



Yellowstone National Park has abundant and diverse wildlife. A wolf chases ravens and magpies from an elk carcass killed by the Slough Creek wolf pack near the Lamar River.

Wildlife

Yellowstone's abundant and diverse wildlife are as famous as its geysers. Habitat preferences and seasonal cycles of movement determine, in a general sense, where a particular animal may be at a particular time. Early morning and evening hours are when animals tend to be feeding and are more easily seen. But remember that the numbers and variety of animals you see are largely a matter of luck and coincidence.

Wild animals, especially females with young, are unpredictable and dangerous. Keep a safe distance from all wildlife. Each year a number of park visitors are injured by wildlife when approaching too closely. Approaching on foot within 100 yards (91 m) of bears or wolves, or within 25 yards (23 m) of other wildlife is prohibited. Please use roadside pullouts when viewing wildlife. Use binoculars or telephoto lenses for safe viewing and to avoid disturbing wildlife.

By being sensitive to its needs, you will see more of an animal's natural behavior and activity. If you cause an animal to move, you are too close. It is illegal to willfully remain near or approach wildlife, including birds, within any distance that disturbs or displaces the animal.

FREQUENTLY ASKED QUESTION:

Where can I see wildlife?

It helps to know the habits and migration patterns of the animals you want to see and the habitats in which they live. For example, bighorn sheep are adapted to live on steep terrain, so you might see them on cliffs in the Tower area. Osprey eat fish, so you would expect to see them along rivers. Bison graze on grasses and sedges, and mate in August, so you are likely to see them in big, noisy herds in the Hayden and Lamar valleys.

Hydrothermal basins provide important habitat for wildlife. For example, some bison live in the Old Faithful area year-round. In the winter, they take advantage of the warm ground and thin snow cover. Both black and grizzly bears visit these areas during the spring when winter-killed animals are available. Rangers at the visitor centers can tell you where wildlife have been seen recently.



Yellowstone is home to the largest concentration of mammals in the lower 48 states. Here, bison, pronghorn, and elk (in the far distance) graze on the northern range.

Mammals

Yellowstone is home to the largest concentration of mammals in the lower 48 states. In addition to having a diversity of small animals, Yellowstone is notable for its predator–prey complex of large mammals, including eight ungulate species (bighorn sheep, bison, elk, moose, mountain goats, mule deer, pronghorn, and white-tailed deer) and seven large predators (black bears, Canada lynx, coyotes, grizzly bears, mountain lions, wolverines, and wolves).

The National Park Service’s goal is to maintain the ecological processes that sustain these mammals and their habitats while monitoring the changes taking place in their populations. Seasonal or migratory movements take many species across the park boundary where they are subject to different management policies and uses of land by humans.

Understanding the links between climate change and these drivers will be critical to informing the ecology and management of Yellowstone’s wildlife in the years to come.

More Information

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Quick Facts

Yellowstone is home to the largest concentration of mammals in the lower 48 states.

- 67 different mammals live here, including many small mammals.
- As of 2019, an estimated 728 grizzly bears live in the Greater Yellowstone Ecosystem.
- Black bears are common.
- Gray wolves were restored in 1995. As of January 2020, 94 live primarily in the park.
- Wolverine and lynx, which require large expanses of undisturbed habitat, live here.
- Seven native ungulate species—elk, mule deer, bison, moose, bighorn sheep, pronghorn, and white-tailed deer—live here.
- As of August 2019, there were approximately 4,830 bison.
- Nonnative mountain goats have colonized northern portions of the park.

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Bears

Yellowstone is home to two species of bears: grizzly bears and black bears. Of the two species, black bears have a much larger range across the United States. The grizzly bear is typically larger than the black bear and has a large muscle mass above its shoulders; a concave, rather than straight or convex, facial profile; and much more aggressive behavior. The grizzly bear is a subspecies of brown bear that once roamed large swaths of the mountains and prairies of the American West. Today, the grizzly bear remains in a few isolated locations in the lower 48 states, including Yellowstone. In coastal Alaska and Eurasia, the grizzly bear is known as the brown bear.

Visitors should be aware that all bears are potentially dangerous. Park regulations require that people stay at least 100 yards (91 m) from bears (unless safely in your car as a bear moves by). Bears need your concern, not your food; it is against the law to feed any park wildlife, including bears.

Grizzly Bears

The Greater Yellowstone Ecosystem and northwest Montana are the only areas south of Canada that still have large grizzly bear (*Ursus arctos horribilis*) populations. Grizzly bears were federally listed in the lower 48 states as a threatened species in 1975 due to unsustainable levels of human-caused mortality, habitat loss, and significant habitat alteration. Grizzly bears may range over hundreds of square miles, and the potential for conflicts with human activities,



Yellowstone is home to both grizzly bears (above) and black bears. Safe traveling in bear country begins before you get on the trail.

especially when human food is present, makes the presence of a viable grizzly population a continuing challenge for its human neighbors in the Greater Yellowstone Ecosystem.

Population

The estimated Greater Yellowstone Ecosystem grizzly bear population increased from 136 in 1975 to a peak of 757 (estimated) in 2014. The 2019 population estimate is 728 bears. The bears have gradually expanded their occupied habitat by more than 50%. As monitored by the Interagency Grizzly Bear Study Team, the criteria used to determine whether the population within the Greater Yellowstone Ecosystem has recovered include estimated population size, distribution of females with cubs, and mortality rates. An

Grizzly Bears

Number in Yellowstone

Approximately 150 with home ranges wholly or partially in the park.

As of 2019, 728 estimated in greater Yellowstone.

Where to See

Dawn and dusk in the Hayden and Lamar valleys, on the north slopes of Mt. Washburn, and from Fishing Bridge to the East Entrance.

Size and Behavior

- Males weigh 200–700 pounds, females weigh 200–400 pounds; adults stand about 3½ feet at the shoulder.
- May live 15–30 years.
- Grizzly bears are generally 1½ to 2

times larger than black bears of the same sex and age class within the same geographic region, and they have longer, more curved claws.

- Lifetime home range: male, 800–2,000 square miles, female, 300–550 square miles.
- Agile; can run up to 40 mph.
- Can climb trees, but curved claws and weight make this difficult. Can swim and run uphill and downhill.
- Adapted to life in forest and meadows.
- Food includes rodents, insects, elk calves, cutthroat trout, roots, pine nuts, grasses, forbes, and large mammals.

- Mate in spring, but implantation of embryos is delayed until fall; gives birth in the winter to 1–3 cubs.
- Considered super hibernators.

Status

- Currently listed as a Threatened Species under the Endangered Species Act.
- Scientists and managers believe the grizzly population is doing well. Grizzlies are raising cubs in nearly all portions of the greater Yellowstone area and dispersing into new habitat. Currently, they occupy 20,522 square miles in the Greater Yellowstone Ecosystem.

estimated 150 grizzly bears occupy ranges that lie partly or entirely within Yellowstone National Park. The number of females producing cubs in the park has remained relatively stable since 1996, suggesting that the park may be at or near ecological carrying capacity for grizzly bears.

There were 40 known or probable grizzly bear mortalities in the Greater Yellowstone Ecosystem in 2018 including 22 inside and 18 outside of the Demographic Monitoring Area. There was one known grizzly bear death inside the park: a subadult male grizzly bear was killed by an adult male.

No visitors were injured by grizzly bears in 2019.

Description

The grizzly bear's color varies from blond to black, often with pale-tipped guard hairs. In the Greater Yellowstone Ecosystem, many grizzly bears have a light-brown girth band. However, the coloration of black and grizzly bears is so variable that it is not a reliable means of distinguishing the two species.

Bears are generally solitary, although they may tolerate other bears when food is plentiful. Grizzlies have a social hierarchy in which adult male bears dominate the best habitats and food sources, generally followed by mature females with cubs, then by other single adult bears. Subadult bears, who are just learning to live on their own away from mother's protection, are most likely to be living in poor-quality habitat or in areas nearer roads and developments. Thus, young adult bears are most vulnerable to danger from humans and other bears, and to being



When combined with other characteristics, a grizzly bear's shoulder hump can help distinguish it from a black bear.

FREQUENTLY ASKED QUESTIONS:

Where are the bears?

People who visited Yellowstone prior to the 1970s often remember seeing bears along roadsides and within developed areas of the park. Although observing these bears was very popular with park visitors, it was not good for people or bears. In 1970, the park initiated an intensive bear management program to return the grizzly and black bears to feeding on natural food sources and to reduce bear-caused human injuries and property damage. The measures included installing bear-proof garbage cans and closing garbage dumps in the park.

Bears are still seen near roads and they may be seen occasionally in the wild. Grizzly bears are active primarily at dawn, dusk, and night. In spring, they may be seen around Yellowstone Lake, Fishing Bridge, Hayden and Lamar valleys, Swan Lake Flats, and the East Entrance. In mid-summer, they are most commonly seen in the meadows between Tower–Roosevelt and Canyon, and in the Hayden and Lamar valleys. Black bears are most active at dawn and dusk, and sometimes during the middle of the day. Look for black bears in open spaces within or near forested areas. Black bears are most commonly observed between Mammoth, Tower, and the Northeast Entrance.

Are grizzly bears considered threatened or endangered?

The Yellowstone grizzly population is listed as a federal Threatened Species as of a court decision on September 24, 2018. Regardless of its listing status, scientists will continue to monitor the long-term recovery goals for grizzly bears.

conditioned to human foods. Food-conditioned bears are removed from the wild population.

Diet

Bears are generalist omnivores that can only poorly digest parts of plants. They typically forage for plants when they have the highest nutrient availability and digestibility. Although grizzly bears make substantial use of forested areas, they make more use of large, non-forested meadows and valleys than do black bears. The longer, less curved claws and larger shoulder muscles of the grizzly bear makes it better suited to dig plants from the soil and rodents from their caches.

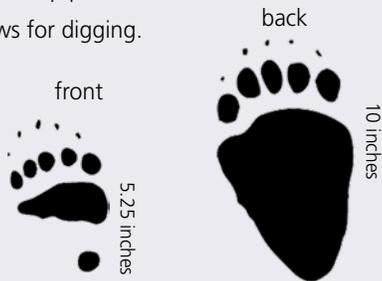
Grizzly bear food consumption is influenced by annual and seasonal variations in available foods. Over the course of a year, army cutworm moths, whitebark pine nuts, ungulates, and cutthroat trout are the highest-quality food items available. In total, grizzly bears in the Greater Yellowstone Ecosystem are known to consume at least 266 species of plant (67%), invertebrate (15%), mammal (11%), fish, and

Identify Grizzly Bears and Black Bears

Grizzly Bear



- Rump lower than shoulders.
- Shoulder hump present.
- Long claws for digging.



Black Bear



- Rump higher than shoulders.
- No shoulder hump.
- Short, curved, claws for climbing.



fungi. They will eat human food and garbage where they can get it. This is why managers emphasize that keeping human foods secure from bears increases the likelihood that humans and bears can peacefully coexist in greater Yellowstone.

Bears spend most of their time feeding, especially during “hyperphagia,” the period in autumn when they may gain more than three pounds per day until they enter their dens to hibernate. In years and locations when whitebark pine nuts are available, they are the most important bear food from September through October. However, not all bears have access to whitebark pine nuts, and in the absence of this high-quality food, the bear’s omnivory lets them turn to different food sources. Fall foods also include pondweed root, sweet cicely root, grasses and sedges, bistort, yampa, strawberry, globe huckleberry, grouse whortleberry, buffaloberry, clover, horsetail, dandelion, ungulates (including carcasses), ants, false truffles, and army cutworm moths.

From late March to early May, when they come out of hibernation, until mid-May, a grizzly bear’s diet primarily consists of elk, bison, and other ungulates. These ungulates are primarily winter-killed carrion (already dead and decaying animals), and

elk calves killed by predation. Grizzly bears dig up caches made by pocket gophers. Other items consumed during spring include grasses and sedges, dandelion, clover, spring-beauty, horsetail, and ants. When there is an abundance of whitebark seeds left from the previous fall, grizzly bears will feed on seeds that red squirrels have stored in middens.

From June through August, grizzly bears consume thistle, biscuitroot, fireweed, and army cutworm moths in addition to grasses and sedges, dandelion, clover, spring-beauty, whitebark pine nuts, horsetail, and ants. Grizzly bears are rarely able to catch elk calves after mid-July. Starting around mid-summer, grizzly bears begin feeding on strawberry, globe huckleberry, grouse whortleberry, and buffaloberry. By late summer, false truffles, bistort, and yampa are included in the diet as grasses and other plants become less prominent.

Hibernation

Bears’ annual denning behavior probably evolved in response to seasonal food shortages and cold weather. Bears hibernate during the winter months in most of the world. The length of denning depends on latitude, and varies in duration from a few days or weeks in Mexico to six months or more in Alaska. Pregnant



By May, this bear had emerged from hibernation and was searching for food to replenish lost body mass.

females tend to den earlier and longer than other bears. Grizzly bear females without cubs den on average for about five months in greater Yellowstone.

Grizzly bears will occasionally re-use a den in greater Yellowstone, especially those located in natural cavities like rock shelters. Dens created by digging, as opposed to natural cavities, usually cannot be reused because runoff causes them to collapse in the spring. Greater Yellowstone dens are typically dug in sandy soils and located on the mid- to upper-one-third of mildly steep slopes (30–60°) at 6,562–10,000 feet (2,000–3,048 m) in elevation. Grizzly bears often excavate dens at the base of a large tree on densely vegetated, north-facing slopes. This is desirable in greater Yellowstone because prevailing southwest winds accumulate snow on the northerly slopes and insulate dens from sub-zero temperatures.

The excavation of a den is typically completed in 3–7 days, during which a bear may move up to one ton of material. The den includes an entrance, a short tunnel, and a chamber. To minimize heat loss, the den entrance and chamber are usually just large enough for the bear to squeeze through and settle into; a smaller opening will be covered with snow more quickly than a large opening. After excavation is complete, the bear covers the chamber floor with bedding material such as spruce boughs or duff, depending on what is available at the den site. The bedding material has many air pockets that trap body heat.

The body temperature of a hibernating bear remains within 12°F (-11°C) of their normal body temperature. This enables bears to react more quickly to danger than hibernators who have to warm up first. Because of their well-insulated pelts and their lower surface area-to-mass ratio compared to smaller

hibernators, bears lose body heat more slowly, which enables them to cut their metabolic rate by 50–60%. Respiration in bears, normally 6–10 breaths per minute, decreases to 1 breath every 45 seconds during hibernation, and their heart rate drops from 40–50 beats per minute during the summer to 8–19 beats per minute during hibernation.

Bears sometimes awaken and leave their dens during the winter, but they generally do not eat, drink, defecate, or urinate during hibernation. They live off of a layer of fat built up prior to hibernation. The urea produced from fat metabolism (which is fatal at high levels) is broken down, and the resulting nitrogen is used by the bear to build protein that allows it to maintain muscle mass and organ tissues. Bears may lose 15–30% of their body weight but increase lean body mass during hibernation.

Bears emerge from their dens when temperatures warm up and food is available in the form of winter-killed ungulates or early spring vegetation. Greater Yellowstone grizzly bears begin to emerge from their den in early February, and most bears have left their dens by early May. Males are likely to emerge before females. Most bears usually leave the vicinity of their dens within a week of emergence, while females with cubs typically remain within 1.86 miles (3 km) of their dens until late May.

Life Cycle

Grizzly bears reproduce slowly compared to other land mammals. Females rarely breed before age four, and typically become pregnant once every three years. Grizzly and black bears breed from May through July, and bears may mate with multiple partners during a single season. Because implantation of a fertilized egg in the uterus is delayed, the embryo does not begin to develop until late November or December, about one month after the mother has denned. This appears to allow her to conserve energy until she enters her den where, in late January or early February, she gives birth to one or two cubs, sometimes three, rarely four. At birth the cubs are hairless and blind, are about eight inches (20 cm) long, and weigh from 8 to 12 ounces (224–336 g). The cubs do not hibernate. They sleep next to the sow, nurse, and grow rapidly. At ten weeks, grizzly bear cubs weigh from 10–20 pounds (4.5–9.0 kg). Male bears take no part in raising cubs, and may actually pose a threat to younger bears. Grizzly bear cubs usually spend 2½, and sometimes 3½, years with their

mother before she or a prospective suitor chases them away so that she can mate again. Females frequently establish their home range in the vicinity of their mother, but male cubs disperse farther.

Grizzly Bears, Black Bears, and Wolves

Grizzly bears are more aggressive than black bears, and more likely to rely on their size and aggressiveness to protect themselves and their cubs from predators and other perceived threats. Their evolution diverged from a common ancestor more than 3.5 million years ago, but their habitats only began to overlap about 13,000 years ago. Grizzly bears, black bears, and gray wolves have historically coexisted throughout a large portion of North America. The behavior of bears and wolves during interactions with each other are dependent upon many variables including age, sex, reproductive status, prey availability, hunger, aggressiveness, numbers of animals, and previous experience in interacting with the other species. Most interactions between the species involve food, and they usually avoid each other. Few instances of bears and wolves killing each other have been documented. Wolves sometimes kill bears, but usually only bear cubs.

Wolves prey on ungulates year-round. Bears feed on ungulates primarily as winter-killed carcasses, ungulate calves in spring, wolf-killed carcasses in spring through fall, and weakened or injured male ungulates during the fall rut. Bears may benefit from the presence of wolves by taking carcasses that wolves have killed, making carcasses more available to bears throughout the year. If a bear wants a wolf-killed animal, the wolves will try to defend it; wolves usually fail to chase the bear away, although female grizzlies with cubs are seldom successful in taking a wolf-kill.

Grizzly Bears and the Endangered Species Act

On July 28, 1975, under the authority of the Endangered Species Act, the US Fish and Wildlife Service listed the grizzly bear in the lower 48 states as “threatened,” in part, because the species was reduced to only about 2% of its former range south of Canada. Five or six small populations, totaling 800 to 1,000 bears, were thought to remain. The



A grizzly bear sow with three cubs defends a carcass from wolves on Alum Creek in Hayden Valley, 2010. Most interactions among the grizzly bears, black bears, and wolves involve food. The species usually avoid each other.

southernmost—and most isolated—of those populations was in greater Yellowstone, where 136 grizzly bears were thought to live in the mid-1970s. The goal of an Endangered Species Act listing is to recover a species to self-sustaining, viable populations that no longer need protection. To achieve this goal, federal and state agencies

- Stopped the grizzly hunting seasons in the Greater Yellowstone Ecosystem.
- Established the Yellowstone grizzly bear recovery area (Yellowstone National Park, John D. Rockefeller, Jr. Memorial Parkway, portions of Grand Teton National Park, national forests surrounding Yellowstone, Bureau of Land Management lands, and state and private land in Idaho, Montana, and Wyoming).
- Created the Interagency Grizzly Bear Study Team to coordinate bear management among the federal agencies and state wildlife managers; the team monitors bear populations and studies grizzly bear food habits and behavior.
- Established the Interagency Grizzly Bear Committee to increase communication and cooperation among managers in all recovery areas, and to supervise public education programs, sanitation initiatives, and research studies.

The Grizzly Bear Recovery Plan was established in 1993 and revised in 2006. It has four demographic and sustainable mortality goals for grizzly bears in the Greater Yellowstone Ecosystem. This plan guides management when the grizzly is on the Threatened Species List. Bear managers use the Grizzly Conservation Strategy when the grizzly is off the

Threatened Species List. The Conservation Strategy is the long-term guide for managing and monitoring the grizzly bear population and assuring sufficient habitat to maintain recovery. It emphasizes coordination and cooperative working relationships among management agencies, landowners, and the public to ensure public support, continue the application of best scientific principles, and maintain effective actions to benefit the coexistence of grizzlies and humans. It incorporates existing laws, regulations, policies, and goals. The strategy has built-in flexibility:

- Grizzly–human conflict management and bear habitat management are high priorities in the recovery zone, which is known as the Primary Conservation Area. Bears are favored when grizzly habitat and other land uses are incompatible; grizzly bears are actively discouraged and controlled in developed areas.
- State wildlife agencies have primary responsibility to manage grizzly bears outside of national parks, including bears on national forests; national parks manage bears and habitat within their jurisdictions.
- The grizzly bear population will be sustained at or above 500 bears in the Greater Yellowstone Ecosystem.
- State and federal wildlife managers will continue to monitor the grizzly population and habitat conditions using the most feasible and

accepted techniques.

- Managers will remove nuisance bears conservatively and within mortality limits outlined above, and with minimal removal of females; they will emphasize removing the human cause of conflict rather than removing a bear.
- Outside the Primary Conservation Area, states develop management plans, with input from affected groups and individuals, that define where grizzly bears are acceptable.

Legal Status of the Population

The grizzly bear population has grown robustly since 1983. The rate of growth has slowed somewhat in the last decade, likely due to increased population density. Grizzlies are raising cubs in all portions of the recovery zone. They have also dispersed into habitat well outside of the recovery zone. Bears range south into Wyoming’s Wind River Range, north of the park through the Gallatin Range, and east of the Absaroka Mountains onto the Plains.

For these reasons, and because the grizzly bear population in the Greater Yellowstone Ecosystem was determined to be a distinct population segment that met all the population criteria for delisting, the Greater Yellowstone grizzly population was removed from the Threatened Species List in 2007 by the US Fish and Wildlife Service. Several groups advocating to re-list the bears as a threatened population filed

Management to Conserve Grizzly Bears

The Issue

The grizzly bear was listed as a threatened species in 1975, which required recovering the species to a self-sustaining population.

History

- 1993: A recovery plan is implemented with three specific recovery goals that have to be met for six consecutive years.
- 2000: Draft Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem is completed.
- 2002: Conservation Strategy is approved after public comment period—16,794 comments were received. It will be implemented when the grizzly is removed from Threatened Species List.

- 2003: Recovery goals are met for the sixth year in a row.
- 2005: US Fish and Wildlife Service proposes removing the grizzly bear from Threatened Species List.
- 2006: Grizzly Bear Recovery Plan is modified to update methods of estimating population size and sustainable mortality.
- 2007: Greater Yellowstone grizzly bear population is removed from the Threatened Species List. Conservation Strategy is implemented.
- 2009: The population is returned to the Threatened Species List.
- 2010: The US Fish and Wildlife Service appeals the decision to keep the grizzly bear on the

Threatened Species List.

- 2011: An appeals court rules the grizzly bear remain on the Threatened Species List.
- 2013: Yellowstone Ecosystem subcommittee and Interagency Grizzly Bear Study Team recommend that grizzly bears be removed from threatened status.
- 2017: The Fish and Wildlife Service announces the removal of Yellowstone grizzlies from the Threatened Species List. Several groups file lawsuits challenging the USFWS decision; the USFWS lost the court case and grizzly bears were placed back on the list of Threatened Species.

Grizzly Bear Recovery Plan: Population Monitoring Criteria (revised 2017)

Population Objectives	Was the criteria met?						
	2013	2014	2015	2016	2017	2018	2019
If the population in the Demographic Monitoring Area (DMA) is 674 or less, total mortality of independent-aged females and dependent young not to exceed 7.6% and mortality of independent-aged males not to exceed 15%. <i>(Criterion instituted in 2017)</i>	N/A	N/A	N/A	N/A	✓	✓	✓
If the population in the DMA is between 674 and 747, total mortality of independent-aged females and dependent young not to exceed 9% and mortality of independent-aged males not to exceed 20%. <i>(Criterion instituted in 2017)</i>	N/A	N/A	N/A	N/A	✓	✓	✓
If the population in the DMA is more than 747, total mortality of independent-aged females and dependent young not to exceed 10% and mortality of independent-aged males not to exceed 22%. <i>(Criterion instituted in 2017)</i>	N/A	N/A	N/A	N/A	✓	✓	✓
Estimated % of total mortality of independent-aged females not to exceed 7.6%. <i>(Criterion updated in 2017)</i>	✓	✓	✓	✓	N/A	N/A	N/A
Estimated % of total mortality of independent-aged males not to exceed 15%. <i>(Criterion updated in 2017)</i>	✓	✓	✓	✓	N/A	N/A	N/A
Estimated % of mortality from human causes for dependent young not to exceed 7.6%. <i>(Criterion updated in 2017)</i>	✓	✓	✓	✓	N/A	N/A	N/A
Sixteen of 18 Bear Management Units (BMUs) within the recovery area must be occupied by females with cubs; no two adjacent BMUs can be unoccupied during the 6-year observation average.	✓	✓	✓	✓	✓	✓	✓
Demographic objective of 48 females producing cubs annually.	✓	✓	✓	✓	✓	✓	✓
Population estimate ≥ 500 bears in the DMA. <i>(Criterion instituted in 2014)</i>	N/A	N/A	✓	✓	✓	✓	✓

lawsuits challenging the decision.

In September 2009, a federal district judge overturned the delisting ruling, placing grizzly bears back on the Threatened Species List claiming: (1) the Conservation Strategy that guides management after delisting was unenforceable and non-binding on state and federal agencies, and (2) that the US Fish and Wildlife Service did not adequately consider the impacts of the potential loss of whitebark pine nuts, a grizzly bear food source.

In January 2010, the Department of Justice and the US Fish and Wildlife Service filed an appeal in the Ninth Circuit Court in San Francisco—contesting, among other points, that the judge did not consider information on whitebark pine provided in the US Fish and Wildlife Service legal briefing, and should have deferred to the opinion of federal experts to interpret biology.

In November 2011, the Ninth Circuit Court of Appeals ruled against the US Fish and Wildlife Service on the whitebark pine issue, resulting in the Greater Yellowstone Ecosystem grizzly bear

population remaining on the Threatened Species List. The panel ruled in favor of the US Fish and Wildlife Service on the issue of the Conservation Strategy providing adequate regulations to conserve bears after delisting.

In June 2017, the US Fish and Wildlife Service announced its decision to remove the grizzly bear from threatened species status. That decision was vacated by a court in September 2018, and grizzly bears were returned to Threatened status in the lower 48 states. Though management of the grizzly bears in Yellowstone National Park changes little whether the species is listed on the Threatened Species List or not, the areas bordering and surrounding the park will be managed by state agencies. Scientists will continue to monitor the long-term recovery goals for grizzly bears and strive to ensure the criteria are met. Several groups filed lawsuits challenging the delisting decision. The USFWS lost the court case and grizzly bears were placed back on the list of Threatened Species.

Black Bears

The black bear (*Ursus americanus*) is the most common and widely distributed bear species in North America. However, the Greater Yellowstone Ecosystem is one of the few areas south of Canada where black bears coexist with the grizzly bears. From 1910 to the 1960s, park managers allowed visitors to feed black bears along park roads, although the National Park Service officially frowned on this activity. During this time, along with Old Faithful, black bears became the symbol of Yellowstone for many people, and are still what some people think of when Yellowstone bears are mentioned. Since 1960, park staff have sought to deter bears from becoming conditioned to human foods.

Population

Little is known about the black bear population in Yellowstone or whether it has been affected by the increase in grizzly bear numbers and distribution since the 1970s. Black bears are commonly observed in the park, especially on the northern range and in the Bechler area of the park. Black bears have few natural predators, although both cubs and adults are occasionally killed by their own kind or by the other large carnivores with which they compete for food—wolves, cougars, and grizzly bears. Vehicle collisions (average = 1 per year) and removals of nuisance bears (average = 1 every 5 years) are not common either. Most black bear mortality in the park is likely attributed to old age or other natural causes. Outside the park, some black bears are killed during state regulated hunting seasons. As their access to human foods has been reduced, human injuries from black bears in the park have decreased from an average of



In Yellowstone, about 50% of black bears are black in color, while others are brown, blond, and cinnamon.

45 per year during the 1930s–1960s to approximately one injury every five years since 1980. Black bears are occasionally radio-collared for management and scientific reasons, with the latter focusing on research on habitat selection and multi-carnivore interactions.

Description

In Yellowstone, about 50% of black bears are black in color; others are brown, blond, and cinnamon. Black bears eat almost anything, including grass, fruits, tree cambium, eggs, insects, fish, elk calves, and carrion. Their short, curved claws enable them to climb trees, but do not allow them to dig for roots or ants as well as a grizzly bear can.

The life cycle of black bears is similar to grizzly bears. Like grizzly bears, black bears spend most of their time during fall and early winter feeding during hyperphagia. In November, they locate or excavate a den on north-facing slopes between 5,800–8,600

Black Bears

Number in Yellowstone

Common

Where to See

Tower and Mammoth areas, most often.

Size and Behavior

- Males weigh 210–315 pounds, females weigh 135–200 pounds; adults stand about 3 feet at the shoulder.
- May live 15–30 years.
- Home range: male, 6–124 square

miles, female, 2–45 square miles.

- Can climb trees; adapted to life in forest and along forest edges.
- Food includes rodents, insects, elk calves, cutthroat trout, pine nuts, grasses and other vegetation.
- Mates in spring; gives birth the following winter to 1–3 cubs.
- Considered true hibernators.
- Have fair eyesight and an exceptional sense of smell.

History

- Were fed by visitors from vehicles and, like grizzlies, used to be fed at dumps within the park.
- As a result, bears lost fear of humans and pursued human food, which resulted in visitor injuries, property damage, and the need to destroy “problem bears.”

feet (1,768–2,621 m), where they hibernate until late March.

Males and females without cubs are solitary, except during the mating season, May to early July. They may mate with a number of individuals, but occasionally a pair stays together for the entire period. Both genders usually begin breeding at age four. Like grizzly bears, black bears also experience delayed implantation. Total gestation time is 200 to 220 days, but only during the last half of this period does fetal development occur.

Birth occurs in mid-January to early February; the female becomes semiconscious during delivery. Usually two cubs are born. At birth, the cubs are blind, toothless, and almost hairless. After delivery the mother continues to sleep for another two months while the cubs nurse and sleep.

Modern Research

The Greater Yellowstone Ecosystem is one of the few areas south of Canada where black bears coexist with grizzly bears. Although grizzly bears in Yellowstone have been studied continuously for more than 50 years, very little research has been conducted on the park's black bears since the 1960s. The last black bear study in YNP was completed during a period when black bear behavior was still influenced by the availability of human foods from garbage dumps, non-bear-proof garbage cans, and recreational hand feeding by park visitors along roadsides.



In the early days of National Park Service management in Yellowstone, black bears could be fed along roadsides and at garbage dumps. Today, black bears in the park are wild.

Thus, there is a scarcity of current information available for park managers to use in making decisions on black bear management. In a current study, a combination of GPS-tracking camera collars and non-invasive DNA samples from hair snares will help biologists learn more about the black bears' population size and density, predatory rates on elk, home range sizes, movements, food habits, and habitat use.

Results from the data are still being analyzed, but some preliminary data have yielded insights. More black bear hair samples are being collected than was expected. GPS readings from tracking collars are showing male black bears to range farther than previously thought, and video from the collars has shown a new variety of food choices and behaviors.

Bear Management

Early Interactions

- Late 1880s: Bears begin gathering at night to feed on garbage behind park hotels.
- 1910: First incidents of bears seeking human food along park roads.
- 1916: First confirmed bear-caused human fatality.

Early Management

- 1931: Park begins keeping detailed records of bear-inflicted human injuries, property damage, and bear control actions.
- 1931–1969: average of 48 bear-inflicted human injuries and more than 100 incidents of property damage occur annually.

Changes in Management in 1970

- 1970: Yellowstone implements a new bear management program to restore bears to a diet of natural foods and to reduce property damage and human injuries.
- Strictly enforcing regulations prohibiting the feeding of bears and requiring proper storage of human food and garbage.
- All garbage cans in the park convert to a bear-proof design.
- Garbage dumps close within and adjacent to the park.

Recent Progress

- Decrease in human injuries from 45 injuries per year in the 1960s to 1 injury per year in the 2000s.

- Decrease in property damage claims from 219 per year in the 1960s to an average of 15 per year in the 2000s.
- Decrease in number of bears that must be killed or removed from the park from 33 black bears and 4 grizzlies per year in the 1960s to an average of 0.34 black bear and 0.2 grizzly bear per year in the 2000s.
- Decrease in bear relocations away from humans from more than 100 black bears and 50 grizzlies per year in the 1960s to an average of 0.4 black bear and 0.6 grizzly bear per year in the 2000s.

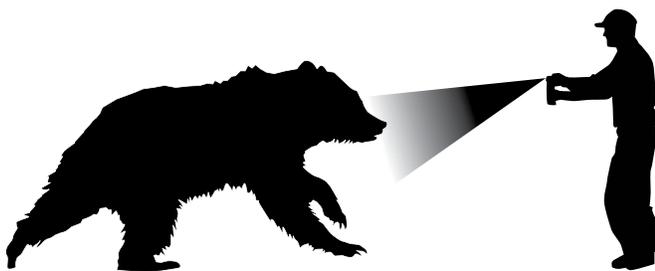
Bear Management

During its first century, Yellowstone National Park was known as the place to see and interact with bears. Hundreds of people gathered nightly to watch bears feed on garbage in the park's dumps. Enthusiastic visitors fed bears along the roads and behaved recklessly to take photographs.

Beginning in 1931, park managers recorded an average of 48 bear-inflicted human injuries and more than 100 incidents of property damage each year in Yellowstone. In 1960, the park implemented a bear management program directed primarily at black bears and designed to reduce the number of bear-caused human injuries and property damages and to re-establish bears in a natural state. The plan included expanding visitor education about bear behavior and the proper way to store food and other bear attractants; installing bear-proof garbage cans; strictly prohibiting feeding of bears; and removing potentially dangerous bears, habituated bears, and bears that damaged property in search of food. The open-pit garbage dumps remained open.

After 10 years, the number of bear-caused human injuries decreased slightly to an average of 45 each year. In 1970, Yellowstone initiated a more intensive program that included eliminating open-pit garbage dumps inside the park with the intention of returning bears to a natural diet of plant and animal foods.

Bear researchers and brothers John and Frank Craighead predicted bears would range more widely and come into more conflict with humans as the bears were weaned off of human food. This prediction was realized in the first years of the revised management program: an annual average of 38 grizzly bears and 23 black bears were moved to backcountry areas, and an annual average of 12 grizzly bears and 6 black bears were removed from the population. However, the number of bear-human conflicts decreased to an annual average of 10 each year after 1972. Bear removals also decreased.



Bear spray works. Know how to use it.

In 1983, the park implemented a new grizzly bear management program that emphasized habitat protection in backcountry areas. The park established “bear management areas” that restricted recreational use where grizzly bears were known to concentrate. The goals were to minimize bear–human interactions that might lead to habituation of bears to people, to prevent human-caused displacement of bears from prime food sources, and to decrease the risk of bear-caused human injury in areas with high levels of bear activity. This program continues today.

Your Safety in Bear Country

On average, bears injure one person each year within Yellowstone National Park. In 2011 and 2015, in separate incidents, three people were killed by bears inside the park. Hiking in bear country takes appropriate preparation. Before you set out, ask about area closures, advisories, and seasonal food habits of local bears. Know what to do if you encounter a bear unexpectedly. Resources are available at visitor centers—where public bear spray demonstrations



Stay clear of animal carcasses. Ravens can be a good indicator that an animal carcass is nearby.



Watch for fresh tracks and scat.

are offered in summer programs—and on the park website (<http://www.nps.gov/yell/planyourvisit/bearsafety.htm>).

Statistically, you're most likely to have an encounter with bears at park roadsides. If you see a bear while driving, do not stop. Regardless of what other people may do, keep moving to the next paved pullout and park safely. If the bear is within 100 yards, watch and take pictures from inside your car. Comply with instructions of park staff on the scene.

As you venture beyond developed areas, stay clear of animal carcasses. Bears are very protective of carcasses as a food source. A single dead animal can attract and hold more than a dozen bears. Many may be bedded down nearby. Watch for gatherings of ravens, magpies, and coyotes. They can be good first indicators that a carcass is nearby. Leave the area immediately by the same route you used to get there.

Bears don't like surprises. Be vigilant about alerting unseen bears to your presence. Some trail conditions make it hard for bears to see, hear, or smell approaching hikers. Make noise by calling out and clapping your hands loudly at regular intervals. Bells are not enough. If you see a bear that hasn't noticed you, leave the area.

Know how to react. If you have a surprise encounter with a bear, do not run. Face the bear and slowly back away. If a bear charges you, stand your ground and use your bear spray. Do not drop your pack. It can help to protect your back from injury. If a bear makes contact with you, fall to the ground onto your stomach and play dead.

A sow protecting her cubs is one of the most dangerous situations you can face in nature. As cute as cubs can be, no photograph of them is ever worth risking personal injury. Always assume mother is nearby and ready to protect her young. For the safety of others, please report all bear incidents and wildlife encounters to a park ranger immediately. Before you set out to enjoy park trails be sure to learn what to do if you unexpectedly encounter a bear.

- **Be alert** for bears and watch for fresh tracks or scat.
- **Make noise** in areas where you can't see far around you.
- **Carry bear spray** that is readily accessible and know how to use it.
- **Hike in groups** of three or more people.
- **Do not run.** If you encounter a bear, back away slowly.

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Staff Reviewer

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Bison

Yellowstone is the only place in the United States where bison (*Bison bison*) have lived continuously since prehistoric times. Yellowstone bison are exceptional because they comprise the nation's largest bison population on public land and are among the few bison herds that have not been hybridized through interbreeding with cattle. Unlike most other herds, this population has thousands of individuals that are allowed to roam relatively freely over the expansive landscape of Yellowstone National Park and some nearby areas of Montana. They also exhibit wild behavior like their ancient ancestors, congregating during the breeding season to compete for mates, as well as migration and exploration that result in the use of new habitat areas. These behaviors have enabled the successful restoration of a population that was on the brink of extinction just over a century ago.

However, some Yellowstone bison are infected with brucellosis, a livestock disease that can be transmitted to wild bison and elk as well as to cattle through contact with infected fetal tissue. To prevent conflicts with ranching and other activities outside the park, the National Park Service (NPS) works with other federal, state, and tribal agencies to manage and develop policies for bison access to winter range in Montana. Conservation of wild bison is one of the most heated and complex of Yellowstone's resource issues. All of the interested parties bring their own wide-ranging values and objectives to the debate.



The bison is the largest land mammal in North America. Each year, bison injure park visitors who approach too closely.

Description

Bison are the largest land-dwelling mammal in North America. Males (2,000 lbs/900 kg) are larger than females (1,100 lbs/500 kg) and both are generally dark chocolate-brown in color, with long hair on their forelegs, head, and shoulders, and short, dense hair (1 in/3 cm) on their flanks and hindquarters. Calves of the year are born after 9 to 9½ months of gestation. They are reddish-tan at birth and begin turning brown after 2½ months. Both sexes have relatively

Quick Facts

Number in Yellowstone

4,829 counted in August 2019. This includes two primary breeding herds: northern (3,667) and central (1,162).

Where to See

- Year-round: Hayden and Lamar valleys.
- Summer: grasslands.
- Winter: hydrothermal areas and along the Madison River. Blacktail Deer Plateau, Tower, and the Gardiner Basin.

Size and Behavior

- Male (bull) weighs up to 2,000 pounds, female (cow) weighs up to 1,000 pounds.
- May live 12–15 years; a few live as long as 20 years.

- Feed primarily on grasses and sedges.
- Mate in late July through August; give birth to one calf in late April or May.
- Can be aggressive, are agile, and can run up to 30 miles per hour.

History

- Yellowstone is the only place in the lower 48 states to have a continuously free-ranging bison population since prehistoric times.
- In the 1800s, market hunting and the US Army nearly caused the extinction of the bison.
- By 1902, poachers had reduced the Yellowstone population to about two dozen animals.

