R. Monastersky

Awaiting the regeneration of Yellowstone

Second in a two-part series

By RICHARD MONASTERSKY

This summer and fall, Yellowstone ranger Tom Tankersley has encountered quite a few park visitors suffering from moonscape mindset. "People come here expecting Mt. St. Helens or something out of 'The Day After,'" he says.

Tankersley and other rangers complain about overly pessimistic news reports telling the nation that its children and even its grandchildren will never see the same Yellowstone beloved by their parents.

For most people, it was difficult last summer to read, watch and hear the daily Yellowstone updates without feeling that fire was destroying the nation's oldest national park. In a gesture symbolizing the concern spreading through the United States, Gov. Thomas H. Kean of New Jersey pledged 1,000 seedlings to Yellowstone to help reforest its burned lands.

Yet scientists both inside and outside the Park Service view the summer's events in Yellowstone more as a renewal than an unprecedented disaster. Even when they walk through the fires' blackest legacy — charred trees standing like skeletons in a bed of ashes — they say the 1988 fires far from destroyed the park. In fact, the scientific consensus holds that these kinds of extensive burns are as native to the area as the grizzly bear.

"Every scientist I've talked to has pretty much shared the opinion that these fires are natural events that have happened in the past," says James Schmitt, a geologist at Montana State University in Bozeman, who coordinated a meeting last month of more than 120 researchers interested in Yellowstone. "This is a part of the ongoing evolution of the greater Yellowstone ecosystem. I personally haven't encountered a scientist who thought that this represents devastation and that it's something terrible that shouldn't have happened. Most agree that inevitably it was going to happen."

Evidence shows that large fires have swept Yellowstone for thousands of years. But these extraordinary events happen infrequently, at intervals measured in centuries rather than years or decades. Such a span means scientists have never before witnessed fire on this scale in Yellowstone, which is probably the most intact ecosystem in the lower 48 states, says Schmitt. Given such an opportunity, researchers are now preparing to study how fire — one of the greatest forces in the forest — will shape the future ecology of Yellowstone.

Along the road between Canyon and Norris, Yellowstone visitors find a scene that might fit preconceived images of fire destruction. Here lies a field of charcoal-crusted lodgepole pines, strewn about the ground like jackstraws. But this place, albeit dramatic, is a rare sight within Yellowstone. The trees were already on the ground when fire swept through last summer; an extreme windstorm felled them several years ago. In other areas of the park, most of the dead, charred trees still stand and will remain upright for many years.

Photographs taken by NASA's high-flying ER-2 aircraft reveal that fire affected about 20 percent of the park. The blazes moved quickly through many areas, jumping over some stands and killing others. Ecologists call such a hopscotch pattern a mosaic.

In most areas, heat from the flames damaged only the top inch of soil on the forest floor. Seeds, plant bulbs and the roots of grasses underneath this layer will sprout up next year. Only a tiny portion of the forest, less than 1 percent of the area burned, suffered intensely hot

ground fires that severely damaged the soil, says John Varley, head of research at Yellowstone.

Almost all vegetation in the park has some sort of natural insurance against fire destruction, Varley says. The lodgepole pine, which makes up 77 percent of the forests in Yellowstone, produces two types of seed-carrying cones. The more numerous type develops on the trees for two years and then opens to drop its seeds to the ground. The fire-insured serotinous form is coated with a strong resin that seals the cone shut. These cones can remain closed on the tree for decades until the heat of a fire burns off the resin and dries them out. The cones then open to sow their seeds.

Past studies have revealed that after a fire, 50,000 to 1 million lodgepole seeds litter each acre of forest—or about 1 to 20 seeds per square foot of ground, according to Varley. This natural reseeding is one reason why Yellowstone's managers will artificially seed only along park boundaries, where bulldozers cleared firelines last summer.

When fire burns a lodgepole, spruce or fir, it often kills the tree, opening up room for a new seedling to develop. Aspens, willows and many ground plants, on the other hand, often survive the flames. These plants actually depend on a periodic fire to shock them out of an unproductive dormant period. With their tops burned, new trees and plants sprout with vigor from roots that survive below ground, Varley says.

Yellowstone biologist Donald G. Despain and others will examine the specifics of how the burned forest regenerates. As fire swept through last summer, Despain raced ahead of the flames to set up large rectangular plots, where he measured and catalogued the vegetation before it burned. In 1979, he and his crew laid out two such plots; this year they laid out nine. He can compare the before-burn snapshots to the same area after the fire, or to another area that did not burn. From the 1979 plots, the researchers found that five years after a fire they can expect some 500 lodgepole pine seedlings about 1 foot tall in each acre of forest.

The staggering size of the summer's fires will allow researchers to compare large patches of burned forest to smaller ones for any difference in regrowth. William H. Romme of the Fort Lewis College in Durango, Colo., who studies forests and fire in Yellowstone, says he wonders whether the middle of a burned area grows in the same way as the edges.

One of the primary fire lessons learned this year, researchers say, is the importance of weather in controlling what burns. Romme, Despain and many others agree that the record drought and unusually high winds were probably the greatest factors behind the uncontrollably large fires in Yellowstone this year. Despain plans to look closely at the day-to-day weather conditions to see how they influenced fire behavior.

