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Fire Uses From the Past

United States Department of Agriculture
Forest Service

Prairie Meadows Burning (1832), George Catlin (1796–1832), oil on canvas. 11 x 14-1/8 inches. National American Art Museum. Gift of Mrs. Joseph Harrison, Jr. ©2003 Smithsonian Institution.

Erratum
In the Fall 2003 issue of *Fire Management Today*, the URL for the Website featured on page 84 for the Wildland Fire Lessons Learned Center is incorrect. The correct URL is <http://www.wildfirelessons.net>.

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On the Cover:

Prairie Meadows Burning (detail—the entire painting is shown on the facing page), an 1832 painting by George Catlin, shows American Indians riding away from an approaching prairie fire. On the Great Plains, Indians used fire for many purposes, including rejuvenating forage for game and disrupting enemy movements during war. See the story by Karl Brauneis beginning on page 4.

The FIRE 21 symbol (shown below and on the cover) stands for the safe and effective use of wildland fire, now and throughout the 21st century. Its shape represents the fire triangle (oxygen, heat, and fuel). The three outer red triangles represent the basic functions of wildland fire organizations (planning, operations, and aviation management), and the three critical aspects of wildland fire management (prevention, suppression, and prescription). The black interior represents land affected by fire; the emerging green points symbolize the growth, restoration, and sustainability associated with fire-adapted ecosystems. The flame represents fire itself as an ever-present force in nature. For more information on FIRE 21 and the science, research, and innovative thinking behind it, contact Mike Apicello, National Interagency Fire Center, 208-387-5460.

Firefighter and public safety is our first priority.

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Fire Use During the Great Sioux War

Karl Brauneis

The Great Sioux War of 1876–77 (see the sidebar) provides a glimpse into the military use of fire by both American Indians and the U.S. Army. The two sides used fire very differently during the campaign. The Sioux and their Northern Cheyenne allies used fire both as a resource management tool and as a tactical weapon to disrupt and impede enemy movements. By contrast, the U.S. Army learned to deploy fire strategically to render the enemy incapable of making war or even of surviving off the reservation.

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The Sioux and Cheyenne traditionally set fire to the prairie as they moved their summer camps in pursuit of game.

Traditional Fire Use

The Sioux and Cheyenne traditionally set fire to the prairie as they moved their summer camps from the Little Bighorn River in present-day southern Montana to the Bighorn Mountains in present-day Wyoming and then to the Black Hills in what is now South Dakota. During a dry year, the area between the Bighorn and Powder Rivers was a "smoky, blackened wasteland" by late August (Greene 1982).

The fires were set to bring forth young grass early the following

Frederic S. Remington, The Grass Fire, *1908 (oil on canvas). On July 30, 1876, Sioux and Northern Cheyenne warriors similarly used fire as a tactical tool to slow down and disrupt movements by the U.S. Army. Artwork courtesy of the Amon Carter Museum, Fort Worth, TX (1961.228).*

The Great Sioux War, 1876–77*

The arrival of Europeans in North America triggered a wave of migrations by American Indians. Decimated by disease and displaced by European settlers, many eastern tribes moved west. Tribes able to acquire firearms often drove less well-armed tribes from their ancestral lands. In addition, the spread of horses across the Great Plains attracted tribal peoples eager to hunt bison and elk. For many tribes, a general westward migration began.

The Lakota, a group of closely related peoples known to whites as the Teton Sioux, spearheaded the migration of Siouan-speaking peoples from the woodlands of Minnesota onto the Great Plains. By 1776, the Sioux had reached the Black Hills in what is now South Dakota. They came to regard the area as the sacred heart of their homeland.

They also spread across the northern Great Plains, becoming the dominant power in an area reaching from what is now the Dakotas into Montana and Wyoming. "These lands once belonged to the Kiowa and the Crows," observed a Sioux chief in the 1850s, "but we whipped these nations out of them, and in this we did what the white men do when they want the land of the Indians."

Inevitably, U.S. territorial expansion brought direct confrontation with the Sioux. In 1804, in a first challenge to U.S. authority, the Teton Sioux threatened the Lewis and Clark Expedition on the Missouri River, demanding a heavy toll in exchange for passage. Cool heads prevailed, and the dispute was resolved without bloodshed.

But sporadic battles began in 1854 and continued into the 1860s. In the Red Cloud War of 1866–68, allied Sioux and Cheyenne forces thwarted U.S. efforts to maintain a trail across prime hunting grounds to gold fields in Montana. In 1874, when the Black Hills gold rush brought large numbers of miners into the most sacred of Sioux lands, the stage was set for another major war.

U.S. forces planned to drive nomadic bands of Sioux onto reservations and then force the agency Sioux to cede the Black Hills by treaty. In winter 1876, three Army columns, aided by Crow and Shoshone allies, were sent to trap the Sioux in their winter villages while the weather immobilized them and their ponies were too gaunt for fighting.

They failed. At least 15 engagements followed, including the Battle of Little Bighorn in June 1876, a great victory for the Sioux and their Cheyenne allies. But in May 1877, Chief Lame Deer's last stand in Montana's Rosebud River country marked the end of organized Sioux resistance. In the months that followed, most remaining bands surrendered.

* Largely based on the Websites "Sioux Nation" and "The Great Sioux War 1876–1877" (at, respectively, <http://www.historytelevision.ca/chiefs/htmlen/sioux/default.asp> and <http://www.du.edu/~dhagen/index.html>).

spring, attracting bison herds for the next year's hunt. The prevailing southwesterly winds would push the fires to the northeast, allowing the Indians to move their camps south and later east. The fires would also force any remaining game in the area to move in the same general direction as the Indians in search of forage in unburned areas.

In a dry year, numerous fires would also start naturally. A single thunderstorm could produce hundreds or even thousands of lightning strikes. At least one soldier noted in his journal that lightning started a fire that was quickly rained out. Dry lightning would have produced fires that burned until doused by rain or stopped by changes in fuel or topography.

> The Great Sioux War provides a sharp contrast in how two different cultures with diverse values and objectives utilized fire.

The Sioux and Cheyenne would have welcomed natural fires that helped them sustain their hunting grounds; today, we would call them wildland fire use. They would also have ignited maintenance burns—today, we would call them prescribed fires—even as they maneuvered against U.S. troops.

Some fires might also have been accidental. Journals kept by soldiers during the campaign make it clear that either side could have inadvertently started wildfires. On several occasions, 2nd Cavalry troopers were ordered to be careful with their cooking fires as they closed in on the enemy (Greene 1998). And First Lieutenant Frank Taylor

Charles Schreyvogel, On the Skirmish Line, *1900 (oil on canvas). Dismounted U.S. cavalrymen use Colt revolvers and Springfield carbines against mounted Plains Indians. During the Great Sioux War, troopers from F Company, 2nd Cavalry, used fire as a strategic weapon on August 29, 1877. Artwork courtesy of the National Cowboy and Western Heritage Museum, Oklahoma City, OK (84.46c.2).*

(Greene 1997) claimed that a threatening prairie fire on July 30, 1876, was "started by embers left at last [enemy] camp."

Tactical Fire Use

Despite the chance of accidental fire, many fires set by the Sioux and Cheyenne were expressly intended to disrupt enemy movements. Early battles on Rosebud Creek (June 17, 1876) and the Little Bighorn River (June 25–26, 1876) involved such rapid attacks that neither side used fire. But the Indians subsequently used fire for tactical purposes. "Indians set fire to the prairie," observed Private William W. Jordan (Greene 1997), attributing the threatening prairie fire of July 30, 1876, to enemy action. "Entire command out fighting fire until dark."

In the days and weeks that followed, fires continued to plague the command of Brigadier General George Crook. "Marched all day through smoke of prairie fires," Private Jordan wrote on August 3. "Weather hot.… The whole country is one sheet of flames, from the valley to the mountain tops." Crook's command would have been near the Tongue River, on the east side of the Bighorn Mountains near the present-day town of Sheridan, WY.

Such fires served to cover the retreating Sioux and Cheyenne. Indian warriors engaged in prolonged campaigns had to move entire villages of women and children. Fire was one of the best tools available for fighting a delaying action, especially when coupled with strike-and-withdraw tactics.

Fire was also used at close quarters to achieve tactical objectives. About an engagement at Spring Creek (October 15–16, 1876), Second Lieutenant Alfred C. Sharpe wrote, "Finally, we reached the foot of the opposite side, and with a cry, we charged up the hill. The Indians then set fire to the tall grass which was dry as tinder. The smoke was blinding and the heat intolerable, but rushing onward and upward, we gained the crest and again drove the villains before us."

Many fires set by the Sioux and Cheyenne were expressly intended to disrupt enemy movements.

At the Battle of Cedar Creek (October 21, 1876), the Sioux fired the ravines surrounding Colonel Nelson Miles and his soldiers. As the Indians withdrew, they continued to burn the prairie, effectively preventing pursuit. The fires grew so intense that Colonel Miles was forced to stop and set backfires (Greene 1991).

Whether the fires of 1876 were tactical, accidental, natural, or set for maintenance purposes, they caused great difficulties for the U.S. troops. For a month, General Crook and his men marched through a blackened landscape devoid of forage. The infantry even passed the cavalry on their wornout mounts, which were finally turned out to fend for themselves. Many horses were also shot. On what became known as Crook's Starvation March, the troops were forced to eat their mounts for survival. Meanwhile, a well-mounted enemy was sometimes spotted just over the next ridge, but impossible to engage.

