Greater Yellowstone is a fire-adapted ecosystem. Smoke may be visible from ongoing fires during the fire season, typically mid-June through September.

Fire

Fire has been a key factor in shaping the ecology of the Greater Yellowstone Ecosystem. Native plant species evolved adaptations so they survive and in some cases flourish after periodic fires. Fire influences ecosystem processes and patterns, such as nutrient cycling and plant community composition and structure. Fire regimes in the western United States changed with the arrival of European and American settlers, whose livestock removed grassy fuels that carried fires and whose roads fragmented the continuity of fire-carrying fuels. Most naturally occurring fires were suppressed to the extent possible. The National Park Service aims to restore fire's role as a natural process in parks when and where this is feasible.

Lightning may ignite dozens of forest fires during a single summer, but most of them go out naturally after burning less than half an acre. Others torch isolated or small groups of trees, become smoldering ground fires, and eventually go out on their own. On rare occasions, wind-driven fires have burned through large areas of forest, as in 1988, when multiple fires crossed more than one million acres in Yellowstone and on surrounding federal lands despite massive efforts to extinguish them. Without frequent small and occasional large fires to create a mosaic of plant communities in different growth stages, biodiversity declines and leaf litter and deadfall accumulate much faster than they can return nutrients to the soil through decay.

FREQUENTLY ASKED QUESTIONS:

How does fire benefit Yellowstone?

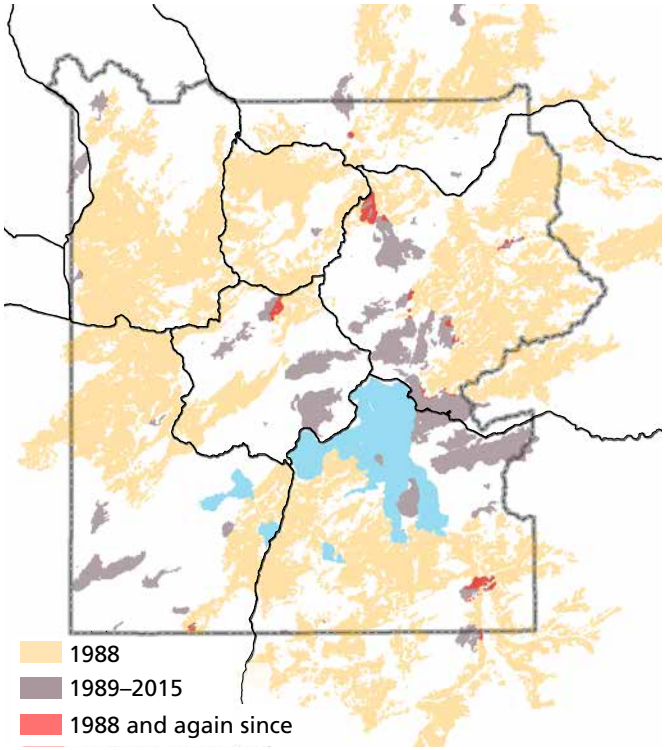
Fires are a natural part of the Greater Yellowstone Ecosystem and vegetation has adapted to fire and in some cases may be dependent on it. Fire promotes habitat diversity by removing the forest overstory, allowing different plant communities to become established, and preventing trees from becoming established in grassland. Fire increases the rate that nutrients become available to plants by rapidly releasing them from wood and forest litter and by hastening the weathering of soil minerals. This is especially important in a cold and dry climate like Yellowstone's, where decomposition rates are slower than in more hot and humid areas. Additionally, natural fires provide an opportunity for scientists to study the effects of fire on an ecosystem.

Why aren't burned trees removed?

Burned trees and those that have died for other reasons still contribute to the ecosystem. For example, dead standing trees provide nesting cavities for many types of animals; fallen trees provide food and shelter for animals and nutrients for the soil. However, park managers will remove dead or burned trees that pose safety hazards along roads or in developed areas.

Evidence of fires that burned before the park was established in 1872 can be found in soil profiles, charcoal found in lake sediments, landslides, and old-growth trees. Research shows large fires have been occurring in Yellowstone since forests became established following the last glacial retreat 14,000 years ago. Yellowstone's fire season typically lasts

from July to the end of September. The number and extent of fires that occur each year depend on what efforts are made to suppress the fires, as well as environmental conditions such as the number and timing of lightning storms and the amount and timing of precipitation.



Burned areas in Yellowstone from 1988 to 2015. So far, the large fires of the 2000s are burning in areas largely unaffected by the 1988 fires. Ongoing research is showing that areas of stand-replacing fires can affect future fire behavior for up to 200 years.

Ignition

Afternoon thunderstorms that release little precipitation occur frequently in the northern Rockies. Yellowstone receives thousands of lightning strikes in a typical summer, but most do not result in fires. A snag may smolder for several days and then burn out because fuels are too moist to sustain combustion or too sparse to permit the fire to spread. The park's forests have few shrubs; understory fuels are predominantly young trees. The moisture content of both live and dead vegetation tends to drop as summer progresses, temperatures increase, and relative humidity decreases. Fuels have often dried out enough to ignite the first wildfire of the year by early July.

