of their mating display .

In the spring of 2018, eight leks were monitored weekly [seven in Grand Teton and one located on adjacent National Elk Refuge (NER) land] and sage-grouse consistently occupied seven leks (Airport, Bark Corral, Moulton, RKO, Spread Creek, Timbered Island, and North Gap-NER). The Airport pit, last active in 2014, was inactive in 2018.

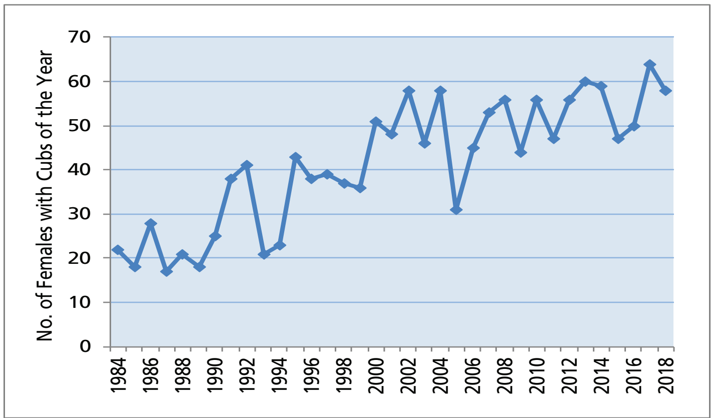
For the six active leks within Grand Teton National Park, the total maximum count of all sage-grouse was 114 and the maximum male count was 81; both lower than the 10-year averages of 157.7 and 110, respectively. Only the Airport (13) and RKO (16) leks had male counts slightly higher than the 10-year average (12.5 and 15.5, respectively). The Moulton lek declined to a male count of 28 this year, dropping from 82 in 2017, a 66% decrease, and about half of the 10-year average (50.1). While this data provides information on general trends of sage-grouse attendance at leks, the relationship of these numbers to the 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.

Intensive conservation efforts over the next 40 years allowed grizzly bears to make a remarkable recovery. For 2018, the GYE grizzly bear population was estimated at 709 (95% confidence interval = 632–786). This estimate is based on the estimated number of unique female grizzly bears with cubs (via Chao2 methodology) in the demographic monitoring area. There are more grizzly bears today, occupying a larger area (25,038 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. Researchers documented grizzlies consuming at least 266 foods, 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,



Estimates of grizzly bear females with cubs of the year, 1984–2018, 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.

A trail camera captures a grizzly bear napping on the partially eaten and cached (buried) carcass of a mule deer. Bears will sometimes guard their food even sleeping on it or nearby until they are ready to consume more.

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 US 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. Subsequently, the guiding document for conservation and management of grizzly bears upon delisting (Final Conservation Strategy 2016- https://www.fws.gov/mountain-prairie/es/FINALCS.DRAFT_Feb_19_2016_FINAL.pdf) was revised and signed by several state and federal wildlife and land management agencies in December 2016. In September 2018, grizzly bears were relisted as threatened under the Endangered Species Act via judicial action. Management of grizzly bears and their habitat continues to be a high priority in the park and parkway to ensure human safety and contribute to the population's recovery.

Harlequin Ducks

Researchers capture a pair of harlequin ducks to track movements and health.

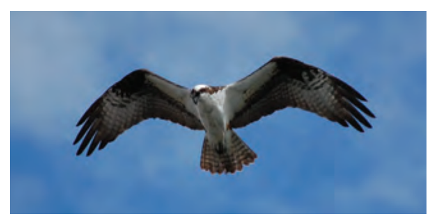
The harlequin duck *(Histrionicus histrionicus)* is a relatively small species that breeds in northern boreal regions of eastern Canada, the Pacific Northwest of the US and Canada, Alaska, and the Rocky Mountains. The population status for North American harlequin ducks is regionally variable; however, in the Rocky Mountain region they are considered a sensitive species and Wyoming lists them as a species of greatest conservation need. Harlequin duck core breeding range exists in Alaska, Washington, Oregon, Idaho, Montana, and Wyoming. The population in Wyoming represents the extreme southern and eastern extent of the western North American breeding population. The harlequin duck is one of the rarest breeding birds in Wyoming and its current breeding range appears to be limited to Yellowstone and Grand Teton National Parks, and the Bridger-Teton and Shoshone National Forests. Little information is available on survivorship, migration movements, winter habitat use areas and general breeding ecology. Better understandings of these subjects are needed in order to conserve harlequin ducks in Wyoming.

In 2018, biologists in Grand Teton collaborated with both the Wyoming Game and Fish Department and the Biodiversity Research Institute for a fourth year to capture breeding pairs in the northern part of Grand Teton National Park. They found only one pair on lower Moose Creek. The biologists equipped the male with a specialized implantable satellite transmitter and the female with a small geolocator device. The male began his migration in early July and arrived on the SW shoreline of Vancouver Island by mid-July, where it remained through the end of the summer. Researchers also captured four other harlequin pairs in Yellowstone National Park and fitted the males with satellite transmitters to track their migrations. One of these males died during migration, one migrated similarly to the Grand Teton male, another migrated to the Oregon coast, and the last migrated to the Puget Sound area of Washington.

In early August, biologists returned to conduct surveys of Berry, Owl, and Moose Creeks to locate females and their broods. They observed a hen with five ducklings in Owl Creek, a hen with four ducklings in Lower Berry Creek, and two lone ducklings and two single hens observed separately in Upper Moose Creek.

As part of the study scientists take blood samples to determine harlequin exposure to specific toxins. Blood tests from five ducks captured in 2016 (3) and 2017 (2) revealed lead levels of <0.033 ppm which is considered background, normal exposure to lead in the environment. Blood mercury (Hg) levels in these ducks were 0.45 ppm at Moose Creek and 0.19 ppm for Lower Berry. Although results are based on a small number of individuals, Hg levels in Moose Creek appear slightly elevated in comparison to other sites in WY, MT, and AK. Additional blood samples taken in 2018 from Moose Creek and Yellowstone will aid further comparisons.

Ospreys

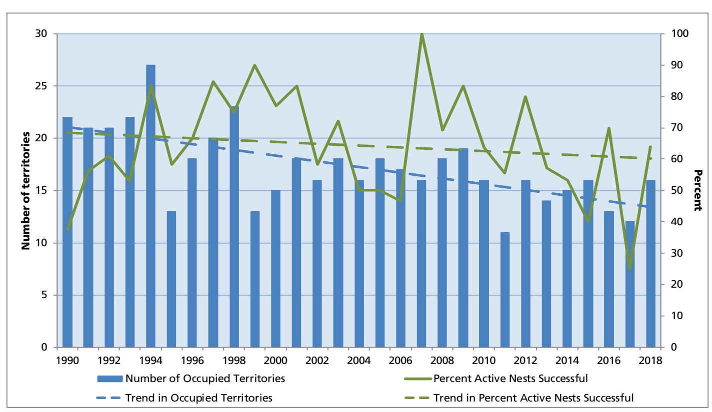


An osprey hovers high above the water to spot fish then plunges feet first to capture its prey.

Ospreys (*Pandion haliaetus*) are medium-sized hawks that prey almost exclusively on fish. The osprey population in Grand Teton is migratory and research documents that ospreys from the park migrate to the Mexican gulf coast and Cuba for the winter. Staff started monitoring osprey nests in 1968. From 1972–1981, only 6–9 nests were occupied each year. More recently, ospreys occupy approximately 15 territories annually (10-year average 14.8). Ospreys nest near low-elevation lakes and along the Snake, Gros Ventre, and Buffalo Fork Rivers and their tributaries.

In 2018, ospreys occupied 16 of 19 (84%) monitored territories. Breeding activity occurred at 14 of these sites and 9 pairs successfully fledged a total of 11 young, on par with the 10-year averages (7.4 successful breeding pairs and 11.6 young) after the lowest number of fledglings were recorded in 2017 (3 chicks total from 2 breeding pairs). Of special note in 2018, the Moran Bay nest fledged 3 chicks which is rare for ospreys in this area.

While the number of territorial pairs has declined since 1990, the trend in active nests that are successful is more stable. 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 once again more prevalent on the landscape, osprey populations may be responding by stabilizing at a lower level.



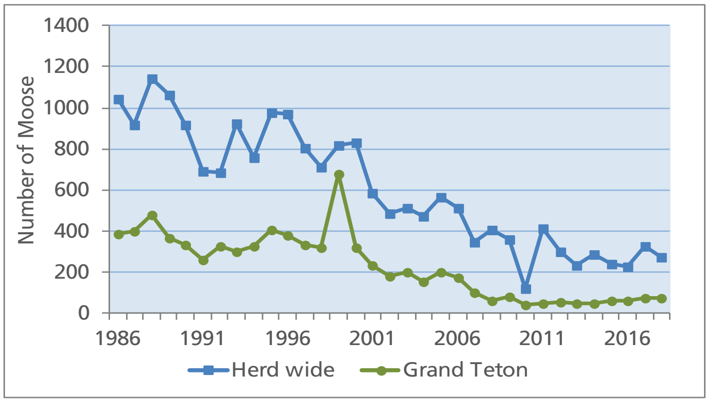
Territorial and successful osprey pairs, Grand Teton National Park, 1990-2018.

Moose

Moose (*Alces alces*) were rare or absent from Grand Teton National Park prior to 1912, but became numerous by 1950. They are better adapted to survival in deep snow than other ungulates in the Greater Yellowstone Ecosystem. Except during the rut, moose are usually found alone or in small family groups. Grand Teton moose are part of the Jackson herd which includes animals outside the park boundaries. The herd experienced a decline from an estimated high of more than 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 conducts an annual aerial trend count of the Jackson moose herd. The count for 2018 totaled 276 moose (roughly 50 less than counted in 2017), including 78 within Grand Teton. Ratios were estimated at 38 calves and 90 bulls per 100 cows.

A moose's fur is made up of two different layers—the longer hollow guard hairs that repel moisture and use trapped air as insulation, and a shorter denser underfur. Guard hairs are thicker and longer in the winter coat.

The moose herd decline likely resulted 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 and wildfire suppression was widespread. Today, grizzly, cougar, and wolf populations have recovered, and large-scale wildfires affected portions of the herd unit in 1988, 2000, and 2010. Studies suggest that nutritional quality of moose forage in areas burned in 1988 is significantly lower than in unburned areas. Individuals summering in these areas have lower pregnancy and calf survival rates. Conversely, winter habitat availability does not appear to be limiting the growth of the Jackson moose population. Moose have narrow temperature tolerances. Temperatures above 57°F trigger moose to seek cooler locations. Many of the shady mature forests bordering the riparian forage areas preferred by moose remain absent after large catastrophic fires. Additionally, warming temperatures associated with changing climate may be affecting moose, by altering their feeding and other activities, potentially affecting food intake.



Jackson moose herd mid-winter counts, 1986-2018 (data from Wyoming Game and Fish Department). These counts are used to estimate overall herd size.

