



Yellowstone National Park has abundant and diverse wildlife. Surrounded by ravens, a bald eagle, and a golden eagle land on an elk carcass killed by the Slough Creek wolf pack near the Lamar River as a coyote watches.

## 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 and elk 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

- Curlee, A.P. et al., eds. 2000. *Greater Yellowstone predators: ecology and conservation in a changing landscape*. Proceedings of the Third Biennial Conference on the Greater Yellowstone Ecosystem. Jackson, WY: Northern Rockies Conservation Coop.
- Garrott, R. et al., editors. 2009. *The ecology of large mammals in Central Yellowstone*. San Diego: Academic Press.
- Ruth, T. et al. 2003. Large carnivore response to recreational big-game hunting along the Yellowstone National Park and Absaroka-Beartooth Wilderness boundary. *Wildlife Society Bulletin*. 31(4):1–12.

### 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 2015, an estimated 717 grizzly bears live in the Greater Yellowstone Ecosystem.
- Black bears are common.
- Gray wolves were restored in 1995. As of January 2016, 99 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.
- Nonnative mountain goats have colonized northern portions of the park.

- Schullery, P. and L. Whittlesey. 1999. Early wildlife history of the Greater Yellowstone Ecosystem. Report, available in Yellowstone Heritage and Research Center Library.
- Streubel, D. 2002. *Small mammals of the Yellowstone Ecosystem*. Juneau, Alaska: Windy Ridge Publishing.
- Feldhamer, G.A., B.C. Thompson, and J.A. Chapman, eds. 2003. *Wild mammals of North America: Biology, management, and conservation*. Baltimore: Johns Hopkins University Press.
- White, P. J., Robert A. Garrott, and Glenn E. Plumb. 2013. *Yellowstone's wildlife in transition*. Cambridge, Massachusetts: Harvard University Press.

## 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 its behavior is much more aggressive. 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. Learning about bears can help you avoid a confrontation.

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 an estimated 717 in 2015, and 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

### Grizzly Bears

#### Number in Yellowstone

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

As of 2015, 717 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 45 mph.
- Can climb trees but curved claws and weight make this difficult. Can also swim and run up and downhill.
- Adapted to life in forest and meadows.
- Food includes rodents, insects, elk calves, cutthroat trout, roots, pine nuts, grasses, 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

- The grizzly bear population in the Greater Yellowstone Ecosystem was returned to the federal threatened species list in 2009.
- Scientists and managers believe the grizzly population is doing well. Grizzlies are raising cubs in nearly all portions of the greater Yellowstone area. They are also dispersing into new habitat. Currently, they occupy 20,522 square miles in the Greater Yellowstone Ecosystem.

Ecosystem has recovered include estimated population size, distribution of females with cubs, and mortality rates. An estimated 150 grizzly bears occupy ranges that lie partly or entirely within Yellowstone. 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 59 known and probable grizzly bear mortalities in the Greater Yellowstone Ecosystem in 2015. Thirty-four were attributed to human causes. Four were of untermimed cause, 2 were natural deaths, and 19 were still under investigation at the time of this printing.

Three human conflicts with grizzly bears occurred inside the park in 2015, and resulted in a human fatality and the removal of a female grizzly and two cubs from the park. (See “Your Safety in Bear Country” and “Human Fatality” in this section.)

#### **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 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 black bears. The longer, less curved claws and larger shoulder muscle mass of the grizzly bear makes it better suited

#### **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 considered threatened. It was removed from the federal threatened species list in 2007, was re-listed in 2009. Regardless of its listing status, scientists will continue to monitor the long-term recovery goals for grizzly bears.

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 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.

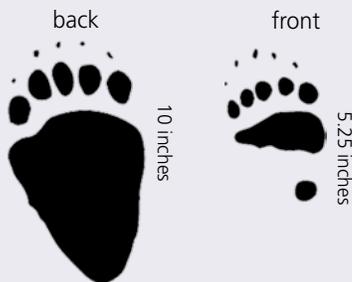
Bears spend most of their time feeding, especially during “hyperphagia,” the period in autumn when they may gain more than three pounds per day until they enter their dens to hibernate. In years and locations when whitebark pine nuts are available, they are the most important bear food from September

## Identify Grizzly Bears and Black Bears

### Grizzly Bear



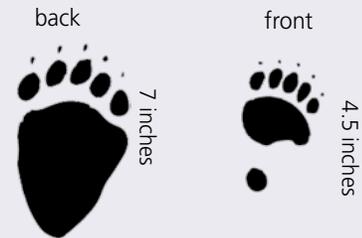
- Rump lower than shoulders.
- Shoulder hump present.



### Black Bear



- Rump higher than shoulders.
- No shoulder hump.



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.



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

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 others become less prominent.



By April 2013, this bear had emerged from hibernation and was searching for food to replenish lost body mass.

### **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 from a few days or weeks in Mexico to six months or more in Alaska. Pregnant females tend to den earlier and longer than other bears. Grizzly bear females without cubs in Greater Yellowstone den on average for about five months.

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 is usually just large enough for the bear to squeeze through and settle; 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 (22°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 about 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 such as 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 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 were thought to remain, totaling 800 to 1,000 bears. The 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



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

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

### **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 remains on the Threatened species list.
- 2013: Yellowstone Ecosystem subcommittee and Interagency Grizzly Bear Study Team recommend that grizzly bears be removed from Threatened status.

## Grizzly Bear Recovery Plan: New Population Monitoring Criteria

Population Objectives	Was the objective achieved?									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Estimated % of total mortality of independent aged females not to exceed 7.6%. (Lowered from 9% in 2012.)	✓	✓		✓	✓		✓	✓	✓	
Estimated % of total mortality of independent aged males not to exceed 15%.	✓	✓		✓			✓	✓	✓	✓
Estimated % of mortality from human causes for dependent young not to exceed 7.6%. (Lowered from 9% in 2012.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Demographic objective of 48 females producing cubs annually. (2006–2013)	✓	✓	✓	✓	✓	✓	✓	✓	N/A	✓
Population estimate ≥ 500 bears in the recovery area. (Criteria instituted in 2014)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓

✓ = Objective was achieved.

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 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.

Meanwhile, management of the bears in the Greater Yellowstone Ecosystem changes little whether it is listed on the threatened species list or not. Scientists will continue to monitor the long-term recovery goals for grizzly bears and strive to ensure the criteria are met.



Management of the bears in the Greater Yellowstone Ecosystem changes little whether it is listed on the threatened species list or not.

## 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 bear (*Ursus arctos*). 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, 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 a black bear is similar to grizzly bears. Like grizzly bears, black bears spend most of their time during fall and winter feeding during hyperphagia. In November they locate or excavate a den on north-facing slopes between 5,800–8,600 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.

## 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

- Like grizzlies, used to be fed at dumps within the park.
- For years, black bears were fed by visitors from vehicles.
- Both of these actions resulted in bears losing fear of humans and pursuing human food, which resulted in visitor injuries, property damage, and the need to destroy “problem bears.”

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.

### 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



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.

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

## 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.

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.

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 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



Bear spray works. Know how to use it.

car. Always comply with instructions of park staff on 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



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



Watch for fresh tracks and scat.

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 and charismatic 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. As you enjoy park trails:

- Before you set out, 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.
- Avoid hiking alone. Hike with three or more people.
- Do not run. Bears have an instinct to chase.

### More Information

2007. Final Conservation Strategy for the Grizzly Bear in the Yellowstone Area. Interagency Grizzly Bear Study Team.

2009. *Greater Yellowstone Coalition, Inc. v. Servheen et al.* Vol. CV 07-134-M-DWM. US District Court for the District of Montana, Missoula Division.

Bjornlie, D. D., F. T. van Manen, M. R. Ebinger, M. A. Haroldson, D. J. Thompson, C. M. Costello. 2014.

Whitebark pine, population density, and home-range size of grizzly bears in the Greater Yellowstone Ecosystem. *PLoS ONE* doi 10.1371/journal.pone.0088160.

Coleman, T.H., C.C. Schwartz, K.A. Gunther, and S. Creel. 2013. Grizzly bear and human interaction in Yellowstone National Park: an evaluation of Bear Management Areas. *Journal of Wildlife Management* 77(7):1311-1320.

Costello, C. M., F. T. van Manen, M. A. Haroldson, M. R. Ebinger, S. Cain, K. Gunther, and D. D. Bjornlie. 2014. Influence of whitebark pine decline on fall habitat use and movements of grizzly bears in the Greater Yellowstone Ecosystem. *Ecology and Evolution*. 4(10):2004-2018.

Craighead, J.C., J.S. Sumner, and J.A. Mitchell. 1995. *The grizzly bears of Yellowstone: Their ecology in the Yellowstone ecosystem*. Washington, DC: Island Press.

Fortin, J.K., C.C. Schwartz, K.A. Gunther, J.E. Teisberg, M.A. Haroldson, M.A. Evans, and C.T. Robbins. 2013. Dietary adjustability of grizzly bears and American Black Bears in Yellowstone National Park. *Journal of Wildlife Management* 77(2): 270–281.

Gunther, K.A. and T. Wyman. 2008. Human habituated bears: The next challenge in bear management in Yellowstone National Park. *Yellowstone Science* 16(2): 35–41.

Gunther, K., R. Shoemaker, K. Frey, M. A. Haroldson, S. L. Cain, F. T. van Manen, and J. K. Fortin. 2014. Dietary breadth of grizzly bears in the Greater Yellowstone Ecosystem. *Ursus*. 25(1):60–72.

Haroldson, M.A., and K.A. Gunther. 2013. Roadside bear viewing opportunities in Yellowstone National Park: characteristics, trends, and influence of whitebark pine. *Ursus* 24(1):27–41.

## Human Fatality from Bear Encounter in Yellowstone during Summer 2015

On August 6, 2015, a 63-year old man from Billings, Montana, was killed by a grizzly bear near the Elephant Back Loop Trail in the Lake Village area of Yellowstone National Park. An Interagency Board of Review determined the man died as a result of traumatic injuries sustained from a bear attack.

In the days immediately following the attack, an adult female grizzly bear and her two female cubs were captured in traps set at the site of the fatality. DNA evidence indicates that the Elephant Back female and one of her two female cubs were both present at the site and left hair and/or scats there. By

association, the Elephant Back female's second cub was likely present as well, as cubs are usually accompanied by their mothers. No DNA, tracks, or other physical evidence from any other grizzly bears, black bears, mountain lions, wolves, or coyotes was found at the incident site.

Due to the DNA evidence linking the Elephant Back female and her cubs to the body burial cache and the consumption of a portion of the body, they were permanently removed from the wild. The adult female grizzly was euthanized and the two cubs were sent to the Toledo Zoo in Ohio.

Attacks by bears are considered rare. A total of eight people have been killed by bears in the park since it was founded in 1872, including two park visitors killed in separate incidents in 2011.

Hikers are encouraged to travel in groups of three or more, make noise on the trail, always carry bear spray that is readily accessible, and be alert for bears. Under no circumstances should anyone run from a bear. Visitors are reminded that park regulations require them to stay at least 100 yards away from bears and wolves and at least 25 yards away from all other large animals.

- Haroldson, M.A., C.C. Schwartz, K.C. Kendall, K.A. Gunther, D. S. Moody, K. Frey, and D. Paetkau. 2010. Genetic analysis of individual origins supports isolation of grizzly bears in the Greater Yellowstone Ecosystem. *Ursus* 1:1–13.
- Herrero, S. 1985. *Bear attacks: Their causes and avoidance*. New York: Nick Lyons Books.
- Interagency Grizzly Bear Study Team. 2013. *Response of Yellowstone grizzly bears to changes in food resources: A synthesis*. Report to the Interagency Grizzly Bear Committee and Yellowstone Ecosystem Subcommittee. U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, Montana, USA. [http://www.nrmssc.usgs.gov/research/igbst/GBFSR\\_Refs](http://www.nrmssc.usgs.gov/research/igbst/GBFSR_Refs)
- Meagher, M. 2008. Bears in transition, 1959–1970s. *Yellowstone Science* 16(2): 5–12.
- Middleton, A.D., T.A. Morrison, J.K. Fortin, M.J. Kauffman, C.T. Robbins, K.M. Proffitt, P.J. White, D.E. McWhirter, T.M. Koel, D. Brimeyer, and W.S. Fairbanks. 2013. Grizzly bears link non-native trout to migratory elk in Yellowstone. *Proceedings of the Royal Society B* 280:20130870.
- Richardson, Leslie, Tatjana Rosen, Kerry Gunther, and Chuck Schwartz. 2014. The economics of roadside bear viewing. *Journal of Environmental Management*. 140:102-110.
- Schullery, P. 1992. *The bears of Yellowstone*. Worland, Wyoming: High Plains Publishing Company.
- Schwartz, C.C., M.A. Haroldson, G.C. White, R.B. Harris, S. Cherry, K.A. Keating, D. Moody, and C. Servheen. 2006. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the Greater Yellowstone Ecosystem. *Wildlife Monographs* 161(1):1–68.
- Schwartz, C.C., M.A. Haroldson, and G.C. White. 2010. Hazards affecting grizzly bear survival in the greater Yellowstone ecosystem. *Journal of Wildlife Management* 74(4):654–667.
- Schwartz, C.C., M.A. Haroldson, K. West, and et al. Yellowstone grizzly bear investigations: Annual reports of the Interagency Grizzly Bear Study Team, Edited by US Department of the Interior. Bozeman, MT.
- Teisberg, J. E., Haroldson, M. A., Schwartz, C. C., Gunther, K. A., Fortin, J. K. and Robbins, C. T. 2014. Contrasting past and current numbers of bears visiting Yellowstone cutthroat trout streams. *Journal of Wildlife Management*, 78: 369–378.
- White, P.J., R.A. Garrott, and G.E. Plumb, eds. 2013. *Yellowstone's Wildlife in Transition*. Cambridge, Massachusetts: Harvard University Press.
- van Manen, F. T., Ebinger, M. R., Haroldson, M. A., Harris, R. B., Higgs, M. D., Cherry, S., White, G. C. and Schwartz, C. C. (2014), Re-Evaluation of Yellowstone Grizzly Bear Population Dynamics not Supported by Empirical Data: Response to Doak & Cutler. *Conservation Letters*, 7: 323–331.

### Staff Reviewer

Kerry Gunther, Bear Management Biologist

## 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 cattle through contact with infected fetal tissue. To prevent conflicts with ranching and other activities outside the park, the National Park Service works with other federal, state, and tribal agencies to manage and develop policies for bison access to winter range outside the boundaries. 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. Bulls are more massive in appearance than cows, and more bearded. For their size, bison are agile and quick, capable of speeds in excess of 30 mph. 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, but 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 short horns that curve upward, with male's 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

### Quick Facts

#### Number in Yellowstone

Estimated at 4,900 in July 2015. This includes two sub-populations in Yellowstone: Northern Range (3,600) and Hayden Valley (1,300).

#### Where to See

- Year-round: Hayden and Lamar valleys.
- Summer: grasslands.
- Winter: hydrothermal areas and along the Madison River. Blacktail ponds, Mammoth and Tower areas.

#### 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, sport hunting, and the US Army nearly caused the extinction of the bison.

- By 1902, poachers reduced Yellowstone's small herd to about two dozen animals.
- The US Army, who administered Yellowstone then, protected these bison from further poaching.
- Bison from private herds augmented the native herd.
- For decades, bison were intensively managed due to belief that they, along with elk and pronghorn, were over-grazing the park.
- By 1968, intensive manipulative management (including herd reductions) of bison ceased.

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, 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.

### **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



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."

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, which is regurgitating partially digested food and chewing it again, to allow 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,

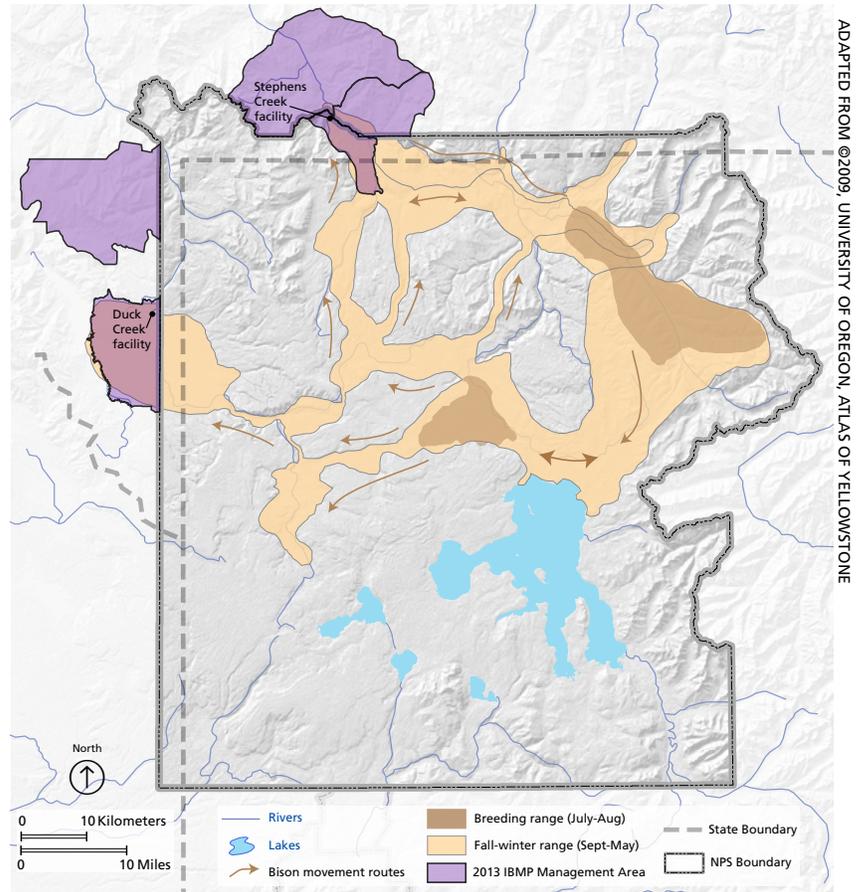
and then consume the most nutritious plants available. High densities of bison can deplete forage in high quality patches, resulting in subsequent use of areas with plants of lower diet quality. Bison in central Yellowstone frequently use thermally influenced areas near geysers, hot springs, fumaroles, 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 km<sup>2</sup>) in the headwaters of the Yellowstone and Madison rivers. Today, this range is restricted to primarily Yellowstone National Park and some adjacent areas of Montana. The bison population is subdivided into the central and northern breeding herds. 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 comprised 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 between the Madison, Firehole, Hayden, and Pelican valleys during the rest of the year. However, some bison travel to the northern portion

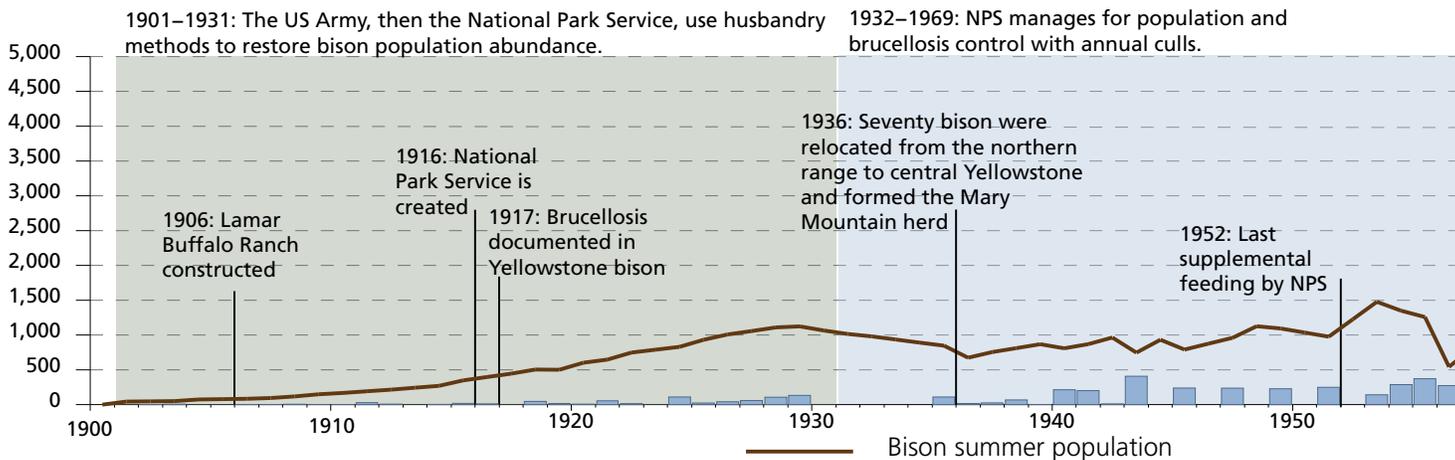


The seasonal distribution of Yellowstone bison is shown here in comparison with the Interagency Bison Management Plan management areas.

of the park and mix with the northern herd before most return to the Hayden Valley for the subsequent breeding season. In addition, there is some evidence numerous females recently switching breeding ranges and successfully breeding and rearing young on their new range.

### History

Historically, Yellowstone bison spent summer in the Absaroka Range north of Yellowstone National Park; in the Lamar Valley-Mirror Plateau area of north-eastern 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 Valley and nearby areas; bison in central Yellowstone spent winter in the Hayden and Pelican valleys; 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 was



Estimated summer population and the number of bison removed the following winter, 1900–2013.

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 way of life for Indians and bison. 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.