A forested area that has burned recently enough to contain only young stands of trees usually doesn't have enough combustible fuel to carry a fire. But as the years pass, trees that don't survive the competition for light and other resources die and eventually fall over. On living trees, older branches die and fall off as they are shaded by new foliage growing above. As a stand grows older and taller, the canopy becomes more broken. This allows enough light to reach the forest floor for a shade-tolerant understory to be established. The accumulation of fuel on the forest floor and the continuity of fuels between the ground, understory, and canopy make older stands more vulnerable to fire. Some forests in Yellowstone may not have burned in at least 300 years and may be particularly prone to lightning ignition.

Quick Facts

Number in Yellowstone

- In 2015, 2,613 acres burned from 10 known wildfire starts; six were considered the accidental result of human activity (campfire, vehicle, cigarette). One of the fires quickly went out on its own, seven were suppressed, and two were allowed to burn while being monitored for public safety.
- Since 1988, the number of fires has ranged from 1 to 78 each year.
- The most active fire year since 1988 was 2003, when nearly 29,000 acres in Yellowstone burned.
- In an average year approximately 26 fires are ignited in Yellowstone by lightning.
- About 75% of fires in Yellowstone never reach more than 0.1 hectares (0.25 acres) in size.
- About 92% of fires in Yellowstone never burn more than 40 hectares (100 acres).

Characteristics

- Yellowstone's landscape has been shaped by naturally caused fire for 14,000 years.
- Factors affecting size and severity of a fire include: type of vegetation fire origin; time since the last stand-replacing fire; moisture in the dead and down logs; length of drought; temperature; humidity; and wind.
- In Yellowstone, on average, fires are detected at 3:03 in the afternoon—fires burn most vigorously during the heat of the day, causing tall smoke plumes to be seen by fire lookouts or sharp-eyed park visitors.

Management Issues

- The park is required to protect human life as well as the approximately 2% of Yellowstone's 2.2 million acres that are considered developed (e.g., roads, buildings, and other infrastructure) from the threat of fire—while at the same time letting fire carry out its ecological role in the landscape as much as possible.

Fire Behavior

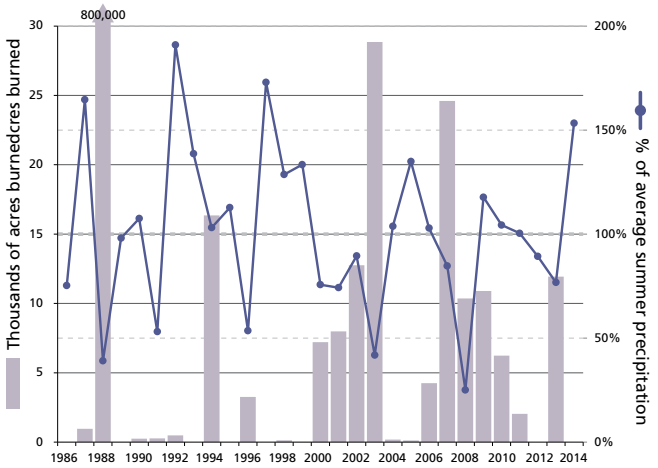
Nearly all of Yellowstone's plant communities have burned at one time or another, but their varied characteristics cause fires to behave differently in them. To quickly assess a fire start and its potential to spread, park staff use different vegetation communities as indicators of fuel load, dominant vegetation, and time since the last fire or other disturbance.

The moisture content of dead and down woody debris and the year's weather trends are the main factors determining the severity of a given fire season. While fires can occur no matter the fuel moisture, many times conditions are too wet for fires to burn. In fact, 85% of all lightning-caused fires burn less than 10 acres. However, when 1,000-hour fuel moistures fall below 13%, fires can grow quickly. If extreme drought continues, all forest types and ages are more likely to burn.

To determine how much water is in the fuel, Yellowstone fire monitoring staff weigh and oven dry fuel samples to determine the moisture content. In a normal fire season, 1,000-hour fuels within the park may average 14–18% fuel moisture. (Dead fuels are classified according to size, and how long they take to dry out when completely soaked; "1,000-hour fuel moisture" refers to the moisture in large fuels such as downed timber that would generally dry out within 42 days. Kiln-dried lumber is 12%.)

Active fire behavior is generally not observed until 1,000-hour fuel moisture contents are less than 18%, and only minimal areas are burned until moisture levels drop to 13%. At that point a fuel moisture threshold is crossed; lightning strikes in forested areas at 13% fuel moisture quickly result in observable smoke columns and, if fuel and vegetation conditions are right, the fire spreads. Below 12%, younger and more varied forest types burn readily, especially when influenced by high winds. During extreme drought years, 1,000-hour fuel moistures may drop as low as 5%.

Depending on the forest type, fuel moisture, weather, and topography, fires can grow in size by isolated or frequent torching and spotting (transport of burning material by wind and convection currents), or by spreading from tree crown to crown. Fires in Yellowstone's subalpine forests seldom spread significantly through ground fuels only. Like weather, terrain can be either an ally or adversary



Acres burned in Yellowstone and summer precipitation as a percentage of the 1980–2010 average. More acres are likely to burn when precipitation is below average.

Of the fires that occur in Yellowstone National Park, 72% are less than 0.2 acres and another 12% range from 0.3 to 9.9 acres. These smaller, less intense fires play a role in this ecosystem by helping to thin out smaller trees and brush and boost the decay process that provides nutrients to the soil.