Biologists are also studying parasites, like carotid artery worms and ticks, 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. In a study begun in 2012, biologists assess the extent of hair loss caused by winter ticks in moose using photographs. Hair loss can leave moose unable to properly thermoregulate. In 2018, biologists analyzed hair loss data from 83 moose. In the southern portion of the park, mean total hair loss (broken and bare patches) for all individuals was 7.9%. Adult males had 4% mean hair loss, and females had 11% mean hair loss. In the northern portion of the park, moose exhibited a 0.8% mean hair loss, with 1% for males and <1% for females. Moose photographed in 2018 had the lowest mean hair loss (5.4) observed since the project began. Biologists continue to explore the relationship between weather indices (e.g. fall/spring temperatures and amount of snow-on-the-ground) and hair loss in moose as these variable may influence tick survival. Earlier studies elsewhere demonstrated that severe winter tick infestations can negatively impact calf survival and tick reproductive success is positively affected by earlier springs and milder winters. While the nature of the link between parasites and the population decline is unknown, it is clear that these parasites are having an impact on the overall health of the moose population.

Mule Deer

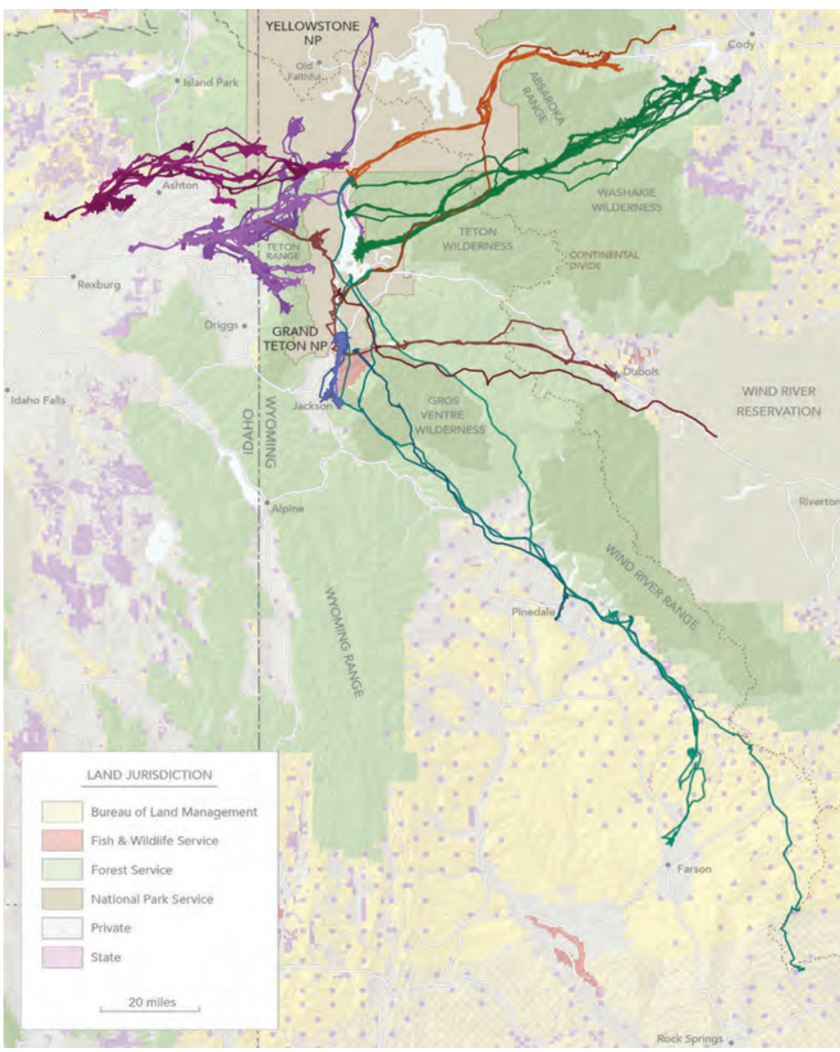
Mule deer (*Odocoileus hemionus*), one of many park animals that are seasonal residents, undertake annual migrations to distant wintering areas to meet their biological needs. Migrations showcase the behavioral strategies species use to exploit seasonal resources in otherwise inhospitable environments. 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.

Park mule deer research provides information essential to protecting important animal migration corridors in the Greater Yellowstone Ecosystem (GYE). Park scientists are documenting the migrations of mule deer moving between summering grounds in Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway and crucial wintering areas throughout the ecosystem. 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 land use patterns along migration routes to identify potential movement barriers, important deer stopover areas, and conservation needs; and working with partners to facilitate conservation of migration routes and important seasonal habitats.

This mule deer buck's tail shows the classic black tip of the species.

Since the project began in 2013, park biologists collared 37 adult female mule deer from summer range in the park and parkway. In 2018, biologists placed 30 GPS collars on adult female mule deer on Idaho winter ranges (10 from Sand Creek Wildlife Management Area and 20 from along the Teton River) in partnership with the Idaho Department of Fish and Game and 10 GPS collars on mule deer summering in the park (4 near Flagg Ranch, 1 at Spalding Bay, 2 from the String Lake area, 1 at Gros Ventre Campground, and 2 near Moose). Collectively, biologists recorded 126 complete migration sequences that describe 7 population-level corridors (travel paths of differing groups). The travel paths derived from the GPS collar data form a complex migration network spanning two states and multiple land management jurisdictions. This project continues to uncover great diversity within the migration network.

New collar deployments identify expanded routes in distance deer travel, as well as maximum elevations and number of land jurisdictions traversed. In 2018, biologists documented a mule deer traveling 190 miles, the longest distance recorded thus far in the project, from Grand Teton to winter range northwest of Rock Springs. While another mule deer crossed the project's highest elevation, a mountain pass of 11,496 feet in the Absaroka Range, traveling from winter range south of Cody to summer in the park.



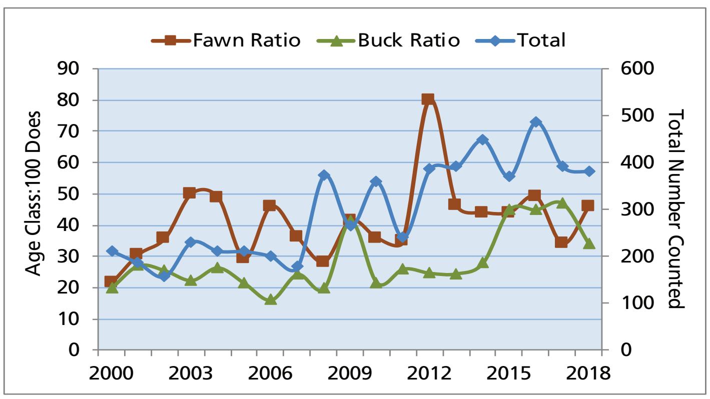
Travel paths of 68 mule deer that migrate seasonally from Grand Teton National Park and the Teton Range. Their migratory paths cross multiple of land management jurisdiction boundaries within the Greater Yellowstone Ecosystem.

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 100-mile route, one-way, 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 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) occurs along the southern portion of the route and in 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 2018 survey, biologists counted 218 pronghorn (in the central valley of Jackson Hole only). Based on this count, biologists estimated that 492 pronghorn summered in Jackson Hole (not including the Gros Ventre), although this estimate had a high degree of uncertainty.

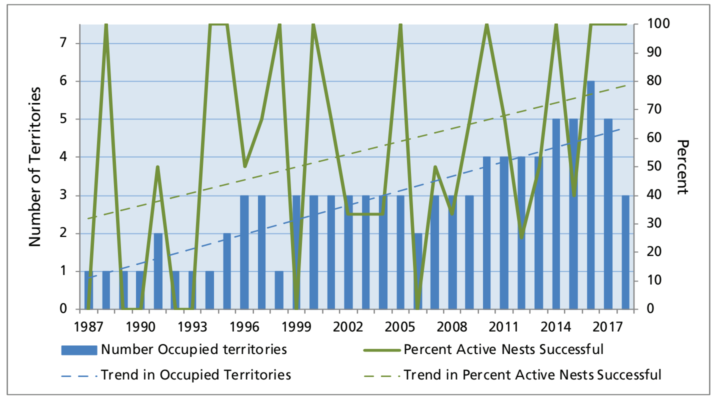
A pronghorn buck is easily distinguished from a doe by his black cheek patch.



Pronghorn count and age/sex ratios during late summer classification counts, 2000-2018 (data from Wyoming Game and Fish Department).

Grand Teton, National Elk Refuge, and Wyoming Game and Fish Department personnel conduct ground surveys in late summer to count and classify pronghorn after fawns are born. A total of 381 pronghorn were counted during the 2018 survey. Ratios were estimated at 46 fawns and 34 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 will maintain good recruitment for the population.

Peregrine Falcons



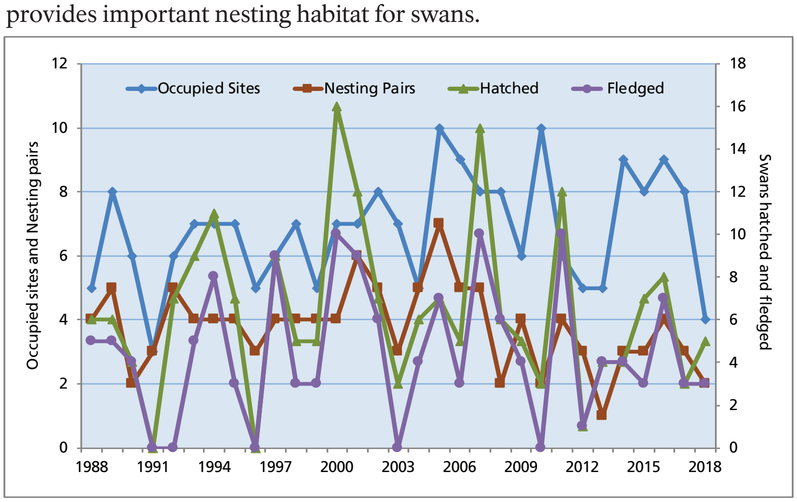
Territorial and successful peregrine falcon pairs, Grand Teton NP, 1987-2018.

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 (used in the US until the 1970s), 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. Following reintroduction, peregrine falcons first attempted nesting in 1987 at Glade Creek and successfully fledged young the next year. Peregrines, once listed as threatened under the Endangered Species Act, were delisted in 1999. Recently, peregrines occupied territories in Garnet, Death, Cascade, and Webb Canyons; Blacktail Butte; and Glade Creek.

In 2018, peregrines occupied three of the eight territories monitored within the park and parkway. Of those occupied territories, peregrines successfully bred at two eyries. In total, these peregrine falcons fledged three chicks in 2018. The Garnet, Death, Moran Bay, Steamboat, and Glade eyries were not occupied this year. A pair of adult peregrines occupied the Webb Canyon territory and successfully fledged two nestlings. After peregrines displayed courtship behavior near Baxter's Pinnacle in Cascade Canyon, park managers established a temporary closure in the area to protect the nesting pair from disturbance due to the popular climbing route located close to the eyrie. The closure was lifted after biologists confirmed that the pair successfully fledged one chick. Adult falcons consistently occupied the Blacktail Butte territory throughout the summer of 2018, but did not initiate a nest. The 2018 breeding statistics were slightly but consistently lower than the 10-year averages. The last year that only three territories were occupied was in 2009.

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.



Trumpeter swan productivity at territories in and adjacent to Grand Teton, 1988-2018.