Strategic Fire Use

By sheer luck, the troops at last stumbled onto a Sioux village and won a decisive victory over Chief American Horse at the Battle of Slim Buttes (September 9, 1876). It was their first real success of the campaign. The following months brought a string of U.S. military successes, including the defeats of Chief Dull Knife at the Battle of Red Fork (November 25, 1876) and Chief Crazy Horse at the Battle of Wolf Mountains (January 8, 1877).

The U.S. Army now turned the hard lessons learned on the Starvation March to its strategic advantage. In July 1877, Colonel Miles ordered his troops to burn off forage. "When the commands turn west or back," he wrote in a general order (Greene 1998), "should the Indians retreat toward the head of the Powder River, I wish the grass burned behind you in the whole section of the country, and the region of the Little Missouri left unsuitable for Indians or game."

The burnings that actually followed might have been more coincidental than purposeful; however, the order by Colonel Miles demonstrates the Army's ability to adapt to—and initiate—a strategic use of fire. "Obviously," concluded the historian Jerome A. Greene (1998), "the burnings by the troops were meant to destroy the grass upon which game—particularly buffalo—and Indian ponies could graze, thus precluding Sioux–Cheyenne use of these traditional hunting lands during the late summer and fall while promoting the necessity of their going into the agencies for survival."

"I wish the grass burned behind you in the whole section of the country, and the region of the Little Missouri left unsuitable for Indians or game."

–Colonel Nelson A. Miles, General Order of July 22, 1877

The war dragged on, with each side using fire. "The Indians have been setting fires in our advance, either accidental or on purpose, thinking they were doing right," reads the diary of Trooper William F. Zimmer (Greene 1998) on August 27. "50 men have been sent out to fight it to keep it out of our camp, which it is threatening."

Two days later, when the troopers reached the Tongue River, the Indians again set the grass on fire. But the Army's strategy ultimately prevailed. By the end of 1877, all Sioux and Cheyenne bands had surrendered—except for Chief Sitting Bull and his followers, who escaped to Canada. But 4 years later, facing starvation, the last free Sioux returned to South Dakota and were sent to a reservation.

Contrasting Fire Use

The Great Sioux War provides a sharp contrast in how two different cultures with diverse values and objectives utilized fire. The Sioux

Charles M. Russell, Crow Burning the Blackfoot Range, *1905 (oil on canvas). Similar fire use during the Great Sioux War led to the monthlong Starvation March for Brigadier General George Crook and his forces. Artwork courtesy of the Buffalo Bill Historical Center, Cody, WY (loan from Mr. and Mrs. W.D. Weiss; L.25.93.3).*

and Cheyenne employed fire as a resource management tool and a highly effective tactical weapon. By contrast, the U.S. Army learned through campaign hardship to deploy fire as a strategic weapon, helping to bring an end to the Great Sioux War.

Published diaries from the campaign (see the sidebar) contain many additional references to wildland fires, including fire use by American Indians. They offer valuable insights for both the historian and the natural resource manager into fire history, wildlife occurrence, and the "natural world" on the northern Great Plains.

Frederic S. Remington, Among the Led Horses, *1909 (oil on canvas). Without the horse, life on the Great Plains was nearly impossible. The care and feeding of horses were essential to military success for both the U.S. Army and American Indians. Artwork courtesy of The Sid Richardson Collection of Western Art, Fort Worth, TX (#116).*

Implications for Management

Fire use during the Great Sioux War illustrates a historical type of wildland fire that has too often been overlooked: cultural fire. Today, Federal agencies recognize three types of wildland fire:

- Wildfire, an unwanted wildland fire;
- Prescribed fire, a wanted wildland fire through ignition by trained professionals; and
- Wildland fire use fire, a wanted wildland fire through natural ignition.

Cultural fires are, in effect, prescribed fires used by past cultures for various purposes. For example, wilderness areas on the Shoshone National Forest in Wyoming were managed with fire by the Sheepeater and Shoshone Tribes and, later, by immigrant shepherds

Diaries From the Great Sioux War

As a resident of the Wind River valley in Wyoming, I find myself ever more intrigued by local western history. Recently, I became aware of several writings by Jerome A. Greene, a research historian for the U.S. Department of the Interior National Park Service in Denver, CO. Dr. Greene has edited and annotated diaries of U.S. soldiers during what is known as the Great Sioux War of 1876–77, including diaries by:

- Private William W. Jordan, Company C, 14th Infantry;
- First Lieutenant Frank Taylor, Company I, 14th Infantry; and
- Trooper William F. Zimmer, Company F, 2nd Cavalry.

In addition, Dr. Greene has published accounts by Captain Anson Mills, the initial commander at the Battle of Slim Buttes (September 9, 1876); and Second Lieutenant Alfred C. Sharpe, who fought in an engagement at Spring Creek (October 15–16, 1876).

These diaries and accounts can be found in the references shown on page 9. Additional reading can be found in:

- Greene, J.A., ed. 1993. Battles and skirmishes of the Great Sioux War, 1876–1877: The military view. Norman, OK: University of Oklahoma Press.
- Greene, J.A., ed. 1994. Sioux and Cheyenne: Indian views of the Great Sioux War, 1876–1877. Norman, OK: University of Oklahoma Press.
- Greene, J.A. 2003. Morning Star Dawn: The Powder River Expedition and the Northern Cheyennes, 1876. Norman, OK: University of Oklahoma Press.
- Martin, G., ed. 1996. With Custer on the Little Bighorn. (The journal of William O. Taylor.) New York, NY: Penguin Books.

to maintain and improve habitat for bighorn and domestic sheep.

Yet the wilderness concept embodied in the Wilderness Act of 1964 fails to recognize the role that cultural fires played in shaping some wilderness landscapes. The notion of wilderness as "an area where the earth and its community of life are untrammeled by man" is predicated on an outdated belief that American Indians had neither the means nor the desire to use technologies such as fire to shape ecosystems to their liking.

Based on that mistaken belief, interagency wildland fire policy now prohibits prescribed fire use in wilderness areas. Fire managers must wait for natural ignitions, which might come in a place where or at a time when wildland fire use would pose too great of a risk of a fire escape. The wilderness resource might suffer as a result.

> The West is dead my friend
> But writers hold the seed
> and what they saw will live
> and grow
> Again to those who read
> – C.M. Rusell, 1917

It's time to reevaluate the outdated thinking behind the proscription on prescribed fire use in wilderness areas. The use of cultural fires in wilderness areas during late summer or fall would allow fire managers to reintroduce fire at a time and place that will reduce the chance of an escaped fire. In addition, the use of late-season cultural fires could help the Federal agencies build a more permanent and professional fire management corps.

Acknowledgments

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Blackfeet Fire Use in Battle*

In September 1835, Osborne Russell and a party of fellow trappers were attacked by "about 80 Blackfeet." The party was camped several miles west of the Madison River in what is now southwestern Montana, near present-day Yellowstone National Park. Located in grass surrounded by "thicket," the campsite was overlooked by two bluffs, one covered "with tall pines … approaching within 40 yds of us," the other "with thick groves of quaking asps." Osborne's account shows that American Indians used fire to drive enemies from cover and that early frontiersmen used backfires for fire protection.

[T]he Indians had gained the bluffs and commenced shooting into the camp from both sides. … In the meantime we concealed ourselves in the thicket around the camp to await a nearer approach, but they were too much afraid of our rifles to come near enough for us [to] use Ammunition - we lay almost silently about 3 hours when finding they could not arouse us to action by their long shots they commenced Setting fire to the dry grass and rubbish with which we were surrounded: the wind blowing brisk from the South in a few moments the fire was converted into one circle of flame and smoke which united over our heads. This was the most horrid position I was ever placed in death seemed almost inevitable but we did not despair but all hands began immediately to remove the rubbish around the encampment and setting fire to it to act against the flames that were hovering over our heads: this plan proved successful beyond our expectations Scarce half an hour had elapsed when the fire had passed around us and driven our enemies from their position. At length we saw an Indian whom we supposed to be the Chief standing on a high point of rock and give the signal for retiring.

* From Russell Osborne, *Journal of a Trapper: Or Nine Years in the Rocky Mountains, 1934-1943* (original manuscript, Utah State Historical Society; on the World Wide Web at <http://www.xmission.com/~drudy/mtman/html/ruslintr.html>).

American Indian Fire Use in the Arid West

Gerald W. Williams

American Indians have been living on the North American Continent for at least 12,000 years and possibly much longer. Over many millennia, Indians used almost every part of the continent, including arid landscapes in the West.

In the arid West, tribes used the different landscapes differently. They visited the mountains during summer and fall, leaving before the snows came. In winter, they stayed in the valleys and lowlands, where deer were plentiful and the climate was usually wet and mild. Still, the forests and mountains were vitally important, supplying food, shelter, and materials for clothing.

Early Documentation

Where arid and semiarid landscapes were not already to their liking, the Indians often changed them. The easiest method for changing the environment was to burn the vegetation. Documentation is difficult to find, because most Indian cultures did not have writing. Their methods for changing the landscape were passed along orally.

However, Indian fire use in the arid West was documented by European explorers beginning in the 1500s. Of course, recording native land use practices was not a priority for the explorers, and the records they left are often haphazard and fragmentary. Moreover, the visitors rarely understood the importance of what they were seeing. They generally believed that the landscapes they found were entirely natural (see the sidebar on page 11).