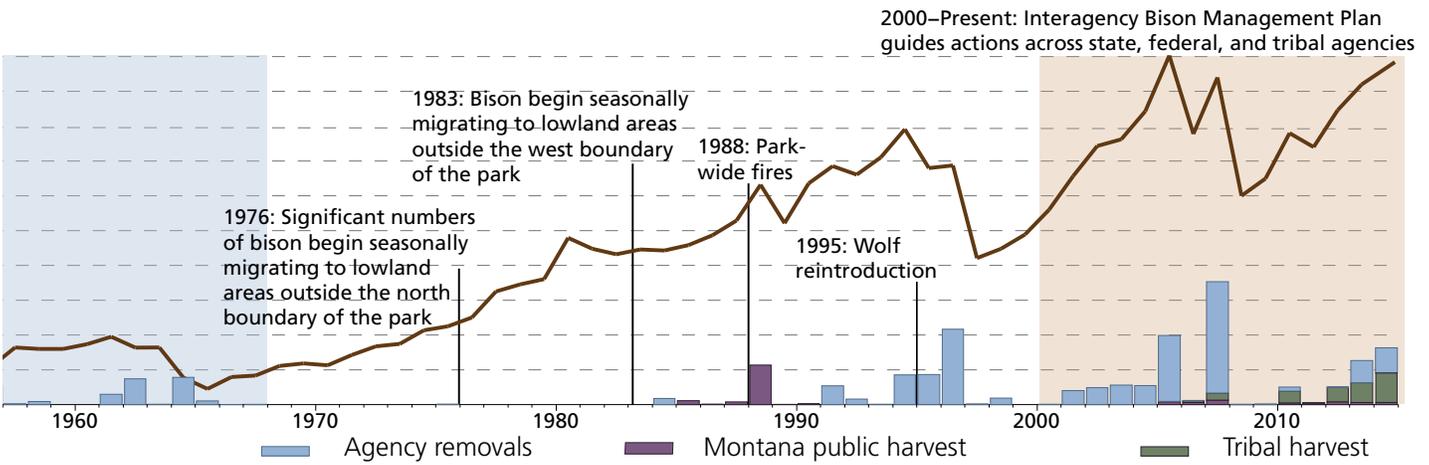
Bison were almost extirpated before 1900, leaving a remnant, indigenous herd of approximately 23 bison in the Pelican Valley of central Yellowstone. In 1902, the US Army administrators of Yellowstone National Park created another herd in northern Yellowstone from 18 female bison that were relocated from a ranch in northern Montana and 3 males from Texas. Protection and stewardship (husbandry), 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 an increase in abundance by 1954.

#### ***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



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



northern Yellowstone during winter, where some of them stayed and remained year-round. This range expansion and dispersal from the central herd 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 although transmission is biologically feasible and has occurred in captivity. Management strategies attempt to prevent bison from commingling with cattle. 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 from wild



Research shows that bison calves pose no risk to cattle.

## 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 about two dozen bison left in Yellowstone. The next hundred years chronicled the slow, but determined efforts of dedicated people to bring this species back from the brink of extinction. The National Park Service is very proud of its role in restoring this iconic species. So, if the bison story in Yellowstone has been such a success, why is there controversy?

### Top 8 things to know about bison management today:

- 1. Yellowstone's bison are unique.** Unlike most bison in the West, which are managed as domestic livestock, Yellowstone's population has thousands of animals that all exhibit wild behavior like their ancient ancestors. They are exposed to predators, severe environmental conditions, and show no evidence of any interbreeding with cattle. A symbol of wild America, the Yellowstone bison are an essential part of a complex ecosystem that is much larger than the national park. Our goal is to maintain this viable, wild, migratory population of bison.
- 2. Migration and tolerance are the crux of the issue.** Bison are a migratory species and they move across a vast landscape. When they are inside Yellowstone, they have access to all the habitat. But in the winter, when they migrate to lower elevations outside the park in search of food, the surrounding states and some private landowners don't offer the same access to habitat. Wild bison are only allowed in limited areas outside of Yellowstone because some are infected with the disease brucellosis that can be transmitted to cattle. Interestingly, some elk that live across the ecosystem, as well as some elk in the park, also carry brucellosis, but their movements are not constrained. For long-term conservation, Yellowstone bison need similar access to habitat and tolerance that other wildlife species are given.
- 3. The future of bison management is a shared responsibility.** In 1995, Montana sued the National Park Service because bison were migrating out of the park onto state lands. A court-mediated settlement was reached in 2000 creating the Interagency Bison Management Plan (IBMP). Today, the park and seven other partners implement this plan, which was approved by the secretaries of the Interior and Agriculture and the Montana governor. While the plan calls for a target population of around 3,000 animals, the size of the herd and the level of tolerance outside the park are two issues often debated by the IBMP partners and their constituents.
- 4. Population reduction is a routine, but unpleasant, part of bison conservation.** The Yellowstone bison herd has high reproductive and survival rates, so when conditions are good its numbers increase rapidly. Since 2000, the herd has averaged more than 4,000 animals each year. Until there is more tolerance for bison in the surrounding states, IBMP managers will continue to cull the herd using two methods: (1) hunting outside the park, and (2) capturing bison near the park boundary then transferring them to Native American tribes for slaughter and distribution of meat and hides to their members. We understand that many people are uncomfortable with the practice of capture and slaughter—we are too, so we're looking for additional alternatives.
- 5. Doing nothing jeopardizes our goal.** We are often asked "Why not just let the bison roam?" The IBMP calls for population control to limit the probability that bison will come in contact with cattle and spread brucellosis. Letting large numbers of bison move unchecked outside the park would threaten tolerance in the future. Faced with increasing numbers of bison, the states could revert to stricter rules again. The loss of current tolerance would be a huge setback for bison conservation.
- 6. We are investigating other options.** We would gladly reduce the frequency and magnitude of capture/ slaughter operations if migrating bison had access to more habitat outside the park or there was a way to transfer live bison elsewhere. Currently, it is against state and federal laws to move any wild bison exposed to brucellosis anywhere except to meat processing facilities. The park is currently studying the feasibility of developing quarantine facilities for bison. From quarantine, animals that repeatedly test negative for brucellosis could be sent alive to other public, private, or tribal lands for conservation, hunting, or food production. If quarantine facilities are built in the future, they will not entirely replace the need for capture/slaughter, nor will they change hunting opportunities outside the park.
- 7. Hunting inside the park is not an option.** Hunting is prohibited in Yellowstone National Park. As a result, the park contains one of the most intact and easily viewable collections of wild animals in North America, drawing visitors from around the world. Now, several groups want to open the park to bison hunting so that they can hunt in the fall and increase the number of animals that are harvested each year. The park strongly opposes this idea. Allowing any hunting in Yellowstone will affect the behavior of many different animals and drastically change the experience visitors have in the park. This is not the future we want for Yellowstone and we don't believe that it's the future the public wants for Yellowstone.
- 8. It's time to craft a new plan and find different ways for the public to get involved.** The park and the state of Montana are working together to update the current bison management plan (IBMP). While the existing plan has been effective at preventing brucellosis transmission and maintaining a viable herd, we believe that we've outgrown it—new data about general biology and disease prevalence are available, and public opinion is shifting toward more tolerance for bison in Montana. We need a new paradigm that accommodates larger herd sizes and allows bison to move more freely on suitable public lands in the Greater Yellowstone Ecosystem. We look forward to engaging the public in this process and exploring new ways for people to make their voices heard. You can find more information about this planning process at the NPS PEPC website at <http://parkplanning.nps.gov/YELLBisonPlan>.

bison or elk back to cattle.

Between 1984 and 2000, more than 3,000 bison that migrated outside Yellowstone National Park and into Montana were harvested by hunters or culled from the population to prevent the possible 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 that prescribed 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. Counts of the central herd increased from about 1,900 bison in 2000 to 3,500 in 2005, and then decreased to 1,400 in 2013 due primarily to large culls of about 1,000 and 1,560 bison at the park boundary during 2006 and 2008, respectively. Conversely, counts of the northern herd increased from about 500 bison in 2000 to 3,200 in 2013. This rapid increase was enhanced by movements of bison from the central herd, and possibly, reduced competition as numbers of northern Yellowstone elk decreased from about 19,000 counted individuals in 1994 to less than 4,000 in 2013.

Yellowstone bison are migratory wildlife, not livestock. One mission of the National Park Service 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 in and near Yellowstone National Park 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



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

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 National Park 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 National Park and nearby Grand Teton National Park, where there were about 800 bison in 2012, is constrained by the availability of low-elevation winter habitat where forage is relatively accessible. Much of Yellowstone and Grand Teton national parks 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 these parks 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 be transmitted between bison and cattle, consumption of agricultural crops, and limited funding for management. Ultimately, it is up to society to decide how they want their federal and state governments to manage bison, including how many bison should be tolerated on public lands, what should be done with “surplus” bison, and how much

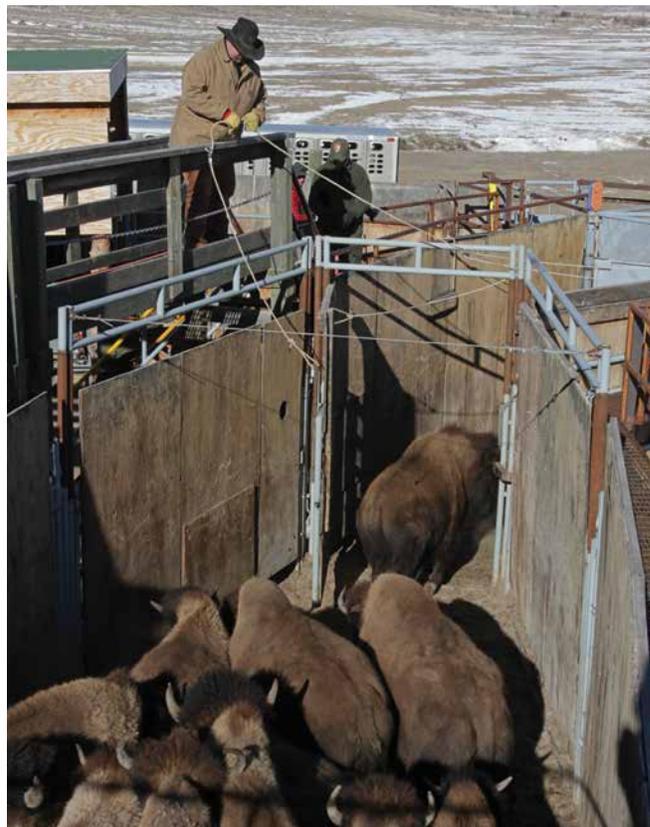
money should be spent on bison management and brucellosis suppression.

The management of bison near the boundary of Yellowstone National Park, 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 ecologically important population. There is no quick and easy resolution, but the intense management of Yellowstone bison is necessary at times to gain



Management operations along the park boundary include hazing, culling, capture, testing, and vaccination. Many of the operations are carried out at the Stephens Creek Facility, shown here in January 22, 2015.

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 currently killing few bison 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 5,000 bison in 2005. 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 National Park. 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 National Park 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 further during some winters, 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 National Park 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 comingling 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 National Park Service cannot achieve bison conservation on its own. When bison cross the boundary of Yellowstone National Park into Montana they are no longer under the jurisdiction of the National Park Service and their management is the prerogative of



The migration of bison outside of Yellowstone National Park (the boundary is marked here with the 1903 arch at the northern entrance) is a hot issue for the Greater Yellowstone Area.

the state and the Gallatin National Forest on National Forest System lands. Bison are managed differently than other wildlife that migrate or disperse outside Yellowstone National Park because the Secretaries of Agriculture and Interior and the Governor of Montana signed a court-mediated agreement in 2000 that included guidelines for limiting bison abundance and distribution in Montana.

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 state and local governments and 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 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 minimal and the current social capacity for public and treaty harvests near the boundary of Yellowstone National Park is probably only about 250 to 300 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 United States, and some bighorn sheep, deer, elk, and moose that spend summer in Yellowstone National Park, 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 National Park Service, Animal and Plant Health Inspection Service, U.S. Forest Service, Montana Department of Livestock, and Montana Fish, Wildlife & Parks. 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 National Park Service has jurisdiction over all bison management actions inside the park, while the Montana Department of Livestock has

lead responsibility outside the park. Property damage issues on private lands are the responsibility of Montana Fish, Wildlife & Parks, who may request assistance from the Department of Livestock. The IBMP uses risk management procedures to maintain spatial and temporal separation between bison and cattle around Yellowstone National Park. For bison to transmit brucellosis directly to cattle, infected bison must leave Yellowstone National Park 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. The plan was designed to progress through a series of management steps that gradually tolerated more bison on winter ranges outside Yellowstone National Park when cattle are not present as the risk of brucellosis transmission from bison to cattle was reduced.

### Adaptive Management

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

## 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](http://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 and Parks (FWP)
- InterTribal Buffalo Council (ITBC)
- Confederated Salish 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 additional habitat in the Gardiner Basin of Montana (State decision Feb 2012).

- As of December 2015, wild bison are tolerated year-round outside the west and northern boundaries.
- Fewer cattle graze lands near park than in 2000.
- A vaccine used in cattle, RB51, is sometimes used for Yellowstone bison.
- The State of Montana is managing a bison hunt on public lands outside the park.
- Four tribes are conducting subsistence bison hunts on unclaimed federal lands outside the park by authority of their respective treaties with the United States.
- Quarantine facilities have been built on Fort Peck Assiniboine and Sioux reservations to accommodate live bison as an alternative to shipments directly to slaughter when bison need to be removed

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 U.S. 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 the higher mountains.

From 2005 to 2010, Montana Fish, Wildlife & Parks and the Animal and Plant Health Inspection Service initiated a quarantine feasibility study with bison calves from Yellowstone National Park that initially tested negative for brucellosis exposure. Two study groups, or cohorts, were held at a research facility north of Yellowstone National Park to evaluate if they would remain free of brucellosis through at least their first pregnancy and calving. By 2010, the quarantine feasibility study was deemed successful and the surviving original bison and their offspring were considered brucellosis free. In February 2010, 87 bison from the first study group were transferred from the quarantine facility to the Green Ranch in Montana owned by Turner Enterprises for additional surveillance. In November 2014, the first cohort of quarantine graduates, plus 25% of their offspring, were transferred from the Green Ranch to tribal lands on the Fort Peck Reservation in northeastern Montana. Seventy-five percent of the offspring were retained by Turner Enterprises as negotiated in their agreement with the State of Montana. In March 2012, agents of the State of Montana transferred 61 bison from the second cohort at the quarantine facility to the Fort Peck Indian Reservation for five years of additional surveillance. In August 2013, the Fort Peck Assiniboine and Sioux Tribes transferred 34 of the Yellowstone bison under their surveillance to the Fort Belknap Reservation in Montana. In November 2014, the original quarantine bison plus 25 percent of the offspring (139 total) at the Green Ranch were transferred to the Fort Peck Reservation.

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.info](http://www.ibmp.info) website). By 2009, several adaptive adjustments to the management plan were approved to improve management of Yellowstone bison, including increased tolerance for bison in some areas north and

west of the boundary of Yellowstone National Park.

Under the IBMP, treaty harvests, the provision of bison meat to American Indian Tribes for consumption, and the restoration of bison to tribal lands to improve their cultural, economic, nutritional, and social well-being are primary options for culling some bison due to the way bison are interwoven into the cultures of tribes. The National Park Service has been working to transfer some Yellowstone bison directly to tribes for immediate slaughter, and is working with the InterTribal Buffalo Council and federal and state animal health officials to develop protocols and facilities for transferring brucellosis-free bison to tribal lands and/or establishing quarantine facilities and terminal pastures 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, with overall abundance during summer ranging between approximately 2,400 and 5,000 (average ~4,000) during 2001 through 2015. Yellowstone bison are managed as wildlife in multiple, large herds that migrate and disperse across an extensive landscape and are 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 3,000 to 3,500 bison. Also, adaptive management adjustments during 2005 to 2012 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 to cattle has occurred, due in part, to successful efforts by the agencies to maintain separation between them. Conversely, numerous transmissions from elk to cattle have occurred since 2000. 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.

### More Information

- Cross, P.C., E.J. Maichak, A. Brennan, B.M. Scurlock, J. Henningsen, G. Luikart. 2013. An ecological perspective on *Brucella abortus* in the western United States. *Revue Scientifique et Technique, Office International des Epizooties* 32:79–87.
- Frank, D. A., R. L. Wallen, and P. J. White. 2013. Assessing the effects of climate change and wolf restoration on grassland processes. Pages 195–205 in P. J. White, R. A. Garrott, and G. E. Plumb. *Yellowstone's wildlife in transition*. Harvard University Press, Cambridge, Massachusetts.
- Freese, C. H., K. E. Aune, D. P. Boyd, J. N. Derr, S. C. Forrest, C. C. Gates, P. J. P. Gogan, S. M. Grassel, N. D. Halbert, K. Kunkel, and K. H. Redford. 2007. Second chance for the plains bison. *Biological Conservation* 136:175–184.
- Gates, C. C., and L. Broberg. 2011. *Yellowstone bison: the science and management of a migratory wildlife population*. University of Montana Press, Missoula, Montana.
- Gates, C. C., C. H. Freese, P. J. P. Gogan, and M. Kotzman, editors. 2010. *American bison: status survey and conservation guidelines 2010*. International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.
- Geremia, C., N. T. Hobbs, P. J. White, J. A. Hoeting, R. L. Wallen, F. G. R. Watson, and D. Blanton. 2014. Integrating population- and individual-level information in a movement model of Yellowstone bison. *Ecological Applications* 24:346–362.
- Geremia, C., P. J. White, R. A. Garrott, R. Wallen, K. E. Aune, J. Treanor, and J. A. Fuller. 2009. Demography of central Yellowstone bison: effects of climate, density and disease. Pages 255–279 in R. A. Garrott, P. J. White, and F. G. R. Watson, editors. *The ecology of large mammals in central Yellowstone: sixteen years of integrated field studies*. Elsevier, San Diego, California.
- Geremia, C., P. J. White, R. L. Wallen, F. G. R. Watson, J. J. Treanor, J. Borkowski, C. S. Potter, and R. L. Crabtree. 2011. Predicting bison migration out of Yellowstone National Park using Bayesian models. *PLoS ONE* 6:e16848.
- Halbert, N. D., P. J. P. Gogan, P. W. Hedrick, J. M. Wahl, and J. N. Derr. 2012. Genetic population substructure in bison at Yellowstone National Park. *Journal of Heredity* 103:360–370.
- Jones, J. D., J. J. Treanor, R. L. Wallen, and P. J. White. 2010. Timing of parturition events in Yellowstone bison—implications for bison conservation and brucellosis transmission risk to cattle. *Wildlife Biology* 16:333–339.
- Kilpatrick, A. M., C. M. Gillin, and P. Daszak. 2009. Wildlife-livestock conflict: the risk of pathogen transmission from bison to cattle outside Yellowstone National Park. *Journal of Applied Ecology* 46:476–485.
- Meagher, M. M. 1973. *The bison of Yellowstone National Park*. Scientific Monograph Series, NPS, Washington, D.C.
- Nishi, J. S. 2010. *A review of best practices and principles for bison disease issues: Greater Yellowstone and Wood Buffalo areas*. American Bison Society Working Paper number 3, Wildlife Conservation Society, Bronx, New York.
- Pérez-Figueroa, A., R. L. Wallen, T. Antao, J. A. Coombs, M. K. Schwartz, P. J. White, and G. Luikart. 2012. Conserving genomic variability in large mammals: effect of population fluctuations and variance in male reproductive success on variability in Yellowstone bison. *Biological Conservation* 150:159–166.
- Plumb, G. E., P. J. White, M. B. Coughenour, and R. L. Wallen. 2009. Carrying capacity, migration, and dispersal in Yellowstone bison. *Biological Conservation* 142:2377–2387.
- Schullery, P., and L. H. Whittlesey. 2006. Greater Yellowstone bison distribution and abundance in the early historical period. Pages 135–140 in A. W. Biel, editor. *Greater Yellowstone public lands: proceedings of the eighth biennial scientific conference on the greater Yellowstone ecosystem*. Yellowstone National Park, Mammoth, Wyoming.
- Schumaker, B. 2013. Risks of *Brucella abortus* spillover in the greater Yellowstone area. *Revue Scientifique et Technique, Office International des Epizooties* 32:71–77.
- Treanor, J. J. 2013. Integrating ecology with management to control wildlife brucellosis. *Revue Scientifique et Technique Office International des Epizooties* 32:239–247.
- Treanor, J. J., C. Geremia, P. H. Crowley, J. J. Cox, P. J. White, R. L. Wallen, and D. W. Blanton. 2011. Estimating probabilities of active brucellosis infection in Yellowstone bison through quantitative serology and tissue culture. *Journal of Applied Ecology* 48:1324–1332.
- Treanor, J. J., J. S. Johnson, R. L. Wallen, S. Cilles, P. H. Crowley, J. J. Cox, D. S. Maehr, P. J. White, and G. E. Plumb. 2010. Vaccination strategies for managing brucellosis in Yellowstone bison. *Vaccine* 28S:F64–F72.
- Treanor, J. J., P. J. White, and R. L. Wallen. 2013. Balancing bison conservation and risk management of the non-native disease brucellosis. Pages 226–235 in P. J. White, R. A. Garrott, and G. E. Plumb. *Yellowstone's wildlife in transition*. Harvard University Press, Cambridge, Massachusetts.
- White, P. J., J. J. Treanor, C. Geremia, R. L. Wallen, D. W. Blanton, and D. E. Hallac. 2013. Bovine brucellosis in wildlife—using adaptive management to improve understanding, technology, and suppression. *Revue Scientifique et Technique Office International des Epizooties* 32:263–270.

## 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 roads and other human activities. About 10 to 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 (above).