Some fires burn with extreme fire behavior and rapid rates of spread. These large, fast moving fires send plumes of smoke thousands of feet into the air and receive much of the public's attention. These large fires (>100 acres) occur less than 10% of the time in the park.

in suppressing unwanted fire. A few natural barriers such as the ridge from Electric Peak south to Mt. Holmes; Yellowstone Lake; and the Absaroka Mountains along the eastern boundary of the park are likely to prevent the spread of a low-to-moderate intensity fire, but fire may cross these features by spotting, covering a distance of two to three miles.

Fire managers may be able to predict a fire's behavior when they know where the fire is burning (vegetation, topography, etc.) and the fuel moisture content. However, predicting fire is much more difficult during extreme drought, such as was experienced in 1988 and in the early 2000s.

Ongoing research in Yellowstone is also showing that forests experiencing stand-replacing fires can affect fire behavior for up to 200 years. When a fire encounters a previously burned forest, its intensity and rate of spread decrease. In some cases, the fire moves entirely around the burned area. Thus, fire managers have another tool for predicting fire behavior: They can compare maps of previous fires with a current fire's location to predict its intensity and spread.

Frequency of Fire

Fire return intervals since European American settlement have ranged from 20–25 years for shrub and grasslands on the northern range to 300 years or more for lodgepole pine forests on the central plateau and subalpine whitebark pine stands. Fire scars on old Douglas-fir trees in the Lamar River valley indicate an average frequency of one fire every 25–60 years.

Until 1900, written records on fires in Yellowstone were sketchy, with generally only large fires reported. From 1900 through 1930, approximately 374 fires burned 11,670 acres. Since 1931, when fire statistics began to be kept more methodically, 1,616 fires have been lightning-caused and 728 were considered human-caused, including those caused by power lines.

The largest fire in the park's written history prior to 1988 occurred when about 18,000 acres burned at Heart Lake in 1931. In 1989, fire ecologists William Romme and Don Despain suggested that without the fire suppression efforts that began in the 1880s, large fires might have occurred during the dry summers of 1949, 1953, 1960, or 1961. They believe that fire behavior in 1988, in terms of heat release, flame height, and rate of spread, was probably similar to that of the large fires that burned in Yellowstone in the early- to mid-1700s.

In 1988, 50 fires burned a mosaic covering about 800,000 acres in Yellowstone as a result of extremely warm, dry, and windy weather combined with an extensive forest cover of highly flammable fuels. Some of the largest fires originated outside the park, and a total of about 1.4 million acres burned in the Greater Yellowstone Ecosystem.

Some of the areas that burned in 1988 have burned again during the drought conditions of subsequent years, although unique conditions are required for such areas to reburn. Rare, extremely high wind events (greater than 20 mph), or more than 80% ground cover of cured elk sedge (*Carex* spp.) during very dry conditions, seem required for fires to again carry through areas burned in 1988. Fire behavior of previously burned areas is generally of a very high intensity—probably because of the high fuel load due to dead and fallen trees. Understanding the conditions necessary for recently burned areas (less than 50 years old) to reburn and modeling for the type of fire behavior seen in these areas is a challenge for fire managers in Yellowstone.

Consequences of Fire

In the first years after a major fire, new vistas appear while the lush growth of new, young trees emerges from the burned ground. Today, decades after the 1988 fires, those young trees are renewed forests, once again filling in vistas. Some visitors still feel the Yellowstone they knew and loved is gone forever. But Yellowstone is not a museum—it is a functioning ecosystem in which fire plays a vital role.

In 1988, fires burned a mosaic covering 1.1 million acres in the Greater Yellowstone Ecosystem as a result of extremely warm, dry, and windy weather combined with an extensive, highly flammable forest cover.

Vegetation and Watersheds

The vegetation in the Greater Yellowstone Ecosystem has adapted to fire and in some cases is dependent on it. Some plant communities depend on the removal of the forest canopy to become established. They are the first to inhabit sites after a fire. Other plants growing on the forest floor are adapted to survive at a subsistence level for long periods of time until fires open the canopy. Fire creates a landscape more diverse in age, which reduces the probability of disease or fire spreading through large areas.

One of the two types of cones produced by lodgepole pines, which make up nearly 80% of the park's forests, is serotinous. Serotinous cones will not release their seeds until the resin sealing them melts, requiring a temperature of at least 113°F (45°C). This adaptation helps ensure the seeds do not disperse until fire creates conditions that favor the establishment of lodgepole pine seedlings: diminished litter on the forest floor and plenty of sunlight through an open canopy.

Fire can limit trees in the grasslands of Yellowstone, such as the Lamar and Hayden valleys. For example, Douglas-fir seeds require conditions that exist only in rare microhabitats in these grasslands. If a seed reaches such a microhabitat during a favorable year, a seedling may develop. Once the tree is growing, it begins to influence the immediate environment. More tree habitat is created and a small forest island eventually appears. Periodic fire kills the small trees before they have a chance to become islands, thus maintaining the grassland.

Mature Douglas-fir trees have thick bark that resists damage by surface fires. In the past in areas like the park's northern range, frequent surface fire kept most young trees from becoming part of the overstory. The widely scattered, large, fire-scarred trees in some of the dense Douglas-fir stands in the northern range are probably remnants of these communities.

Trees in Greater Yellowstone are adapted to fire. This serotinous cone from a lodgepole pine tree was opened by fire, allowing it to release its seeds.

Some soils respond quickly after fires, but others may continue to support little vegetation.