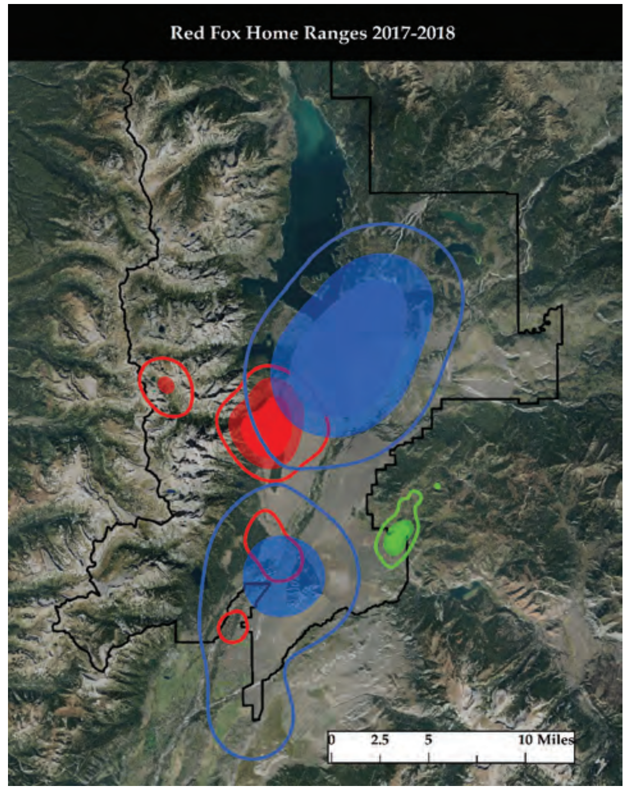
The number of occupied swan sites, nesting pairs, and young hatched and fledged fluctuated widely over the 30 years since monitoring began. Biologists monitor 18 historic nesting territories: 13 within the park and parkway plus 5 outside but adjacent to park boundaries. In 2018, nesting territories were monitored from the air by a Wyoming Game and Fish biologist. Swan pairs exhibited breeding behavior at two territories: Swan Lake and Christian Pond. Both territories successfully hatched chicks (3 at Christian Pond and 2 at Swan Lake). The swan family at Christian Pond was observed leaving with the three week-old cygnets and walking over land to Emma Matilda Lake. They remained at Emma Matilda Lake for the rest of the summer season but only 1 of the 3 chicks survived until the end of the season.

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.

Red Fox

Habituation of red foxes (*Vulpes vulpes*) to humans in national parks appears to be increasing in recent years. Habituated foxes have been documented at Acadia, Crater Lake, Grand Teton, and Mount Rainier National Parks. Anthropogenic food sources undoubtedly attract foxes. This includes the purposeful feeding of individual foxes by park visitors, ingestion of fish remains left by anglers during winter, and accidental feeding by park employees in developed areas. Habituation can cause numerous issues, including harm to the wildlife ingesting processed foods, traffic hazards for wildlife and humans, health and safety concerns (e.g., aggression and disease transmission) for park visitors and employees, and property damage. Therefore, park resource managers aim to minimize the potential for human-fox conflicts while maintaining this valued ecological and wildlife viewing resource.

To address habituation issues and make effective management decisions, park staff began a monitoring project in 2016 to gain a better understanding of fox ecology. Data collected from this project will aid in assessments of temporal and spatial movements, distribution, foraging patterns, and diets of this resourceful and charismatic species. Increased ecological understanding of foxes coupled with enhanced outreach and education efforts will greatly reduce human-fox conflicts in Grand Teton, as well as provide a template for addressing this wildlife management issue in parks throughout the country.



Home range estimates for 3 female red foxes using locations from winter 2017–winter 2018, downloaded from GPS collars. The different colors refer to different individuals, and show 95%, 75% and 50% home range estimates.

A biologist carefully tags a sedated red fox after weighing and measuring it.

In the winter of 2018, biologists trapped, collared or marked, and collected samples from foxes in developed areas. Live trapping using box traps occurred near Moose, Beaver Creek, the Murie Center, Teton Science School, Colter Bay, Jackson Lake Dam, Jackson Lake Lodge, and Signal Mountain Lodge. Blood and hair samples were collected for disease and diet analyses, and foxes were individually marked with ear tags and/or fitted with a collar (GPS or VHF). Samples were also collected from any known fox mortalities (primarily from vehicle collisions).

The 3 store-on-board GPS collars that were deployed in the winter of 2017 successfully released and were recovered in the winter of 2018. To date, a total of 22 foxes have been captured and sampled, with a total of 18 foxes collared. Biologists will continue the study and capture additional foxes in the winter of 2019.

J. Metten

NATURAL RESOURCES

Sagebrush Steppe & High Elevation Vegetation

Grand Teton National Park hosts intact native plant communities that have seen very little direct human alteration. Sagebrush steppe occupies much of the valley floor and represents an incredibly diverse plant community with 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 influenced by direct and indirect effects of changing climate. Biologists are studying the overall health of this plant community and documenting long-term trends to aid in conservation efforts.

Approximately 15% of the park's sagebrush steppe acreage has been affected by human habitation and agriculture over the past two hundred years. In 2009, park managers initiated long-term restoration of the Kelly Hayfields—sagebrush steppe lands that were converted to agricultural use in the late 1890s and early 1900s, then abandoned when they became park lands in 1950. Understanding the intact sagebrush steppe plant community provides baseline information for evaluating ecological restoration success.

This year was the seventh year that vegetation biologists conducted monitoring studies of intact sagebrush communities, as well as some areas that are undergoing restoration. In 2018, biologists sampled more than 700 micro-plots in 14 sample frames distributed throughout native sagebrush steppe communities. They compared these plots to earlier study results to examine the types and rates of change occurring in the sagebrush steppe community. By fall of 2018, eight different units totaling 1,484 acres were in various stages of restoration including 1,151 acres seeded with native plant species (125 acres seeded in 2018). Monitoring efforts on sites seeded prior to 2013 show the vegetation composition to be stable over the last three years, though portions of some sites retain significant populations of nonnative species mixed in with the native grasses, forbs, and shrubs that were seeded into the sites. Monitoring data collected from restoration sites seeded in 2014 and 2015 suggests native plant seeding was successful. In 2016, biologists observed sage-grouse using restoration units for the first time since treatments began and grouse return to use the area annually.

Biologists inventory vegetation in high-elevation plots.

High elevation (alpine/sub-alpine) ecosystems in Grand Teton also host intact plant communities that may be at risk of a rapidly changing climate. In 2017, park biologists established high-elevation monitoring in the upper South Fork of Cascade Canyon. They located monitoring sites in dry and mesic areas to capture changes in vegetation due to both climate and the predicted melt-out of Schoolroom Glacier over the next quarter century. These sites will be revisited in 2019–2020.

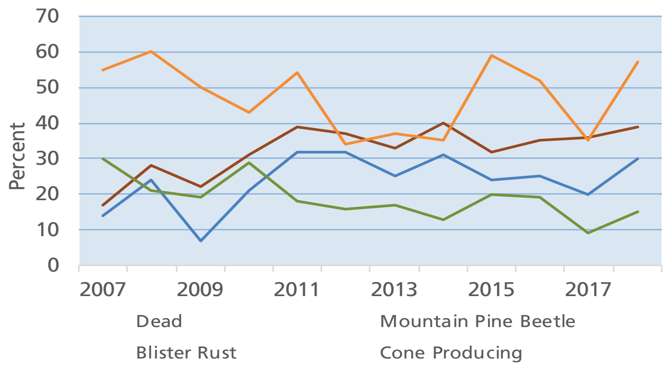
Whitebark Pine

Blister rust cankers are visible on a whitebark branch. While mature trees slowly decline when infected with blister rust, it is often fatal for young trees or renders them unable to produce cones.

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 greater ecological role compared to its abundance, whitebark influences biodiversity and forest structure. These trees maintain water availability by trapping snow, promoting snowdrift retention and protracting 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.

In the past two decades whitebark pine has experienced unprecedented mortality due to the combined effects of native mountain pine beetle, nonnative white pine blister rust, and changing climate conditions. Overflights of the Greater Yellowstone Ecosystem in 2009 found visible beetle activity in 90% of all watersheds containing whitebark pine. This work is currently being repeated to gain an updated status of whitebark mortality after the nearly 15-year beetle epidemic. Ground surveys by park staff in 2018 indicate that there are still many areas of active mountain pine beetle infestation in Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway. The park and parkway encompass over 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. Blister rust, found throughout the park and parkway, is causing extensive damage to cone-bearing branches, seedlings, and saplings.

Grand Teton began annual whitebark pine monitoring in 2007 using 26 permanent transects. Park staff monitor six of these transects annually and the remainder in rotation. The graph below depicts the transects monitored in a specific year which accounts for some of the variability, but does not mask the trends from year to year. Overstory mortality associated with the mountain pine beetle epidemic has decreased slightly since 2014, although additional overstory mortality occurs annually and areas of intense beetle activity remain in Grand Teton. Over 50% of individual whitebark are infected with blister rust and blister rust is present in 92% of the sampled transects. The severity of rust infection is increasing annually, indicated by the number of rust cankers counted on each sampled whitebark. The proportion of live whitebark that produce cones has decreased slowly and overall seed quantity has decreased with increased overstory mortality. Among whitebark sampled in 2018, 39% were dead (the highest mortality recorded to date), 30% attacked by beetles, 57% of live surveyed were infected with blister rust, and 15% 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 100 acres. 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.



Monitoring data shows an increase in dead whitebark pine over time and a decrease in cone-producing individuals. The presence of mountain pine beetle and blister rust persists.

Archeological Sites

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway contain a diverse array of archeological resources that help tell the story of prehistoric and historic human occupation in the park. There are 547 identified archeological sites within the park and parkway, 96% of which are recorded in the NPS database. The diverse archeological record portrays a snapshot view into Jackson Hole's storied past, including over 11,000 years of American Indian habitation within and adjacent to the Teton Range. Additional sites speak to the historic occupation of the park beginning in the late 19th century and include homesteads, roads, trails, irrigation ditches, and trash dumps. The vast majority of the park and parkway's 333,700 acres has not been surveyed, and the sum total of knowledge about archeological resources amounts to less than 4.5% of that area. The opportunity to discover new facts about the valley's history through archeological study is vast.


An underwater archeologist maps a boat that sank in Jackson Lake.

During the summer of 2018, park staff worked with the NPS Submerged Resources Center to document a shipwreck in Jackson Lake. Underwater archeologists documented submerged resources using hand mapping, photography, and side scan sonar imagery. Underwater archeology in the park's cold high-elevation lakes requires specialized skills and experience. The team also investigated the areas surrounding boat docks in the lake to advise on mooring systems and check for submerged resources in high-use areas.

Park cultural resource staff worked with a number of youth educational groups in 2018, including Pura Vida and the Montana Conservation Corps. Younger students learned about excavation through fun activities and site visits, and older students assisted park archeologists with important survey work. Over the course of the summer a park seasonal archeologist conducted several small surveys to fulfill requirements set out in Section 110 of the National Historic Preservation Act. An archeologist from the regional office assisted with a survey for the Moose-Wilson Road corridor. Contract archeologists conducted survey work in advance of proposed telecommunications installations in the park.