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 2015 survey, 329 bighorn sheep were observed, including 166 in Montana and 163 in Yellowstone. These results represent a decline of 22%

### Quick Facts

#### Number in Yellowstone

329 in the northern Yellowstone area in 2015 (163 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 backcountry of eastern Absarokas.

#### 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 4–5 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 1–2 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.

as compared to the 2014 survey results of 421 total sheep observed. In Montana numbers declined by 26%, while Yellowstone numbers were 17% lower. This decline is partially linked to an all-aged pneumonia outbreak during the winter of 2014–2015.

### 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 and 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.



### More Information

Barmore, W.J. Jr. 2003. *Ecology of ungulates and their winter range in Northern Yellowstone National Park*,



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

*Research and Synthesis 1962–1970*. Yellowstone Center for Resources.

Buechner, H.K. 1960. The bighorn sheep in the United States, its past, present, and future. *Wildlife Monographs* 1960(4):174.

Fitzsimmons, N.N., S.W. Buskirk, and M.H. Smith. 1995. Population history, genetic variability, and horn growth in bighorn sheep. *Conservation Biology* 9(2):314–323.

Geist, V. 1976. *Mountain sheep a study in behavior and evolution*. Chicago: University of Chicago Press.

Hughes, S.S. 2004. The sheepeater myth of northwestern Wyoming. In P. Schullery and S. Stevenson, ed., *People and place: The human experience in Greater Yellowstone: Proceedings of the 4th Biennial Scientific Conference on the Greater Yellowstone Ecosystem*, 2–29. Yellowstone National Park, WY: National Park Service, Yellowstone Center for Resources.

Krausman, P. R. and R. T. Bowyer. 2003. Mountain sheep (*Ovis canadensis* and *O. dalli*). In G.A. Feldhamer, B.C. Thompson and J. A. Chapman, ed., *Wild mammals of North America: Biology, management, and conservation*. 2nd ed. Baltimore, MD: The Johns Hopkins University Press.

White, P.J., T.O. Lemke, D.B. Tyers, and J.A. Fuller. 2006. Bighorn sheep demography following wolf reintroduction, Short Wildlife communication to *Biology*.

White, P.J., T.O. Lemke, D.B. Tyers, and J. A. Fuller. 2008. Initial effects of reintroduced wolves *Canis lupus* on bighorn sheep *Ovis canadensis* dynamics in Yellowstone National Park. *Wildlife Biology* 14(1):138–146.

### Staff Reviewer

Travis Wyman, Biological Technician

## Mountain Goats

Descendants of mountain goats (*Oreamnos americanus*) introduced in Montana during the 1940s and 1950s, established a population in the park in the 1990s and have reached a relatively high abundance in the northeastern and northwestern portions via the Absaroka and Gallatin mountain ranges. 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.



### More Information

- Laundré, J.W. 1990. The status, distribution, and management of mountain goats in the Greater Yellowstone Ecosystem, final report. Pocatello, ID: Idaho State University, Department of Biological Sciences.
- Lemke, T.O. 2004. Origin, expansion, and status of mountain goats in Yellowstone National Park. *Wildlife Society Bulletin* 32(2):532–541.
- Lyman, R.L. 1998. *White goats, white lies: The abuse of science in Olympic National Park*. Salt Lake City: University of Utah Press.
- Schullery, P. and L. Whittlesey. 2001. Mountain goats in the Greater Yellowstone Ecosystem: A prehistoric and historical context. *Western North American Naturalist* 61(3):289–307.
- Varlet, N.C.L. 1996. Ecology of mountain goats in the Absaroka range, south-central Montana. MS. Bozeman, MT: Montana State University.

### Staff Reviewer

Travis Wyman, Biological Technician

### Quick Facts

#### *Nonnative species*

#### Number in Yellowstone

208 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 ridgetops; 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 curve less and are thinner and sometimes longer than males.

## Elk

Yellowstone provides summer range for an estimated 10,000–20,000 elk (*Cervus elaphus*) from 6–7 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 90% 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.

Bull elk are one of the most photographed animals in Yellowstone, due to their huge antlers. 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, they 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 6–7 different herds.
- Winter: <5,000

#### Where to See

- Summer: Gibbon Meadows, Elk Park, 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; <100 year-round along the Firehole and Madison rivers; south to the Jackson Hole Elk Refuge in Jackson, Wyoming.

#### Size and Behavior

- Male (bull) weighs about 700 pounds and is about 5 feet high at the shoulder; female (cow) weighs about 500 pounds and is slightly shorter; calf is about 30 pounds at birth.

- Bulls have antlers, which begin growing in the spring and usually drop in March or April of the next 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, or very occasionally females.

- The average, healthy, mature bull has 6 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 4 to 5 points.
- Three-year-old bulls have thicker antlers.
- Four-year-old and older bulls typically have 6 points; antlers are thicker and longer each year.
- Eleven- or twelve-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). 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 other intensely, and wrestle for dominance. While loud and extremely strenuous, fights rarely cause



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

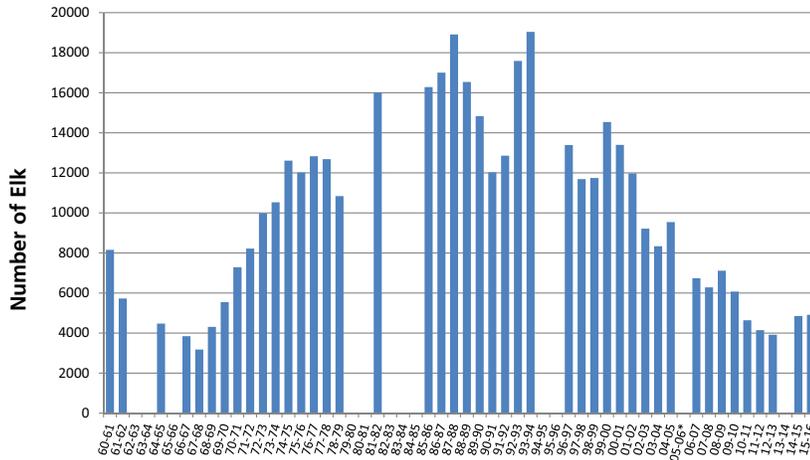
serious injury. The weaker bull ultimately gives up and wanders off.

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 ten days bedded down between nursing. 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 22 years.

### Population

The high elevation grasslands of the park provide summer habitat for 10,000–20,000 elk. However, less than 5,000 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, and decrease the amount of forage that 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 winters with high snowpack, elk delay migration. In years with lower snowpack and earlier

**Northern Yellowstone Cooperative Winter Elk Counts**  
Compiled by the Northern Yellowstone Cooperative Wildlife Working Group



Winter counts of the northern range elk herd in Yellowstone National Park and adjacent areas of Montana, 1960–2016. Counts were not adjusted for elk sightability and gaps represent years where no official count was conducted.

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, and shorten 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. It also migrates outside of the park into the Gallatin National Forest and onto private lands.

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 79 by the end of 2012. The elk count dropped to 3,915 in early 2013, the lowest since culling ended in the park in the 1960s. However, 4,844 elk were counted in winter 2015 suggesting the decline has stabilized. 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–wolf interactions are contributing to a release of willows and other woody vegetation from the effects of herbivory on the northern range. Wolves have altered the group sizes, habitat selection, movements, distribution, and vigilance of elk 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. Research is underway to determine how climate, hydrology, wolf predation/avoidance, and herbivory interact in their effects on these woody species.

### ***Elk in the Interior***

Only one herd lives both winter and summer inside the park. The Madison–Firehole elk herd (less than 100 animals) has been the focus of a research study since November 1991. Researchers are examining how environmental variability effects 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 most of the last two decades, the Jackson herd, which currently numbers about 12,000, 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 also 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.”

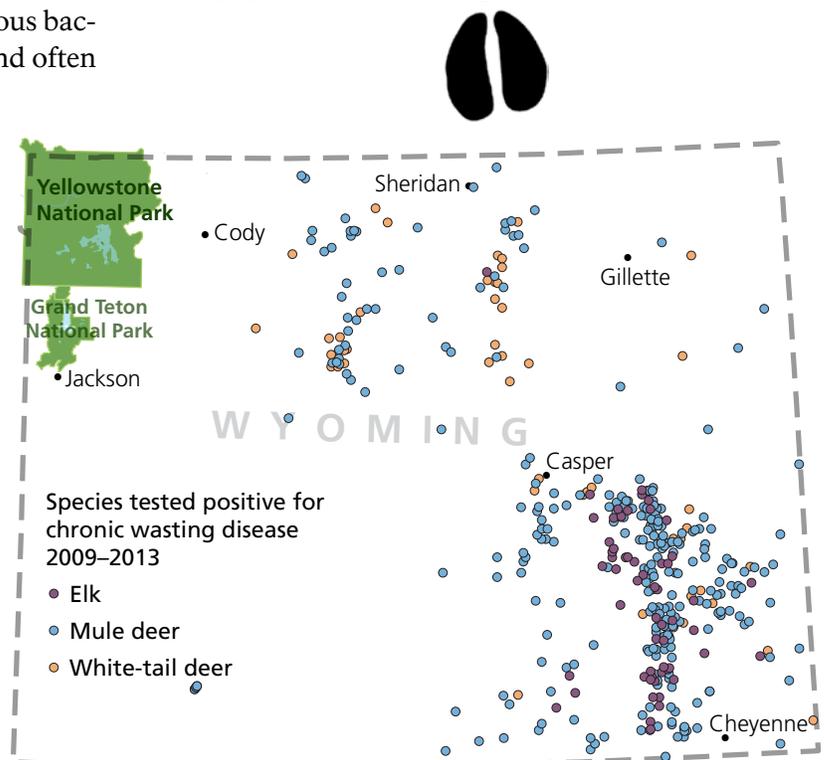
The prevalence of brucellosis in Yellowstone elk is low; the rate of exposure to brucellosis in 100 adult female elk captured on the park’s northern range during the winters of 2000 to 2005 was 2%; it was 3% in 130 neonatal elk on the park’s northern range during the summers of 2003–2005; and it was 3% in 73 adult female elk captured in the park’s Madison–Firehole drainages during 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 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 Greater Yellowstone are at moderate risk for exposure to chronic wasting disease (CWD). This fatal infection, transmitted by animal contact or through the environment, has spread to within 130 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.



Individual cases of chronic wasting disease, by species, recorded in Wyoming from 2009–2013.

## More Information

- Barber, S.M., L.D. Mech, and P.J. White. 2005. Yellowstone elk calf mortality following wolf restoration: Bears remain top summer predators. *Yellowstone Science* 13(3): 37–44.
- Barnore, W.J. Jr. 2003. Ecology of ungulates and their winter range in northern Yellowstone National Park, Research and Synthesis 1962–1970. Yellowstone Center for Resources.
- Beja-Pereira, A., B. Bricker, S. Chen, C. Almendra, P.J. White, and G. Luikart. 2009. DNA genotyping suggests that recent brucellosis outbreaks in the greater Yellowstone area originated from elk. *Journal of Wildlife Diseases* 45(4):1174–1177.
- Borkowski, J.J., P.J. White, R.A. Garrott, T. Davis, A.R. Hardy, and D.J. Reinhart. 2006. Behavioral responses of bison and elk in Yellowstone to snowmobiles and snow coaches. *Ecological Applications* 16(5):1911–1925.
- Garrott, R.A., et al. 2005. Generalizing wolf effects across the greater Yellowstone area: a cautionary note. *Wildlife Society Bulletin* 33:1245–1255.
- Garrott, R.A., P.J. White, and F.G.R. Watson. 2008. *The Ecology of Large Mammals in Central Yellowstone: Sixteen Years of Integrated Field Studies In Terrestrial Ecology Series*. London, UK: Academic Press, Elsevier.
- Hardy, A.R. 2001. Bison and elk responses to winter recreation in Yellowstone National Park. MS. Bozeman, MT: Montana State University.
- Houston, D.B. 1982. *The Northern Yellowstone Elk: Ecology and Management*. New York: Macmillan Publishing Co.
- Kreeger, T.J. 2002. Brucellosis in elk and bison in the Greater Yellowstone area. Cheyenne, WY: Wyoming Game and Fish Department for the Greater Yellowstone Interagency Brucellosis Committee.
- Middleton, A.D., T.A. Morrison, J.K. Fortin, M.J. Kauffman, C.T. Robbins, K.M. Proffitt, P.J. White, D.E. McWhirter, T.M. Koel, D. Brimeyer, and W.S. Fairbanks. 2013. Grizzly bears link non-native trout to migratory elk in Yellowstone. *Proceedings of the Royal Society B* 280:20130870.
- National Research Council. 2002. *Ecological Dynamics on Yellowstone's Northern Range*. Washington, DC: National Academy Press.
- White, P.J., and R.A. Garrott. 2005. Northern Yellowstone elk after wolf restoration. *Wildlife Society Bulletin* 33:942–955.
- White, P.J., and R.A. Garrott. 2005. Yellowstone's ungulates after wolves – expectations, realizations, and predictions. *Biological Conservation* 125:141–152.
- White, P.J. et al. 2003. Evaluating the consequences of wolf recovery on northern Yellowstone elk. Yellowstone Center for Resources.
- White, P.J., et al. 2005. Yellowstone after wolves – EIS predictions and ten-year appraisals. *Yellowstone Science* 13:34–41.
- White, P.J., K.M. Proffitt, and T.O. Lemke. 2012. Changes in elk distribution and group sizes after wolf restoration. *American Midland Naturalist* 167:174–187.
- White, P.J., R.A. Garrott, K.L. Hamlin, R.C. Cook, J.G. Cook, and J.A. Cunningham. 2011. Body condition and pregnancy in northern Yellowstone elk - evidence for predation risk effects? *Ecological Applications* 21:3–8.
- White, P.J., K.M. Proffitt, L.D. Mech, S.B. Evans, J.A. Cunningham, and K.L. Hamlin. 2010. Migration of northern Yellowstone elk - implications of spatial structuring. *Journal of Mammalogy* 91:827–837.
- White, P.J., R.A. Garrott, and G.E. Plumb, eds. 2013. *Yellowstone's Wildlife in Transition*. Cambridge, Massachusetts: Harvard University Press.
- Williams, E.S., M.W. Miller, T.J. Kreeger, R.H. Kahn, and E.T. Thorne. 2002. Chronic wasting disease of deer and elk: A review with recommendations for management. *Journal of Wildlife Management* 66(3):551–563.

## Staff Reviewer

Dan Stahler, Wildlife Biologist

## Moose

Moose in Yellowstone are one of four subspecies of moose (*Alces alces shirasi*) in North America, and are found in forested areas and willow flats from south-eastern British Columbia to northern 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. Despite its size, a moose can slip through the woods without a sound. Moose, especially cows with calves, are unpredictable and have chased people in the park.

Both sexes are dark brown, often with tan legs and muzzle. Bulls can be distinguished from cows by their antlers. Adults of both sexes have “bells”—a pendulous dewlap of skin and hair that dangles from the throat and has no known function.

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. An adult moose



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

consumes approximately 10–12 pounds of food per day in the winter and approximately 22–26 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.

Moose are solitary creatures for most of the year, except during the mating season or rut. During the rut, both bulls and cows are vocal: the cows may be heard grunting in search of a mate, and bulls challenge one another with low croaks before clashing with their antlers. The weaker animal usually gives up before any serious damage is done; occasionally the opponent’s antlers inflict a mortal wound.

Bulls usually shed their antlers in late November or December, although young bulls may retain their antlers as late as March. Shedding their heavy antlers helps them conserve energy and promotes easier winter survival. In April or May, bulls begin to grow new antlers. Small bumps 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

### Quick Facts

#### Number in Yellowstone

- Fewer than 200
- Population has declined in last 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.



Like many ungulates, a moose calf can walk a few hours after birth and stays close to its mother. Even so, a moose calf often becomes prey for bears or wolves and less frequently for cougars or coyotes.

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 spikes; prime adult bulls usually grow the largest antlers—as wide as five feet from tip to tip. When the antler reach their full size, the bull rubs and polishes his antlers on small trees in preparation for the rut.

Cows are pregnant through the winter; gestation is approximately eight months. When ready to give birth, the cow drives off any previous year's offspring that may have wintered with her and seeks out a thicket in which to give birth.

### Population

Moose appear to have been scarce in Yellowstone until the latter half of the 1800s and in Jackson Hole until early in the 1900s. 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 their population increase because moose in Greater Yellowstone depend on mature spruce/fir forests for winter survival, unlike other North American moose populations that prefer shrubland that has been disturbed by events like fires.

Although some Rocky Mountain moose populations have continued to grow and spread into new habitat, those in Yellowstone have declined. Estimated at roughly 1,000 in the 1970s, by 1996 (the most recent data) the Yellowstone moose population declined to less than 200, with the northern range population down by at least 75% since the 1980s.

The moose 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

forage and a harsh winter. 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 fires 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 continuing to limit 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 at a density that depends on current ecological conditions and hunting pressure.

The State of 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 2 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. Since winter 2013–2014, a northern Yellowstone National Park moose study has been underway with the main objective to estimate population abundance and vital statistics of northern Yellowstone moose using non-invasive methods.

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.

### More Information

- Barmore, W.J. Jr. 2003. Ecology of ungulates and their winter range in Northern Yellowstone National Park, Research and Synthesis 1962–1970. Yellowstone Center for Resources.
- Becker, S.A. 2008. Habitat selection, condition, and survival of Shiras moose in northwest Wyoming In Department of Zoology and Physiology. M.S. University of Wyoming.
- Tyers, D.B. and L.R. Irby. 1995. Shiras moose winter habitat use in the upper Yellowstone River Valley prior to and after the 1988 fires. *Alces* 31:35–43.
- Tyers, D.B. 2008. Moose population and history on the northern Yellowstone winter range. *Yellowstone Science* 16.

### 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

The State of Montana Department of Fish, Wildlife, and Parks surveys the northern range population outside the park. In April, 2014 an aerial survey detected 1,806 mule deer in the Gardiner Basin area. No surveys are conducted within the park. While the relative distribution of mule deer across their



Mule deer (above) are common in Yellowstone, living throughout the park in almost all habitats; white-tailed deer are scarce and generally occur along streams and water in the northern range.

## Mule Deer



### Number in Yellowstone

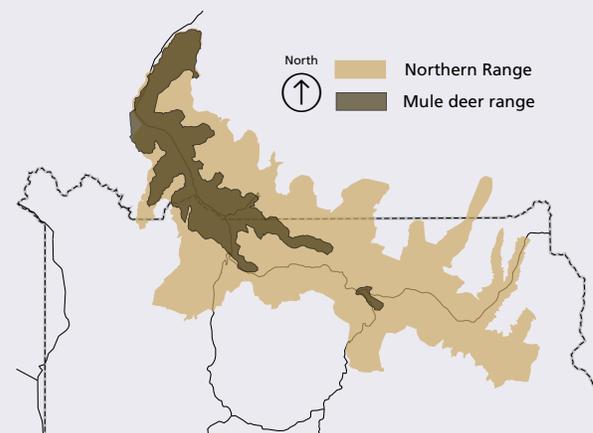
Summer: 1,850–1,900; winter: less than 400

### 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.

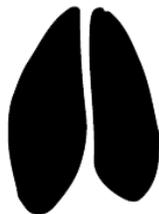


Mule deer winter range lies primarily north of the park boundary.

winter range has remained similar over the last two decades, the population appears to have increased in recent years. Mule deer populations may decline during severe winters, when deep snow and extremely cold temperatures make foraging difficult.

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



### More Information

- Barmore, W.J. 2003. Ecology of ungulates and their winter range in northern Yellowstone National Park: Research and synthesis, 1962–1970. Mammoth Hot Springs, WY: National Park Service, Yellowstone Center for Resources.
- Compton, B.B., R.J. Mackie, and G.L. Dusek. 1988. Factors influencing distribution of white-tailed deer in riparian habitats. *Journal of Wildlife Management* 52(3):544–548.
- Council, National Research. 2002. *Ecological Dynamics on Yellowstone's Northern Range*. Washington, DC: National Academy Press.
- Frank, D.A. 1998. Ungulate regulation of ecosystem processes in Yellowstone National Park: Direct and feedback effects. *Wildlife Society Bulletin* 26(3):410–418.
- Hill, R.R. 1956. Forage, food habits, and range management of the mule deer. In W. P. Taylor, ed., *The deer of North America: The white-tailed, mule and black-tailed deer, genus Odocoileus, their history and management*, 393–414. Harrisburg, PA and Washington, DC: The Stackpole Co. and Wildlife Management Institute.
- Houston, D.B. 1982. *The northern Yellowstone elk: Ecology and management*. New York: Macmillian Publishing Co.
- Mackie, R.J., D.F. Pac, K.L. Hamlin, and G.L. Dusek. 1998. *Ecology and management of mule deer and white-tailed deer in Montana*. Helena, MT: Department of Fish, Wildlife and Parks.
- Singer, F.J. and J.E. Norland. 1994. Niche relationships within a guild of ungulate species in Yellowstone National Park, Wyoming, following release from artificial controls. *Canadian Journal of Zoology* 72:8.
- Williams, E.S., M.W. Miller, T.J. Kreeger, R.H. Kahn, and E.T. Thorne. 2002. Chronic wasting disease of deer and elk: A review with recommendations for management. *Journal of Wildlife Management* 66(3):551–563.

### White-tailed Deer



©2014 STERLING MOORE

#### 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.

#### 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, similar to bison and bighorn sheep. The horns are made of modified, fused hair that grows over permanent bony cores, but they 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 they average 1–2 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



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.

black cheek patch.

### Behavior

Females that bred the previous fall commonly deliver a set of twins in May or June. The newborn fawns are a uniform grayish-brown and weigh 6–9 pounds. They can 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 youngsters join together in nursery herds along with yearling females.

