Chapter 3

# The Human Aftermath

## *Taking stock*

To improve cooperation on issues that cross their boundaries, the Greater Yellowstone Coordinating Committee (GYCC) was organized in the 1980s with representation from Yellowstone and Grand Teton national parks and six national forests. In the wake of the 1988 fires, the GYCC assembled 15 interagency teams to collect data and make initial assessments on topics ranging from air quality to recreational use.

### Post-Fire Assessment and Research

A panel of scientists, chaired by Norman Christensen, a botanist from Duke University with extensive experience in fire research, was selected by the GYCC to prepare an independent evaluation of "the apparent ecological impacts and implications of the 1988 fires as they related to the area's watersheds, fisheries, wildlife, forests, soils, ranges, and biological diversity." With 10 other scientists from academic institutions across the country and two researchers from the U.S. Forest Service, Christensen also developed a list of post-fire research needs. The GYCC assessment and the findings of this panel are among the many documents that served as references for this book.[1]

Most of the previous research on fire impacts in wildland areas had been done in relatively small areas and after the fact. The Yellowstone fires, which prompted large-scale research and monitoring projects on a variety of topics, demonstrated the importance of having baseline data that was collected before the fires for comparison purposes. The pre-fire records that had been compiled by government agencies and academic researchers have

*The Yellowstone Tourist: Was the abundance or distribution of this species affected by the fires of 1988?*

made it possible to answer many questions on how the 1988 fires have affected various components of the Yellowstone ecosystem. For example, since a number of elk studies were already underway, the fires provided an unprecedented opportunity to document fire effects on a large elk population. But for topics on which no pre-fire data was available, such as amphibian abundance and distribution, many questions remain unanswered.

Burn it and they will come.

More than 250 research projects have been initiated in the greater Yellowstone area to study fire effects since 1988. The National Park Service provided more than $6 million to support 32 projects involving scientists from 70 institutions; some of this funding came from a special Congressional appropriation for a post-fire research program, and the remainder was diverted from other programs at Yellowstone and other national parks. In 1991, of the 204 projects for which research permits were granted in Yellowstone, 60 were focused partly or entirely on fire impacts.

Results from 58 studies relating to the 1988 fires were presented at the park's second biennial science conference in 1993, and about half of these papers were compiled in *The Ecological Implications of Fire in Greater Yellowstone* (1996), edited by Jason Greenlee and published by the International Association of Wildland Fire. By 1996, the number of research projects in the park that related to fire impacts had dropped to 10. The rapid decline in fire-related research in Yellowstone reflects both the loss of funding specifically designated for it, and the speed with which the once headline-grabbing fires moved to the back pages of ecological concerns in Yellowstone. When it became evident that, with a few possible exceptions such aspen and moose, the fires would have little impact on species diversity and abundance in the park, research attention turned to more pressing concerns, such as bison management and the reintroduction of wolves.

A stimulus for new research.

But some of the researchers whose names appear in the following pages have been willing and able to obtain funding to carry on long-term monitoring projects, and Yellowstone continues to provide the stimulus for new fire-related research. In the spring of 2000, David McGinnis brought the first group of ecology students from the University of Iowa to spend two weeks measuring "forest-meadow edge re-establishment patterns" in the park. Updated annually with new slides, John Burger's lecture on "The Yellowstone Fires: A Force for Change and Regeneration in a Natural Ecosystem" at the University of New Hampshire remains his most popular, now presented to biology students for whom 1988 was more than a half-life ago.

### Yellowstone: A Cause for Universal Joy

"Momentous questions are now agitating the scientific world, calling for experiment and observation which are daily becoming less possible, owing in a great measure to the obliterating influences of modern civilization…

"Much has already been said concerning the benefits to be derived by science from the setting aside of this tract of land and the protection of its natural features. In fact, this was one of the inducements offered for the passage of the bill [establishing Yellowstone National Park] in both houses of Congress. Dr. Hayden, in speaking of this bill says, 'I believe it will mark an era in the popular advancement of scientific thought not only in this country, but throughout the civilized world. That our legislators, at a time when public opinion is so strong against appropriating the public domain for any purpose however laudable, should reserve for the benefit and instruction of the people, a tract of 3,578 square miles, is an act that should cause universal joy throughout the land. This noble deed may be regarded as a tribute from our legislators to science, and the gratitude of the nation and of men of science in all parts of the world is due them for this munificent donation.'"