In anticipation of projects, Grand Teton invites consultation with 24 traditionally associated American Indian tribes. These consultations aid collaboration and inform decision-making. In 2018, Grand Teton conducted one in-person consultation and held many conversations with Tribal Historic Preservation Officers.

Montana Conservation Corps students learning how to conduct a field survey.

Historic Structures

Grand Teton National Park, in accordance with the National Historic Preservation Act of 1966, evaluates park properties for historic significance and integrity. Following these criteria, 736 historic resources within the park are listed in or determined eligible for the National Register of Historic Places (NRHP). Many of these buildings, linear resources (trails, roads, ditches), and cultural landscape features are organized within 44 historic districts. These properties reflect prominent historic themes that define the character of Jackson Hole and the park, such as homesteading, agriculture, dude ranching, conservation, recreation, and tourism. Two properties possess exceptional national significance and have been designated National Historic Landmarks (NHL)—the Murie Ranch for its association with the conservation movement and Jackson Lake Lodge as the first example of modern architecture within a national park.

In addition to identifying, evaluating, and preserving these historic resources, the park is responsible for assessing how park activities will affect historic properties. During 2018, a fire suppression system was installed in the Murie residence in order to assure protection of the NHL. A new roof was also installed on the structure. Additional in-kind preservation work was conducted on a number of other historic structures. The park, in collaboration with state and local professionals, completed a stabilization plan for the Sky Ranch property. The Historic Structure Report for Mormon Row, also completed in 2018, includes the history and construction chronology of the remaining residences, a detailed condition assessment of multiple structures, as well as recommendations for preserving and maintaining this iconic property.

Park staff continue to work collaboratively with the NPS Western Center for Historic Preservation on several major projects including the large stabilization effort of the main and Corse cabins at the Bar BC Dude Ranch. Volunteers contributed more than 3,000 hours of service towards these projects in 2018, with the Montana Conservation Corps providing a substantial portion. The Grand Teton National Park Foundation funded these stabilization efforts. The Western Center also assisted with projects at Menor's Ferry, Crandall Studio, Mormon Row, White Grass Ranch, and the Moose Entrance kiosk.

A preservationist cinches the cable brace used to hold the structure together while stabilization work is done on the deteriorating main Bar BC cabin.

Staff from the park and the Western Center collaborate on the Grand Teton Hammer Corps program. Inspired by the dedication of past volunteers and determined to better support historic preservation efforts, the park with support from the Grand Teton National Park Foundation launched the Hammer Corps in 2016, the official volunteer program for cultural resource projects. In 2018, its third year of operation, the Hammer Corps provided much needed help in maintaining historic resources. Throughout the summer, volunteer groups stabilized structures at Sky Ranch, 4 Lazy F, and the Menor's Ferry Transportation Shed. By harnessing a reliable volunteer work force, park staff hope to effectively tackle annual preservation maintenance needs and provide opportunities for interested members of the public to get involved preserving these special places. In 2018, Grand Teton's Hammer Corps hosted 29 residential and day group volunteers who contributed more than 1,000 hours of service. These efforts included a group of historic preservation students from Morgan State University. The park plans to continue this program in 2019 with the foundation's support.

The iconic T.A. Moulton barn on Mormon Row.

Museum Collection & Archives

Grand Teton's natural history collection contains mounts of native animals like this porcupine shown gnawing on an antler for its mineral content.

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 records is comprised of traditional registers 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, including Paul Petzoldt, Glen Exum, and Yvon Chouinard. With finding aids to assist research, the archives are a well organized resource available by appointment to park staff and the public.

Grand Teton's museum collection preserves objects that represent the human historical record, such as natural history specimens, archeological materials (projectile points 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 lacks 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 in Tucson, Arizona, to ensure the preservation of the materials. A small number of pieces from the Vernon Collection are displayed in two of the park's visitor centers. In 2017, park staff installed a new exhibit of the David T. Vernon collection and contemporary items entitled "Living Traditions, Reflections from the Past." Historic and contemporary items come together to illustrate enduring cultural traditions and document changes in those traditions over time. These pieces show how modern Native American art is a reflection of the past blended with elements of contemporary Native culture.

A few 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 park continues to explore options to develop appropriate facilities for the park collections.

In partnership with Idaho State University's Geosciences and Geography Department, Grand Teton's museum program is working to document the history of recreational use in Grand Teton. Research in 2018 continued from the previous year to focus on collecting oral histories from Jenny Lake climbing rangers in addition to park concessioners operating river trips on the Snake River since the mid-1950s.

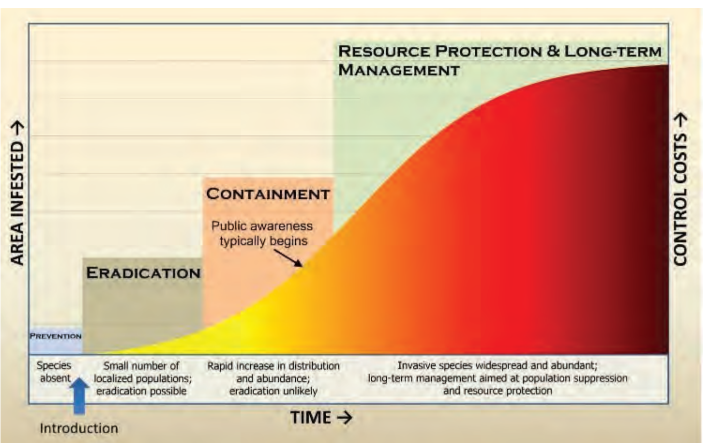
As of 2018, 85.78% of the one-million-item collection is processed and cataloged. While the park curator completed a full inventory of the collection, updates to the collections management database are still in progress to document Grand Teton's natural and cultural history.

Grand Teton's collection includes unique western furniture and fixtures made by Thomas Molesworth for the Brinkerhoff Lodge.

Aquatic Invasive Species

Aquatic invasive species (AIS) are aquatic organisms that are not native in a particular watershed. These species vary in size and phylum and are most often, but not solely, introduced to a new watershed via watercraft. Once introduced, the species can thrive without the presence of their natural predators or competitors. This can result in major alterations to native ecosystems, and adversely affect recreation, water utilization, and the local economy. A few examples of species that have recently expanded their range near Grand Teton National Park include curly leaf pondweed (*Potamogeton cripus*), flowering rush (*Butomus umbellatus*), and fish species such as burbot (*Lota lota*). Quagga and zebra mussels (*Dreissena bugensis and D. polymorpha*, respectively) are two of the most impactful invasive species in the US and significantly expanded their range in the last 10–20 years, but have not been found in the park or parkway.

A tool called the invasion curve was developed in recent years to help illustrate the various stages of an invasion by a nonnative species. Grand Teton currently sits at the base of the curve in prevention mode when it comes to most AIS. When quagga or zebra mussels are detected in a waterbody a jump to containment management is typically enacted due to the dramatic impacts they have been known to induce. Containment management often includes enacting strict regulations on accessing waterbodies, increased monitoring, an increase in the number personnel for vetting equipment, and for decontaminating watercraft as they come and go from the waterbody.



The invasion curve chart illustrates the limited time frame in which an invasive species can be prevented or contained.

An AIS employee works with a hotsy (hot water sprayer tool) to decontaminate a boat last used in Lake Powell, a known site of quagga mussel infestation.

The park has enacted measures to prevent the introduction of AIS, inspecting watercraft and educating boaters on practices to prevent the spread of unwanted species. In 2018, for the third year, the park had watercraft inspection stations at two locations operating daily for nine hours during prime visitation periods (May 19–September 30). Crews inspected 18,505 watercraft, with an additional 3,463 commercial rafts passing through the stations. (Commercial rafts are only used on the Snake River and therefore are not contamination sources.) In the summer of 2018, 189 boats/day came through the stations an increase from previous years (177 boats/day in 2017 and 157 boats/day in 2016). Staff preformed 28 decontaminations to reduce the risk of AIS introduction. Boaters can help prevent AIS introductions and speed inspections by ensuring they drain, clean, and dry their watercrafts and gear after every use.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a naturally occurring prion disease of cervids (species in the deer family). The disease attacks the brain causing animals to become emaciated, display abnormal behavior and poor coordination, and eventually die. Since its 1967 discovery in a captive herd of mule deer in Colorado, CWD spread geographically and increased in prevalence locally. CWD is now relatively well established and widely distributed in the southeastern portion of Wyoming with scattered endemic pockets found in deer and elk populations extending to the northwest.

In October 2008, the Wyoming Game and Fish Department (WGF) reported that a three-year-old female moose from Star Valley tested positive for CWD, within 50 miles of Grand Teton National Park. National Park Service direction for management of CWD states that parks in close proximity (60 miles) to areas where CWD has been detected should initiate a targeted surveillance program to monitor deer and elk for clinical signs of the disease and submit samples for diagnostic testing from all deer and elk found dead (NPS Director's CWD Guidance memo 2002). Consequently, park staff intensified active and targeted (animals with clinical signs of the disease) surveillance efforts in collaboration with WGF personnel.

Biologists collected the retropharyngeal lymph nodes and/or obex from road-killed cervids and hunter-killed elk during the park's elk reduction program and submitted those samples to the Wyoming State Veterinary Laboratory for testing. In 2018, NPS personnel collected a total of 108 samples from cervids in the park: 17 mule deer, 2 white-tailed deer, 2 moose, and 87 elk. Twenty-seven samples were collected from roadkilled individuals, one from an elk that died of unknown causes (but not roadkill), and 80 samples were obtained during the elk reduction program. A sample from an adult male mule deer collected in the park in early November near the town of Kelly was found to be positive for CWD. This marks the first detection of CWD in Grand Teton. No other samples were found to be positive for the disease. The spread of CWD in elk generally lags behind deer. The closest elk hunt unit in which CWD has been confirmed is roughly 80 miles from Grand Teton, southeast of Cody.

Park biologists completed a plan to guide actions including enhancing CWD surveillance efforts, minimizing disease spread, conducting applied research, and increasing communication and outreach efforts. Park staff are working in cooperation with other agencies and partners on this effort.

Integrated Pest Management

Grand Teton National Park managers remain committed to the safety, health, and well-being of park visitors and employees. That commitment includes the dedication of personnel, resources, and time to the park's Integrated Pest Management (IPM) program, tasked with prevention, response to, and mitigation of pest related issues in park visitor facilities, employee housing, and other structures. In 2018, IPM responses included intrusions into structures by bats, mice, insects, birds, and mammal species.

Currently, the park's biggest pest issue is the ingress of bats into employee quarters. At least 12 species of bats are native to the park and also vital to the ecosystem as voracious consumers of insects. However, their intrusion into housing units can carry serious consequences for human inhabitants as bats are a reservoir for rabies and other diseases. In 2018, the IPM team responded to 41 bat related incidents in park buildings, representing nearly 40% of all IPM cases. However, the combined efforts of the IPM team (consisting of Science and Resource Management and Facilities staff) in 2017 to exclude bats from housing units with previously high exposure potential proved successful, resulting in a sharp decrease in human exposures. These interdivisional efforts continued in 2018 with a focus on exclusion work in the historic Lupine Meadows housing area.