Although Engelmann spruce and subalpine fir are thin-barked, they grow in cool, moist habitats where conditions that enable fires to burn are infrequent. In 1988, 28% of the park's whitebark pine burned, though it grows in open, cold, high-altitude habitats that accumulate fuel very slowly and have only a short season between snowmelt and snowfall during which fires can ignite and carry. Caches of whitebark pine seeds collected by red squirrels and Clark's nutcrackers and the hardiness of whitebark pine seedlings on exposed sites give this tree an initial advantage in large burned areas over conifers dependent on wind to disperse seeds. However, this slow-growing and long-lived tree is typically more than 60 years old before reaching full cone production, and young trees may die before reproducing if the interval between fires is too short or if faster-growing conifers overtake them.

Tree seedlings sprout and grow at variable rates between the surviving trees and the fallen and standing snags. As root systems of standing dead trees decay and lose their grip on the soil, the trees fall—sometimes hundreds at once in the presence of a strong wind. However, many trees remain upright for more than a decade after dying by fire or other cause.

Fires may stimulate regeneration of sagebrush, aspen, and willows, but their growth is also affected by other influences such as climate and wildlife browsing. Aspen have thin bark, but the clones are

connected by a network of underground roots that can survive even very hot surface and crown fires. Although the above-ground stems may be killed, fire stimulates the sprouting of suckers from the roots, and fire leaves bare mineral soil suitable for the establishment of aspen seedlings.

Soils in Yellowstone that support little vegetation have been largely unaffected by fire. Soils that have dense, diverse vegetation before a fire are likely to respond quickly after the fire with a variety of species and nearly complete cover. Though above-ground parts of grasses and forbs are consumed by flames, the below-ground root systems typically remain unharmed, and for a few years after fire these plants commonly increase in productivity because fire rapidly releases nutrients from wood and forest litter. The regrowth of plant communities begins as soon as moisture is available, which may be within days at some sites.

Plant growth was unusually lush in the first years after the 1988 fires because of the mineral nutrients in the ash and increased sunlight on the forest floor. Moss an inch or more thick became established in burned soils, and may have been a factor in moisture retention, promoting revegetation and slowing erosion.

The amount of soil loss and sediment deposits in streams after the 1988 fires varied greatly. Although extensive erosion and mud slides occurred along the Gibbon River after heavy rains in the summer of 1989, it is not known how much the fires contributed to this. Vegetation regrowth slowed this erosion by 1991. About a quarter of the Yellowstone Lake and Lewis Lake watersheds and half of the Heart Lake watershed burned to some extent, but no significant changes have been detected in stream bank erosion, substrate composition, channel morphology, nutrient enrichment, or plankton production, nor have any discernible fire-related effects been observed in the fish populations in the six rivers that have been monitored regularly since 1988.

Wildlife

Wildfires do not significantly affect the abundance of most wildlife species in Yellowstone. Relatively few animals died as a direct result of the large fires in 1988, and most of those deaths were caused by smoke inhalation. Of Yellowstone's seven native ungulate species, only the moose has experienced a population decline that appears to have persisted since 1988. Although moose population estimates have been imprecise, it appears that with less willow and subalpine fir available for winter browse, and snow accumulating more deeply with many forest canopies gone, moose winter mortality increased. Mortality in all ungulate species was unusually high in the winter after the fires, but it is difficult to know how much of that was the result of burned forage rather than drought, large herd sizes, and the relatively severe winter. Elk, bison, and deer populations soon rebounded.

Wildlife continue to use burned areas after fires.

Of the 38 grizzly bears wearing radio transmitters when the fires began, 21 had home ranges burned by one or more of the fires. Thirteen of those bears moved into burned areas after the fire front had passed, three adult females without young stayed within active burns as the fire progressed, three bears remained outside the fire perimeters, one adult female was not located for another two years, and another adult female was never located again at all. In a study from 1989–92, bears were found grazing more frequently at burned than unburned sites, especially on clover and fireweed. Even though bear feeding activity in some whitebark pine areas decreased substantially, the fires had no discernible impact on the number of grizzly bears in the Greater Yellowstone Ecosystem.

Rodents probably had the highest fire-related mortality of any mammals. Although many could escape the fires in burrows, others died of suffocation as the fires came through. They also were more exposed to predators because they temporarily lost the cover of grasses and other plants. But, because of their capacity to have multiple litters with

many young per year, rodents quickly repopulated burned areas.

Most birds were not directly harmed by the fires and some benefited. Raptors hunted rodents fleeing the fires, but young osprey that were still in their nests died. Post-fire habitat changes helped some birds. Cavity-nesting birds, such as Barrow's goldeneye, flickers, and bluebirds had many dead trees for their nests. Robins and flickers found ants and worms more easily. Boreal owls, however, lost some of the mature forests they need.

Managing a Natural Process

The National Park Service allows lightning-ignited fires to burn in Yellowstone provided they are not a threat to human life and property. The park is required to protect human life as well as the approximately 2% of Yellowstone's 2.2 million acres that are considered developed (e.g., roads, buildings, and other infrastructure) from the threat of fire while at the same time letting wildfire carry out its ecological role in the landscape as much as possible.