— Theo. B. Comstock, geologist participating in the 1873 Yellowstone expedition[2]

## Damage to Park Facilities

Although 5% of the park is zoned as "developed," only about 1% of the park's land area has been paved over or otherwise built upon. Despite the large portion of the park that was swept by fire, the firefighting priority given to protecting these developed areas kept them largely intact in 1988. Nearly all of the damage to park facilities occurred in the Old Faithful area, where 19 buildings in a complex of 400 were destroyed, including 12 concessioner cabins. Six buildings were damaged but salvageable. Sprinklers had previously been installed in many of the buildings and on the roof of the Old Faithful Inn, and the spraying of buildings with chemical foam retardants as the fire front approached helped minimize the losses. Of the 38 backcountry patrol cabins, only the Sportsman Lake cabin was destroyed, but the others had varying degrees of damage from water or the fire shelters that had been nailed on.[3]

Structural rehabilitation in the park also included repair or replacement of bumper logs, signs, posts, snow poles and guardrails along roads; drainage ditches and culverts clogged with ash and debris; 23 picnic areas and campgrounds (out of 61) that were damaged by fire or used as fire camps; about 29 miles of frontcountry trails and boardwalks damaged by fire or falling trees; trail signs, boundary markers, and the wooden water bars used to prevent erosion on backcountry trails; 73 backcountry bridges; backcountry campsites that had been burned over; smoke detectors damaged by prolonged exposure to smoke; and more than 10 miles of power lines, 300 utility poles, and 8 telephone pedestals.

Most of this rehabilitation was completed by the end of 1989. As soon as the fires had passed, crews began cutting the thousands of trees that could threaten public safety by falling in developed areas or across power lines. This chore will need to continue for as long as fire-damaged trees remain standing in the park, their root systems slowly weakening.

*The Sportsman Lake cabin: pre-fire (constructed in 1912) and post-fire (completed in 1989). It will take a while longer for the trees to grow back.*

## Fire Suppression Impacts

Like many of the fire management decisions made in 1988, the attempt to minimize the use of heavy equipment was controversial. Even after fire suppression efforts began in mid-July, they were sometimes restricted not because of a "let it burn" attitude, but because of a "don't damage the park" goal. Disturbances to the landscape that result from fire suppression activities are considered destructive in a way that naturally occurring fire is not. Areas in which fireline was constructed are more susceptible to erosion than are most burned areas, which remain protected by duff, roots, and needles, and still contain the organic material that will be the basis for revegetation. Environmental impacts also resulted from the dropping of water and fire retardants, the use of wetting and foaming agents on buildings, and from the transport and housing of thousands of firefighters. Off-road travel left meadows riddled with vehicle tracks, in some places three miles from the nearest road, that may remain apparent for decades. Scars left by firefighting done in the park up to 50 years ago, when less was understood about landscape rehabilitation, are still visible today.[4]

National Park Service policy now requires rehabilitation of this type of human-caused disturbance. For Yellowstone after the fires of 1988, there were two goals. One was purely aesthetic, comparable to cosmetic surgery: to minimize the visual impact of fire suppression activities by making these areas appear to the park visitor as though they'd never been hit by a shovel, much less a bulldozer. The other goal was ecological, analogous to reattaching severed flesh: to return the topsoil and other organic debris that had been dug out to create firelines to as near its original position as possible. This would protect the genetic integrity of the native seed source, instead of using seed from external sources.[5]

At times up to 200 people were working on the rehabilitation effort, including crews from the National Park Service, the U.S. Forest Service, the Student Conservation Association, the Youth Conservation Corps, and private contract fire crews, with overall supervision provided by Eleanor Clark, Yellowstone's chief landscape architect. Most of the following information and the photographs on this page came from her report to the park.[6]

Derived primarily from volcanic material, many Yellowstone soils are relatively infertile and highly erodible, particularly when disturbed. Organic matter is slow to decay in the cold, dry climate, and development of soil capable of supporting vegetation may take thousands of years. Protecting the accumulated organic matter was therefore of primary importance in preparing for the eventual rehabilitation of disturbed areas. The groundwork was laid as soon as fire suppression efforts began in July, when the park's landscape staff provided on-site guidance to the fire commanders on how to minimize the damage of firelines by limiting their depth, using curvilinear rather than straight lines, avoiding timbered areas,

*Top photo: Bulldozer line for the North Fork fire, October 1988. Bottom: Same site after rehabilitation and the natural falling of some dead trees, July 1991.*

feathering the edge of the corridor, and setting aside the removed topsoil and organic debris for later restoration. The techniques used were similar to those employed when park land must be dug up to install a sewer line.

Bulldozer and hand firelines.

Nearly all of the fireline constructed in the park was done for the North Fork fire. It was fought from its start in the Targhee National Forest on July 22, with 30 miles of bulldozer line and 320 miles of hand line, but its perimeter encompassed more than 500,000 acres by the time it was declared out on November 18. The Clover Mist fire, which started a month earlier in the park from a lightning strike and was initially allowed to burn, attained a perimeter around nearly 400,000 acres but had only 90 miles of hand line and no bulldozer line.

Construction of bulldozer fireline, typically 12 to 24 feet wide, was the most destructive suppression technique used in the North Fork fire. It typically requires removal of all surface vegetation, root material, and one or more foot of soil with heavy excavating equipment. However, by angling the bulldozer blade and reducing the depth of cut to usually no more than six inches, only the necessary organic material for vegetative growth was removed and set aside in windrows immediately adjacent to where it had been taken. Slash from cut trees and shrubs was piled to the side of the fireline away from the approaching fire front.