Pronghorn form groups most likely for increased protection against predators. When one individual detects danger, it flares its white rump patch,

### Quick Facts

#### Number in Yellowstone

449 in late summer, 2015 (highest count since 1992)

#### Where to See

- Summer: Lamar Valley; some may be near the North Entrance near 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 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.

signaling the others to flee. The pronghorn is adapted well for outrunning its enemies—its oversized windpipe and heart allow 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.

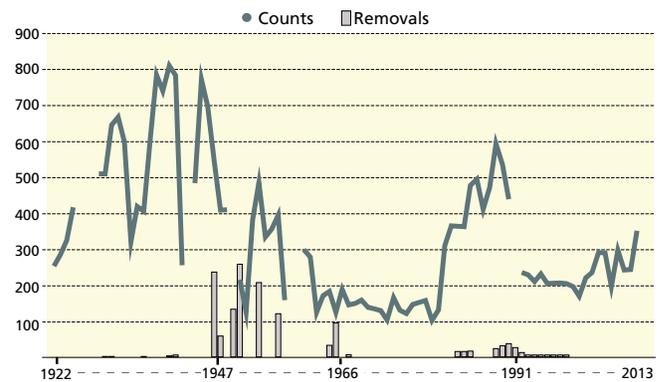
The pronghorn breeding season begins mid-September and extends through early October. During the rut the older males “defend” groups of females (called a harem). They warn any intruding males with loud snorts and wheezing coughs. If this behavior does not scare off the opponent, a fight may erupt. The 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; they eat succulent forbs during spring and summer. They can eat lichens and plants like 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 blood stream. 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 1–5 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 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,



Pronghorn removals and spring counts in Yellowstone and adjacent areas of Montana, 1918–2013. The most recent count in August 2014 was 397, the highest since 1991.

pronghorns roam the sagebrush prairies in herds totaling nearly 500 thousand 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. Although hunting has not been allowed north of the park since the 1970s, 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 is low due to coyote predation, and development of private land north of the park has reduced available winter range. The pronghorn winter range in the park is former agricultural land infested with nonnative vegetation of low nutritional quality.

Recent evidence of migration and dispersal into Paradise Valley and mixing with pronghorn herds outside the park should improve the long-term viability of the Yellowstone population. Research continues to search for answers to the population decline. This small population is susceptible to extirpation from random catastrophic events such as a severe winter or disease outbreak.



## More Information

- Barmore, W.J. Jr. 2003. Ecology of ungulates and their winter range in Northern Yellowstone National Park, Research and Synthesis 1962–1970. Yellowstone Center for Resources.
- Barnowe-Meyer, K.K. 2009. The behavioral ecology and population genetics of pronghorn in Yellowstone National Park. University of Idaho, Moscow, Idaho.
- Barnowe-Meyer, K.K., P.J. White, T.L. Davis, and J.A. Byers. 2009. Predator-specific mortality of pronghorn on Yellowstone's northern range. *Western North American Naturalist* 69(2):186–194.
- Barnowe-Meyer, K.K., P.J. White, and J.A. Byers. 2011. Maternal investment by Yellowstone pronghorn following winter habitat deterioration. *Western North American Naturalist* 71:222–233.
- Barnowe-Meyer, K.K., P.J. White, T.L. Davis, D.W. Smith, R.L. Crabtree, and J.A. Byers. 2010. Influences of wolves and high-elevation dispersion on reproductive success of pronghorn (*Antilocapra americana*). *Journal of Mammalogy* 91:712–721.
- Byers, J.A. 2003. *Built for speed: A year in the life of pronghorn*. Harvard University Press.
- Keating, K. 2002. History of pronghorn population monitoring, research, and management in Yellowstone National Park. Report to the National Park Service by USGS Northern Rocky Mountain Science Center, Bozeman, MT. O'Gara, B.W. and J.D. Yoakum. 2004. *Pronghorn: Ecology and management*, Edited by Richard E. McCabe. Boulder, CO: University Press of Colorado.
- Sawyer, H., F. Lindzey, and D. McWhirter. 2005. Mule deer and pronghorn migration in western Wyoming. *Wildlife Society Bulletin* 33(4):1266–1273.
- Scott, M.D. 2004. History of pronghorns translocated from Yellowstone National Park. In *21st Biennial Pronghorn Workshop Proceedings*, 114–133.
- Taylor, M. 2006. Ancient corridors: The trapper's point story of the prehistoric path of the pronghorn. In A. W. Biel, ed., *Greater Yellowstone public lands: A century of discovery, hard lessons, and bright prospects: Proceedings of the 8th Biennial Scientific Conference on the Greater Yellowstone Ecosystem*, 178–180. Yellowstone National Park, WY: Yellowstone Center for Resources.
- White, P.J. and J. Treanor. 2002. Yellowstone Pronghorn Conservation Assessment Workshop. Yellowstone National Park, Yellowstone Center for Resources.
- White, P.J., J.E. Bruggeman, and R. A. Garrott. 2007. Irruptive population dynamics in Yellowstone pronghorn. *Ecological Applications* 17(6):1598–1606.
- White, P.J., et al. 2007. Partial migration and philopatry of Yellowstone pronghorn. *Biological Conservation* 135:518–526.
- White, P.J., C.N. Gower, T.L. Davis, J.W. Sheldon, and J.R. White. 2012. Group dynamics of Yellowstone pronghorn. *Journal of Mammalogy* 93:1129–1138.

## 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 early in the 1900s. In 1973, the US Fish and Wildlife Service listed the northern Rocky Mountain wolf (*Canis lupus*) as an endangered species and designated Greater Yellowstone as one of three recovery areas. From 1995 to 1997, 41 wild wolves from Canada and northwest Montana were released in Yellowstone National Park. 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 Greater Yellowstone and has provided a place for research on how wolves may affect many aspects of the ecosystem.

### 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.

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



Members of the Delta pack, November 2013.

their winter prey is elk; 10–15% of their summer prey is deer. They also can kill bison.

Many other animals benefit from wolf kills. For example, when wolves kill an elk, ravens 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 magpies to invertebrates—consume the remains.

### 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. The discovery of this change 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

### Quick Facts

#### Number in Yellowstone

- An estimated 500 wolves in the Greater Yellowstone Ecosystem.
- As of January 2016, there were 99 wolves in the park, 50 in the northern range, and 49 in the interior. Ten packs were noted.
- As of January 2016, 26 wolves in the park wear a radio collar (27%).

#### Where to See

- They inhabit most of the park now, look 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 km<sup>2</sup>); varies with pack size, food, season.
- Average lifespan is 4 years in wild; can live up to 12 years in the wild in rare cases.
- Three color phases: gray is the most common; white is usually in the high Arctic; and black is common only in the Rockies.
- Prey primarily on hooved 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 3–10 weeks unless disturbed.
- Human-caused death is the highest mortality factor for wolves outside the park; the leading cause inside the park is wolves killing other wolves.



Historical and current range of gray wolves.

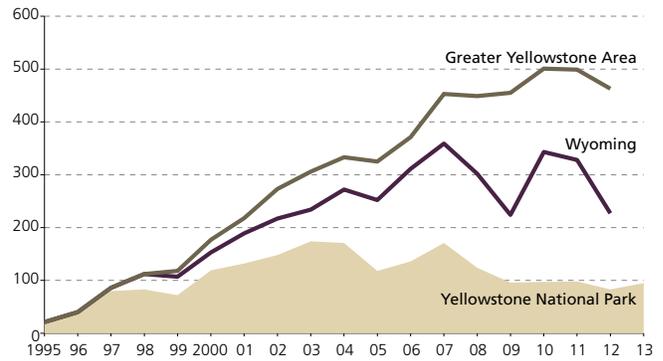
predators, management of ungulates outside the park, and weather (e.g. drought, winter severity). Weather patterns influence forage quality and availability, ultimately impacting elk nutritional condition. Consequently, changes in prey selection and kill rates through time result from complex interactions among these factors. Current NPS research focusses on the relative factors driving wolf predation over the last two decades.

### 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 Greater Yellowstone Ecosystem.



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



Greater Yellowstone wolf population, 1995–2013.

Disease periodically kills a number of pups and old adults. Outbreaks of canine distemper have occurred in 2005, 2008 and 2009. In 2005, distemper killed two-thirds of the pups within the park. Infectious canine hepatitis, canine parvovirus, and bordetella have also been confirmed among Yellowstone wolves, but their effect on mortality is unknown.

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

### 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.



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

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 collars. These collars enable researchers to gather data on an individual, and also monitor the population as a whole to see how wolves are effecting 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 US Fish and Wildlife Service's criteria for a recovered wolf population since 2002. The US Fish and Wildlife Service in 2013 estimated about 1,592 wolves and 71 breeding pairs in the Northern Rocky Mountain Distinct Population Segment including areas of Idaho, Montana, and Wyoming.

The gray wolf was removed from the endangered species list in 2011 in Idaho and Montana but is currently protected as endangered species in the state of Wyoming. Wolves are hunted in Idaho and Montana under state hunting regulations.

## 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
- 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 resulted 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 and the Northern Rocky Mountain Distinct Population is no longer listed.
- 2014: Wolves were relisted in Wyoming.

### Current Status

- Wolves are now delisted in Montana and Idaho, but not Wyoming. The US Fish and Wildlife Service will monitor the delisted wolf populations for a minimum of five years to ensure that they continue to sustain their recovery.

## 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 here 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, National Park Service 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



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

mistakes of the past and help prevent similar mistakes in the future. One such law was the Endangered Species Act, passed in 1973. The US Fish and Wildlife Service 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. (National Park Service policy also calls for restoration of native species where possible.)

### Restoration Proposed

National Park Service 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 US Fish and Wildlife Service 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 US Fish and Wildlife Service to prepare, in consultation with the National Park Service and the US Forest Service, an environmental impact statement (EIS)

on 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 National Park and central Idaho.

Staff from Yellowstone, the US Fish and Wildlife Service, and participating states prepared for wolf restoration to the park and central Idaho. The US Fish and Wildlife Service 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, US Fish and Wildlife Service 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. Four days later they were joined by another six wolves. The wolves ranged from 72 to 130 pounds in size 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 Greater Yellowstone Ecosystem. Wolves have preyed primarily on elk and these carcasses have provided food to a wide variety of other animals, especially scavenging species. They 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.



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, regulated hunting is allowed in Montana and Idaho and managed by those states. 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 <http://www.fws.gov/mountain-prairie/species/mammals/wolf/>

So far, data suggests 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 and grizzly bears, coyotes, cougars) prey on elk—and people hunt the elk outside the park. Thus, interactions of wolves with elk and other ungulates has 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 Greater Yellowstone Ecosystem. The effects depend on a complex of 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 are collaborating on a comparative research program involving three additional wolf-ungulate systems in the western portion of the Greater Yellowstone Ecosystem. 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 (and specifically not the killing) of reintroduced wolves and their offspring from the Yellowstone and central Idaho experimental population areas, but 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 US Fish and Wildlife Service 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 Greater Yellowstone Ecosystem and the other recovery areas. A court decision required the wolf to be listed again as an endangered species. In 2009, the US Fish and Wildlife Service again delisted wolf populations in Montana and Idaho, but not in Wyoming.



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

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, and a proposal by the US Fish and Wildlife Service to delist wolves in Wyoming was still pending. In 2012, a Congressional directive required the US Fish and Wildlife Service 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 the state’s management plan. Wolves are now hunted in Montana and Idaho during regulated seasons but hunting wolves is currently on hold in Wyoming. The US Fish and Wildlife Service and State of Wyoming are currently assessing their options for meeting delisting requirements under the Endangered Species Act.

The US Fish and Wildlife Service 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 US Fish and Wildlife Service may consider relisting the species, and even emergency relisting, if the available data demonstrates such an action is needed, as it does with all recovered species.

Wolves are now managed by the appropriate state, tribal, or federal agencies; management in national parks and national wildlife refuges continue 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, not showing sufficient fear of humans, etc., do not run. Stop, stand tall, watch what the wolf is going to do. If it approaches, wave your arms, yell, flare your jacket, and if it continues, throw something at it or use bear pepper spray. Group up with other people, continue waving and yelling.
- Report the presence of wolves near developed areas or any wolf behaving strangely.

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

### Outlook

The future of wolves in Greater Yellowstone 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.



### More Information

- Almberg, E.S., P.C. Cross, L.D. Mech, D.W. Smith, J.W. Sheldon, and R.L. Crabtree. 2011. Infectious diseases in Yellowstone’s canid community. *Yellowstone Science* vol. 19.
- Bangs, E.E., and S.H. Fritts. 1996. Reintroducing the gray wolf to central Idaho and YNP. *Wildlife Society Bulletin* 24(3):402–413.

- Garrott, R.A., J.A. Gude, E.J. Bergman, C. Gower, P.J. White, and K.L. Hamlin. 2005. Generalizing wolf effects across the greater Yellowstone area: A Cautionary Note. *Wildlife Society Bulletin* 33(4):1245–1255.
- Garrott, R.A., P.J. White, and F.G.R. Watson. 2008. *The ecology of large mammals in Central Yellowstone: Sixteen years of integrated field studies in terrestrial ecology* Series. London, UK: Academic Press, Elsevier.
- Gunther, K.A. and D.W. Smith. 2004. Interactions between wolves and female grizzly bears with cubs in YNP. *Ursus* 15(2):232–238.
- Hebblewhite, M. and D.W. Smith. 2010. Wolf community ecology: Ecosystem effects of recovering wolves in Banff and Yellowstone national parks. In M. Musiani, L. Boitani, and P. Paquet, editors, *The world of wolves: new perspectives on ecology, behavior and policy*. Calgary: University of Calgary Press
- MacNulty, D.R., D.W. Smith, L.D. Mech, and L.E. Eberly. 2009. Body size and predatory performance in wolves: Is bigger better? *Journal of Animal Ecology* 78(3):532–539.
- Mech, L.D. and L. Boitani. 2003. *Wolves: Behavior, ecology, and conservation*. Chicago: University Of Chicago Press.
- Merkle, J.A., D.R. Stahler, and D.W. Smith. 2009. Interference competition between gray wolves and coyotes in Yellowstone National Park. *Canadian Journal of Zoology* 87 87:56–63.
- Metz, M.C., D.W. Smith, J.A. Vucetich, D.R. Stahler, and R.O. Peterson. 2012. Seasonal patterns of predation for gray wolves in the multi-prey system of Yellowstone National Park. *Journal of Animal Ecology* doi:10.1111/j.1365- 2656.2011.01945.x.
- Peterson, R. et al. 2002. Leadership behavior in relation to dominance and reproductive status in gray wolves. *Canadian Journal of Zoology* 80: 1405–1412.
- Ruth, T.K. 2000. Cougar–wolf interactions in Yellowstone National Park: Competition, demographics, and spatial relationships. *Wildlife Conservation Society*. August:1–28.
- Smith, D.W. 2007. Wolf and human conflicts: A long, bad history. In M. Bekoff, ed., *Encyclopedia of human–animal relationships*. 402–409. Westport, CT: Greenwood Press.
- Smith, D.W. and G. Ferguson. 2005. *Decade of the wolf: Returning the wild to Yellowstone*. Guilford, CT: The Lyons Press.
- Smith, D.W. et al. 2000. Wolf–bison interactions in Yellowstone National Park. *Journal of Mammalogy* 81(4):1128–1135.
- Smith, D. et al. 2004. Winter prey selection and estimation of wolf kill rates in YNP. *Journal of Wildlife Management* 68(1): 153–166.
- Stahler, D. R. et. al. 2013. The adaptive value of morphological, behavioural and life-history traits in reproductive female wolves. *Journal of Animal Ecology*. 82(1):222–234, US Fish and Wildlife Service. <http://www.fws.gov/mountain-prairie/species/mammals/wolf/>
- VonHoldt, B.M. et al. 2008. The genealogy and genetic viability of reintroduced Yellowstone grey wolves. *Molecular Ecology* 17:252–274.
- White, P.J., D.W. Smith, J.W. Duffield, M. Jimenez, T. McEneaney, and G. Plumb. 2004. Yellowstone after wolves: Environmental Impact Statement predictions and ten-year appraisals. *Yellowstone Science* vol. 13.
- White, P.J R.A.Garrott, and G.E. Plumb, eds. 2013. *Yellowstone's Wildlife in Transition*. Cambridge, Massachusetts: Harvard University Press.

#### Staff Reviewer

Erin Stahler, Biological Technician  
Doug Smith, Senior Wildlife Biologist

## 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 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, 16–20 inches high at the shoulder.
- Average life span 6 years; up to 13 years in the park.
- Home range: 3–15 square miles.
- Primarily eat voles, mice, rabbits, other small animals, and carrion—and only the very young elk calves in the spring.
- 4–8 pups are born in April in dens; emerge in May.

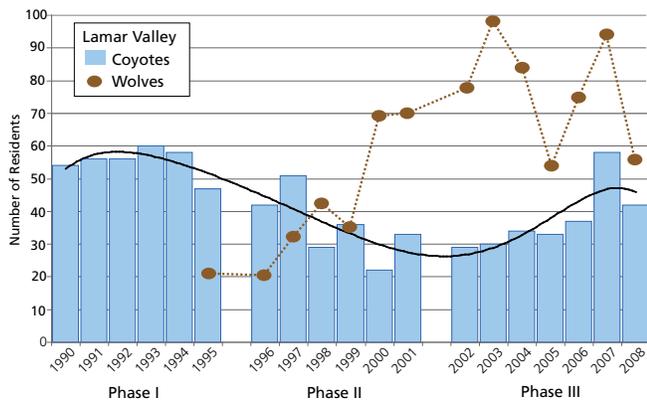
#### History

- 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. On the northern range, the coyote population decreased as much as 50% after wolves were restored as a result of competition with wolves for food, attacks by wolves, and loss of territory to them. 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 have occurred here, including a few attacks.

Park staff scare coyotes from visitor-use areas and becoming habituated to humans with cracker-shell rounds, bear pepper spray, or other negative stimuli. Animals that continue to pose a threat to themselves or to humans are killed. Coyotes and other park wildlife are wild and potentially dangerous and should never be fed or approached.



### More Information

- Crabtree, R.L., and J.W. Sheldon. 1999. The ecological role of coyotes on Yellowstone's northern range. *Yellowstone Science* 7:15–23.
- Crabtree, R.L., and J.W. Sheldon. 1999. Coyotes and canid coexistence in Yellowstone. Pages 126–163 in T. W. Clark, et al, editors. *Carnivores in Ecosystems: the Yellowstone Experience*. New Haven: Yale University Press.



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

- Gese, E.M. 1999. Threat of predation: do ungulates behave aggressively towards different members of a coyote pack? *Can. J. Zool.* 77:499–503.
- Gese, E.M. et al. 1996. Foraging ecology of coyotes: the influence of extrinsic factors and a dominance hierarchy. *Can. J. Zool.* 74:769–783.
- Gese, E.M. et al. 1996. Social and nutritional factors influencing dispersal of resident coyotes. *Anim. Behav.* 52:1025–1043.
- Gese, E.M. and R.L. Ruff. 1997. Scent-marking by coyotes: the influence of social and ecological factors. *Anim. Behav.* 54:1155–1166.
- Gese, E.M. and R.L. Ruff. 1998. Howling by coyotes: variation among social classes, seasons, and pack sizes. *Can. J. Zool.* 76: 1037–1043.
- Gese, E.M., T.E. Stotts, and S. Grothe. 1996. Interactions between coyotes and red foxes in Yellowstone National Park, Wyoming. *Journal of Mammalogy* 77(2):377–382.
- Gese, E.M., R.L. Ruff, and R.L. Crabtree. 1996. Intrinsic and extrinsic factors influencing coyote predation of small mammals in Yellowstone National Park. *Canadian Journal of Zoology* 74(5):784–797.
- Moorcroft, P., M. A. Lewis, and R.L. Crabtree. 1999. Home range analysis using a mechanistic home range model. *Ecology* 80:1656–1665.
- Moorcroft, P.R., M.A. Lewis, and R.L. Crabtree. 2006. Mechanistic home range models capture spatial patterns and dynamics of coyote territories in Yellowstone. *Proceedings of the Royal Society Biological Sciences* 273:1651–1659.

### Staff Reviewer

Doug Smith, Senior Wildlife Biologist

## Red Foxes

The red fox (*Vulpes vulpes*) 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. (Yellowstone’s fox is *V. v. macroura*.) Little is known about any of these subspecies. Most foxes in the lower 48 states, especially 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



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

genetically and physically than wolves and foxes. 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 foxes was similar to mainland and island populations of foxes in Australia and their habitat use 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 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: 3–7 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.
- Distinguish 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, 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.

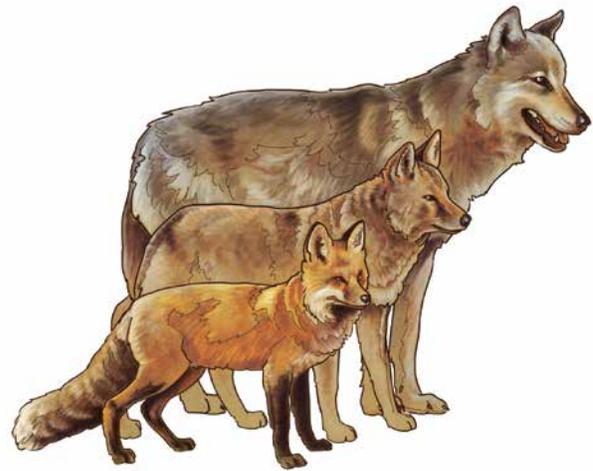
Recent research shows that red foxes are more nocturnal than coyotes, and strongly prefer forested habitats, while coyotes tend to use sagebrush and open meadow areas. In this way, potential competition between foxes and coyotes is minimized. Foxes do not seem to actively avoid coyotes during an average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

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 foxes, it also shows the importance of obeying rules to avoid inadvertently causing the death of one of Yellowstone's animals.