The IPM team continues to work with the University of Wyoming-National Park Service Research Station at the historic AMK Ranch, along with the Epi-Aid team from the US Public Health and the Center for Disease Control to effectively manage human-bat interactions. As a result of this partnership, park managers are better prepared to respond quickly and efficiently to potential bat exposures. Park staff continue to raise awareness of the severity of bat exposure to employees, partners, concessioners, and visitors while encouraging appropriate reactions from the individuals.

Sealing cracks and joints in buildings helps exclude bats and other pests.

Future IPM efforts in bat exclusion will focus on employee, partner, visitor, and concessioner education and continued exclusionary efforts in other problem housing units at Lupine Meadows, Moran, Colter Bay, and elsewhere. Employees can assist by diligently reporting any pest issues in their housing units and workspaces to the park IPM team and immediately reporting to their supervisor any bat exposure.

Elk Reduction Program

The legislation that created the expanded Grand Teton National Park in 1950 included a provision for controlled reduction of elk in the park, when necessary, for the proper management and protection of the elk herd. A long-term objective of the program is to reduce the need to harvest elk within the park. Management of elk in the park and on the National Elk Refuge (NER) is guided by the Bison and Elk Management Plan (BEMP), completed and implemented by the US Fish and Wildlife Service and the National Park Service in 2007. The plan calls for working collaboratively with the Wyoming Game and Fish Department (WGF) to achieve an objective of 11,000 elk in the Jackson herd, a wintering population of 5,000 elk on the NER, and working toward bull to cow ratios in the park that are reflective of an unhunted population. Also outlined in the plan is a strategy to restore previously cultivated lands in the park to improve habitat condition on elk winter and transitional range. The plan projected that roughly 1,600 elk would summer in the park given plan implementation.

The need for the elk reduction program (ERP) is evaluated and determined jointly by Grand Teton and WGF on an annual basis, based on plan objectives and data collected throughout the previous year during both the mid-summer classification count in the park and the mid-winter trend count that includes elk wintering outside of the park.

Both the annual mature bull ratio and the five-year running average were below the threshold identified in the BEMP, at 28 and 30 bulls per 100 cows, respectively. At this level biologists recommended no bull harvest for 2018. The 2018 mid-winter trend count was 10,877 elk and the three-year running average 10,770, which the WGF considers at objective. The trend is stable; however, elk wintering on the refuge number well above the 5000 elk objective (for eight of the last ten years). The mid-winter calf ratio, which is strongly tied to the level of population growth, was 20 calves per 100 cows. With the trend for the Jackson elk herd remaining stable, the antlerless harvest in 2018 was intended to slow growth of the herd. Park managers are discussing with other agency partners conditions under which an ERP would not be warranted in some years since the population has been at objective since about 2013.

Hunt season structure remained similar to 2017 with no permits offered in Hunt Area (HA) 79, although 75 Type 4 permits were validated there for five days. The number of permits authorized In HA 75 was reduced from 600 to 575. Specifically, 25 fewer Type 4 permits were offered while the number of Type 6 permits remained the same.

The 2018 elk reduction program was conducted for 43 days from October 27–December 9. HA 79 was open from October 27–October 31, while HA 75 was open for the season duration, although the Antelope Flats portion of HA 75 closed on November 26th. The reason for the short season in HA 79 was that fewer elk were observed in a portion of the hunt area during summer surveys and the productivity of these elk was reduced compared to more southern residents—a pattern similar to the northern migratory elk in the Teton Wilderness and southern Yellowstone. The reduction in hunting pressure on antlerless elk in HA 79 is generally consistent with management objectives in adjacent hunt areas 70 and 71.

A total of 185 elk were harvested in 2018 (3 in HA 79 and 182 in HA 75). The majority (83%) of elk taken were cows. Three spike bulls were also illegally harvested. Almost 55% of the harvest occurred during the last half of November. This harvest pattern is similar to that observed the last five years and is typical when a late migration occurs.

A bull elk bugles amid his harem during the fall rut. The vocalization announces his dominance and helps him gather mates and locate other bulls.

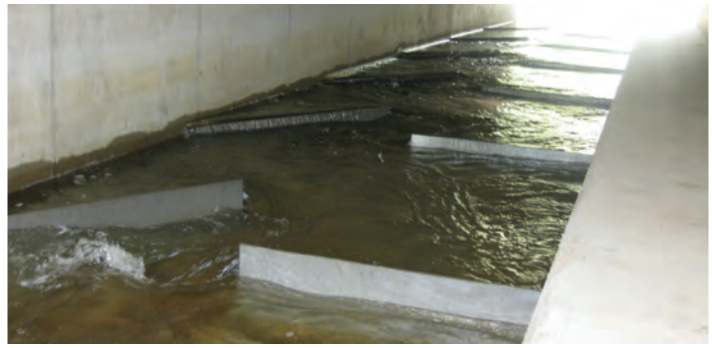
Fish Passage

Park biologists monitor the health of park fisheries. Of special concern is the fragmentation of fish habitat, usually the result of human actions. Alterations to a water course can make it difficult for fish to travel and impede their ability to use critical portions of the waterway. Mitigating obstacles can facilitate fish passage. Irrigation ditches draw from several drainages in the park for agricultural purposes within or adjacent to the park. Water drawn from perennial streams is also host to fishes who can end up trapped or entained in these ditches. Once entrained, fish have difficulty finding their way back into streams and may die prematurely. Fisheries biologists monitor fish passage and/or entrainment especially in Spread Creek, the Granite Supplemental Ditch, and Ditch Creek.

Removal of a diversion dam at Spread Creek in 2010 allowed fish to access 65 miles upstream; however, the water diverted from the stream still captures some fish as they are migrating downstream. Previously the park partnered with the Wyoming Game and Fish Department (WGF), Trout Unlimited (TU), the Snake River Fund, and numerous volunteers to help return about 100–300 cutthroat trout back to the stream annually. In 2018, deteriorating rock weirs caused significant change to the flow and as less water entered the irrigation ditches there was a corresponding decline in the number of fish getting trapped.

Another irrigation system, the Granite Supplemental Ditch, draws from the Snake River to irrigate lands in the "West Bank" region of Jackson Hole. Observations indicate this large draw of river water entrains several species of fish at varying life stages each summer. In an attempt to understand how this ditch, which crosses paths with some perennial streams, affects the fish that enter the ditch from the river, park personnel teamed with WGF and TU to implant transmitters in 15 cutthroat in 2017 and another 30 in 2018 to monitor their fate. Data analysis is still ongoing but preliminary results suggest that the mortality rate is about 80% for trout that enter the ditch, although some adult cutthroat are able to escape after first entering the ditch. High numbers of other fish get stranded in this ditch and are less capable of escaping due to high water velocities at the headgates; they likely experience higher mortality rates. Quantifying the impacts on the fishery as a whole is difficult to ascertain due to the volume of water that is drawn through the ditch in the summer.

Water once again flows as the primary channel of Ditch Creek is restored.



Ditch Creek highway culvert is outfitted with baffles to aid fish swimming upstream by giving them spots to rest out of the main current.

Ditch Creek flows out of the Gros Ventre Mountains east of Grand Teton, through the Antelope Flats portion of the park, and meets the Snake River about a mile north of Moose. The creek hosts several species of spawning fishes including Snake River fine-spotted cutthroat trout, bluehead (categorized as extremely rare by WGF), Utah and mountain sucker, and other small non-game species. Settlers started manipulating the stream's 9.4-square mile alluvial fan on Antelope Flats in the early 1900s, adding some 150 miles of irrigations ditches to the fan alone and channelizing the stream to better facilitate agricultural pursuits. In 1957 and 1960 two bridges and culverts were installed across the stream. These culverts were not engineered for fish passage and turned out to be too long and steep for fish to negotiate in early summer when attempting to access spawning habitat upstream of these obstacles.

In 2012 and 2014, park staff installed baffles in the culverts to mitigate the situation. Unfortunately the stream also aggraded and eroded west of Mormon Row Road in 2014, effectively forestalling the efforts to restore fish passage. While aggrading and avulsing is the stream's natural tendency, the ditches and repeated channelization of the stream caused a new series of barriers to materialize. In 2017, the park partnered with the Grand Teton National Park Foundation, One Fly, and Patagonia to successfully raise funds and hire an excavation company to reactivate the primary channel and restore Ditch Creek as a fish-passable stream. In 2018, fish from the Snake River could access more than 23 miles of the stream's headwaters for the first time in nearly six decades. Biologists captured and tagged 82 fish (Snake River fine-spotted cutthroat trout, bluehead suckers, mountain suckers, and Utah suckers) over three years to track how the fish used the newly accessible habitat. Antennas to track the fish were affected by higher than average runoff in 2018, but biologists recorded tagged fish entering the stream and passing two of the former barriers. The third barrier that requires additional mitigation is the stream-altered changes to the rock weirs that were intended to assist fish access to the perched culvert.

Habitat connectivity is vital in ensuring a healthy fishery, making it more resilient to disturbances by providing access to more spawning grounds and increasing the number of life histories that can be expressed in the system. Working with water rights holders to increase the efficiency of irrigation ditches and reduce entrainment are strategies that could help keep the fishery healthy.

Human-Bear Interface

Cubs play with a sign posted for their safety.

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway provide ideal habitat for free-ranging black and grizzly bears. Grand Teton receives more than five million visitors per year, most of whom visit during the peak summer season. Consistently high levels of human recreation in bear habitat create a high potential for human-bear interactions.

To decrease conflicts, park staff strictly enforce food storage regulations and all park facilities have bear-resistant garbage receptacles. The park emphasizes "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, has installed 755 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, or injure (or kill) humans. In 2018, park staff recorded 136 human-bear confrontations and 8 human-bear conflicts. Of the eight conflicts: a grizzly bear caused minor damage by chewing on plastic water line markers near Flagg Ranch, two bears of unknown species caused property damage (one bear tore small holes in a tent and fully flattened another unoccupied tent in the Jenny Lake Campground and the other bear damaged a window screen, grill cover, and door mat at the Brinkerhoff Lodge), and five involved black bears (a bear ripped a tent rainfly and damaged a deflated water floaty while the four other incidents resulted in food rewards). The food rewards included:

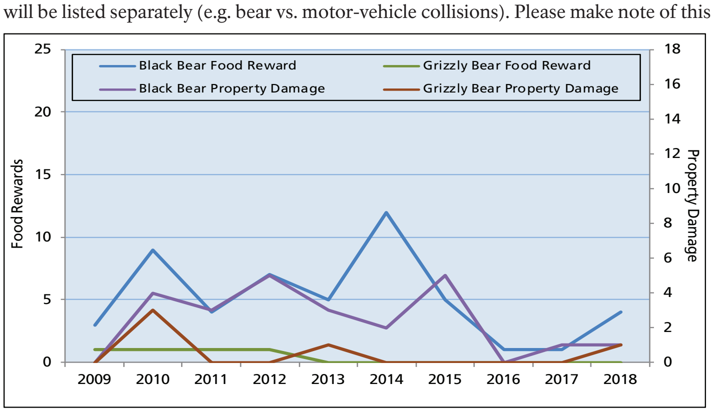
- A yearling black bear that ate from a barbecue grease trap and damaged a grill at the AMK Ranch in June,
- A black bear sow (with three cubs-of-the-year) that ate an apple from an unattended pack by the Signal Mountain Boat Launch in August,
- A black bear that ate granola from an unattended pack hung in a tree near Inspiration Point in mid-August, and
- The same black bear sow and cubs from the August incident (minus a cub that disappeared in September) were intentionally fed several pieces of fruit from two different vehicles on the Signal Mountain Road. The bears then approached a park maintenance vehicle and attempted to climb into the truck bed. Based on the known history of this family group, staff recommended removal of this black bear family for displaying habituated and food conditioned behavior. On Oct 5, 2018, the family was caught in a culvert trap. The sow was euthanized and the two cubs were transferred to an accredited captive facility.