Firelines created by bulldozers, which were usually accessible from established roads, were rehabilitated using a rubber-tired excavator to scarify the upper six inches of compacted subsoil, allowing for root growth and water infiltration. The upper layer of organic material that contained most of the viable seed was returned as near to the surface as possible. Then larger trees, deadfall snags, and boulders were replaced. A hand crew followed the excavator to take care of soil raking, small slash replacement, and stump removal.

Rehabilitation efforts intensified in mid-September in order to lessen damage to the organic soil layer before winter, and priority was given to steep areas with the most potential for erosion. By November 21, when the project was shut down for the season, crews had been working on snow-covered ground for several weeks, but most of the firelines and helispots for the North Fork fire had been rehabilitated and backcountry trash removed.

*Firefighter at North Fork dozer line.*

Chainsaws, shovels, and the combination hoe and axe named a "pulaski" after its inventor were used to dig firelines by hand, often in areas accessible only by trail or helicopter. Trees, shrubs, pine needle duff, sod, and organic debris were removed along a line two to four feet wide within a wider corridor cleared of large vegetation, leaving a windrow of topsoil and organic material pushed off to the side.

Erratic fire behavior and frequent burn-over of fireline resulted in irregular fireline locations, multiple lines that were built as the fire moved, and severe soil compaction as the lines were used as access trails by the fire crews. But limiting the width of the fireline corridor, using curvilinear routes and following animal trails where possible minimized the visual scar.

Because of their location, hand firelines had to be rehabilitated using hand tools, flush-cutting stumps and constructing water bars of rocks or weathered logs before returning topsoil, sod, duff, and other organic debris as near to the original position as possible. Stumps were blackened with ash or covered with duff or soil to foster breakdown. Slash was scattered over the rehabilitated area to protect the surface from wind and water erosion, and feathered away from the disturbed area to blend it in with its surroundings.

Explosive fireline.

Dynamite, which can clear a fireline of varying width depending on the type and strength of the charge, is especially useful in sagebrush, grass, and other low shrubby vegetation, where it can quickly be set up with a detonation cord. However, the explosion removes most of the topsoil and seed sources in the fireline, making rehabilitation difficult. Unlike the bulldozer and handlines, the scars left by 18 to 24-inch wide explosive fireline near the Madison River are still visible today, even to the untrained eye.

Fire crew camps.

About 255 acres in the park were used for fire camps, staging areas, and helispots. Base camps were established in areas with road access to provide temporary shelter for fire crews; spike camps were set up in the backcountry. At the command center for the Snake River fire, carpenters and electricians assembled a makeshift town of mess halls, medical units, latrines, light poles, showers, and supply caches, rumbling night and day with the sound of trucks, helicopters, and generators. Soil compaction caused by vehicle and foot traffic was minimal at many of the spike camps; more severe impacts occurred at base camps such as Madison Campground, which supported hundreds of firefighters for several months. During rehabilitation, aeration and raking were done to relieve soil compaction and promote regrowth. Site monitoring in 1989 and 1990 indicated that the rehabilitated areas were generally stable and revegetated with minimal erosion.

Helispots.

Creating backcountry landing zones for helicopters required removal of vegetation and loose organic material. Meadows were favored because of safety concerns and the presence of vegetation that would recover quickly from blowing. Helispots that required felling large trees created significant intrusions that were difficult to visually rehabilitate, but by enlarging natural openings, or creating irregularly-shaped openings that mimicked natural ones and felling trees in the direction they might have blown down, within a few years a rehabilitated helispot could appear to be a natural opening or windstorm area.

Fire retardant and water drops.

Several million gallons of water were dropped by helicopter, drawing down some smaller streams and ponds, and some stream channel disturbance occurred where impoundments were constructed to facilitate water removal. More than a million gallons of ammonium phosphate base fire retardant were dropped within the park boundary, much of it on the North Fork fire. This killed some fish and could temporarily increase the nutrient load in runoff, but there has been no evidence of a long-term impact (see page 93). The chemical foaming agents used in developed areas to protect structures were low toxicity detergents that appeared to have dispersed into the soil during snowmelt the following spring.


*When smoke gets in your clothes:*
*Madison base camp, September 1988.*

## Archeological Sites

Archeological evidence of humans in the Yellowstone area dates back to more than 11,000 years ago and extends through the first explorations by Euroamericans in the early 19th century and the first park administration in 1872. Although only a very small portion of the park has been surveyed for archeological remains, more than 1,100 sites have been documented, including prehistoric burials near Fishing Bridge and small campsites indicated by only a few obsidian chips, rock shelters, and tipi rings.