## More Information

- Almberg, E. S., P. C. Cross, L. D. Mech, D. W. Smith, J. W. Sheldon, and R. L. Crabtree. 2011. Infectious diseases in Yellowstone's canid community *Yellowstone Science* vol. 19.
- Crabtree, R.L. 1998. On the trail of a gray ghost. *National Wildlife* 36(3):48.
- Crabtree, R.L. 1997. A new forest carnivore: Yellowstone's mountain fox. *National Wildlife* 35.
- Crabtree, R.L. 1993. Gray ghost of the Beartooth: on the taxonomic trail of the mountain fox. *Yellowstone Science* 1:13–16.



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

- Crabtree, R.L., and J.W. Sheldon. 1999. Coyotes and canid coexistence in Yellowstone. Pages 127–163 in Clark, T.W., et al, editors. *Carnivores in ecosystems: the Yellowstone experience*. New Haven: Yale University Press.
- Fuhrmann, R.T. 2002. Tracking down Yellowstone's red fox: Skis, satellites and historical sightings. *Yellowstone Science* 10:1.
- Fuhrmann, R.T. 1998. Distribution, morphology, and habitat use of the red fox in the northern Yellowstone ecosystem. M.S. Thesis. Bozeman: Montana State University.
- Gehrt, S.D. and W.R. Clark. 2003. Raccoons, coyotes, and reflections on the mesopredator release hypothesis. *Wildlife Society Bulletin* 31(3): 836–842.
- Gese, E.M. et al. 1996. Interactions between coyotes and red foxes in Yellowstone National Park, Wyoming. *Journal of Mammalogy* 77(2): 377–382.
- Kamler, J.F. and W.B. Ballard. 2002. A review of native and nonnative red foxes in North America. *Wildlife Society Bulletin* 30(2): 370–379.
- Swanson, B.J., R.T. Fuhrmann, and R.L. Crabtree. 2005. Elevational isolation of red fox populations in the Greater Yellowstone Ecosystem. *Conservation Genetics* 6:123–131.
- Van Etten, K.W., K.R. Wilson, and R.L. Crabtree. 2007. Habitat use of red foxes in Yellowstone National Park based on snow tracking and telemetry. *Journal of Mammalogy* 88:1498–1507.

## Staff Reviewer

Doug Smith, Senior Wildlife Biologist

## 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 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, 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. Several more field seasons will be required before a population estimate can be generated. However, preliminary evidence from 2014 and 2015 research indicates a healthy population still exists.

While disease and starvation are occasional causes of cougar deaths, competition with other cougars or predators, and human hunting (during legal seasons



COURTESY KERRY MURPHY

This cougar was photographed by researchers under controlled research conditions.

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 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

### Quick Facts

#### Number in Yellowstone

26–42 (across all age classes) on the northern range; others in park seasonally.

#### Where to See

Seldom seen

#### Behavior and Size

- Litters range from 2–3 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, 8–10 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 marmots and other small mammals.
- 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 in the cat’s eyes and show your teeth while making noise.

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 June through 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 8–10 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 was photographed by a remote camera during the 2014 research study.

proportion of males and females establish 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 3–4 days consuming an elk or deer and 4–5 days hunting for the next meal. Cougars catch other animals—including red squirrels, porcupines, marmots, grouse, and moose—if the opportunity arises.

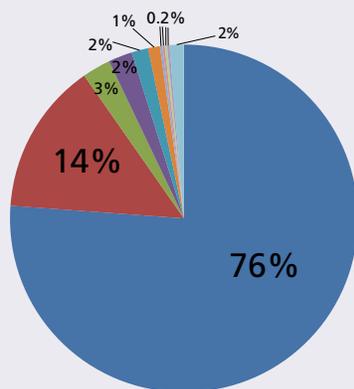
Cougars are solitary hunters who face competition for their kills from other large mammals. Even though a cached carcass is harder to detect, scavengers and competitors such as bears and wolves sometimes find it. In Yellowstone, black and grizzly bears will take over a cougar's kill. Coyotes will try, but can be killed by the cougar instead. 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 learn about the ecological relationships between the two species. As social animals, wolves use different hunting techniques than 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.

### Cougar Kills

Between 1998 and 2005, researchers documented 473 known or probable cougar kills, which included:

- 345 elk
- 64 mule deer
- 12 bighorn sheep
- 10 pronghorn
- 7 marmots
- 5 porcupines
- 1 red fox
- 1 mountain goat
- 1 blue grouse
- 1 golden eagle
- 6 other cougars



Interspecific kills occurred, but few were fed upon.

## History

In the early 1900s, cougars were killed as part of predator control in the park. By 1925, very few individuals remained. However, cougar sightings in Yellowstone have increased dramatically since the mid-1900s.

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 a predator. Of the 88 cougars that were 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 4 days at each kill. The study also documented that wolves interfered with or scavenged more than 22% of the cougar-killed ungulates. The monitoring associated with this project has been completed and all of the radio-collars have been removed, but years of data are still being analyzed. New research is underway 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.



## More Information

- Biek, R., N. Akamine, M.K. Schwartz, T.K. Ruth, K.M. Murphy, and M. Poss. 2006. Genetic consequences of sex-biased dispersal in a solitary carnivore: Yellowstone cougars. *Biology Letters* 2(2):312–315.
- Hornocker, H.G. and S. Negri. 2009. *Cougars: Ecology and Conservation*. Chicago: University of Chicago Press.
- National Park Service. 2014. *Yellowstone Cougar Project Annual Report*. Yellowstone Center for Resources. Mammoth: Wyoming.
- Murphy, K.M. 1998. *The ecology of the cougar (Puma concolor) in the northern Yellowstone ecosystem: Interactions with prey, bears, and humans*. PhD. Moscow, ID: University of Idaho.
- Murphy, K.M., G.S. Felzien, M.G. Hornocker, and T.K. Ruth. 1998. Encounter competition between bears and cougars: Some ecological implications. *Ursus* 10:55–60.
- Murphy, K.M., I. Ross, and M.G. Hornocker. 1999. The ecology of anthropogenic influences on cougars. In T. Clark, S. Minta, P. Kareiva and P. Curlee, ed., *Carnivores in Ecosystems*. New Haven: Yale University Press.
- Ruth, T.K. 2004. "Ghost of the Rockies": The Yellowstone cougar project. *Yellowstone Science* 12(1): 13–24.
- Ruth, T.K., D.W. Smith, M.A. Haroldson, P.C. Buotte, C.C. Schwartz, H.B. Quigley, S. Cherry, K.M. Murphy, D. Tyers, and K. Frey. 2003. Large-carnivore response to recreational big-game hunting along the Yellowstone National Park and Absaroka-Beartooth Wilderness boundary. *Wildlife Society Bulletin* 31(4):1150–1161.
- Ruth, T. K., Mark H. Haroldson, P. C. Buotte, K. M. Murphy, H. B. Quigley, and M. G. Hornocker. 2011. Cougar survival and source-sink structure on Greater Yellowstone's Northern Range. *Journal of Wildlife Management* 75(6):1381–1398.
- Ruth, T. K., P. C. Buotte, and H. B. Quigley. 2010. Comparing VHF ground-telemetry and GPS cluster methods to determine cougar kill rates. *Journal of Wildlife Management* 74(5):1122–1133.
- Ruth, T. K., P. C. Buotte, and M. G. Hornocker. In Press (due out 2015). *Yellowstone Cougars: Ecology Before and During Wolf Reestablishment*. University Press of Colorado, Boulder, Colorado.
- Sawaya, M., T. K. Ruth, S. Creel, J. J. Rotella, H. B. Quigley, S. T. Kalinowski. 2011. Evaluation of noninvasive genetic sampling methods for cougars using a radio-collared population in Yellowstone National Park. *Journal of Wildlife Management* 75(3):612–622.

### Staff Reviewer

Dan Stahler, Wildlife Biologist

## Canada Lynx

Historical information suggests lynx were present, but uncommon, in Yellowstone National Park during 1880 to 1980. The presence and distribution of lynx in the park was documented during 2001 to 2004, when several individuals were detected in the vicinity of Yellowstone Lake and 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 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 is considered much of the critical habitat for the species in the Greater Yellowstone Ecosystem.

### Habitat

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



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

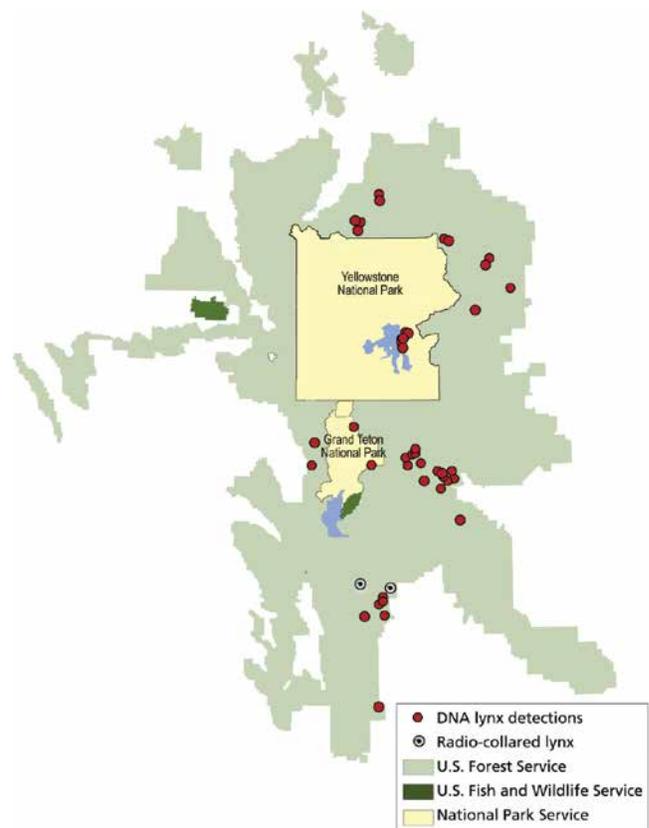
Few; 112 known observations

#### 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, brown on throat and ruff; tufted ears; short tail; hind legs longer than front.
- 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: 4–5 inches.
- Solitary, diurnal and nocturnal.
- Eats primarily snowshoe hares, especially 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.



### More Information

Murphy, K., T. Potter, J. Halfpenny, K. Gunther, T. Jones, and R. Lundberg. 2005. The elusive Canada lynx: Surveying for Yellowstone's most secretive threatened carnivore. *Yellowstone Science* 13(2): 7–15.

Murphy, K.M., T.M. Potter, J.C. Halfpenny, K.A. Gunther, M.T. Jones, P.A. Lundberg, and N.D. Berg. 2006. Distribution of Canada Lynx in Yellowstone National Park. *Northwest Science* 80(3):199–206.

Murphy, S.C. and M.M. Meagher. 2000. The status of wolverines, lynx, and fishers in Yellowstone National Park. In A. P. Curlee, A. Gillesberg and D. Casey, ed., *Greater Yellowstone predators: Ecology and conservation in a changing landscape*, 57–62. Northern Rockies Conservation Cooperative and Yellowstone National Park.

Ruggiero, L.F. et al. ed. 2000. Ecology and Conservation of Canada Lynx in the US. Boulder: University of Colorado.

Squires, J.R. 2005. Conservation challenges of managing lynx. *Yellowstone Science* 13(2): 10–11.

Squires, J.R. and R. Oakleaf. 2005. Movements of a male Canada lynx crossing the Greater Yellowstone Area, including highways. *Northwest Science* 79(2–3):196–201.

### 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.
- Distinguish from lynx: has several black rings that do not fully circle the tail; no black tip on tail, shorter ear tufts, smaller track (2 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*, that 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. Bats cannot recover quickly (if at all) from these substantial population declines because most species that are vulnerable to



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.

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. This species has experienced substantial declines in the eastern US and Canada as a result of WNS. Research suggests that access to building attics within Yellowstone National Park is critical for reproductive success and the long-term conservation of the little brown bat.

### 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 2–6 weeks, are weaned around 5–10 weeks, and become mature in 1–2 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 7–8 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 within maternity roosts are important for the reproductive success of little brown bats. The selection of these places makes sense from an evolutionary standpoint. 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. Consequently, most management efforts directed towards bats involve excluding bats from occupying human facilities.

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 fall 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 an arrangement of ligaments and leg muscles that enables them to hang passively from their perch while sleeping.

## More Information

- Adams, R. A. 2003. *Bats of the Rocky Mountain West: natural history, ecology, and conservation*. Boulder, CO: University Press of Colorado.
- Altringham, J.D. 1996. *Bats: biology and behavior*. Oxford: Oxford University Press.
- Bogan, M.A., and K. Geluso. 1999. Bat roosts and historic structures on National Park Service lands in the Rocky Mountain Region. Final report submitted to the National Park Service, Denver, CO. USGS Midcontinent Ecological Science Center, University of New Mexico, Albuquerque, NM.
- Fenton, M.B., and R.M.R. Barclay. 1980. *Myotis lucifugus*. Mammalian Species Publication No. 142. *American Society of Mammalogists*. 142:1–8.
- Keinath, D.A. 2007. Yellowstone’s world of bats: Taking inventory of Yellowstone’s night life. *Yellowstone Science* 15(3):3–13.

## Staff Reviewer

John Treanor, Wildlife Biologist

## 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 used in building their lodges. 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 about 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 and 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, beaver can resemble round rocks. Beavers are most active in the early

### 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.

#### Behavior and Size

- Crepuscular: active in evening and morning
- If living on rivers, may build bank dens instead of lodges.
- One colony may support 2–14 beavers that are usually related. Six is considered average.
- 35–40 inches long, including tail.
- Weighs 30–60 pounds.

- Average life span: 5 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.

morning and late evening, which seem 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 it 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 and increased to 127 by 2007; dropping to 118 in 2009 and 112 in 2011. While the long-term increase is partly attributable to the improving ability of aerial observers to locate colonies, the park's population of beavers probably has grown in the last 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.

### More Information

- Consolo Murphy, S. and D.D. Hanson. 1993. Distribution of beaver in Yellowstone National Park, 1988–1989. In R. S. Cook, ed., *Ecological issues on reintroducing wolves to Yellowstone National Park*. Vol. Scientific Monograph NPS/NRYELL/NRSM-93/22. US Department of the Interior, National Park Service.
- Consolo-Murphy, S. and R.B. Tatum. 1995. Distribution of beaver in Yellowstone National Park, 1994, Edited by National Park Service, Yellowstone National Park.
- Jonas, R.J. 1955. A population and ecological study of the beaver (*Castor canadensis*) of Yellowstone National Park. Vol. MS. Moscow, ID: University of Idaho.
- Murphy, S.C. and D.W. Smith. 2002. Documenting trends in Yellowstone's beaver population: A comparison of aerial and ground surveys in the Yellowstone Lake Basin. In R.J. Anderson and D. Harmon, ed., *Yellowstone Lake: Hotbed of chaos or reservoir of resilience?: Proceedings of the 6th Biennial Scientific Conference on the Greater Yellowstone Ecosystem*, 172–178. Yellowstone National Park, WY: Yellowstone Center for Resources and The George Wright Society.
- Rue, III, L.E. 1964. *The world of the beaver*. New York: J.B. Lippincott, Co.
- Slough, B.G. 1978. Beaver food cache structure and utilization. *Journal of Wildlife Management* 42(3):644–646.
- Smith, D.W. and D.B. Tyers. 2008. The beavers of Yellowstone. *Yellowstone Science*. 16(3): 4–15.
- Smith, D.W., and D.B. Tyers. 2012. The history and current status and distribution of beavers in Yellowstone National Park. *Northwest Science* 86(4):276–288.

### Staff Reviewer

Erin Stahler, Biological Technician  
Doug Smith, Senior Wildlife Biologist

## 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. While the recent US Fish and Wildlife Service review of the pika found no current need to list the species as threatened or endangered, 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.

### Research

The National Park Service Pikas in Peril project, a three-year project started in 2010, assessed the vulnerability of the pika to climate change by studying pika populations within western national parks:



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

Crater Lake, Great Sand Dunes, Grand Teton, Lassen Volcanic, Rocky Mountain and Yellowstone National Parks, and in Craters of the Moon and Lava Beds National Monuments. More information can be found at the project website: [science.nature.nps.gov/im/units/ucbn/monitor/pika/pika\\_peril/index.cfm](http://science.nature.nps.gov/im/units/ucbn/monitor/pika/pika_peril/index.cfm).



### Staff Reviewer

Kerry Gunther, Bear Management Biologist

### Quick Facts

#### Number in Yellowstone

Abundant

#### Where to See

Tower and Mammoth areas, most often

#### Identification and behavior

- 7–8.4 in. 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.
- Breed 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.
- Eat plant foods such as 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 it 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 spottier records prior to that were made in sagebrush-grassland habitat at



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

elevations below 6,500 feet (2,000 m) where the average annual precipitation is less 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 1–4 litters per year with 1 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 6–10 ft (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.



### More Information

- Gunther, K.A., R.A. Renkin, J.C. Halfpenny, S.M. Gunther, T. Davis, P. Schullery, and L. Whittlesey. 2009. Presence and distribution of white-tailed jackrabbits in Yellowstone National Park. *Yellowstone Science* 17(1): 24–32.
- Barnosky, E.H. 1994. Ecosystem dynamics through the past 2000 years as revealed by fossil mammals from Lamar Cave in Yellowstone National Park. *Historical Biology* 8:71–90.
- Lim, B.K. 1987. *Lepus townsendii*. *Mammalian Species* 288:1–6.
- Streubel, D. 1989. *Small mammals of the Yellowstone ecosystem*. Boulder, CO: Roberts Rinehart.

### 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, 3–4 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; uses 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

### Quick Facts

#### Number

2006–2009: seven documented in eastern Yellowstone and adjoining national forests (two females and 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 2–4 young each year. Females give birth in dens excavated in snow.
- Den in deep 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.



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.

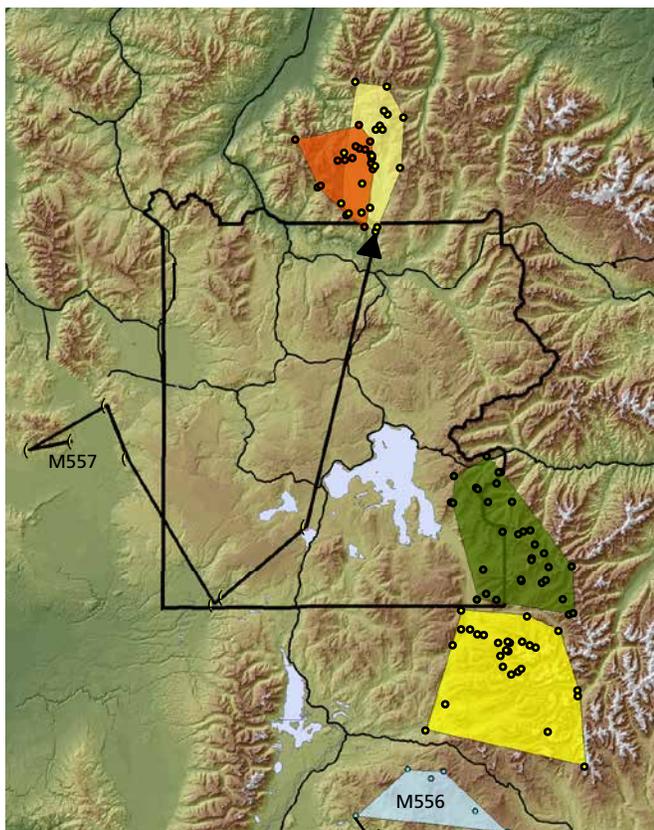
in the lower 48 states by the 1930s. Some population recovery has occurred, but the species has not been documented recently in major portions of its historic range. In the Greater Yellowstone Area, wolverines have been studied using live traps, telemetry, and aerial surveys. A group sponsored by the 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 mi<sup>2</sup> (447 km<sup>2</sup>); for three males, 350 mi<sup>2</sup> (908 km<sup>2</sup>). 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 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 United States 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. 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. Due to uncertainty of the role that climate change would have on wolverines and their habitat in the foreseeable future, plans to list the species are on hold. In Montana, which has the largest wolverine population of the lower 48 states, an annual quota of 5 wolverines were available for harvest by licensed trappers in recent years.



Home ranges of five wolverines documented in 2009.