Park staff work diligently to prevent bears from developing nuisance behaviors. When humans fail to secure their food, bears can develop unwanted behaviors. Trained staff follow an established protocol to haze bears from developed areas and roadways, when necessary. Grand Teton staff hazed bears 51 times in 2018, using noise (yelling, horns, sirens), vehicle threat pressure, and throwing small rocks or sticks.

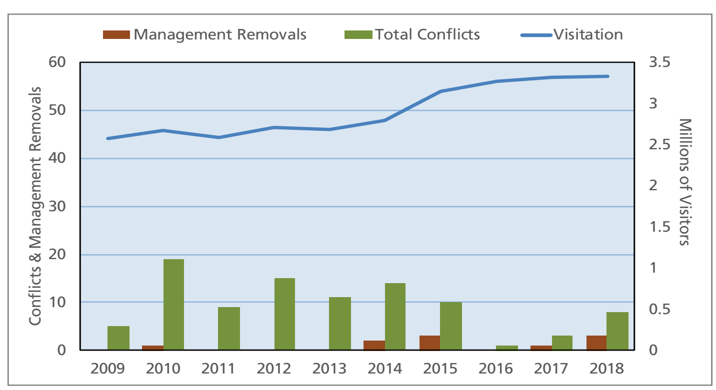
Park managers also implement seasonal closures to protect bear habitat and to address human safety concerns. In addition to regular annual closures (Grassy Lake Road closed to motorized use April 1–May 31 and Willow Flats closed to public entry May 15– July 15 to protect grizzly bear foraging opportunities), three special area closures occurred on the Moose-Wilson Road in August to protect fall foraging opportunities beside the narrow road, along with nine temporary closures (e.g. around carcasses) to provide for visitor safety and/or protect foraging opportunities for bears.

Since 2007, the Wildlife Brigade, a corps of paid and volunteer staff, manages traffic and visitors at roadside wildlife jams, promotes ethical wildlife viewing, patrols developed areas to secure bear attractants, and provides bear information and education. In 2018, they recorded 561 wildlife jams including 169 for grizzly bears, 231 for black bears, 31 for bears of unrecorded species, 90 for moose, and 40 for other species such as bison, elk, and great gray owls.

*Starting in 2017 reports define human-bear conflicts as instances when bears damage property, obtain human foods, or injure (or kill) humans. Human-caused bear mortality will be listed separately (e.g. bear vs. motor-vehicle collisions). Please make note of this change when reading 2012-2016 human-bear interface reports.

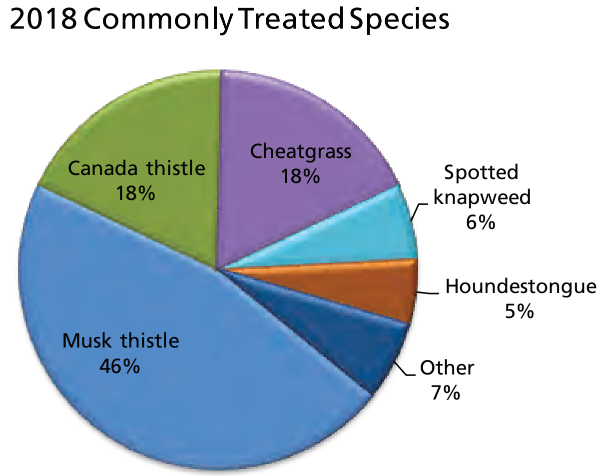


Bears receiving human-food rewards or causing property damage in Grand Teton.



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. Invasive plants alter habitats by displacing native vegetation communities, affecting wildlife distribution, and limiting foraging opportunities for ungulates, invertebrates, and other native grazers. During the 2018 field season, vegetation staff, along with partners and contractors, actively surveyed 8,222 weed infested acres, specifically treating 2,260 acres within these areas for 27 invasive nonnative plant species.

Invasive plants have multiple origins. In addition to accidental introductions from Eurasia, early homesteaders planted nonnative cultivar and ornamental plant species prior to establishment of the park, and many of these species still persist. Today, humans inadvertently transport weed seeds on their vehicles, clothing, and in construction materials. Wildlife, domestic stock, and livestock feed also transport weed seeds in the park. Areas particularly at risk to invasive plant infestations include disturbed areas along roads, levees, and pathways, as well as trails, utility corridors, and building sites. Formerly disturbed sites within the park such as homesteads, hayfields, and gravel pits remain a management challenge.

Grand Teton biologists prioritize control efforts according to plant species, abundance, and site characteristics, based on threats posed to ecological processes and prospects for successful treatment. Some infestations can be eradicated if treated when an outbreak is still small and a seedbank not well established. Other species have become so common that containment of current infestations is now the primary goal. Invasive plants listed as federal, state, or county "noxious weeds" are particularly aggressive plants and legally deemed to be detrimental to agriculture, navigation on inland waterways, fish and wildlife, and/or public health. Park staff focus efforts on locating and using the best treatment practices to address listed noxious plant species. Examples of sites where biologists successfully managed noxious weeds in recent years include: Barker Meadow (multiple weed species), Moran Cemetery (Dalmatian toadflax), Bradley-Taggart Trailhead and meadow (yellow toadflax), and Kelly Hayfields (musk thistle). Salt cedar (tamarisk) and perennial pepperweed are priority targeted species in the Snake River corridor. In 2018, biologists found none growing north of Moose and only a single young salt cedar south of Moose; this success results from years of effort by park and partner organizations working to eradicate these species locally.

Using rafts to access portions of the river bottom that are far from roads, weed crews use backpack sprayers to treat weeds.

Management actions in 2018 included herbicide treatments by backpack sprayers and horse-, truck-, UTV-, and tractor-mounted spray equipment. Biologists carefully select herbicides to minimize impacts to non-targeted species and water sources. Staff and volunteer groups also implemented mechanical treatments, hand pulling, and removal with shovels or cutting tools. Park staff invested the majority of their labor in disturbed portions of the sagebrush-steppe communities that dominate the lower elevations of the park. Additionally, invasive plant treatment as part of the Kelly Hayfields restoration, which aims to return nearly 4,500 acres of former agricultural land to native habitat, continues to be a large focus of program resources.

Backcountry weed surveys in 2018 included a post-fire invasive inventory and priority species treatment for the Berry, Owl, and Webb drainages. The multi-year Snake River project continued, completing the effort to update invasive plant inventories and treat priority species along the length of the river's riparian corridor within the park. Overall, in 2018, invasive plant crews surveyed and treated noxious weed species on 895 backcountry and riparian acres, traveling 330 miles over 45 days.

Partnerships with Teton County Weed and Pest District, the Northern Rockies Exotic Plant Management Team, the Jackson Hole Weed Management Association, and the Greater Yellowstone Coordinating Committee are very important to successful invasive plant management. Interagency collaborations with the Bridger Teton National Forest and the National Elk Refuge are equally essential. In July 2018, the invasive plant management program actively participated in numerous events aimed at noxious weed management and habitat improvement in the greater Jackson Hole and Grand Teton ecosystems (including the multi-agency Gros Ventre River Spray Days, Hunter Ranch and Stewart's Draw treatments, and priority treatments on the Caribou Targhee National Forest).

Kelly Warm Spring

Fishery staff spent many days removing aquatic vegetation from the spring to ensure the effectiveness of the treatment.

Kelly Warm Spring is a thermal feature that has a long history of aquarium dumping leading to the proliferation of nonnative species in the spring. Nonnatives persisted throughout the warm spring effluent and, as in the past, biologists found some warm water species in Ditch Creek, a tributary to the Snake River. Since 2012, biologists annually monitoring the dispersal of nonnative fishes originating from the warm spring consistently found goldfish (*Carassius auratus*), native to east Asia, and tadpole madtoms (*Notorus gyrinus*), native in much of eastern North America, in Ditch Creek, some within 10 yards of the Snake River.

Biologists also found American bullfrogs (*Lithobates catebeianus*), another species with a wide latitudinal native range, that were introduced for unknown reasons in the 1950s and continue to thrive in the thermal feature and its effluent. The bullfrog is implicated in declines of native amphibian populations throughout the world due to both direct and indirect factors. In Grand Teton National Park native amphibians are nearly wholly absent in the bullfrog's occupied range with only a couple western toads being found on the periphery of bullfrog inhabited waters.

In 2016, the National Park Service began a study on the fall movements and over wintering habitat used by American bullfrogs. The frogs displayed more upstream movements than downstream movements with a majority of their largest movements occurring before the first cold snap of the season. The winter range was more widespread than managers had hoped leaving the species less vulnerable to mechanical removal efforts.

A Wyoming Game & Fish biologist disperses rotenone at the prescribed concentration by rowing a drip can systematically around the spring.

Biologists analyzed studies of the ecology and potential threats in Kelly Warm Spring and its effluent to propose management solutions with the goal of returning the spring to a more natural state. After several years of collecting data and environmental analysis, park resource managers moved forward with a plan to restore native fishes to Kelly Warm Spring. The plan included using rotenone, a chemical that is lethal to organisms with gills, to treat the nonnative infested spring and its effluent. Park fisheries personnel invested more than 400 hours to minimize the treatment area and the amount of rotenone formulation needed to complete the restoration goals. This included diverting water flow from the Savage Ditch to terminal ditches to safeguard the Snake River and other water bodies. Repeated raking to remove aquatic vegetation from the treatment area was needed to keep the plants from absorbing the poison and rendering the treatment less effective.

Fishery staff removed dead fish from the spring and dewatered Savage Ditch before reactivating the ditch and opening the area to the public. Goldfish were the most abundant fish collected. They gathered approximately 15 five-gallon buckets of carcasses and deposited them in bear-resistant dumpsters.

Twenty-two people from multiple NPS branches, with vital assistance from Wyoming Game and Fish personnel, completed the treatment August 21, 2018. The treatment successfully reduced the quantity of invasive species in the spring but failed to remove all fishes present, a necessary first step in restoring a native assemblage to the spring. Confounding factors included warm water, warm ambient temperatures, strong ground water influences, persistent sunshine, silty bottoms, abundant macrophytes, and algae. Approximately 600–700 pounds of dead fish were removed from the treatment area after the application, estimated to be more than half of the biomass removed. Rotenone tolerant and intolerant species survived the application. Bullfrog tadpoles experienced high mortality rates but were not completely eliminated from the system. Alternative treatment strategies are being considered for future efforts. Resource managers plan to modify the treatment strategy in an attempt to achieve complete restoration, but the control action was an important step in improving the condition of Kelly Warm Spring.