- The US Army, who administered Yellowstone at the beginning of the 20th century, protected these bison from further poaching.
- Bison from private herds were used to establish a herd in northern Yellowstone.
- For decades, bison numbers were reduced due to belief that they, along with elk and pronghorn, were over-grazing the park.
- By 1968, herd reductions of bison ceased.
- Reductions began again in the 2000's due to increasing numbers and litigation over migration into Montana.

short horns that curve upward, with male's horns averaging slightly longer than those of adult females.

All bison have a protruding shoulder hump. Large shoulder and neck muscles allow bison to swing their heads from side to side to clear snow from foraging patches, unlike other ungulates that scrape snow away with their front feet. Bison are agile, are strong swimmers, and can run 35 miles per hour (55 kph). They can jump over objects about 5 feet (1.5 m) high and have excellent hearing, vision, and sense of smell.

Behavior

Bison are mostly active during the day and at dusk, but may be active through the night. They are social animals that often form herds, which appear to be directed by older females. Group sizes average about 20 bison during winter but increase in summer to an average of about 200, with a maximum of about 1,000 during the breeding season (known as the rut) in July and August. Bison are sexually mature at age two. Although female bison may breed at these younger ages, older males (>7 years) participate in most of the breeding.

During the rut mature males display their dominance by bellowing, wallowing, and engaging in fights with other bulls. The winners earn the right to mate with receptive females. Once a bull has found a female who is close to estrus, he will stay by her side until she is ready to mate. Then he moves on to another female. Following courtship, mature males separate and spend the rest of the year alone or in small groups. Group sizes decrease through autumn and into winter, reaching their lowest level of the year during March and April.



The bull bellows during rutting season, while a disinterested cow continues to graze.

FREQUENTLY ASKED QUESTION:

What is the difference between a bison and a buffalo?

In North America, both "bison" and "buffalo" refer to the American bison (*Bison bison*). Generally, "buffalo" is used informally; "bison" is preferred for more formal or scientific purposes. Early European explorers called this animal by many names. Historians believe that the term "buffalo" grew from the French word for beef, "boeuf." Some people insist that the term "buffalo" is incorrect because the "true" buffalo exist on other continents and are only distant relatives. In this book, we use "bison."

Diet

Yellowstone bison feed primarily on grasses, sedges, and other grass-like plants (more than 90% of their diets) in open grassland and meadow communities throughout the year. They also eat forbs (weeds and herbaceous, broad-leafed plants) and browse (the leaves, stems, and twigs of woody plants) through the year, but those usually comprise less than 5% of the diet. They typically forage for 9 to 11 hours daily. Bison are ruminants with a multiple-chambered stomach that includes microorganisms such as bacteria and protozoa to enable them to effectively digest plant material. Bison alternate between eating and ruminating (regurgitating partially-digested food and chewing it again), a process that allows microorganisms to further break down plant material into volatile fatty acids and other compounds. Their large digestive tract allows them to digest lower-quality foods with greater efficiency than other ungulates such as cattle, deer, or elk.

Interaction with Other Wildlife

Wolves and grizzly bears are the only large predators of adult bison. Dead bison provide an important source of food for scavengers and other carnivores. Bison will rub against trees, rocks, or in dirt wallows in an attempt to get rid of insect pests. Birds such as the magpie perch on a bison to feed on insects in its coat. The cowbird will also follow close behind a bison, feeding on insects disturbed by its steps.

Migration

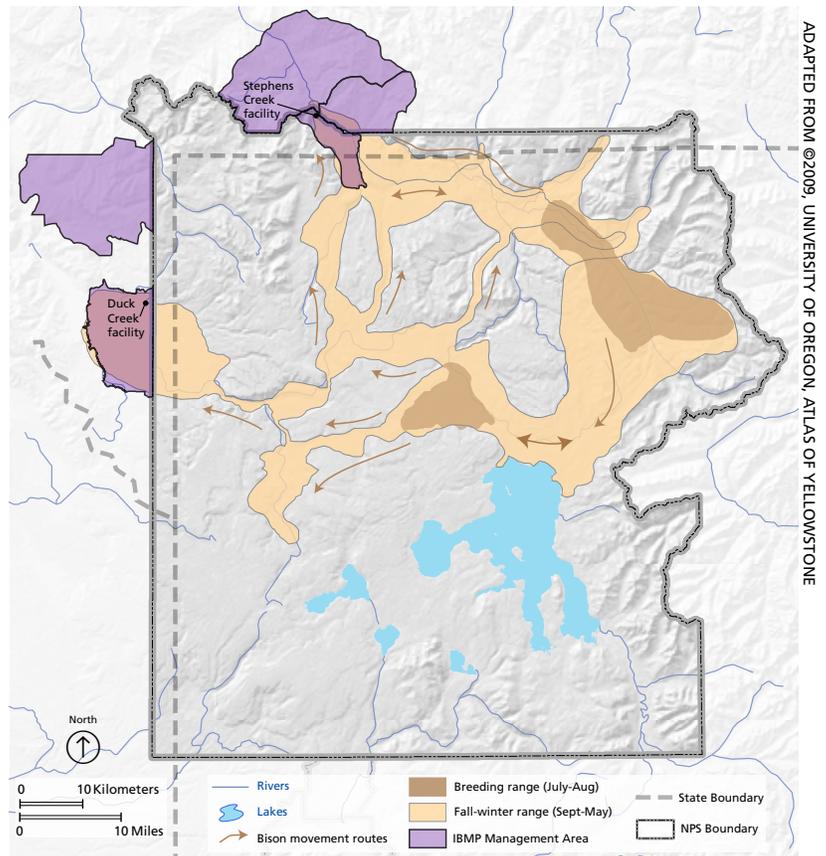
Like most other ungulates of the Greater Yellowstone Ecosystem, bison will move from their summer ranges to lower elevation as snow accumulates and dense snowpack develops. Most bison alter their diets somewhat during winter, feeding in lowland

meadows with concentrated sedges and grasses compared to a more diverse diet during the rest of the year. Bison appear to select foraging areas during winter based more on plant abundance than quality, and then consume the most nutritious plants available. High densities of bison can deplete forage in high-quality patches, resulting in subsequent use of areas with plants of lower diet quality. Bison in central Yellowstone frequently use thermally influenced areas near geysers, hot springs, fumaroles, and rivers with less snow during winter. Forested areas are used occasionally for shade or shelter, escape from insects and other disturbances, or to travel between foraging areas or seasonal ranges.

Habitat

Yellowstone bison historically occupied approximately 7,720 square miles (20,000 km²) in the headwaters of the Yellowstone and Madison rivers. Today, this range is primarily restricted to Yellowstone and some adjacent areas of Montana. The bison population lives and breeds in the central and northern regions of the park. The northern breeding herd congregates in the Lamar Valley and on adjacent plateaus for the breeding season. During the remainder of the year, these bison use grasslands, wet meadows, and sage-steppe habitats in the Yellowstone River drainage, which extends 62 miles (100 km) between Cooke City and the Paradise Valley north of Gardiner, Montana. The northern range is drier and warmer than the rest of the park, and generally has shallower snow than in the interior of the park.

The central breeding herd occupies the central plateau of the park, from the Pelican and Hayden valleys with a maximum elevation of 7,875 feet (2,400 m) in the east to the lower-elevation and thermally-influenced Madison headwaters area in the west. Winters are often severe, with deep snows and temperatures reaching -44°F (-42°C). This area contains a high proportion of moist meadows composed of grasses, sedges, and willows, with upland grasses in drier areas. Bison from the central herd congregate in the Hayden Valley for breeding. Most of these bison move among the Madison, Firehole, Hayden,

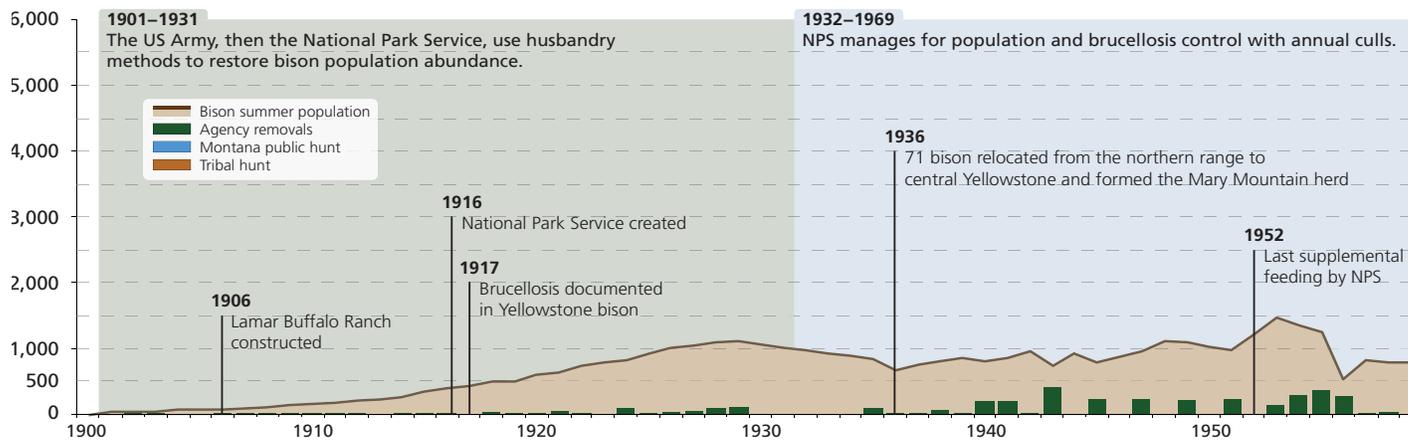


The seasonal distribution of Yellowstone bison is shown here in comparison with the Interagency Bison Management Plan management areas.

and Pelican valleys during the rest of the year. However, increasing numbers of bison are travelling to the northern portion of the park and mixing with the northern herd. Fewer and fewer return to the Hayden Valley for the subsequent breeding season, and some females who switched breeding ranges have successfully bred and reared young on their new range.

History

Historically, Yellowstone bison spent summer in the Absaroka Range north of Yellowstone; in the Lamar Valley-Mirror Plateau area of northeastern Yellowstone; in the Hayden Valley of central Yellowstone; and in the Madison-Pitchstone plateaus of southwestern Yellowstone. Bison in northern Yellowstone spent winter in the Lamar and Pelican valleys; bison in central Yellowstone spent winter in the Hayden Valley and Firehole River drainage; and bison in southwest Yellowstone spent winter on the Snake River plains. From 30 to 60 million bison may have roamed North America before the mid 1800s. Their historical range spread from the Pacific Ocean to the Appalachian Mountains, but their main habitat



Estimated summer population and the number of bison removed the following winter, 1900–2018.

was the Great Plains where Plains Indian tribes developed a culture that depended on bison. Almost all parts of the bison provided something for the American Indian way of life—food, tools, shelter, or clothing; even the dung was burned for fuel. Hunting bison required skill and cooperation to herd and capture the animals. After tribes acquired horses in the 1600s, they could travel farther to find bison and hunt the animals more easily.

The Brink of Extinction—and Recovery

European American settlers moving west during the 1800s changed both the Native Americans' and bison's way of life. Market hunting, sport hunting, and a US Army campaign in the late 1800s nearly eliminated bison. Yellowstone was the only place in the contiguous 48 states where wild, free ranging bison persisted. The US Army, which administered Yellowstone at the turn of the 20th century, protected these few dozen bison from poaching as best they could. The protection and recovery of bison in Yellowstone is one of the great triumphs of American conservation.

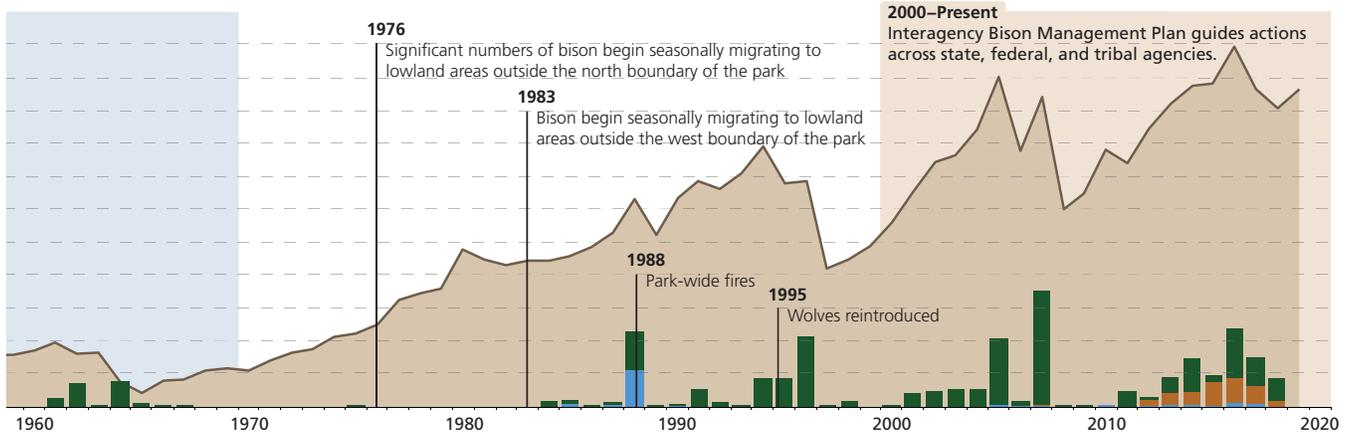
Bison were almost extirpated before 1900, leaving a remnant, indigenous herd of approximately 23 bison in the Pelican Valley of central Yellowstone. In 1902, the Army administrators created another herd in northern Yellowstone from 18 pregnant female bison that were relocated from a ranch in northern Montana, three males from Texas, and a few calves from Pelican Valley. Protection and stewardship, along with supplemental feeding, allowed these bison to propagate to more than 1,500 animals by 1954. The relocation of 71 animals from the northern herd to central Yellowstone (half to Hayden Valley and half to the Firehole area) to form the Mary Mountain herd in 1936 contributed to the increase in abundance.

Early Range Management

Frequent culling by park managers limited bison numbers through 1966, but abundance rapidly increased after a moratorium on culling in the park was instituted in 1969. Bison numbers quadrupled from about 500 in 1970 to 2,000 in 1980, and then approached 3,000 by 1987. At the same time, elk numbers in northern Yellowstone increased from about 4,000 in 1968 to 12,000 by the mid-1970s and 19,000 by 1988. As herbivore (plant eaters) numbers increase in an area, the amount of forage available to sustain each individual decreases, which can eventually lead to a decrease in nutrition and body condition and, in turn, lower pregnancy and survival rates. To avoid these effects, bison and elk began to change their movement patterns and expand their winter ranges to access more food resources as their numbers increased. Only a few bull bison left the park before 1975, but thereafter, larger groups with female bison began migrating across the northern and western boundaries into Montana during winter. Also, in the 1980s bison from the central herd began moving to northern Yellowstone during winter, where some of



Three mounted rangers separate bison for slaughter at the Lamar Buffalo Ranch in December 1930.



them stayed and remained year-round. This range expansion and dispersal from central to northern Yellowstone appeared to be induced by relatively high bison densities combined with deep snow pack during some winters that further limited food availability, especially in the central portion of the park.

Brucellosis

Brucellosis, caused by the bacterium *Brucella abortus*, can cause pregnant cattle, elk, and bison to abort their calves. The bacteria can be transmitted between individual bison and also among bison, elk, and cattle via contact with infected birth tissues. No cure exists for brucellosis in wild animals.

Cattle brought this nonnative disease to the region when pioneers settled the West. The disease was subsequently transmitted to local wildlife populations. Many bison and elk in the Greater Yellowstone Ecosystem have been exposed to the bacterium that causes brucellosis. Today, all cattle that use overlapping ranges with bison are vaccinated for brucellosis when they are calves.

Although extremely rare in the United States, humans can contract brucellosis by consuming unpasteurized, infected milk products or contacting infected birth tissue. It cannot be contracted by eating cooked meat from an infected animal. In humans, the disease is called undulant fever and is treated with antibiotics.

Presence in Yellowstone

Brucellosis was discovered in Yellowstone bison in 1917. They probably contracted the disease from domestic cattle raised in the park to provide milk and meat for visitors. Now about 50% of the park's bison test positive for exposure to the *Brucella* organism. However, testing positive for exposure (seropositive)

does not mean the animal is infectious and capable of transmitting brucellosis. For example, people who received smallpox immunization during their childhood will test positive for smallpox antibodies even though they are not infected with the disease and cannot transmit it. Research indicates about 15% of seropositive female bison are infectious at the time of testing. Male bison do not transmit the disease to other bison. Transmission between males and females during reproduction is unlikely because of the female's protective chemistry.

Bison have not been known to transmit brucellosis to cattle under natural conditions, though transmission is biologically feasible and has occurred in captivity. All cattle infected by wildlife in the greater Yellowstone area were infected by elk. When livestock are infected, there is economic loss to producers from abortions and still births, slaughtering infected animals, increased disease-testing requirements, and the potential for decreased marketability of their cattle. As a result, producers and regulators are concerned about transmission of the bacteria



Research shows that bison calves pose no risk of brucellosis transmission to cattle.

from wild bison or elk back to cattle. Current and historic management strategies attempt to prevent bison from commingling with cattle. Research indicates it is time to turn our efforts to preventing the commingling of elk and cattle.

Since 1985, more than 10,000 Yellowstone bison have been harvested by hunters in Montana or culled from the population, primarily to protect Montana's cattle industry and prevent the unlikely transmission of brucellosis from bison to cattle.

Bison Management

In the year 2000, the State of Montana and the federal government developed an Interagency Bison Management Plan. Revised in 2016, the plan prescribes collaborative actions to reduce the risk of brucellosis transmission from Yellowstone bison to cattle (including the culling of some bison near the park boundary) while conserving a viable population of bison with some migration to essential, lower-elevation winter ranges on public lands in the state. No plan was developed for elk.

Summer counts of bison in central and northern Yellowstone have varied widely under this plan. The aerial count of bison on July 29–30, 2019, was 4,829, including 3,667 in northern Yellowstone and 1,162 in central Yellowstone. Bison abundance in the northern breeding herd increased 10% from a count of 3,337 in August 2018 to 3,667 in July 2019. Counts of the northern herd averaged 3,722 over the last five years and were relatively stable (range: 3,337 to 4,008). Bison abundance in the central herd remained stable from a count of 1,190 during August 2018 to a count of 1,162 during July 2019. Counts of the central herd over the last five years were similar and averaged 1,186. The central herd continues to exhibit a lower potential for population growth compared to the northern herd.

Yellowstone bison are migratory wildlife, not livestock. One mission of the NPS is to preserve native wildlife species and the processes that sustain them. A wild population can be defined as one that is free-roaming within a defined conservation area that is large enough to sustain ecological processes such as migration and dispersal, sufficiently abundant to mitigate the loss of existing genetic variation, and subject to forces of natural selection such as competition for breeding opportunities and food, predation, and substantial environmental variability. Thousands of bison inhabit a heterogeneous, spacious landscape



Wildlife Biologist Rick Wallen extracts serum from a bison blood sample to conduct a brucellosis exposure test. January 22, 2015.

in and near Yellowstone with a diverse association of native ungulates and predators that are subject to natural selection factors. They have high genetic diversity compared to many other populations of plains bison, and are one of a few bison populations with no evidence of potential cattle ancestry. Also, they migrate seasonally to areas where food supplies are more abundant, available, or nutritious at different times of the year. In other words, bison in Yellowstone are not managed like domestic stock on a ranch and are generally allowed to move freely within the park—though some intervention occurs near the boundary and developed areas to reduce conflicts with humans and outlying jurisdictions.

The substantial recovery of free-ranging bison populations outside Yellowstone is constrained by the availability of low-elevation winter habitat where forage is relatively accessible. Much of Yellowstone is mountainous, with deep snow pack that limits access to forage and increases energy expenditures during winter. Also, large portions of the original range for bison are no longer available outside the park due to agriculture and development. Furthermore, there are political and social concerns about allowing bison outside these parks, including human safety and property damage, competition with livestock for grass, diseases such as brucellosis that can potentially be transmitted between bison and cattle, consumption of agricultural crops, and limited funding for management. Ultimately, it is up to society to decide how it wants the federal and state governments to

Success and Controversy

The protection and recovery of bison in Yellowstone is one of the great triumphs of American conservation. In 1902, after years of market hunting and poaching, there were only two dozen bison left in Yellowstone. Over the next hundred years, park employees worked to bring bison back from the brink of extinction. We succeeded, and now face the challenge of helping to manage a healthy, rapidly growing population of bison that sometimes roams beyond our borders onto private land and land managed by other agencies.

Challenges

Yellowstone's bison population is growing; the park's borders are not.

Allowing the bison population to grow indefinitely could result in overgrazing in certain areas and possibly mass starvation of animals in Yellowstone, as well as larger migrations and greater conflict outside the park. Due to high rates of survival and reproduction, the bison population is currently increasing by 10 to 17% per year. Predation by wolves and bears has little effect on bison numbers. However, Yellowstone encompasses a limited amount of habitat and bison are not allowed to migrate freely outside the park like deer, elk, and other animals.

The State of Montana treats bison differently than other wildlife.

Bison are not allowed to move freely outside Yellowstone due to fears by livestock interests that they might transmit brucellosis to cattle and compete with cattle for grass, as well as concerns for human safety and property damage. These fears have resulted in Montana legislation that prohibits moving live bison from the park to other conservation areas. For long-term conservation, Yellowstone bison need access to habitat outside the park, similar to other migratory wildlife like elk (another species that carries brucellosis).

Hunting inside the park is not an option.

Hunting is prohibited in Yellowstone, which is why the park offers some of the best wildlife viewing in the world. A few groups want to open the park to bison hunting, but Yellowstone managers strongly oppose this idea. Allowing hunting in Yellowstone would affect the behavior of animals and drastically change the experience people expect when they visit. This is not the future we want for Yellowstone, and we don't believe it's the future the public wants either.

Eight agencies make decisions about Yellowstone bison.

In 1995, Montana sued the National Park Service because bison were migrating out of the park on to state lands. A court-mediated settlement reached in 2000 created the Interagency Bison Management Plan (IBMP), which set a population target of around 3,000 animals and established a cooperative effort to manage bison in and around Yellowstone. If you care about bison, we encourage you to learn more about the agencies and tribes that play a role in deciding their future.

Bison need to be managed.

Until there is more tolerance for bison outside Yellowstone, the population will be controlled by hunting outside the park and capture near the park boundary. Captured bison



New calves stand out bright orange against the rest of the northern range herd in Lamar Valley

are transferred to Native American tribes for slaughter and distribution of meat and hides to their members. With our IBMP partners, we're pursuing alternatives to hunting and capture like quarantine and expanded tolerance.

Our Goals

Maintain a viable, wild, migratory population.

Yellowstone is one of the few places where bison live much like their ancestors did: unfenced, and unprotected from harsh winters, drought, or predation. Yellowstone bison also provide a physical link to those ancestors, and show no evidence of interbreeding with domestic cattle. They were declared our national mammal in 2016.

Send Yellowstone bison to other conservation areas.

Right now, it's against Montana state law to move wild bison exposed to brucellosis anywhere except to meat processing and research facilities within the state. We've started a quarantine program for bison in collaboration with the Assiniboine and Sioux tribes on the Fort Peck Reservation in Montana. From quarantine, animals that repeatedly test negative for brucellosis could be sent alive to other public, private, or tribal lands. Quarantine could reduce the number of bison shipped to slaughter, and facilitate the restoration of plains bison in other suitable areas of the country.

In August 2019, Yellowstone National Park transferred 55 male bison to Fort Peck. While this is a good start, substantial work remains to continue building a sustainable quarantine program. If quarantine is going to succeed, more capacity and partner involvement will be necessary in the future. We want to expand the quarantine program to ensure a more regular and predictable number of bison can move through the protocols. Yellowstone cannot do this alone. Our partners, including IBMP and others, need to play an increased role to make the program sustainable over the long-term.

Develop a new bison management plan.

While the existing plan (IBMP 2000) has been effective at preventing brucellosis transmission and maintaining a viable population, we believe that we've outgrown it. New data about bison biology and disease prevalence are available, and public opinion is shifting toward more tolerance for bison in Montana. We need a new paradigm that recognizes bison as wildlife and gives them the ability to move more freely on suitable public lands outside the park.

manage bison, including how many bison should be tolerated on public lands, what should be done with “surplus” bison, and how much money should be spent on bison management and brucellosis suppression.

The management of bison near the boundary of Yellowstone, which includes hazing, capture, culling, and vaccination, is unsettling to many people. Park staff are often asked why bison are managed differently from other wildlife and not allowed to move freely into Montana and disperse to new areas. Conversely, other people believe bison should be kept in the park and either managed like livestock or hunted to reduce numbers below the capacity of the winter habitat to support them. Many constituents are adamant that Yellowstone bison should be relocated elsewhere instead of being culled (e.g., shipped to slaughter) due to concerns about brucellosis transmission to cattle.

The debate about how to conserve and manage Yellowstone bison involves a variety of issues, including

- abundance—how many are enough?
- distribution—where will bison be tolerated outside the park?
- brucellosis infection—what should be done and what can be done to suppress the disease and/or lessen transmission risk to cattle?
- genetic integrity—what should be done to preserve existing genetic diversity and population substructure?
- habitat—should humans intervene to control ungulate numbers and grazing effects?
- wildness—what intensity and types of management are appropriate in a national park whose mission is to preserve native species and the ecological processes that sustain them?

Incorporated in these over-arching issues is a broad spectrum of beliefs, concerns, and values held by a diverse range of stakeholders, including advocates, local community members, regulators and scientists, American Indian tribes, and the national and international public. Many of these constituents from across the spectrum of values support the conservation of wild Yellowstone bison, but with differing views regarding what constitutes responsible management actions to mitigate conflicts. The challenge for bison managers is how to consider this wide variety of viewpoints to reach a reasonable solution for the long-term conservation of this iconic and



Many of the management operations are carried out at the Stephens Creek facility, shown here in January 22, 2015.

ecologically important population. There is no quick and easy resolution, but the intense management of Yellowstone bison is necessary at times to gain tolerance for them in modern society in the short term and enhance the conservation of this valuable population and the habitats that sustain them over the long term.

Ecosystem-wide Interaction

Yellowstone bison are prolific and have high survival rates, with wolves killing fewer bison than elk because elk are more vulnerable prey. As a result, bison numbers increase rapidly when environmental conditions are suitable, with abundance increasing to more than 4,000 individuals on several occasions and reaching a high of approximately 5,500 bison in 2016. At these numbers, a winter with deep snow pack can induce many hundreds of bison to migrate into Montana because lower-elevation habitat for bison is limited by mountains within Yellowstone. As a result, bison will continue to move from the park into Montana during winter, with higher numbers migrating as bison abundance and winter severity increase.

Due to existing agriculture and development in the Yellowstone and Madison River valleys, however, there is not sufficient low-elevation, valley-bottom habitat north and west of Yellowstone where bison are currently tolerated that could sustain many hundreds or thousands of bison for extended lengths of time during winter. Thus, bison could rapidly fill available habitat, and, if given the opportunity, attempt to migrate farther during some winters, a pattern which will eventually bring them into areas (e.g., Paradise Valley) occupied by many hundreds of cattle. Without human intervention, some bison

that spend winter north and west of Yellowstone in Montana will not migrate back into the park during spring but will attempt to expand their range into other areas with suitable habitat but currently no tolerance for bison. In addition, there are still tangible concerns about the transmission of brucellosis from bison to cattle, with regulatory and economic consequences of cattle contracting brucellosis. As a result, there is a need to manage bison to prevent commingling with cattle.

Furthermore, there are political and social concerns about allowing large numbers of these massive, wild animals into Montana, and options for relocating Yellowstone bison elsewhere are limited by real and perceived disease and social concerns. Therefore, bison will at times need to be intensively managed and culled from the population to prevent the limited tolerance for wild bison on the landscape in Montana from being rescinded.

Multiple Jurisdictions, Multiple Interests

The NPS cannot achieve bison conservation on its own. When bison cross the boundary of Yellowstone into Montana, they are no longer under the jurisdiction of the NPS and their management is the prerogative of the state and the Custer Gallatin National Forest on National Forest System lands. Bison are managed differently than other wildlife that migrate or disperse outside Yellowstone.

The State of Montana allows some bison to migrate outside Yellowstone National Park and occupy suitable winter range near the park boundary—and tolerance on additional range may occur in the future. However, mass migrations of many hundreds of bison out of the park have, at times, upset



The migration of bison outside of Yellowstone National Park (the boundary is marked here with the 1903 arch at the North Entrance) is a challenging issue for the greater Yellowstone area.

state and local governments, as well as many private landowners and cattle operators. As a result, if bison were allowed to increase in abundance and disperse unimpeded into cattle-occupied areas of Montana, it is likely those bison would be lethally removed by state employees or during regulated hunts. Also, the state agencies would likely retract tolerance for bison in Montana. Due to chronic brucellosis infection in Yellowstone bison, the state agriculture department has superseding management authority. Thus, management practices such as hunting, hazing, capture, and culling are necessary at times to limit the abundance and distribution of bison and allow people (including federal and state managers) time to learn to live with, and manage, bison.

The demand for bison for quarantine or research is currently low and the current social capacity for public and treaty harvests near the boundary of Yellowstone is probably less than 500–600 bison each winter. Thus, bison will at times need to be removed from the population by other means, such as shipments to slaughter facilities or terminal pastures, even though there is little political or social support for such actions. Wild ungulates are commonly harvested throughout most of the US, and some bighorn sheep, deer, elk, and moose that spend summer in Yellowstone, but migrate to lower elevations in surrounding states in autumn and winter, are harvested during regulated hunts.

Interagency Bison Management Plan

In 2000, the federal government and the State of Montana signed an agreement that established guidelines for cooperatively managing the risk of brucellosis transmission from bison to cattle—primarily by excluding bison from areas used by cattle. This Interagency Bison Management Plan (IBMP) also emphasized preserving the bison population as a natural component of the ecosystem and allowing some bison to occupy winter ranges on public lands in Montana. Five agencies were originally responsible for implementing the plan—the NPS, Animal and Plant Health Inspection Service (APHIS), US Forest Service (USFS), Montana Department of Livestock (MTDOL), and Montana Fish, Wildlife & Parks (MTFWP). The Confederated Salish and Kootenai Tribes of the Flathead Nation, Nez Perce Tribe, and InterTribal Buffalo Council were added as members in 2009 due to their treaty hunting rights on some unoccupied federal lands in southwestern Montana

and their commitment to restoring bison.

The IBMP members cooperatively support various management and monitoring activities for bison. The NPS has jurisdiction over all bison management actions inside the park, while the MTDOL has lead responsibility outside the park. Property damage issues on private lands are the responsibility of MTFWP, who may request assistance from the MTDOL. The IBMP uses risk-management procedures to maintain spatial and temporal separation between bison and cattle around Yellowstone. For bison to transmit brucellosis directly to cattle, infected bison must leave Yellowstone where there are no cattle, enter areas where cattle graze, shed infectious tissues via abortions or live births, and have cattle contact these tissues before they are removed from the environment or the *Brucella* bacteria die. As the risk of brucellosis transmission from bison to cattle is reduced, the plan is designed to progress through a series of management steps that gradually tolerate more bison on winter ranges outside Yellowstone when cattle are not present.

Adaptive Management

The plan was adjusted in 2005 and 2006 to include bison hunting as a management action outside Yellowstone and increase tolerance for bull bison in Montana because there appears to be little risk of them transmitting brucellosis to cattle during winter

and spring. These adjustments allowed bison not tested for brucellosis exposure to migrate to winter ranges outside the park and provide hunting opportunities for state-licensed hunters as well as tribes with rights reserved through treaties with the US government to hunt on certain federal lands. Since 2005, these hunts have been implemented with variable harvest levels depending on how many bison move outside the park in response to snow depths.

In December 2017, the NPS, APHIS, and Montana Department of Livestock agreed to implement a quarantine program to identify brucellosis-free Yellowstone bison and transfer them to the Fort Peck Indian Reservation. During 2018, sixty-five male, 14 female, and 15 calf bison completed quarantine and were sent to the Assiniboine and Sioux tribes at Fort Peck. These transfers were highly acclaimed by the tribes and the public as a major conservation advancement. The Fort Peck Tribes have agreed to transfer about 70% of Yellowstone bison that complete assurance testing to the InterTribal Buffalo Council for restoration on Indian lands elsewhere. Yellowstone biologists have recommended capturing and placing another 110 juvenile and young adult bison into quarantine at NPS and APHIS facilities this winter.

The IBMP members meet several times each year in public venues to review, evaluate, and modify operating procedures for accomplishing the objectives of the plan (see meeting minutes at the www.ibmp).

Quick Facts about the Interagency Bison Management Plan

- Final Environmental Impact Statement for the Interagency Bison Management Plan (IBMP) for the State of Montana and Yellowstone National Park was adopted in 2000.
- Adaptive management plan was developed in 2008.
- www.ibmp.info provides bison management documents to the public.

Interagency Partners

- National Park Service (NPS)
- Animal and Plant Health Inspection Service (APHIS)
- US Forest Service (FS)
- Montana Department of Livestock (DOL)
- Montana Department of Fish, Wildlife & Parks (FWP)

- InterTribal Buffalo Council (ITBC)
- Confederated Salish and Kootenai Tribes of the Flathead Nation
- Nez Perce Tribe

Objectives

- Maintain a wild, free-ranging bison population.
- Reduce risk of brucellosis transmission from bison to cattle.
- Maintain and preserve the ecological function that bison provide in the Yellowstone area, such as their role as grassland grazers and as a source of food for carnivores.
- Maintain genetic integrity of the bison population.
- Prevent dispersal beyond conservation area.

- Lower brucellosis prevalence because it is not a native organism.

Current Status

- Yellowstone bison have access to 75,000 acres of habitat in the Gardiner Basin of Montana.
- As of December 2015, wild bison are tolerated year-round outside the west and northern boundaries.
- Fewer cattle graze lands near park than did in 2000.
- The State of Montana is managing a bison hunt on public lands outside the park.
- Five tribes are conducting subsistence bison hunts on unclaimed federal lands outside the park by authority of their respective treaties with the US government.

info website). Since 2009, numerous adaptive adjustments to the management plan, including increased tolerance for bison in some areas north and west of the boundary of the park, have been approved to improve management of Yellowstone bison.

In 2016, the IBMP was adjusted to provide year-round tolerance for bison in some areas of Montana located north and west of Yellowstone. Over time, this should enhance bison resoration in these historically occupied areas and increase treaty hunting opportunities while decreasing the frequency and extent of hazing and capture.

Bison are interwoven into the cultures of American Indian tribes, and, under the IBMP, the primary options for culling bison are treaty harvests, the provision of bison meat and hides to tribes for consumption and cultural use, and the restoration of bison to tribal lands to improve their cultural, economic, nutritional, and social well-being. The NPS has been working to transfer some Yellowstone bison directly to tribes for processing, and is working with federal and state animal health officials to develop protocols and facilities for transferring brucellosis-free bison to tribal lands and/or establishing quarantine facilities on tribal lands in accordance with applicable state, federal, and tribal codes.

Plan Outcomes

The conservation of bison has been relatively successful under the IBMP. Since 2001, bison numbers have averaged about 4,250 and ranged between 2,970 and 5,460 after calving in the summer. Yellowstone bison are managed as wildlife in multiple, large herds that migrate and disperse across an extensive landscape and are therefore subject to a full suite of native ungulates and predators, other natural selection factors, and substantial environmental variability. Yellowstone bison have a relatively high degree of genetic variation, which should be maintained for centuries with a fluctuating population size that averages about 3,500 bison. Also, adaptive management adjustments during 2005 to 2016 increased the tolerance for bison on habitat in Montana.

Likewise, mitigation of the risk of brucellosis transmission from bison to cattle has occurred under the IBMP. To date, no documented transmission of brucellosis from Yellowstone bison directly to cattle has occurred, due in part to successful efforts by the agencies to maintain separation of bison from cattle. Conversely, dozens of transmissions from elk to

cattle have occurred since 1998. Currently, the risk of brucellosis transmission from bison to cattle is low during winter and spring because few cattle are in the areas where bison are tolerated north and west of the park. By the time more cattle are released onto public and private lands north and west of the park during mid-June and July, the bison calving season has ended and bison are usually following the progressive green-up of new grasses back into the park interior as snow melts at higher elevations. Brucellosis transmission risk is limited due to the combined effects of management to maintain separation between cattle and bison; the synchrony of most bison parturition events into a short period and in areas separate from cattle summer ranges; the cleaning of birth sites by female bison and the relatively quick environmental degradation of *Brucella* in late spring weather; and scavenger removal of potentially infectious birth tissues that makes it unlikely that viable *Brucella abortus* bacteria would remain for cattle to encounter.

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Bighorn Sheep

Although widely distributed across the Rocky Mountains, bighorn sheep (*Ovis canadensis*) persist chiefly in small, fragmented populations that are vulnerable to sudden declines as a result of disease, habitat loss, and disruption of their migratory routes due to roads and other human activities. Between 10 and 13 interbreeding bands of bighorn sheep occupy steep terrain in the upper Yellowstone River drainage, including habitat that extends more than 20 miles north of the park. These sheep provide visitor enjoyment as well as revenue to local economies through tourism, guiding, and sport hunting. Mount Everts receives the most concentrated use by bighorn sheep year-round.

Population

From the 1890s to the mid-1960s, the park's bighorn sheep population fluctuated between 100 and 400. Given the vagaries of weather and disease, bighorn sheep populations of at least 300 are desirable to increase the probability of long-term persistence with minimal loss of genetic diversity. The count reached a high of 487 in 1981, but a keratoconjunctivitis (pinkeye) epidemic caused by *Chlamydia* reduced the population by 60% the following winter, and the



All bighorn sheep have horns. The rings on horns can be used to determine age, though it is easier to count the rings on a ram (left).

population has been slow to recover. Although the temporary vision impairment caused by the infection is rarely fatal for domestic sheep that are fenced and fed, it can result in death for a sheep that must find its forage in steep places.

During the 2018 survey, a total of 345 bighorn sheep were observed, including 214 in Montana and 131 inside Yellowstone National Park. This is slightly

Quick Facts

Number in Yellowstone

345 in the northern Yellowstone area in 2018 (131 counted inside the park).

Where to See

- Summer: slopes of Mount Washburn, along Dunraven Pass.
- Year-round: Gardner Canyon between Mammoth and the North Entrance.
- Also: On cliffs along the Yellowstone River opposite Calcite Springs; above Soda Butte; in the eastern Absaroka mountains.

Behavior and Size

- Average life span: males, 9–12 years; females 10–14 years.
- Adult male (ram): 174–319 pounds, including horns that can weigh 40 pounds. The horns of an adult ram can make up 8–12% of his total body weight.
- Adult female (ewe): up to 130 pounds.

- Horn growth is greatest during the summer and early in life. Female horns grow very little after four to five years, likely due to reproductive costs.
- The horn size of bighorn sheep rams can influence dominance and rank, which affects social relationships within herds.
- Older ram horns may be “broomed” or broken at the tip, which can take off one to two years of growth.
- Mating season begins in November.
- Ram skulls have two layers of bone above the brain that function as a shock absorber, an adaptation for the collision of head-on fighting that is used to establish dominance between rams of equal horn size, especially during mating.
- One to two lambs born in May or June.