Where arid and semiarid landscapes were not already to their liking, American Indians often changed them.

Alvar Nuñez Cabeza de Vaca (1905), one of the earliest visitors to the arid West, is a good case in point. Arriving in the region in the 1530s, he mentioned that Indians in what is now Texas burned the plains and timber. The purpose, he said, was to drive off mosquitos, gather lizards, kill deer, and "deprive the animals [deer] of pasture, compelling them to go for food where the Indians want [them to go for easier killing]." He did not draw a connection between the fires he saw and the open landscapes he found.

Such accounts suggest that tribes routinely used fire long before the coming of the Spaniards. Indians applied fire to the land to renew the biota they needed to survive—for example, to regenerate the forage and thereby to concentrate bison herds in certain places for hunting. The ecological impacts were extensive. Southwestern landscapes, notably the open ponderosa pine forests that came to symbolize the American West, were highly adapted to frequent fires, including those intentionally set by the original inhabitants (Alcoze 2003).

But by the 1840s and 1850s, when settlers from the United States began arriving in great numbers, many tribes in the arid West were already on the verge of extinction. Imported diseases, such as smallpox, malaria, and influenza, had destroyed up to 90 percent of the native population. The early demise of so many tribes meant that an entire way of life was gone by the 1850s, never to be restored.

Later Documentation

Nevertheless, broadcast burning was so useful for the Indians that it persisted into the early 20th century. In the early 1850s, Howard Stansbury (1852) noted Indian-set fires in the Huntsville area of Utah. A.W. Whipple (1854) also noted Indian-set fires near Purcell and Chickasha, OK. Major William Thornton (n.d.) observed two signal fires in 1855 along the Arkansas River in southern Colorado. He then sent a scouting party "to examine the conditions of a large prairie fire, which had been lighted by the Indians and appeared to be approaching us."

In 1870, John Wesley Powell (1878), the famous explorer and mapmaker for the U.S. Geological Survey, reported Indians burning the land throughout the mountains of Utah. Powell deplored the practice, claiming that "the fires can,

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Presettlement North America: A *Tabula Rasa?*

Many people believe that North America was originally a pristine and natural wilderness covered by ancient forests. Rather amazingly, millions of American Indians were supposedly "transparent in the landscape, living as natural elements of the ecosphere. Their world, the New World of Columbus, was a world of barely perceptible human disturbance" (Shetler 1982). The notion of presettlement North America as a peaceful, mythical, magical world—sometimes referred to as a *tabula rasa* (from the Latin for clean slate, meaning an original land without features, empty and free)—has influenced the modern environmental movement.

However, as Daniel Botkin (1995) has pointed out, Indians "had three powerful technologies: fire, the ability to work wood into useful objects, and the bow and arrow.

> To claim that people with these technologies did not or could not create major changes in natural ecosystems can be taken as Western civilization's ignorance, chauvinism, and old prejudice against primitivism—the noble but dumb savage. There is ample evidence that Native Americans greatly changed the character of the landscape with fire, and that they had major effects on the abundances of some wildlife species through their hunting."

The notion of North America as a *tabula rasa* has roots in the experience of early European explorers. In the 1500s and 1600s, when European explorers first traversed many parts of North America, they found many areas emptied of their original inhabitants. A number of Indian populations were already on the verge of collapse, decimated by new diseases such as smallpox and influenza, against which they had no immunity.

In addition, warfare (with old enemies and the new immigrants), new technologies (horses, ironware, and firearms), new methods of making a living (such as sheep grazing or European-style farming), new food sources (through Federal handouts on reservations), new restrictions on movement (by treaty), and forcible removal from ancestral lands all disrupted traditional ways of life. Another huge cultural change, usually in areas dominated by Spanish missions, was the adoption of Catholicism at the point of a sword. The missions also changed traditional land uses, sometimes indenturing Indians as servants.

Each of these influences had far-reaching consequences, some positive but many negative, on Indian cultures and populations. As a result, European explorers and settlers rarely saw or understood the cause-and-effect relationships between traditional Indian land use practices and the landscapes they found. Unwittingly, they created the myth that nature had shaped everything. To this day, the myth persists that enormous landscapes, such as the entire State of West Virginia, were never populated by American Indians.

then, be very greatly curtailed by the removal of the Indians" and that "once protected from fires, the forests will increase in extent and value."

Franklin B. Hough, chief of the USDA Division of Forestry, documented in his *Report on Forestry* (1882) that in 1880 Indians set fires in Houston County, TX; in Douglas, Boulder, Rio Grande, and Weld Counties, CO; in Beaver, Kane, Salt Lake, and Sevier Counties, UT; and in Colfax, Moa, and Socorro Counties, NM. Cornelius Shear

> Broadcast burning was so useful for American Indians that it persisted into the early 20th century.

(1901) noted that Indians set fires in West Texas, New Mexico, and Arizona to improve grazing. R.L. Hensel (1923) noted Indian-set fires on the Santa Rita Range Reserve in Arizona. David Jurney (in press) noted many recorded instances of Indian-set fires in the Gulf Coast area, especially in Texas and Arkansas. Aldo Leopold (1924) mentioned Indian-set fires near Prescott, AZ.

Many observers simply noted that Indians set fires in the arid country, without attributing the fires to any particular tribe or band (Cabeza de Vaca 1905; Darrah 1951; Hensel 1923; Hough 1882, Jurney [in press]; Leopold 1924; Shear 1901; Stansbury 1852; Thornton n.d.; Whipple 1854; Williams 2003). But

many reports, books, and articles also mention specific tribes (see the sidebar).

Purposes and Techniques

Henry T. Lewis (1973) listed 70 different reasons why Indians ignited the vegetation. Other writers have listed fewer reasons using different categories (Kay 1994; Russell 1983). From more than 300 studies describing or mentioning Indian fire use (Williams 2003), I derived 11 major reasons:

- Hunting,
- Managing crops,
- Improving growth and yields in wild plants,
- Fireproofing areas,
- Collecting insects,
- Managing pests,
- Fighting wars and sending signals,
- Extorting goods from other people,
- Clearing areas for travel,
- Felling trees, and
- Clearing riparian areas.

Many accounts attribute purposeful burning by Indians to their desire for "mosaics, resource diversity, environmental stability, predictability, and the maintenance of ecotones" (Lewis 1985). Many fires were deliberately set to partially open up the landscape, thereby increasing the variety of habitats and resources available for consumption. William Cronon (1983) described "two ways of living, two ways of belonging to an ecosystem":

1. Modifying the environment to enhance nature's abundance, and
2. Changing the natural order to increase production.

Generally, Indians used the first method, burning to promote landscape diversity. Ecotones and edge effects gave tribal peoples greater security and stability in their lives. By contrast, white settlers generally preferred the second method. Through farming and grazing, they created more uniform ecosystems, thereby increasing food supplies and leading to the development of towns and cities.

To achieve the desired effects, Indians carefully chose where and when to burn. In the arid West, they extensively burned the prairies and low hills. There is less evidence that they burned forests in the mountains (Booth 1994). Of course, far fewer white people traveled into the mountains, so fires set there might have escaped detection.

Indian-set fires differed from natural fires in location, seasonality, frequency, and intensity. For example, lightning fires typically burn in middle to late summer, whereas Indian fires in the hills and valleys tended to be set during fall to help promote plant growth during winter.

Indians tended to burn ecosystems and habitats differently, depending on the resources being managed. They rarely set fires when forests were susceptible to crown fires (Pyne 1995). Tribes set fires that,

Who Burned the Land?

Fire use on a landscape level is not documented for every tribe or band in the arid West. Some tribes might not have used fire, or perhaps nobody saw and recorded its use. However, documentation exists for large-scale fire use by dozens of tribes in the region (Williams 2003), including:

- Apache (Bell 1870; Gifford 1940; Moore 1972; Seklecki and others 1996; Swetnam and Baisan 1996; Williams 2003);
- Arapaho (Kephart 1916);
- Cocopa (Castetter and Bell 1942; Drucker 1941; Hough 1882);
- Havasupai (Spier 1928);
- Hopi (Gifford 1940);
- Karankawa (Foster 1998);
- Maricopa (Drucker 1941);
- Mohave (Castetter and Bell 1942; Drucker 1941);
- Navajo (Gifford 1940; Hill 1938; Hough 1882; Stewart 1942);
- Osage (Irving 1832);
- Paiute (Chavez and Warner 1976; Drucker 1941; Fowler 1986; Steward 1941, 1943; Stewart 1942);
- Papago (Drucker 1941);
- Pima (Drucker 1941; Rea 1979);
- Pueblo (Gifford 1940);
- Santa Ana (Gifford 1940);
- Shoshone (Bryant 1948, 1951; Egan 1917; Steward 1938, 1941, 1943);
- Tohono O'odham (Lewis 1994);
- Ute (Gifford 1940; Lewis 1994; Stewart 1942);
- Walapia (Drucker 1941);
- Yavapai (Drucker 1941); and
- Yuma (Castetter and Bell 1951; Drucker 1941).

Many fires were deliberately set to partially open up the landscape, thereby increasing the variety of habitats and resources available for consumption.

for the most part, did not destroy entire forests or ecosystems, were relatively easy to control, and were designed to encourage new plant growth.