Because of Yellowstone's long history of fire, by 1988 there were unlikely to have been many prehistoric sites in the park that had not been exposed to it before. Wickiups (small tipi-shaped shelters of wood once used by American Indians) had deteriorated over the years in the harsh climate, and some that had so far gone unrecorded may have vanished entirely in 1988. However, all of the wickiups that were known to have survived until the summer of 1988 were still present afterward, although most of the poles at one wickiup were charred at the base.[7] Such structures cannot be preserved forever, but the fires demonstrated the need to document such sites before they disintegrate any further.

Most surface rock in the park appeared to have been unchanged by the fires, which probably moved too quickly to heat it to temperatures at which breakage could occur (about 350°C for some types of rock). Obsidian Cliff, a National Historic Landmark because of its use as a quarry site by American Indians, showed signs of having been burned over in the past; the shattering, feathering, and surficial weathering that resulted from the 1988 fires were less severe than if this had been the first time it had burned.[8]

When soil has no protective layer of duff or lies beneath burning deadfall, it may be subjected to such high temperatures (500° to 700°C) that it will oxidize, leaving a stain that is visible in recently burned areas. Depending on the timing and intensity of subsequent rainfall, the stain may remain as part of the sedimentary record.[9] Even the most intense fires will rarely heat soil more than 7 to 10 cm below the surface, so buried artifacts are unlikely to be affected by the fires themselves. National Park Service staff from the Midwest Archeological Center in Lincoln, Nebraska, examined three burned areas in northwestern Wyoming in the fall of 1988 that included both lodgepole pine and meadow habitat. In the lodgepole pine study area between Canyon and Norris, where a thin layer of soil covering bedrock or glacially deposited cobbles was covered by a layer of forest duff, they found that the 1988 fires burned the duff and left the soil below unaltered.[10]

*Wickiup*

However, forest fires may affect artifacts more than 10 cm below the surface where the root system of a tree has burned or organic material has accumulated. In one meadow site with highly organic soil that was charred and still burning in the fall of 1988, smoke rose from a depth of 20 cm and metal parts of the excavation equipment became too hot to handle, making it impossible to ascertain the possible depth of the charred material.[11]

Changes in soil chemistry and the loss or reduction of ground cover can increase erosion and cause freeze-thaw processes to penetrate to a greater depth, increasing site perturbation. Archeological material at the top of a slope may erode and be redeposited further down, while that at the bottom of a slope may be buried by sediment. Treefall also increases pedoturbation (mixing of the soil through biological processes) and creates a hollow that may catch eroding charred soil and charcoal and be mistaken for an archeological feature. However, be-

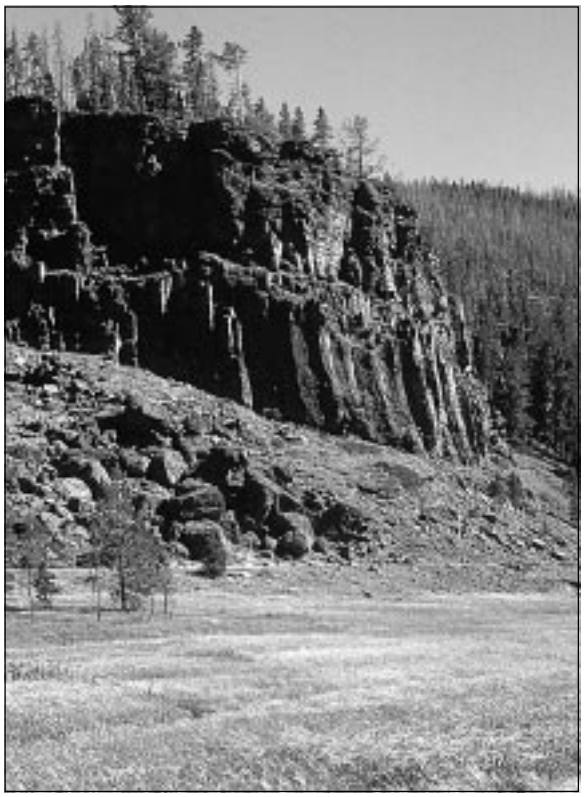
cause archeological sites are generally not located on steep slopes, they are less likely to be affected by the most severe erosion that may result from fire.

Fires may change the landscape in ways that complicate the interpretation of an archeological site, but by clearing away deadfall and underbrush, they can increase the likelihood that new sites such as lithic scatters will be detected, and make it possible to conduct more thorough examinations of already known sites. For example, behind Obsidian Cliff lies a 20-square-mile plateau that was a major source of the obsidian used and traded by American Indians across the West for thousands of years. Although the lack of trees in a 1878 photograph of Obsidian Cliff was probably due to fire, by the 1970s the plateau was heavily forested with lodgepole pine. After many of these trees burned in 1988, the quarry sites could be documented for the first time, but easier access by the public has required more frequent patrolling of the area to deter and penalize theft and vandalism.