Habitat

- Feed primarily on grasses; forage on shrubby plants in fall and winter.
- Rocky Mountain bighorn sheep, found in greater Yellowstone, differ from other currently recognized subspecies in the United States: Desert bighorn sheep, which is currently listed as an endangered species, Dall sheep found in Alaska and northwestern Canada, and Stone's sheep, which are a subspecies of Dall sheep.

Management

- Early reports of large numbers of bighorn sheep in Yellowstone have led to speculation they were more numerous before the park was established.
- A chlamydia (pinkeye) epidemic in 1981–1982 reduced the northern herd by 60%.



Most bighorn sheep in Yellowstone are migratory, wintering in lower-elevation areas along the Yellowstone, Lamar, and Gardner rivers, and moving to higher-elevation ranges from May through October.

below the 10-year average of 358 sheep. Additionally, in 2018, lamb-to-ewe ratios of 20:100 were below the 10-year average (28:100), with very low lamb recruitment observed on the Cinnabar, Corwin, and Mt. Everts winter ranges.

During 2005-2015, the population increased steadily. A decline occurred in 2015 related to an all-ages pneumonia event. In spite of the 2015 decline, overall bighorn sheep numbers in the northern Yellowstone remain substantially above the long-term average.

Competition with Other Species

Bighorn sheep populations that winter at high elevations are often small, slow-growing, and low in productivity. Competition with elk as a result of dietary and habitat overlaps may have hindered the recovery of this relatively isolated population after the pinkeye epidemic. Rams may be hunted north of the park, but the State of Montana has granted few permits in recent years because of the small population size.

Although wolves occasionally prey on bighorn sheep, the population has increased since wolf reintroduction began in 1995. Longer-term data are needed to show whether sheep abundance may be inversely related to elk abundance on the northern range. The Wyoming Game and Fish Department, Montana Fish, Wildlife & Parks, the Idaho Department of Fish and Game, Montana State University, the US Forest Service, and several non-governmental organizations are cooperating with the National Park Service to study how competition with nonnative mountain goats, which were introduced in the Absaroka Mountains in the 1950s, could affect bighorn sheep there.



Bighorn sheep exhibit some habituation to humans. Be alert to them along the road and never feed them.

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Staff Reviewer

Travis Wyman, Biological Technician



Mountain Goats

Descendants of mountain goats (*Oreamnos americanus*) introduced in the Absaroka and Madison mountain ranges during the 1940s and 1950s established a population in Yellowstone National Park in the 1990s. They have reached a relatively high abundance in the northeastern and northwestern portions of the park. Investigations of paleontological, archeological, and historical records have not found evidence that the mountain goat is native to greater Yellowstone.

Many people consider the goats a charismatic component of the ecosystem, including those who value the challenge of hunting them outside the park. But the colonization has raised concerns about the goats' effects on alpine habitats. Competition with high densities of mountain goats could also negatively affect bighorn sheep, whose range overlaps that of mountain goats.

Habitat

Mountain goats live in alpine habitats. Studies of alpine vegetation in the northeast portion of the park during 2002 and 2003 suggest that ridge-top vegetation cover is lower, and barren areas along alpine ridges are more prevalent in areas that have received relatively high goat use. Studies by Idaho State University and the National Park Service during 2008–2010 suggest goats are affecting the soil chemistry of sites they inhabit by increasing the availability of soil nitrogen through deposition of urine and



Mountain goats are not native to the Greater Yellowstone Ecosystem.

feces. Soil rockiness may be increasing slightly over time at sites with high goat presence, but no large-scale effects have been detected so far with respect to vegetation (species, community structure).

Colonization of suitable habitats south of The Thunderer and along the eastern park boundary within the Absaroka Mountain Range appears to be occurring, with a larger number of groups with females and young observed on Saddle Mountain and on Castor and Pollux peaks during recent years. Mountain goats have not been surveyed in the park since 2014 due to both poor flying conditions for survey aircraft and budgetary constraints.

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Quick Facts

Nonnative species

Number in Yellowstone

200–300 in and adjacent to Yellowstone.

Where to See

- Infrequently seen; northeastern and northwestern portions of the park in alpine habitat.
- Winter: steep, south-facing slopes, windblown ridge tops; Spring: south- and west-facing cliffs; Summer: meadows, cliffs, ravines, and forests.

Behavior and Size

- Mature male (billy) weighs 300 or more pounds; female (nanny) weighs 150 pounds.
- Young (kids) born in late May–June.
- Females usually begin to breed at 2½ years.
- Live in precipitous terrain.
- Both sexes have horns; females' horns curve less and are thinner and sometimes longer than males.

Staff Reviewer

Travis Wyman, Biological Technician



Elk

Yellowstone provides summer range for an estimated 10,000–20,000 elk (*Cervus canadensis*) from six to seven herds, most of which winter at lower elevations outside the park. These herds provide visitor enjoyment as well as revenue to local economies through hunting outside the park. As Yellowstone’s most abundant ungulate, elk comprise approximately 85% of winter wolf kills and are an important food for bears, mountain lions, and at least 12 scavenger species, including bald eagles and coyotes. Competition with elk can influence the diet, habitat selection, and demography of bighorn sheep, bison, moose, mule deer, and pronghorn. Elk browsing and nitrogen deposition can affect vegetative production, soil fertility, and plant diversity. Thus, changes in elk abundance over space and time can alter plant and animal communities in Yellowstone.

Description

Elk are the most abundant large mammal found in Yellowstone. European American settlers used the word “elk” to describe the animal, which is the word used in Europe for moose (causing great confusion for European visitors). The Shawnee word “wapiti,” which means “white deer” or “white-rumped deer,” is another name for elk. The North American elk is considered the same species as the red deer of Europe.

Due to their huge antlers, bull elk are one of the most photographed animals in Yellowstone. Bull elk begin growing their first set of antlers when they are about one year old. Antler growth is triggered in spring by a combination of two factors: a depression of testosterone levels and lengthening daylight. The first result of this change is the casting or shedding



Bull elk grow antlers for the fall mating season and keep them through the winter. The antlers fall off for the new year’s growth.

of the previous year’s “rack.” Most bulls drop their antlers in March and April. New growth begins soon after.

Growing antlers are covered with a thick, fuzzy coating of skin commonly referred to as “velvet.” Blood flowing in the skin deposits calcium that makes the antler. Usually around early August, further hormonal changes signal the end of antler growth, and the bull begins scraping the velvet off, polishing and sharpening the antlers in the process.

The antler-growing period is shortest for yearling bulls (about 90 days) and longest for healthy, mature bulls (about 140 days). Roughly 70% of the antler growth takes place in the last half of the period, when the antlers of a mature bull will grow two-thirds of an inch each day. The antlers of a typical, healthy bull are 55–60 inches long, just under six feet wide, and weigh about 30 pounds per pair.

Quick Facts

Number in Yellowstone

- Summer: 10,000–20,000 elk in six to seven different herds.
- Winter: <4,000.

Where to See

- Summer: Cascade Meadows, Madison Canyon, and Lamar Valley.
- Autumn, during “rut” or mating season: northern range, including Mammoth Hot Springs; Madison River.

- Winter: migrate north to the northern range and around Gardiner, Montana; south to the Jackson Hole Elk Refuge in Jackson, Wyoming.

Size and Behavior

- Males (bulls) weigh ~700 pounds and are ~five feet high at the shoulder; females (cows) weigh ~500 pounds and are shorter; calves are ~30 pounds at birth.
- Bulls have antlers, which begin growing in the spring and usually

drop in March or April of the following year.

- Feed on grasses, sedges, other herbs and shrubs, bark of aspen trees, conifer needles, burned bark, aquatic plants.
- Mating season (rut) in September and October; single calves born in May to late June.

Elk Antlers

Antlers are usually symmetrical and occur on males and, only rarely, females.

- The average, healthy, mature bull has six tines on each antler, and is known in some parts of the US as a “six point” or “six by six.”
- One-year-old bulls grow 10–20-inch spikes, sometimes forked.
- Two-year-old bulls usually have slender antlers with four to five points.
- Three-year-old bulls have thicker antlers.
- Four-year-old and older bulls typically have six points; antlers are thicker and longer each year.
- Eleven- or 12-year-old bulls often grow the heaviest antlers; after that age, the size of antlers generally diminishes.

Horns vs. Antlers

Antlers, found on members of the deer family, grow as an extension of the animal's skull. They are true bone, are a single structure, and, generally, are found only on males. Horns, found on pronghorn, bighorn sheep, and bison, are a two-part structure. An interior portion of bone (an extension of the skull) is covered by an exterior sheath grown by specialized hair follicles (similar to human fingernails). Horns are usually found on both males and (in a diminutive form) females. Antlers are shed and regrown yearly while horns are never shed and continue to grow throughout an animal's life. One exception is the pronghorn, which sheds and regrows its horn sheath each year.

Bulls retain their antlers through the winter. When antlered, bulls usually settle disputes by wrestling with their antlers. When antlerless, they use their front hooves (as cows do), which is more likely to result in injury to one of the combatants. Because bulls spend the winter with other bulls or with gender-mixed herds, retaining antlers means fewer injuries sustained overall. Also, bulls with large antlers that are retained longer are at the top of elk social structure, allowing them preferential access to feeding sites and mates.

Mating Season

The mating season (rut) generally occurs from early September to mid-October. Elk gather in mixed herds—many females and calves, with a few bulls nearby. Bulls bugle to announce their availability and fitness to females and to warn and challenge other bulls. When answered, bulls move toward one another and sometimes engage in battle for access to the cows. They crash their antlers together, push each



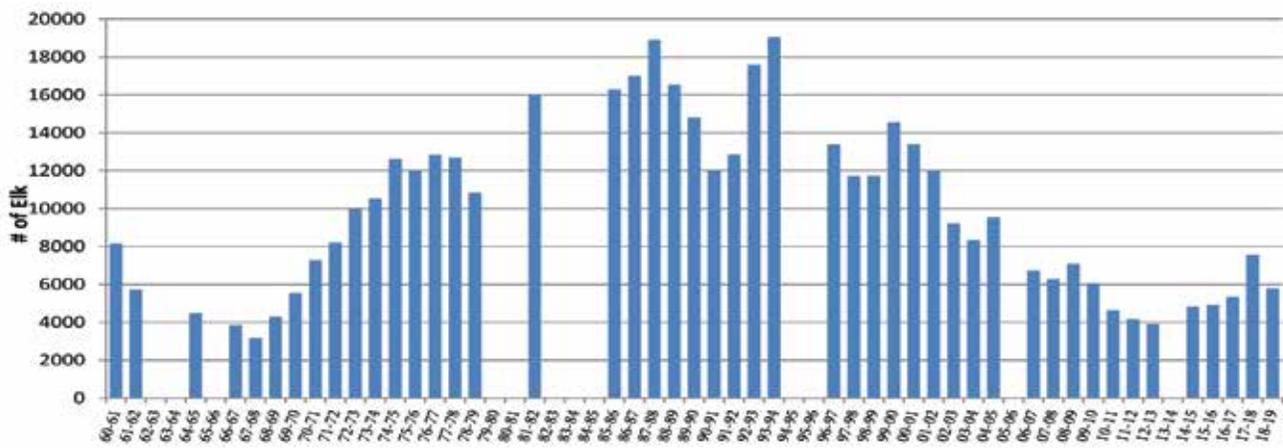
Elk calves can walk within an hour of birth, but they spend much of their first week to 10 days bedded down between nursing sessions.

other intensely, and wrestle for dominance. While loud and extremely strenuous, fights rarely cause serious injury. The weaker bull ultimately gives up and wanders off.

Calves are born in May and June. They are brown with white spots and have little scent, providing them with good camouflage from predators. They can walk within an hour of birth, but they spend much of their first week to 10 days bedded down between nursing sessions. Soon after, they begin grazing with their mothers, and join a herd of other cows and calves. Up to two-thirds of each year's calves may be killed by predators. Elk calves are food for black and grizzly bears, wolves, coyotes, cougars, and golden eagles. Female elk can live 17–18 years. Rare individuals may live 25 years.

Population

The high elevation grasslands of the park provide summer habitat for 10,000–20,000 elk. However, fewer than 4,000 elk spend winter in the park. Climate is an important factor affecting the size and distribution of elk herds. Many ungulates migrate to increase their access to high-quality food. They prefer to feed on young plants, which are the most nutritious. In winter, colder temperatures and snowfall decrease the amount of forage that grows, which means less forage is accessible to wildlife. This forces elk to migrate to areas where forage is more available. The timing and routes of northern Yellowstone elk migration closely follow the areas of seasonal vegetation growth and changes in snow depth. After



Winter counts of the northern range elk herd in Yellowstone National Park and adjacent areas of Montana, 1960–2019. Counts are not adjusted for visibility, and gaps represent years where no official count was conducted.

winters with high snowpack, elk delay migration. In years with lower snowpack and earlier vegetation green-up, elk migrate earlier.

Ungulates that migrate typically give birth around periods of peak vegetation green-up to overlap with high-nutrition plant phases. Nutritious food allows mothers and calves to build up fat reserves. Changes in climate will undoubtedly impact newborn elk, but it is difficult to predict whether that impact will be positive or negative. Earlier spring could lead to a longer snow-free season where migration and access to food are not encumbered. However, a longer growing season, without increased access to high-quality forage, might have a negative impact. Warmer temperatures could increase the rate of green-up, causing the plants to complete their growth cycle faster, thus shortening the period of time that food is available and accessible. Also, earlier spring could result in a mismatch in the timing of calving and the date of peak plant nutrition, resulting in high mortality of newborn calves.

Elk on the northern range

Yellowstone’s largest elk herd winters along and north of the park’s winter boundary. With more moderate temperatures and less snowfall than the park interior, this area can support large numbers of wintering elk. The herd winters in the area of the Lamar and Yellowstone river valleys from Soda Butte to Gardiner, Montana. Currently, the majority of the northern herd migrates outside of the park into the Custer Gallatin National Forest and onto private land.

After decades of debate over whether this range was overgrazed by too many elk, public concern has shifted to the herd’s small size. The winter count,

which was approximately 17,000 when wolf reintroduction began in 1995, fell below 10,000 in 2003. It fluctuated between 6,000 and 7,000 as the wolf population on the park’s northern range declined from 94 in 2007 to 50 by the end of 2015. The elk count dropped to 3,915 in early 2013, the lowest since culling ended in the park in the 1960s. However, the January 2018 aerial survey counted 7,579 elk on the northern range, including elk that reside both inside YNP and just north of the park but still on winter range. This count was 29% higher than the 2017 survey results of 5,349 elk, and was 48% higher than the 2013 low. In 2019, interagency biologists counted 5,800 elk. While these raw counts do not account for factors known to influence number of elk counted (e.g., snow cover, group size, sightability of elk across habitat types), these recent trends in minimum count estimates suggest herd size has stabilized or is even increasing. Decreased numbers have been attributed to large carnivore recovery (wolves, cougars, bears), hunter harvest, and drought-related effects on pregnancy and survival. The State of Montana has reduced the permits issued for this herd so that hunting of females now has little impact on population size.

There are some indications that elk–carnivore interactions are contributing to a release of willows and other woody vegetation from the effects of herbivory on the northern range. Carnivores play some role in altering elk behavior, group size, habitat selection, movements, and distribution; while the proportion of browsed aspen, cottonwood, and willow leaders has decreased in some areas during recent years, and cottonwood and willow heights have increased significantly. Others argue that lower elk densities over

the past two decades—resulting from the combined effects of predators (wolves, cougars, bears), human hunters, and weather—has necessarily altered the impact of elk browsing. Research is under way to determine the relative effects of climate, hydrology, carnivore predation/avoidance, and herbivory on these woody species.

Elk in the Interior

Only one herd lives both winter and summer inside the park. The Madison–Firehole elk herd (fewer than 100 animals) has been the focus of a research study since November 1991. Researchers are examining how environmental variability affects ungulate reproduction and survival. Prior to wolf restoration, the population was naturally regulated by severe winter conditions to a degree not found in other, human-hunted elk herds. The elk are also affected by high fluoride and silica levels in the water and plants they eat, which affect enamel formation and wear out teeth quickly—thus shortening their lives. The typical life span is 13 years; elk on the northern range regularly live to about 18 years. Information gained in this study will be useful in comparing non-hunted and hunted elk populations.

Elk in the Greater Yellowstone Ecosystem

The Greater Yellowstone Ecosystem is home to approximately 30,000–40,000 elk. For the last decade, the Jackson herd, which currently numbers about 11,000, has been larger than the northern Yellowstone herd. Some ranges and migratory routes overlap, and some interchange occurs among the herds. Summer range in the southern part of Yellowstone National Park is used by part of the Jackson herd as well as by elk from the North Fork Shoshone and northern Yellowstone herds. Because the wildlife responsibilities of the National Park Service, the US Fish and Wildlife Service, the US Forest Service, and state wildlife agencies coincide, elk management in Greater Yellowstone requires substantial coordination among government agencies with different priorities.

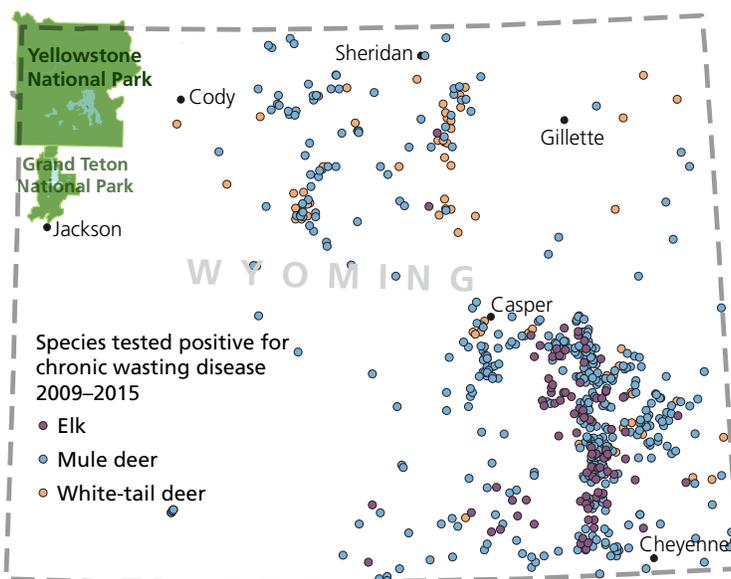
Disease in Greater Yellowstone

Brucellosis

Many elk and bison in the Greater Yellowstone Ecosystem have been exposed to the bacterium that causes brucellosis. Brucellosis is a contagious bacterial disease that originated in livestock and often causes infected cows to abort their first calves. It is transmitted primarily when susceptible animals directly contact infected birth material. No cure exists for brucellosis in wild animals. For more information about brucellosis, see “Bison.”

The prevalence of brucellosis in Yellowstone elk is low; the rate of exposure to brucellosis in 100 adult female elk captured on the park’s northern range during the winters of 2000 to 2005 was 2%; it was 3% in 130 neonatal elk on the park’s northern range during the summers of 2003–2005; and it was 3% in 73 adult female elk captured in the park’s Madison–Firehole drainages during the winters of 1996–1998. Elk are commonly observed within 100 yards of bison during late winter and spring when brucellosis-induced abortion or calving occurs in Yellowstone.

Because of their high densities, elk that are fed in winter have sustained high levels of brucellosis; winter feeding on the northern range stopped more than 50 years ago. Elk are fed during the winter at the National Elk Refuge in Jackson, Wyoming, in addition to 22 Wyoming-run feed grounds. The feed grounds were created in the 1900s to maintain Wyoming’s elk herds and limit depredation as



Individual cases of chronic wasting disease, by species, recorded in Wyoming from 2009–2015.

migratory routes from summer range to lower elevation winter ranges became blocked by settlement in the Jackson area. Transmission of brucellosis from feed ground elk, where an average of 30% have tested positive for exposure to the bacteria, was the apparent source of infection in Wyoming cattle in 2004.

Chronic Wasting Disease

Elk, deer, and moose in and near Yellowstone National Park are at risk for infection by chronic wasting disease (CWD). This fatal infection, transmitted by animal contact or through the environment, has spread to within 10 miles of the park. National Park Service staff and partners will continue surveillance and, if necessary, take action to minimize both transmission of the disease and the effects of intervention on the elk population and other park resources.

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Staff Reviewer

Dan Stahler, Wildlife Biologist



Moose

Yellowstone moose are the smallest of four subspecies of moose (*Alces alces shirasi*) in North America. Found in forested areas and willow flats from southeastern British Columbia to southern Colorado, they are better adapted to survival in deep snow than other ungulates in Greater Yellowstone. Except during the rut, moose are usually found alone or in small family groups. This behavior, and their use of habitat where they are often well concealed, impedes accurate estimates of population size and distribution.

Description

Moose are the largest members of the deer family in Yellowstone. Both sexes have long legs that enable them to wade into rivers and through deep snow, to swim, and to run fast. Moose, especially cows with calves, are unpredictable and have chased people in the park.

Moose are dark brown, often with tan legs and muzzle. Bulls have antlers for most of the year, or pedicles (flat bony protrusions on the skull) in the winter after antlers are cast. Females are distinguished from bulls without antlers by the white patch beneath their tail. Adults of both sexes have “bells”—a pendulous dewlap of skin and hair that dangles from the throat. Bulls urinate in wallows and lay down and splash in it spreading the scent all over them. The dewlap holds the scent that is then dispersed by the wind.

Quick Facts

Number in Yellowstone

- Fewer than 200
- Population has declined in past 40 years due to loss of old-growth forests surrounding the park, hunting outside the park, burning of habitat, and predators.

Where to See

- Marshy areas of meadows, lake shores, and along rivers.

Behavior and Size

- Adult male (bull) weighs close to 1,000 pounds; female (cow) weighs up to 900 pounds; 5½ to 7½ feet at the shoulder. Young weigh 25–35 pounds at birth.
- Usually alone or in small family groups.
- Mating season peaks in late September and early October; one or two calves born in late May or June.
- Lives up to 20 years.



Bull moose usually shed their antlers in the beginning of winter to help conserve energy and survive the winter.

In summer, moose eat aquatic plants like water lilies, duckweed, and burweed. But the principle staples of the moose diet are the leaves and twigs of the willow, followed by other woody browse species such as gooseberry and buffaloberry. In winter when available, moose exhibit a high preference to subalpine fir. An adult moose consumes approximately 10–12 pounds of food per day in the winter and as much as 50 pounds of food per day in the summer.

Some moose that summer in the park migrate in winter to lower elevations west and south of Yellowstone where willow remains exposed above the snow. But many moose move to higher elevations (as high as 8,500 feet) to winter in mature stands of subalpine fir and Douglas-fir.

During the rut, both bulls and cows are vocal. Cows emit a drawn out groan in search of a mate, and bulls challenge one another with low guttural and repetitive grunts before clashing with their antlers. The weaker bull usually gives up before any serious damage is done; on rare occasions the opponent’s antlers inflict a mortal wound.

Bulls usually shed their antlers in late December to late January, although young bulls may retain their antlers as late as March. Shedding their heavy antlers helps moose conserve energy and promotes easier

winter survival. In April or May, bulls begin to grow new antlers. Small bumps called pedicles on each side of the forehead start to swell, then enlarge until they are knobs covered with a black fuzz (called velvet) and fed by blood that flows through a network of veins. Finally, the knobs change into antlers and grow until August. The antlers are flat and palmate (shaped like a hand). Yearlings grow six- to eight-inch forked antlers; prime adult bulls usually grow the largest antlers—as wide as five feet from tip to tip. When the antlers reach their full size, the bull rubs his antlers on small trees and brush to remove the velvet and polish the antlers in preparation for the rut. Cows breed in early fall; gestation is approximately eight months. Cows most commonly give birth to a single calf in Yellowstone.

Population

Moose appear to have been scarce in Yellowstone until the latter half of the 1800s and in Jackson Hole until the early 1900s. The first documented report of a moose on the northern range was 1913. Predator-control programs, forest-fire suppression, and restrictions on moose hunting contributed to their subsequent range expansion and increased numbers.

Forest-fire suppression was probably the most important factor in moose population increase because moose in Greater Yellowstone depend on mature spruce/fir forests for winter survival, unlike other North American moose populations that prefer large willow flats or shrubland that has been created by events like fires or logging.

The Yellowstone moose population has declined from roughly 1,000 in the 1970s to about 200 in 1996 (the most recent data), with the northern range population down by at least 75% since the 1980s. The population declined steeply following the fires of 1988 that burned mature fir forests. Many old moose died during the winter of 1988–89, probably as a combined result of the loss of good moose winter forage and a harsh winter. Large populations of elk and bison, which also browse willow, likely reduce the amount of willow forage available for moose. Unlike moose habitat elsewhere, northern Yellowstone does not have woody browse species that will come in quickly after a fire and extend above the snowpack to provide winter food.

Recent studies south of the park also suggest that fire on the summer ranges of migratory moose is partially responsible for the population decline. The

population of moose that uses burned areas is declining more rapidly than the portion of the population that forages in unburned areas.

Predation of moose calves by bear and wolf populations may be limiting population growth, but the low pregnancy rates of greater Yellowstone moose suggest limits set by food availability. Long-term studies suggest that North American moose populations tend to erupt, crash, and then stabilize for a time.

Montana has noted a state-wide decline in moose populations. Moose hunting in the districts immediately north of Yellowstone has been limited to antlered bulls since 1996. Only two permits were issued in those districts in 2014. In 2012, Montana Fish, Wildlife and Parks began a study to assess and monitor the population across the state. A three-year northern Yellowstone National Park moose study was recently completed between the winters of 2013–2014 and 2015–2016 with the main objective to estimate population abundance and vital statistics of northern Yellowstone moose. Population modeling based on fecal DNA determined that there are between 149 and 168 moose on the northern range inside Yellowstone and that the annual population-growth rate is 4%, (considered moderate growth). However, because mature conifer forest (important wintering habitat) were reduced by the 1988 fires and large populations of elk and bison compete with moose for willow browse, northern YNP moose will likely persist at a low density. Today, moose are most likely seen in the park's southwestern corner and in the Soda Butte Creek, Pelican Creek, Lewis River, and Gallatin River drainages.

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Staff Reviewer

Dan Stahler, Wildlife Biologist

Deer

The Greater Yellowstone Ecosystem is home to both mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*). The mule deer, also called blacktail deer, is an exclusively western species commonly seen in open-brush country throughout the western states. Widely dispersed throughout Yellowstone National Park during the summer, mule deer migrate seasonally, and most of the population winters outside of the park. Although the white-tailed deer is the most common deer species throughout North America, it has never been abundant in Yellowstone. This may be due to habitat and elevation constraints on the northern range or competition from other ungulates that are better suited to park habitat. The two species are differentiated by their antler shape and tail size and appearance.

Behavior

All species of deer use their hearing, smell, and sight to detect predators such as coyotes, cougars, or wolves. They probably smell or hear the approaching predator first, then may raise their heads high and stare hard, rotating ears forward to hear better. If a deer hears or sees movement, it flees.

Population

In 2018, aerial surveys detected 1,996 mule deer in the Gardiner Basin area and across the northern range of Yellowstone Park. This was the highest population count since 2009, and above the ten-year average of 1,901. Deer population numbers have increased each year since a low in 2012 following a severe winter. In 2018, recruitment was 29 fawns per 100 adults, lower than the long-term average of 41 fawns per 100 adults. This likely reflects fawn mortality from harsh winter conditions during 2017–18 on mule deer range in and outside Yellowstone National Park.

While the relative distribution of mule deer across their winter range has remained similar over the past two decades, the population appears to cyclically increase and decrease. Mule deer populations may decline during severe winters, when deep snow and extremely cold temperatures make foraging difficult, thereby increasing starvation and predation susceptibility.

Although researchers estimate that northern Yellowstone has a summer mule deer population

Mule Deer



Number in Yellowstone

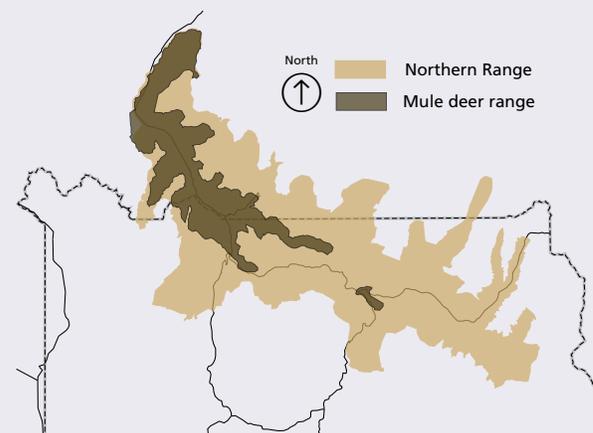
Summer: 1,850–1,900; winter: fewer than 400

Where to See

Summer: throughout the park; Winter: North Entrance area.

Size and Behavior

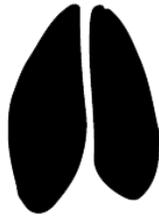
- Male (buck): 150–250 pounds; female (doe): 100–175 pounds; 3½ feet at the shoulder.
- Summer coat: reddish; winter coat: gray-brown; white rump patch with black-tipped tail; brown patch on forehead; large ears.
- Males grow antlers from April or May until August or September; shed them in late winter and spring.
- Mating season (rut) in November and December; fawns born late May to early August.
- Lives in brushy areas, coniferous forests, grasslands.
- Bounding gait, when four feet leave the ground, enables it to move more quickly through shrubs and rock fields.
- Eats shrubs, forbs, grasses; conifers in spring.
- Predators include wolves, coyotes, cougars, and bears.



Mule deer winter range lies primarily north of the park boundary.

of 1,850 to 1,900, fewer than several hundred stay in the park all winter. Unlike elk and bison, many of which remain in the park throughout the year, mule deer are preyed upon by wolves, coyotes, cougars, and bears in the park mostly in the summer. Because of the mule deer's seasonal distribution, the relative scarcity of white-tailed deer, and the abundance of elk, which are the main prey of wolves, wolf recovery in Yellowstone is believed to have had little effect on deer populations and recruitment.

Although the primary causes of deer mortality are winter kill and predation, mule deer and white-tailed deer outside the park are subject to state-regulated harvesting in the fall. Because of their scarcity, little is known about the white-tailed deer that inhabit the northern range, and the population within the park is not monitored.



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White-tailed Deer



Number in Yellowstone

Scarce, not monitored

Where to See

Along streams and rivers in the northern range.

Size and Behavior

- Adults 150–250 pounds; 3½ feet at the shoulder.
- Summer coat: red-brown; winter coat: gray-brown; throat and inside ears with whitish patches; belly, inner thighs, and underside of tail white.
- Waves tail like a white flag when fleeing.
- Males grow antlers from May until August; shed them in early to late spring.
- Mating season (rut) peaks in November; fawns born usually in late May or June.
- Eats shrubs, forbs, grasses; conifers in spring.
- Predators include wolves, coyotes, cougars, and bears.

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Staff Reviewer

Travis Wyman, Biological Technician

Pronghorn

The North American pronghorn (*Antilocapra americana*) is the surviving member of a group of animals that evolved in North America during the past 20 million years. It is not a true antelope, which is found in Africa and southeast Asia. The use of the term “antelope” seems to have originated when the first written description of the animal was made during the 1804–1806 Lewis and Clark Expedition.

Description

The pronghorn has true horns made of modified, fused hair that grows over permanent bony cores. Their horns differ from those of other horned animals in two major ways: the sheaths are shed and grown every year, and they are pronged. (A number of other horned mammals occasionally shed their horns, but not annually.) Adult males typically have 10–16-inch horns that are curved at the tips. About 70% of the females also have horns, but theirs average one to two inches long and are not pronged. The males usually shed the horny sheaths in November or December and begin growing the next year’s set in February or March. The horns reach maximum development in August or September. Females shed and regrow their horns at various times.

Pronghorn are easy to distinguish from the park’s other ungulates. Their deer-like bodies are reddish-tan on the back and white underneath, with a large white rump patch. Their eyes are very large, which provides a large field of vision. Males also have a black cheek patch.



Pronghorn evolved in North America 20 million years ago. They can run sprints at 45–50 miles per hour, an adaptation to outrun an extinct cheetah.

Behavior

Females that bred the previous fall commonly deliver a set of twins in May or June. The newborn fawns are uniform grayish-brown and weigh six to nine pounds. They walk within 30 minutes of birth and are capable of outrunning a human in a couple of days. The young normally stay hidden in the vegetation while the mother grazes close by. After the fawns turn three weeks old, they begin to follow the females as they forage. Several females and their young join together in nursery herds, along with yearling females.

For increased protection against predators, pronghorn form groups. When one individual detects danger, it flares its white rump patch, signaling the others to flee. The pronghorn is adapted well for outrunning its enemies—its oversized windpipe and heart allow

Quick Facts

Number in Yellowstone

505 in April 2018. Highest count since 1992:536.

Where to See

- Summer: Lamar Valley; some may be near the North Entrance at Gardiner, Montana.
- Winter: between the North Entrance and Reese Creek.

Behavior and Size

- Male (buck) weighs 100–125 pounds; female (doe) weighs 90–110 pounds; adult length is 45–55 inches and height is 35–40 inches at shoulder.
- Average life span: 7–10 years.

- Young (fawns) born in late May–June.
- Live in grasslands.
- Can run for sustained sprints of 45–50 mph.
- Eat sagebrush and other shrubs, forbs, some grasses.
- Both sexes have horns; males’ horns are pronged.

History

- Prior to European American settlement of the West, pronghorn population estimated to be 35 million.
- Early in the 1800s, pronghorn were

abundant in river valleys radiating from Yellowstone; settlement and hunting reduced their range and numbers.

- Park management also culled pronghorn during the first half of the 1900s due to overgrazing concerns.

Management Concerns

- Pronghorn are a species of special concern in the park.
- This small population could face extirpation from random catastrophic events such as a severe winter or disease outbreak.

large amounts of oxygen and blood to be carried to and from its unusually large lungs. Pronghorn can sustain sprints of 45–50 mph. Such speed, together with keen vision, make the adults difficult prey for any natural predator. Fawns, however, can be caught by coyotes, bobcats, wolves, bears, and golden eagles.

The pronghorn breeding season begins mid-September and extends through early October. During the rut, the older males “defend” groups of females (called a harem). They warn any intruding males with loud snorts and wheezing coughs. If this behavior does not scare off the opponent, a fight may erupt. The contenders slowly approach one another until their horns meet; then they twist and shove each other. Eventually, the weaker individual will retreat. Although the fights may be bloody, fatalities are rare.

The most important winter foods are shrubs like sagebrush and rabbitbrush; pronghorn eat succulent forbs during spring and summer. They can eat lichens and plants such as locoweed, lupine, and poisonvetch that are toxic to some ungulates. Their large liver (proportionately, almost twice the size of a domestic sheep’s liver) may be able to remove plant toxins from the bloodstream. Grasses appear to be the least-used food item, but may be eaten during early spring when the young and tender shoots are especially nutritious.

During winter, pronghorn form mixed-sex- and -age herds. In spring, they split into smaller bands of females, bachelor groups of males between one and five years old, and solitary older males. The small nursery and bachelor herds may forage within home ranges of 1,000 to 3,000 acres while solitary males roam smaller territories (60 to 1,000 acres in size). Pronghorn, including three-fourths of the individuals



Pronghorn fawns are very vulnerable to predation in their first half-hour of life. However, within two days of birth, fawns can outrun a human being, and they pick up speed as they grow.

in Yellowstone, migrate between different winter and summer ranges to more fully utilize forage within broad geographic areas.

Population

During the early part of the 1800s, pronghorns ranked second only to bison in numbers, with an estimated 35 million throughout the West. The herds were soon decimated by conversion of rangeland to cropland, professional hunters who sold the meat, and ranchers who believed that pronghorns were competing with livestock for forage. Today, due to transplant programs and careful management, pronghorns roam the sagebrush prairies in herds totaling nearly 500,000 animals.

The pronghorn’s population fluctuations on the northern range show the effects of management interventions as well as natural shifts in forage availability, competition with elk, and predation. Efforts to keep pronghorn in the park with fences and winter feeding reduced their abundance and use of migratory routes by the 1920s, and about 1,200 pronghorn were removed from 1947 to 1967 to address perceived sagebrush degradation. Complaints about crop depredation led to the removal of about 190 pronghorn on private land from 1985 to 2002. The reason for the sudden population decline in the early 1990s remains unclear, but fawn survival appears to have been low. This was probably due to coyote predation and reduction of winter range north of the park through development by private land owners. Pronghorn winter range inside the park is former agricultural land infested with nonnative vegetation of low nutritional quality.



Reduction of pronghorn winter range north of the park through development by private land owners, likely contributed to populations declines in the 1990s.

Since the mid 2000's, the pronghorn population has seen a steady rebound in population, and since 2012, the population has recovered to the highest population estimates since the early 1990's. Removal of fences and better forage availability in areas adjacent to Yellowstone National Park appear to have reduced predation factors on pronghorn on the winter range, and those are some of the factors attributed to increases in pronghorn numbers. Outside Yellowstone National Park, a limited pronghorn hunt was re-established in response to population increases beginning in 2016. Since the early 2000's, evidence of migration and dispersal into Paradise Valley as well as mixing with pronghorn herds outside the park, indicate long-term viability of the Yellowstone population. Research continues to search for answers concerning the Yellowstone pronghorn herd. This small population continues to be susceptible to extirpation from random catastrophic events, such as a severe winter or disease outbreaks.

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Staff Reviewer

Travis Wyman, Biological Technician



Wolves

Although wolf packs once roamed from the Arctic tundra to Mexico, loss of habitat and extermination programs led to their demise throughout most of the United States by the early 1900s. In 1973, the US Fish and Wildlife Service (FWS) listed the northern Rocky Mountain wolf (*Canis lupus*) as an endangered species and designated Greater Yellowstone Ecosystem (GYE) as one of three recovery areas. From 1995 to 1997, 41 wild wolves from Canada and northwest Montana were released in Yellowstone. As expected, wolves from the growing population dispersed to establish territories outside the park, where they are less protected from human-caused mortalities. The park helps ensure the species' long-term viability in GYE and has provided a place for research on how wolves may affect many aspects of the ecosystem. January 12, 2020 marks the 25th year anniversary since wolves returned to Yellowstone.

Description

Wolves are highly social animals and live in packs. Worldwide, pack size will depend on the size and abundance of prey. In Yellowstone, average pack size is 10 individuals. The pack is a complex social family, with older members (often the alpha male and alpha female) and subordinates, each having individual personality traits and roles within the pack. Packs defend their territory from other, invading packs by howling and scent-marking with urine. Research in Yellowstone since reintroduction has highlighted the adaptive value of social living in wolves—from



Members of the Delta pack, November 2013.

cooperative care of offspring, group hunting of large prey, defense of territory and prey carcasses, and even survival benefits to infirmed individuals.

Wolves consume a wide variety of prey, large and small. They efficiently hunt large prey that other predators cannot usually kill. In Yellowstone, 90% of their winter prey is elk; 10–15% of their summer prey is deer. They also kill bison.

Many other animals benefit from wolf kills. For example, when wolves kill an elk, ravens and magpies arrive almost immediately. Coyotes arrive soon after, waiting nearby until the wolves are sated. Bears will attempt to chase the wolves away, and are usually successful. Many other animals—from eagles to invertebrates—consume the remains.

Since reintroduction, genetic studies have evaluated Yellowstone wolves' genetic health, kinship within and between packs, connectivity with other Northern Rocky mountain populations, and even genes linked to physical and behavioral traits. One

Quick Facts

Number

- An estimated 528 wolves resided in the Greater Yellowstone Ecosystem as of 2015.
- As of January 2020, there are at least 94 wolves in the park. Eight packs were noted.
- In general, wolf numbers have fluctuated between 83 and 108 wolves since 2009.