Impacts of Fire Use

Some people disagree that Indians used fire on a scale large enough to affect ecosystems (Vale 2002; West 1988). One author called the idea that Indians purposely burned forests to preserve them "preposterous" (Coman 1911). Until the 1980s, according to Stephen J. Pyne (1995), "the question of 'Indian burning' was a quaint appendix to fire management." For example, a classic textbook on fire control from the 1970s found it "at least a fair assumption that no habitual or systematic burning was carried out by the Indians" (Brown and Davis 1973).

Many people still believe that the enormous burned areas found by John Wesley Powell and others in the arid West were naturally caused by lightning (Barrett and Arno 1982; Seklecki and others 1996). Indeed, the West gets thousands of lightning strikes each year, including many that start fires. However, most lightning tends to strike rocky outcrops and other places not conducive to ignition; and most of the small snag fires that do start are quickly extinguished by rain or eventually go out on their own. It seems highly unlikely that the extensive fire effects observed in the presettlement West, especially at lower elevations, can be attributed to lightning.

Many of those fire effects are inscribed in the ecosystems themselves. Early travelers noted the open, parklike appearance of many dry western forests at lower elevations, especially ponderosa pine. Noting the fire scar record in the old pines, Harold Weaver (1967) observed that "fires occurred as frequently as fuel accumulated in sufficient quantity to support combustion over the forest floor, whenever weather conditions were favorable, and whenever lightning strikes or Indians caused them to start." Such fires generally occurred at intervals of 1 to 5 years.

Indian-set fires differed from natural fires in location, seasonality, frequency, and intensity.

Although there is no way to tell for sure how many of these fires were human caused, it seems likely that most of the acres burned were due to Indian-set fires. Daniel Botkin (1990), George Gruell (1985), and Samuel Wilson (1992) all noted dramatic changes in the landscape after tribes were removed to reservations or decimated by war and disease. "After the Indians died or moved away," observed Wilson (1992), "the Europeans began to describe the forest as dense and scrubby, with impenetrable thickets of vegetation beneath the woodland canopy."

Stephen J. Pyne (1982) observed that "the modification of the American continent by fire at the hands of Asian immigrants [American Indians] was the result of repeated, controlled surface burns on a cycle of one to three years.… So extensive were the cumulative effects of these modifications that it may be said that the general consequence of the Indian occupation of the New World was to replace forested land with grassland or savannah, or, where the forest persisted, to open it up and free it from underbrush."

Land Management Implications

The results astounded white explorers and settlers, who sent back glowing reports of the lands they found. The wonderful prairies filled with grasses higher than a horse's back were powerful magnets for people who wanted to make a fresh start in a new world. The early settlers transformed millions of acres in the arid West into farms and pastures—and eventually into highways and cities.

The settlers recognized—and often adopted—fire use as a powerful tool for managing the southwestern prairies and hills. The practice of burning large landscapes, also widespread in the South, became known as "Paiute forestry," a direct but derogatory reference to southwestern tribal burning habits (Greeley 1920, Hough 1882, Jurney [In press], Saveland 1995, Schiff 1962). Beginning in the late 19th century, such practices were discouraged by the States and, later, by the USDA Forest Service because of fire damage to young trees, watersheds, and game animals.

Without periodic fire, ecosystems have changed in many parts of the West. Native trees are dying from insects and disease, and highly flammable woody vegetation has built up in forest understories or invaded grasslands. Whether still growing or dead, these materials are fueling uncharacteristically severe fires in the West, often with catastrophic results.

Although little of the original open prairie remains, Federal and State agencies still manage millions of

acres of forest and rangeland in the arid West. Today, under the ecosystem-based approach to Federal land management, reintroducing Indian-type fire is a distinct possibility. But managers often find themselves stymied by controversy or lack of funds.

Overlooking the interaction of Indians and ecosystems has often led to the erroneous conclusion that people are a problem in the "natural" ecosystems of the Southwest. Actually, people must become part of the solution: As the record of Indian fire use shows, people were the primary force in the development of many western ecosystems, and the virtual disappearance of that force often ails the land today. Land managers can benefit from that insight.

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American Indian Influence on Fire Regimes in California's Coastal Ranges*

Jon E. Keeley

Understanding the historical pattern of human impacts on landscapes is critical to correctly interpreting the ecological basis for vegetation distribution. In some parts of the world, such as the Mediterranean Basin, a long and intensive utilization of resources has greatly altered the distribution of forests and woodlands. Was vegetation distribution in the coastal ranges of California similarly influenced by humans before Euro-American colonization?

Was vegetation distribution in the coastal ranges of California influenced by humans before Euro-American colonization?

Figure 1—*Vegetation mosaic in the coastal ranges of California. Such commonplace scenes in coastal California originated when human-caused fires became frequent enough to open the native chaparral. Photo: John E. Keeley, U.S. Geological Survey, Sequoia Kings Canyon Field Station, Three Rivers, CA.*

Fire-Dependent Landscape

The natural vegetation in much of California's coastal ranges has long been chaparral shrubland. Natural grassland is widespread only on the very arid interior margins of the central and southern coastal ranges. On less arid sites on coastal slopes, the natural dominant cover is shrubs rather than grasses and forbs.

Historically, fire seems to have played a key role in opening up the native shrublands. Today, grasslands dominated by nonnative plants cover about 25 percent of the landscape (fig. 1); less than 1 percent of these grasslands have a significant native grass presence. Ecological studies in the coastal ranges have failed to discover any clear soil or climate factors explaining grassland and shrubland distribution patterns. However, shrubland communities are readily displaced by annual grasses and forbs under high fire frequency.*

Natural fire frequencies from lightning are low in the coastal ranges. Modeling studies and circumstantial evidence, such as fossil pollen and charcoal deposition, suggest that fire return intervals were shorter where American Indians were present than natural ignitions would explain. Today, humans are responsible for the vast majority of ignitions in the region. The same was likely true before Euro-American colonization.

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* Based on Jon E. Keeley, "Native American Impacts on Fire Regimes of the California Coastal Ranges," in *Journal of Biogeography* 29 [March 2002]: 303–320.

* For more information on fire regimes in coastal California, see Jon E. Keeley, "Fire and Invasive Plants in California Ecosystems," *Fire Management Today* 63(2) [Spring 2003]: 18–19.

Even before Europeans arrived, the coastal ranges of California had relatively high human population densities. Agriculture was unknown in the region, and marine or riverine resources were not enough to sustain the high populations. Terrestrial resources were key. For example, we know from archeological evidence that American Indians used mortars, pestles, and other milling devices to grind acorns as well as seeds from native grasses and forbs.

The native shrublands formed dense, impenetrable stands with limited resources for American Indians. Lightning fires would not have been frequent enough to maintain the open shrublands/grasslands that people needed to subsist in high numbers. However, an additional human subsidy of ignitions readily produces such landscape mosaics.

Purposes for Burning

American Indians would have had strong reasons for using fire to convert dense chaparral into an open mosaic of shrubland/grassland:

- ***Increasing seed, bulb, and fruit production.*** Shrublands converted to herbaceous associations would have been dominated by important plant resources. For example, chia was one of the richest sources of fat in the American Indian diet.
- ***Increasing habitat for game.*** Repeated burning produces grassland with patches of shrubland, excellent habitat for game such as deer, valley quail, brush rabbit, and mourning dove.
- ***Increasing water resources.*** Conversion of chaparral to grassland increases annual streamflows by reducing evapotranspiration. By using fire to keep streamflows perennial, American Indians would have obviated the need for seasonal migration when streams dried up.
- ***Reducing hazards.*** American Indians shared the top of the food chain with the highly feared grizzly bear, now extinct but formerly widespread in the coastal ranges. By using fire to reduce chaparral near villages, American Indians would have diminished the threat of being surprised by bears, ambushed by human enemies, or overrun by wildfires driven by dry Santa Ana winds.
- ***Facilitating travel and resource extraction.*** Travel through chaparral is nearly impossible without extreme epidermal abrasion. Frequent burning would have cleared routes for travel and helped reveal mineral resources such as steatite, tourmaline, and clay, which were quarried and used in food processing, hunting, and decorations.

American Indians would have had strong reasons for using fire to convert dense chaparral into an open mosaic of shrubland/grassland

For many reasons, American Indians used fire to convert a large part of California's coastal landscape from shrubland to grassland. Holocene peoples performed similar agropastoral modifications of ecologically related shrublands in the Mediterranean Basin. Much of the converted California landscape was subsequently maintained by Euro-American colonizers as pasture.

Management Implications

Understanding the role that American Indians played in shaping vegetation patterns in California's coastal range is critical for today's land managers. Woody vegetation was likely the natural dominant cover over large stretches of landscape, including areas that today are grasslands dominated by nonnative species. Attempts to introduce native bunchgrasses in such areas, in the mistaken belief that they were the dominant natural vegetation before Euro-American colonization, might be misguided and will likely fail.

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Reports of American Indian Fire Use in the East

Hutch Brown

Fire use by American Indians has long been a contentious subject. Pyne (1995) noted that fire use by native peoples to alter ecosystems is almost universal, a contention supported by a growing body of studies (see the sidebar). They include a recently published, long-ignored study from 1954 by Omer C. Stewart, introduced by the anthropologist Henry T. Lewis and the ecologist M. Kat Anderson. Stewart (2003) marshaled compelling evidence that American Indians used fire to shape ecosystems all across the continental United States.