## More Information

- Aubry, K.B., K.S. McKelvey, and J.P. Copeland. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. *Journal of Wildlife Management* 71(7):2147–2158.
- Copeland, J.P., J.M. Peek, C.R. Groves, W.E. Melquist, K.S. McKelvey, G.W. McDaniel, C.D. Long, and C.E. Harris. 2007. Seasonal habitat associations of the wolverine in central Idaho. *Journal of Wildlife Management* 71(7):2201–2212.
- Inman, R.M., R.R. Wigglesworth, K.H. Inman, M.K. Schwartz, B.L. Brock, and J.D. Rieck. 2004. Wolverine makes extensive movements in the greater Yellowstone ecosystem. *Northwest Science* 78(3):261–266.
- Krebs, J., E. Lofroth, J. Copeland, V. Banci, D. Cooley, H. Golden, A. Magoun, R. Mulders, and B. Shults. 2004. Synthesis of survival rates and causes of mortality in North American wolverines. *Journal of Wildlife Management* 68(3):493–502.
- Murphy, S.C., and M.M. Meagher. 2000. The status of wolverines, lynx, and fishers in Yellowstone National Park. In A.P. Curlee, A. Gillesberg and D. Casey, ed., *Greater Yellowstone predators: Ecology and conservation in a changing landscape*, 57–62. Northern Rockies Conservation Cooperative and Yellowstone National Park.
- Murphy, K., J. Wilmot, J. Copeland, D. Tyers, and J. Squires. 2011. Wolverines in Greater Yellowstone. *Yellowstone Science* 19(3): 17–24.
- Robinson, B. and S. Gehman. 1998. Searching for “skunk bears”: The elusive wolverine. *Yellowstone Science* 6(3): 2–5.
- Ruggiero, L.F., K.S. McKelvey, K.B. Aubry, J.P. Copeland, D.H. Pletscher, and M.G. Hornocker. 2007. Wolverine conservation and management. *Journal of Wildlife Management* 71(7):2145–2146.
- Squires, J.R., J.P. Copeland, T.J. Ulizio, M.K. Schwartz, and L.F. Ruggiero. 2007. Sources and patterns of wolverine mortality in western Montana. *Journal of Wildlife Management* 71(7):2213–2220.
- Ulizio, T.J., J.R. Squires, D.H. Pletscher, M.K. Schwartz, J.J. Claar, and L.F. Ruggiero. 2006. The efficacy of obtaining genetic-based identifications from putative wolverine snow tracks. *Wildlife Society Bulletin* 34(5):1326–1332.
- U.S. Fish & Wildlife Service (2014) Endangered and Threatened Wildlife and Plants; Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States; Establishment of a Nonessential Experimental Population of the North American Wolverine in Colorado, Wyoming, and New Mexico Federal Register, 79,47522–47545.

## 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, 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, hawks.

### Behavior

- Breed February through May, typically March and April; one litter of 3–5 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, 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, grizzly bears.

### Behavior

- Hibernate as early as mid-July through March.
- Breed in early spring; one litter of 6–8 young per year.
- Young, after they leave the burrow, are vulnerable to long-tailed weasels and hawks.
- During cool spring weather, Uinta ground squirrels active at all times of day, as the weather warms activity more limited to morning, late afternoon, and evening.
- During winter, Uinta ground squirrels are sometimes active near the Albright Visitor Center and hotel at Mammoth Hot Springs. 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

- Prefers sagebrush valleys, shrub communities, and forest openings.
- Eat primarily plant material, especially 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 arouses frequently during the winter.
- Breeding begins as snowmelt occurs, usually late March until mid-May; one litter of 5–6 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 and it 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; 1 litter of 6–7 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 6–9 young per year.
- Solitary animals except during breeding and rearing of young.



## Marten (*Martes americana*)



### Identification

- 18–26 inches long, 1–3 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; 1–5 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 maintaining tunnels in the winter; also dig shallow burrows.
- Typically breed from mid-February to November; up to four litters of 2–10 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 6–8 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, including an unsuspecting gopher.
- Do not hibernate, but 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 (*Lutra 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.

### More Information

Crait, J.R. et al. 2006. Late seasonal breeding of river otters in Yellowstone National Park. *American Midland Naturalist* 156: 189–192.

Crait, J.R. and M. Ben-David. 2006. River otters in Yellowstone Lake depend on a declining cutthroat trout population. *Journal of Mammalogy*. 87: 485–494.



## 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 National Park, including raptors, songbirds, shorebirds, and waterfowl. About 150 species build their 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 in Yellowstone National Park.

The Yellowstone National Park bird program monitors a small portion of its breeding bird species to gather information like reproduction, abundance, and habitat use. Data is collected on multiple species from a wide variety of taxonomic groups, and has 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 so that appropriate management action can be taken, if necessary.

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

## Breeding Bird Surveys

Breeding bird surveys are a nationwide monitoring effort coordinated by the US Geological Survey and the Canadian Wildlife Service's Research Center. Since the 1980s, Yellowstone National Park has participated in these long-term surveys conducted throughout North America. The surveys are

### 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, 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 birds.

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 Pond and Floating Lake Island, 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 on early morning walks 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.

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 stay in Yellowstone year-round include the common raven, Canada goose, trumpeter swan, dusky grouse (formerly blue grouse), gray jay, 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 <http://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.**

road-based with the registered observer recording all birds seen and heard within a quarter mile radius with points occurring every half mile. The surveys are conducted in June, during the height of the songbird breeding season. Yellowstone has three routes: Mammoth area, Northeast Entrance area (Tower Junction to Round Prairie), and the interior (Dunraven Pass through Hayden Valley and Yellowstone Lake).

In 2014, surveyors detected 2,800 individuals of 81 species. The Yellowstone route (Dunraven Pass to Mary Bay) had the highest diversity and number of individuals. The Yellowstone route had 5 to 6 times the number of individuals than either of the other two routes. Large flocks of Canada geese along the Yellowstone River accounted for 70% of all observations along the interior route. Canada goose numbers were relatively stable from 1987 to 2009, after which they increased substantially for unknown reasons.

### More Information

Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://www.nps.gov/yell/naturescience/birdreports.htm>

Crick, H.Q.P. 2004. The impact of climate change on birds. *Ibis* 146:48–56.

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

McEneaney, T. 1988. *Birds of Yellowstone: A practical habitat guide to the birds of Yellowstone National Park—and where to find them*. Boulder, CO: Roberts Rinehart Publishers.

Yellowstone National Park 2014. *Field Checklist of the Birds of Yellowstone National Park*.

### Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner



Bald eagles are one of more than a dozen raptor (birds of prey) species in Yellowstone. The peregrine falcon and bald eagle are recovered endangered and threatened species.

## Raptors

The park supports 19 breeding raptor species. Additional species use the Yellowstone landscape during migrations and seasonal movements. The bird program monitors bald eagles, ospreys, and peregrine falcons. Bald eagles and peregrine falcons were previously listed as endangered and threatened species and their monitoring is required by law. The osprey is monitored because a food source, the cutthroat trout, declined in Yellowstone Lake. Other species that occur in the park such as golden eagles 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, science-based program started in 2011 and designed to learn more about the park's raptors. The initiative, concluded in 2015, inventoried and monitored select raptor species to provide baseline information on population size, productivity, and seasonal movements for species other than bald eagles, ospreys, and peregrine falcons.

The Yellowstone Raptor Initiative selected golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), American kestrels (*Falco sparverius*), prairie falcons (*Falco mexicanus*), and owls as focal species. The initiative relied on citizen science to acquire valuable data on raptors in the park. A detailed project report will be available in 2016.

### Bald Eagles

The bald eagle (*Haliaeetus leucocephalus*) was named the national symbol of the United States 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. More than 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 lower than in the rest of the park. However, in 2015, eight of eleven active nests on Yellowstone Lake were successful, indicating that eagles may have switched to other prey sources in the absence of cutthroat trout.

### 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.

From 2010 to 2015, a raptor observation program documented 24 raptor species in Yellowstone. Bald eagles were the second most commonly reported species (16%) after red-tailed hawks (22%). A recent

study found little evidence to support the claim that cutthroat trout declines have resulted in lower nesting success for bald eagles on Yellowstone Lake.

### More Information

1940. Bald Eagle Protection Act of 1940 In 16 US Code 668-668d, 54 Stat. 250.

Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://www.nps.gov/yell/naturescience/birdreports.htm>

Baril, L.M., D.W. Smith, T. Drummer, and T.M. Koel. 2013. Implications of cutthroat trout declines for breeding ospreys and bald eagles at Yellowstone Lake. *Journal of Raptor Research* 47(3): 234–245.

Buehler, D.A. Bald Eagle. *The Birds of North America Online*. <http://bna.birds.cornell.edu/bna/>

Harmata, A. 1994. Yellowstone's bald eagles: Is the park a "black hole" for the national symbol? *Yellowstone Science* 2.

Harmata, A.R. and B. Oakleaf. 1992. *Bald eagles in the greater Yellowstone ecosystem: an ecological study with emphasis on the Snake River, Wyoming*, Edited by Wyoming Game and Fish Department. Cheyenne, WY.

Harmata, A.R., G.J. Montopoli, B. Oakleaf, P.J. Harmata, and M. Restani. 1999. Movements and survival of bald eagles banded in the Greater Yellowstone Ecosystem. *Journal of Wildlife Management* 63(3):781–793.

Swenson, J.E. 1975. *Ecology of the bald eagle and osprey in Yellowstone National Park*. M.S. Bozeman, MT: Montana State University.

### Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner

## Quick Facts

### Number in Yellowstone

- In 2015, park staff monitored 19 active bald eagle nests.
- Of the 19 active nests, 13 (68%) were successful.
- 18 young were produced. Productivity for active nests in 2015 (0.95 young per nesting female), was greater than the 31-year average (0.7).

### 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

- Habitat can be a clue to which

eagle you are seeing.

- Bald eagles are usually near water where they feed on fish and waterfowl. They also nest in large trees close to water.
- Golden eagles hunt in open country for rabbits and other small mammals.
- Exception: Both feed on carcasses in the winter, sometimes together.

### 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.

## Osprey

Like many other birds of prey, osprey (*Pandion haliaeetus*) populations declined due to pesticide use in the mid-1900s. Populations rebounded during the latter part of the 1900s. The first study of osprey in Yellowstone National Park occurred in 1917 by M. P. Skinner, the park's first naturalist. 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.

Since monitoring began, Yellowstone's population of osprey has been considered relatively stable. On average, 50% of nests succeed (produce young) each year, with each successful nest producing an average of one to two young.

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.

### 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 ospreys and improved nesting success at Yellowstone Lake.



Ospreys are monitored by park staff. In 2015, 30 active nests were monitored in Yellowstone.

### More Information

- Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://www.nps.gov/yell/naturescience/birdreports.htm>
- Baril, L.M., D.W. Smith, T. Drummer, and T.M. Koel. 2013. Implications of cutthroat trout declines for breeding ospreys and bald eagles at Yellowstone Lake. *Journal of Raptor Research* 47(3): 234–245.
- Poole, A.F., R.O. Bierregaard, and M.S. Martell. Osprey. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>

### Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
 Lisa Baril, Yellowstone Raptor Initiative  
 Katy Duffy, Interpretive Planner

## Quick Facts

### Number in Yellowstone

- In 2015, 30 active nests were monitored, with 50% of them successful, similar to the 28-year average (51%).
- 28 young were produced. Productivity for active nests in 2015 (0.93 young per nesting female) was greater than the 28-year average (0.86).
- Only one osprey nest at Yellowstone Lake was successful in 2015. Lower reproduction may have been due to increased

precipitation during Spring.

### 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

- Usually 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 2–3 eggs in May to June.
- Eggs hatch in 4–5 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 farther.

### 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



Peregrine falcons are a recovered endangered species in Yellowstone.

increasing on its own 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 climate change. For example, to assess the levels of

## Quick Facts

### Number in Yellowstone

- In 2015 park staff monitored 27 of the 36 known peregrine breeding territories. Not all territories are occupied annually and several are currently vacant.
- The 27-year average nest success is 74%, while the average nest success for 2015 was 33%.
- The 27-year average productivity is 1.62 young per breeding pair, while the 2015 average was 0.71 young per occupied territory.

### 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 3–4 eggs in late April to mid-May.
- Young fledge in July or early August.
- Dives at high speeds (can exceed 200 mph) to strike prey in mid-air.

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.

#### **More Information**

Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://www.nps.gov/yell/naturescience/birdreports.htm>.

Enderson, J.H., R.J. Oakleaf, R.R. Rogers, J.S. Sumner. 2012. Nesting performance of peregrine falcons in Colorado, Montana, and Wyoming, 2005–2009. *The Wilson Journal of Ornithology* 124(1):127–132.

White, C.M., N.J. Clum, T.J. Cade, and W. Grainger Hunt. Peregrine Falcon. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>.

#### **Staff Reviewers**

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner



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. They are monitoring the trumpeter swan, common loon, and colonial nesting species, like the double-crested cormorant and American white pelican. Yellowstone has years of data about the rate and success of nesting for some of these species, but little information about changes in the timing of nesting activity—an indicator of climate change.

## Colonial 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 0.7–1.2 acres in size, depending on lake water levels, yet hundreds of birds have nested there in a single year. The birds have been surveyed for more than 30 years, with some data going back to 1890 when nesting American white pelicans (*Pelecanus erythrorhynchos*) and California gulls (*Larus californicus*) were first noted in this area.

Currently, pelicans, California gulls, and double-crested cormorants (*Phalacrocorax auritus*) nest with varying rates of success. Very wet and cold late spring weather and the declining cutthroat trout population could be factors. In 2015, 291 pelican chicks, and 9 cormorant chicks fledged. No California gull chicks were observed.

## Habitat

Birds nesting on the Molly Islands are subject to extreme environmental conditions ranging from flooding, frosts that can occur at any time of year, and 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 last 20 years. Caspian terns (*Hydroprogne caspia*), have not nested on the islands since 2005. The reason(s) for the declines is unknown but is likely related to cutthroat trout population diminishing in Yellowstone Lake.

Caspian terns 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 nests were confirmed by 1928. Prior to the late 1970s, the Molly Islands were surveyed only intermittently, but have been surveyed annually since that time.

American white pelicans spend the summer mainly on Yellowstone Lake and the Yellowstone River. These large white birds are often mistaken for trumpeter swans until their huge yellow beak and throat pouch are seen. Their black wing tips distinguish them from swans, which have pure white wings.

## More Information

Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://www.nps.gov/yell/learn/nature/birdreports.htm>  
Evans, R.M., and F.L. Knopf. American white pelican. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>

## Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner

## Common Loons

The park's common loon (*Gavia immer*) population is one of the most southerly breeding populations in North America. The majority of Wyoming's population of breeding common loons occurs in Yellowstone. 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. Wyoming'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, Wyoming's population has declined by 42%. Yellowstone's loon population has declined since surveys began in 1989. 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 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.



The common loon is a species of concern in Yellowstone.

### Population

In 2015, park biologists checked at least 18 lakes for loon activity. Some lakes, like Yellowstone Lake, had more than one loon territory. Eleven of the lakes were occupied by at least one loon, with a total estimate of 26 adult loons. Four loonlets fledged during 2015.

## Quick Facts

### Number in Yellowstone

- In 2015, 26 loons in 13 lakes. Eleven territorial pairs.

### 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 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 only remains 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.
- All factors affecting loon reproduction in Yellowstone are unknown, but human disturbance of shoreline nests has a negative impact.

### **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. Wyoming's breeding population is isolated and totals approximately 16 territorial pairs including 11 in Yellowstone. 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, as do the loss of breeding habitats and water level fluctuations (e.g., erratic spring flooding). 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.

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 Lake did not exceed that threshold although they still contained mercury.

Loons are long-lived; they have relatively low chick production and a poor ability to colonize 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.

### **More Information**

Annual Bird Program Reports. National Park Service, Yellowstone National Park. <http://http://www.nps.gov/yell/naturescience/birdreports.htm>  
Mcintyre, Judith W., Jack F. Barr, David C. Evers, and James D. Paruk. Common loon. The birds of North America Online. <http://bna.birds.cornell.edu/bna/>

### **Staff Reviewers**

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner

## 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. Small populations survived in isolated areas such as the Greater Yellowstone Ecosystem, where the population was thought to number only 69.

As a result of conservation measures, populations across the continental United States began increasing. Today there are approximately 46,000 trumpeter swans in North America. Swans in the Greater Yellowstone Ecosystem played a significant role in the population resurgence, but by the early 1960s, 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 dropped 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 predation, climate change, and human disturbance. There are currently only two breeding pairs in Yellowstone and 19 additional non-breeding swans,



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

including 17 swans released in the park since 2013.

During the 2015 breeding season, the two pairs of trumpeter swans nested in Yellowstone. The Riddle Lake pair produced one cygnet. The other pair of swans nested on a floating nest platform installed at Grebe Lake in 2011 as part of a new management plan to increase swan productivity in the park. That nest produced two cygnets in 2014.

Three trumpeter swans were released in Hayden Valley on the Yellowstone River in 2015. This follows the release of four trumpeter swans during 2014. Staff expect that at least one of the released swans will become bonded to their release location and return with a mate the following spring. 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

## Quick Facts

### Number in Yellowstone

23 resident swans in 2015, including releases and young of the year.

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, have narrower heads, have a pink mandible stripe, have no 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 4–6 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.

Canada—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.

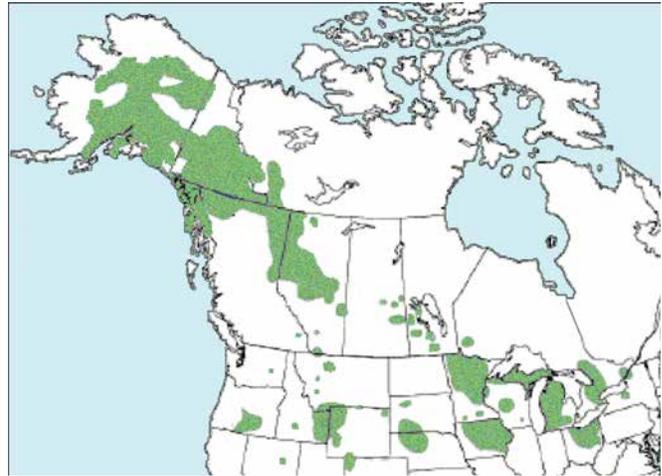
Federal agencies conduct two annual surveys: The February survey counts how many migrant swans winter in the region; the September survey estimates the resident swan population and annual number of young that fledge (leave the nest).

### Outlook

Trumpeter swans are particularly sensitive to human disturbance. Because of this, park managers restrict human activity in known swan territories and nesting areas. Scientists are also conducting studies to determine the habitat requirements for nesting swans.



Trumpeter swans are a species of concern in Yellowstone.



Current nesting range of trumpeter swans.

### More Information

- Mitchell, C.D., and M.W. Eichholz. Trumpeter swan. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>
- Proffitt, K.M. 2008. Yellowstone National Park trumpeter swan conservation assessment. Rocky Mountains Cooperative Ecosystem Studies Unit.
- Proffitt, K.M., T.P. McEneaney, P.J. White, and R.A. Garrott. 2009. Trumpeter swan abundance and growth rates in Yellowstone National Park. *Journal of Wildlife Management* 73:728–736.
- Proffitt, K.M., T.P. McEneaney, P.J. White, and R.A. Garrott. 2010. Productivity and fledging success of trumpeter swans in Yellowstone National Park, 1987–2007. *Waterbirds* 33:341–348.
- Smith, D.W. and N. Chambers. 2011. The future of trumpeter swans in Yellowstone National Park: Final report summarizing expert workshop, April 26–27, 2011. National Park Service, Yellowstone Center for Resources, Yellowstone National Park, Wyoming.
- Squires, J.R. and S.H. Anderson. 1995. Trumpeter swan (*Cygnus buccinator*) food habits in the Greater Yellowstone Ecosystem. *American Midland Naturalist* 133(2):274–282.
- Squires, J.R. and S.H. Anderson. 1997. Changes in trumpeter swan (*Cygnus buccinator*) activities from winter to spring in the greater Yellowstone area. *American Midland Naturalist* 138(1):208–214.
- White, P.J., K.M. Proffitt, T.P. McEneaney, R.A. Garrott, and D.W. Smith. 2011. Yellowstone's trumpeter swans in peril? Drastic decrease in resident swans over the past 40 years. *Yellowstone Science* 19:12–16.

### Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner



Songbirds, like 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 the willow–bird study, the breeding bird survey, and the forest burn survey.

### Songbirds and Willows

Scientists are studying how the growth of willows in Yellowstone’s northern range might be affecting songbirds that use this habitat. Willows and other woody vegetation have been highly suppressed in Yellowstone’s northern range since the early 1900s. The loss and low stature of willows has been attributed to several factors including elk herbivory, reduced beaver populations, consumption by fire, and/or climate change. Since 1997–1998, however, park biologists have observed that some willow stands in the northern range are expanding in height. Willow stands are one of a few deciduous wetland habitats in the Greater Yellowstone Ecosystem. Bird diversity is considerably higher in wetland habitat types than in adjacent grasslands, shrublands, and upland coniferous forests.

Several Yellowstone bird species only breed in willow communities including Wilson’s warbler (*Cardellina pusilla*), willow flycatcher (*Empidonax traillii*), and gray catbird (*Dumetella carolinensis*). Willow growth has increased in some parts of the park’s northern range, for reasons still being studied. An increase in willow growth may support re-colonization by these and other bird species.

Monitoring of willow–songbird communities in Yellowstone began in 2005. Using data collected through monitoring, scientists will compare the presence and abundance of breeding songbirds across the range of willow growth conditions found throughout Yellowstone’s northern range. Over time, the study

will be able to track changes in bird species composition as willow stands continue to change in structure.

### Surveys of Burned Forests

Birds are among the first returning vertebrates to a fire-affected area. 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 woodpeckers (*P. villosus*) use trees that burned in low to moderately severe fires, two to four years after the fire. Northern flickers 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 used later by chickadees, nuthatches, and bluebirds.

Because fire size, frequency, and intensity is 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.

### More Information

- Baril, L.M., A.J. Hansen, R. Renkin, and R. Lawrence. 2011. Songbird response to increased willow (*Salix* spp.) growth in Yellowstone’s northern range. *Ecological Applications* 21:2283–2296.
- Saab, V., W. Block, R. Russell, J. Lehmkuhl, L. Bate, and R. White. 2007. Birds and burns of the interior West: descriptions, habitats, and management in western forests. Gen. Tech. Rep. PNW-GTR-712. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station.

### Staff Reviewers

- Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner



Ravens are one of the nearly 300 bird species that have been sighted in Yellowstone National Park. They are common and seen frequently in developed areas.