Other scientists are already examining how various soil components fare after the fires. In the arid West, where downed wood can sit for decades without rotting, fire performs an important ecological task by releasing nutrients trapped in the dead wood. It is not, though, a pure boon to the soil, because many of the liberated nutrients don't return to the ground. Instead, much of the nitrogen in the wood turns into a gas and dissipates. Also, on some steep slopes that burned, erosion will wash away now-unprotected soil.

Smoldering logs, which bake the ground at temperatures of up to 1,200°F, can even make the soil repel water. In areas that receive an intense heat treatment, waxes and oils can evaporate from organic material on the forest floor and coat particles in the soil, creating a mat that keeps rain from soaking into the ground. The effect lasts until the mat breaks down—anywhere from a week to a few years, says Roberta Hartford of the Forest Service Intermountain Fire Sciences Laboratory in Missoula, Mont.

In this era of interdisciplinary science, researchers will combine their efforts in a broad look at how the general Yellowstone ecosystem responds to fires. The unique opportunity for wide-scale studies was one theme stressed at last month's meeting of researchers, Schmitt says.

Big game after the flames

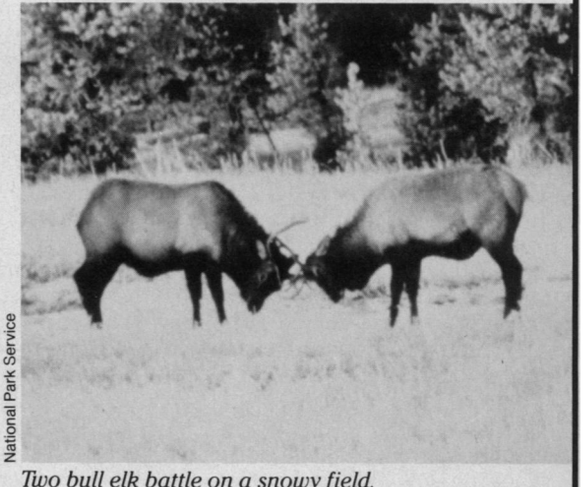
Elk, bison, moose and grizzlies are among Yellowstone's most famous citizens, and many people have expressed concern for the large mammals and birds in the park, where 200 big-game animals died in fires this year, mostly from smoke inhalation. Each form of wildlife feels the effects of fire in its own way, and researchers will be monitoring how the animals react in the coming months and years.

Over time, most large mammals will probably benefit from the summer's fire, say park researchers. Nutrients in the ash should fertilize the soil and create more nutritious forage. In addition, the burning of forests clears temporary habitats for animals by opening gaps in the dense needle roof that keeps sunlight from reaching the floor.

In the short term, however, ecologists expect the coming cold to claim a large number of elk from the park's northern herd, which spends its winters pawing for food beneath the snow. While some 15 percent of the winter rangeland burned, ecologists say this year's *drought* will affect large grazers like elk and bison more than the fire will. Record-low summer rainfall cut grass growth by as much as 60 percent in certain areas, says plant ecologist Linda Wallace.

The park's northern elk herd is the largest in the world, numbering slightly over 20,000, says biologist Mark Boyce from the University of Wyoming in Laramie. Eight years of mild winters allowed the herd to swell beyond the range's estimated carrying capacity, which researchers peg at approximately 15,000 elk. Normally, some 2,000 members of this herd die during winter. But because of the overpopulation, Boyce expects that a winter of average snowfall would kill 4,000 to 5,000 of the herd—a figure that does not include any effects of drought or fire.

Some people are calling for the Park Service to feed the northern elk herd this winter, especially if snowfall is normal or above average. Varley and other scientists, however, say this tactic brings animals together, causing diseases to spread more easily than if the animals were off in their normally small winter groups. Moreover, experts say feeding selects for elk that do well on the supplied food, which are not necessarily the fittest elk. — *R. Monastersky*



National Park Service

Two bull elk battle on a snowy field.

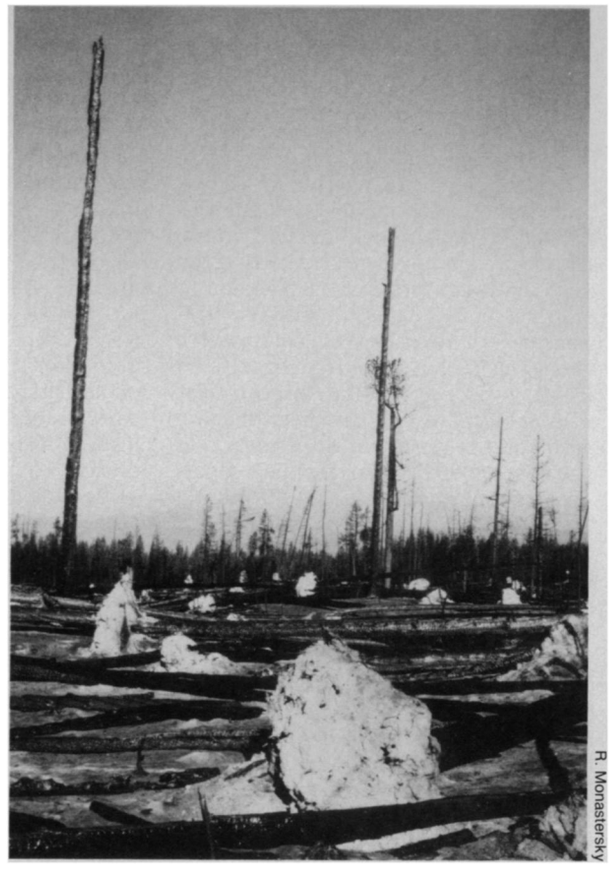
Many scientists will examine the changes in the park's aquatic world, in particular observing the 136-square-mile Yellowstone Lake. According to some studies, the abundance of plankton and nutrients in the lake's water has dropped in recent years, says Varley. Some researchers suggest changes in the climate may have caused the decline, while others think the lake's productivity may swing along with the fire cycle. Since much of the lake's watershed burned this year, runoff will bring a flood of nutrients into the basin and allow researchers to take a close look at this and other fire effects.