Where to See

- They inhabit most of the park; peak activity is at dawn and dusk.
- The northern range of Yellowstone is one of the best places in the world to watch wolves.

Size and Behavior

- 26–36 inches tall at the shoulder, 4–6 feet long from nose to tail tip; males weigh 100–130 pounds, females weigh 80–110 pounds.
- Home range within the park is 185–310 square miles (300–500 km²); varies with pack size, food availability, and season.
- Average lifespan in the park is four to five years, average outside is two to three years. The oldest known wolf here was 12.5 years old.
- Two main color variations exist in Yellowstone in approximately equal proportions: black and gray.

- Prey primarily on hoofed animals. In Yellowstone, 90% of winter diet is elk; summer prey consist of more deer and smaller mammals.
- Mate in February; give birth to average of five pups in April after a gestation period of 63 days; young emerge from den at 10–14 days; pack remains at the den for three to ten weeks unless disturbed.
- Leading cause of death for wolves within the park is death by other wolves; leading cause of death for wolves outside the park is human-caused.

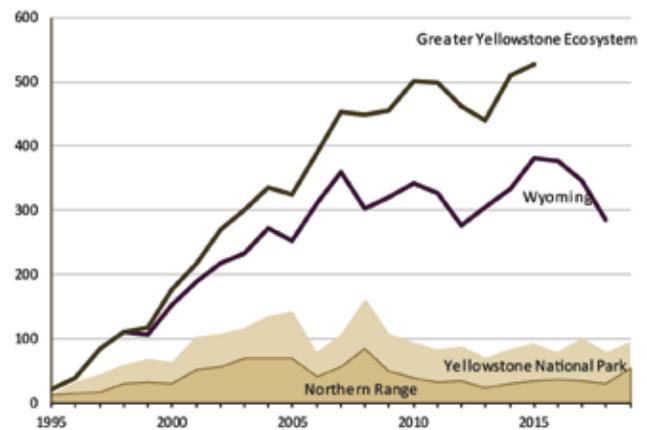


Historical and current range of gray wolves.

fascinating discovery involves coat color. About half of wolves in Yellowstone are dark black in color, with the other half mostly gray coats. The presence of black coats was due to a single gene (a beta defensin gene termed CBD103 or the K-locus), with all black coated individuals carrying a mutation linked to this coat color—a mutation believed to have originated in domestic dogs of the Old World. The origin of the K-locus in wolves likely came from hybridization between dogs and wolves in northwest North America within the last 7,000 years as early humans brought domestic dogs across the Bering Land Bridge. In Yellowstone, this discovery set the stage for studies that explored the link between coat color, reproduction, survival, and behavior. It was found that the K-locus gene is involved in immune function in addition to causing black coat color,



Wolves (back) are larger than coyotes (middle) and red foxes (front).



Greater Yellowstone wolf population, 1995–2019.

suggesting an additional role in pathogen defense. For example, black wolves have greater survivorship during distemper outbreaks. Another study found gray wolves to be more aggressive than black colored wolves during territorial conflict, as well as have higher reproductive success. During breeding season, there is also greater mate choice between opposite color male and female pairs compared to same colored pairs. Together, these data suggest fitness trade-offs between gray and black coat color, evidence for the maintenance of the black coat color in the population.

Changes in Their Prey

From 1995 to 2000, in early winter, elk calves comprised 50% of wolf prey, and bull elk comprised 25%. That ratio reversed from 2001 to 2007, indicating changes in prey vulnerability and availability. Although elk is still the primary prey, bison has become an increasingly important food source for wolves. While there is some predation on bison of all age classes, the majority of the consumption comes from scavenging winter-killed prey or bison

Interesting Wolf Behavior

Wolves kill each other and other carnivores, such as coyotes and cougars, usually because of territory disputes or competition for carcasses. In 2000, however, the subordinate female wolves of the Druid pack exhibited behavior never seen before: they killed their pack's alpha female; then they carried her pups to a central den and raised them with their own litters.

In 2019, a subordinate female wolf of the Junction Butte pack killed the pups of the pack's alpha female; then the rest of the pack raised the subordinate female's pups.



Wolves arrived in Yellowstone National Park via truck on January 12, 1995.

dying from injuries sustained during breeding season. The discovery of these changes emphasizes the importance of long-term monitoring to understand predator-prey dynamics. Changes in wolf predation patterns and impacts on prey species like elk are inextricably linked to other factors, such as other predators, management of ungulates outside the park, and weather (e.g. drought, winter severity). Weather patterns influence forage quality and availability, ultimately impacting elk nutritional condition. Consequently, changes in prey selection and kill rates through time result from complex interactions among these factors. Current National Park Service

(NPS) research focusses on the relative factors driving wolf predation over the past 25 years.

Population

In the first years following wolf restoration, the population grew rapidly as the newly formed packs spread out to establish territories with sufficient prey. The wolves have expanded their population and range, and now are found throughout the GYE.

Disease periodically kills a number of pups and old adults. Outbreaks of canine distemper occurred in 2005, 2008, and 2009. In 2005, distemper killed two-thirds of the pups within the park. Infectious canine

Wolf Restoration

The Issue

The wolf is a major predator that had been missing from the Greater Yellowstone Ecosystem for decades until its restoration in 1995.

History

- Late 1800s–early 1900s: predators, including wolves, are routinely killed in Yellowstone.
- 1926: The last wolf pack in Yellowstone is killed, although reports of single wolves continue.
- 1974: The gray wolf is listed as endangered; recovery is mandated under the Endangered Species Act.
- 1975: The long process to restore wolves in Yellowstone begins.
- 1991: Congress appropriates money for an EIS for wolf recovery.
- 1994: EIS completed for wolf reintroduction in Yellowstone and central Idaho. More than 160,000 public comments received—the largest number of public comments on any federal proposal at that time.

- 1995 and 1996: 31 gray wolves from western Canada relocated to Yellowstone.
- 1997: 10 wolves from northwestern Montana relocated to Yellowstone National Park; US District Court judge orders the removal of the reintroduced wolves in Yellowstone but stays his order, pending appeal. (Decision reversed in 2000.)
- 1995–2003: Wolves prey on livestock outside Yellowstone much less than expected: 256 sheep, 41 cattle are killed.
- 2005: Wolf management transfers from the federal government to the states of Idaho and Montana.
- 2008: Wolf populations in Montana, Idaho, and Wyoming removed from the endangered species list, then returned to the list.
- 2009: The US Fish and Wildlife Service again delisted wolf populations in Montana and

Idaho, but not in Wyoming. A legal challenge results in the Northern Rocky Mountain wolf population being returned to the federal endangered species list.

- 2011: Wolf populations were again delisted in Montana and Idaho by action of Congress, and the US Fish and Wildlife Service proposed delisting wolves in Wyoming.
- 2012: Based on a Congressional directive, wolves were delisted in Wyoming.
- 2014: Wolves were relisted in Wyoming.
- 2017: Wolves were delisted in Wyoming, and the Northern Rocky Mountain Distinct Population is no longer listed.

Current Status

- As of April 26, 2017, gray wolves are delisted in Montana, Idaho, and Wyoming.

hepatitis, canine parvovirus, and bordetella have also been confirmed among Yellowstone wolves, but their effects on mortality are unknown.

Sarcoptic mange, an infection caused by the mite *Sarcoptes scabiei*, reached epidemic proportions among northern range wolves in 2009. The mite is primarily transmitted through direct contact and burrows into the wolf's skin, which can initiate an extreme allergic reaction and cause the wolf to scratch the infected areas, resulting in hair loss and secondary infections. By the end of 2011, the epidemic had mostly subsided; however, the infection is still present at lower prevalences throughout the park.

Wolf packs are highly territorial and communicate with neighboring packs by scent-marking and howling. Occasionally packs encounter each other, and these interactions are typically aggressive. Larger packs often defeat smaller groups, unless the small group has more old adult or adult male members. Sixty-five percent of collared wolves are ultimately killed by rival packs.

The park's wolf population has declined substantially since 2007, when the count was 171. Most of the decrease has been in packs on the northern range, where it has been attributed primarily to the decline in the elk population and available territory. Canine distemper and sarcoptic mange have also been factors in the population decline.

Each year, park researchers capture a small proportion of wolves and fit them with radio tracking and GPS collars. These collars enable researchers to gather data on an individual, and also monitor the population as a whole to see how wolves are affecting other animals and plants within the park. Typically, at the end of each year, only 20% of the population is collared.

Wolves in the Northern Rocky Mountains have met the FWS's criteria for a recovered wolf population since 2002. As of December 2015, the US Fish & Wildlife Service estimated about 1,704 wolves and 95 breeding pairs in the Northern Rocky Mountain Distinct Population Segment.

The gray wolf was removed from the endangered species list in 2011 in Idaho and Montana. They were delisted in Wyoming in 2016, and that decision was held up on appeal in April 2017. Wolves are hunted in Idaho, Wyoming, and Montana under state hunting regulations.



A wolf is released from its cage into the pen in 1995. One of the reintroduction pens remains standing. Park managers are discussing whether it should be left as a historic site or taken down to return the site to its natural condition.

Wolf Restoration

History

In the 1800s, westward expansion brought settlers and their livestock into direct contact with native predator and prey species. Much of the wolves' prey base was destroyed as agriculture flourished. With the prey base removed, wolves began to prey on domestic stock, which resulted in humans eliminating wolves from most of their historical range. Predator control, including poisoning, was practiced in the park in the late 1800s and early 1900s. Other predators such as bears, cougars, and coyotes were also killed to protect livestock and "more desirable" wildlife species, such as deer and elk.

The gray wolf was present in Yellowstone when the park was established in 1872. Today, it is difficult for many people to understand why early park managers would have participated in the extermination of wolves. After all, the Yellowstone National Park Act of 1872 stated that the Secretary of the Interior "shall provide against the wanton destruction of the fish and game found within said Park." But this was an era before people, including many biologists, understood the concepts of ecosystem and the interconnectedness of species. At the time, the wolves' habit of killing prey species was considered "wanton destruction" of the animals. Between 1914 and 1926, at least 136 wolves were killed in the park; by the 1940s, wolf packs were rarely reported. By the mid-1900s, wolves had been almost entirely eliminated from the 48 states.

An intensive survey in the 1970s found no evidence of a wolf population in Yellowstone, although

an occasional wolf probably wandered into the area. A wolf-like canid was filmed in Hayden Valley in August 1992, and a wolf was shot just outside the park's southern boundary in September 1992. However, no verifiable evidence of a breeding pair of wolves existed. During the 1980s, wolves began to reestablish breeding packs in northwestern Montana; 50–60 wolves inhabited Montana in 1994.

In the 1960s, NPS wildlife management policy changed to allow populations to manage themselves. Many suggested at the time that for such regulation to succeed, the wolf had to be a part of the picture.

Also in the 1960s and 1970s, national awareness of environmental issues and consequences led to the passage of many laws designed to correct the mistakes of the past and help prevent similar mistakes in the future. One such law was the Endangered Species Act, passed in 1973. The FWS is required by this law to restore endangered species that have been eliminated, if possible. By 1978, all wolf subspecies were on the federal list of endangered species for the lower 48 states except Minnesota. (NPS policy also calls for restoration of native species where possible.)

Restoration Proposed

NPS policy calls for restoring native species when (a) sufficient habitat exists to support a self-perpetuating population, (b) management can prevent serious threats to outside interests, (c) the restored subspecies most nearly resembles the extirpated subspecies, and (d) extirpation resulted from human activities.

The FWS's 1987 Northern Rocky Mountain Wolf Recovery Plan proposed reintroduction of an "experimental population" of wolves into Yellowstone. An experimental population, under section 10(j) of the Endangered Species Act, is considered nonessential and allows more management flexibility. Most scientists believed that wolves would not greatly reduce populations of mule deer, pronghorns, bighorn sheep, white-tailed deer, or bison; they might have minor effects on grizzly bears and cougars; and their presence might cause the decline of coyotes and increase of red foxes.

In 1991, Congress provided funds to the FWS to prepare, in consultation with the NPS and the US Forest Service, an environmental impact statement (EIS) on the restoration of wolves. In June 1994, after several years and a near-record number of public comments, the Secretary of the Interior signed the Record of Decision for the final EIS for

reintroduction of gray wolves to Yellowstone and central Idaho.

Staff from Yellowstone, the FWS, and participating states prepared for wolf restoration to the park and central Idaho. The FWS prepared special regulations outlining how wolves would be managed as an experimental population.

Park staff completed site planning and archeological and sensitive-plant surveys for the release sites. Each site was approximately one acre enclosed with 9-gauge chain-link fence in 10 x 10-foot panels. The fences had a two-foot overhang and a four-foot skirt at the bottom to discourage climbing over or digging under the enclosure. Each pen had a small holding area attached to allow a wolf to be separated from the group if necessary (i.e., for medical treatment). Plywood boxes provided shelter if the wolves wanted isolation from each other.

Relocation and Release

In late 1994 and early 1995, and again in 1996, FWS and Canadian wildlife biologists captured wolves in Canada and relocated and released them in both Yellowstone and central Idaho. In mid-January 1995, 14 wolves were temporarily penned in Yellowstone; the first eight wolves on January 12, and the second six on January 19, 1995. Wolves from one social group were together in each acclimation pen. On January 23, 1996, 11 more wolves were brought to Yellowstone for the second year of wolf restoration.



Canadian and American wildlife biologists captured wolves in Canada and relocated and released them in both Yellowstone and central Idaho. Wolves were temporarily penned before their release.

Current Wolf Management

Wolves are managed by the appropriate state, tribal, or federal agencies. Management authority depends on current status and location of subpopulations.

Within Yellowstone National Park, no hunting of wolves is allowed. Outside the park, Montana, Idaho, and Wyoming regulate and manage hunting. Because wolves do not recognize political boundaries and often move between different jurisdictions, some wolves that live within the park for most of the year, but at times move outside the park, are taken in the hunts.

For current information about management of wolves around Yellowstone visit <https://www.fws.gov/mountain-prairie/es/grayWolf.php>

Four days later they were joined by another six wolves. The wolves ranged from 72 to 130 pounds and from approximately nine months to five years in age. They included wolves known to have fed on bison. Groups included breeding adults and younger wolves one to two years old.

Each wolf was radio-collared as it was captured in Canada. While temporarily penned, the wolves experienced minimal human contact. Approximately twice a week, they were fed elk, deer, moose, or bison that had died in and around the park. They were guarded by law enforcement rangers who minimized how much the wolves saw humans. The pen sites and surrounding areas were closed to visitation and marked to prevent unauthorized entry. Biologists checked on the welfare of wolves twice each week, using telemetry or visual observation while placing food in the pens. Although five years of reintroductions were predicted, no transplants occurred after 1996 because of the early success of the reintroductions.

Some people expressed concern about wolves becoming habituated to humans while in the acclimation pens. However, wolves typically avoid human contact. Confinement was also a negative experience for them and reinforced their dislike of human presence.

Results of the Restoration

Preliminary data from studies indicate that wolf recovery will likely lead to greater biodiversity throughout the GYE. Wolves have preyed primarily on elk, and these carcasses have provided food to a wide variety of other animals, especially scavenging species. Wolves are increasingly preying on bison, especially

in late winter. Grizzly bears have usurped wolf kills almost at will, contrary to predictions and observations from other areas where the two species occur. Wolf kills, then, provide an important resource for bears in low-food years. Aggression toward coyotes initially decreased the number of coyotes inside wolf territories, which may have benefited other smaller predators, rodents, and birds of prey.

So far, data suggest wolves are contributing to decreased numbers of elk calves surviving to adulthood and decreased survival of adult elk. Wolves may also be affecting where and how elk use the habitat. Some of these effects were predictable but were based on research in relatively simple systems of one to two predator and prey species. Such is not the case in Yellowstone, where four other large predators (black bears, grizzly bears, coyotes, and cougars) prey on elk—and people hunt the elk outside the park. Thus, interactions of wolves with elk and other ungulates have created a new degree of complexity that makes it difficult to project long-term population trends.

The effect of wolf recovery on the dynamics of northern Yellowstone elk cannot be generalized to other elk populations in the GYE. The effects depend on complex factors including elk densities, abundance of other predators, presence of alternative ungulate prey, winter severity, and—outside the park—land ownership, human harvest, livestock depredations, and human-caused wolf deaths. A coalition of natural resource professionals and scientists representing federal and state agencies, conservation organizations and foundations, academia, and land owners is collaborating on a comparative research program involving three additional wolf-ungulate



Wolf watchers at Slough Creek, one of the best places in the world to observe wild wolves.

systems in the western portion of the GYE. Results to date indicate the effects of wolf predation on elk population dynamics range from substantial to quite modest.

The Role of the Courts

Several lawsuits were filed to stop the restoration on a variety of grounds. These suits were consolidated, and in December 1997, the judge found that the wolf reintroduction program in Yellowstone and central Idaho violated the intent of section 10(j) of the Endangered Species Act because there was a lack of geographic separation between fully protected wolves already existing in Montana and the reintroduction areas in which special rules for wolf management apply. The judge wrote that he had reached his decision “with utmost reluctance.” He ordered the removal (specifically *not* the killing) of reintroduced wolves and their offspring from the Yellowstone and central Idaho experimental population areas, then immediately stayed his order, pending appeal. The Justice Department appealed the case, and in January 2000 the decision was reversed.

Legal Status of a Recovered Population

The biological requirements for removing the wolf from the endangered species list have been achieved: at least 300 wolves and three consecutive years of at least 30 breeding pairs across three recovery areas. The FWS approved wolf management plans in Idaho and Montana, and in 2008 it delisted wolves in these two states and in Yellowstone and Grand Teton national parks. Several environmental groups sued to stop the delisting, however. They successfully argued that the Wyoming wolf management plan was flawed and that genetic connectivity had not been established between the GYE and the other recovery areas. A court decision required the wolf to be listed again as an endangered species. In 2009, the FWS again delisted wolf populations in Montana and Idaho, but not in Wyoming. A legal challenge resulted in the Northern Rocky Mountain wolf population being returned to the federal endangered species list.

In 2011, wolf populations were again delisted in Montana and Idaho by an action of Congress. In 2012, a Congressional directive required the FWS to reissue its 2009 delisting, which stated that “if Wyoming were to develop a Service-approved regulatory framework it would be delisted in a separate rule” (74 FR 15123, April 2, 2009, p. 15155).

On September 30, 2012, wolves in Wyoming were delisted and began to be managed by the state under an approved management plan. However, on September 23, 2014, wolves were relisted in Wyoming following litigation over that management plan. On April 25, 2017, wolves were delisted following an appeal of the previous litigation decision by the US District Court. On April 25, 2017, wolves were delisted yet again following an appeal of the previous litigation decision by the US District Court. Wolves are now hunted in Montana, Wyoming, and Idaho during regulated seasons.

The FWS will continue to monitor the delisted wolf populations in Montana and Idaho for at least five years to ensure that they continue to sustain their recovery. The FWS may consider relisting the species, and even emergency relisting, if the available data demonstrate such an action is needed.

Wolves are now managed by the appropriate state, tribal, or federal agencies; management in national parks and national wildlife refuges continues to be guided by existing authorizing and management legislation and regulations.

Your Safety in Wolf Country

Wolves are not normally a danger to humans, unless humans habituate them by providing them with food. No wolf has attacked a human in Yellowstone, but a few attacks have occurred in other places.

Like coyotes, wolves can quickly learn to associate campgrounds, picnic areas, and roads with food. This can lead to aggressive behavior toward humans.

What You Can Do

- Never feed a wolf or any other wildlife. Do not leave food or garbage outside unattended. Make sure the door is shut on a garbage can or dumpster after you deposit a bag of trash.
- Treat wolves with the same respect you give any other wild animal. If you see a wolf, do not approach it.
- Never leave small children unattended.
- If you have a dog, keep it leashed.
- If you are concerned about a wolf—it’s too close, or is not showing sufficient fear of humans—do not run. Stop, stand tall, and watch what the wolf does. If it approaches, wave your arms, yell, flare your jacket. If it continues, throw something at it or use bear pepper spray. Group up with other people, and continue

waving and yelling.

- Report the presence of wolves near developed areas or any wolf behaving strangely.

To date, eight wolves in Yellowstone have become habituated to humans. Biologists successfully conducted aversive conditioning on some of them to discourage them from being close to humans, but two had to be killed.

Outlook

The future of wolves in GYE will depend on how livestock depredation and hunting of wolves outside the park are handled. Wolf populations will also continue to be affected by the availability of elk, deer, and bison, which fluctuates in response to hunting quotas, winter severity, and disease. To what extent wolves may have contributed to the decline in the northern Yellowstone elk population since the mid-1990s, or the possibly related resurgence of willow in some areas, is an ongoing topic of debate.



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Coyotes

Coyotes (*Canis latrans*) are intelligent and adaptable. They can be found throughout North and Central America, thriving in major urban areas as well as in remote wilderness. This adaptability helped coyotes resist widespread efforts early in the 1900s to exterminate them in the West, including in Yellowstone National Park, where other mid-size and large carnivores such as cougars and wolves were eradicated. The coyote is a common predator in Greater Yellowstone, often seen traveling through open meadows and valleys.

Description

Often mistaken for a wolf, the coyote is about one-third the wolf's size with a slighter build. Its coat colors range from tan to buff, sometimes gray, and with some orange on its tail and ears. Males are slightly larger than females.

During the 1900s, coyotes partially filled the niche left vacant after wolves were exterminated from the park. In Yellowstone, they lived in packs or family groups of up to seven animals. This social organization is characteristic of coyotes living in areas free



Coyotes are abundant throughout the park, and pup survival has increased. Coyotes may be killed by disease and vehicle-collisions as well as by other carnivores like wolves and cougars.

from human hunting. With the reintroduction of wolves, Yellowstone coyotes have returned to a more typical social organization—pairs with pups.

Coyotes, also known as “song dogs,” communicate with each other by a variety of long-range vocalizations. You may hear groups or lone animals howling, especially during dawn and dusk periods. Coyotes also mark with their scent (urine and feces) to communicate their location, breeding status, and territorial boundaries.

Quick Facts

Number in Yellowstone

Abundant

Where to See

Meadows, fields, other grasslands, and foraging for small mammals along roadways.

Size and Behavior

- Weigh 25–35 pounds, stand 16–20 inches high at the shoulder.
- Average life span six years; up to 13 years in the park.
- Home range: three to fifteen square miles.
- Primarily eat voles, mice, rabbits, other small animals, and carrion—and very young elk calves in the spring.
- Four to eight pups are born in April in dens; emerge in May.

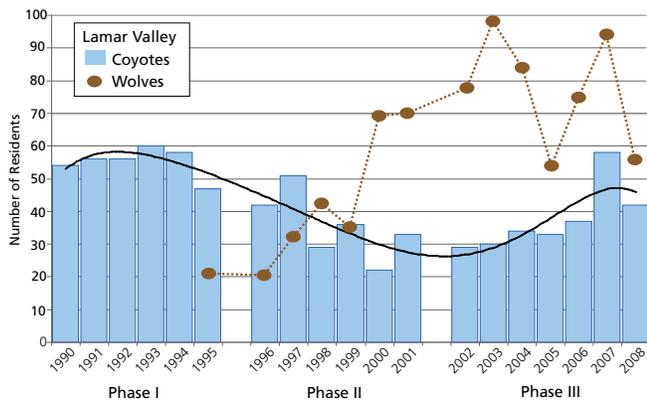
History

- Like other predators, coyotes were often destroyed in the early part of the 1900s because they sometimes preyed on livestock.
- Coyotes continued to thrive because their adaptability enabled them to compensate for the destruction efforts.
- Elimination of wolves probably resulted in high coyote population densities; wolves' absence opened a niche that coyotes could partially occupy in Yellowstone.

Population

Until 1995, coyotes faced few predators in Yellowstone other than cougars, who will kill coyotes feeding on cougar kills. After wolves were restored, however, dozens of coyote pups and adults were killed by wolves—primarily when feeding on other animals killed by wolves. After wolves were restored on the northern range, the coyote population decreased by as much as 50% as a result of competition for food, attacks by wolves, and loss of territory to wolves. More recent trends in the Lamar Valley, however, indicate that the coyote population has increased.

Comparisons of coyote population and behavioral data from before and after wolf restoration provide evidence of how the presence of wolves is changing ecological relationships on the northern range. A reduced coyote population could mean that smaller predators, such as the native red fox, whose numbers were previously kept low by coyotes, will have less competition for small prey and their populations may increase.



Mid-winter coyote counts from the Yellowstone Ecological Research Center; year-end wolf counts from Yellowstone National Park.

Coyotes and Humans

Coyotes also face threats from humans. They quickly learn habits like roadside feeding. This may lead to aggressive behavior toward humans and can increase the risk of the coyote being hit by a vehicle. Several instances of coyote aggression toward humans, including a few attacks, have occurred in Yellowstone.

Park staff scare coyotes away from visitor-use areas and prevent them from becoming habituated to humans by hazing with cracker-shell rounds, bear pepper spray, or other negative stimuli. Animals that continue to pose a threat to human safety or property are killed.



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Coyotes (middle) are larger than red foxes (front) and smaller than wolves (back).

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Staff Reviewer

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Red Foxes

The red fox (*Vulpes vulpes macroura*) has been documented in Yellowstone since the 1880s. In relation to other canids in the park, red foxes are the smallest. Red foxes occur in several color phases, but they are usually distinguished from coyotes by their reddish-yellow coat that is somewhat darker on the back and shoulders, with black “socks” on their lower legs. “Cross” phases of the red fox (a dark cross on their shoulders) have been reported a few times in recent years near Canyon and Lamar Valley. Also, a lighter-colored red fox has been seen at higher elevations.

Three native subspecies exist at high elevations in the United States: the Sierra (*V. v. nectar*), Cascade (*V. v. cascadenis*), and Rocky (*V. v. macroura*) mountains and are collectively called mountain foxes. Little is known about any of these subspecies. Most foxes in the lower 48 states, particularly in the eastern and plains states, are a subspecies of fox from Europe introduced in the 1700s and 1800s for fox hunts and fur farms. The foxes that survived the hunt or escaped the fur farms proliferated and headed westward.

Population

Red foxes are more abundant than were previously thought in Yellowstone. The many miles of forest edge and extensive semi-open and canyon areas of the park seem to offer suitable habitat and food for foxes. They are widespread throughout the northern part of the park with somewhat patchy distribution elsewhere in the park. During the past century, especially within the past few decades, the number of fox sightings has significantly increased. This could be related to better documentation beginning in 1986. Wolves and coyotes are more closely related both genetically and physically than wolves and foxes.



During winter, red foxes may increase their activity around dawn and dusk, and even sometimes in broad daylight.

Wolves successfully competed with coyotes, causing a decline in the coyote population when they were reintroduced. This may have caused an increase in the number of fox sightings in core wolf areas such as the Lamar Valley.

A research project conducted between 1994–1998 determined at least two subpopulations of foxes live in the Greater Yellowstone Ecosystem. At about 7,000 feet in elevation, there seemed to be a dividing line with no geographical barriers separating these foxes. The genetic difference between these subpopulations was similar to the differences between mainland and island populations of foxes in Australia. Habitat use across the two groups was different as well. In addition, their actual dimensions, such as ear length and hind-foot length, were adapted to some degree for colder environments with deep snow and long winters. A yellowish or cream color most often occurs above 7,000 feet in areas such as Cooke City and the Beartooth Plateau, and this variation is being studied by researchers.

Quick Facts

Number in Yellowstone

Unknown, but not nearly as numerous as coyotes.

Where to See

- Hayden and Pelican valleys, Canyon Village area.
- Typical habitat: edges of sagebrush/grassland and within forests.

Size and Behavior

- Adult males weigh 11–12 pounds; females weigh average 10 pounds.

- Average 43 inches long.
- Average life span: three to seven years; up to 11 years in Yellowstone.
- In northern range, home range averages 3.75 square miles, with males having slightly larger range than females.
- Several color phases; usually red fur with white-tipped tail, dark legs; slender, long snout.
- Barks; rarely howls or sings.
- Distinguished from coyote by size, color, and bushier tail.
- Solitary, in mated pairs, or with female from previous litter.
- Prey: voles, mice, rabbits, birds, amphibians, other small animals.
- Other food: carrion and some plants.
- Killed by coyotes, wolves, mountain lions.

Behavior

Foxes are not often seen because they are nocturnal, usually forage alone, and travel along edges of meadows and forests. During winter however, foxes may increase their activity around dawn and dusk, and even sometimes in broad daylight. In late April and May, when females are nursing kits at their dens, they are sometimes more visible during daylight hours, foraging busily to get enough food for their growing offspring.

Recent research shows that red foxes are more nocturnal than coyotes, and strongly prefer forested habitats, while coyotes tend to use sagebrush and open-meadow areas. In this way, potential competition between foxes and coyotes is minimized. Foxes do not seem to actively avoid coyotes during an average day, they just stick with forested habitat, sleep when coyotes are most active, and then forage opportunistically. Foxes will visit carcasses (e.g., wolf kills) for the occasional big meal, especially during winter, but this is much rarer than the scavenging coyotes that park visitors can expect to see regularly.

Foxes can become habituated to humans, usually due to being fed. In 1997, one fox was trapped and relocated three times from the Tower Fall parking area because visitors fed it human food. The fox was relocated between 10 and 60 miles away from Tower, but it returned twice. Finally, the fox came to Mammoth where it was fed again and as a result was killed by managers. While this story gives us interesting information about the homing instinct of the fox, it also shows the importance of obeying rules to avoid inadvertently causing the death of one of Yellowstone's animals.



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Red foxes (front) are smaller than coyotes (middle) and wolves (back).

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Staff Reviewer

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Cougars

The cougar (*Puma concolor*), also known as mountain lion, is the one of the largest cats in North America and a top predator native to Greater Yellowstone. (The jaguar, which occurs in New Mexico and Arizona, is larger.) As part of predator-removal campaigns in the early 1900s, cougars and wolves were killed throughout the lower 48 states, including in national parks. Wolves (*Canis lupus*) were eradicated, and, although cougars were probably eliminated from Yellowstone, the species survived in the West because of its cryptic nature and preference for rocky, rugged territory where the cats are difficult to track. Eventually, the survivors re-established themselves in Yellowstone in the early 1980s, possibly making their way from wilderness areas in central Idaho.

Population

Prior to wolf reintroduction (1987–1993), Yellowstone National Park’s northern range was occupied year-round by an estimated 15 to 22 cougars, including adults, subadults, and kittens. There were 26–42 cougars estimated after wolf establishment (1998–2005). In 2014, a new study began which seeks to estimate population abundance in the same region using noninvasive genetic-survey methods. Preliminary evidence from 2014–17 indicates a healthy population still exists in numbers comparable to those from a decade ago. Biologists estimated between 29–45 individuals resided across the northern portion of Yellowstone (all age and sex classes combined).



This male cougar was photographed by a remote camera during the 2014 research study.

While disease and starvation are occasional causes of cougar deaths, competition with other cougars or predators, and human hunting (during legal seasons outside protected areas), are the main causes of cougar mortality. Habitat fragmentation and loss are the main long-term threats to cougar populations across the western United States.

Behavior

Cougars live throughout the park in summer, but few people ever see them. The northern range of Yellowstone is prime habitat for cougars because snowfall is light and prey always available. Cougars follow their main prey as they move to higher elevations in summer and lower elevations in the winter.

Adult male cougars are territorial and may kill other adult males in their home range. Male territories may overlap with several females. In non-hunted

Quick Facts

Number in Yellowstone

Estimated 29–45 (across all age classes) on the northern range; others in park seasonally.

Where to See

Seldom seen

Size and Behavior

- Litters range from three to four kittens; 50% survive first year.
- Adult males weigh 145–170 pounds; females weigh 85–120 pounds; length, including tail, 6.5–7.5 feet.

- Average life span: males, eight–10 years; females, 12–14 years. Cougars living in areas where they are hunted have much shorter average life spans.

- Preferred terrain: rocky breaks and forested areas that provide cover for hunting prey and for escape from competitors such as wolves and bears.

- Prey primarily on elk and mule deer, plus smaller mammals, especially marmots.
- Bears and wolves frequently displace cougars from their kills.

- Male cougars may kill other male cougars within their territory.
- Adult cougars and kittens have been killed by wolves.

Interaction with Humans

Very few documented confrontations between cougars and humans have occurred in Yellowstone.

If a big cat is close by, stay in a group; carry small children; make noise. Do not run, do not bend down to pick up sticks. Act dominant—stare into the cat’s eyes and show your teeth while making noise.

populations, such as in Yellowstone, the resident adult males living in an area the longest are the dominant males. These males sire most of the litters within a population; males not established in the same area have little opportunity for breeding.

Although cougars may breed and have kittens at any time of year, most populations have a peak breeding and birthing season. In Yellowstone, males and females breed primarily from February through May. Males and females without kittens search for one another by moving throughout their home ranges and communicating through visual and scent markers called scrapes. A female's scrape conveys her reproductive status. A male's scrape advertises his presence to females and warns other males that an area is occupied. After breeding, the males leave the female.

In Yellowstone, most kittens are born between June and September. Female cougars den in a secure area with ample rock and/or vegetative cover. Kittens are about one pound at birth and gain about one pound per week for the first 8–10 weeks. During this time, they remain at the den while the mother makes short hunting trips and then returns to nurse her kittens. When the kittens are about 10 weeks old, the female begins to hunt over a larger area. After making a kill, she moves the kittens to the kill. Before hunting again, she stashes the kittens. Kittens are rarely involved in killing until after their first year.

Most kittens leave their area of birth at 14 to 18 months of age. Approximately 99% of young males disperse 50 to 400 miles; about 70–80% of young females disperse 20 to 150 miles. The remaining



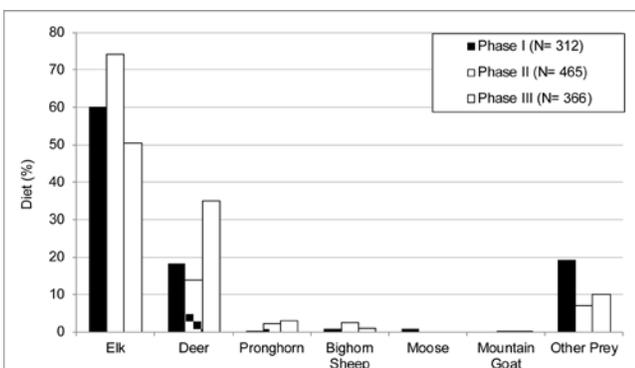
This male cougar kitten was briefly examined and genetically sampled in summer of 2016.

proportion of males and females establishes living areas near where they were born. Therefore, most resident adult males in Yellowstone are immigrants from other areas, thus maintaining genetic variability across a wide geographic area. In Yellowstone, cougars prey upon elk (mostly calves) and deer. They stalk the animal then attack, aiming for the animal's back and killing it with a bite to the base of the skull or the throat area.

A cougar eats until full, then caches the carcass for later meals. Cougars spend an average of three to four days consuming an elk or deer and four to five days hunting for the next meal. Cougars catch other animals—including red squirrels, porcupines, marmots, grouse, and moose—if the opportunity arises.

Cougars are solitary hunters who face competition for their kills from other large mammals. Even though a cached carcass is harder to detect, scavengers and competitors such as bears and wolves sometimes find it. In Yellowstone, black and grizzly bears will take over a cougar's kill. Coyotes will try, but can be killed by the cougar while doing so. Wolves displace cougars from approximately 6% of their elk carcasses.

Although cougars and wolves once co-existed across much of their historical range, ecological research on each species has often had to be conducted in the absence of the other. By assessing pre- and post-wolf reintroduction data, biologists can



Species composition of cougar-killed prey, including primary ungulate prey species and other prey (e.g., marmots, grouse, foxes, coyotes, porcupines), across three research phases (phase I: 1987–1993; phase II: 1998–2004; and phase III: 2014–present; sample sizes of kills detected are indicated in parentheses).

learn about the ecological relationships between the two species. As social animals, wolves use different hunting techniques from the solitary cougar, but the two species prey on similar animals. While prey is abundant this competition is of little concern, but, a decrease in prey abundance could lead to an increase in competition between these carnivores.

History

In the early 1900s, cougars were killed as part of predator control in the park and likely eradicated, along with wolves, in the 1930s. However, cougars naturally recolonized by the early 1980s.

From 1987 to 1996, the first cougar-ecology study was conducted in Yellowstone National Park. The research documented population dynamics of cougars in the northern Yellowstone ecosystem inside and outside the park boundary, determined home ranges and habitat requirements, and assessed the role of cougars-as-predator. Of the 88 cougars captured, 80 were radio-collared.

From 1998 to 2006, the second phase of that research was conducted. Researchers monitored 83 radio-collared cougars, including 50 kittens in 24 litters. Between 1998 and 2005, researchers documented 473 known or probable cougar kills. Elk comprised 74%: 52% calves, 36% cows, 9% bulls, 3% unknown sex or age. Cougars killed about one elk or deer every 9.4 days and spent almost four days at each kill. The study also documented that wolves interfered with or scavenged more than 22% of the cougar-killed ungulates. New research is under way to evaluate population abundance, predation patterns, and competition with other carnivores.

Very few cougar-human confrontations have occurred in Yellowstone. However, observations of cougars, particularly those close to areas of human use or residence, should be reported.



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Staff Reviewer

Dan Stahler, Wildlife Biologist

Canada Lynx

Historical information suggests lynx (*Lynx canadensis*) were present, but uncommon, in Yellowstone National Park during 1880 to 1980. The presence and distribution of lynx in the park was documented from 2001 to 2004, when several individuals were detected in the vicinity of Yellowstone Lake and the on the Central Plateau. A lynx was photographed in 2007 along the Gibbon River, and another lynx was observed near Indian Creek Campground in the northwestern portion of Yellowstone during 2010. Tracks of an individual were verified near the Northeast Entrance in 2014. Reliable detections of lynx continue to occur in surrounding National Forest System lands. Evidence suggests lynx successfully reproduce in the greater Yellowstone ecosystem (GYE), though production is limited.

In 2000, the US Fish and Wildlife Service listed the lynx as threatened in the lower 48 states. Portions of the park and surrounding area are considered much of the critical habitat for the species in the GYE.

Habitat

Lynx habitat in the Greater Yellowstone Ecosystem is often naturally patchy due to natural fire frequency and is generally limited to conifer forests above 7,700 feet where the distribution of its primary prey, the



In December 2007, Fred Paulsen, a Xanterra Parks and Resorts employee in Yellowstone, photographed this lynx along the Gibbon River. In 2010, visitors also saw a lynx, which was wearing a radio collar—indicating it may have come from Colorado where the population is collared.