By contrast, a collection of articles published in 2002 raised doubts about native fire use in North America (Vale 2002). The authors argued that the scale of American Indian fire use has been greatly overblown. They made a good point: Records and eyewitness accounts of wildland fires set by American Indians are relatively sparse. In fact, the scale of American Indian fire use and its impact on the land will probably never be fully known anywhere with absolute certainty. Too much depends on extrapolation from fragmentary historical, biological, archeological, and paleoecological evidence.

Hough's 1882 Study

Yet the evidence remains too strong to simply dismiss or ignore. A good example comes from Franklin B. Hough's ground-breaking *Report on Forestry* (1882). Hough, the first chief of the USDA Division of Forestry, reported to Congress on the condition of forests in the United States at a time of growing concern over forest destruction and resource waste. His study contains a long section on wildland fires, including many reports made by Hough's correspondents in the field

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The evidence that American Indians used fire to shape their environments is too strong to simply dismiss or ignore.

References on American Indian Fire Use

Literature on the ecological impact of wildland burning by American Indians has been growing since the ground-breaking studies by Omer C. Stewart in 1954 (Stewart 2003) and E.V. Komarek in the 1960s (Komarek 1965, 1967, 1969). Still, the scattered pieces of evidence have long appeared inconsequential, partly because scholars have treated them in isolation.

Now a comprehensive 112-page list of references is available on fire use by American Indians in North America (Williams 2003). The list draws on bibliographies from many articles, reports, chapters, and books on the subject. It has hundreds of entries; many are annotated. The sources are divided into six categories:

- *General North America:* no specific tribe or location;
- *Boreal forests:* Alaska and Canada;
- *East:* east of the Mississippi River, including the Great Lakes region;
- *Rocky Mountains, Southwest, and Great Plains;*
- *California;* and
- *Pacific Northwest:* Oregon, Washington, and the Great Basin.

Looked at in its entirety, the growing mountain of evidence that American Indians shaped ecosystems through the use of fire seems overwhelming. Readers can obtain more information from Gerald (Jerry) Williams, USDA Forest Service, Mail Stop 1111, 1400 Independence Avenue, SW, Washington, DC 20250-1103, 202-205-0958 (voice), 202-205-0885 (fax), gwilliams02@fs.fed.us (e-mail).

(see the sidebar). This article draws on their reports to discuss some of the impacts and implications of American Indian fire use in the East.

By 1880, most surviving tribes were confined to reservations, their traditional way of life either a memory or in severe decline. The few tribes that continued their ancestral way of life, such as some Apaches in the Southwest and some Seminoles in Florida, faced severe pressure from whites. Their land management practices—including fire use—might well no longer have fully reflected their traditions many thousands of years old.

In the East, Government policy and the effects of war and disease had all but eliminated American Indians from entire regions by 1880. In Virginia, for example, where the Jamestown settlers found well-populated rivers and a flourishing Powhatan culture in 1607, almost all American Indians had vanished by 1750.* However, correspondents in States where intact tribes remained or were still remembered often reported burning by American Indians.

> The whole country had "the appearance of a beautiful park. A deer could be seen at a distance of a quarter mile, and a carriage could be drawn in any direction."
>
> –Report from Mississippi

South

A striking example came from P.H. Skipwith of La Fayette County in northern Mississippi, where the Holly Springs National Forest is today. Skipwith recalled first passing through the area in May 1832, when "the Indians were still here." It was, he reported, their "custom to burn the woods every fall, which kept down the undergrowth."

The result was a remarkably open savanna. "The few large post oaks were scattered sparsely over the hills, and the intervening spaces were covered with prairie grass and flowers, giving the whole country the appearance of a beautiful park. A deer could be seen at a distance of a quarter mile [0.4 km], and a carriage could be drawn in any direction."

The Piney Woods of East Texas were once similarly open. "The Indians were formerly in the habit of burning the woods to check the undergrowth, at which time the woods

* According to one source, the Commonwealth of Virginia recognizes eight tribes, two of which have small reservations based on treaties predating the United States. For more information, see the Virginia Museum of Natural History Website at <http://www.vmnh.net/native.htm>.

A 19th-Century Snapshot of Burning Practices

Franklin B. Hough's *Report on Forestry* (1882) contains a section on fire that summarized laws and regulations governing burning in individual States and other countries. It also discussed past large fires, such as the great Peshtigo Fire of 1871. Interestingly, the report made perhaps the first systematic attempt to collect national data from a single fire season—the 1880 fire season.

In his fire season report for 1880, Hough summarized accounts from "correspondents in the several States and Territories," county by county. The correspondents reported on the number of fires, acreage burned, fire cause, fire suppression activities, fire damage, and reasons for any deliberate burning. In effect, Hough delivered a snapshot of fire management in the United States in 1880, including burning by American Indians.

Hough's correspondents were anything but objective observers, and none seem to have been American Indians. Hough himself cautioned that his correspondents relied greatly on hearsay, "for in a great majority of cases the origin of these fires is to them unknown." To the extent that their reports were credible, they offered glimpses of American Indian practices from afar, their interpretations probably colored by prejudice.

Still, report after report mentioned burning by American Indians. Hough counted 21 cases of fires caused by American Indians out of the 464 cases he attributed to "the direct or incidental act of man." Most cases were in the West, where presettlement conditions in many areas were not yet far in the past. But even in the East, some of Hough's correspondents reported past or present native fire use.

"The manner of makinge their boates [sic]," from a drawing in about 1585 by John White near the ill-fated Roanoke colony in what is now coastal North Carolina. Coastal tribes made canoes by using fire to hollow out large trees (foreground). Fire also gave them the technology they needed to fell large trees (background, upper right) and buck the boles (upper left). They would have used the technology not only for boatmaking, but also for agricultural clearing and acquiring timber for village palisades and buildings.

"The woods had been kept burned by the Indians so that there was nothing but large timber when the whites came in."

–Report from Alabama

were vast open savannas," wrote E.C. Douglass from Houston County, where the Davy Crockett National Forest is today. "Now, the undergrowth is destroying the grass and very materially injuring the cattle range."

In southern Florida, American Indians were still burning the woods, according to Dr. R.B. Potter of Dade County. "Frequent fires occurred at intervals in this county from November to June, having been generally set by Seminole Indians or worthless whites," wrote Potter. "… These forest fires existed almost every day at some point in the pine woods during the season above mentioned." The frequent fires killed undergrowth but did "little injury to the large timber."

Dr. S.C. Williams of Calhoun County in northeastern Alabama, near today's Talladega National Forest, described an old custom of firing the woods "for the purpose of keeping down the bushes so as to have a good cattle range." He seemed to suggest that the custom originated with the American Indians, who used fire to maintain an open old-growth forest. "The woods had been kept burned by the Indians so that there was nothing but large timber when the whites came in," wrote Williams. "The burning has been left off gradually, until now it is a rare thing except in the mountains."

Upper Midwest

In northern Minnesota, H. Richardson of Morrison County alluded to fires caused by American Indians. "The people should be more generally informed on the subject [of fire danger], including the Indians who roam about the country," he declared. In Richardson's view, the American Indians were among those responsible for destructive fires.

What Richardson might have meant is illuminated by Hough's summary of an account by Father Peter Pernin, a priest who survived the 1871 Peshtigo Fire. Pernin partly attributed the fire to practices common to the inhabitants of northeastern Wisconsin, including the American Indians. "The hunters and the Indians roam continually through these forests, especially in autumn," he wrote. "… When evening comes they kindle a great fire," and in the morning they leave the embers "without a thought about extinguishing them." The embers ignited surrounding dry leaves and caused widespread fires, generally ignored by the inhabitants so long as they remained harmless surface burns. But a combination of circumstances in 1871 (Haines and Kuehnast 1970) blew them up into a series of tragedy fires across Michigan and Wisconsin.

The ignitions and fuel conditions that contributed to such blowups mostly came from settlers clearing farms, loggers burning slash, and workers building railroads (Gess and Lutz 2002; Pyne 2001; Wells 1968). But by the 1880s, the associated dangers were increasingly clear. Where Indians continued their ancestral burning practices, they took part of the blame.

Northeast

Although Hough's correspondents in the Northeast did not mention American Indian burning practices, Hough himself filled the gap in a section called, "Custom of Burning as practiced by the New England Indians." Hough quoted "colonial records in 1677" that cited "great damage … in the outskirt plantations" from "Indians kindling fires in the woods in the latter part of the yeare [sic]." The record, apparently a court document, called for regulating fire use by the American Indians, confirming Hough's own belief in the need for rigorous fire control.

Hough professed a strong conviction that "Indian traditions" shaped many landscapes through fire use, including "in many instances the prairies" of the East. He pointed out that the "treeless soil in Wisconsin, Michigan, and elsewhere" contained extensive root systems that, "if let alone, would in a very few years make their appearance as young woodlands … by the simplest law of budding [f]rom living roots and natural growth." The trees, he concluded, were "time and again repressed … by fires" deliberately set by American Indians.

Burning Legacy

Particularly in the South and adjoining areas, the decline of traditional American Indian culture does not seem to have reversed some of its effects on the land, at least not immediately. Account after account suggested that surface burns in spring or fall were common and widely tolerated. The fires apparently maintained open forests with large trees and abundant herbaceous cover.

Many of Hough's correspondents described a fiery landscape. "One-tenth part of the county is overrun every year by fires," reported John Pitman of Laurel County in eastern Kentucky, on what is now the Daniel Boone National Forest. From early March until late summer, "fires could be seen most of the time in two or three directions in this and neighboring counties," according to Dr. R. Wood of Amelia County in central Virginia.