Livestock Grazing

Grand Teton National Park permits livestock grazing due to traditional land use that existed prior to the park's establishment. When Grand Teton was expanded in 1950, the enabling legislation allowed ranches on inholdings to retain their grazing allotments indefinitely while another 26 ranches were granted grazing privileges for the lifetime of immediate family members and heirs. 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 by 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 NPS/US Forest Service lands to the park's fenced and irrigated Elk Ranch pasture which also predates the park's establishment.

In 2018, 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 concessioner 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 cattle grazing.

Cowboys drive cattle onto a grazing allotment at Elk Ranch Flats in the park. The irrigated pastures also attract bison, elk, and pronghorn.

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.

Mountain Goats

Mountain goats molt their winter coats each spring. The timing of the molt is dependent on their nutrition and for a nanny, like this one, if it had a kid. Males will molt about two weeks before females.

Mountain goats (*Oreamnos americanus*) are native to many rugged mountains of the northwest US, 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 some individuals dispersed to new areas. Observations 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 and thought to represent a few transient individuals. Since then park biologists have documented adult female mountain goats (nannies) with young (kids) each year, indicating that a breeding population is now established in the park.

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 extreme, especially in the winter. As mountain goats and bighorn sheep share similar habitats and forage, the potential for competition and the risk of pathogen transmission between the species could pose additional threats to the already stressed sheep population.

Since 2014, park biologists have captured 15 mountain goats (12 nannies, 1 subadult billy, and 2 kids) to better understand goat distribution, numbers, survival, movements, and reproduction in the Tetons. Captured animals were sexed, aged, weighed, collared with a GPS radio collar, and sampled for pneumonia pathogens before being released. Relative to surrounding mountain goat herds, few pneumonia pathogens were found. This result is unexpected because the Snake River Range population, the likely source of mountain goats in the Tetons, carries all the pathogens known to cause pneumonia.

All locations for radio-collared goats were within the park during the winter; however, several goats moved back and forth between Teton Canyon on the Caribou-Targhee National Forest (CTNF) and Cascade Canyon/Paintbrush Canyon within the park during the summer. Summer distributions of collared goats were generally between Cascade Canyon and Snowshoe Canyon. Preliminary analysis of radio collar data indicates that the elevational movements of goats were variable throughout the year. Two goats spent time at higher elevations during the winter months, descended to lower elevations during spring and fall, and then returned to higher elevation in the summer.

Wyoming Game and Fish Department personnel counted a total of 66 mountain goats during an aerial survey of bighorn sheep in mid-February. More than 45% of the observed goats were in the vicinity of Cascade and Paintbrush Canyons, but a few were as far south as Prospectors/Mt Hunt (1 young billy) and as far north as Colter Canyon. A total of 46 adults and 20 juveniles (kids) were observed. Assuming half of the adults were nannies, the ratio would be 44 kids per 100 nannies.

NPS field crews deployed two remote camera traps from early July through mid-September 2018 in the North Fork of Cascade Canyon to aid monitoring efforts. Several cameras were also deployed at natural mineral licks on the CTNF and in the park. In addition, "Wanted" posters displayed at trailheads on the east and west slopes of the Tetons solicited mountain goat observations. Park visitors and staff submitted 36 observations of mountain goats. Observations spanned the length of the range, from Cody Peak to Ranger Peak. Most observations still occurred in the central portion of the range, but multiple observations in Death Canyon, on Prospectors Mountain, and several peaks at the north end of the Tetons suggest that goats are expanding their use of the area.

In 2017, park biologists initiated a genetics study in collaboration with several partners to confirm the source of Teton Range mountain goats. Biologists gathered genetic samples for analysis from three populations—Snake River Range (30 individuals), Teton Range (47), and the Northern Absaroka/Beartooth Range (28) and examined how genetics were shared among the three populations. Preliminary results suggest that given the two potential source populations evaluated, the mountain goats in the Teton Range most likely originated from those in the Snake River Range.

The park released a mountain goat management plan/environmental assessment for public review in December 2018. A final decision on the proposal to control nonnative goats is expected in 2019.

The occurrence of twin kids in most established mountain goat populations is unusual. In the Teton herd twins are fairly common and park biologists even observed a set of triplets. This indicates an expanding herd.

Native Plant Restoration


Park staff spray for weeds in one section of the hayfields restoration project while bison graze on another section.

Native plant revegetation and ecological restoration return degraded or damaged habitats to functioning ecological systems. A primary goal of vegetation management in Grand Teton National Park is to restore disturbed areas to protect the integrity of the park's native plant communities and the wildlife species that depend on them. Successful work to reestablish native plant communities must also include efforts to minimize the establishment of invasive, nonnative species. All revegetation and restoration work conducted in Grand Teton National Park is accomplished by conserving local topsoil and using plant materials that originate within park boundaries that are genetically suited to the natural ecotypes associated with a specific plant community. Research shows that using locally occurring native plant materials adapted to the local environment translates into greater success of restoration for ecosystem function.

In 2018, the revegetation crew worked on 16 separate projects, seeding disturbed areas associated with park infrastructure improvements such as waterline replacements, building construction and repairs, and trail construction and rehabilitation. A major focal point for revegetation was rehabilitating habitat disrupted by replacement of two large water lines in the park. In several targeted project areas, field technicians salvaged native plants to replant once construction efforts were completed.

All revegetation and restoration areas are seeded with ecologically appropriate mixes consisting of native grass, forb, and shrub seed originating from materials hand collected within the park. Additional native seed is generated by seed increase, where locally hand-collected seed is grown and harvested in fields outside the park. In recent years, vegetation management staff has diversified its seed sources and enhanced productivity by harvesting seed from fields planted within the park. In 2018, a large quantity of seed was harvested from a site within the Kelly Hayfields restoration project, efficiently and sustainably contributing locally sourced native seed for future restoration.

2018 Revegetation and Restoration Accomplishments	
Revegetation projects seeded	38.5 acres
Kelly Hayfields restoration seeded	126 acres
Hand-collection of native seed	29 species
Bult material weight	509 lbs
Final seed weight	99 lbs
Mechanically harvested seed in the park	600 lbs

Park vegetation crews continue long-term restoration of the 4,500-acre Kelly Hayfields from nonnative pasture grass to native plant communities that provide important habitat supporting elk, bison, antelope, sage grouse, other birds, and pollinators. Techniques for restoration include herbicide applications to remove nonnative hay crop species and invasive plants, native seed collection and seeding, monitoring, and adaptive follow-up treatments. Entering the tenth year of project implementation, the park's restoration team continues to evaluate results and consider input from various resource experts and land managers to guide and prioritize restoration efforts for the next ten years. In 2018, vegetation staff seeded 126 acres using a seed mix containing 31 native species. Acquisition of new specialized seeding equipment in 2017 improved the staff's capability to establish important native forb and shrub species in restoration areas, increasing species richness in the restoration seed mix. As of November, 2018, 1,484 acres are in stages of restoration treatment, 1,151 acres were seeded with native vegetation, and many of these acres are beginning to provide functional habitat for wildlife.

Trail & Pathway Use

The popular Taggart Lake Trail travels through a young forest growing after the 1985 Beaver Creek Fire to a beautiful glacially carved lake.

Researchers, including the park social scientist, study visitor use on park trails and pathways. Since 2009, there is generally an increasing trend in visitor use for trails leading to the backcountry. Infrared trail counters are installed at key locations throughout the park, and estimate the number of visitors entering the backcountry via the trail system during the summer months (approximately June to September). There are also some counters located further into the backcountry. Trail counters count visitors traveling in both directions, and data is aggregated by the hour. Some trail counters are validated by comparing the counter-recorded visitor use and actual counts taken by a research technician; most counters have a low error rate.

Between June and September of 2018, the Taggart Lake north trail counter detected the most people when compared to the other counters, with an estimated 58,109 visitors (an 11% increase in visitation compared to the same timeframe in 2017 and a 144% increase compared to 2009). The trail counter on the Bradley Lake trail indicates that 27% of those in the Taggart trail system go to Bradley Lake, while 18% used the south Taggart trail in 2018. These data indicate that the most popular route in the Taggart trail system is the north trail to Taggart Lake and back on that same trail to the parking area.

The next highest trail counter, the Cascade Canyon trail counter, detected an estimated 52,367 visitors. This counter was first placed in August 2016. Comparing August and September of 2016 to the same timeframe in 2018 shows a 22% increase in use. It is possible that the closures of Hidden Falls and Inspiration Point for trail reconstruction influenced the increased use within Cascade canyon. The southwest Jenny Lake counter estimated 51,063 visitors on the southwest Jenny Lake Loop trail. While this indicates a 9% increase over 2009, this counter shows more variation in use levels and 2013 registered as the peak use year.

The String Lake north and south counters each indicated nearly 46,000 visitors headed in both directions on the String Lake loop trail, making this the third busiest trail system of those with counters.

In addition to trails, researchers monitor the multiuse pathway system within Grand Teton National Park. Construction on the first section of the paved pathway, between Moose and Jenny Lake, was completed in May 2009. Completion of a second section of pathway, between the park's south boundary on Highway 89 and Moose, followed in May of 2012. Starting in 2009, researchers installed infrared counters and trail cameras at key locations to understand the timing and volume of use, including potential effects on wildlife. In the summer of 2018, five infrared counters were installed along the pathway at the same locations used since 2012: Jenny Lake, north of Taggart parking, west of Dornan's, north of the airport, and south of Gros Ventre junction (from approximately June to August).

These counters give an approximation of visitor use, and also batch the total number of users in hour-long periods. Counters cannot determine the direction a visitor is traveling, or if one user is triggering multiple counters along the pathway (which is likely). Overall, there were a total of 62,205 detections on the five pathway counters between June and August of 2018. Given the limitations of the counters, a liberal estimate would be that pathway use comprises slightly less than 3% of the park's total recreation visits during the same time frame.

Analysis of variance by examining the number of detections at each counter over past seven years (between June and August) indicates a statistically significant variation in levels of use between years on different counters; however, this variation does not indicate an increase in use on the multiuse pathway system overall.

Analysis of trail and pathway data helps park managers to better understand visitor use (including levels of use, timing of use, and distribution of use). This in turn aids in decision making to meet the objectives of providing for visitor enjoyment while protecting park resources.