Quick Facts

Number in Yellowstone

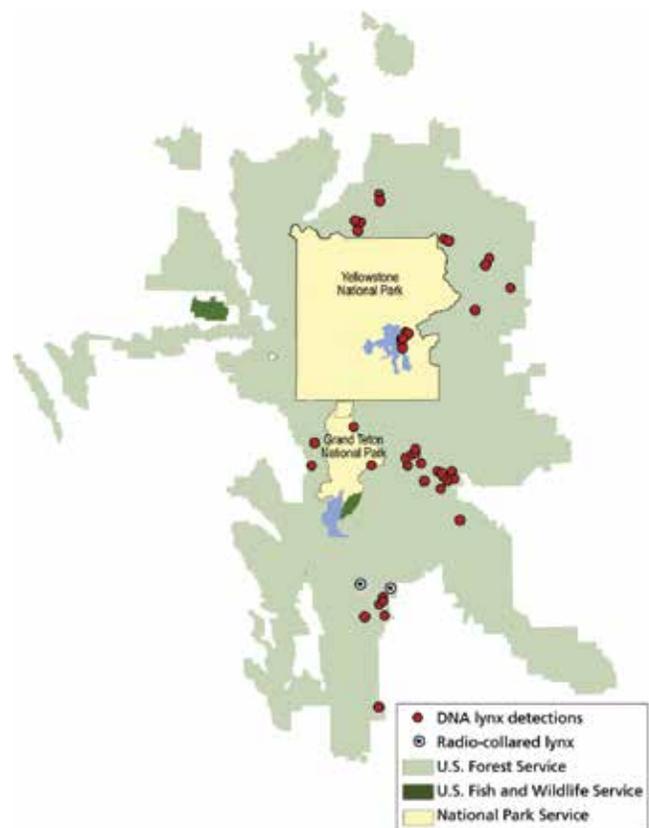
Few; 112 known observations

Where to See

- Very rarely seen.
- Typical habitat: cold conifer forests.

Size and Behavior

- Adult: 16–35 pounds, 26–33 inches long.
- Gray-brown fur with white, buff, or brown on throat and ruff; tufted ears; short tail; hind legs longer than front legs.
- Distinguish from bobcat: black rings on tail are complete; tail tip solid black; longer ear tufts; larger track.
- Wide paws with fur in and around pads; allows lynx to run across snow.
- Track: four to five inches.
- Solitary; diurnal and nocturnal.
- Eats primarily snowshoe hares, particularly in winter; also rodents, rabbits, birds, red squirrels, and other small mammals, particularly in summer.



DNA-based detections of lynx documented in the Greater Yellowstone Ecosystem, 1996 to 2008. Numerous locations of radio-collared lynx from Colorado that were obtained using satellite-based telemetry are unavailable. Data provided by Endeavor Wildlife Research, Wild Things Unlimited, the US Forest Service, and the National Park Service.

snowshoe hare, is often insufficient to support lynx residency and reproduction. The lower-quality habitat means home ranges in this ecosystem are larger than those farther north, with lynx traveling long distances between foraging sites.



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Staff Reviewer

Dan Stahler, Wildlife Biologist

Bobcats

Lynx rufus



Number in Yellowstone

Unknown, but generally widespread.

Where to See

- Rarely seen; most reports from rocky areas and near rivers.
- Typical habitat: rocky areas, conifer forests.

Size and Behavior

- Adult: 15–30 pounds; 31–34 inches long.
- Color ranges from red-brown fur with indistinct markings to light buff with dark spotting; short tail; ear tufts.
- Distinguished from lynx: has several black rings that do not fully circle the tail; no black tip on tail; shorter ear tufts; smaller track (two inches).
- Solitary; active between sunset and sunrise.
- Eats rabbits, hares, voles, mice, red squirrels, wrens, sparrows, grouse; may take deer and adult pronghorn.



Bats

Bats are the only mammals capable of sustained, flapping flight, which has given rise to a great diversity of species throughout the world. The bat species that have been documented in Yellowstone National Park are all insectivores (insect-eaters). To support the energy demands for flight, insectivorous bats must eat a large number of insects. Nursing females may consume their own body weight in food each night during the summer. In temperate environments, bats mate in late summer or autumn, just before entering into hibernation for the winter. During spring and summer, bats tend to be highly localized near sources of food, water, and roosting structures. They roost in natural habitats, including thermally heated caves, as well as in bridges, buildings, and other human structures, which can lead to conflicts with human use and historical preservation plans.

Population

Bat-monitoring efforts using acoustic surveys and mist-net captures have identified the following thirteen bat species in Yellowstone National Park:

- Little brown bat (*Myotis lucifugus*)
- Big brown bat (*Eptesicus fuscus*)
- Long-eared myotis (*Myotis evotis*)
- Long-legged myotis (*Myotis volans*)
- Townsend's big-eared bat (*Corynorhinus townsendii*)
- Fringe-tailed bat (*Myotis thysanodes*)
- Hoary bat (*Lasiurus cinereus*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Spotted bat (*Euderma maculatum*)
- Pallid bat (*Antrozous pallidus*)
- California Myotis (*Myotis californicus*)
- Western-Small-footed Myotis (*Myotis ciliolabrum*)
- Yuma myotis (*Myotis yumanensis*)

Bat monitoring in Yellowstone seeks to establish baseline data on the distribution, activity, and habitat use by bat species—before we begin to see evidence of the arrival of the disease white-nose syndrome (WNS).

The fungal pathogen *Pseudogymnoascus destructans*, which causes WNS, has been responsible for declines as high as 99% in wintering bat populations, leading to regional extinctions of several species in northeastern North America. In 2016, two bats were confirmed to be infected in Washington State. Bats cannot recover quickly, if at all, from these



Physical adaptations to their environments have given bats their looks. The large ears of this Townsend's big-eared bat (*Corynorhinus townsendii*), held by a researcher, help it locate its prey.

substantial population declines because most species that are vulnerable to WNS rear only a single pup per female each year.

It is important to identify the location of maternity roosts and hibernacula, locations that are used for reproduction and over-winter survival, respectively. Female bats captured with mist-nets and fitted with radio transmitters have helped to identify buildings that serve as maternity roosts (where females raise young) for little brown bats. Research suggests that access to building attics within Yellowstone National Park is critical for their reproductive success and long-term conservation.

Quick Facts

Species in Yellowstone

13

Where to See

Dawn and dusk in areas with insects.

Behavior

- Develop and reproduce slowly, which is unusual given their small body size.
- Typically mate in the fall. In bats that hibernate, fertilization is delayed until the female emerges from hibernation. For most greater Yellowstone bats, hibernation ends around mid-April and the females give birth in mid-June.
- Most give birth to one pup a year, although four species in the greater Yellowstone area have two or more pups at a time. These species typically begin flying in two to six weeks, are weaned around five to ten weeks, and become mature in one to two years.
- Few predators specialize on bats. Predators are generally opportunistic and include owls, falcons, hawks, snakes, and raccoons.
- Of bats that survive their first year, 40–80% survive seven to eight years; many bats live 10–30 years.

Habitat

Roosts provide bats with protection from weather and predators, and the type of roosting structure available affects foraging and mating strategies, seasonal movements, morphology, physiology, and population distribution. Bats in Greater Yellowstone use both natural habitats and man-made structures including bridges and abandoned mines.

Research suggests that the thermal conditions in maternity roosts are important for the reproductive success of little brown bats. Young bats can maximize their growth rate, wean, and begin to fly and forage earlier because they are not using much energy to stay warm.

Bats are long-lived (10–30 years) and show fidelity to maternal roost sites where they have successfully raised young. For this reason, park managers try to exclude bats from the attics of park buildings. In 1904, the “type specimen” that describes the subspecies of little brown bat found in Yellowstone was collected from the Lake Hotel.

The presence of other bats in Yellowstone is probably restricted by the limited location of suitable roosts and/or the distribution of moths and beetles on which more specialized bats forage. It is likely that most western bat species migrate short distances from their summer roosts to their winter hibernating locations. However, bat activity has been documented during every month of the year, which suggests that multiple species may remain within Yellowstone over winter. Some species migrate long distances to areas where temperature and insect populations remain high enough for continued activity. These species usually do not hibernate. In Greater Yellowstone, the hoary bat likely migrates south for the winter.

Physical Adaptations

Bats with long, narrow wings (e.g., the hoary bat) are fast but less maneuverable fliers that typically forage in open areas. Bats with short, broad wings (e.g., Townsend’s big-eared bat) are slower but more agile and typically forage in forested areas or along the edge of vegetation. A few Yellowstone bats, such as long-eared myotis, pallid bat, and Townsend’s big-eared bat, can glean insects off the surface of vegetation, and have wing shapes that enable them to hover and carry larger prey.

Bats use an echolocation system to navigate and find food in the dark. Many species produce pulses of high-frequency, ultrasonic sound and listen for

the returning echoes. The echoes provide bats with a sonic picture of the environment, which includes the movement of prey. High-frequency calls are less likely to alert predators and are effective for locating prey, although some moths have developed organs on their abdomens capable of detecting such calls. Most bats also use lower-frequency calls (often audible to humans) to communicate with each other. Also, contrary to the expression “blind as a bat,” bats typically have excellent vision that can be used for hunting.

Bats make efficient use of the energy obtained through foraging by regulating their body temperature (thermoregulation). To conserve energy, bats can lower their metabolic rate and body temperature (torpor), but they are then unable to carry out normal activities. Most bat species in Greater Yellowstone undergo torpor that may continue for months and is typically a seasonal response to a prolonged drop in temperature or reduction in food supply.

At rest, bats roost head down, which makes them less vulnerable to predators and facilitates flight. A bat can remain upside down for months because of cavities in its cranium that pool blood and other fluids away from the brain and because of an arrangement of ligaments and leg muscles that enables them to hang passively from their perch while sleeping.

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Beavers

The beaver (*Castor canadensis*) is a keystone species that affects habitat structure and dynamics through the damming and diverting of streams and the felling of trees and other woody vegetation. The resulting ponds and flooding help create an environment favorable to willow and aspen, the beavers' preferred winter foods and lodge-building material. The territoriality of beavers probably deters two colonies from locating within 165 feet (50 m) of each other, and most streams in the park lack either suitable vegetation or a sufficiently low gradient to provide beavers with habitat, but information about the distribution and number of beaver colonies in the park over time adds to our understanding of the long-term effects of changes in vegetation and climate.

Habitat

Beavers live throughout Yellowstone National Park but are concentrated in the southeast (Yellowstone River delta area), southwest (Bechler area), and northwest portions (Madison and Gallatin rivers) of the park. These areas are likely important habitat because of their waterways, meadows, and the presence of preferred foods such as willow, aspen, and cottonwood.

However, beavers are not restricted to areas that have their preferred foods. Essentially no aspen exist in most areas where beavers' sign is most abundant, such as the Bechler River, or in other areas where beavers periodically live, such as Heart Lake, the lower Lamar River and Slough Creek area, Slide



The beaver is a keystone species that affects habitat structure and dynamics through the damming and diverting of streams, and the felling of trees and other woody vegetation.

Lake, and the lower Gardner River. In these areas, beavers use willows for construction and for food. Where their preferred plants are few or absent, beavers may cut conifer trees and feed on submerged vegetation such as pond lilies.

Beavers are famous dam builders, and examples of their work can be seen from the roads in the park. Most dams are on small streams where the gradient is mild and the current is relatively placid during much of the year. Colonies located on major rivers or in areas of frequent water-level fluctuations, such as the Lamar River, den in holes in the riverbank. An old dam is visible at Beaver Lake between Norris and Mammoth.

When hunched over their food, beavers can resemble round rocks. Beavers are most active in the

Quick Facts

Number in Yellowstone

100 colonies estimated in 2015

Where to See

- Willow Park (between Mammoth and Norris), Beaver Ponds (Mammoth area), Harlequin Lake (Madison area), and the Gallatin River along US 191.
- In the backcountry: upper Yellowstone River (Thorofare region), Bechler River, and Slough Creek. Occasionally seen in the Lamar, Gardner, and Madison rivers.
- Wait in areas near known beaver activity. You may see them

swimming or clambering onto the bank to gnaw at trees and willows. Listen for the sound of the beaver slapping its tail on the water before it submerges to seek safety.

Size and Behavior

- Crepuscular: active in evening and morning.
- If living on rivers, may build bank dens instead of lodges.
- One colony may support two to 14 beavers that are usually related. Six is considered average.
- 35–40 inches long, including tail.
- Weighs 30–60 pounds.

- Average life span: five years.
- Male and female beavers look alike—thick brown fur, paddle-shaped tail.
- Like wolves, beavers live in family groups, which are called colonies. Fewer than 5% of mammals live organized like this.

Other Information

- Beavers are native to Yellowstone.
- Yellowstone's beavers escaped most of the trapping that occurred in the 1800s due to the region's inaccessibility.

early morning and late evening, which seems to allow them to use areas near human use. Beavers do not appear to avoid areas of moderate to high levels of human use. Several occupied lodges in Yellowstone are close to popular backcountry trails and campsites.

Population

The first survey of beavers in the park, conducted in 1921, reported 25 colonies, most of them cutting aspen trees. Although the survey was limited to parts of the northern range, comparing the locations of those beaver colonies with subsequent survey results demonstrates how beavers respond and contribute to changes in their habitat. A 1953 survey found eight colonies on the northern range, but none at the sites reported in 1921, and a lack of regrowth in cut aspen. Willow were also in decline during this period.

To help restore the population of beavers on Gallatin National Forest, 129 beavers were released into drainages north of the park from 1986 to 1999. Park-wide aerial surveys began in 1996, with a count of 49 colonies; an increase to 127 by 2007; and decreases to 118 in 2009 and 112 in 2011. While the long-term increase is partly attributable to the improved capability of aerial observers to locate colonies, the park's population of beavers probably has grown in the past 15 years. Some of the increase likely came from beavers dispersing from the national forest, but they would not have survived without suitable habitat. The increase has occurred throughout the park and is likely related to the resurgence in willow since the late 1990s, at least on the northern range, and possibly in the park interior. Nearly all of the colonies documented in recent years were located in or near willow stands, none near aspen.

Willow, which is more common in the park than aspen, is a hardier shrub that quickly regenerates after being clipped by beavers. The reason for the prolonged decline and relatively sudden release of willow on the northern range, and whether aspen have begun a sustained surge in recruitment, are topics of intense debate. Possible factors include the relationship of these plant species to changes in the abundance of beavers and elk, fire suppression, the reintroduction of wolves, and climate change.



The preferred foods of beaver are willow, aspen, and cottonwood. Where their preferred plants are few or absent, beavers may cut conifer trees and feed on submerged vegetation such as pond lilies.

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Pikas

The pika (*Ochotona princeps*) is considered an indicator species for detecting ecological effects of climate change. While abundant in the Greater Yellowstone Ecosystem, pika numbers are declining in some areas of lower elevations in response to increased warming, which reduces their suitable habitat. The US Fish and Wildlife Service review of the pika found no current need to list the species as threatened or endangered; however, pikas will likely disappear from some lower-elevation or warmer sites.

Behavior

Pikas are territorial. They inhabit rocky alpine and sub-alpine zones, feeding on the vegetation that fringes their preferred talus slopes. Because pikas do not hibernate, this relative of the rabbit must gather enough plant materials during the short growing season to survive the winter. Piles of drying vegetation, called haystacks, and a distinctive high-pitched call are the most recognizable indicators of active pika habitat. Prolific breeders, pikas usually have two litters of young each summer. The mortality rate is high for the youngsters, and the first litter has a greater rate of survival. These small mammals are sensitive to temperatures above 77.9°F (25.5°C); therefore, they are most active during cooler parts of the day.

Outlook

The National Park Service's five-year project, Pikas in Peril, assessed the vulnerability of the pika to climate change by studying populations in eight western national parks. The study located many small, isolated territories in Yellowstone. Initial analysis at



A pika, blending in with its surroundings, carries greenery to its haystack. Yellowstone provides classic talus habitat for pikas.

the end of 2015 predicted that pika habitat would decline 80% by 2026 and that pika would eventually be extirpated from the park. Further analysis found that habitat sites did not decline; but population modeling showed that resident turnover can be high (50% between some years). Turnover is exacerbated by winter cold stress, summer heat stress, and variation in site-habitat quality. High genetic diversity among the Yellowstone pika population may increase their resistance to these stressors. www.nps.gov/orgs/1778/pikas-in-peril.htm.

Reviewer

Tom Rodhouse, Natural Resources
Stewardship and Science Directorate



Quick Facts

Number in Yellowstone

Abundant

Where to See

Tower and Mammoth areas.

Identification and Behavior

- 7–8.4 inches long, 5.3–6.2 ounces (about the size of a guinea pig).
- Active year-round; agilely darts around on rocks; travels through tunnels under snow.
- Breeds in spring; two litters per year.
- Often heard but not seen; makes a distinct shrill whistle-call or a short "mew."
- Grey to brown with round ears; no tail; blends in with rocks.
- Scent-marks by frequently rubbing cheeks on rocks.
- In late summer, it gathers mouthfuls of vegetation to build "haystacks" for winter food; defends haystacks vigorously.
- Haystacks often built in same place year after year; have been known to become three feet in diameter.

- Like rabbits and hares, pika eat their own feces, which allows additional digestion of food.

Habitat

- Found on talus slopes and rock falls at nearly all elevations in the park.
- Eats grasses, sedges, aspen, lichen, and conifer twigs.
- Predators include coyotes, martens, and hawks.

Management Concerns

Pikas are vulnerable to loss of habitat related to climate change.

White-tailed Jackrabbits

Considered an agricultural or garden pest in many parts of the country, the white-tailed jackrabbit (*Lepus townsendii*) found a niche in Yellowstone. Most of the park is too forested or accumulates too much snow to provide suitable habitat, but in lower-elevation areas of the northern range this animal can feed on sagebrush, rabbitbrush, and other shrubs during the winter. The jackrabbit is preyed upon by bobcats, coyotes, wolves, eagles, hawks, and owls in the park, but perhaps because of its limited distribution, it does not appear to provide a significant source of food for these species.

Description

Despite its common name, the jackrabbit is more closely related to other hares than to rabbits (*Sylvilagus spp.*). Like the much smaller snowshoe hare (*L. americanus*), which resides in Yellowstone's coniferous forests, the jackrabbit has a grayish-brown summer coat that turns nearly white to provide winter camouflage in areas with persistent snow cover. The slightly smaller black-tailed jackrabbit (*L. californicus*), which is found in lower elevation areas, has not been documented in the park and is generally less common in greater Yellowstone.

Population

Nearly all of the 501 jackrabbit observations recorded in 2008, and the spottier records kept prior to that year were made in sagebrush-grassland habitat



The coat of white-tailed jackrabbits turns white during winter in Yellowstone and other areas with snow.

at elevations below 6,500 feet (2,000 m) where the average annual precipitation is fewer than 16 inches (40 cm). Less than 1% of the park (about 18,700 acres) is located in these areas, which are found in the Gardiner Basin, along the Gardner River, and in Mammoth Hot Springs. Although some jackrabbit populations are known to fluctuate markedly over the short or long term, no evidence has been found that the abundance or distribution of jackrabbits in Yellowstone has changed substantially since the park was established in 1872. Jackrabbits are found as high as 14,600 feet (4,200 m) in Colorado, but a

Quick Facts

Number in Yellowstone

Common in suitable low elevation habitats in the park.

Where to See

Elevations below 6,500 feet from the Blacktail Plateau to Mammoth to the Gardiner Basin area.

Identification

- Easily distinguished from true rabbits by their large ears, large feet, and generally large body size.
- Use their ears to listen for danger and to radiate body heat. Large ears allow them to release excess body heat and tolerate high body temperatures.
- Summer coat is grayish brown,

with a lighter underside. In Yellowstone and other places where there is persistent and widespread snow cover, the coat changes to nearly white in winter. Ears are rimmed with black.

Habitat

- Found in prairie-grassland and grass-shrub steppe habitat types in western high plains and mountains. They generally prefer grass-dominated habitats and have also been found to flourish above treeline in the alpine zone and avoid forested areas.

Behavior

- Have one to four litters per year with up to 15 offspring.

- Gestation is 36–43 days.
- In most areas, the breeding season of white-tailed jackrabbits averages 148 days and may run late February to mid July. Breeding in the northern Yellowstone ecosystem is not well documented.
- Feed on grasses, forbs, and shrubs at night and are less active during the day.
- Can run from 35 to 50 mph (56 to 80 kph) and cover six to ten feet (2–3 m) with each bound. Will also swim when being pursued by predators.

limiting factor in Yellowstone appears to be snow, which begins to accumulate earlier in the winter, attains greater depths, and lasts later into spring with increasing elevation.



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Staff Reviewer

Kerry Gunther, Bear Management Biologist

Snowshoe Hares

Lepus americanus



Number in Yellowstone

Common in some places.

Where to See

Norris Geyser Basin area.

Identification

- 14.5–20 inches long, weighs three to four pounds.
- Large hind feet enable easy travel on snow; white winter coat offers camouflage; gray summer coat.
- Transition in seasonal fur color takes about 70–90 days; seems to be triggered in part by day length.

Habitat

- Found particularly in coniferous forests with dense understory of shrubs, riparian areas with many willows, or low areas in spruce-fir cover.
- Rarely venture from forest cover except to feed in forest openings.
- Eat plants; use lodgepole pine in winter.
- Preyed upon by lynx, bobcats, coyotes, foxes, weasels, some hawks, and great horned owls.

Behavior

- Breed from early March to late August.
- Young are born with hair, grow rapidly, and are weaned within 30 days.
- Docile except during the breeding season when they chase each other, drum on the ground with the hind foot, leap into the air, and occasionally battle.
- Mostly nocturnal; their presence in winter is only advertised by their abundant tracks in snow.



Wolverines

A mid-size carnivore in the weasel family, the wolverine (*Gulo gulo*) is active throughout the year in cold, snowy environments to which it is well adapted. Its circumpolar distribution extends south to mountainous areas of the western United States, including the greater Yellowstone area where they use high-elevation islands of boreal (forest) and alpine (tundra) habitat. Wolverines have low reproductive rates, and their ability to disperse among these islands is critical to the population's viability. Climate-change models predict that by 2050, the spring snowpack needed for wolverine denning and hunting will be limited to portions of the southern Rocky Mountains, the Sierra Nevada range, and greater Yellowstone, of which only the latter currently has a population. Wolverines are so rarely seen and inhabit such remote terrain at low densities that assessing population trends is difficult and sudden declines could go unnoticed for years.

Population

Commercial trapping and predator-control efforts substantially reduced wolverine distribution in



US FOREST SERVICE/GARDINER RANGER DISTRICT

Remote cameras, like the one that took this photo, were used to record wolverine activity at live traps during a collaborative study in the greater Yellowstone area from 2006 to 2009. Here, wolverine F3 revisits a live trap, which did not capture her, in 2008. Each trap was baited with a skinned beaver carcass obtained from Montana fur trappers and had a transmitter that signaled up to 18 miles when the trap was triggered.

the lower 48 states by the 1930s. Some population recovery has occurred, but the species has not been documented recently in major portions of its historic range. In the greater Yellowstone area, wolverines have been studied using live traps, telemetry, and aerial surveys. A group sponsored by the Wildlife Conservation Society has documented ranges that extend into Yellowstone National Park along the northwest and southwest boundary. A second group, which included researchers from the National Park Service, the US Forest Service, and the Northern Rockies Conservation Cooperative, which surveyed the eastern part of the park and adjoining national forest from 2006 to 2009, documented seven wolverines. The average annual range for the two monitored females was 172 square miles (447 km²); for three males, it was 350 square miles (908 km²). The other two males, both originally captured by the Wildlife Conservation Society, dispersed from west and south of the park: M557 established a home range north of the park in 2009; M556 became the first confirmed wolverine in Colorado in 90 years. But to create a breeding population there, he will need to find a female.

Conservation Status

Wolverine populations in the US Rockies are likely to be genetically interdependent. Even at full capacity, wolverine habitat in the Yellowstone area would

Quick Facts

Number

2006–2009: seven documented in eastern Yellowstone and adjoining national forests (two females, five males).

Size and Behavior

- 38–47 inches long, 13–31 pounds.
- Opportunistic eaters. Eat burrowing rodents, birds, eggs, beavers, squirrels, marmots, mice, and vegetation (including whitebark pine nuts); chiefly a scavenger in winter, but has also been known to take large prey such as deer, elk, and moose.
- Active year-round, intermittently throughout the day.
- Breed April to October; one litter of two to four young each year. Females give birth in dens excavated in snow, under log jams and uprooted trees in avalanche chutes.
- Mostly solitary except when breeding.

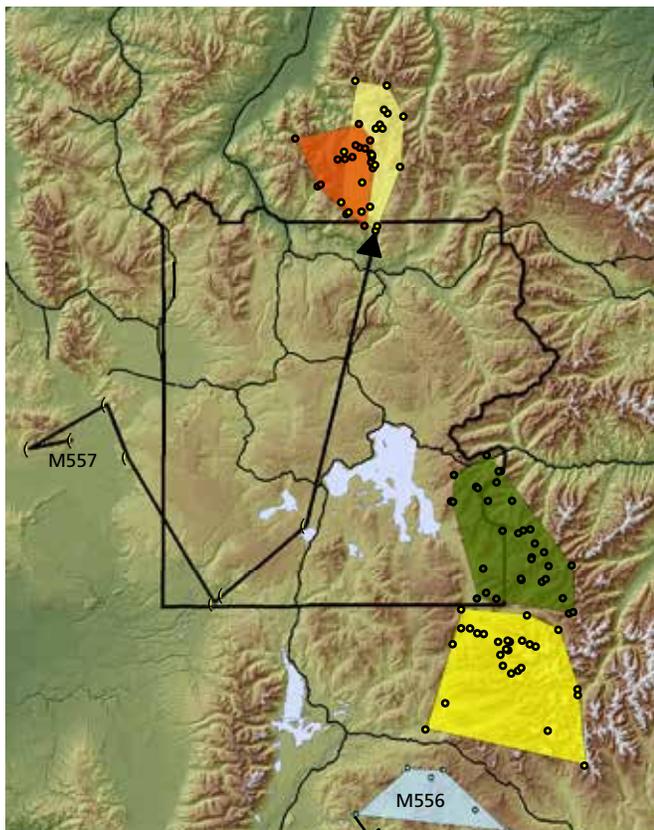
Management Concerns

- In August 2014, the US Fish and Wildlife Service withdrew a proposal to list wolverines living in the lower 48 states as a threatened species under the Endangered Species Act.
- Due to uncertainty of the effects of climate change on wolverines and their habitat in the foreseeable future, plans to list the species are on hold.

support too few females to maintain viability without genetic exchange with peripheral populations. The rugged terrain that comprises a single wolverine home range often overlaps several land-management jurisdictions. Collaborative conservation strategies developed across multiple states and jurisdictions are therefore necessary for the persistence of wolverines in the continental United States.

In August 2014, the US Fish and Wildlife Service withdrew a proposed rule to list the wolverine as a threatened species under the Endangered Species Act in the contiguous United States. In spring 2016, a US District court ordered the US Fish and Wildlife Service to reconsider the proposed rule.

Climate change impacts on wolverine habitat, specifically the likelihood of declining habitat in high elevation snowpack for denning females, had been identified as a chief threat to this species. Until recent years, wolverines could still be trapped in Montana which is home to the largest populations of Wolverines in the lower 48 States. In 2019, however, the state closed trapping for this species.



Home ranges of five wolverines documented in 2009.

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Staff Reviewer

Dan Stahler, Wildlife Biologist



Other Small Mammals

Badger (*Taxidea taxus*)



Identification

- 22–28 inches long, 13–25 pounds.
- Short and stout; adapted to digging.
- Light body with dark stripe down back and darker feet. Broad head forms a wedge. Sides of face are white with black patches, white stripe from nose extends towards back.

Habitat

- Prefers open areas like grasslands.
- Adapted to eat ground squirrels, pocket gophers, and other small rodents; will also eat ground-nesting birds and their eggs. Average badger needs to eat about two ground squirrels or pocket gophers a day to maintain its weight. Digs burrows in pursuit of prey.
- Adults preyed on by mountain lions, bears, and wolves. Coyotes and eagles will prey on young.

Behavior

- Mostly solitary except in mating season (summer and early fall). Have delayed implantation; active gestation starts around February.
- Excavated dens are used for daytime resting sites, food storage, and giving birth. Typically have one entrance, marked by a mound of soil. May be inactive in their dens for up to a month in winter, but they are not true hibernators.
- Mostly active at night. May live up to 14 years.



Golden-mantled Ground Squirrel (*Spermophilus lateralis*)



Identification

- 9–12 inches long, 7.4–11 ounces.
- Adult head and shoulders are reddish-brown, their “mantle.”
- Often mistaken for a least chipmunk (described below); distinguished by larger size, more robust body, shorter tail, and stripes that do not extend onto the sides of the head.

Habitat

- Found throughout Yellowstone at all elevations in rocky areas, edges of mountain meadows, forest openings, tundra.
- 87% of diet consists of fungi and leaves of flowering plants; other foods include buds, seeds, nuts, roots, bird eggs, insects, and carrion.
- Predators include coyotes, weasels, badgers, hawks, and grizzly bears.

Behavior

- Hibernate October to March or April.
- Breeding occurs shortly after both males and females emerge from hibernation; one litter of five young per year.



Red Squirrel (*Tamiasciurus hudsonicus*)



Identification

- 11–15 inches long, 6.7–7 ounces.
- Brownish-red on its upper half; dark stripe above white ventral side; light eye ring; bushy tail.
- Quick, energetic.
- Loud, long chirp to advertise presence; much more pronounced in the fall.

Habitat

- Spruce, fir, and pine forests; young squirrels found in marginal aspen habitat.
- Eat conifer seeds, terminal buds of conifer trees, fungi, some insects; sometimes steal young birds from nests.
- Preyed on by coyotes, grizzly bears, and hawks.

Behavior

- Breed February through May, typically in March and April; one litter of three to five young.
- One of the park's most territorial animals; territorialism ensures winter food supply.
- In fall, cuts cones from trees and caches them in middens, which are used for years and can be 15 by 30 feet; grizzlies search out these middens in whitebark pine and limber pine habitat to obtain the nuts.



Uinta Ground Squirrel (*Spermophilus armatus*)



Identification

- 11–12 inches long, weighs 7–10 ounces.
- Grayish back and rump with fine white spots on back; nose and shoulders are tan to cinnamon; tail is grayish underneath.

Habitat

- Found in disturbed or heavily grazed grasslands, sagebrush meadows, and mountain meadows up to 11,000 feet.
- Eat grasses, forbs, mushrooms, insects, and carrion (including road-killed members of its own species).
- Preyed on by long-tailed weasels, hawks, coyotes, badgers, and grizzly bears.

Behavior

- Hibernate as early as mid-July through March.
- Breed in early spring; one litter of six to eight young per year.
- Young, after they leave the burrow, are vulnerable to long-tailed weasels and hawks.
- During cool spring weather, Uinta ground squirrels are active at all times of day; as the weather warms, activity is more limited to morning, late afternoon, and evening.
- During winter, Uinta ground squirrels are sometimes active near the Albright Visitor Center and Mammoth Hot Springs Hotel. Perhaps they are aroused from hibernation due to ground temperatures rising as hydrothermal activity increases in the vicinity. No one knows for sure.

Least Chipmunk (*Tamias minimus*)



Identification

- 7.5–8.5 inches long, 1.2 ounces.
- Smallest member of the squirrel family; one of three chipmunk species in the park.
- Often mistaken for golden-mantled ground squirrel; distinguished by smaller size, longer tail, and lateral stripes that extend onto the sides of the head.

Habitat

- Prefer sagebrush valleys, shrub communities, and forest openings.
- Eat primarily plant material, particularly seeds and other fruits, but will also eat conifer seeds and some insects.
- Preyed on by various hawks, grizzly bears, and probably foxes and coyotes.

Behavior

- In Yellowstone, this species hibernates but also stores some food and probably rouses frequently during the winter.
- Breeding begins as snowmelt occurs, usually late March until mid-May; one litter of five to six young per year.
- Little is known about their vocalizations, but they do have “chipping” (which may be an alarm) and “clucking” calls.
- Can be identified by quick, darting movements; seems to carry its tail vertically when moving.



Short-tailed Weasel (Ermine) (*Mustela erminea*)



Identification

- 8–13 inches long, 2.1–7 ounces.
- Typical weasel shape: very long body, short legs, pointed face, long tail.
- Males about 40% larger than females.
- Fur is light brown above and white below in summer; all white in winter except for tail, which is black-tipped all year.
- Compare to long-tailed weasel and marten.

Habitat

- Eat voles, shrews, deer mice, rabbits, rats, chipmunks, grasshoppers, and frogs.
- Found in willows and spruce forests.

Behavior

- Breed in early to mid-summer; one litter of six to seven young per year.
- Can leap repeatedly three times their length.
- Will often move through and hunt in rodent burrows.



Long-tailed Weasel (*Mustela frenata*)



Identification

- Typical weasel shape: a very long body, short legs, pointed face, long tail.
- 13–18 inches long, 4.8–11 ounces.
- Fur is light brown above and buff to rusty orange below in summer; all white in winter, except for tail, which is black-tipped all year.
- Males 40% larger than females.
- Compare to marten and short-tailed weasel.

Habitat

- Found in forests, open grassy meadows and marshes, and near water.
- Eat voles, pocket gophers, mice, ground and tree squirrels, rabbits; to a lesser degree, birds, eggs, snakes, frogs, and insects.

Behavior

- Breed in early July and August; one litter of six to nine young per year.
- Solitary animals except during breeding and rearing of young.



Marten (*Martes americana*)



Identification

- 18–26 inches long, one to three pounds.
- Weasel family; short limbs and long, bushy tail; fur varies from light to dark brown or black; irregular, buffy-to-bright-orange throat patch.
- Smaller than a fisher; buffy or orange bib rather than white.
- Compare to long-tailed weasel and short-tailed weasel.

Habitat

- Found in conifer forests with understory of fallen logs and stumps; will use riparian areas, meadows, forest edges and rocky alpine areas.
- Eat primarily small mammals such as red-backed voles, red squirrels, snowshoe hares, flying squirrels, chipmunks, mice and shrews; also to a lesser extent birds and eggs, amphibians and reptiles, earthworms, insects, fruit, berries, and carrion.

Behavior

- Solitary except in breeding season (July and August); delayed implantation; one to five young born in mid-March to late April.
- Active throughout the year; hunts mostly on the ground.
- Rest or den in hollow trees or stumps, in ground burrows or rock piles, in excavations under tree roots.



Montane Vole (*Microtus montanus*)



Identification

- 5–7.6 inches long, 1.2–3.2 ounces.
- Brownish to grayish-brown, occasionally grizzled; ventral side is silvery gray; relatively short tail is bi-colored.

Habitat

- Found at all elevations in moist mountain meadows with abundant grass and grassy sagebrush communities; also common in riparian areas.
- Grass is their primary food.
- Probably the most important prey species in the park; eaten by coyotes, raptors, grizzly bears, other animals.

Behavior

- Active year-round, maintain tunnels in the winter; also dig shallow burrows.
- Typically breed from mid-February to November; up to four litters of two to ten young per year.



Pocket Gopher (*Thomomys talpoides*)



Identification

- 6–10 inches long, 2.6–6.3 ounces.
- Very small eyes and ears; brown or tan smooth fur; short tail; long front claws for burrowing; large external pouches for carrying food.

Habitat

- Only range restriction seems to be topsoil depth, which limits burrowing.
- Preyed upon by owls, badgers, grizzly bears, coyotes, weasels, and other predators.
- Snakes, lizards, ground squirrels, deer mice, and other animals use their burrows.
- In the top six to eight inches below the surface, they forage for forbs, some grasses and underground stems, bulbs, and tubers.

Behavior

- Transport food in cheek pouches to underground cache. Grizzly bears sometimes dig up these caches, which can include unsuspecting gophers.
- Do not hibernate; instead burrow into the snow; often fill tunnels with soil, forming worm-like cores that remain in the spring after snow melts.
- Breed in May and April; one litter of five young per year.
- Burrow systems are elaborate and often bi-level; can be 400–500 feet long.
- Very territorial; only one per burrow.



River Otter (*Lontra canadensis*)



Identification

- 40–54 inches long; 10–30 pounds.
- Sleek, cylindrical body; small head; tail nearly one third of the body and tapers to a point; feet webbed; claws short; fur is dark, dense brown.
- Ears and nostrils close when underwater; whiskers aid in locating prey.

Habitat

- Most aquatic member of weasel family; generally found near water.
- Eat crayfish and fish; also frogs, turtles, sometimes young muskrats or beavers.

Behavior

- Active year-round. Mostly crepuscular but have been seen at all times of the day.
- Breed in late March through April; one litter of two young per year. Females and offspring remain together until next litter; may temporarily join other family groups.
- Can swim underwater up to 6 miles per hour and for 2–3 minutes at a time.
- Not agile or fast on land unless they find snow or ice, then can move rapidly by alternating hops and slides; can reach speeds of 15 miles per hour.
- May move long distances between waterbodies.

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Yellow-bellied Marmot (*Marmota flaviventris*)



Identification

- 20–28 inches long; 3.5–11 pounds.
- One of the largest rodents in Yellowstone.
- Reddish-brown upper body; yellowish belly; small ears; prominent active tail.

Habitat

- Found from lowest valleys to alpine tundra, usually in open grassy communities and almost always near rocks.
- Feed on grasses and forbs in early summer; switch to seeds in late summer; occasionally will eat insects.
- Prey for coyotes, grizzlies, and golden eagles.

Behavior

- Hibernate up to 8 months, emerging from February to May depending on elevation; may estivate in June in response to dry conditions and lack of green vegetation and reappear in late summer.
- Breed within two weeks of emerging from hibernation; average five young per year.
- Active in morning, late afternoon, and evening.
- Colonies consist of one male, several females, plus young of the year.
- Vocalizations include a loud whistle (early settlers called them “whistle pigs”), a “scream” used for fear and excitement; a quiet tooth chatter that may be a threat.
- Males are territorial; dominance and aggressiveness demonstrated by waving tail slowly back and forth.





Nearly 300 bird species have been sighted in Yellowstone, including raptors, songbirds, shorebirds, and waterfowl. About 150 species, like this Ruby-crowned kinglet, build nests and fledge their young in the park.

Birds

Records of bird sightings have been kept in Yellowstone since its establishment in 1872. These records document nearly 300 species of birds to date, including raptors, songbirds, shorebirds, and waterfowl. Approximately 150 species nest in the park. The variation in elevation and broad array of habitat types found within Yellowstone contribute to the relatively high diversity. Many of the birds are migratory species. There are currently no federally listed bird species known to breed in Yellowstone National Park.

The Yellowstone National Park bird program monitors a small portion of its breeding bird species to gather information on reproduction, abundance, and habitat use. Data are collected on multiple species from a wide variety of taxonomic groups and

have been maintained for 25 or more years for several species. Long-term monitoring efforts help inform park staff of potential shifts in ecosystem function, e.g., climate change effects, for Yellowstone's bird community and may guide future conservation of the park's birds and their habitats.

Climate Change

The timing of the availability of food sources for birds may change with rising temperatures and changing weather patterns. Birds are sensitive to shifts in seasonal weather patterns and show a relatively rapid response to these fluctuations. For example, climate change has been shown to influence migration patterns, population size and distribution, the timing of reproduction, and nesting success for birds. Through monitoring, birds can be used as environmental health indicators to help managers detect changes in ecosystem function and, if necessary, take appropriate management action.

The Yellowstone bird program monitors the spring arrival of species to the park, as well as the timing of nest initiation and fledging for several raptor species, which may be useful in observing the effects of climate change in Yellowstone.

More Information

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Follett, D. 1986. *Birds of Yellowstone and Grand Teton national parks*. Boulder, CO: Roberts Rinehart.

Quick Facts

Number in Yellowstone

285 documented species; approximately 150 species nest in the park.

Species of Concern

- Trumpeter swan
- Golden eagle
- Common loon

Current Management

The Yellowstone National Park bird program monitors the park's bird species, including species of concern. The program's core activities are monitoring raptors (bald eagles, ospreys, peregrine falcons, and golden eagles), wetland birds, and passerine/near passerine birds (songbirds and woodpeckers).

FREQUENTLY ASKED QUESTION:

Where are good birding locations?