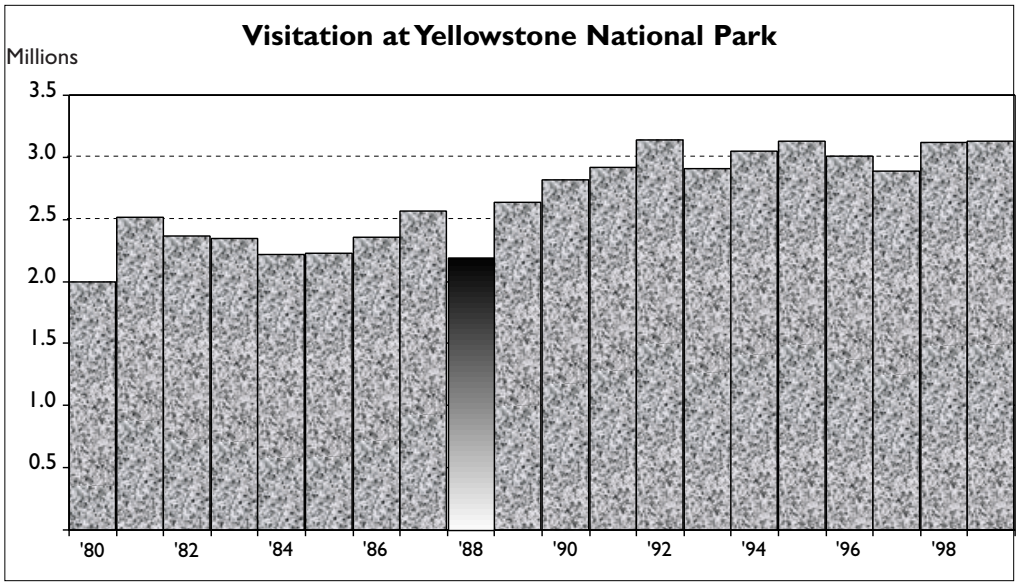
The Baronett Cabin, named in 1870 for the man who constructed the first bridge across the Yellowstone River, remained in use until about 1920. But by the time the site was recorded in 1985, the cabin's roof and upper walls were gone, and tall grass and dense clumps of sagebrush made ground visibility difficult and survey transects impossible. When the site was re-examined in the fall of 1988 by Ann Johnson, now the park archeologist, more features and artifacts were visible, including a wagon road, the remnants of several outbuildings, tin cans, and glass bottles. The remaining walls of the cabin had burned, leaving a trench where the bottom row of logs had been. Johnson expected that the fill that had been inside the cabin, including many artifacts, would shift into this trench over time. Within a year, lush regrowth concealed the site entirely.[12]

To take advantage of the brief period before regrowth, archeologists surveyed specific burn areas in the park during the summers of 1989 and 1990 to document sites and any damage that may have been caused by the fires or suppression efforts, and identify sites that might be disturbed by post-fire rehabilitation activities. While they were there, they also evaluated sites' eligibility for placement on the National Register of Historic Places. Ground visibility ranged from 100% in areas that had sustained very intense fires and revegetation had not yet occurred, to near zero in areas that were already densely vegetated by new growth. About 224 miles of trails, bulldozed firebreaks, and handcut fire lines were surveyed, along with more than 160 acres slated for rehabilitation. In 1989, 96 sites were documented for the first time, including two prehistoric sites along the Yellowstone River. In 1990, another 11 previously unrecorded sites were documented, six prehistoric and five Euroamerican.[13]

*Creating a firebreak may expose archeological sites.*



*Obsidian Cliff, 1999.*




## Visitor and Economic Impacts

September 10, 1988 was the first day in Yellowstone's 116-year history that the entire park was closed. However, throughout that summer visitors often had to suddenly alter their routes because of road and facility closures, or were required to travel in ranger-led convoys that were subject to long delays. About 4,000 people were evacuated from Grant Village on July 23, and again on August 21. On August 24, Canyon lodging and campgrounds were evacuated. Old Faithful was evacuated on September 7, and Mammoth Hot Springs, where the park's headquarters are located, on September 10. Visitor accommodations in the park, which in previous years had remained open until late September or mid-October, all closed for the season on September 8. In addition to these disruptions, many people found their park visits marred by the smoke which often obscured scenic vistas, and by the aircraft that could be heard almost constantly during the height of suppression activities. But some visitors were thrilled at having the rare opportunity to witness an ecological phenomenon of this scale and impact.

How visitors are counted.

The number of vehicles coming through each park entrance is mechanically counted and used to derive an annual visitation estimate. Although October 1988 visitation increased 40% over the same month in 1987, with 175,000 people coming to see what all the fuss was about, total visitation for 1988 was nearly 400,000 (15%) less than in 1987. This drop in visitors translated into economic losses for many local enterprises, especially those that earn most of their income during the summer. Some did a brisk business in supplying the thousands of firefighters and journalists with food and lodging, but some outfitters lost their fall revenues due to trip cancellations and national forest closures that occurred because of the fire danger.