## 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 and oil from a preen gland enable this bird to survive cold waters.

### Ravens

Several raven relatives 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 some have learned to follow wolves while they hunt elk. They begin feeding as soon as wolves tear into a carcass because ravens are not able to rip open thick skin. Ravens are willing to eat almost anything and are frequently seen near parking lots searching for food—some have even learned to unzip and unsnap packs. Do not feed them.

Recent surveys indicate 200–300 ravens are present in the northern range of Yellowstone. Based on a 2012 study by biologists at the University of

Washington, 64% of the total 243 ravens counted on the northern range were in natural settings away from human areas, while 36% were in human areas.

### Sandhill Cranes

Sandhill cranes (*Grus canadensis*) nest in Yellowstone each summer. Their guttural calls announce their presence long before most people see them. Their gray feathers blend in well with their grassland habitat. The tallest birds in Yellowstone, they stand about 4 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.

### More Information

Boarman, W.I., and B. Heinrich. Common raven. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>  
Kingery, H.E. and M.F. Willson. American dipper. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>  
Tacha, T.C., S.A. Nesbitt, and P.A. Vohs. Sandhill crane. The Birds of North America Online. <http://bna.birds.cornell.edu/bna/>

### Staff Reviewers

Doug Smith, Senior Wildlife Biologist  
Lisa Baril, Yellowstone Raptor Initiative  
Katy Duffy, Interpretive Planner



Sandhill cranes are the tallest birds in Yellowstone.



Clark's nutcrackers collect seeds from whitebark and limber pine trees and bury them for later.



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.

### Native Fish

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

### Quick Facts

#### Number in Yellowstone

11 native species

- 3 sport fish: cutthroat trout (Yellowstone and westslope), Arctic grayling, mountain whitefish
- 8 non-sport fish: longnose dace, speckled dace, redbside shiner, Utah chub, longnose sucker, mountain sucker, Utah sucker, and 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 apparently illegally introduced into Yellowstone Lake.
- Whirling disease is now present in Yellowstone Lake, the Yellowstone and Firehole rivers, and Pelican Creek.
- New Zealand mud snails, which form dense colonies and compete with native species are also present.
- Competition and hybridization occurs with nonnative rainbow trout (Slough Creek) and brook trout (Soda Butte Creek).

now takes action to ensure their recovery.

An environmental compliance process culminating in a parkwide 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 fluvial 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.

Cutthroat trout are the only native trout of the park and were the dominant fish species here prior to Euroamerican settlement. Native cutthroat trout are thought to be among the most ecologically important fish of the Greater Yellowstone Ecosystem and highly regarded by anglers. Several factors, nonnative species and disease among them, are threatening the persistence of these fish. The National Park Service strives to use the best methods available for addressing threats, with a focus on direct, aggressive intervention, and welcomed assistance by visiting anglers.

### History

When Yellowstone became a national park, approximately 40% of its waters were barren of fish—including Lewis Lake, Shoshone Lake, and the Firehole River above Firehole Falls.

Early park managers stocked fish into new locations, produced fish in hatcheries, and introduced several nonnative species in order to increase recreational fishing opportunities. Today, about 40 lakes have fish; the others were either not stocked or have reverted to their original fishless condition.

The ranges and densities of Yellowstone's native trout and grayling were substantially altered during the 1900s due to exploitation and introduction of nonnative species. Nonnative species in the park include brook trout, brown trout, lake chub, long-nose sucker, lake trout, and rainbow trout. These nonnative species continue to contribute 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.

The US Fish and Wildlife Service maintained an aquatic research and monitoring program in the park until 1996. Since then, National Park Service fisheries managers have focused on the same objectives:

manage aquatic resources as an important part of the park ecosystem, preserve and restore native fishes and their habitats, and provide anglers with the opportunity to fish for wild fish in a natural setting.

Despite changes in species composition and distribution, large-scale habitat degradation has not occurred. 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 river otters and 20 species of bird.

### Influences of Some Nonnative Species

Aquatic nuisance 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 effects are less dramatic. (See: "Nonnative Fish and Aquatic Invasive Species" in this chapter.)

### Fishing in Yellowstone

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



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.)

#### 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, visitor centers, and online. [www.nps.gov/yell/planyourvisit/fishdates.htm](http://www.nps.gov/yell/planyourvisit/fishdates.htm)

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 scented bait is allowed.
- 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 brook and rainbow trout must be killed in the Lamar River drainage.

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

#### Anglers Assist with Native Species Conservation

The Native Trout Conservation Area is a large region within the park where native cutthroat trout are actively being harmed by introduced nonnative fish. Angling is one way that the nonnative fish can be selectively removed from an area without damaging the native fishery. In some areas, anglers are strongly encouraged, and in some cases required, to harvest nonnatives. This harvest will help to save the native fish and the natural ecosystems they support.

Angler groups have supported management actions, such as closing the Fishing Bridge to fishing in the early 1970s. Yellowstone cutthroat trout support a \$36 million annual sport fishery. The money generated from fishing licenses has helped fund research

on aquatic systems and restoration projects. Anglers contribute to the fisheries database by filling out a Volunteer Angler Report card that is issued with each fishing license. This information helps managers monitor the status of fisheries throughout the park.

Observing fish in their natural habitat is also a popular activity for visitors. In the 1980s and 1990s, fisheries biologists monitored non-consumptive use of aquatic resources for about a decade at Fishing Bridge and LeHardy's Rapids. In 1994, approximately 176,400 visitors watched fish at LeHardy's Rapids, where spawning cutthroat can be observed jumping the rapids. At Fishing Bridge, approximately 167,000 people watched cutthroat trout in the waters below the bridge.

#### More Information

- 100th Meridian Initiative: [www.100thmeridian.org](http://www.100thmeridian.org)
- Franke, M.A. 1997. A grand experiment: The tide turns in the 1950s: Part II. *Yellowstone Science* 5(1).
- Franke, M.A. 1996. A grand experiment: 100 years of fisheries management in Yellowstone: Part I. *Yellowstone Science* 4(4).
- Koel, T. et al. 2014. Yellowstone Fisheries and Aquatic Sciences Report 2012–2013. National Park Service: Yellowstone National Park.
- Lilly, B. and P. Schullery. 2000. *Bud Lilly's Guide to Fly Fishing the New West*. Portland, OR: Frank Amato Publications.
- National Exotic Marine and Estuarine Species Information System: [invasions.si.edu/nemesis](http://invasions.si.edu/nemesis)
- National Park Service. 2011. Native Fish Conservation Plan /Environmental Assessment for Yellowstone National Park. Yellowstone Center for Resources.
- Parks, R. 1998. Fishing Yellowstone National Park. Helena, MT: Falcon.
- Schullery, P. 2008. Vaguely disquieting scenes: Fishing bridge and the evolution of American sport fishing. *Yellowstone Science* 16(3): 24–33.
- Varley, J.D. and P. Schullery. 1998. *Yellowstone fishes: Ecology, history, and angling in the park*. Mechanicsburg, PA: Stackpole Books.

#### Staff Reviewers

- Todd Koel, Supervisory Fishery Biologist  
Pat Bigelow, Fishery Biologist  
Phil Doepke, Fishery Biologist



Of the 11 native species in Yellowstone, three are considered sport fish: Arctic grayling (above), cutthroat trout (two subspecies: Yellowstone cutthroat trout and westslope cutthroat trout), and mountain whitefish.

## Native Fish Species

### Arctic Grayling

Fluvial (entirely stream-dwelling) Arctic grayling (*Thymallus arcticus*) were historically common within the Madison, Gibbon (below Gibbon Falls), Firehole (below Firehole Falls), and Gallatin rivers. However, by the 1950s the introduction of competing nonnative fishes such as brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*), and the fragmentation of migratory pathways by the construction of the Hebgen Dam outside the park led to the elimination of fluvial grayling from their entire native range within the park. The only known populations left in the park are adfluvial (fish that spend a majority of their life in a lake and spawn in tributary streams) descendants of fish that were stocked in Cascade and Grebe lakes. They are also present in Wolf Lake and occasionally in the Gibbon River.

The arctic grayling is sometimes confused with mountain whitefish, but can be easily differentiated by its large dorsal fin.

### Restoration

One of the goals of the park's 2010 Native Fish Conservation Plan is to restore fluvial grayling so that they reside in approximately 20% of their historical distribution. The upper reaches of Grayling Creek are considered the best potential site for immediate fluvial grayling restoration, but are currently occupied by brown trout and hybridized cutthroat trout. A small waterfall exists near the park boundary in Grayling Creek, which flowed directly into the Madison River prior to the construction of Hebgen

Dam in 1914. It is not known if grayling were ever present upstream of the waterfall, but they were historically abundant downstream from it.

This project, begun with barrier construction in 2012, aims to establish Arctic grayling and westslope cutthroat trout to one of the largest and most remote drainages in the species historic range within Yellowstone.

In summer of 2013 the 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 of the Grayling Creek watershed with native fluvial Arctic grayling and westslope cutthroat trout was scheduled to begin in 2015. The project is expected to take nearly a decade to remove nonnative fish and establish both species.

### More Information

Kaya, C. 2000. Arctic grayling in Yellowstone: Status, management, and recent restoration efforts. *Yellowstone Science*. 8(3).

Kruse, T.E. 1959. Grayling of Grebe Lake, Yellowstone National Park, Wyoming. *Fishery Bulletin* 149(59):307–351.

### Staff Reviewers

Pat Bigelow, Fishery Biologist

Todd Koel, Supervisory Fishery Biologist

## Yellowstone Cutthroat Trout

Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*; YCT) are the most widespread native trout of the park and were the dominant fish species here prior to Euroamerican settlement. They are an important species in Yellowstone National Park, upon which many other species depend. They provide an important source of food for an estimated 20 species of birds, and mammals including bears, river otters, and mink. In the recent past, fishing for cutthroat trout has supported a \$36 million annual sport fishery.

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, predation, 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.

### 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 1984 the average number of YCT caught at survey sites reached 19.1 per net. Catch per unit effort increased from an average of 11.8 (8.7–15.0) in 2010 to 28.4 (23.7–33.0) in 2014. The increase in catch each year was primarily due to an



Spawning Yellowstone cutthroat trout.

influx of young, juvenile cutthroat trout within the system; however, increased catches of large, older-age fish also occurred. Cutthroat trout had a mean total length of 358 millimeters in 2012, 382 millimeters in 2013, and 405 millimeters in 2014. These mean lengths were much lower than those observed in earlier years. In 2014, most (53%) cutthroat trout were large adults between 430 and 620 millimeters in total length, while juveniles and subadults (29%) were less than 325 millimeters in total length.

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 the nonnative parasite that causes whirling disease.

Two-thirds of the park streams that were part of the species' native habitat outside the Yellowstone Lake watershed still contain genetically pure YCT; other streams have YCT hybridized with introduced rainbow trout. The objectives of Yellowstone's Native Fish Conservation Plan (2010) include recovery of

## Quick Facts

### Number in Yellowstone

The number of Yellowstone cutthroat trout spawning at Clear Creek, a Yellowstone Lake tributary where monitoring began in 1945, peaked at more than 70,000 in 1978 and fell to 538 by 2007.

### Where to See

Yellowstone Lake, Fishing Bridge, LeHardy's Rapids, Trout Lake

### Identification

Red jaw slash

### Behavior

- Yellowstone cutthroat is native

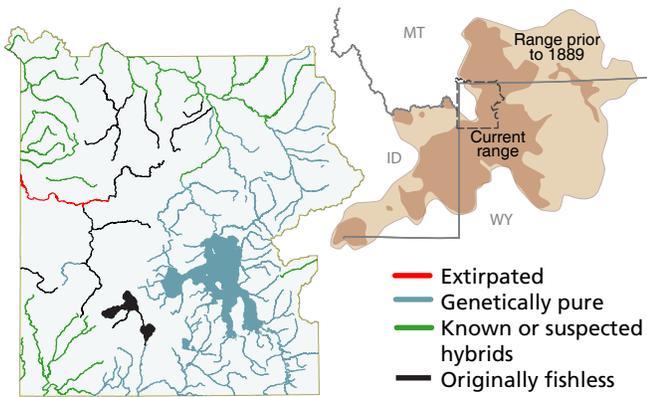
to the Yellowstone River, its tributaries, the Snake River, and the Falls River.

- Require cold, clean water in streams or lakes.
- Spawn in rivers or streams in early May through 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, and

other plants, and plankton.

### Management Concerns

- In the 1960s, fisheries managers determined that angler harvest was excessive and negatively impacting the fishery. Increasingly restrictive angling regulations were put into place, which helped restore cutthroat trout population numbers and age structure.
- Whirling disease and illegally introduced lake trout in Yellowstone Lake now pose a serious threat to the cutthroat trout population.



Past and present range of the Yellowstone cutthroat trout.

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

### 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 has (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. Here, it's possible that fish swam across the Continental Divide at the headwaters of Pacific Creek and Atlantic Creek and, thus, swam from the Pacific to the Atlantic watersheds.

### Restoration

Restoring YCT to park waters is an important component of the Native Fish Conservation Plan. In 2012, park staff began an effort to remove nonnative brook trout from the Elk Creek drainage above a natural fish barrier near the Yellowstone River. This project will require multiple years of nonnative fish removal before YCT can be introduced, but the project is an opportunity to replicate rare small-stream resident YCT in the park. Further efforts to restore and conserve YCT are occurring in the Lamar River Drainage where a barrier to protect upper Soda Butte Creek was constructed in 2013 and similar barriers are being considered for Slough Creek and the upper Lamar River.

## Westslope Cutthroat Trout



Historically the most abundant and widely distributed subspecies of cutthroat trout throughout the West, the westslope cutthroat trout (*Onchorhynchus 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 form of the species, 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 species. 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 a hybridized form.

### Restoration

Integral to our native species restoration program is having brood sources from which to reestablish native populations. A brood should be accessible, secure from contamination, self-sustaining, genetically diverse, abundant, of traceable origin, and pose no risk to existing wild populations. Genetically pure WCT have only persisted in one tributary of the Madison River drainage (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. Stocking was completed in High Lake in 2009, and in East Fork Specimen Creek in 2012. Evidence suggests those populations are rapidly becoming established. Another restoration project is designed to create an Upper Missouri River WCT brood stock in Goose Lake, where nonnative fish removal was conducted in 2011 and stocking of fry began in 2013. The largest WCT restoration effort in Yellowstone is the Grayling Creek project (See: Arctic grayling), which will restore WCT to over 20 miles of native habitat.

## Mountain Whitefish



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, clear and 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.

Unlike other native fish, the mountain whitefish spawns in the fall. It generally feeds along the bottom, eating aquatic insect larvae, and competes with trout for the same food.

### More Information

2009. Yellowstone cutthroat trout: Conserving a heritage population in Yellowstone Lake. Mammoth Hot Springs, WY: National Park Service.
- Baril, L.M., D.W. Smith, T. Drummer, and T.M. Koel. 2013. Implications of cutthroat trout declines for breeding ospreys and bald eagles at Yellowstone Lake. *Journal of Raptor Research* 47(3): 234–245.
- Bigelow, P.E., T.M. Koel, D. Mahony, B. Ertel, B. Rowdon, and S.T. Olliff. 2003. Protection of native Yellowstone cutthroat trout in Yellowstone Lake, Yellowstone National Park, Wyoming, Edited by US Department of the Interior, National Park Service. Fort Collins, CO: National Park Service, Water Resources Division.
- Gresswell, R.E. and J.D. Varley. 1988. Effects of a century of human influence on the cutthroat trout of Yellowstone Lake. In R.E. Gresswell, ed., Status and management of interior stocks of cutthroat trout, 45–52. Vol. *Symposium 4*. American Fisheries Society.
- Gresswell, R.E., W.J. Liss, and G.L. Larson. 1994. Life-history organization of Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) in Yellowstone Lake. *Canadian Journal of Fisheries and Aquatic Sciences* 51(S1):298–309.
- Gresswell, R.E. 1995. Yellowstone cutthroat trout. In M. K. Young, ed., *Conservation assessment for inland cutthroat trout*, 36–54. Fort Collins, CO: US Forest Service, Rocky Mountain Forest and Range Experiment Station.
- Heckmann, R. 1994. Cutthroats and parasites: Yellowstone Lake's complex community of fish and companion organisms. *Yellowstone Science* 2(3).

Kerkvliet, J., C. Nowell, and S. Lowe. The economic value of a predator: Yellowstone trout. In A. P. Curlee, A. Gillesberg and D. Casey, ed., *Greater Yellowstone predators: Ecology and conservation in a changing landscape: Proceedings of the third biennial conference on the Greater Yellowstone Ecosystem*, 143–150. Yellowstone National Park, WY: Northern Rockies Conservation Cooperative and Yellowstone National Park.

- Koel, T.M., P.E. Bigelow, P.D. Doepke, B.D. Ertel, and D.L. Mahony. 2005. Nonnative lake trout result in Yellowstone cutthroat trout decline and impacts to bears and anglers. *Fisheries* 30(11):10–19.
- Koel, T.M., P.E. Bigelow, P.D. Doepke, B.D. Ertel, and D.L. Mahoney. 2006. Conserving Yellowstone cutthroat trout for the future of the Greater Yellowstone Ecosystem: Yellowstone's Aquatic Sciences Program. *Yellowstone Science* 14(2).
- Koel, T.M., D.L. Mahony, K.L. Kinnan, C. Rasmussen, C.J. Hudson, S. Murcia, and B.L. Kerans. 2006. *Myxobolus cerebralis* in native cutthroat trout of the Yellowstone Lake ecosystem. *Journal of Aquatic Animal Health* 18(3):157–175.
- May, B.E., W. Urie, and B.B. Shepard. 2003. Range-wide status of Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*): 2001, Edited by US Forest Service, Montana Fish, Wildlife and Parks, Montana Cooperative Fishery Research Unit. Bozeman, MT.
- National Park Service, Yellowstone National Park. 2010. Native Fish Conservation Plan / Environmental Assessment, Edited by Department of the Interior. Yellowstone Center for Resources.
- Reinhart, D.P., S.T. Olliff, and K.A. Gunther. Managing bears and developments on cutthroat spawning streams in Yellowstone National Park. In A.P. Curlee, A. Gillesberg and D. Casey, ed., *Greater Yellowstone predators: Ecology and conservation in a changing landscape: Proceedings of the third biennial conference on the Greater Yellowstone Ecosystem*, 161–169. Yellowstone National Park, WY: Northern Rockies Conservation Cooperative and Yellowstone National Park.
- Varley, J.D. and P. Schullery. 1995. The Yellowstone Lake crisis: Confronting a lake trout invasion: a report to the director of the National Park Service. Yellowstone National Park, WY: National Park Service, Yellowstone Center for Resources.

### Staff Reviewers

- Jeff Arnold, Fishery Biologist  
Pat Bigelow, Fishery Biologist  
Brain Ertel, Fishery Biologist  
Todd Koel, Supervisory Fishery Biologist



Yellowstone Lake is home to one species of native non-sport fish, the longnose dace. Like other minnows in Yellowstone, this small fish lives in a variety of habitats and is food for trout.

## Other Native Fish

### Mottled Sculpin

The mottled sculpin (*Cottus bairdi*) lives in shallow, cold water throughout Yellowstone except in the Yellowstone River above Lower Falls and in Yellowstone Lake. This species eats small insects and some fish, and is consumed by trout.

### 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. Sucker species can be distinguished by their habitat:

- 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.

### 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, and can be found in Yellowstone Lake.



This sucker was caught in Pelican Creek.

- 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.



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 the crafts brought in by park visitors before they put their boats or angling gear in the water. They inspect visitor's equipment and



A team of park staff and volunteers inspect all visitor watercraft before they put their boats or angling gear in the water to prevent the arrival of more aquatic nuisance species.

### Quick Facts

#### The Issue

Aquatic invaders can irreversibly damage the park's ecosystems.

#### Current Status

- In the US currently, 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, one nonnative disease-causing microorganism

(whirling disease). Three of these species are having a significant detrimental effect (lake trout, New Zealand mud snails, 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, which include:
- 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.

decontaminate it, if necessary. Such decontamination is usually adequate to prevent the entry of most aquatic invasive species.

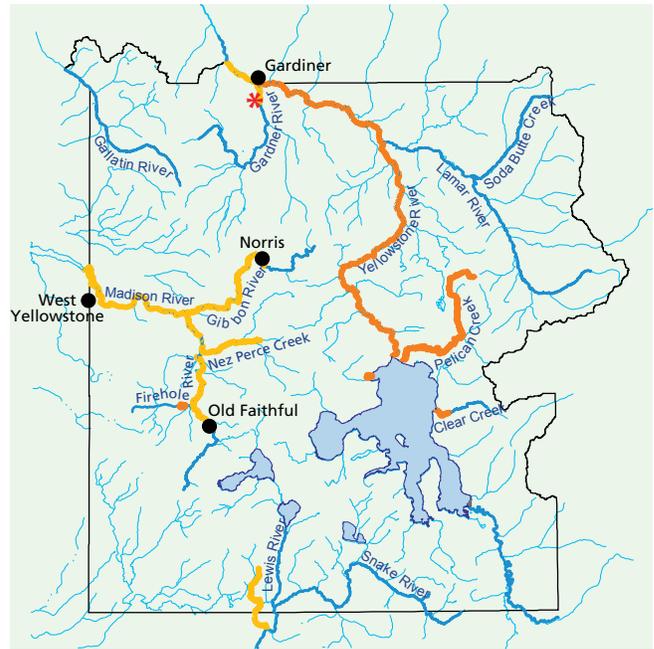
### Arrival in Yellowstone

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 diversity. 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 antipodarium*) is an invasive species that became established in the western United States since the 1980s. In suitable habitat, especially in geothermal streams with



— Whirling disease  
— New Zealand mud snails  
\* Red-rimmed melania

Locations in Yellowstone National Park where whirling disease, New Zealand mud snails, or red-rimmed melania have been documented.