That depends on what kind of birds you want to see, the time of day you are looking, and your location in the park. In general, riparian areas and wetlands, especially those with shrubby willows, aspen, and cottonwoods, attract the greatest diversity and abundance of songbirds.

Hayden Valley is one of the best places to view water birds and birds of prey. Shorebirds feed in the mud flats at Alum Creek. Sandhill cranes often nest in the valley. Ducks, geese, and American white pelicans cruise the river. Bald eagles and osprey hunt for fish along the river; northern harriers fly low looking for rodents in the grasses. Great gray owls are sometimes seen searching the meadows for food (these birds are sensitive to human disturbance). Blacktail Ponds and Floating Island Lake, between Mammoth and Tower Junction, and the Madison River west of Madison Junction are also good places to look for birds.

Many birds, such as American robins and common ravens, are found throughout the park. Other species live in specific habitats. For example, belted kingfishers are found near rivers and streams while Steller's jays are found in moist coniferous forests.

Spring is a good time to look for birds. Migration brings many birds back to the park from their winter journeys south; other birds are passing through to more northern nesting areas. Songbirds are singing to establish and defend their territories; and many ducks are in their colorful breeding plumages,

which makes identification easier.

Watch for birds in the early morning from mid-May through early July. At all times, but especially during the nesting season, birds should be viewed from a distance. Getting too close can stress a bird (as it can any animal) and sometimes cause the bird to abandon its nest. As with all park wildlife, visitors should keep at least 25 yards away from birds and their nests.

Most birds migrate to lower elevations and more southern latitudes beginning in August. At the same time, other birds pass through Yellowstone. Hawk-watching can be especially rewarding in Hayden Valley late August through early October. In early November, look for tundra swans on the water.

Birds that can be viewed in Yellowstone year-round include the common raven, Canada goose, trumpeter swan, dusky grouse (formerly blue grouse), gray jay, black-billed magpie, red-breasted nuthatch, American dipper, and mountain chickadee. A few species, such as common goldeneyes, bohemian waxwings, and rough-legged hawks, migrate here for the winter.

Visitors may report sightings with a bird observation form, available at www.nps.gov/yell/learn/nature/wildlife-sightings.htm and at visitor centers.

Please note: The use of audio bird calls is illegal in the park.

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Staff Reviewers

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Great horned owls are one of more than a dozen raptor (birds of prey) species in Yellowstone.

Raptors

The park supports 19 breeding raptor species, with additional species during migrations and seasonal movements. The park monitors bald eagles, golden eagles, ospreys, and peregrine falcons. Bald eagles and peregrine falcons were previously listed as endangered and threatened species, and the park has continued monitoring since their delisting. The osprey is monitored because of the decline of one of their primary food sources, the cutthroat trout in Yellowstone Lake. The park monitors golden eagles because they are affected by expanding energy development and increasing human activity across the United States. Other species that occur in the park, such as American kestrels and Swainson's hawks, are of growing conservation concern throughout their ranges in the United States.

Yellowstone Raptor Initiative

The Yellowstone Raptor Initiative was a five-year (2011–2015) program designed to provide baseline information for species not previously monitored, including golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), American kestrels (*Falco sparverius*), prairie falcons (*Falco mexicanus*), and owls. .

Surveys located 28 pairs of golden eagles, and it is likely that more breed within the park. Observed breeding success was low on average and should be the subject of research in the future.

Researchers documented at least 60 red-tailed hawk territories across the northern range, with particularly high local density on the Blacktail Deer Plateau. Red-tailed hawks also exhibited variable breeding success that was, on average, much lower than the level thought necessary to maintain a stable population. Efforts to continue monitoring this species using citizen science are ongoing.

Swainson's hawks proved a difficult species to survey in Yellowstone. Most studies have focused on their association with agricultural land, and the park represents a somewhat unorthodox habitat for Swainson's hawks.

At least 17 species of raptor use Hayden Valley as a migration corridor, comparable to other migration sites in the Intermountain Flyway. The Initiative provided the first look at owl distribution and occurrence in the park. Continued surveys, will improve our knowledge and understanding of this understudied group of raptors. Finally, while not monitored during this study, accipiters are of growing conservation concern, particularly northern goshawks, and should be considered in future raptor studies.

Owls

Owl surveys continued after the completion of the Raptor Initiative in 2015, enabled by volunteers. Surveys provide an index of sites that attract advertising males of several northern forest owl species. Owl species diversity was lower in 2019 than in previous years, but surveyors observed the greatest overall owl abundance since surveys were initiated in 2013. In 2019, observers detected individuals of four owl species: boreal owl (10), great horned owl (5), northern saw-whet owl (16), and northern pygmy-owl (1).

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Bald Eagles

The bald eagle (*Haliaeetus leucocephalus*) was named the national symbol of the US by Congress in 1782. Found near open water from Mexico to Alaska, bald eagles may range over great distances but typically return to nest in the vicinity where they fledged. In greater Yellowstone, they feed primarily on fish, but also on waterfowl and carrion. Numbers declined dramatically during most of the 1900s due to habitat loss, shooting, and pesticide contamination. In 1967, the US Fish and Wildlife Service listed the bald eagle as an endangered species in 43 states, including Idaho, Montana, and Wyoming. Habitat protection, restrictions on killing, and restrictions on pesticide use led to population growth and delisting of the species in 2007. Bald eagles nesting in northwestern Wyoming are part of the Rocky Mountain breeding population that extends into Idaho and Montana.

Population

Bald eagles, which may reuse the same nest year after year, occupy territories near the park's major rivers and lakes. The number of eaglets that fledge each year depends partly on weather and can fluctuate widely. Juveniles may migrate west in the fall, but adults often stay in the park year-round. Historically, about half of the park's known bald eagle nests have been in the Yellowstone Lake area, where the productivity and success rates are generally much



Bald eagles are a recovered endangered species.

lower than in the rest of the park. However, in 2019, only eight of twenty active nests in the park were on Yellowstone Lake. Of those eight, three were successful and fledged five young in total. A recent study found little evidence to support the claim that cut-throat trout declines have resulted in lower nesting success for bald eagles on Yellowstone Lake.

Outlook

Research has shown that human presence can disturb eagle nesting and foraging; therefore, nest areas in national parks may be closed to visitors. Yellowstone manages nest sites on a case-by-case basis.

Bald Eagle Quick Facts

Number in Yellowstone

- In 2019, park staff monitored 31 bald eagle territories. Of 20 active nests seven (35%) successfully fledged young.
- Nine young were produced. Productivity for active nests in 2019 (0.45 young per nesting female) was just below average (0.73).

Identification

- Large, dark bird; adult (four or five years old) has completely white head and tail.
- Females larger than males, as is true with most predatory birds.
- Immature bald eagles show varying amounts of white; they can be mistaken for golden eagles.

Habitat

- Bald eagles are usually found near water where they feed on fish and waterfowl. They also generally nest in large trees close to water.

Behavior

- In severe winters, eagles may move to lower elevations such as Paradise Valley, north of the park, where food is more available. On these wintering areas, resident eagles may be joined by migrant bald eagles and golden eagles.
- Feed primarily on fish and waterfowl, except in winter when fish stay deeper in water and lakes and rivers may be frozen. Then they eat more waterfowl. Eagles will also eat carrion in winter if it is available.

- Form long-term pair bonds.
- Some adults stay in the park year-round, while others return to their nesting sites by late winter.
- Lays one to three eggs (usually two) from February to mid-April.
- Both adults incubate the eggs, which hatch in 34 to 36 days.
- At birth, young (eaglets) are immobile, downy, have their eyes open, and are completely dependent upon their parents for food.
- Can fly from the nest at 10–14 weeks old.
- Some young migrate in fall to western Oregon, California, and Washington.

Golden Eagles

Golden eagles (*Aquila chrysaetos*) are large, long-lived raptors that feed on grouse, small mammals (e.g., rabbits, marmots, and ground squirrels), and carrion. Across the western US, and in Wyoming in particular, there are growing concerns about the status of golden eagle populations due to broad-scale energy development (wind, gas) and increasing human activity. To better understand the current population status and the drivers of population trends across the ecosystem, park biologists began focused study of golden eagles in Yellowstone in 2011.

Surveys located 28 golden eagles territories inside the park. The resulting density in northern Yellowstone (one territory per 49.7 km²) is relatively high. Likewise, territory occupancy rates from 2011 to 2019 have been consistently high (100%). In contrast, low average productivity at these nests (0.35 young/occupied territory) is driven by both infrequent nesting attempts and low nest success. For example, in 2019, researchers monitored 18 occupied territories through the end of the breeding season; eight pairs nested and five nests were successful in fledging six young. With such low productivity, the Yellowstone golden eagle population may be dependent on outside immigration, although much about the status of the park's golden eagle population remains unknown.

In other studies, reproductive failure of eagles and other raptors has been correlated with weather (e.g., high failure in high precipitation years), often interacting with food availability. Research is investigating golden eagle habitat use in the park's northern range to better understand local population dynamics.

Outlook

In response to broad concerns about golden eagle populations, Wyoming has initiated a golden eagle working group, and the US Fish and Wildlife Service has instituted a western US study modeling eagle habitat suitability, human development risks, lead exposure, and large-scale movements. Better understanding of the ecology of YNP eagles requires study of their food habits, toxicology, survival, and movement both within and outside the park. In recent years, extensive data relating to these key topics have been collected in two study areas flanking the park to the north and east, and complementary research within the park is ongoing.



Golden eagles are named for the yellow feathers at the base of the neck.

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Staff Reviewers

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Osprey

Like many other birds of prey, osprey (*Pandion haliaeetus*) populations declined due to pesticide use in the mid-1900s and rebounded in the latter part of the century, after the banning of pesticides such as DDT. The first study of osprey in Yellowstone National Park was conducted by M. P. Skinner, the park's first naturalist, in 1917. It was not until 1987 that the Yellowstone National Park bird program began monitoring breeding osprey annually, although an extensive survey on reproduction, diet, and habitat was conducted during the 1970s.

Ospreys are surveyed via fixed-wing aircraft and by ground-based surveys from May through August. During the survey flights, the majority of nests are monitored for occupancy and breeding activity. In addition, all suitable lakes and rivers are surveyed for potential new territories and nest sites.

Since monitoring began, Yellowstone's population of osprey has declined, particularly on and around Yellowstone Lake. Nest success has remained relatively stable, with about 50% of nests producing one to two young per year.

Research

A recently completed study conducted by park biologists found a significant relationship between the declines in cutthroat trout and osprey reproduction at Yellowstone Lake. Recent increases in the number of young cutthroat trout caught by the Yellowstone fisheries program during the fall netting assessment are encouraging. An increase in cutthroat trout production may lead to an increase in nesting pairs of osprey and improved nesting success at Yellowstone Lake.



Ospreys are monitored by park staff. In 2017, 27 active nests were monitored in Yellowstone.

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Quick Facts

Number in Yellowstone

- In 2019, 20 active nests were monitored, of which 70% were successful, above the 32-year average (52%).
- Productivity for active nests in 2019 (1.4 young per nesting female) was also above the 32-year average (0.89).
- The single active osprey nest on Yellowstone Lake in 2019 was unsuccessful.

Identification

- Slightly smaller than the bald eagle.
- Mostly white belly, white head with dark streak through eye.
- Narrow wings, dark patch at bend.
- Fledglings have light edges to each dark feather on their backs and upper wing surfaces, which gives them a speckled appearance.

Habitat

- Dependent on fish for food, osprey are usually found near lakes (such as Yellowstone Lake), river

valleys (such as Hayden, Madison, Firehole, and Lamar valleys), and in river canyons (such as the Gardner Canyon and the Grand Canyon of the Yellowstone River).

Behavior

- Generally returns to Yellowstone in April and leaves in September.
- Builds nest of sticks in large trees or on pinnacles close to water.
- Lays two to three eggs in May to June.
- Eggs hatch in four to five weeks

Peregrine Falcons

The peregrine falcon is among the fastest birds, flying at up to 55 mph and diving at more than 200 mph when striking avian prey in mid-air. Peregrine populations began to decline in the 1940s because of pesticide contamination. One of three North American subspecies, the peregrine in Greater Yellowstone (*Falco peregrinus anatum*) was considered extirpated by the 1970s. As part of a national reintroduction program, captive-bred peregrines were released in Yellowstone and Grand Teton national parks during the 1980s. They typically reside in Greater Yellowstone from March through October, when their favored prey—songbirds and waterfowl—are most abundant. During winter, they migrate as far south as Mexico or Central America.

History

In 1962, Rachel Carson sounded an alarm about the irresponsible use of pesticides with her landmark book, *Silent Spring*. Among the dangers she described were the adverse effects of chemicals—particularly DDT—on the reproductive capacity of some birds, especially predatory species such as the bald eagle and peregrine falcon. Her book raised public awareness of this issue, and was one of the catalysts leading to the United States banning some of the most damaging pesticides.

The peregrine falcon was among the birds most affected by the toxins. It was listed as Endangered in 1970. Yellowstone National Park was a site for peregrine reintroductions in the 1980s, which were discontinued when the peregrine population began



TOM STANTON

Peregrine falcons are a recovered endangered species in Yellowstone.

increasing following restrictions on organochlorine pesticides in Canada and the United States, habitat protection, and the reintroduction program. The falcon made a comeback in much of its former range, and was delisted in 1999.

In Yellowstone, the most nesting pairs recorded was 32 in 2007, and they produced 47 fledglings. Although nesting pairs may reuse the same eyrie for many years, their remote locations on cliff ledges makes it impractical to locate and monitor activity at all eyries in a single year.

Yellowstone National Park's protected conditions and long-term monitoring of peregrines provide baseline information to compare against other populations in the United States. Continued monitoring is essential, not only for comparisons with other populations, but also because peregrine falcons and other raptors are reliable indicators of contaminants such as polybrominated diphenyl ether (PBDE), and of climate change. For example, to assess the levels

Quick Facts

Number in Yellowstone

- In 2019 park staff monitored 29 of the 36 known peregrine breeding territories. Nineteen territories were occupied.
- Thirteen of 17 occupied territories with known breeding outcomes fledged at least 26 young in 2019. Nest success was 76%, slightly above the 32-year average (71%).
- In 2019 average productivity was 1.5 young per occupied territory, approximately equal to the 32-year average.

Identification

- Slightly smaller than a crow.
- Black "helmet" and a black wedge below the eye.
- Uniformly gray under its wings. (The prairie falcon, which also summers in Yellowstone, has black "armpits.")
- Long tail, pointed wings.

Habitat

- Near water, meadows, cliffs.
- Nests on large cliffs over rivers or valleys where prey is abundant.

Behavior

- Resident in the park March through October, when its prey—songbirds and waterfowl—are abundant.
- Lays three to four eggs in late April to mid-May.
- Young fledge in July or early August.
- Dives at high speeds (can exceed 200 mph/320 kph) to strike prey in mid-air.

of PBDE and other contaminants, scientists collect eggshell remains after peregrines have left their nests for the season.

Recovery in Yellowstone

While the organochlorines found in peregrine eggshell fragments and feather samples have declined significantly, several studies indicate that certain flame-retardant chemicals developed in the 1970s for use in electronic equipment, textiles, paints, and many other products leach into the environment and have been found in birds of prey at levels that impair their reproductive biology. In 2010, 2011, 2013, and 2014 eggshell fragments, feathers, and prey remains were collected from nest sites in Yellowstone after fledging occurred. Comparative data on eggshell thickness, which is an indicator of environmental contaminants, is within the range considered normal for the Rocky Mountain Region.

The major cause of peregrine endangerment is no longer a threat and Yellowstone's peregrine population appears stable. Productivity and nesting success

have been relatively high in both 2018 and 2019 compared with the 32-year average, although the relatively low nesting success and productivity over the past decade warrants continued close monitoring of this species and may require further study to determine the cause(s).

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American white pelicans, sometimes mistaken for trumpeter swans at a distance, and other colonial nesting birds nest primarily on the Molly Islands in the southeast arm of Yellowstone Lake.

Wetland Birds

Approximately 30% of the bird species that breed in Yellowstone depend on wetlands. Scientists are concerned about these species because wetlands are expected to diminish as global and local temperatures increase. Yellowstone has years of data about the rate and success of nesting for some wetland species, but little information about changes in the timing of nesting activity—an indicator of climate change.

Colony Nesting Birds

Colonial nesting birds nest primarily on the Molly Islands in the southeast arm of Yellowstone Lake. These two small islands are cumulatively just 0.7–3.0 acres in size, depending on lake water levels, yet hundreds of birds have nested there in a single year.

Prior to the late 1970s, the Molly Islands were surveyed only intermittently. Some data go back to 1890 when nesting American white pelicans (*Pelecanus erythrorhynchos*) and California gulls (*Larus californicus*) were first noted in the area. Caspian terns (*Hydroprogne caspia*) are suspected of nesting on the Molly Islands as early as 1917, although information on breeding status was not collected until 1933. Double-crested cormorant (*Phalacrocorax auritus*) nests were confirmed by 1928.

Currently, pelicans, California gulls, and double-crested cormorants nest with varying rates of success. Photographic interpretation from three aerial surveys conducted June through August 2019, showed approximately 613 pelican nests that fledged an estimated 175 young. Biologists were unable to confirm if 16 nesting double-crested cormorants were successful in fledging any young. Though California gulls were observed on the island, none attempted to nest. As in recent years, no Caspian terns were observed on the islands.

Habitat

Birds nesting on the Molly Islands are subject to extreme environmental conditions ranging from flooding to frosts that can occur at any time of year to high winds. As a result, birds nesting there experience large year-to-year fluctuations in the number of nests initiated and fledglings produced. Populations of American white pelicans, California gulls, and double-crested cormorants have declined over the past 20 years. Caspian terns have not nested on the islands since 2005.

The reasons for the decline in colonial nesting birds are not well understood, but a previous study indicates that high levels of water in Yellowstone Lake are associated with low reproduction for nesting pelicans. Notably, quick spring melt-off events can cause a significant rise in the water level on Yellowstone Lake and flood the Molly Islands.

The decline in cutthroat trout, a known food source for the Molly Island colonial nesting birds, may also influence nesting success. Furthermore, bald eagles on Yellowstone Lake that formerly depended on cutthroat trout may have switched prey to target the flightless and vulnerable young of these colonial nesting species.

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Common Loons

The majority of the Greater Yellowstone Ecosystem's (GYE) breeding common loon (*Gavia immer*) population occurs in Yellowstone and is one of the most southerly breeding populations in North America. The common loon is listed as a Species of Special Concern in Wyoming because of its limited range, small population, sensitivity to human disturbance, and loss of breeding habitat outside of Yellowstone. The GYE's breeding loon population is isolated from populations to the north by more than 200 miles, limiting immigration from other populations. Since the mid-2000s, the population in the GYE has declined by 38%. Yellowstone's loon population has declined since surveys began in 1989, with a more dramatic decline in 2006. Since the mid-2000s, Wyoming's population has declined by 38%. Yellowstone's loon population has declined since surveys began in 1989, with a more dramatic decline in 2006. However, detailed data from a study initiated in 2012 indicate that the number of loons present in the park can vary widely from year to year. Continuing research



The common loon is a species of concern in Yellowstone.

will try to analyze any trends in productivity, nesting success, and number of breeding pairs to attempt to determine why some years are more productive than others.

Population

In 2019, biologists and park staff checked at least 34

Quick Facts

Number in Yellowstone

- In 2019, 39 loons in total. 15 territorial pairs. Seven successful nests produced 9 young.

Identification

- Breeding adults (March–October) have black and white checkering on back, a black bill, red eyes, and iridescent green head and neck. The neck has a black and white chinstrap and distinctive collar.
- Loon chicks hatch with a blackish-brown down and a white belly and retain this plumage for two weeks. Body feathers emerge at 4½ weeks on the chick's upper back. By six weeks, brown down remains only on the neck and flanks.
- Gray juvenile plumage is present at seven weeks.
- Juveniles and winter adults have dark upperparts and white underparts.

Habitat

- Summer on ponds or lakes: large lakes, such as Yellowstone, Lewis, and Heart lakes; and smaller ones such as Grebe and Riddle lakes.

- Winter on open water.
- May be found foraging or resting on larger, slow-moving rivers.
- Nest sites are usually on islands, hummocks in wetlands, or floating bog mats.
- Pairs nesting on lakes smaller than 60 acres usually require more than one lake in their territory. Lakes smaller than 15 acres are rarely used.

Behavior

- Primarily eat fish (4–8 inches).
- Unable to walk on land.
- Migrate in loose groups or on own, not in organized flocks. Arrive at summer lakes and ponds at or soon after ice-off.
- Four common calls: wail—for long-distance communication; yodel—used as a territorial signal by males only; tremolo—a staccato call, usually by an agitated adult; and hoot—a contact call, often between adults or adults and their young.

- Females generally lay two eggs, typically in June.
- Males and females share incubation duties equally. Chicks hatch after 27–30 days. Both adults also care for their young.
- Chicks are able to fend for themselves and attain flight at 11–12 weeks.
- In late summer, adults form social groups, especially on larger lakes, before leaving in October.

Management Concerns

- The breeding population in Wyoming is isolated; populations to the north are more than 200 miles away.
- Loons can be bioindicators of the aquatic integrity of lakes, responding to lead and mercury levels.
- Not all factors affecting loon reproduction in Yellowstone are known, but human disturbance of shoreline nests has a negative impact.

known or historic loon territories. Twenty of the territories were occupied by at least one loon. In total, the park housed 39 adult loons and 15 pairs. Twelve pairs attempted to nest, and five of those failed. The seven successful pairs produced nine loonlets during 2019.

Distribution

In the western United States, common loons breed in Idaho, Montana, Washington, and Wyoming. The total western US breeding population is estimated at 90 territorial pairs. In 2019, Yellowstone National Park hosted 70% of the GYE's total loon population and 67% of the breeding pairs. Furthermore, YNP loons produced 53% of the ecosystem's fledged chicks, highlighting the park's important role in regional loon population stability and persistence. Western populations of breeding common loons are known to overwinter from Washington south to California. Spring and fall migrants in Wyoming represent breeding populations from Saskatchewan that overwinter around Mexico's Baja California peninsula.

Outlook

There are several threats to Wyoming's loon populations. Direct human disturbance to shoreline nests and chicks lowers survival rates and adversely affects numerous loon territories in YNP each year. Increased outreach to the public to minimize shoreline disturbance could help improve the long-term outlook for loons within the park. Throughout YNP and Wyoming, the loss of breeding habitats and water level fluctuations (e.g., erratic spring flooding) also impact loon nest success and productivity.

Contaminants like lead (from sinkers) and mercury, in combination with hazards on wintering

grounds (e.g., marine oil spills and fishing nets) challenge loon reproduction and survival even further. Visitors to Yellowstone's lakes can help minimize disturbance of loon nests by staying on trails during the breeding season, avoiding shorelines, and, as with all wildlife species, giving adult and fledgling loons plenty of space.

Several loons are killed every year on Yellowstone Lake by gill nets as bycatch in the park's effort to remove invasive lake trout from the lake. Ongoing research will better assess patterns in gillnetting mortalities to improve coordination with fisheries crews, thereby reducing the threat to local loons while allowing for continued lake trout removal.

Fish are the primary prey of loons. As part of a multi-park study on mercury concentration in fish, fish from various lakes where loons nest were screened for mercury. Fish were sampled from Beula, Grebe, Yellowstone, and Lewis lakes. Fish from Beula, Grebe, and Yellowstone lakes exceeded the threshold at which fish-eating birds may be affected by mercury toxicity. Fish from Lewis did not exceed that threshold, although they still contained mercury.

Loons can live up to 30 years, have relatively low chick production, and are poor colonizers to new breeding areas. Given the very small size and isolation of Wyoming's breeding loon population, it is at a particularly high risk of local extinction.

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Staff Reviewers

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Trumpeter Swans

The trumpeter swan (*Cygnus buccinator*), named for its resonant call, is North America's largest wild waterfowl, with a wingspan of up to eight feet. These swans require open water, feed mainly on aquatic plants, and nest in wetlands. Although they once nested from Alaska to northern Missouri, trumpeter swans were nearly extirpated in the lower 48 states by 1930 due to habitat loss and hunting. A small population of approximately 70 birds survived in the Greater Yellowstone Ecosystem. With intensive management, this population provided the basis for widespread swan recovery later in the century.

As a result of conservation measures, populations across the continental United States began increasing. As of 2015, there are approximately 63,000 trumpeter swans in North America belonging to three distinct subpopulations: the Pacific, the Rocky Mountain, and the Interior. Swan numbers in the Greater Yellowstone Ecosystem, belonging to the Rocky Mountain subpopulation, grew steadily through the early 1960s, after which cygnet production in Yellowstone and subsequent recruitment of adults into the breeding population began declining.

Population

The park's resident trumpeter swan population increased after counts began in 1931 and peaked at 72 in 1961. The number began declining shortly after and dropped further after the Red Rock Lakes National Wildlife Refuge feeding program ended and winter ponds were drained in the early 1990s. Other factors contributing to the decline may include



A pair of trumpeter swans successfully fledged four cygnets (young) on Grebe Lake in 2012.

predation, climate change, and human disturbance. In 2019, park biologists observed 27 trumpeter swans in Yellowstone, including 21 adults and 6 cygnets. Two pairs attempted to nest in the park, on Swan Lake and an unnamed pond west of Lilypad Lake in the Bechler region, and a third pair on Grebe Lake did not nest in 2019. A fourth pair attempted to nest on Junco Lake, outside the park's southern boundary. Both nest attempts in the park were successful, hatching at least seven cygnets and fledging four.

Four young trumpeter swans were released in Yellowstone in 2019 in Hayden Valley on the Yellowstone River, near the confluence with Alum Creek. Staff hope that these released swans will become bonded to their release location and return the following spring. In total, the park has released 35 cygnets over a seven-year period. Although several individuals are frequently seen within the park boundaries during the breeding season, none of the

Quick Facts

Number in Yellowstone

27 resident swans in 2019, including three territorial pairs.

Trumpeter swans are increasing in the Rocky Mountains, stable in the Greater Yellowstone Ecosystem, but declining in Yellowstone National Park.

Identification

- White feathers, black bill with a pink streak at the base of the upper mandible.
- During migration, can be confused with the tundra swan. Trumpeters are larger and have narrower heads, a pink mandible stripe, and

lack a yellow spot in front of the eye.

Habitat

- Slow-moving rivers or quiet lakes.
- Nest is a large, floating mass of vegetation.

Behavior

- Feed on submerged vegetation and aquatic invertebrates.
- Low reproduction rates.
- Can fail to hatch eggs if disturbed by humans.
- Lay four to six eggs in June; young (cygnets) fledge in late September

or early October.

- Usually in pairs with young in summer; larger groups in winter.

Management Concerns

- Limiting factors in Yellowstone appear to be flooding of nests, predation, possibly effects of drought caused by climate change, and less immigration into the park from outside locations.
- Because swans are sensitive to human disturbance during nesting, nest areas are closed to public entry.

released cygnets have nested within the park yet.

Swans typically take at least four years to reach sexual maturity, so biologists are hopeful some of these young birds may breed in coming years. The release program is part of an ongoing effort to augment Yellowstone's swan populations and increase the number of breeding pairs that nest inside the park.

Nearly all Rocky Mountain trumpeter swans—including several thousand that migrate from Canada—over-winter in ice-free waters in the Greater Yellowstone Ecosystem, but only a portion of them remain here to breed.

The best available scientific evidence suggests that Yellowstone provides marginal conditions for nesting and acts as a sink for swans dispersing from more productive areas. This effect has been compounded in recent decades by reduced wetland areas (due to long-term drought or warmer temperatures) and community dynamics (e.g., changes in bald eagle diets due to the limited availability of cutthroat trout in Yellowstone Lake.). Trumpeter swan presence in the park may therefore be primarily limited to occasional residents and wintering migrants from outside the park. Concern about the Greater Yellowstone Ecosystem population has resulted in cooperative efforts between state and federal agencies to monitor swan distribution and productivity.

Across the region, federal agencies currently survey swans in September to estimate the resident swan population and annual number of cygnets produced.

Outlook

Trumpeter swans are particularly sensitive to human disturbance. Because of this, park managers restrict



Trumpeter swans are a species of concern in Yellowstone.



Current nesting range of trumpeter swans.

human activity in known swan territories and nesting areas. A graduate study investigating the habitat requirements for nesting swans and the drivers for the observed local population decline has also been initiated.

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Staff Reviewers

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Songbirds, such as this mountain chickadee, and woodpeckers comprise the majority of bird species in Yellowstone National Park.

Songbirds and Woodpeckers

Songbirds and woodpeckers, or passerine and near passerine species, comprise the majority of bird species in Yellowstone National Park. They are monitored through counts in willow stands, recently burned forests, mature forests, and grasslands/sagebrush steppe; the North American Breeding Bird Survey; fall migration surveys; and a summer and early fall banding station.

Willows

Willow stands are one of a few deciduous wetland habitats in the Greater Yellowstone Ecosystem. Bird diversity is considerably higher in wetland habitats than in grasslands, shrublands, and upland coniferous forests. Several Yellowstone bird species, including Wilson's warbler (*Cardellina pusilla*), willow flycatcher (*Empidonax traillii*), and gray catbird (*Dumetella carolinensis*), only breed in willow communities.

From the early 1900s, growth of willows and other woody vegetation on Yellowstone's northern range was stunted (suppressed) by elk browsing, reduced beaver populations, consumption by fire, and/or climate change. Correlated with the recovery of several large predator species in the park, some willow stands in the northern range have grown taller and thicker since the mid-1990s, creating a range of growth conditions in current willow stands.

Monitoring of willow–songbird communities in Yellowstone began in 2005. Scientists compare the presence and abundance of breeding songbirds across different willow stand conditions. In 2019, park staff recorded 35 songbird species in willows. Species richness (diversity) and average songbird abundance was higher in taller than in suppressed willows. Recovered willow stands provide shrubby cover for ground- and low-nesting species such as song sparrows. Suppressed willows appear to

provide habitat for generalist and grassland/sagebrush species. Willow stands are slowly changing and biologists plan to regularly reassess the vegetation characteristics as bird communities continue to be monitored.

Mature Forests

While the importance of mature and old growth forests to songbirds is poorly understood, mature forests notably provide nesting habitat and foraging opportunities for many species that young stands do not. Climate warming may cause more frequent and severe fires in Yellowstone National Park, which could disproportionately impact mature forest stands that, by definition, take longer to regenerate post-burn.

Due to the potential loss of this habitat type as the climate changes, park biologists initiated songbird surveys in three mature forest types in 2017 to document the bird communities that currently use them. No surveyed forests had a major disturbance (i.e., wildfire) in at least 100 years, although forest structure and tree species composition varied. In 2019, observers recorded 26 species and the most abundant species were yellow-rumped warbler (*Setophaga coronata*), dark-eyed junco (*Junco hyemalis*), mountain chickadee (*Poecile gambeli*), and American robin (*Turdus migratorius*). Species richness increased with forest complexity from 15 species in lodgepole-dominated and mixed lodgepole-spruce forests to 20 species in Douglas fir and spruce.

Burned Landscapes

Birds are among the first returning vertebrates to a forests affected by fire. Birds that nest in cavities of trees depend on forest fires to provide their habitat—and different species depend on different effects of forest fires. For example, black-backed (*Picoides arcticus*), American three-toed (*P. dorsalis*), and hairy



Three-toed woodpeckers nest in trees that burned in low to moderately severe fires, and hunt for the beetles in the bark.

(*P. villosus*) woodpeckers use trees that burned in low to moderately severe fires, two to four years after the fire. Northern flickers (*Colaptes auratus*) move into severely burned areas three years after a fire. Standing dead trees left behind after a fire attract bark and wood-boring beetles—primary prey for woodpeckers. Nest cavities created by woodpeckers are later used by chickadees, nuthatches, bluebirds, owls, and some species of duck.

Because fire size, frequency, and intensity are expected to increase with climate change, scientists are studying how the different bird species use different types of post-burn forests and they are developing monitoring methods for the future.

Grasslands/Sagebrush Steppe

Grasslands are a threatened habitat type across the continent and grassland songbirds are the most imperiled songbird guild in North America. In Yellowstone, grasslands and sagebrush steppe are impacted by invasive plants, changing intensities of ungulate browse, and climate change. In 2019, bird program staff and volunteers conducted songbird surveys in sagebrush steppe and grasslands across the northern range, in areas that vary in bison grazing intensity as well as native and invasive plant species composition.

Staff observed 24 species of songbird in grasslands and sagebrush steppe in 2019. In areas with high grazing intensity and abundant non-natives, the most abundant species were horned lark (*Eremophila alpestris*), Brewer's blackbird (*Euphagus cyanocephalus*), and western meadowlark (*Sturnella neglecta*).

At other sites, species diversity varied significantly, although Brewer's sparrow (*Spizella breweri*), vesper sparrow (*Pooecetes gramineus*), and savannah sparrow (*Passerculus sandwichensis*) were all common.

Breeding Bird Surveys

North American Breeding Bird Surveys (BBS) are a continent-wide monitoring effort coordinated by the US Geological Survey, the Canadian Wildlife Service's Research Center, and Mexico's National Commission for the Knowledge and Use of Biodiversity (CONABIO). Since the 1980s, Yellowstone National Park has participated in these long-term surveys conducted throughout North America. The surveys are road-based with the registered observer recording all birds seen and heard within a quarter mile radius; survey points occur every half mile. Surveys are conducted in June, during the height of the songbird breeding season, and occur on three routes: Mammoth (Indian Creek to Tower Junction), Northeast Entrance (Tower Junction to Round Prairie), and the Yellowstone route (Dunraven Pass to Mary Bay).

In 2019, surveyors detected 2,285 individuals of 80 species. The greatest overall bird abundance (1,243) was observed along the Yellowstone route through the interior. Large flocks of Canada geese along the Yellowstone River accounted for 51% of all observations along the interior route. Canada goose numbers were relatively stable from 1987 to 2010, after which they increased substantially.

Fall Migration

Fall migration represents an important and vulnerable part of the annual cycle for many songbirds. As they make the long journey south to winter range, migrating songbirds must find appropriate places to rest and refuel. During this season, the songbird community within Yellowstone National Park changes, accommodating species and individuals who do not breed here but are just passing through. In addition to breeding-season efforts, bird program staff monitor autumn songbirds in willow stands, mature forest, and grassland/sagebrush steppe to better document patterns in habitat use by fall resident and migrating passerines.

Songbirds, particularly migrants, were most abundant and diverse in willows in the fall, consistent with patterns seen during the breeding season.

In sagebrush steppe, migrants were more frequent and more diverse than resident songbirds, while mature forest largely provided fall habitat for resident species. Dark-eyed juncos were the most common fall songbird species in willows as well as in mature forest. In grasslands and sagebrush steppe, Brewer's blackbirds were the most commonly observed species. These fall surveys help highlight the year-round importance of Yellowstone to the resident and migrant avian community.

Banding Station

While songbird counts can provide good estimates for songbird diversity and abundance, they do not provide any information about measures of demography, i.e., reproduction and survival. To improve our understanding of songbird demography in the park, the bird program began annual operations of a mist-netting and songbird banding station in 2018, located in a willow-lined riparian corridor on the northern range. During the breeding season, researchers participated in the international MAPS (Monitoring Avian Productivity and Survivorship) program, operated by the Institute for Bird Populations. To help assess use of riparian habitats by juvenile and migrating songbirds, staff continued banding operations into the fall, through late September.

In 2019, staff captured 163 birds belonging to 28 different species during the breeding season, including 11 songbird species which were not identified during point count surveys of the same willow corridor. In the fall, an additional 310 birds of 31 species were captured. The most commonly captured species in the breeding season were yellow warbler (*Setophaga petechia*) and warbling vireo (*Vireo gilvus*) and, in the fall, Wilson's warbler.



Biological technicians take vital statistics and measurements from a Yellow warbler while fitting the bird with a band.

Continued netting and banding efforts in future years will provide additional demographic information that will help researchers better understand songbird population dynamics within the park.

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American avocets are one of the nearly 300 bird species found in Yellowstone National Park. These shorebirds sweep their upturned bills back and forth through shallow water to collect aquatic invertebrates.

Other Notable Birds

American Dippers

The dark-gray American dipper (*Cinclus mexicanus*) bobs beside streams and rivers. Also called the water ouzel, the dipper dives into the water and swims in search of aquatic insects. Thick, downy feathers made waterproof with oil from a preen gland enable this bird to thrive in cold waters.

Ravens

Several members of the Corvid family (jays, crows, and ravens) live in Yellowstone, including the common raven (*Corvus corax*). Common ravens are smart birds, able to put together cause and effect. Ravens are attracted to wolf kills and may follow wolves while they hunt elk. Wolves also provide better access to carrion, as ravens are not able to rip open thick skin on their own. Ravens are willing to eat almost anything and are frequently seen near parking lots searching for food. Do not feed them.

Recent surveys indicate 200–300 ravens are present in the northern range of Yellowstone and 53% of those are in wolf habitat, away from human areas. Before wolf reintroduction, nearly 74% of ravens likely used human areas. Researchers are further investigating seasonal and spatial patterns in raven habitat use, and ravens' relationships with humans and wolves using satellite transmitters by monitoring raven movements using satellite transmitters.

Clark's Nutcrackers

Clark's nutcracker (*Nucifraga columbiana*) is common throughout Yellowstone. Nutcrackers are important seed dispersers for many western conifers and are the primary disperser for whitebark pine (*Pinus albicaulis*). Whitebark pine seeds are the preferred food resource for nutcrackers and the

two species are heavily dependent on one another. Whitebark pine prevalence is threatened throughout the west, including the park due to infestations of mountain pine beetle, white pine blister rust, and a changing climate and fire regime. To track nutcrackers' response to projected declines in whitebark pine, researchers are monitoring nutcracker populations, habitat and food selection.

Sandhill Cranes

Sandhill cranes (*Grus canadensis*) nest in Yellowstone each summer. Because their gray feathers blend in well with the grassland habitat, their guttural calls announce their presence long before most people see them. The tallest birds in Yellowstone, they stand about four feet (1.2 m) high. They have a wingspan of approximately 6.5 feet (2 m) and are often mistaken for standing humans or other animals at a distance.

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Yellowstone cutthroat trout are found in Yellowstone National Park and are a keystone species. They provide an important source of energy for many species of birds and mammals.

Fish and Aquatic Species

For millennia, humans harvested Yellowstone fish for food. From the park's inception more than a century ago, fishing has been a major form of visitor recreation. It is this long-standing tradition and integration with the parks' cultural significance that allows the practice of recreational fishing to continue in Yellowstone National Park today. In some cases, it also contributes to the National Park Service goal of preserving native species. The biological significance of fish to ecosystems makes them an ongoing subject of study and concern.

History

About 8,000–10,000 years ago twelve species, or subspecies, of native fish, including Arctic grayling, mountain whitefish, and cutthroat trout, dispersed to this region following glacial melt. These native fish species provided food for both wildlife and human inhabitants. The distribution of native fish species was originally constrained by natural waterfalls and watershed divides. These landscape features provided a natural variation of species distributed across the landscape and vast areas of fishless water. At the time Yellowstone National Park was established in 1872, approximately 40% of its waters were barren

Quick Facts

Number in Yellowstone

- 11 native species
 - Arctic grayling
 - cutthroat trout (Yellowstone and westslope)
 - mountain whitefish
 - longnose dace, speckled dace
 - reidside shiner
 - Utah chub
 - longnose sucker, mountain sucker, Utah sucker
 - mottled sculpin
- 5 nonnative species
 - brook trout
 - brown trout
 - lake trout
 - lake chub
 - rainbow trout

History

- When the park was established, many of its waters were fishless.
- Park waters were stocked with native and nonnative fish until the mid-1950s.
- Stocking changed the ecology of many Yellowstone waters as nonnative fish displaced or interbred with native species.
- By the 1960s, native trout populations were in poor condition, and the angling experience had declined.
- By the late 1980s, native trout had recovered in some areas due to restrictions in fish harvest.