*Traffic delay on the West Entrance Road, August 1988.*

Paul Polzin, a management professor at the University of Montana in Missoula who studied park visitation data, found that although the number of visitors dropped in 1988, the average length of stay remained fairly constant (about 3.5 days, of which 2 were spent outside the park), as did the proportion of expenditures made inside (46%) and outside the park (54%).[14] The proportion of visitors coming into the park through each of its five entrances also remained fairly constant. Although Polzin assumed this was because "the fires were dis-

tributed throughout the park, affecting all areas," it may have been simply that people who came to Yellowstone in 1988, before or after the fires, did not make their decision based on the presence or absence of charred trees.

More visitors without fires?

Polzin also believed that park visitation and tourism revenues in the surrounding communities were lower in subsequent years than if the fires had not occurred. Based on the overall trend in park visitation since 1971, the increases in tourist visits to Montana and national forests, and nation-wide travel activity in subsequent years, he projected that without the fires, Yellowstone visitation would have risen 8.8% in 1988, 8.4% in 1989, and 19.9% in 1990—reaching a record high each year. Based on the park's visitor count for 1987, that would have brought visitation to 3.6 million by 1990. The study did not extend its projections past 1990, noting that "it is unknown how long this potential lag in growth will continue." For those who accept Polzin's projections and are concerned about visitation growth, this "without fires" scenario may be cause for regarding the fires as a blessing. With fires, the highest visitor count since 1988 has been 3.1 million, which has been reached in four years since 1988.

Impact on tourism revenues.

But the loss of hypothetical visitors can be converted into the loss of millions of hypothetical dollars. Based on tourists' average daily expenditures for lodging, travel, food, and other recreation-related items from June through September, 1988–90, Polzin projected how much more would have spent in the park and the five gateway communities if the fires had not occurred and his projected visitation levels had been reached. He concluded that a total of nearly $60 million would have been added to the actual tourist expenditures of about $240 million in the three peak seasons during that period. (This estimate assumes that none of the would-be visitors who did not enter the park because of the fires visited a gateway community anyway.) Although government expenditures of about $33 million for fire-related supplies, equipment, and services in 1988 partially offset the loss of tourist dollars, the study noted that only about $10.8 million of these payments went to the seven "primary impact communities."

Except for 1988, annual park visitation did increase each year from 1985 through 1992, by a total of about 41%. A study by David Snepenger, a business professor at Montana State University, found that tourism in Montana rose 54% during that same period (as measured by accommodation tax receipts), with the increase concentrated in four counties, including one of the two Montana counties that border the park.[15] While this disparity may suggest that park visitation after 1988 was less than it would have been had the fires not occurred, it could also be taken as evidence that the fires were not a major factor in Montana tourism revenues.

How many people visit Yellowstone each year is influenced by a variety of factors, including the weather, the price of gasoline, and shifts in the popularity of other recreation options. It would therefore be difficult to prove that the fires had any long-term impact on Yellowstone's visitor count. The prospect of seeing vistas of dead trees may have kept some people away, but others have been drawn by curiosity. Total visitation reached a record 2.7 million the year after the fires, and has repeatedly exceeded 3 million since then. The park's geothermal features, which are among its most popular tourist attractions, were not altered by the fires, and today the only areas of the park where public use may still be affected by the fires are backcountry trails and campgrounds where falling snags pose a nuisance and safety threat.

*Ignoring the eruption of smoke in the distance, undaunted visitors await Old Faithful, July 1988.*

## Public Attitudes Toward Fire

The Yellowstone fires occurred at a time when the problem of "exurban" fire was becoming more widely recognized. As Stephen Pyne observed the following year, "How to cope with fires in sprawling residential and recreational communities nestled in wildlands (in areas without clear jurisdiction for fire services) has become a national, even international conundrum."[16] For many people, fire is as destructive in a national park as it would be in their backyard, and an increasing number of people have backyards near wildland areas, affecting their reaction to the scenes they were witnessing on their television screens.

On an aesthetic level, the Yellowstone fires evoked a negative response that 16 years of natural fire management had done little to prevent. Even park employees who appreciated the ecological importance of the fires and had to defend the park's firefighting efforts over phone lines buzzing with outraged citizens, mourned the transformation of a favorite view or hiking trail. As reports of the advancing fire fronts came in that summer, their pleas went up in the smoke. "Oh no, not Fairy Falls! Don't take Fairy Falls too!" Of course, Fairy Falls is still there, tumbling down 200 feet over the rocks. It just doesn't look quite the way they remember.

Alistair James Bath examined attitudes toward the fires for his Ph.D. dissertation at the University of Calgary, Alberta during a nine-month period beginning in June 1989.[17] He obtained data from more than 4,500 respondents, including interviews conducted in the park, surveys filled in by visitors leaving the park, and randomly sampled residents in Montana and Idaho who were mailed surveys. (A portion of the visitors participating in the interviews and exit surveys would have been from Montana and Idaho, but their opinions were grouped with those of other park visitors.) More than half of the survey participants had been to Yellowstone at least once before the fires. Interviewed visitors who had seen the effects of the fire had the most favorable attitudes overall; Montana and Idaho residents who had not seen the fire effects were the most negative. Although most respondents disagreed with the statement, "All fires in Yellowstone National Park should be suppressed regardless of how they start," those who had seen the fire effects tended to disagree more strongly.