Yellowstone National Park operates under the 2009 Federal Wildland Fire Policy, which continues to evolve with experience and new knowledge. For example, current guidelines allow firefighters to manage a natural fire for multiple objectives. In the past, fires were required to be categorized as "suppression" or "fire-use for resource benefit." Now, firefighters can suppress one flank of a fire to protect structures and people while allowing another flank to burn to achieve natural fire benefits.

The Antelope Fire of 2010 was an example of managing a fire for multiple objectives. It was suppressed on its west flank to protect people using the roads, and other values at risk. It was monitored, but not suppressed, as it moved south and east away from developed areas. A similar strategy was used in the 2009 Arnica Fire, which burned in 300-year-old lodgepole pine forests but threatened visitor travel, power lines, and Lake Village.

Working Across Boundaries

Wildfire is a great example of interagency cooperation and coordination. Federal agencies, state and local governments, and private contractors all play a role in managing fire in the park. For example, the National Park Service sometimes relies on Forest Service smoke jumpers to assist with the park's remote fires. In return, the National Park Service sends its helicopter or engine to the Silver Gate or Cooke City areas, which are located on or adjacent to the Gallatin and Shoshone national forests. Since 2009, the park's wildland engine has been staffed by both National Park Service and Forest Service firefighters. Programmable radios ensure communication between National Park Service and Forest Service dispatch, which improves firefighter safety. The National Park Service is also working with its partners to develop Community Wildfire Protection Plans to help plan and prepare for a wildfire that may threaten homes.

History of Fire Management

Fire suppression in Yellowstone National Park began with the arrival of the US Army, which was placed in charge of protecting the park in 1886. The Army, which was in Yellowstone until 1918, successfully extinguished some fires in the belief that suppression would help save the forests. However, it is difficult to determine how much effect a small group of men could have had on overall fire frequency or the extent of fires in a large park without motorized vehicles or good roads. Fire suppression was most successful on the grasslands of the northern range, which were relatively accessible from the park headquarters in Mammoth Hot Springs.

More effective fire fighting techniques and airplanes became available after World War II, but even then, fire suppression did not result in a significant increase in fuel loads except perhaps on the northern range. Records indicate fire was almost completely excluded (suppresed) from the Douglas-fir, sagebrush steppe, and aspen communities on the northern range from 1886 until 1987.

By the 1940s, ecologists recognized fire was a natural and unavoidable change agent in many ecosystems, including relatively arid portions of the Rocky Mountains. In the 1950s and 1960s, other parks and forests began to experiment with controlled burns. In 1972, Yellowstone became one of several national parks to initiate programs that allowed some natural fires to burn. Two backcountry areas in the park totaling 340,000 acres, Mirror Plateau and Two Ocean Plateau, were designated as locations where natural fires could burn.

After three years, during which 10 fires burned a total of 831 acres in the two natural fire zones, the non-suppression area was expanded to include most of the park, except for developed areas and a buffer

zone at the park boundary. Starting with Yellowstone National Park and Bridger-Teton National Forest in 1976, cooperative agreements were adopted among all Greater Yellowstone federal lands that by 1986 allowed natural fires to burn across shared public land boundaries.

From 1972 to 1987, 235 fires were allowed to burn 33,759 acres in Yellowstone. The summers of 1982–1987 were wetter than average, which may have contributed to the relatively low fire activity during that period. Yellowstone's fire managers began revising the park's fire management plan. The new plan permitted some lightning-caused fires to burn under natural conditions; provided for suppressing fires that threatened human life, property, special natural features and historic and cultural sites; and recommended prescribed burns when and where necessary and practical to reduce hazard fuels. It was in the final stages of approval in spring 1988.

However, Yellowstone's "new" fire management plan was suspended in July 1988 as a consequence of the large fires that occurred that summer. After these fires, a national policy review team examined the national fire policy again and reaffirmed the importance of natural fire policies in national parks and wilderness areas. However, the report also offered recommendations, including the establishment of more specific criteria to determine under what circumstances fires are permitted to burn and more reduction of hazard fuels near developed areas. These recommendations were incorporated into Yellowstone's 1992 fire management plan. Other revisions occurred to the park's fire management plan in 2004 and 2014.

This old fire truck was pressed into use during the 1988 fires. Fire management policy, like the equipment, has been updated many times since that fiery year.

The 1988 Fires

The Yellowstone fires of 1988 have been described as being instrumental in the public's understanding of the role of fire in ecosystems, history-making, and career-building. In June of 1988, park managers and fire behavior specialists allowed 18 lightning-caused fires to burn after evaluating them, according to the fire management plan. Eleven of these fires burned themselves out, behaving like many fires had in

History of Fire Management in Yellowstone

The Issue

For the first 100 years of the park's existence, managers believed fires had to be extinguished to preserve park resources. Subsequent scientific research revealed:

- fires have occurred in Yellowstone for as long as there has been vegetation to burn,
- fire plays a role in creating the vegetation patterns of the landscape,
- fire is a part of the ecosystem park managers want to preserve, and
- suppressing fires alters the natural landscape and diminishes diversity.