- In 2001, fishing regulations changed to require the release of all native fishes caught in park waters.

Threats

- Lake trout were illegally introduced into Yellowstone Lake.
- Whirling disease and New Zealand mud snails are present in some waterways.
- Competition and hybridization occurs with nonnative rainbow trout in Slough Creek and Tower Creek.

of fish including Lewis Lake, Shoshone Lake, and the Firehole River above Firehole Falls.

Park inhabitants and visitors fished for sustenance and survival in this wild, remote place. While most hunting was curtailed by early park management, fishing was not only allowed but encouraged. Driven by the desire to establish recreational fishing in more park waters and new technology that enabled the long-distance transport of fish, early park managers stocked fish into fishless waters, reared fish in hatcheries, and introduced several nonnative species. The majority of the nonnative fish introductions were trout species (lake trout, brook trout, brown trout, and rainbow trout), but other species were also introduced.

Constrained by geography, the native fish within the stocked waters were forced to live together with the nonnatives, be displaced to downstream habitats, or die out. The ranges and densities of Yellowstone's native trout and grayling were substantially altered. Nonnative species contributed to the decline in the park's native fish population by competing for food and habitat, preying on native fish, and degrading the genetic integrity of native fish through hybridization. By the 1930s, managers realized the destructive impact caused by nonnative fish. As a result, the National Park Service (NPS) created a formal stocking policy to discontinue these efforts.

Even though stocking of nonnatives stopped, stocking of Yellowstone cutthroat trout from Yellowstone Lake continued both within and outside the species' native range. Overall, from the early 1880s to the mid-1950s, more than 300 million fish were stocked throughout Yellowstone. Today, about 40 lakes have fish; the others were either not stocked or have reverted to their original fishless condition.

Influences of Some Nonnative Species

Aquatic invasive species disrupt ecological processes because they are not indigenous to the ecosystem. Invasive organisms can cause species extinction, with the highest extinction rates occurring in freshwater environments. Aquatic nonnative species that are having a significant detrimental effect on the park's aquatic ecology include lake trout in Yellowstone Lake; brook, brown, and rainbow trout in the park's streams and rivers; and the parasite that causes whirling disease. Though there are other aquatic nonnative species in the park, their impacts do not appear to be as significant.

Conservation

Yellowstone's approach to native fish conservation has greatly evolved over the past several decades, as continued losses of native fish and altered ecology were realized. Management now focuses on large-scale actions to preserve and restore native fish faced with nonnative threats. The success of these activities requires a broad approach; includes a wide range of partners and stakeholders; and utilizes independent scientific oversight, assessment, and periodic adjustments to ensure conservation goals are being met.

Despite changes in species composition and distribution, large-scale habitat degradation has not occurred in park waters. Water diversions, water pollution, and other such impacts on aquatic ecosystems have rarely occurred in Yellowstone. Consequently, fish and other aquatic inhabitants continue to provide important food for mammals such as bears, river otters, mink, and at least sixteen species of bird.

Fishing in Yellowstone

About 50,000 of the park's four million visitors fish each year. Fishing has been a popular recreational activity for visitors for more than 100 years, and many people come to Yellowstone just to fish. Though angling is an anomaly in a national park where the primary purpose is to preserve natural environments and native species in ways that maintain natural conditions. Fishing can help support preservation of native species.

Anglers Assist with Native Species Conservation

The activities necessary to preserve and restore native fish varies by species and drainages across the park. In order to promote the preservation of native fish in Yellowstone, the park has designated the Native Trout Conservation Area for special management.



Many people, like this angler on the Gardner River, come to Yellowstone to fish.

FREQUENTLY ASKED QUESTION:

Why is fishing lead-free in Yellowstone?

Birds such as loons, waterfowl, cranes, and shorebirds are vulnerable to lead poisoning. While we can do little about natural hazards, we can minimize the effects of lead on these species. Yellowstone National Park bans most lead tackle. (Terminal tackle must be lead-free; large down-rigger weights used to fish for deep-dwelling lake trout are permissible because they are too large to be ingested.)

Within that area, fishing regulations are structured so that recreational anglers help selectively remove non-native species from the area without damaging the native fishery. In some areas, angler harvest will help to save the native fish and the natural ecosystems they support.

Anglers contribute to the fisheries database by filling out a Volunteer Angler Report card that is issued with each fishing license. This information helps monitor the status of fisheries throughout the park. Angler groups have also lent support to management actions, such as closing the Fishing Bridge to fishing in the early 1970s. Yellowstone cutthroat trout support a \$36 million annual sport fishery to the local economy. Also, money generated from fishing licenses helps fund research on aquatic systems and restoration projects.

Decisions about how best to achieve native fish preservation and recovery goals must be based in sound scientific research and be consistent with the mission of the National Park Service. In past years, a team of fishing volunteers assisted the fisheries program with several other projects. These projects included nonnative species removal, species composition, fish barrier evaluation, and injury and mortality rates of barbed and barbless hooks. Their extensive help collecting data and biological samples allows park biologists to learn about many more areas than park staff would have time to access.

Fishing Regulations

Fishing regulations in Yellowstone National Park are structured to strongly support native fish conservation goals. Complete regulations are available at all ranger stations, and visitor centers, online at www.nps.gov/yell/planyourvisit/fishing.htm, and in stores where fishing licences can be purchased.

In summary:

- Fishing is only allowed from the Saturday before Memorial Day through the first weekend in November.
- A park permit is required, state fishing licenses are not valid.
- Tackle must be lead-free and barbless. No organic or inorganic bait is allowed. Felt-soled footwear is prohibited.
- All cutthroat trout, Arctic grayling, and mountain whitefish must be released.
- Lake trout must be killed if caught in Yellowstone Lake and its tributaries.
- Nonnative trout must be killed in the Lamar River drainage and the Yellowstone River drainage above Knowles Falls.

Certain waters are closed to protect rare or endangered species, nesting birds, critical habitat, or to provide undisturbed vistas.

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The three native species most popular with Yellowstone anglers are: Arctic grayling, cutthroat trout (above; two subspecies: Yellowstone cutthroat trout and westslope cutthroat trout), and mountain whitefish.

Native Fish Species

Yellowstone's native fish underpin natural food webs, have great local economic significance, and provide exceptional visitor experiences. Though policies of the National Park Service provide substantial protection from pollution and land-use practices that often degrade habitat, historic management efforts by the park service subjected native species to the effects of nonnative fish introductions, egg-taking operations, commercial fishing, and intensive sport-fishery harvest into the middle of the twentieth century.

To reverse declining native fish populations and loss of ecosystem integrity, the National Park Service now takes action to promote their recovery. A Native Fish Conservation Plan/Environmental Assessment was completed in 2010. The National Park Service aims to reduce long-term extinction risk and restore the ecological role of native species, including Arctic grayling, westslope cutthroat trout, and Yellowstone cutthroat trout, while ensuring sustainable native fish angling and viewing opportunities for visitors. Scientific peer review continues to provide guidance for future efforts on Yellowstone fisheries. The National Park Service strives to use the best methods available for addressing threats, with a focus on direct, aggressive intervention, and welcome assistance by visiting anglers.

Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*)

Yellowstone cutthroat trout (YCT) are the most widespread native trout in the park and were the dominant fish species here prior to Euroamerican settlement. They are an important species, upon which many other species depend. They provide an important source of food for an estimated 16 species of birds, as well as mammals including bears, river otters, and mink.

Genetically pure YCT populations have declined throughout their natural range in the Intermountain West, succumbing to competition with and predation by nonnative fish species, a loss of genetic integrity through hybridization, habitat degradation, and angling harvest. Many of the remaining genetically pure YCT are found within the park. State and federal wildlife agencies classify YCT as a sensitive species. However, the US Fish and Wildlife Service does not warrant listing the YCT as a threatened species under the Endangered Species Act.

Description

- Red slash along jaw and spots common to all cutthroat varieties.
- Body mostly yellow-brown with darker olive or gray hues on the back, lighter yellow on sides.
- Highly variable black spotting pattern.

Distribution

- Native to the Yellowstone River, Snake River, and Falls River drainages.
- Require cold, clean water in streams or lakes.

Behavior

- Spawn in rivers or streams from late April until mid-July.
- Most important foods are aquatic insects—mayflies, stoneflies, caddisflies, etc.—and other small aquatic animals, plus terrestrial insects that fall into the water.
- Also eat smaller fish, fish eggs, small rodents, frogs, algae and other plants, and plankton.

Population

The Yellowstone cutthroat trout population in the Yellowstone Lake ecosystem has declined substantially since the mid-1980s. Lake-wide sampling began

in 1968, and in 2014 the average number of YCT caught at survey sites reached a recent high of 28.4 fish per 100 meters of net. Average number of fish in 2019 was 21.1 fish per 100 meters of net.

Monitoring at Clear Creek, a Yellowstone Lake tributary, began in 1945. The number of YCT spawning there peaked at more than 70,000 in 1978 and fell to 538 by 2007. The decline is attributed to predation by nonnative lake trout, low water during drought years, and *myxobolus cerebralis*, the nonnative parasite that causes whirling disease.

Two-thirds of the streams that were part of the species' native habitat outside the Yellowstone Lake watershed still contain genetically pure YCT; in other streams, they have hybridized with rainbow trout.

History

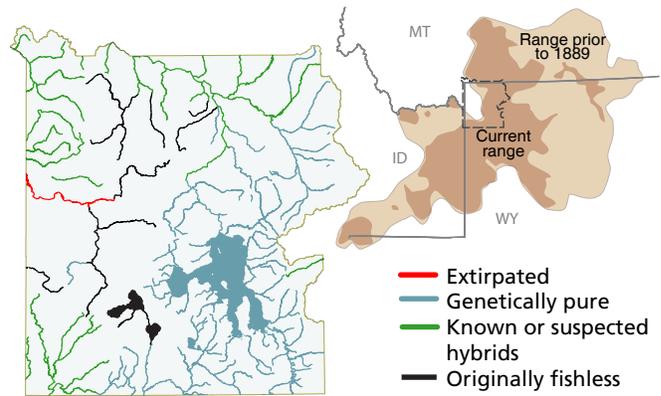
Yellowstone Lake and the Yellowstone River together contain the largest inland population of cutthroat trout in the world. While the Yellowstone cutthroat trout is historically a Pacific drainage species, it naturally traveled across the Continental Divide into the Atlantic drainage. One possible such passage in the Yellowstone area is Two Ocean Pass, south of the park in the Teton Wilderness.

The variety of habitats resulted in the evolution of various life-history types among Yellowstone cutthroat trout. Some populations live and spawn within a single stream or river (fluvial), some live in a stream and move into a tributary to spawn (fluvial-adfluvial), some live in a lake and spawn in a tributary (lacustrine-adfluvial), and still others live in a lake and spawn in an outlet stream (allacustrine). Life-history diversity within an ecosystem helps protect a population from being lost in a single extreme natural event.

Habitat remains pristine within Yellowstone National Park, but nonnative fish species pose a serious threat to native fish. In Yellowstone Lake, lake trout are a major predator of cutthroat trout. In other waters, brown, brook, and rainbow trout all compete with cutthroat trout for food and habitat. Rainbow trout pose the additional threat of hybridizing with cutthroat trout. Because of the lack of barriers in the lower reaches of most drainages, nonnative fish have been dispersing upstream and have replaced, or threaten to replace, cutthroat trout.

Restoration

The objectives of Yellowstone's Native Fish Conservation Plan (2010) include recovery of YCT



Past and present range of the Yellowstone cutthroat trout.

abundance in the lake to levels documented in the late 1990s, maintaining access for spawning YCT in at least 45 of Yellowstone Lake's 59 historical spawning tributaries, and maintaining or restoring genetically pure YCT in the current extent of streams occupied by pure or hybrid YCT.

Lamar River: Because no barriers to upstream fish migration exist in the mainstem Lamar River, descendants of rainbow trout stocked in the 1930s have spread to many locations across the watershed and hybridized with cutthroat trout. Genetic analysis indicates that cutthroat trout in the headwater reaches of the Lamar River remain genetically unaltered.

To protect remaining Yellowstone cutthroat trout, the NPS implemented a selective removal approach. A mandatory kill fishing regulation on all rainbow trout caught upstream of the Lamar River bridge was instituted in 2014. All nonnative fish and identifiable cutthroat x rainbow trout hybrids upstream of Knowles Falls must be killed. Selective removal by electrofishing has been conducted annually through the Lamar Valley since 2013. In 2019, 7% of fish sampled during electrofishing surveys upstream of the Lamar River Canyon were classified as rainbow or hybrid trout. This low percentage is a stark contrast to work conducted downstream of the Canyon.

In 2015, 136 fish were sampled downstream of the Lamar River Bridge. Based on field identification, 48% were Yellowstone cutthroat trout, 19% were rainbow trout, and 31% were hybrids. The majority of these fish were tagged with radio transmitters or passive integrated transponder (PIT) tags as part of an ongoing research project to determine whether Yellowstone cutthroat, rainbow, and hybrid trout are using the same areas to spawn, to determine spawn timing, and to inform management actions.

Slough Creek: In Slough Creek, rainbow/cutthroat

trout hybrids have increasingly been found with over the past decade. A barrier to upstream fish movement was constructed. With a barrier in place and rainbow trout no longer allowed passage into the system, existing rainbow and hybrid trout can be managed effectively with angling and electrofishing removal.

Soda Butte Creek: Brook trout became established in Soda Butte Creek outside the park boundary and spread downstream into park waters in the early 2000s. Initially, brook trout were isolated in headwater reaches by a chemical barrier created by mine contamination upstream of Cooke City, Montana. When the mine tailings were capped and water quality improved, brook trout passed downstream and began to negatively impact the cutthroat trout.

For nearly two decades, interagency electrofishing surveys were enough to keep brook trout populations low, but this action did not prevent range expansion. Over time, brook trout spread downstream and became a threat to the Lamar River. In addition, rainbow trout hybridization continued to be identified in cutthroat trout upstream of Ice Box Canyon.

In 2013 Ice Box Falls was modified to be a complete barrier to upstream fish movement, thus entirely eliminating the threat of nonnative fish traveling upstream. Nearly 450 brook trout were removed during the chemical treatment in 2015. Only two brook trout were collected from Soda Butte Creek during a second treatment in 2016. Since 2017, eDNA and electrofishing sampling as well as electrofishing surveys, found no evidence of brook trout in the system. This is a good indication that a complete kill was achieved in the drainage.

Elk Creek Complex: There is a natural cascade barrier in Elk Creek just upstream from its confluence with the Yellowstone River. The cascade prevented fish from naturally populating the system, so the Elk, Lost, and Yancey creeks complex of streams (Elk Creek Complex) was fishless when first stocked with cutthroat trout in the early 1920s. In 1942, the streams were stocked with brook trout, resulting in the complete loss of cutthroat trout.

The Elk Creek Complex was treated with rotenone annually from 2012 to 2014 to remove brook trout. Once clear of brook trout, reintroduction of native Yellowstone cutthroat trout began. Antelope and Pebble creeks provided fish for stocking in October 2015. Additional stocking took place in 2016 and 2017. Natural reproduction was also documented in 2017 during electrofishing surveys.

Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*)



Historically the most abundant and widely distributed subspecies of cutthroat trout, the westslope cutthroat trout (*Oncorhynchus clarkii lewisi*, WCT) occupies less than 5% of its former range in the upper Missouri River drainage. It evolved from a common ancestor of the Yellowstone subspecies, and shares their food and habitat requirements. By the 1930s, WCT were nearly eliminated from park streams because of the stocking of competing trout (nonnative brook and brown trout) and interbreeding with nonnative rainbow and Yellowstone cutthroat trout. In most of its remaining habitat (an estimated 64% of the approximately 641 stream miles it once occupied in the park), it exists only in hybridized form.

Description

- Red slash along jaw and dark spots, common to all cutthroat varieties, along top and tail.
- Greenish gray in color.
- Larger, irregular spots along lateral line and toward gills and head.
- Crimson streak above the belly.
- Sometimes mistaken for rainbow trout.

Distribution

- Prior to restoration work, genetically pure populations only existed in Last Chance Creek and Oxbow/Geode Creek complex.
- Restored populations are now found in the East Fork Specimen and Grayling creeks, Goose and High lakes, and the upper portion of the Gibbon River drainage, including Wolf and Grebe lakes and surrounding tributaries and streams.
- Hybridized populations found in many river drainages in the Madison Basin.

Restoration

Native species restoration depends on secure brood sources. A brood should be accessible, safe from

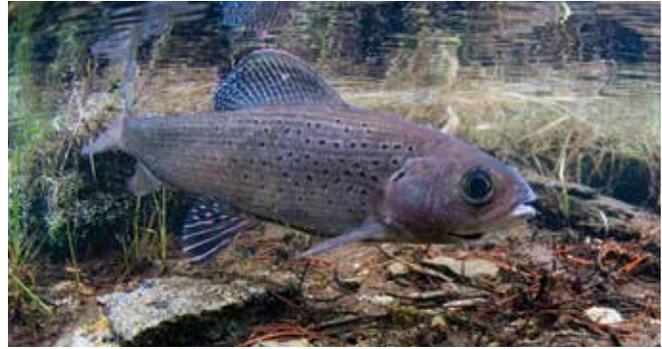
contamination, self-sustaining, genetically diverse, abundant, of traceable origin, and pose no risk to existing wild populations.

Genetically pure WCT only persisted in one tributary in the Madison River drainage (now called Last Chance Creek), and in the Oxbow/Geode Creek complex where they were introduced in the 1920s. In 2006, Yellowstone began efforts to restore WCT in East Fork Specimen Creek and High Lake by constructing a fish barrier, removing nonnative fish, and stocking genetically pure WCT. In 2016 and 2018, surveys conducted throughout East Fork Specimen Creek indicated a naturally reproducing population of westslope cutthroat trout, with all fish appearing healthy. Unfortunately research in 2019 revealed that hybridized fish have moved upstream of the constructed barrier, threatening the restored portion of the creek. The long-term goal for this watershed is to integrate East Fork Specimen Creek into a larger westslope cutthroat trout restoration project that includes the North Fork to improve the resilience of this isolated population to natural threats.

A range expansion project is being conducted in Goose Lake and two other small, historically fishless lakes in the Firehole drainage. Nonnative fish removal was conducted in 2011 and staff stocked fry from 2013 to 2015. The long-term project goal is to one day use this pure westslope population as a brood source, providing offspring for restoration projects elsewhere within the upper Missouri River system.

Another range expansion project is the upper Gibbon River. In 2017, native fish restoration began on the upper portion of Gibbon River, above Virginia Cascades. This project encompasses more than 18 stream miles and 232 lake acres (Wolf, Grebe, and Ice lakes). Since fall of 2017, park biologists have introduced approximately 59,000 westslope cutthroat and 140,000 arctic grayling to Wolf, Grebe, and Ice lakes and surrounding tributaries. Fish removal continued on the upper Gibbon River in 2018 and 2019 between Virginia Cascades and Little Gibbon Falls. Complete removal of non-native fish in this section of river will take several years. Future restoration projects for westslope cutthroat trout and Arctic grayling will take place in will be in North Fork Specimen and Cougar creeks. Once completed, native fish will be restored to an additional 61 km of stream waters.

Arctic Grayling (*Thymallus arcticus montanus*)



Arctic grayling were indigenous to the park in the headwaters of the Madison and Gallatin rivers and to the Gibbon and Firehole rivers below their first falls. Fluvial grayling were eliminated from their entire native range within the park by the introduction of competing nonnative fishes such as brown trout and brook trout, and the fragmentation of migration pathways by the construction of the Hebgen Dam outside the park. Grayling within the upper Gallatin River drainage disappeared around 1900, while grayling in the upper Madison River drainage disappeared by 1935. The only known populations left in the park were adfluvial (primarily lake-dwelling) descendants of fish that were stocked in Cascade and Grebe lakes.

Description

- Large sail-like dorsal fin
- Large scales
- Dark spots on the front half of its body.
- Sometimes confused with mountain whitefish.

Behavior

- Spawning behavior of fluvial populations is unknown. Adfluvial populations migrate to streams in June. Spawn over many types of stream bed material, from sand to coarse rubble.
- Similar to trout, they eat true flies, caddisflies, macroinvertebrates, and small crustaceans. Younger, smaller fish feed on zooplankton.

Distribution

- Cascade, Grebe, Wolf, and Ice lakes.
- Gibbon River. Sometimes found in Madison and Firehole rivers.

Restoration

One of the goals of the park's 2010 Native Fish Conservation Plan is to restore fluvial grayling to approximately 20% of their historical distribution. The upper reaches of Grayling Creek are considered the best site for immediate fluvial grayling restoration. Near the park boundary, a small waterfall exists in the creek (which flowed directly into the Madison River prior to the construction of Hebgen Dam in 1914).

The Grayling Creek restoration project aims to establish Arctic grayling and westslope cutthroat trout to 95 kilometers (59 miles) of connected stream habitat in one of the most remote drainages in the species historic range within Yellowstone.

In summer of 2013, a barrier was completed at the waterfall to prevent upstream movement of nonnative fish. During August 2013, a crew of 27 biologists from Yellowstone National Park, Montana Fish, Wildlife and Parks, Gallatin National Forest, Turner Enterprises, and US Fish and Wildlife Service treated the stream segment with piscicide to remove all fish. A second treatment took place in 2014. Restocking the Grayling Creek watershed with native fluvial Arctic grayling and westslope cutthroat trout began in 2015 and continued through 2017. The effort included moving approximately 950 juvenile and adult westslope cutthroat trout to the lower reaches of Grayling Creek, above the project barrier. In addition, 54,200 westslope cutthroat trout eggs and 210,000 fluvial grayling eggs were placed in remote-site incubators throughout the upper watershed. In 2018, park biologists and Montana State University researchers began to monitor the success of reintroduction efforts on upper Grayling Creek. Results of this study are expected in late 2020.

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Mountain Whitefish (*Prosopium williamsoni*)



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The mountain whitefish (*Prosopium williamsoni*) is a slender silver fish, sometimes confused with Arctic grayling. It lives in Yellowstone's rivers and streams and requires deep pools and clear, clean water. This species is very sensitive to pollution. The mountain whitefish has persisted in its native waters, unlike the Arctic grayling. Mountain whitefish are commonly caught by anglers in most of the park's large rivers. They are less common in smaller streams.

Description

- Yellow or olive-green to dark-gray. No spots.
- Body nearly round on cross-section.
- Small mouth with no teeth.

Behavior

- Spawns in fall.
- Generally feeds along the bottom, eating aquatic insect larvae, and competes with trout for the same food.

Distribution

- Heart Lake and its tributaries.
- The Yellowstone River below the Lower Falls, and the Lamar, Gardiner, Gibbon, Madison, Snake, and Lewis rivers.

Mottled Sculpin (*Cottus bairdi*)

The mottled sculpin lives primarily in shallow, cold water throughout Yellowstone, but it is also found in the Yellowstone River above the Lower Falls and in Yellowstone Lake. It has modified pectoral and pelvic fins to help it move and grip the bottom of the stream.

It lacks scales and a swim bladder. It eats small insects, fish, and fish eggs, and is consumed by trout.



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Minnows

Yellowstone's minnows are small fish living in a variety of habitats and eating a variety of foods. All four species occurring in Yellowstone are eaten by trout:

- Utah chub (*Gila atraria*): Largest of the minnows (12 inches); native to Snake River drainage; seems to prefer slow, warm waters with abundant aquatic vegetation.
- Longnose dace (*Rhinichthys cataractae*): Most often found behind rocks and in eddies of cold, clear waters of the Yellowstone and Snake river drainages; also found in Yellowstone Lake.
- Redside shiner (*Richardsonius balteatus*): Minnow of lakes; native to the Snake River drainage; has been introduced to Yellowstone Lake, where it might compete with native trout because its diet is similar to that of young trout.
- Speckled dace (*Rhinichthys osculus*): Lives in the Snake River drainage.

Suckers



Suckers are bottom-dwelling fish that use ridges on their jaws to scrape flora and fauna from rocks. They are eaten by birds, bears, otters, and large cutthroat trout.

- Mountain sucker (*Catostomus platyrhynchus*): cold, fast, rocky streams and some lakes.
- Longnose sucker (*C. catostomus*): Yellowstone River drainage below the Grand Canyon; Yellowstone Lake and its surrounding waters (introduced). Equally at home in warm and cold waters, streams and lakes, clear and turbid waters.
- Utah sucker (*C. ardens*): Snake River drainage.

Concurrent with the decline in cutthroat trout is a steady, long-term decline in the introduced longnose sucker population in Yellowstone Lake. The mechanism causing this decline is unclear. Longnose

suckers occur, primarily, throughout the shallow water, littoral zones of the lake, and spawn along the lake shore and in tributaries during the spring. Predation by lake trout during the summer is not significant but it is possible that consumption of suckers by lake trout is higher during winter when water temperatures are extremely cold, allowing lake trout to exploit shallow water habitats where the suckers reside.

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Preparing for restoration

Liberalization of creel limits, mandatory kill regulations for anglers, and electrofishing by biologists are effective tools for the selective removal of nonnative species. However, in some instances these tools cannot completely eliminate the invaders. In those cases, barriers and chemical treatments are considered. Some natural barriers already exist; sometimes modifications to natural structures can complete barriers to upstream migration. In a few places, barriers must be completely fabricated. Once native trout are protected from invasion, selective removal continues or, if necessary, chemical treatment is used to eliminate nonnative species. Following reduction or removal of unwanted species, stocking boosts or restores native fish.

Piscicides are toxins which remove fish from habitats where nets, electrofishing, angling, traps, or other mechanical methods are impractical or ineffective. With the exception of sea lamprey control in the Great Lakes, all fish removal projects in the United States use piscicide containing the natural compounds rotenone or antimycin. Biologists in Yellowstone National Park have used rotenone in formulations approved by the Environmental Protection Agency in High Lake and East Fork Specimen Creek (2006–2009), Goose Lake (2011), Elk Creek (2012–2014), Grayling Creek (2013–2014), Soda Butte Creek (2015–2016), and upper Gibbon River, and Wolf, Grebe, and Ice lakes to remove nonnative fish species.

Rotenone occurs in the roots, stems, and leaves of tropical plants in the pea family (*Fabaceae*). Ingestion has a relatively minor effect on land animals because the enzymes and acids of the digestive system break it down. Rotenone must be absorbed into the bloodstream, usually across the gill membrane, to be harmful. It kills by inhibiting the biochemical reaction some cells use to turn nutrients into energy. Essentially, rotenone starves the cells, causing death.

To treat a section of stream, rotenone is applied at a lethal rate determined by the volume, speed, and temperature of the water. Farther downstream, potassium permanganate

is added to the water to neutralize the rotenone. Rotenone is quickly broken down in the environment by sunlight and readily binds to sediments or organic matter in the water. The rapid degradation and dissipation result in a short window of time to successfully remove nonnative fish.

Unfortunately, piscicides impact all gill-breathing aquatic organisms, including non-target fish species (i.e., native fishes), larval amphibians, and macroinvertebrates. To reduce potential impacts on non-target organisms, specialists use a minimum dosage of rotenone for short periods of time. Biologists limit treatment areas and leave recovery intervals between treatments. All treatments in Yellowstone National Park have been, and will continue to be, conducted during late summer or fall to avoid impacts to amphibians in early developmental stages. Research conducted during these treatments provides strong evidence benthic macroinvertebrates and amphibians in Yellowstone have not been significantly impacted in the long term.



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Many nonnative fish were introduced to Yellowstone to meet the expectation of recreational anglers.

Nonnative Fish Species

Nonnative fish distribution and their influence on native fish are not static. While they have not been intentionally stocked since the 1930s, nonnative fish continue to advance into new habitats and hybridize with or displace native fish.

Hybridization of cutthroat trout resulting from rainbow trout range expansion continues to be the greatest threat to the park's remaining native fish populations in waters outside the Yellowstone River headwaters, Yellowstone Lake, and the Snake River headwaters.

Not all of the movement by nonnative fish in Yellowstone has occurred naturally. Nonnative lake trout, intentionally introduced by managers in 1890 to Lewis and Shoshone lakes, and introduced (possibly intentionally) to Yellowstone Lake in the mid-1980s, first appeared in angler catches in 1994. The lake trout population expanded and, over the following decade, caused a rapid decline in the Yellowstone cutthroat trout population in Yellowstone Lake.



Eastern Brook Trout (*Salvelinus fontinalis*)



Eastern brook trout was the first nonnative species introduced in Yellowstone. They were stocked in the (then fishless) Firehole River in 1889. Brook trout are native to the eastern and northeastern United States from Hudson Bay down to the Carolinas and through the Great Lakes.

Description

- Sides spotted with red, pink, or yellow dots, haloed with blue.
- Light spots on dark skin.
- Back, dorsal, adipose, and tail fins have a marbled (vermiculated) appearance.
- Lower fins have a vivid white stripe on the tip

Behavior

- Spawn in fall between September and December. Have a strong tendency to return to natal streams.
- Food selection similar to other trout, but tend to feed on a wider variety of foods.

Distribution

- Widely distributed in most river drainages due to historic stocking.
- Not present in the Gallatin River, Yellowstone Lake, or the Yellowstone River above the Upper Falls.

Brown Trout (*Salmo trutta*)



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The brown trout is the only nonnative fish species in Yellowstone that is not native to North America. This European species was introduced to Yellowstone in the latter part of the 19th century and was recorded as two different species: the Von Behr and the Loch Leven brown trout. These are now thought to be two varieties of the same species and most of the populations in Yellowstone are indistinguishable.

Description

- Dark in color, olive, brown, or yellow.
- Pale halos around black spots.
- Vibrant red or orange spots.

Behavior

- They spawn in fall, migrating to small tributaries of large rivers, upstream in small rivers, or to lake inlets.
- Eat mostly insects, crustaceans, and mollusks but have a reputation for eating larger prey: other fish, crayfish, birds, mice, and frogs.

Distribution

- Widely distributed in Gallatin, Gibbon, Firehole, Madison, Lewis, Snake, Gardner, and Yellowstone rivers.
- Not present upstream of Knowles Falls on the Yellowstone River, Yellowstone Lake or the Bechler or Falls rivers.

Cutthroat x Rainbow Trout Hybrids

In waters where rainbow trout have been introduced, either by intentional, historic stocking or by invasion from a downstream source, the result has been a serious degradation of the cutthroat trout population through interbreeding of the two species. Cutthroat/rainbow trout hybrids will have characteristics (coloration and spotting patterns) that are consistent with both species, making identification often difficult.

Presently, hybridized cutthroat trout exist throughout the

Rainbow Trout (*Oncorhynchus mykiss*)



Rainbow trout are native to North America in waters that drain to the Pacific Ocean from northern Mexico to Alaska. Of the nonnative fish in Yellowstone, the rainbow trout has the closest geographic origin. As the most adaptable members of the salmonid family, they have been successfully introduced throughout the world.

Description

- Silvery body, red lateral band, often white on the edge of lateral fins.
- Numerous black spots on head and back, none on belly.

Behavior

- Mainly spring spawners between March-July. Select populations spawn in fall.
- Eats aquatic and terrestrial insects, crustaceans, mollusks and earthworms.

Distribution

- Widely distributed due to historic stocking efforts.
- Not present in Yellowstone Lake.
- Not present in the Yellowstone River above the Upper Falls or the Snake River.



Bechler, Falls, Gallatin, Gardner, and lower Lamar rivers, and the Yellowstone River below the Upper Falls.

Lake Trout (*Salvelinus namaycush*)



Lake trout are native to Canada, Alaska, the Great Lakes, New England, and parts of Montana. Lake trout were intentionally stocked in Lewis and Shoshone lakes in 1890 by the US Fish Commission (a predecessor of today's US Fish & Wildlife Service). The species was first documented in Yellowstone Lake in 1994. Evidence from chemical patterns in lake trout ear bones sampled in the late 1990s indicate that the initial stock originated from nearby Lewis Lake some time in the 1980s. Despite major efforts to remove them by gillnetting, the lake trout have had a significant ecological impact on the native Yellowstone cutthroat trout, an important food for other native animals. Lake trout differ from cutthroat trout as potential prey because they can grow larger, occupy deeper areas of the lake, and spawn in the lake instead of in shallow tributaries.

Description

- Dark-gray body with white spots; numerous spots on head.
- Deeply forked tail.
- Often white on the edge of fins.

Behavior

- Lake trout are voracious, efficient predators.
- Frequently live >25 years and grow very large. The Wyoming state record weighed 50 pounds (23 kg).
- Fall spawners (September/October). A 12-pound female could produce up to 9,000 eggs annually.
- About 30% of a mature lake trout's diet is cutthroat trout. They can eat up to 41 cutthroat trout per year and can consume cutthroat trout up to 55% of their own size.

Distribution

- Heart, Lewis, Shoshone, and Yellowstone lakes.

Population in Yellowstone Lake

Lake trout are a serious threat to the native Yellowstone cutthroat trout population and, as a result, the National Park Service (NPS) has worked to suppress the population. Although lake trout need energy-rich prey to continue to grow, they can persist for years with minimal food resources. Nonnative lake trout could decimate the native cutthroat trout population and then persist at high numbers on other foods, giving cutthroat trout no chance to recover. Lake trout also consume foods that have historically fed cutthroat trout in Yellowstone Lake, thereby making cutthroat trout recovery impossible until the lake trout population is suppressed.

Taking Action

In 1995, after confirming lake trout were successfully reproducing in Yellowstone Lake, the NPS convened a panel of expert scientists to determine the likely extent of the problem, recommend actions, and identify research needs. The panel recommended that the park suppress lake trout in order to protect and restore native cutthroat trout. The panel also indicated that direct removal efforts such as gillnetting or trapnetting would be most effective but would require a long-term, possibly perpetual, commitment.

Lake trout gillnetting begins as ice is leaving the lake in spring and continues into October. Gillnet operations remove lake trout from the population and also provide valuable data—population estimates, age structure, maturity, and potential new spawning areas—leading to more effective control. Incidental catch of native cutthroat trout is minimized by fishing deeper waters not typically used by cutthroat trout.

As initial gillnetting efforts expanded, the number



Since 2009, the park has contracted a commercial fishing company to increase the catch of lake trout.

of lake trout removed from the population also increased. This suggested the lake trout population was continuing to grow. In 2008 and 2011, scientific panels were convened to re-evaluate the program and goals. The panel concluded netting is still the most viable option for suppressing lake trout. Both reviews also indicated a considerable increase in suppression effort would be needed over many years to collapse the lake trout population.

Starting in 2009, the park contracted a commercial fishing company to increase the take of lake trout through gillnetting. From 2011 to 2013, they also used large, live-entrapment nets that allow removal of large lake trout from shallow water while returning cutthroat trout to the lake with little mortality.

Anglers are encouraged to fish for lake trout, and are required to kill all lake trout caught in Yellowstone Lake and its tributaries. Of the total lake trout removed from Yellowstone Lake, anglers have removed approximately five percent.

Lake Trout Response to Increased Suppression Efforts

More than 3.4 million lake trout have been removed from Yellowstone Lake since 1994. In 2019, National Park Service and contracted crews captured more than 282,000 lake trout—the majority of which were two-year-old fish. Catches of lake trout in the larger meshes decreased in 2019 compared to similar effort in 2018, indicating a further population decline. Catch rate in these meshes has dropped dramatically from 3.2 lake trout per net night in 2012 to less than 0.8 lake trout in 2019



Student Conservation Association interns hold a large lake trout from Yellowstone Lake.

The number of lake trout caught during distribution surveys remained relatively constant from 2010 to 2017, ranging from 360 to 618 fish annually. Annual catches declined in 2018 and 2019 to 263 and 240 fish, respectively, the lowest numbers observed since 2010. Annual mean total length from 2010–2019 ranged from 313 to 344 millimeters (12–13.5 in.).

Increases in catch can reflect increased efficiency, increased abundance, or both. Improvements in gear, knowledge, and experience can lead to more efficient removal, despite a decreasing population. Hence, independently monitoring the effectiveness of suppression activities, as well as updating population models, is an important aspect of the program.

Quick Facts

The Issue

Nonnative lake trout in Yellowstone Lake threaten the survival of native Yellowstone cutthroat trout and species that depend on them.

Background

- 1890s: The park stocked fish; lake trout were introduced to Lewis and Shoshone lakes.
- 1980s–1990s: Lake trout illegally introduced into Yellowstone Lake
- 1994: First verified lake trout caught in Yellowstone Lake.
- A mature lake trout can eat ~41 cutthroat trout per year.

- The cutthroat trout population in Yellowstone Lake is ~10% or less of historic highs.
- Many wildlife species, including the grizzly bear, otter, and bald eagle, depend on cutthroat trout for a portion of their diet.
- Most predators can't catch lake trout because the trout live in deep water, spawn in the lake, and are large.

Current Status

- Gillnetting has removed more than 3.4 million lake trout since 1994.
- Anglers catch approximately 20,000 lake trout each year.

- Population models estimate a 71% decline in age 6+ lake trout since 2012.
- Lake trout recruitment remains strong. However, recent results indicate that is beginning to decrease as well.

Outlook

With continued aggressive control efforts, fisheries managers expect to reduce lake trout numbers and lessen impacts to cutthroat trout. Recent monitoring indicates Yellowstone cutthroat trout in Yellowstone Lake are starting to rebound and the lake trout population is in decline.

Population modeling has shown that the lake trout population expanded through 2012, but increased gillnetting has begun to reduce lake trout numbers and biomass (total weight) in Yellowstone Lake, particularly in older age classes. Abundance models show no population growth for lake trout age 2–3 years, a decrease in fish 3–5 years, and a 71% decrease 6 years and older. Overall lake trout abundance has decreased 32% across all ages since the population peaked in 2012. Total annual mortality rates have been steadily increasing over the past several years and have exceeded 50% in three of the last four years. In addition, the total biomass of lake trout removed annually has increased from 0.5 kilograms per hectare to over 4.0 kilograms per hectare. If this trend continues, models predict a population crash within the next 5 to 10 years.

Discovery of New Species in Yellowstone Lake

On August 22, 2019, a gill net set in 158 feet of water northeast of Stevenson Island pulled in one fish of a new species (*Coregonus sp.*) not previously known to exist in Yellowstone Lake. At this point, what is known is this was a cisco, but the exact species or strain is still being determined genetically. It was a 3-year-old immature female, and based on otolith microchemistry, likely hatched in Yellowstone Lake. It is not likely this species arrived in Yellowstone naturally, as the nearest source populations are in northern Montana. There are no existing waterways between Yellowstone Lake and any known cisco populations.

In its native range, cisco are a preferred prey item for lake trout where the two species overlap. They prey mostly on aquatic invertebrates and tend to reside at mid-water depths.

Research guides methodology

In 2010, Yellowstone developed the Native Fish Conservation Plan. This adaptive management plan guides efforts to recover native fish and restore natural ecosystem functions based on scientific assessment.

In 2011, the National Park Service and the US Geological Survey launched a movement study to target lake trout embryos in spawning beds and identify general and seasonal movement patterns. The results helped gillnet operators to target lake trout more efficiently.