After visitors had seen the fire effects, they regarded some fire management practices more favorably, but knowledge of fire ecology remained meager. When asked whether nine statements about the 1988 fires were true or false, respondents who were seeing post-fire Yellowstone for at least the second time had the highest score; area residents who hadn't seen the fire effects had the lowest. Only slightly more than half of the survey participants who had visited after the fires knew that the statement, "The fires of 1988 destroyed habitat for many big game animals," was false.

### On Second Thought

Most Montana and Idaho participants in a 1989 mail survey agreed with the statement, "The Yellowstone National Park fires should have been put out when they first began." Visitors surveyed at Yellowstone were less critical of park management. However, more visitors agreed with the statement, "The National Park Service handled the recent fires properly," before they entered the park than they did when they were surveyed after their visit.


*Visitors focus on a grizzly bear, undeterred by the standing snags, October 1992.*

## Renewing Yellowstone's Fire Policy

As a result of the controversy surrounding the Yellowstone fires, all natural fire management programs at national parks were suspended in 1988 pending further study. Three congressional hearings were held and the Secretaries of the Interior and Agriculture appointed a committee to evaluate fire management policies for national parks and wilderness areas. Their report, issued in May 1989, upheld the need for fire in maintaining a wildland ecosystem, but criticized several aspects of the National Park Service's fire management plans, finding that agency budgets and the training and experience of many fire managers were inadequate.[18] Fire behavior analysts under-estimated the potential size and intensity of the fires because of their inability to accurately predict weather trends and take into consideration the effects of prolonged drought. Reduction of hazardous fuels near developed areas prior to the fires would have eased the chore of keeping the fires at bay.

More specific guidelines.

The committee also called for specific criteria that would be applied to determine under what circumstances fires would be permitted to burn, taking into account weather conditions, the availability of firefighting resources, and the potential impact on neighboring communities. "The ecological effects of prescribed natural fire support resources objectives in parks and wilderness, but in some cases the social and economic effects may be unacceptable." In the same way that most people's immediate reaction to the fires was prompted by their impression of what Yellowstone had looked like in recent decades, the park's fire plans and those of other land management agencies had been driven largely by observations of fire behavior over the previous few decades. Like park visitors, fire managers would have to adopt a longer view about fire's potential role in Yellowstone.

Although the public comment period brought little scientific disagreement on the basic principles, Yellowstone's natural fire policy remained on hold and all fires were fought until the park formally adopted a revised wildfire management plan in May 1992. The plan strengthened the coordination mechanisms between the park and the surrounding national forests, established criteria to determine which fires must be suppressed, and clarified the policy regarding protective "buffer zones" near gateway communities. As under Yellowstone's prior policy:

- Any fire that is human-caused or that threatens human life or property is considered "wildfire" and suppressed as quickly as possible using methods that will minimize damage to the park's natural and cultural resources.
- Naturally ignited fires that do not threaten human life or property may be allowed to burn if they are "within prescription"—if they meet certain criteria pertaining to fire behavior, weather, and fuel moisture content.

Considering the fire situation outside the park.

However, to classify a naturally ignited fire as within prescription, park managers must now also give consideration to the regional and national fire situation, including the number of fires underway and the availability of firefighters and equipment. Once a fire has been determined to be within the prescription, it is monitored daily to make sure that the criteria are still met and that adequate suppression resources are available to ensure that it will remain within the prescription during the next 24, hours, given the forecast for weather and fire behavior.

In 1995 the Secretaries of the Interior and Agriculture for the first time issued a joint fire management policy to ensure that federal land management agencies would have compatible, coordinated programs. They also confirmed that, "Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role." Agreements between Yellowstone and the surrounding national forests that permit some fires to burn across forest boundaries into the park and vice versa have been revalidated since 1988. Each year before the fire season begins, the fire management officers from the national parks and national forests in the greater Yellowstone area meet to review fire severity predictions and plans.

Fire management personnel.

The size of the fire management staff at a national park is now determined using a formula that takes into consideration the length of the fire season as well as the likelihood of large fires. Yellowstone's wildland fire staff has about tripled in size since 1988, and there is also more fire management expertise at the regional and national levels of the National Park Service. Yellowstone uses funds provided by an NPS-wide program to support three year-round fire management positions, a seasonal crew, and part of the cost of a summer helicopter operation. Several other full-time positions are paid for directly out of park funds, and each summer more than 100 Yellowstone employees qualify for their "red card," indicating that they have received the necessary training and passed the fitness test required for assignment to a fire crew if the need arises. Just as Yellowstone must turn to other government agencies for help in case of serious fires, these employees assist in areas outside the park when called upon.

Fuel and weather monitoring.