> "It is fully demonstrated that where fires are kept out of forests, they soon become so entangled with undergrowth that all other vegetation is blocked off."
>
> –Report from Missouri

Descriptions of a correspondingly open landscape abound. "We have here thousands of acres with nothing to be seen but pine trees and wire-grass," wrote Dr. J.B. Randall from Jefferson County in southeastern Georgia. Maryland's coastal plain, today densely forested unless farmed, mowed, or grazed, featured a woodland "so thin that fires seldom do much damage," according to E.S. Tradwin of Wicomico County. "We have very little undergrowth timber on account of fires," noted W.F. White of Hillsborough County in central Florida, referring to the open pine plains now increasingly rare in the South.

In the Blue Ridge and Allegheny Mountains, which grow heavy woods except on rocky ridgetops, annual "undermining" fires burned in several States, opening up the forest. "The fire merely takes the leaves and bushes, and allows the grass to grow up early in the spring, making a fine range for cattle and sheep," wrote C.C. Smith of Grainger County in eastern Tennessee. In the Pennsylvania Alleghenies, a 10-day burn in May reportedly blackened 8,000 acres (3,200 ha). "On perhaps half of this," noted David C. Lang of Bedford County, "the injury was limited to the young growth of one or two years, the older timber being but little hurt."

Elsewhere, too, many fires were described as killing young trees but leaving large trees intact. William Gibson of Mercer County, on Pennsylvania's border with Ohio, described a large fire as "undermining large trees, completely clearing the ground." A similar report of large surface fires in "debris and young growth" came from B.A. Merritt of Suffolk County on Long Island, NY. According to George H. Ambrose of Levy County in northern Florida, fires "ran over about one township" in March, "killing the young timber, but doing but little damage to the older growth."

Burning Purposes

Where did all this fire come from? Surprisingly, Hough's correspondents reported only three instances of lightning fire. Although many fires were reportedly accidental, most were deliberately set, particularly in the South. Purposes ranged from clearing farmland, to stalking or smoking out game, to finding chestnuts under leaves in the fall, to regenerating forage for cattle.

In the upper Midwest, clearing land seems to have been the primary purpose for burning; in the South and adjoining areas, it was regenerating forage. "Ninety-five per cent [sic] of the fires in the woods are caused by persons who want to

range cattle in the mountains," reported W. Milner from Virginia's Shenandoah Valley. "Forest fires occur to a greater or less extent annually; a few are caused by accident, nearly all are started by persons who wish to pasture their cattle," wrote J.W. Yeley of Vinton County in southern Ohio, near what is today the Wayne National Forest.

American Indians had analogous purposes for burning. The mention by Hough's Mississippi correspondent Skipwith of being able to see a deer at a quarter mile suggests that spotting game was one purpose. Today, game is often hidden from view in the East's dense forest undergrowth, even if the animal is only a few dozen yards away. Burning would have opened up the woods, increasing chances for hunting success. In Hough's day, Southerners continued "to burn the undergrowth, so that they can better see the game," according to an Arkansas correspondent.

Moreover, the rich prairie vegetation would have afforded better forage than the sparse herbaceous layer on the shady floors of today's dense woods in the South. Hough's Florida correspondent Potter, who lumped the Seminoles together with "worthless whites" for burning in the woods, suggested that whites and Indians had the same purpose for fire use. Florida law, according to J.W. Keyes of Calhoun County, allowed people to "burn the woods" at certain times "so that new grass may spring up for stock." The grass would have been equally good for deer. Such accounts suggest that settlers adopted native burning practices and adapted them to their own purposes, for example using fire to regenerate forage for cattle rather than game.

Pine plantation underburn on the Croatan National Forest in North Carolina, March 2001. Today's fire use in southern pine forests has roots in ancestral burning practices by American Indians. Photo: Ken VanBuskirk, USDA Forest Service, Olympic National Forest, WA, 2001.

Burning Decline

By 1880, the culture of light burning was under attack. Many of Hough's correspondents frowned on fire use and called for its prohibition, arguing that it did long-term damage to forests. Hough himself shared their views. Indeed, the entire purpose of the section on fire, he explained, was to highlight "the importance of the injuries that are done to forests by running fires" and the need for legislation to stop the damage.

Where fire exclusion was already in effect, the land had dramatically changed. W.L. Scroggs of Dade County in southwestern Missouri described his area as "two-thirds prairie land, and the fires that do damage here are prairie fires." However, with so much of the land now fenced and under cultivation, fires were "few and far between." The result was a striking resurgence of woodland. "I have lived in this county thirty-three years," wrote Scroggs, "and it is my opinion that there is as much as 500 per cent more of timber in the county now than then."

In northern Mississippi, the fire-maintained savanna described by Skipwith soon disappeared after "a penalty was imposed by law for setting fire to the woods." As a result, "a thick undergrowth of black-jack [oak] has grown up, effectually destroying the grass and flowers." On North Carolina's coastal plain, W.M. Baldwin described a similar successional process after fires "happily" stopped 20 years before. In many parts of the East, the dense woodland so familiar today got its start at about this time.

Lost Biodiversity

Skipwith was not the only correspondent to suggest that losing fire meant losing biodiversity. "It is fully demonstrated," wrote L.J. Roach of Camden County in south-central Missouri, "that where fires are kept out of forests, they soon become so entangled with undergrowth that all other vegetation is blocked off." The mixed landscape of forest and prairie found by early settlers in many parts of the East was becoming a thing of the past. "Twenty-five years ago our openings were sparsely covered with

large burr and white oak trees," observed E. Reynolds of Fond du Lac County in southeastern Wisconsin. "They [the openings] have all disappeared."

Another report came from L. Ballard in Monroe County, on West Virginia's border with Virginia. "We have fires annually in Peter's Mountain, one of the Alleghenies, usually in the latter part of April, or first of May, but occasionally in autumn," wrote Ballard. "They are usually set for the purpose of increasing the range." The fires extended "some 25 miles [40 km] in length, by from 3 to 10 [5–16 km] in width," doing "immense damage to the young timber." By implication, large trees survived and a flourishing layer of grass and herbs furnished rich forage for cattle.

But in the 20th century, the fires stopped in the area known as Peters Mountain, much of which is now on the densely forested Jefferson National Forest in Virginia. In the 1980s, researchers discovered that an endangered flower, the Peters Mountain mallow, requires fire to germinate. Prescribed burns on protected land have since brought the flower back from the edge of extinction.

The Peters Mountain mallow evolved with fire and depended on it for survival. The flower probably flourished under the frequent fire regime described by Ballard, then almost disappeared after several decades of fire exclusion. The implication is clear: Peters Mountain must have been burning for hundreds or thousands of years in fires set by American Indians. Otherwise, the Peters Mountain mallow would never have evolved or would have perished long before.

Management Implications

What does it mean for land managers today that American Indians in the East likely used fire to shape landscapes to their liking? Over the last four centuries, the land and its use have irrevocably changed. Many eastern forests are probably far more dense than they were at the time of European settlement (Pyne 1982). Almost everywhere, land managers are preoccupied by threats from invasive species and loss of open space. Conditions will never again be the same as those found by the first European explorers.

Still, many ecosystems in the East evolved with fire. For land managers to protect and restore healthy ecosystems, they must understand the role that human-caused fire might have played in the structure, function, and composition of forests in the East for thousands of years. For example, American Indians tended to use fire to create landscape mosaics and thereby increase resource diversity (Williams 2000). Judiciously applied, such insights might help land managers better "think like a forest" (Oelschlaeger 2003) in finding local solutions that work for the land.

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Early Voices for Light Burning

Hutch Brown

Forests and fires don't mix—or so most people thought throughout much of the 20th century. But in the 19th century, many people thought differently. They believed that some forests needed fire to stay healthy.

A good example came from "a correspondent in Burlington County, New Jersey," who communicated with Franklin B. Hough, the first chief of the USDA Division of Forestry, about burning practices in 1880. In Hough's *Report on Forestry* (1882), the correspondent stated:

> I have had under my care large tracts of growing timber, and have had very little loss from fire. Our plan is to burn over our tracts early in spring, before the sap starts—burning up all the underbrush, leaves, &c. We have found that a fire in February does not hurt the growing timber; and should summer fires come in from adjoining property that has been neglected, they have nothing to feed on but very green leaves, &c., and they are much more easily controlled. Even if they go through the woods they find little to burn; they get up but little heat, and do but little damage. The Pemberton and New York Railroad runs through our tract,* and summer fires are common, but they hardly require looking after, so far as our tract is concerned. I think there should be a law requiring every owner of timber and brush land in our general pineries, to burn all the leaves that may fall during the winter, thus leaving no fuel for summer fires (Hough 1882).

"I think there should be a law requiring every owner of timber and brush land in our general pineries, to burn all the leaves …"

–New Jersey timber manager, 1880

Widespread Fire Use

This voice from New Jersey was echoed in Georgia (see the sidebar on page 24) and later in California and other parts of the South and West (see Carle 2002). Indeed, case after case in Hough's *Report on Forestry,* which helped set the stage for the system of Federal timber reserves that gave birth to the national forests and parks in the United States, suggests that light burning was widespread in the 19th century.