History

- 1886–1918: US Army suppresses fire in Yellowstone.
- 1940s: More effective fire fighting techniques become available after World War II. Around the same time, ecologists recognize fire is a natural and unavoidable change agent in many ecosystems.
- 1972: Yellowstone begins allowing some natural fires.
- 1972–1987: 235 natural, unsuppressed fires burned 33,759 acres—mostly in two dry years: 1979 and 1981.
- Spring 1988: Approval of a new fire management policy for Yellowstone is suspended.
- 1988: 793,880 acres burn in Yellowstone, sparking an increase in the public understanding and acceptance of the role of fire in wildland areas.
- 1989: A national policy review team reaffirms the importance of natural fire policies in national parks and wilderness areas.
- 1992: Yellowstone issues a new fire management plan incorporating the 1989 review team's recommendations.
- 2004: Yellowstone's fire management plan is revised.
- 2009: Yellowstone begins operating under the 2009 Federal Wildland Fire Policy, which allows firefighters to manage fires for multiple objectives.
- 2014: Yellowstone's fire management plan is revised.

previous years. The spring of 1988 was wet until the month of June, when hardly any rain fell. Park managers and fire behavior specialists expected that July would be wet, as it had been historically.

Rains did not come in July as expected. By late July, after almost two months of little rain, the moisture content of grasses and small branches reached levels as low as 2 or 3%, and downed trees were as low as 7% (recall that when fuel moisture falls below 13%, fires can grow quickly). In addition, a series of unusually high winds fanned flames that, even in dry conditions, would not have moved with great speed.

Because of the extremely dry conditions, no new natural fires were allowed to burn after July 15 except those started adjacent to existing fires that were clearly going to burn into existing fires. Even so, within a week the fire acreage in the park doubled to about 17,000 acres. After July 21, all fires—including those started naturally—were fully suppressed as staffing would allow. (Human-caused fires had been

Significant Events during the 1988 Fires

Date	Event
June 14	Storm Creek Fire begins
June 23	Shoshone Fire begins
June 25	Fan Fire begins
June 30	Red Fire begins
July 5	Lava Fire begins
July 11	Mink and Clover fires begin
July 14	On a backcountry fishing trip near the eastern border of Yellowstone National Park, Vice President George H.W. Bush must leave early when fire comes close to camp.
July 21	Yellowstone National Park begins suppressing all fires.
July 22	North Fork Fire begins
July 25	Fire camp crew jumps into West Thumb Bay to escape flames.
August 20	"Black Saturday": Fires double to more than 480,000 acres
September 3	Storm Creek Fire burns over Silver Tip Ranch, north of Yellowstone National Park; the historic ranch survives.
September 7	Fire storm blasts Old Faithful area; Old Faithful Inn is saved and no one is injured.
September 10	Residents of Mammoth Hot Springs evacuated as fire moves across Bunsen Peak toward the area.
September 11	Rain and snow fall.

More than $120 million was spent fighting the fires in the Greater Yellowstone Ecosystem. Rain and snow in September finally stopped the advance of the fires.

FREQUENTLY ASKED QUESTIONS:

How much of the park burned in 1988?

The 1988 fires affected approximately 800,000 acres of the park. Five fires burned into the park that year from adjacent public lands, including the largest, the North Fork fire. It started accidentally and burned more than 410,000 acres.

How were weather conditions different than in previous years?

Yellowstone usually experiences afternoon showers three or four days each week during the summer, but in 1988 no measurable rain fell for almost three months. The most severe drought in the park's recorded history occurred that summer. Also, a large number of lightning strikes came with a series of dry storm fronts. This lightning started many of the fires and storm fronts stoked them with particularly high and sustained winds.

Could the fires have been put out?

It is possible the few fires that started in early June might have been extinguished. However, between 1972 and 1987, the average fire had gone out naturally after burning only one acre. So, while the early fires were monitored closely and some were contained from going out of the park, the history of fire behavior in Yellowstone, coupled with an abnormally wet spring, suggested these fires would go out as previous fires had. After July 15, all fires were fought aggressively from the moment they were detected. Despite the largest fire fighting effort at that time in the history of the nation, weather finally contained the fires when snow fell in September.

Did Yellowstone's fire management policy change after the fires of 1988?

After the fires of 1988, a national policy review team examined the national fire policy again, and concluded that natural fire policies in national parks and wilderness areas were basically sound. It also recommended improvements that were incorporated into the National Park Service's fire policy of June 1990 and into Yellowstone National Park's fire management plan of 1992.

suppressed from the beginning.) On July 27, during a visit to Yellowstone, the Secretary of the Interior reaffirmed that all fires would be fought, regardless of their origin.

Fighting the Fires

An extensive interagency fire suppression effort was initiated in mid-July in the Greater Yellowstone Ecosystem in an attempt to control or contain this unprecedented series of wildfires. The extreme weather conditions and heavy, dry fuel accumulations presented even the most skilled professional firefighters with conditions rarely observed.

Accepted fire fighting techniques were often ineffective because fires spread long distances by spotting, a phenomenon in which wind carries embers across unburned forest to start spot fires ahead of the main fire. In the severe conditions of 1988, fires were spotting up to a mile and a half ahead—jumping roads, rivers, even the Grand Canyon of the Yellowstone River.

Fires often moved two miles per hour, with common daily advances of five to ten miles. The fast movement, coupled with spotting, made direct attacks on the fires impossibly dangerous, as fire crews could easily be overrun or trapped between a main fire and its outlying spot fires. Even during the night, fires could not be fought. Typically, wildfires "lie down" at night as humidity increases and temperature decreases. But in 1988, the humidity remained low at night, and fire fighting was complicated by the danger of falling trees.