The most significant change in Yellowstone's fire management program since 1988 has been the increased use of computers and access to "real time" weather data over the Internet. Working with the National Interagency Fire Center in Boise, Idaho, park staff use computerized software programs to monitor fire risks. In addition to manually collected data on temperature, precipitation, relatively humidity, wind, and fuel moisture, three automated weather stations in backcountry locations transmit data on fire-related climate conditions to park headquarters so that fire danger can be assessed.

Fuel loads in developed areas that are considered hazardous are reduced by physically removing the debris or prescribed burning. Reducing the possibility of fire in developed areas in and around the park increases the likelihood that a naturally ignited fire will be able to burn within prescription. While a prescription fire is underway, fire monitors check the site daily to assess weather conditions, fuel load, and rate of spread. Fuel samples are weighed, oven-dried, and re-weighed to determine the moisture content and how intensely and quickly the fire may spread.

In July 2000, a study plot was set up in an unburned area adjacent to the Two Smoke Fire underway on Pitchstone Plateau. Data was collected on aspects such as vegetation composition, tree density, fuel load, and litter depth. As anticipated, the fire soon burned through the study plot, making possible an immediate pre-and post-burn comparison, as well as an assessment of revegetation in future years.

Since 1988, the extent of both human- and lightning-caused fires in Yellowstone has been relatively insignificant, but has fluctuated from year to year depending largely on environmental factors. The 10 fires of 1993 burned less than one acre combined, but because of dry conditions in 1994, the most active fire season

since 1988, only four of the 48 lightning strikes met the criteria for a prescription fire. There were also 16 human-caused fires in 1994, including four that started from sparks off falling power lines.

Although the 2000 fire season has been called "the worst in 50 years" for the West, Yellowstone was relatively unaffected by the drought and its burned acreage was less than half of that in 1994. The revised fire policy does make a difference in such years, however, and reduced the acreage that would have been allowed to burn if only concerns for safety and protecting developed areas in and around the park had been considered. But because the available firefighting resources were being stretched to cover the many fires burning elsewhere in the country, Yellowstone's skeleton fire crew was theoretically supposed to immediately suppress all fires, even those from lightning ignitions in areas that were far from developed areas and will have to burn eventually.

The controversy continues.

The post-1988 rationale for the policy was clear—Yellowstone shouldn't take the risk of allowing small fires to grow big at a time when there's no one to call for help—but it bore seeds of bureaucratic illogic waiting for the right conditions to sprout. It is precisely in "bad" fire seasons such as that of 2000 when many of Yellowstone's own "red-carded" employees have been sent elsewhere that the park is least able to immediately suppress every lightning ignition. Every fire is monitored, but the reality is that park managers must allocate the available staff to deal with the more potentially serious fires and some fires that make "ecological sense" are suppressed. Such a predicament provides one rationale for setting controlled burns rather than waiting for lightning to do the job: by conducting burns in areas ripe for naturally-caused fires at times of less risk, the potential for serious fires when firefighting crews are most in demand would be reduced. (See page 15 for more information about the use of controlled burns in Yellowstone.)

Yellowstone's fire policy, although far more widely understood and accepted than it was in 1988, remains unsatisfactory for those who object to any strategy other than an immediate effort at total suppression, and for those who favor the use of prescribed burns to prevent large fires. The controversy about fires, like that about wolves or snowmobiles, usually reflects a difference in view about Yellowstone's role as a national park. At one end of the spectrum are those who criticize park managers for not doing enough to keep nature in its proper place, who want Yellowstone to be managed as "safe and attractive forests," as advocated by Thomas Bonnickson, head of the Department of Recreation and Parks at Texas A&M, who testified during the Congressional hearings on the Yellowstone fires.[19] At the other extreme are those who object to any intervention in Yellowstone to suit the convenience or preferences of the human species, and who value Yellowstone according to the extent to which it remains "wild" and uncontrolled.

**Yellowstone Fires Since 1988**

| Year | Number of Fires: Prescription | Number of Fires: Suppressed | Acres Burned |
|---|---|---|---|
| 1988 | * | 45 | 793,880 |
| 1989 | * | 24 | 10 |
| 1990 | * | 43 | 247 |
| 1991 | * | 29 | 270 |
| 1992 | 15 | 14 | 485 |
| 1993 | 5 | 5 | < 1 |
| 1994 | 4 | 60 | 16,238 |
| 1995 | 9 | 7 | <2 |
| 1996 | 13 | 11 | 3,261 |
| 1997 | 12 | 1 | < 1 |
| 1998 | 11 | 2 | 125 |
| 1999 | 11 | 4 | 10 |
| 2000** | 2 | 31 | 7,209 |

*After the natural fire policy was suspended on July 15, 1988, all fires in the park were suppressed until the revised policy was approved in 1992.
**Estimate as of September 21. Nearly all lightning-ignited fires were at least theoretically to be suppressed because of the difficult fire season elsewhere in the West.