By today's standards, the points made by the correspondent from New Jersey sound remarkably advanced:

- Controlled burns serve specifically to protect large trees from damage by fire, a technique that forest managers today are rediscovering (Friederici 2003).
- Adjoining property is by definition "neglected" when it is not routinely burned, suggesting that fire use in fire-dependent forest types is key to responsible land management.

Hough (1882) printed the report from New Jersey without comment. Elsewhere in his report, however, he warned against such views. "In our reports from correspondents," he declared, "it will be seen that in some instances whole communities regard these fires with satisfaction …." Hough advocated laws to prevent "the injuries that are done to forests by running fires." As models, he listed laws from Europe, where forest fire was usually condemned.

Transition to Fire Exclusion

Hough's work reflected a transitional period. In Hough's day, people routinely used fire in the woods for purposes ranging from land clearing, to roadbuilding, to slash burning. Just as in developing countries today, the seasonal smoke that filled the air was widely seen as a sign of progress and development. Free-ranging fires were widely ignored unless they threatened farms, mills, and communities.

But the laissez-faire era of forest destruction, based on the belief that America's forest resources were inexhaustible, was coming to a close. By the 1880s, conservationists were decrying the waste and devastation they saw everywhere. Steeped in the principles of

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* Railways were corridors of fire ignited by sparks from 19th-century locomotives in dense early-successional vegetation along railroad tracks. Hough (1882) identified "locomotive sparks" as a major cause of accidental fires.

European forestry, most deplored contemporary burning practices. For example, one of Hough's correspondents from Florida claimed that "it is ever damaging to forests anywhere to burn them over annually," and a correspondent in Alabama called for "legislation that will prevent any person from firing the woods at any time." Hough's work expressed a growing controversy.

In the early 20th century, the fledgling USDA Forest Service became the standard-bearer in the fight against light burning (Arno and Allison-Bunnell 2002; Carle 2002; Pyne 2001). By the 1930s, the fight was practically over. Despite a few stubborn holdouts (Carle 2002; Pyne 1982), the culture of fire control had prevailed.

Uphill Struggle

Today, fire use advocates face a long uphill struggle against a powerful legacy of fire exclusion (Arno and Allison-Bunnell 2003; Carle 2002; Pyne 2000). Fortunately, they can draw inspiration from the early practitioners of light burning, buried and fragmented though much of their story remains. Excellent renditions of the light burning story come from Pyne (1982) and, more recently, Carle (2002).

Light Burning in Georgia

Southern pine forest types once covered some 125 million acres (51 million ha). Much of the area was in open forest maintained by fire (Bonnicksen 2000). In the 19th century, private landowners seasonally burned the pineries as a "safeguard against destructive forest fires" and to "secure this inestimable range for stock," according to Dr. J.B. Randall of Wadley, GA (Hough 1882):

We have here thousands of acres with nothing to be seen but [longleaf] pine trees and wire-grass, the latter, all summer, as green as an oat-field, and affording an unlimited and luxuriant pasturage for cattle, sheep, and goats. Frost kills the grass, and by bur[n]ing off the old sedge in the winter it comes up again in the spring as regular and green as a wheat-field, with no shrubbery or undergrowth to obstruct the view as far as the eye can reach. … It is the accumulation of years that creates these destructive forest fires. Were they burnt off regularly every winter or early in the spring there would seldom be any trouble in controlling the fires.

Today, fire use advocates face a long uphill struggle against a powerful legacy of fire exclusion.

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The author thanks Gerald W. Williams, the national historian for the Forest Service, Washington Office, Washington, DC, for furnishing the section of Hough (1882) on which this article is based.

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Altered Fire Intervals and Fire Cycles in the Northern Rockies*

Stephen W. Barrett

Fire history surveys and subsequent fire regimes classifications provide an important basis for understanding the role of fire in western ecosystems (Agee 1993; Brown 2000; Quigley and others 1996). Information on historical fire regimes can be used to develop ecosystem process models and subsequent management plans at various scales (Brown 2000; Cissel and others 1999; Hardy and others 1998).

> Fuel buildups have promoted a shift toward potentially more severe fires in the frequent-fire regimes.

In 2002, I developed an empirically based fire regimes classification for forests of the Northern Rocky Mountains (table 1) to support subsequent terrain modeling of fire regimes (Jones and others 2002) for land management planning (Barrett 2002). My fire history database generally covers the period before the onset of fire exclusion between about 1900 and 1935 (Arno 2000; Hessburg and others 1999). However, a subset of 421

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* The article is distilled from a contract final report (Barrett 2002) prepared for a recent USDA Forest Service landscape modeling project (Jones and others 2002).

Table 1—*Fire regimes in forests of the Northern Rockies, by mean fire interval, typical tree mortality from fire, and characteristic location.*

Fire regime [a]	*Mean fire interval*	*Tree mortality* [b]	*Characteristic sites/forest types*
NL	10–25 yrs	< 20%	Climax ponderosa pine, dry Douglas-fir, dry grand fir
MS1	25–40 yrs	≤ 30%	*West of Continental Divide:* Warm–dry forests codominated by ponderosa pine, western larch, Douglas-fir, lodgepole pine
			East of Continental Divide: Cool–dry montane forest and adjacent cold–dry subalpine sites; limber pine in foothills bordering Great Plains; Douglas-fir and lodgepole pine bordering intermountain valleys
MS2	40–120 yrs	50–100%	*West of Continental Divide:* Productive or steep sites dominated by western redcedar, western hemlock, moist grand fir, moist Douglas-fir, subalpine fir
			East of Continental Divide: Productive or steep sites dominated by Douglas-fir or limber pine; gentle to moderately steep subalpine sites dominated by lodgepole pine
MS3	50–275 yrs	Variable	Upper subalpine fir, whitebark pine, subalpine larch
SR1	100–180 yrs	80–100%	Productive or steep subalpine sites dominated by lodgepole pine, subalpine fir, Engelmann spruce; juxtaposed with MS regimes
SR2	200–325 yrs	80–100%	Productive or steep subalpine sites dominated by lodgepole pine, subalpine fir, Engelmann spruce; unproductive sites dominated by lodgepole pine; juxtaposed with SR1 regimes

a. NL = nonlethal; MS1 = short-interval mixed severity; MS2 = moderate- to long-interval mixed severity; MS3 = variable-interval mixed severity; SR1 = moderate- to long-interval stand replacement; SR2 = long-interval stand replacement.
b. During or after a fire of typical severity.
Source: Barrett (2002).

plots in the nonlethal (NL) and mixed severity (MS) fire regimes provides direct evidence of fire exclusion.

More Severe Fires

Data from 137 plots in the NL fire regime suggested that the overall mean fire interval (MFI) was 17 years historically, as opposed to 76 years long in the same plots today (fig. 1). Similarly, data from 142 plots in the MS1 regime suggested that the historical MFI was about 30 years long, versus 100 years today (fig. 2). Resultant fuel buildups have promoted a shift toward potentially more severe fires in both the NL and MS1 fire regimes (Arno 2000). However, the increased severity potential might be even more pronounced in MS1 stands because such sites generally are more productive.

Data from 117 plots in the moderately long-interval MS2 fire regime suggested that the overall MFI was 71 years historically, versus 98 years at present (fig. 3). The current fire interval in that regime type is still shorter than the mean maximum interval of 107 years historically, but fire exclusion clearly has lengthened many fire intervals.

Today's fire intervals in the MS1 and MS2 stands thus average about 25 years longer than in NL stands (figs. 1–3). This might seem counterintuitive, because many NL stands occur near major valley bottoms and hence were among the first affected by fire exclusion. A possible reason for the discrepancy is that fuel reduction by livestock grazing might have been more pronounced in areas that had a higher proportion of MS1 than NL terrain (Arno and Gruell 1983; Gruell 1985; Jones and others 2002). In fact, early-day rangers in such heavily grazed regions as southwestern Montana and eastern Idaho extolled the virtues of grazing as an effective fire suppression tool. As for the relatively productive MS2 stands, fire exclusion evidently extended some intervals that began during the 1800s at the height of the Little Ice Age (Barrett and others 1997; Graumlich 1987).

Decline of Whitebark Pine

Interpreting fire exclusion's effects on the high-elevation MS3 regime is inherently difficult because of sparse data and highly variable fire occurrence before 1900. Data from 25 plots suggested that the MFI averaged 135 years long historically, as opposed to only 90 years at present (fig. 4). The current mean interval also is just half the length of the maximum historical interval, suggesting that most stands are still within their historical range of ecological conditions.

At the landscape scale, repeatedly extinguishing fires has contributed to the rapid decline of whitebark pine by favoring successional replacement by shade-tolerant trees.

At the landscape scale, however, repeatedly extinguishing fires has contributed to the rapid decline of whitebark pine by favoring successional replacement by shade-tolerant trees (Brown and others 1994; Keane and others 1990; Murray and others 1998). Even in the expansive Selway–Bitterroot Wilderness of Idaho and Montana, which has one of the longest and most active wildland fire use programs in the United States, mean annual burned area in the subalpine zone has declined dramatically compared to historical rates (Brown and others 1994; Rollins and others 2001).

As for the stand replacement (SR) fire regimes, fire exclusion's effects are not detectable at the stand scale because the natural fire intervals often exceed the length of the fire exclusion period to date (Agee 1993; Barrett and others 1991). However, area fire cycles—the time required to burn an area equal in size to the study area (Romme 1980)—often reveal fire frequency changes in SR-dominated landscapes.