The Park Service recently finished a three-year study on streams, and hydrologists plan to examine how fires change the conditions within the fluvial system. Depending on the size of the snowfall, spring meltwater and rains should carry a pulse of ash and sediments down into the streams and rivers, and that may hurt certain fish, says biologist Robert Gresswell, who is with the U.S. Fish and Wildlife Service in Yellowstone.

After the first year, however, the fish will most likely benefit from the loss of tree cover over small streams in the higher slopes. With more sun shining on them, streams will warm faster in the springtime, lengthening the growing season for insects and fish. Gresswell cautions, though, that these predictions are based on studies of drainages much smaller than those burned this year.

Scientists are also preparing to monitor how the fires will affect the level of the water table, which has dropped in recent years because of meager winter snowpacks. They expect that an unusually large flow of water next spring will feed into the dwindling groundwater reservoirs — an indirect result of the burned vegetation.

In a simple sense, trees serve as a conveyor belt for water, transporting moisture from the ground into the atmosphere. Much of the water absorbed by tree roots reaches the air through a process called evapotranspiration. With a few hundred thousand acres of forest burned, less vegetation will be available to transport water into the air, Varley notes. The extra groundwater may regenerate some dried lakes and ponds.



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Although featured in several media reports about the fires, this scene of downed, charred logs is not typical in the park. In the majority of burnt areas, most dead trees remain standing for years.

In the north end of Yellowstone, the Blacktail Deer Plateau stretches before the eyes as a wilderness of rolling prairie land, dotted by small stands of trees. Well-worn animal trails lace the hills, and almost every step is met by telltale evidence of the digestive processes of some elk or bison. Although the range has seemingly escaped human impact through the past century, a keen-eyed observer might spy two wire fences atop a distant hill.

Here, plant ecologist Linda Wallace is exploring how fires affect the reproduction of grasses such as Idaho fescue and wheat grass. Fences around two plots of burned and unburned land prevent elk and other grazers from chewing her growing data.

Grasses usually reproduce asexually by sending out roots that sprout shoots near the main clump. They might invade a small bare patch in this manner. Fire often clears larger bare areas that can support normally uncompetitive grass seeds, allowing new genetic variations to develop within the grass community, says Wallace of the University of Oklahoma in Norman, who is working under contract for the National Park Service.

In some burned areas, timothy and other ground plants have already started to regrow, and most of the burned grasses will spring back vigorously next year, Wallace says. Other researchers will examine how the fires altered the nutrient levels in the grassland soil, particularly to see whether the net amount increased or decreased after last summer.

For ecologists, one of the unique aspects this year is the variety of habitats that burned. Fire stormed through many normally fire-resistant vegetations. "We've seen habitat types burn this year that we've never seen burn before in the period that science has been interested in that sort of thing. And so we're very interested in going into some of these habitats," Varley says.

One newly burned area is the wettest spot in the park, the Absaroka Crest, which normally receives 80 to 100 inches of precipitation a year. Another area piquing the interest of scientists is the forest burned by the Arrow fire 12 years ago. After that blaze, small lodgepole seedlings sprouted from seeds dropped by serotinous cones. These same seedlings burned this year, but they were far too young to have produced cones of their own. The area is now left without an indigenous source for seeds.

With time, perhaps decades, seeds will migrate into this part of the forest from surrounding growth. But what will happen until then? Normally after fire burns a lodgepole stand, a meadow develops that lasts about a decade before young trees poke above the grasses and signal the return of the forest. Varley wonders whether this kind of burn-after-a-burn can produce a much longer-lived meadow, perhaps one that survives for a century.

"That will be interesting to see," he says. "I'm just as excited as heck about that area."

Next year, as wildflowers and seedlings sprout from burned ground, visitors as well as researchers will flock to survey the regeneration of Yellowstone — a natural process that will roll on for hundreds of years. In one sense, it may be true that fire has deprived tomorrow's children of the Yellowstone their parents knew. Yet they will have a chance to see the park as it may have been some three centuries earlier, long before wandering fur trappers even set foot upon the land. □