In 2013, NPS and Montana State University conducted a mark/recapture study of lake trout in

Yellowstone Lake. In order to estimate population size, 2,400 lake trout were tagged and released back into the lake. More than 86% of tagged fish were recaptured. Results produced an estimate of the number of lake trout present in the lake: 367,650 fish greater than 210 millimeters (8.3 in.) long.

The mark-recapture study also helped estimate rates of capture for four size classes. This effort removed 72% of lake trout 210–451 millimeters (8.3–17.8 in.) in length, 56% for fish 451–541 millimeters (17.8–21.3 in.) long, 48% for fish 541–610 millimeters (21.3–24.0 in.) long, and 45% for fish more than 610 millimeters (>24.0 in.) long. These results supported previous estimates and highlighted the difficulty in catching older, mature lake trout, which eat the most native cutthroat trout and have the highest reproductive success.

Future of Lake Trout Control

With current technology, lake trout probably cannot be eliminated from Yellowstone Lake. However, ongoing management of the problem can significantly reduce lake trout population growth and maintain the cutthroat trout population, which is a critical ecological link between Yellowstone Lake and its surrounding landscape.

Reducing the lake trout population to a level that will have only minor impacts to the cutthroat trout population is predicted to take place in the near future—provided we maintain current high levels of suppression effort. Given the high reproductive potential of this lake trout population, it will rebound immediately and dramatically if we reduce the suppression effort.

Present research efforts by Yellowstone National Park biologists and collaborating scientists at the USGS Montana Cooperative Fishery Research Unit and Montana State University focus on killing lake trout embryos on spawning sites. So far, only 50 acres of lake trout spawning areas have been identified by tracking tagged fish, visual observations during SCUBA diving, and remote observations with underwater cameras.

One technique uses lake trout carcasses from the gillnetting operation to kill lake trout embryos. Carcasses are shredded and deposited on the rocky areas where lake trout naturally spawn. Natural decomposition of the shredded fish decrease the dissolved oxygen in the areas around the embryos, making the spawning site inhospitable. Tests showed

almost complete mortality of lake trout embryos at the treatment site within a couple of weeks. This technique shows great potential for increasing the effectiveness of the suppression program. A similar technique uses pellets of vegetative materials which, limited research has shown, are less of an attractant to bears, easier to handle, and just as effective at killing embryos. These options will be explored further in the coming field season.

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Lake Chub (*Couesius plumbeus*)



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Though native to the Missouri and Yellowstone river drainages in Montana and Wyoming, the lake chub is not native to Yellowstone National Park waters. It was most likely introduced by bait fishermen into Yellowstone Lake, McBride Lake, and Abundance Lake in the Slough Creek drainage.

Description

- Dull gray or bluish-gray.
- Rarely more than 6 inches long.

Behavior

- Inhabits cooler lakes and streams, prefers small creeks to large rivers.
- Spring spawner.
- Competes with small trout for food, but likely provides fodder for trout over 16 inches.

Distribution

- Established but uncommon in Yellowstone Lake. Removed from Lake Abundance in 1969.
- Well-established in the Slough Creek drainage.

Unsuccessfully Introduced Nonnatives

At the end of the nineteenth century/early twentieth century, it was commonly believed among park managers and anglers that nature sometimes needed human “help” to make fisheries better. These introduced fish are no longer found in Yellowstone.

Yellow perch (*Perca flavescens*)

In the early 1900s, yellow perch were introduced to Goose Lake and other small lakes in the Lower Geyser Basin. In 1938, fisheries managers removed them from Goose Lake in an attempt to keep the perch from spreading to the Firehole River.

Atlantic salmon (*Salmo salar*)

In 1908, land-locked Atlantic salmon were stocked in Yellowstone Lake and in Duck Lake near West Thumb.



The lake trout, introduced to Yellowstone Lake, is one of several aquatic nonnative species having a significant detrimental effect on the park's aquatic ecology.

Aquatic Invasive Species

An aquatic invasive species disrupts ecological processes because it is not indigenous to the ecosystem. Invasive organisms can cause species extinction, with the highest extinction rates occurring in freshwater environments. In addition to nonnative fish in Yellowstone, three aquatic invasive species are having a significant detrimental effect:

- *Myxobolus cerebralis*, a parasite that causes **whirling disease** in cutthroat trout and other species;
- **New Zealand mud snails** (*Potamopyrgus antipodarum*), which form dense colonies and compete with native species; and
- **Red-rimmed melania** (*Melanooides tuberculatus*), a small snail imported by the aquarium trade starting in the 1930s, was discovered in the warm swimming area at the confluence of the Boiling River with the Gardner River in 2009.

Preventing the arrival of additional aquatic invasive species is critical because eliminating them after they become established in a watershed is usually

impossible and efforts to reduce their impact can be extremely expensive. Each summer, a small team of park technicians inspect visitor's watercraft and gear before they put them in the water. A decontamination is performed if necessary. Such decontamination is



To prevent the arrival of more aquatic nuisance species, a team of park staff and volunteers inspect all visitor watercraft before they put their boats or angling gear in the water.

Quick Facts

The Issue

Aquatic invaders can irreversibly damage the park's ecosystems.

Current Status

- In the US, more than 250 nonnative (from another continent) aquatic species, and more than 450 nonnative (moved outside their natural range) aquatic species exist.
- At least 8 aquatic invasive species exist in Yellowstone's waters: two mollusks, five fish, and one nonnative, disease-causing

microorganism (whirling disease). Three of these species are having a significant detrimental effect (lake trout, New Zealand mud snails, and whirling disease).

- Park staff continues to educate visitors about preventing the spread of aquatic invasive species.

What You Can Do

Read and follow the instructions provided in the fishing regulations, and remember to **clean, drain, and dry** all gear.

- It is illegal to use any live bait in Yellowstone National Park.
- It is illegal to transport fish among any waters in the Yellowstone region.
- It is illegal to introduce any species to Yellowstone waters.
- Prior to launching, watercraft must be inspected and may be required to undergo decontamination.

usually adequate to prevent the entry of most aquatic invasive species.

Arrival in Yellowstone

During the late 1880s when the Army administered Yellowstone, the US Fish Commission (a predecessor of today's US Fish and Wildlife Service) stocked nonnative fish in some park waters. These stockings comprise the first known, deliberate introductions of nonnative fish to Yellowstone. Four trout species were widely introduced—brook, brown, lake, and rainbow. Rainbow trout hybridize with native cutthroat trout, thus diluting genetic purity. All four compete with and prey upon native fish.

Other aquatic invasive species, such as the New Zealand mud snail and the parasite causing whirling disease, probably arrived via unaware boaters and anglers carrying the organisms from other locations around the country. We may never know exactly how those species were introduced to the park, but anglers can help prevent other species from arriving.

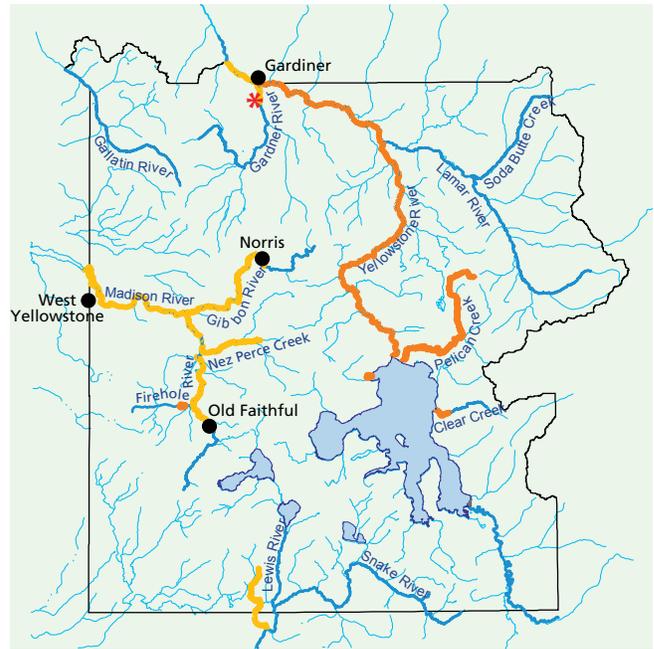
New Zealand Mud Snails

The New Zealand mud snail (*Potamopyrgus antipodarum*) is an invasive species that became established in the western United States in the 1980s. In suitable habitat, especially in geothermal streams with high primary production, it can form dense colonies on aquatic vegetation and rocks along streambeds, crowding out insect communities—a primary food for immature trout and other native species.

New Zealand mud snails consume a large amount of algae, which is a primary food for native aquatic invertebrates. Its overall impact on algae is likely to affect entire stream food webs. With its protective shell, the mud snail provides little if any nutrition as prey and may pass through a fish alive. Scarcely a quarter-inch long, mud snails may cling to boats, waders, and other fishing gear by which they are transferred inadvertently to another watershed. Because the species can reproduce asexually, a single mud snail is all that is required to establish a new colony.

Population

First detected in the park in 1994, New Zealand mud snails are now abundant in several park streams. It remains absent or uncommon in other Greater Yellowstone streams, suggesting that its upstream



Locations in Yellowstone National Park where whirling disease, New Zealand mud snails, or red-rimmed melania have been documented.

population density and distribution is limited by colder temperatures, low productivity, and unstable substrates associated with spring runoff.

Impacts of Mud Snails

Once mud snail colonies become established in a stream, removing them without disrupting native invertebrate populations is not feasible with any known method. Mud snail research in Greater Yellowstone aims to determine the species' impacts on other aquatic organisms and stream ecology. A study of the Gibbon and Madison rivers found that 25–50% of the macroinvertebrates were mud snails, and the areas they occupied had fewer native mayflies, stoneflies, and caddisflies—insects important in the diet of salmonids and several bird species.



New Zealand mud snails shells resting on a dime.

Red-rimmed Melania

Red-rimmed melania (*Melanoides tuberculatus*), a small snail imported by the aquarium trade starting in the 1930s, were discovered in 2009 at the confluence of the Boiling River, a thermal spring, and the Gardner River. Live snails were found downstream for approximately one kilometer. The following year, a survey of 18 similar thermal areas in the park found no additional melania. The species has a narrow temperature tolerance (18–32°C) and is unlikely to survive downstream of the Boiling River during the winter, but it could become established in other thermal water in the park.

Whirling Disease

Whirling disease is caused by a microscopic parasite from Europe (*Myxobolus cerebralis*) that can infect some trout and salmon; it does not infect humans. It has been detected in 25 states. During the parasite's life cycle, it takes on two different forms as spores and requires two hosts: a common aquatic worm (*Tubifex tubifex*) and a susceptible fish. Cutthroat trout are susceptible, especially during the first months of life. The parasite feeds on the fish's cartilage, and the infection can cause skeletal deformities, a blackened tail, and whirling swimming behavior. Because the fish cannot feed normally and is more vulnerable to predation, whirling disease can be fatal. No practical treatment exists for fish infected with this disease or for the waters containing infected fish.

Whirling Disease

The Issue

Whirling disease is a parasitic infection of fish caused by a microscopic protozoan that destroys the cartilage of juvenile trout, resulting in skeletal deformities and sometimes whirling behavior. Seriously infected fish have a reduced ability to feed or to escape from predators, and mortality is high.

Background

- The disease was first described in Europe more than 100 years ago. It was detected in the United States in the mid-1950s, and in Yellowstone in 1998.
- It most likely came to the US in frozen fish products.
- Recent laboratory tests suggest cutthroat trout are highly susceptible. Lake trout and grayling appear immune to the disease, and brown trout are resistant but can be infected and can carry the parasite.
- There is no practical treatment.

Presence in Yellowstone

Whirling disease was first detected in Yellowstone in 1998 in cutthroat trout from Yellowstone Lake. It has since been found in the Firehole, Madison, Gibbon, Gallatin, and Lamar rivers and throughout the Yellowstone Lake watershed. In the lake, the infection has spread to about 20% of the cutthroat trout. The parasite is most prevalent in the two known infected tributaries, Pelican Creek and the Yellowstone River downstream of the lake outlet. Infection has been most severe in Pelican Creek, which once supported nearly 30,000 upstream-migrating cutthroat trout. Significant declines in Pelican Creek's spawning population have been attributed to the combination of whirling disease and predation by nonnative lake trout in Yellowstone Lake. The finding of adult fish in the lake with the parasite's spores that survived their initial infection suggests some resilience of Yellowstone cutthroat trout to whirling disease.



©SASCHA HALLETT/ OREGON STATE UNIV.

These rainbow trout show the characteristic black tail and skeletal deformities indicative of whirling disease.

Studying the Disease

Yellowstone National Park's cutthroat trout spawning streams, which vary widely in thermal, hydrological, and geological characteristics, provide an exceptional opportunity to study whirling disease in native trout. Park staff have been working with Montana State University's Department of Ecology to measure how the infection rate might vary in different stream conditions. Certain fish-eating birds have also been shown to disperse the parasite. Research has shown that the parasite can pass through the gastrointestinal tract of some birds, such as great blue herons, and remain alive.

Results of a 2018 survey suggest that whirling disease risk remains very high in Pelican Creek. Overall, however, it does not appear that whirling disease has spread widely throughout spawning tributaries to Yellowstone Lake. In addition, prevalence of infection in juveniles and adults within the lake remains

low. Despite this, there are still many unknowns concerning the parasite, particularly in the unique environmental context of Yellowstone.

Park staff emphasize prevention by educating people participating in water-related activities—including anglers, boaters, or swimmers—to take steps to help prevent the spread of the disease. This includes thoroughly cleaning mud and aquatic vegetation from all equipment and inspecting footwear before moving to another drainage. Anglers should not transport fish between drainages and should clean fish in the body of water where they were caught.

Emerging Threats

The aquatic invasive species which pose the greatest risk to ecologic, recreational, and economic values in the Yellowstone area include zebra and quagga mussels, Asian clams, Asian carp species, Eurasian watermilfoil, hydrilla, flowering rush, and viral hemorrhagic septicemia. Fisheries biologists believe several of these species could spread to Yellowstone. Their arrival might be avoided if anglers remember:

- **Remove** all plants, animals, mud, sand, and other debris from your boat, boots, and equipment.
- **Do not** dump water from other sources into Yellowstone waters.
- **Drain** your boat bilge area, live well, and other compartments away from all waters.
- **Dry** all equipment in the sun for 5 days or use high-pressure, hot (>140°F) water (available at car washes outside the park) to clean your boat, trailer, waders, boots, and equipment.

Dreissenid Mussels

Zebra mussels (*Dreissena polymorpha*) and closely related quagga mussels (*Dreissena bugensis*) collectively called dreissenids, are of particular concern given their ability to attach to watercraft, survive many days out of water, and cause irreparable harm.

Zebra mussels are native to Eastern Europe and western Asia. They were first discovered in North America in 1988 in Lake St. Clair, one of the water bodies connecting the Great Lakes. It is believed that this invasive species was introduced through ballast water discharges from international shipping.

Following their initial invasion, zebra mussels spread quickly across most of the eastern United States and Canada. Zebra mussels are inadvertently transported to new water bodies by boaters who



USFWS

Zebra mussel colony.

trailer their boats between infected bodies of water.

Zebra mussels drastically alter the ecology of infested water bodies and may severely impact ecosystems. Once established, these efficient filter-feeders consume significant biomass of phytoplankton, depleting the foundation of the aquatic food web. Zebra mussels can attach to most hard surfaces, forming mats that may be up to 18 inches thick. Mussels can impact recreation activities and associated economies by covering docks, boats, and beaches, in addition to causing severe infrastructure and economic damage by blocking water supply pipes of power and water-treatment plants, irrigation systems, and industrial facilities.

Zebra mussels' native predators from Europe, certain types of birds and fish, are not present in North America. Though some ecologically similar species do exist, they do not appear to have significant impact on reducing established mussel populations. Annual testing of Yellowstone and Lewis lakes has been negative for Dreissenid mussels as of 2019.

On Yellowstone's Doorstep

On November 8, 2016, the State of Montana Department of Fish, Wildlife, and Parks announced that laboratory studies had identified invasive mussel larvae in water samples from the Tiber and Canyon Ferry reservoirs.

Extensive sampling has found no adult or larval mussels, but environmental DNA in the Tiber Reservoir tested positive for mussels in 2017. No evidence was found in 2018; however, prevention and inspection efforts on the reservoirs will continue.

Another aquatic invader of concern is curly-leaf pondweed (*Potamogeton crispus*), which has been identified in local areas and waterways adjacent to the park.

Asian Carp

The **bighead carp** (*Hypophthalmichthys nobilis*), **black carp** (*Mylopharyngodon piceus*), and **silver carp** (*Hypophthalmichthys molitrix*) occur in at least 24 states. They out-compete native fish, reduce forage for other fish, and can transmit disease. Silver carp are also known for their ability to jump great distances out of the water when boats travel near them, causing injury to boaters.

Silver carp are native to Southeast Asia and east Russia and were intentionally introduced into the United States in 1973 in an attempt to improve water quality, increase fish production in culture ponds, and serve as biological control and as food fish. These fish now occur in at least 18 states and are naturally reproducing. Both the silver and the bighead carp compete for food (zooplankton) with native fish.

Black carp are native to Asia and eastern Russia. These fish were unintentionally introduced as a stowaway with intentionally introduced grass carp. Black carp now occur in at least 5 states. Black carp may reduce populations of native mussels and snails through predation and negatively affect the aquatic ecosystem. None of these species are currently found in Wyoming or Montana.

These invasive species may continue to be spread intentionally or through accidental introductions as fish or fish eggs and through water currents.

Asian Clam

Since the introduction of **Asian clam** (*Corbicula fluminea*) to the United States in 1938, it has spread into many of the major waterways and is now found in 46 of the states. The species have not been completely distinguished, but most varieties are small light-colored bivalves, yellow-green to light-brown in color.

The native ranges are in temperate to tropical southern Asia west to the eastern Mediterranean; Africa, except in the Sahara desert; and south-east Asian islands south into central and eastern Australia. The Asian clam is a filter feeder that removes particles from the water column. It can be found at the sediment surface or slightly buried. Its ability to reproduce rapidly, coupled with low tolerance of cold temperatures (2–30°C), can produce wild swings in population sizes from year to year in northern water bodies.

Eurasian watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) has spread across all of the United States except Hawaii and Wyoming. In 2007, it was found in Montana.

This nonnative aquatic plant tends to live in calm waters such as lakes, ponds, and calm areas of rivers and streams. It grows especially well in water that experiences sewage spills or abundant motorboat use.

Eurasian watermilfoil colonizes via stem fragments carried on boating equipment, emphasizing why boats should be thoroughly cleaned.

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Amphibians are valuable indicators of environmental stressors such as disease or climate change. Researchers monitor amphibian populations in the park.

Amphibians

Amphibians are an important part of Yellowstone’s aquatic and terrestrial ecosystems. Many of Yellowstone’s reptiles, birds, mammals, and fish prey on larval and adult amphibians, and amphibians, in turn, eat a variety of vertebrate and invertebrate species. Amphibians are also sensitive to disease, pollution, drought, variations in annual snowpack, and the arrival of nonnative species; these documented sensitivities make them valuable indicators of environmental change. Amphibians often congregate in large numbers for breeding or overwintering. As a result, they can be adversely affected by localized disturbance or the loss of individual breeding or overwintering sites. Amphibian populations that are affected by one or more of these stresses may exhibit changes in their distribution or abundance. These changes can, in turn, have cascading effects on other aspects of the ecosystem.

Declines in amphibian populations are occurring globally in areas where habitat destruction is

pervasive, but also in protected areas. About one-third of all amphibian species are believed to be threatened with extinction. Yellowstone includes some of the most climatologically and topographically complex landscapes in the lower 48 states and therefore provides a valuable study area to examine how climate may influence amphibian distribution and trends. Information about the status and trends of amphibians here may shed light on declines documented in other high-elevation locations or other protected areas around the West.

Population

Annual surveys since the early 2000s have documented four amphibian species as widely distributed in Yellowstone: boreal chorus frogs, Columbia spotted frogs, western tiger salamanders, and western toads occur in wetlands and ponds throughout Yellowstone. In 2014, the plains spadefoot (*Spea bombifrons*) was confirmed in Yellowstone through genetic analyses. Spadefoots are rarely seen because

Quick Facts

Number in Yellowstone

5 species: Western tiger salamander, boreal chorus frog, Western toad, Columbia spotted frog, and plains spadefoot toad.

Identification

Toads are not taxonomically different from frogs. The species called “toads” are associated with drier skin and more terrestrial habitats.

Status

- Columbia spotted and boreal chorus frogs are widely distributed with many breeding sites in the park.

- Western tiger salamanders are common and abundant on the northern range and in Hayden Valley.
- Western toads are abundant in some areas.
- None of the park’s amphibians are federally listed as threatened or endangered.
- Scientists are concerned about the Western toad, which has declined sharply in other parts of the West.

Research

- 2000: Researchers begin inventorying amphibians.

- 2005: Long-term amphibian monitoring begins in Yellowstone.
- 2014: A breeding population of plains spadefoot (*Spea bombifrons*) was confirmed near Fountain Flat Drive.

Survival in winter

To survive the winter, some Yellowstone amphibians go into water that does not freeze (spotted frogs), others enter underground burrows (salamanders and toads), and others (boreal chorus frog) tolerate freezing and go into a heart-stopped dormancy for the winter in leaf litter or under woody debris.

they spend most daylight hours (and most of the year for that matter) underground. Currently, a single breeding population is known to exist within Yellowstone. However, monitoring efforts are under way to locate additional breeding sites because plains spadefoots typically do not disperse far from their natal pond.

In Yellowstone, amphibians depend on limited suitable habitat with shallow, quiet waters needed for egg laying and larval development. Annual differences in snowpack and precipitation change the extent and location of wetland sites, resulting in considerable year-to-year variation in amphibian reproduction. Breeding data collected across the park and since 2006 show that annual variations in breeding are common. Multi-year monitoring data indicate that amphibian populations using small, shallow, isolated wetlands are most susceptible to drought or changes in precipitation. In contrast, amphibian populations occupying deeper wetlands and ponds appear to be more stable through time.

Since the 1950s, air temperatures have increased across this region and changes in the flooding patterns, or even the complete drying of wetlands, have been documented. Since 2006, annual visits to approximately 250 wetlands across Yellowstone have further documented annual variation in the availability of wetlands. These data suggest that in hot, dry years (e.g., 2007) upwards of 40% of the park's wetlands dry up. In cool, wet years (e.g., 2011), most wetlands across the park are flooded and available to support amphibian breeding. Further warming is anticipated for this region and could contribute to the drying of wetlands as well as influence the distribution and abundance of amphibians and other wetland-dependent species.

Disease agents, such as ranavirus and chytrid fungus (*Batrachochytrium dendrobatidis*), could also affect the survival and reproduction of amphibian populations in Yellowstone. Ranavirus has been found in tiger salamanders and Columbia spotted frogs collected from die-offs since 2008 and has also been involved with die-offs of all four widely distributed species in the region. Chytrid fungus usually appears in Columbia spotted frogs and western toads following metamorphosis and does not necessarily cause a fatal infection. The DNA of the chytrid fungus has been identified in skin swabs collected from both species in Yellowstone, though the impacts at the population level have not been determined. Since

Amphibian or Reptile?

Both amphibians and reptiles are ectothermic ("cold-blooded"), meaning they derive body heat from outside sources rather than generate it internally. Reptiles have scaly, dry skin. Some lay eggs; others bear live young. Amphibians have thin, moist glandular skin permeable by water and gases. The young must pass through a larval stage before changing into adults. Amphibious means "double life" and reflects the fact that salamanders, toads, and frogs live in water as larvae and on land for much of the rest of their lives.

2015, 44% of tissue samples (tail clips) collected from larval amphibians (frog and toad tadpoles) have tested positive for ranavirus. These findings highlight that several factors, including host susceptibility and environmental conditions, may determine whether an infection is lethal and results in a die-off or a decline in population abundance.

Studying Amphibians in Yellowstone

The Greater Yellowstone Network (GRYN) has led a collaborative monitoring of wetlands and amphibians in Yellowstone since 2006. Long-term monitoring of amphibian populations provides an opportunity to observe trends that may not be apparent at local scales or in areas with more direct human influences on habitat quality.

Amphibians are monitored at catchments (or watersheds) that average approximately 500 acres in size. On average, 30 catchments are revisited during annual monitoring visits (up to 24 in Yellowstone, and seven in neighboring Grand Teton National Park). All wetlands within the selected catchment are visited each summer, when two independent observers search for amphibians' breeding evidence (i.e., eggs, larvae, or recently metamorphosed individuals) and document important habitat characteristics and the presence or absence of surface water.

The objectives of GRYN's annual monitoring are to estimate the proportion of monitored catchments and wetlands used for breeding by each native amphibian species annually, to consider whether the rate and direction of use may be changing through time, and to document the number of wetlands within catchments that are potentially suitable for amphibian breeding.

This annual monitoring is then combined with local climate data to carefully examine the links among climate, wetlands, and amphibians. Taken

together, amphibian and wetland monitoring data from the past decade, coupled with local climate information, will help support predictions of amphibian occurrence under different climate scenarios.

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Western Tiger Salamander (*Ambystoma mavortium*)



Identification

- The only salamander species in Yellowstone.
- Adults range up to nine inches, including the tail.
- Head is broad, with a wide mouth.
- Color ranges from light-olive or brown to nearly black, often with yellow blotches or streaks on back and sides; belly is dull lemon yellow with irregular black spots.
- Aquatic larvae have a uniform color and large, feathery gills behind the head; they can reach sizes comparable to adults.

Habitat

- Breeds in ponds and fishless lakes.
- Widespread in Yellowstone in a great variety of habitats, with sizable populations on the northern range.

Behavior

- Adult salamanders emerge from hibernation from late April to June, depending on elevation, and migrate to breeding ponds where they lay their eggs.
- Mass migrations of salamanders crossing roads are sometimes encountered, particularly during or after rain.
- After migration, returns to its moist home under a rock or log, and in rodent burrows.
- Feeds on adult insects, insect nymphs and larvae, small aquatic invertebrates, tadpoles, juvenile frogs and other small vertebrates.
- Preyed upon by a wide variety of animals, including mammals, fish, snakes, and birds such as sandhill cranes and great blue herons.

Boreal Chorus Frog (*Pseudacris maculata*)



Identification

- Adults reach one to 1.5 inches in length, and females are usually larger than males; newly metamorphosed juveniles are less than one inch long.
- Brown, olive, tan, or green (sometimes bicolor) with a prominent black stripe on each side from the nostril through the eye and down the sides to the groin; three dark stripes down the back, often incomplete or broken into blotches.

Habitat

- Common, but seldom seen due to its small size and secretive habits.
- Lives in moist meadows and forests near wetlands.
- Lays eggs in loose, irregular clusters attached to submerged vegetation in quiet water.

Behavior

- Breeds in shallow temporary pools or ponds during the late spring.
- Calls are very conspicuous and resemble the sound of a thumb running along the teeth of a comb.
- Males call and respond, producing a loud and continuous chorus at good breeding sites from April to early July, depending on elevation and weather.
- Usually calls in late afternoon and evening.
- Tadpoles eat aquatic plants; adults eat mostly insects.
- Eaten by fish, predacious aquatic insect larvae, other amphibians, garter snakes, mammals, and birds.

Western Toad (*Anaxyrus boreas*)



Identification

- Yellowstone's only true toad species confirmed to breed in the park.
- Adults range up to about four inches, juveniles just metamorphosed from tadpoles are only one inch long.
- Stocky body and blunt nose.
- Brown, gray, or olive-green with irregular black spots, lots of "warts," and usually a white or cream-colored stripe down the back.
- Tadpoles are usually black and often congregate in large groups.

Habitat

- Once common throughout the park, now appears to be much rarer than spotted frogs and chorus frogs; scientists fear this species has experienced a decline in the ecosystem.
- Adults can range far from wetlands because of their ability to soak up water from tiny puddles or moist areas.
- Lays eggs in shallow, sun-warmed water, such as ponds, lake edges, slow streams, and river backwaters.

Behavior

- Tadpoles eat aquatic plants; adults eat algae, insects (particularly ants and beetles), worms, and other small invertebrates.
- Sometimes active at night.
- Defends itself against predators by secreting an irritating fluid from numerous glands on its back and behind the eyes.
- Eaten by snakes, mammals, ravens, and large wading birds.

Columbia Spotted Frog (*Rana luteiventris*)



Identification

- Common in deeper wetlands and beaver ponds.
- Maximum length is about three inches, newly metamorphosed juveniles less than one inch long.
- Upper surface of the adult is gray-brown to dark-olive to green, with irregular black spots; skin is bumpy; underside is cream-colored and may be splashed with brilliant orange on the thighs and arms.
- Tadpoles have long tails and may grow to three inches long.

Habitat

- Found all summer along or in rivers, streams, smaller lakes, marshes, ponds, and rain pools.
- Lays eggs in stagnant or quiet water, in globular masses surrounded by jelly.

Behavior

- Breeds from April to early June, depending on temperatures and elevation.
- Tadpoles metamorphose between July and September.
- Tadpoles eat aquatic plants; adults eat mostly insects but, like many other adult amphibians, are highly opportunistic in their food habits.

Plains Spadefoot Toad (*Spea bombifrons*)



Identification

- A single breeding population has been identified in the Lower Geyser Basin east of Fairy Creek.
- Protruding eyes with vertical pupils, a prominent bony boss (raised bump) between the eyes.
- Has a single, dark tubercle, or “spade,” on each of the hind feet.

Habitat

- Uses its spade to dig shallow summer burrows or deeper winter burrows. Newly metamorphosed animal may burrow in mud near its natal pond or hide in cracks in the hard earth.
- Typically occurs in warmer climates in the western United States. Scientists speculate that spadefoots are found in geothermally influenced habitat in Yellowstone because the warmer ambient conditions facilitate overwinter survival.

Behavior

- Breeds in ephemeral pools following significant rainfall.
- Tadpoles develop from eggs in two to six days.
- Produces cannibalistic and noncannibalistic tadpole body types.
- Tadpoles develop for three to six weeks before metamorphosis.



Reptiles are not well studied in Yellowstone National Park. The bullsnake (shown here) is one of six, and the largest, reptile species found in the park.

Reptiles

Yellowstone provides a valuable area for the study of reptiles. Information about the status and trends of reptiles here may shed light on declines documented in other high-elevation protected areas of the western United States. Many reptiles congregate to breed or overwinter, and they can be adversely affected by disturbance or loss of key sites.

Quick Facts

Number in Yellowstone

Reptiles are less studied than amphibians in Yellowstone. There are 6 confirmed species:

- bullsnake
- prairie rattlesnake
- rubber boa
- sagebrush lizard
- common garter snake
- terrestrial garter snake.

Status

- None of the park's reptiles are federally listed as threatened or endangered.
- Researchers began inventorying reptiles and amphibians in 2000.

Bullsnake (*Pituophis catenifer sayi*)

Identification

- A subspecies of the gopher snake is Yellowstone's largest reptile, ranging from 50 to 72 inches long.
- Yellowish with a series of black, brown, or reddish-brown blotches down the back; the darkest, most contrasting colors are near the head and tail; blotches are shaped as rings around the tail.
- Head resembles a turtle's in shape, with a protruding scale at the tip of the snout and a dark band extending from the top of the head through the eye to the lower jaw.

Habitat

- In Yellowstone, found at lower elevations; in drier, warmer climates; and in open areas, e.g., near Mammoth.

Behavior

- Lives in burrows and eats small mammals—behavior that gave the gopher snake its name.
- Often mistaken for a rattlesnake because of its appearance and its defensive behavior: when disturbed, it will coil up, hiss loudly, and vibrate its tail against the ground, producing a rattling sound.

Prairie Rattlesnake (*Crotalus viridis*)



Identification

- Can be more than 48 inches in length.
- Greenish-gray to olive green, greenish-brown, light-brown, or yellowish with dark brown splotches down its back that are bordered in white.

Habitat and Behavior

- Only dangerously venomous snake in the park.
- Lives in the lower Yellowstone River areas of the park, including Reese Creek, Stephens Creek, and Rattlesnake Butte, where the habitat is drier and warmer than elsewhere in the park.
- Usually defensive rather than aggressive.
- Only two snake bites are known during the history of the park.

Rubber Boa (*Charina bottae*)



Identification

- Infrequently encountered in Yellowstone, perhaps due to its nocturnal and burrowing habits.
- One of two species of snakes in the United States related to tropical boa constrictors and pythons.
- Maximum length of 28 inches.
- Back is brown or greenish-brown, belly is lemon-yellow; scales are small and smooth, making it almost velvety to the touch.

Habitat and Behavior

- Eats small prey including mammals, amphibians, lizards, other snakes, and even small birds.
- May spend great deal of time partially buried under leaves and soil, and in rodent burrows.
- Usually found in rocky areas near streams or rivers with shrubs or trees nearby.
- Recent sightings have occurred in the Bechler region and Gibbon Meadows.

Similar species:

The racer (*Coluber constrictor*) can be found from southern British Columbia, east to Maine, and south across the United States to southern Florida and southern California. Racers, as their name implies, are fast and sleek snakes, unlike the slow-moving rubber boa.

Racers also have larger eyes than rubber boas and round pupils. Any sightings of this species should be reported to resource managers.



Sagebrush Lizard (*Sceloporus graciosus*)



Identification

- Only lizard in Yellowstone.
- Maximum size of five inches from snout to tip of the tail; males have longer tails and may grow slightly larger than females.
- Gray or light brown with darker brown stripes on the back set inside lighter stripes on the sides, running the length of the body; stripes not always prominent and may appear as a pattern of checks down the back; underside usually cream or white.
- Males have bright-blue patches on belly and on each side, with blue mottling on the throat.

Habitat

- Usually found below 6,000 feet but in Yellowstone can live at elevations up to 8,300 feet.
- Populations living in thermally influenced areas are possibly isolated from others.
- Most common along the lower portions of the Yellowstone River near Gardiner, Montana, and upstream to the mouth of Bear Creek; also occurs in Norris, Shoshone, and Heart Lake geyser basins, and in other hydrothermal areas.

Behavior

- Comes out of hibernation about mid-May and is active through mid-September.
- Diurnal, generally observed during warm, sunny weather in dry, rocky habitats.
- During the breeding season, males do push-ups on elevated perches to display their bright-blue side patches to warn off other males.
- Feed on various insects and arthropods.
- Eaten by bullsnakes, terrestrial gartersnakes, prairie rattlesnakes, and some birds.
- May shed tail when threatened or grabbed.

Common Gartersnake (*Thamnophis sirtalis*)



Identification

- Medium-sized snake up to 34 inches long.
- Nearly black background color with three bright stripes running the length of the body; underside is pale yellow or bluish-gray.
- Most distinguishing characteristics of this species in this region are the irregular red spots along the sides.

Habitat

- Thought to be common in the past, now in decline for no apparent reason.
- Closely associated with permanent surface water.
- In Yellowstone area, observed only in the Falls River drainage in the Bechler region and three miles south of the south entrance along the Snake River.

Behavior

- Generally active during the day.
- In the Yellowstone area, it eats mostly toads, chorus frogs, fish remains, and earthworms; can eat relatively poisonous species. Reliance on amphibian prey may contribute to reports of decline of this species in the greater Yellowstone area.
- Predators include fish, birds, and carnivorous mammals.

Terrestrial Gartersnake (*Thamnophis elegans*)



JEFF ARNOLD

Identification

- Most common reptile in the park.
- Six to 30 inches long.
- Brown, brownish-green, or gray with three light stripes—one running the length of the back and one stripe on each side.

Habitat

- Usually found near water in all areas of the park.
- Eats small mammals, fish, frogs, tadpoles, salamanders, earthworms, slugs, snails, and leeches.

Behavior

- May discharge musk from glands at the base of the tail when threatened.
- Gives birth to as many as 20 live young in late summer or fall.

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Carabid beetle

Insects

There are approximately 1.5 million described insect species in the world--three times the number of all other known species combined. Insects provide many critical ecosystem services, including pollinating native plant communities; providing a food source for hundreds of bird, amphibian, reptile, and mammal species; acting as primary and secondary decomposers; recycling nutrients to create organic soil; acting as predators and parasites to keep pest species in check; and providing economic benefits through crop pollination, honey, wax, silk, and other products. Despite these crucial functions, until recently insects in Yellowstone National Park were studied only opportunistically through external research projects.

Over the last several decades, insect studies have

been conducted to document easily recognizable groups. The majority of groups, even at the order-level, remain understudied. Yellowstone has genus or species level records for the following orders:

- Coleoptera (beetles)—487
- Hymenoptera (bees, wasps, ants, and sawflies)—67 (365)
- Orthoptera (grasshoppers and cicadas)—51
- Diptera (true flies)—403
- Ephemeroptera (mayflies)—72
- Hemiptera (true bugs)—38
- Lepidoptera (moths and butterflies)—237
- Odonata (dragonflies)—47
- Plecoptera (stoneflies)—92
- Trichoptera (caddisflies)—141
- Megaloptera (dobsonflies)—2

Quick Facts

- Insect diversity, abundance, trends, and baseline species list remain largely unknown.
- Until recently insects in Yellowstone were studied only opportunistically through external research projects.
- In 2018, The National Environmental Observatory Network (NEON) began to monitor ground beetle diversity, mosquitoes, and tick-borne disease in the park.
- YNP staff are replicating the NEON beetle monitoring protocols at seven Northern Range sites.
- There are approximately 1.5 million described insect species in the world--three times the number of all other known species combined.
- Insects provide many critical ecosystem services, including pollination, providing a food source, acting as decomposers, recycling nutrients, and acting as predators and parasites.

Recent analysis of a 27-year study in Germany, which is illustrative of global trends possibly found in Yellowstone National Park, documented an 82% mid-summer decline in flying insect biomass regardless of habitat type and unexplained by changes in weather, land use, or habitat characteristics. Except for a few groups like butterflies, bees and beetles, Yellowstone National Park insect diversity, abundance, trends, or baseline species lists remain largely unknown. Studies in the park have included the following: investigation of the respiratory physiology and thermal preference of water scavenger beetles in thermal features (2011–2013); benthic macroinvertebrate surveys to detect aquatic invasive species; annual butterfly counts (2003–ongoing); a thermal area tiger beetle project to investigate heavy metal metabolism (2017–ongoing); analysis of dragonfly larvae to detect methylmercury levels (2013–ongoing); a Bioblitz that documented 391 species (2009); a project that studied bee diversity and documented

350 species (2010–2012); and several insect studies that examined the effects of the 1988 fires and more recent beetle-kill forest die-offs. Recently, the western bumblebee (*Bombus occidentalis*), has become a candidate for listing under the Endangered Species Act, so a survey to document its occurrence in the park was conducted in 2017. Two high-elevation stoneflies, *Lednia tumana* and *Zapada glacier* are also candidate species for “Threatened” status.

In 2018 The National Environmental Observatory Network (NEON) initiated a 30-year project to monitor ground beetle diversity, mosquitoes, and tick-borne disease occurrence in the park. Yellowstone staff are replicating the NEON beetle monitoring protocols at seven Northern Range climate monitoring sites across an elevation gradient from 5,300 feet to 9,500 feet. This effort will examine a sentinel taxa

(*Carabidae*) to infer population trends across other insect groups. Park staff are also collaborating with the Department of Agriculture to monitor grasshoppers, a potentially significant herbivore. It is currently unknown how the combination of climate change and the spread of invasive plant species will affect insects and native plant pollination, which are key to ecosystem functions supporting ungulate and bird habitat. Monitoring representative insect groups to detect changes over time is important. These studies will inform management actions to mitigate potential species loss.

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