Fire fighting efforts were directed at controlling the flanks of fires and protecting lives and property in their paths. The fire experts on site generally agreed

The Yellowstone fires of 1988 received more media attention than any other event in the history of national parks up to that time.

that only rain or snow could stop the fires. They were right: one-quarter inch of snow on September 11 stopped the advance of the fires.

By the last week in September, 42 lightning-caused fires had occurred in or burned into the park, but only eight were still burning. More than $120 million had been spent in control efforts on fires in the Greater Yellowstone Ecosystem, and most major park developments—and a few surrounding communities—had been evacuated at least once as fires approached within a few miles. The fire suppression efforts involved many different federal and state agencies, including the armed forces. At the height of the fires, 10,000 people were involved simultaneously. This was the largest such cooperative effort undertaken to date in the United States.

Confusion in the Media

The Yellowstone fires of 1988 received more national attention than any other event in the history of

1988 Fires in Yellowstone

Numbers in Yellowstone

- 9 fires caused by humans.
- 42 fires caused by lightning.
- 36% (793,880 acres) of the park was affected.
- Fires which began outside of the park burned 63% or approximately 500,000 acres of the total acreage.
- About 300 large mammals perished as a direct result of the fires: 246 elk, 9 bison, 4 mule deer, 2 moose.
- $120 million spent fighting the fires.
- Total of 10,000 people involved in these efforts.

Management Issues

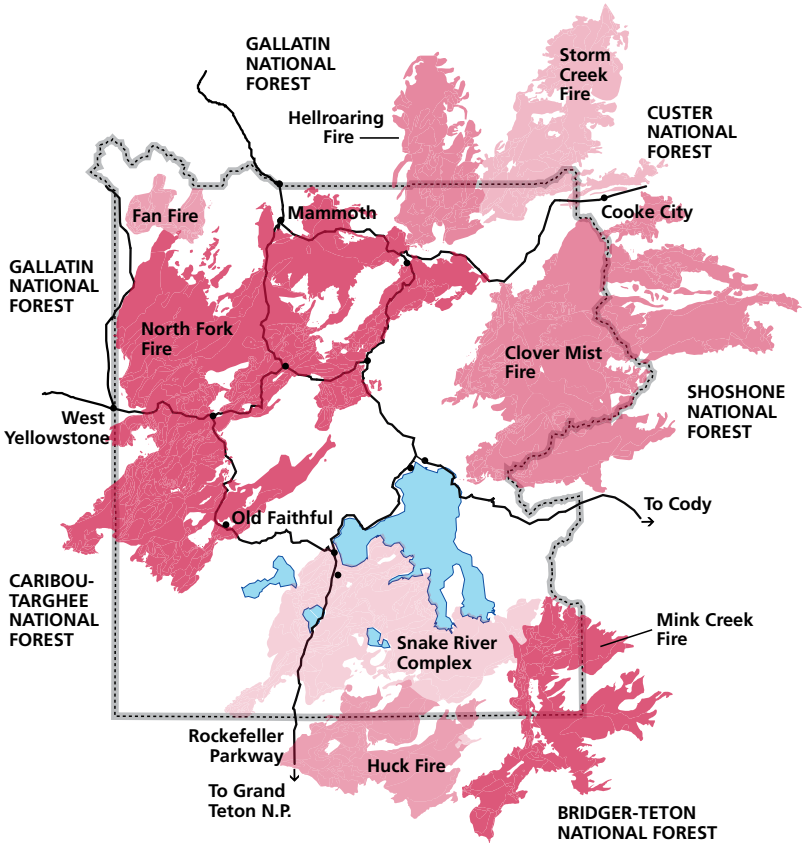
- Until July 15, park managers followed the policy to let naturally caused fires burn.
- Beginning July 15, park managers suspended the natural fire policy and began suppressing new natural fires.
- After July 21, park managers began fighting all fires, including natural fires that had been allowed to burn.
- The 1988 fires comprised the largest fire fighting effort in the United States at that time.
- Effort saved human life and property, but had little impact on the fires themselves.
- Rain and snow in September finally stopped the advance of the fires.

national parks up to that time. Unfortunately, many media reports were inaccurate or misleading and confused or alarmed the public. The reports tended to lump all fires in the Yellowstone area together as the "Yellowstone Park Fire;" they referred to these fires as part of the park's natural fire program, which was not true; and they often oversimplified events and exaggerated how many acres had burned. In Yellowstone National Park itself, the fires affected—but did not devastate—793,880 acres or 36% of total park acreage.

A number of major fires started outside the park. These fires accounted for more than half of the total acres burned in the greater Yellowstone area, and included most of the fires that received intensive media attention. The North Fork Fire began in the Targhee National Forest and suppression attempts began immediately. The Storm Creek Fire started as a lightning strike in the Absaroka–Beartooth Wilderness of the Custer National Forest northeast of Yellowstone; it eventually threatened the Cooke City–Silver Gate area, where it received extended national media coverage.

Additional confusion resulted from the mistaken belief that managers in the Yellowstone area let park fires continue burning unchecked because of the natural fire plan—long after such fires were being fought. Confusion was probably heightened by misunderstandings about how fires are fought: if crews were observed not taking action on a fire, casual observers might think the fire was merely being monitored. In fact, in many instances, fire bosses

Firefighters worked to prevent historic structures like the Old Faithful Inn from burning.



This map of fires from 1988 uses colors only to help you see fire boundaries. Colors do not indicate anything else.