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

### Are More Aquatic Invasive Species On Their Way?

Several nonnative aquatic species are spreading through the United States, among them the species listed below. Fisheries biologists believe they are moving toward Yellowstone. Their arrival might be avoided if anglers remember:

- It is illegal to use any fish as 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.
- To clean all of their gear properly.

**Eurasian water-milfoil** has spread to 46 of the 48 contiguous United States. In 2007, it was found in Montana. Wyoming and Maine are the only states still free of this aquatic invader.

This nonnative aquatic plant lives 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, such as Bridge Bay.

Eurasian water-milfoil colonizes via stem fragments carried on boating equipment, emphasizing why boats should be thoroughly cleaned, rinsed, and inspected before entering Yellowstone National Park.

Three **nonnative plankton** species that can displace native zooplankton that are important food for cutthroat trout may be on their way. These nonnative zooplankton have long spines, which make them difficult for young fish to eat.

**Zebra mussels** are a particularly damaging aquatic invasive species. They 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.

Zebra mussels cause severe economic and ecological damage. Zebra mussels attach to most hard surfaces forming thick mats that may be up to 18 inches thick. Zebra mussels drastically alter the ecology of infested water bodies and may severely impact sport fisheries.



New Zealand mud snails shells resting on a dime.

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 inadvertently transferred 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 in all of the major watersheds. Although the mud snail is abundant in several streams, it remains absent or uncommon in other Greater Yellowstone streams, suggesting that its upstream 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.

#### **Red-rimmed Melania**

The red-rimmed melania (*Melanoides 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. The following year, a survey of 18 of the park's most popular hot springs found melania only in the Boiling River soaking area and downstream approximately 1 km. 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 are 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.

#### **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 River 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



©STEPHEN ATKINSON/ OREGON STATE UNIV.

These rainbow trout show the characteristic black tail and skeletal deformities indicative of whirling disease.

## 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 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.

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.

### 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 2012 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.

### More Information

- Bartholomew, J.L. and P.W. Reno. 2002. The history and dissemination of whirling disease. In J.L. Bartholomew and J. C. Wilson, ed., *Whirling disease: Reviews and current topics*. Vol. Symposium 29. Bethesda, MD: American Fisheries Society.
- Kerans, B.L. and A.V. Zale. 2002. The ecology of *Myxobolus cerebralis*. In J.L. Bartholomew and J.C. Wilson, ed., *Whirling disease: Reviews and current topics*, 145–166. Vol. Symposium 29. Bethesda, MD: American Fisheries Society.
- Koel, T.M., D.L. Mahony, K.L. Kinnan, C. Rasmussen, C.J. Hudson, S. Murcia, and B.L. Kerans. 2007. Whirling disease and native cutthroat trout of the Yellowstone Lake ecosystem. *Yellowstone Science* 15(2).
- MacConnell, E. et al. 1997. Susceptibility of grayling, rainbow, and cutthroat trout to whirling disease by natural exposure to *Myxobolus cerebralis*. Whirling Disease Symposium, Logan, UT.
- Murcia, S., B.L. Kerans, E. MacConnell, and T.M. Koel. 2006. *Myxobolus cerebralis* infection patterns in Yellowstone cutthroat trout after natural exposure. *Diseases of Aquatic Organisms* 71(3):191–199.

### Staff Reviewer

Pat Bigelow, Fishery Biologist  
Todd Koel, Supervisory Fishery Biologist

## Lake Trout

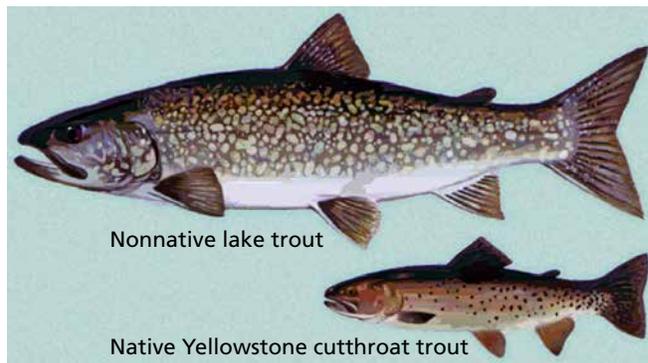
Lake trout (*Salvelinus namaycush*) are native to Canada, Alaska, the Great Lakes, New England, and parts of Montana. Lake trout were intentionally stocked in Lewis and Shoshone lakes in 1890 by the U.S. Fish Commission (a predecessor of today's US Fish and Wildlife Service). The species was first documented in Yellowstone Lake in 1994 and evidence from chemical patterns in the ear bones of lake trout captured in the late 1990s indicate that they were introduced illegally from a nearby lake some time in the 1980s. Despite major efforts to remove them by gillnetting, the lake trout are having 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 shallow tributaries.

Cutthroat trout comprise about 80% of a mature lake trout's diet. Biologists estimate 41 cutthroat trout are saved each year for every mature lake trout caught.

### 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 has worked to suppress the lake trout population.

In 2008, a scientific review panel set up to evaluate the lake trout suppression program overwhelmingly agreed that the Yellowstone Lake cutthroat trout population is in serious trouble, but that suppression



Nonnative lake trout prey on native Yellowstone cutthroat trout. Biologists estimate 41 cutthroat trout are saved each year for every mature lake trout caught.

efforts could restore this population to healthy levels. They believed very little time remained to turn the situation around, and recommended park managers increase lake trout removal.

Members of the 2008 review panel reconvened in 2011 to assess progress and provide further guidance. Population modeling suggests that the removal effort in 2010 must be doubled to curtail further population growth. Even if a measurable decline in lake trout abundance can be obtained, a maintenance program of monitoring and removals will be required.

Starting in 2009, the park contracted with Hickey Brothers Fisheries, LLC, a commercial fishing company, to increase the take of lake trout. Beginning in 2011, 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.

A movement study, to pinpoint lake trout spawning beds and identify movement patterns, was

## Quick Facts

### The Issue

Nonnative lake trout in Yellowstone Lake threaten the survival of native Yellowstone cutthroat trout and species that depend on it.

### Background

- During the time the park stocked fish, lake trout were introduced to Lewis and Shoshone lakes (1890s).
- Lake trout probably were introduced into Yellowstone Lake in the 1980s and 1990s.
- In 1994, an angler caught the first verified lake trout in Yellowstone Lake.

- One mature lake trout can eat approximately 41 cutthroat trout per year.
- The cutthroat trout population in Yellowstone Lake could fall to 10% or less of historic highs.
- Many wildlife species, including the grizzly bear and bald eagle, may depend on the 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 1.7 million lake trout since 1994.
- Recreational anglers catch approximately 20,000 lake trout each year.

### 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.

launched in 2011 by National Park Service and the US Geological Survey. Over 300 lake trout were equipped with telemetry tags and over 40 stationary receivers were deployed throughout the lake to monitor movements. Additionally, NPS and Montana State University began a mark/recapture study of lake trout in Yellowstone Lake in 2013. In order to estimate population size, 2,398 lake trout captured in trap nets were given 2 plastic “spaghetti” tags and released back to the lake. The ratio and distribution of recaptures of these fish aids researchers in estimating the total number of lake trout in the lake. Anglers catching any tagged fish should return the tags to their nearest Ranger Station or the Fisheries Office in Yellowstone National Park.

Hydroacoustic surveys (using sonar-based fish finders) are used to assess the lake trout’s seasonal movements within the lake. The surveys confirmed lake trout concentrations in the western portion of Yellowstone Lake. These surveys also revealed medium-sized (12–16 inches) lake trout tended to reside in deeper water (greater than 130 feet) than Yellowstone cutthroat trout. Now biologists can more easily target lake trout without harming cutthroat trout. Hydroacoustic data also provides minimum abundance estimates of both cutthroat and lake trout, which is invaluable information for long-term evaluation of control efforts.

#### ***Gill Nets and Anglers Control the Population***

Lake trout gillnetting begins as ice is leaving the lake and continues into October. Gill net operations removed lake trout from the population and also provide valuable data—numbers, age structure, maturity, and potential new spawning areas—leading



Since 2009, the park has contracted a commercial fishing company to increase the catch of lake trout.



Student Conservation Association interns hold a large lake trout from Yellowstone Lake.

to more effective control. To minimize the bycatch of cutthroat trout while maximizing the removal of lake trout requires knowledge of the optimum location, timing, and type of gear to use.

Anglers also contribute to lake trout management. They are encouraged to fish for lake trout, and are required to kill all lake trout caught in Yellowstone Lake and its tributaries. They tend to be most successful at catching lake trout 15–24 inches long, which are found in shallow, near-shore waters in June and early July. Of the total lake trout removed from Yellowstone Lake, anglers have removed approximately 10 percent.

#### ***Results***

More than 1.7 million lake trout have been removed from Yellowstone Lake since the lake trout’s presence was confirmed in 1994. In 2014, National Park Service and contracted crews captured more than 277,000 lake trout. Because the amount of effort put into gillnetting as well as the lake trout’s abundance affects the number removed, the number caught per 100 meters of net in one night (catch per unit of effort, CPUE) is also monitored. This number has been rising since 2002, suggesting that the population has been increasing faster than the fish are being removed, until 2012. In 2012, increases in net effort led to a significant decrease in CPUE, the first drop seen since 2002. CPUE decreased even further in 2013 and 2014.

One goal of Yellowstone’s Native Fish Conservation Plan (2010) is to reduce the population

by 25% each year until it collapses to an insignificant level. Population modeling suggests this may be possible with a continued increased effort.

#### **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.

#### **More Information**

- Bigelow, P.E. 2009. Predicting areas of lake trout spawning habitat within Yellowstone Lake, Wyoming. Doctoral dissertation, University of Wyoming, Laramie, WY.
- Gresswell, R.E. 2009. Scientific review panel evaluation of the National Park Service lake trout suppression program in Yellowstone Lake, August 25–29, 2008: Final report, October 2009, Edited by USGS Northern Rocky Mountain Science Center. Bozeman, MT.
- Koel, T.M., P.E. Bigelow, P.D. Doepke, B.D. Ertel, and D.L. Mahony. 2005. Nonnative lake trout result in Yellowstone cutthroat trout decline and impacts to bears and anglers. *Fisheries* 30(11):10–19.

- Koel, T.M., P.E. Bigelow, P.D. Doepke, B.D. Ertel, and D.L. Mahony. 2006. Conserving Yellowstone cutthroat trout for the future of the Greater Yellowstone Ecosystem: Yellowstone's Aquatic Sciences Program. *Yellowstone Science* 14(2).
- Middleton, A.D., T.A. Morrison, J.K. Fortin, M.J. Kauffman, C.T. Robbins, K.M. Proffitt, P.J. White, D.E. McWhirter, T.M. Koel, D. Brimeyer, and W.S. Fairbanks. 2013. Grizzly bears link non-native trout to migratory elk in Yellowstone. *Proceedings of the Royal Society B* 280:20130870.
- Munro, A.R., T.E. McMahon, and J.R. Ruzycki. 2006. Where did they come from?: Natural chemical markers identify source and date of lake trout introduction in Yellowstone Lake. *Yellowstone Science* 14(2).
- Wyoming Water Project. 2014. *Science supporting management of Yellowstone Lake fisheries: Responses to frequently asked questions*. Trout Unlimited: Lander, WY. <http://wyomingtu.org/wp-content/uploads/2014/03/Science-Supporting-Management-of-Yellowstone-Lake-Fisheries.pdf>
- Ruzycki, J.R., D.A. Beauchamp, and D.L. Yule. 2003. Effects of introduced lake trout on native cutthroat trout in Yellowstone Lake. *Ecological Applications* 13:23–37.

#### **Staff Reviewer**

- Pat Bigelow, Fishery Biologist  
Todd Koel, Supervisory Fishery Biologist



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 to 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. These toads are rarely seen because

### Quick Facts

#### Number in Yellowstone

5 species: blotched tiger salamander, boreal chorus frog, boreal 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.

- Tiger salamanders are common and abundant in some portions of the Yellowstone, such as the northern range and Hayden Valley.
- Boreal toads are abundant in some local areas.
- None of the park’s amphibians are federally listed as threatened or endangered.
- Scientists are concerned about the boreal 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 underground. Currently, a single breeding population is known to exist within Yellowstone. However, monitoring efforts are underway 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 the complete drying of wetlands have been documented. Since 2006, annual visits to approximately 165 wetlands across Yellowstone have further documented annual variation in the availability of wetlands. This data suggests 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 and 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 been involved with die-offs of all four widely distributed species in the region. Chytrid fungus does not necessarily cause a fatal infection and usually appears in Columbia spotted frogs and western toads following metamorphosis. 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. Similarly, 70% of tissue samples (tail clips) collected from live

## 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 to 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.

larval amphibians in 2015 were positive for ranavirus DNA. 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), which average approximately 500 acres in size. On average, 30 catchments are revisited during annual monitoring visits. 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 between climate, wetlands, and amphibians. Taken together, amphibian and wetland monitoring data from the last decade, coupled with local

climate information, will help support predictions of amphibian occurrence under different climate scenarios.

### More Information

- Corn, P.S. 2007. Amphibians and disease: Implications for conservation in the Greater Yellowstone Ecosystem. *Yellowstone Science*. 15(2).
- Gould, W. R., D. A. Patla, R. Daley, P. S. Corn, B. R. Hossack, R. Bennetts, and C. R. Peterson. 2012. Estimating occupancy in large landscapes: Evaluation of amphibian monitoring in the Greater Yellowstone Ecosystem. *Wetlands* 32:379-389.
- Hossack, B. R., W. R. Gould, D. A. Patla, E. Muths, R. Daley, K. Legg, and P. S. Corn. 2015. Trends in Rocky Mountain amphibians and the role of beaver as a key-stone species. *Biological Conservation* 187:260-269.
- McMenamin, S.K., E.A. Hadly, and C.K. Wright. 2008. Climatic change and wetland desiccation cause amphibian decline in Yellowstone National Park. *Proceedings of the National Academy of Sciences* 105(44):16988-16993.
- Patla, D., S. St-Hilaire, A. Ray, B. R. Hossack, and C. R. Peterson. Amphibian mortality events and ranavirus outbreaks in the Greater Yellowstone Ecosystem. *Herpetological Review*, In press.
- Ray, A. and D. Patla. 2015. Greater Yellowstone Network amphibian monitoring: 2012-2013 biennial status report. Natural Resource Data Series NPS/GRYN/NRDS—2015/XXX. National Park Service, Fort Collins, Colorado.
- Ray, A. M., A. J. Sepulveda, B. Hossack, D. Patla, and K. Legg. 2014. Using monitoring data to map amphibian hotspots and describe wetland vulnerability in Yellowstone and Grand Teton national parks. *Park Science* 31:112-117, 119.
- Ray, A. M., A. J. Sepulveda, B. Hossack, D. Patla, D. Thoma, R. Al-Chokhachy, and A. Litt. 2015. Monitoring Greater Yellowstone Ecosystem wetlands: can long-term monitoring help us understand their future? *Yellowstone Science* 22:44-52.
- Schook, D. M. and D. J. Cooper. 2014. Climatic and hydrologic processes leading to wetland losses in Yellowstone National Park, USA. *Journal of Hydrology* 510:340-352.
- Schneider, D., J. Treanor, J. Richards, J. Wood, E. Lee, and A. Waag. 2015. Plains spadefoot, *Spea bombifrons*, confirmed in Yellowstone. *Northwestern Naturalist* 96(3):227-229.
- Stebbins, R.C. 2003. A field guide to Western reptiles and amphibians. 3rd edition. Boston: Houghton-Mifflin Co.

### Staff Reviewer

Kristin Legg, Greater Yellowstone Network Program Manager  
Andrew Ray, Aquatic Ecologist, Greater Yellowstone Network  
John Treanor, Wildlife Biologist

## Blotched Tiger Salamander (*Ambystoma tigrinum melanostictum*)



### Identification

- The only salamander in Yellowstone.
- Adults range up to 9 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.
- Larvae, which are aquatic, have a uniform color and large feathery gills behind the head; they can reach sizes comparable to adults but are considerably heavier.

### Habitat

- Breeds in ponds and fishless lakes.
- Widespread in Yellowstone in a great variety of habitats, with sizable populations in the Lamar Valley.

### Behavior

- Adult salamanders come out from hibernation in 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, return to their moist homes under rocks and logs and in burrows.
- Feed on adult insects, insect nymphs and larvae, small aquatic invertebrates, frogs, tadpoles, and even 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 1 to 1.5 inches in length, and females are usually larger than males; newly metamorphosed juveniles are less than 1 inch long.
- Brown, olive, tan, or green (sometimes bicolored) 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.
- Live 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, 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 call in late afternoon and evening.
- Tadpoles eat aquatic plants; adults mostly eat insects.
- Eaten by fish, predacious aquatic insect larvae, other amphibians, garter snakes, mammals, and birds.

### Boreal Toad (*Bufo boreas boreas*)



JEFF ARNOLD

#### Identification

- Adults range up to about 4 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.
- Lay eggs in shallow, sun-warmed water, such as ponds, lake edges, slow streams, and river backwaters.

#### Behavior

- Tadpoles eat aquatic plants; adults eat insects, especially 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 suitable wetland habitat.
- Maximum length is 3.2 inches, newly metamorphosed juveniles less than one inch long.
- Upper surface of the adult is gray-brown to dark olive or even green, with irregular black spots; skin is bumpy; underside is white splashed with brilliant orange on the thighs and arms on many but not all individuals.
- Tadpoles have long tails and may grow to 3 inches long.

### Habitat

- Found all summer along or in rivers, streams, smaller lakes, marshes, ponds, and rain pools.
- Lay eggs in stagnant or quiet water, in globular masses surrounded by jelly.

### Behavior

- Breeds in May or early June, depending on temperatures.
- Tadpoles mature and change into adults between July and September.
- Tadpoles eat aquatic plants, adults mostly eat insects but are highly opportunistic in their food habits (like many other adult amphibians).

## Plains Spadefoot Toad (*Spea bombifrons*)



### Identification

- A single breeding population has been identified in the Lower Geyser Basin east of Fairy Creek in Yellowstone National Park.
- Protruding eyes with vertical pupils, and a prominent bony boss (raised bump) between the eyes.
- Have a single, dark tubercle, or “spade,” on each of their hind feet .

### Habitat

- Uses its spade to dig shallow summer burrows or deeper winter burrows. Newly metamorphosed animals may burrow in mud near their natal pond or hide in cracks in the hard earth.
- Typically occur in warmer climates in the western United States, and it has been speculated that spadefoots may be found in geothermally influenced habitat in Yellowstone that facilitates overwinter survival.

### Behavior

- Breeds in ephemeral pools following significant rainfall.
- Tadpoles develop from eggs in 2 to 6 days.
- Produces cannibalistic and noncannibalistic tadpole body types.
- Tadpoles develop for 3 to 6 weeks before metamorphosis.



Reptiles are not well studied in Yellowstone National Park. The bull snake, shown here, is one of six reptile species and the largest species found in the park.

## Reptiles

Yellowstone provides a valuable study area; 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.

### More Information

Parker, J. and S. Anderson. 2001. Identification guide to the herptiles of Wyoming. Cheyenne, WY: Wyoming Game and Fish Department.

Patla, D.A. and C.R. Peterson. 1999. Are amphibians declining in Yellowstone National Park? *Yellowstone Science*. 7(1): 2–11.

Stebbins, R.C. 2003. A field guide to Western reptiles and amphibians. 3rd edition. Boston: Houghton-Mifflin Co.

### Staff Reviewer

Jeff Arnold, Ecologist

### Quick Facts

#### Number in Yellowstone

6 species: bull snake, prairie rattlesnake, rubber boa, sagebrush lizard, valley garter snake, and wandering garter snake. They are less studied than amphibians in Yellowstone.

#### Status

- None of the park's reptiles are federally listed as threatened or endangered.
- Researchers began inventorying reptiles and amphibians in 2000.

## Bull Snake (*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; drier, warmer climates; and open areas such as near Mammoth.

### Behavior

- Lives in burrows and eats small rodents—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 (*Crotalis viridis 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 24 inches.
- Back is gray or greenish-brown, belly is lemon yellow; scales are small and smooth, making it almost velvety to the touch.

#### Habitat and Behavior

- Eats rodents.
- 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.

### Sagebrush Lizard (*Sceloporus graciosus 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 the belly and on each side, with blue mottling on the throat.

#### Habitat

- Usually found below 6,000 feet but in Yellowstone lives 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 other hydrothermal areas.

#### Behavior

- Come out of hibernation about mid-May and 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 bull snakes, wandering garter snakes, rattlesnakes, and some birds.
- May shed tail when threatened or grabbed.

### Valley Garter Snake (*Thamnophis sirtalis fitchi*)



#### Identification

- Subspecies of the common garter snake.
- 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 subspecies in our 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.
- Predators include fish, birds, and carnivorous mammals.

## Wandering Garter Snake (*Thamnophis elegans vagrans*)



JEFF ARNOLD

### **Identification**

- Most common reptile in the park.
- 6 to 30 inches long.
- Brown, brownish green, or gray with three light stripes—one running the length of the back and a stripe on each side.

### **Habitat**

- Usually found near water in all areas of the park.
- Eats small rodents, 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.





## National Park Service Mission

The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The National Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.



U.S. Department of the Interior  
National Park Service

Yellowstone National Park



YELLOWSTONE  
ASSOCIATION



000902

\$16.95