Year	Counter Name				
	Jenny Lake	Cottonwood Creek	Dornan's	North of Airport	South Boundary
2012	144^{a}	151^{a}	147^{a}	110^{a}	73^{a}
2013	210^{b}	125^{a,b}	104^{b}	88^{a}	122^{a,b,c}
2014	168^{a}	92^{c}	102^{b}	43^{b,c}	120^{c,d,e}
2015	163^{a}	98^{b,c}	125^{a,b}	91^{a}	153^{b,c,d}
2016	162^{a}	54^{d}	127^{a,b}	24^{c}	161^{d}
2017	161^{a}	102^{b,c}	98^{b}	25^{c}	93^{a,b,e}
2018	144^{a}	129^{a,b}	132^{a,b}	63^{b}	82^{a,e}

^{a,b,c,d,e} Superscript with different letters indicate statistically significant differences between years within the same counter

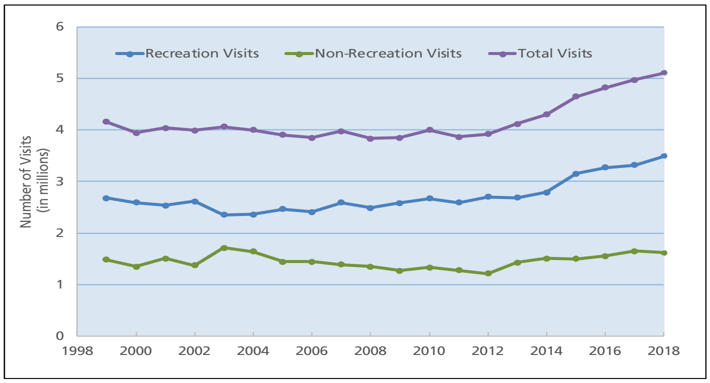
The table shows information gathered from the paved pathway counters.

Visitor Use

Use of Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway by visitors is both a primary reason for their establishment and a factor influencing resource condition. Increases in visitation may affect natural and cultural resources, as well as the quality of visitor experiences. Some factors that may influence visitation to parks include economic conditions, weather, and gasoline prices.

In 2018, the national parks had almost 500 million annual visits, collectively. More than 330 million of these visits were recorded as recreation visits, meaning that the visitor entered lands or water administered by the National Park Service to use the park (alternatively, examples of a non-recreation visit include commuters, employees of the NPS going to work, access to inholdings, etc.). Compared to 2017, recreation visits were down 3.8% service-wide in 2018.

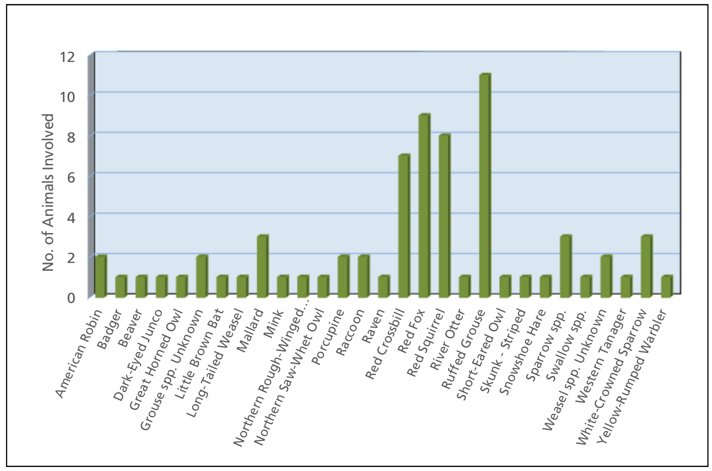
Visitors enjoy a ranger-led campfire program.



Annual Grand Teton NP visitation 1998–2018.

Grand Teton National Park had record visitation for the fifth consecutive year. In 2018, the park received more than 5.1 million visits, a 3.8% increase from last year's visitation, and a 19% increase in visitation over the past five years. Over half of visitation (51%) occurred between June and August. Although there are no day-use limits, lodging and campgrounds in the park have limited available space, and on most July and August nights, one or more forms of accommodation are full.

Wildlife-Vehicle Collisions



Wildlife casualties from motor vehicle collisions on Grand Teton National Park roads are common occurrences often resulting in property damage. Since 1991, park staff record data on wildlife-vehicle collisions to help identify appropriate measures to lower the number of collisions, and improve the safety of park roads for humans and wildlife.

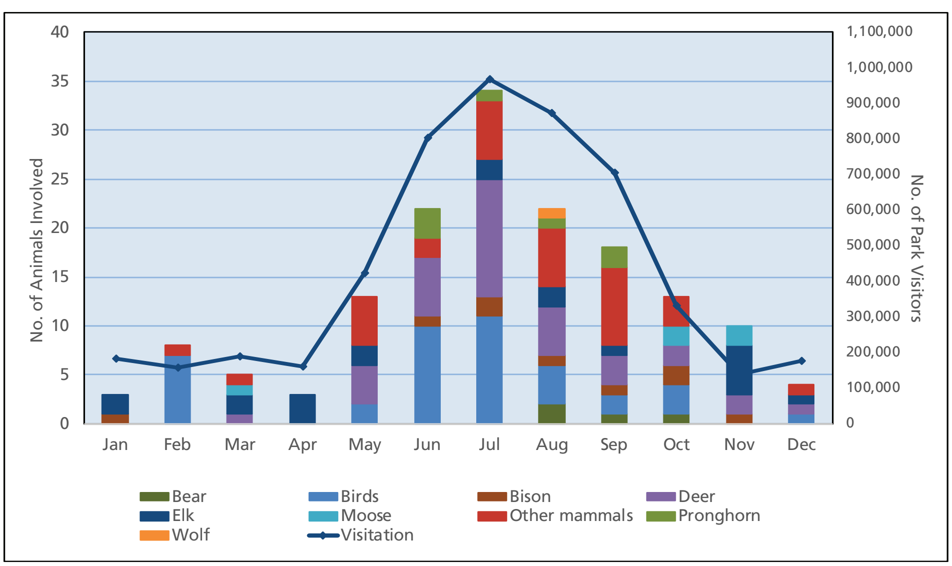
In 2018, 146 collisions occurred involving 155 animals. Although there were fewer incidents and animals killed in 2018 compared to 2017, the overall trend in collisions has increased over the last two decades. The long-term increase may reflect, in part, greater efforts in recent years to document collisions, including those involving smaller bodied species. However, data collection for the larger mammals remains consistent providing a relatively unbiased trend. In 2018, collisions involved 77 ungulates, similar to the 2017 total of 78; however, trends within ungulate species did not remain stable. Elk and moose collisions both increased in 2018 compared to 2017. The increased number of moose hit is concerning due to declining number of individuals in the Jackson herd. The number of deer collisions remained relatively similar between 2017 and 2018. In contrast, the number of collisions involving pronghorn and bison both declined by nearly 40%. In 2018, 83% of incidents resulted in a confirmed animal death. In incidents where a carcass could not be located near the road, some animals may have died later from injuries sustained in the collision. The majority of collisions occurred during the snow-free months (119 from May–October) and peaked in July, which coincided with peak visitation.

A total of 39 species (23 mammals and 16 birds) were involved in collisions in 2018. Large mammals accounted for 84 of the 155 animals involved. Ungulates comprised 50% of individuals involved, mid- to large-sized carnivores 5%, small mammals 20%, and birds 25%. Collisions involving birds and small mammals rarely cause property damage, are less conspicuous, and are under reported. There are likely significantly more birds and small mammals struck by vehicles, and it generally remains unknown how these mortalities influence their population demographics.

When possible, park staff also record the time of day that a wildlife-vehicle collision occurred. For the 28% of incidents with a known time of day, 80% of collisions involving bison and 100% involving elk and moose occurred at night. More deer and pronghorn collisions with known times occur during daylight hours (77% for deer and 80% for pronghorn).

Park staff documented the highest number of wildlife-vehicle collisions on US Hwy. 89/191/26 (47%), followed by the North Park Road (30%), Teton Park Road (14%), Moose-Wilson Road (2%), Gros Ventre-Antelope Flats loop (3%), and other roads (4%). On US Hwy. 89/191/26, as in previous years, most incidents occurred between Spread Creek and Moran Junction (22%) and Moose Junction to Snake River Overlook (17%). The majority (79%) of incidents with bison, moose, and elk occurred on US Hwy. 89/191/26. For deer, 56% of the collisions occurred on US Hwy. 89/191/26, 28% on the North Park Road, 3% on the Teton Park Road, and 13% on other roadways. Pronghorn collisions followed a similar trend in 2018: 71% occurred on US Hwy. 89/191/26 and 29% on the Teton Park Road.

The park implemented several mitigation measures in the last decade to address wildlife-vehicle collisions, including the permanent reduction in nighttime speed limit from 55 to 45 mph on US Hwy. 89/191/26; continued use of variable message signs at strategic locations to inform drivers of current wildlife activity near roadways; the installation of permanent digital speed readers at Moose Alley, Elk Ranch Flats, Snake River Hill, and Gros Ventre Junction; and painting wider road surface lines to delineate narrower travel lanes that indirectly encourage motorists to follow designated speed limits.



Animals killed in wildlife-vehicle collisions by month during 2018, in Grand Teton NP.

Research Permits

Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway (JDR) use the National Park Service's computerized Research Permit and Reporting System (RPRS) to manage research permits submitted to the park. Research within the park has occurred since the park's creation, but with the online RPRS system there is a more complete record of permits from 2001–2018. Since the implementation of this system, the number of permits entered into the database has steadily increased. The number of finalized permits fluctuates annually but generally is increasing with a high in 2017 of 90 permits issued for research within Grand Teton and JDR.

Prospective researchers submit proposals to the park through RPRS. Park staff with subject matter expertise review proposals to determine if the study will contribute to science and yield results that would benefit the ecosystem. In addition, park staff are asked to communicate with researchers in order to ensure that there is minimal impact on visitors and park resources (both natural and cultural) through the course of their research. The Chief of Science and Resource Management approves permits for appropriate investigations as recommended by staff.

One of Grand Teton's earliest partnerships for research was with the University of Wyoming in the 1940s. Since then institutions from across the country and world have conducted research in the park and parkway. Since 1990, a total of 1288 permits have been issued. Currently the database lists 88 separate institutions that have operated within the boundaries of Grand Teton and JDR with a total of 374 permits granted among them. The University of Wyoming had the most permits with 42, followed closely by the US Geological Survey with 34 permits. While the National Park Service had 11 research permits, another major partner in the Greater Yellowstone Ecosystem, the Wyoming Game and Fish Department, held 11 permits.

The more detailed records since 2015 disclose that 75% of the permits issued during that period were for new research with the remainder issued for renewed permits. The average annual field season for permittees was 150 days (ranging from 2 days to 3 years, 7 months). The average study lasted 6.6 years (the USFS annual land inventory is the longest running study at 106 years).

A motion sensitive camera set to observe use of a fish spawning area captures a group of pelicans feeding on the fish.

Since the inception of RPRS, the database records information on the various subjects that researchers study within the park and parkway. Animals remained the primary focus of research requests in 2018. The park issued 10 permits for research on birds, 2 for animal communities, 9 for invertebrates, and 7 for mammals, showing a change from the more mammal dominated research of past years. Since 2001, Grand Teton finalized 507 permits for animal studies (175 mammals, 129 birds, 99 invertebrates/insects, 38 fish, 27 reptiles/amphibians, and 30 animal communities). Other leading topics for research included hydrology/water resources (88 permits), geology (81), plant communities (75), visitor use (25) and geography (25). The research permit database is available to the public online at https://irma.nps.gov/rprs/IAR/Search.

Research by scientists working for the National Park Service and those working for other institutions aids in furthering the understanding of the unique Greater Yellowstone Ecosystem and its many components.

A biologist observes a peregrine falcon nest from a distance to see if breeding was successful.