Burned Areas within Yellowstone National Park in 1988

Burn Type	Acres	% of Park
Crown fire (consuming the forest canopy, needles, and ground cover and debris)	323,291	15%
Mixed (mixture of burn types in areas where most of ground surface was burned)	281,098	13%
Meadows, sagebrush, grassland	51,301	2%
Undifferentiated (variety of burn types)	37,202	2%
Undelineated (surface burns not detectable by satellite because under unburned canopy)	100,988	4%
Total Burned Area	793,880	36%
Total Unburned Area	1,427,920	64%

Data from the Spatial Analysis Center, Yellowstone National Park, 1989. Table adapted from *Yellowstone in the Afterglow: Lessons From the Fires*, Mary Ann Franke, 2000.

The 1988 fires presented an unprecedented opportunity to study the landscape-scale ecological effects of an infrequent natural disturbance—a large, severe fire in this case—in an ecological system minimally affected by humans.

—Monica Turner, 9th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, "The '88 Fires: Yellowstone and Beyond"

recognized the hopelessness of stopping fires and concentrated their efforts on protecting developed areas.

The most unfortunate public and media misconception about the Yellowstone fire fighting effort may have been that human beings can always control fire. These fires could not be controlled; their raw, unbridled power cannot be over-emphasized. Firefighters were compelled to choose their fights very carefully, and they deserve great praise for working so successfully to save all but a few park buildings.

Post-fire Response and Ecological Consequences

By late September, as the fires were diminishing, plans were already underway in Yellowstone to develop comprehensive programs for all aspects of post-fire response. These included replacing, rehabilitating, or repairing damaged buildings, power lines, fire lines, trails, campsites, and other facilities. Education rangers developed programs to interpret the fires and their effects for visitors and for the general public. Other education specialists developed indoor and outdoor exhibits, publications, and trails to help visitors learn about these historic fires. The park also cooperated with other agencies and state and local governments in promoting the economic recovery of communities near the park that were affected by the fires.

Scientists wanted to monitor the ecological processes following these major fires. The National Park Service cooperated with other agencies and independent researchers and institutions in developing comprehensive research directions for this unparalleled scientific opportunity. Observations actually began while the fires were still burning.

Consequences of the 1988 Fires

What DID Change

These changes have been caused entirely or in part by the fires of 1988:

- ✓ The replacement of thousands of acres of forest with standing or fallen snags and millions of lodgepole pine seedlings.
- ✓ The establishment of aspen seedlings in areas of the park where aspen had not previously existed.
- ✓ A decline in the moose population because of the loss of old growth forest.
- ✓ Shifts in stream channels as a result of debris flows from burned slopes.
- ✓ An increase in the public understanding and acceptance of the role of fire in wildland areas.
- ✓ A program to reduce hazard fuels around developed areas.

Recent research was presented September 2008 at the 9th Biennial Scientific Conference on the Greater Yellowstone Ecosystem, "The '88 Fires: Yellowstone and Beyond." Proceedings at www.nps.gov/yell/learn/nature/upload/9thconf_88fires.pdf. Volume 17, issue 2 of *Yellowstone Science* dedicated to the conference is available at www.nps.gov/yell/learn/upload/YS_17_2_sm.pdf.

What Did NOT Happen

Many predictions were made about the 1988 fires' long-term consequences for visitation, wildlife, and vegetation. However, the following have not come to pass:

- ✗ A long-term drop in park visitation.
- ✗ Flooding downstream of the park because of increased runoff on bare slopes.
- ✗ A decline in fish populations because increased erosion silted up the water.
- ✗ An increase in fish populations in smaller streams where deforestation and loss of shade could result in warmer water and higher nutrient levels.
- ✗ More rapid invasion of nonnative plants into burned areas and corridors cleared as fire breaks.
- ✗ An increase in lynx following a boom in snowshoe hares as a result of changes in forest structure.
- ✗ An increase in the elk population because of improved forage.
- ✗ A decline in the grizzly bear population because of smaller whitebark pine seed crops.
- ✗ Another big fire season in Yellowstone because of all the fuel provided by so many dead and downed trees.

Yellowstone National Park's photographer established photo points, or specific locations to be photographed in 1988 and in subsequent years. This set shows a pond along the road between Canyon and Norris junctions, as it appeared in 1988 (left) and 1989 (right).

Burning at a variety of intensities, the fires killed many lodgepole pines and other trees, but did not kill most other plants; they merely burned the tops, leaving roots to regenerate. Temperatures high enough to kill deep roots occurred in less than 0.1% of the park. Only under logs and in deep litter accumulations, where the fire was able to burn for several hours, did lethal heat penetrate more deeply into the soil. Where water was available, new plant growth began within a few days. In dry soils, the rhizomes, bulbs, seeds, and other reproductive tissues had to wait until soil moisture was replenished the following spring.

Though animal movements were sometimes affected dramatically by the passage of fires, relatively few animals died. However, portions of the northern range burned, which affected winter survival of grazing animals when coupled with summer drought conditions. In this and many other ways, fires dramatically altered the habitat and food production of Yellowstone for the short term.

The fires of 1988 created a landscape of burns, partial burns, and unburned areas—called a mosaic. A mosaic provides natural firebreaks and sustains a greater variety of plant and animal species. Vegetation capable of sustaining another major fire will be rare for decades, except in extraordinary situations.

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