Some researchers (Johnson and others 1990; Johnson and Larsen 1991; Johnson and others 2001) assert that fire exclusion has not affected fire cycles in such forests because climate is the primary controlling force. However, data from two of the largest study areas to date—the 326,000-acre (132,000-ha) east side of Glacier National Park (GNP) in Montana (Barrett 1993b, 1996, 1997b) and the 200,000-acre (81,000-ha) Lamar study area in Yellowstone National Park (Barrett 1994a)—did not support that contention.

Altered Fire Cycles

For the GNP study area, conservative estimates of fire cycles for the 18th and 19th centuries were 225 and 250 years, respectively. The fire cycle for the 20th century, based on observed fires, was 625 years, despite increasingly frequent macroclimatic droughts (Barrett and others 1997; Graumlich 1987) and favorable fire weather during many fire seasons (Finklin 1986). Similarly, the fire cycle between

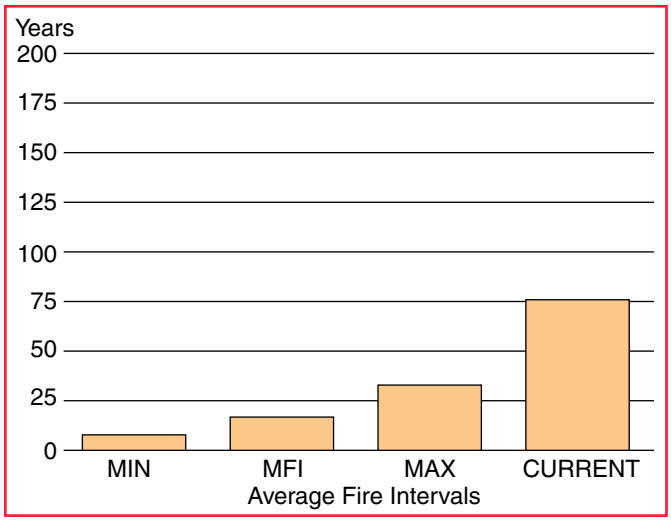

Figure 1—*Historical versus current fire intervals in the NL (nonlethal) fire regime, based on 137 plots sampled between 1979 and 2000. Average historical fire intervals are for the period before the last fire; MIN = minimum fire interval, MFI = mean fire interval, MAX = maximum fire interval. The average current fire interval is based on the number of years between the last fire and the sampling year.*

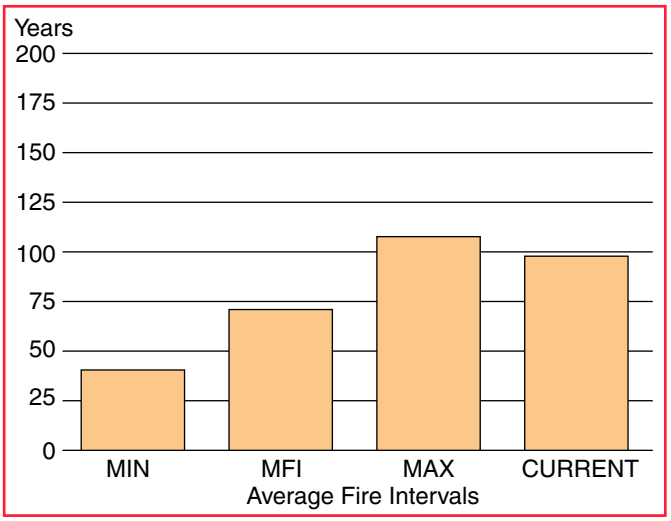

Figure 3—*Historical versus current fire intervals in the MS2 (moderate- to long-interval mixed severity) fire regime, based on 117 plots sampled between 1979 and 2000. Average historical fire intervals are for the period before the last fire; MIN = minimum fire interval, MFI = mean fire interval, MAX = maximum fire interval. The average current fire interval is based on the number of years between the last fire and the sampling year.*

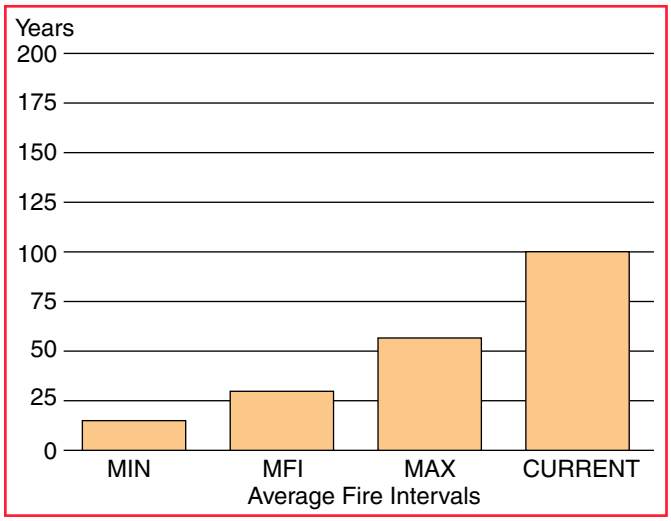

Figure 2—*Historical versus current fire intervals in the MS1 (short-interval mixed severity) fire regime, based on 142 plots sampled between 1979 and 2000. Average historical fire intervals are for the period before the last fire; MIN = minimum fire interval, MFI = mean fire interval, MAX = maximum fire interval. The average current fire interval is based on the number of years between the last fire and the sampling year.*

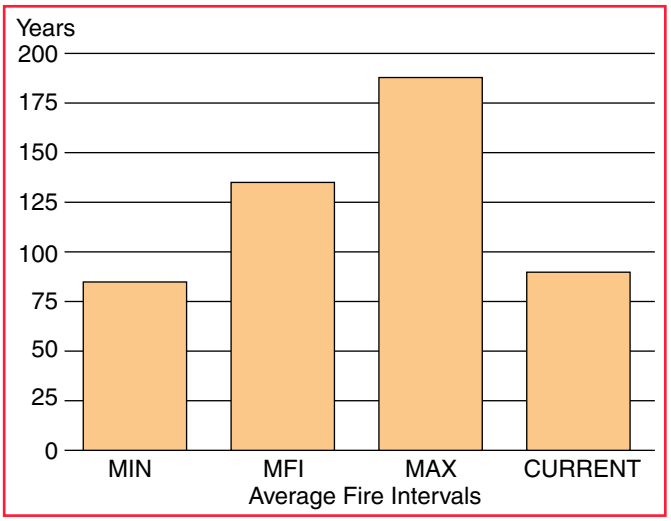

Figure 4—*Historical versus current fire intervals in the MS3 (variable-interval mixed severity) fire regime, based on 25 plots sampled between 1979 and 2000. Average historical fire intervals are for the period before the last fire; MIN = minimum fire interval, MFI = mean fire interval, MAX = maximum fire interval. The average current fire interval is based on the number of years between the last fire and the sampling year.*

1900 and 1987 in the Yellowstone study area—that is, before the extensive 1988 fires (Romme and Despain 1989)—had decreased 15- to 30-fold compared to the 18th- and 19th-century fire cycles. Although the 1988 fires might have been within the historical range of occurrence, I concluded that fire exclusion had been effective because no similar fire-free period had occurred in the pre-1900 fire chronology (Barrett 1994a).

Fire exclusion thus can affect even the relatively long-interval fire regimes (Baker 1993; Keane and others 1998; Romme and Knight 1982), albeit more subtly than the frequent-fire types. Rather than promoting unnatural succession at the stand scale, fire exclusion in the SR, MS2, and MS3 regimes has influenced landscape-scale patterns and processes (Barrett and others 1991; Hessburg and others 1999; Quigley and others 1996). For

example, fire exclusion has promoted "artificially induced mosaic homogeneity" in some areas (Romme and Knight 1982).

The implications of altered landscape mosaics are uncertain. However, fire exclusion might promote reduced biodiversity (Murray and others 1998; Rollins and others 2001; Romme and Knight 1982) and the spread of insect and disease epidemics (Barrett and others 1991; Hessburg and others 1999).

Fire regimes could be shifting as a result of global climate change, but this is still highly speculative (Agee 1993; Morgan and others 2001). Presumably, major climate-induced departures from historical fire regimes would occur over relatively long periods and thus might be detectable largely in hindsight—as occurred with long-term fire exclusion. Conversely, if climate-induced changes in fire regimes were so abrupt as to be catastrophic, restoring presettlement-type forests might be among society's least pressing concerns.

Management Focus

Without firm evidence that historical fire regimes are no longer relevant to ecosystem-based management, those regimes will likely continue to serve as a foundation for forest planning. Ultimately, because forests and fire regimes are affected by many complex and interacting factors, subjectively establishing a desired future condition for any given locale will likely continue as a main focus of forest management.

Fire exclusion can affect even the relatively long-interval fire regimes, albeit more subtly than the frequent-fire types.

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> Fire exclusion has promoted a reduction in biodiversity and might be enhancing the spread of insect and disease epidemics.

WEBSITES ON FIRE*

Real-Time Observation Monitor and Analysis Network

Do you need access to real-time weather data? This Website is for you. Known by its acronym ROMAN, the site gives real-time access to weather observations from networks across the United States. The system displays data in fast-loading formats tailored to the wildland fire community, with an interface that is intuitive, interactive, and dynamic. Complex scripting and high-resolution graphics are minimal to ensure quick delivery of requested products, such as real-time observation monitoring, 24-hour to 30-day summaries and meteograms, precipitation tables, and weather near fires displays. More products are planned, including real-time analysis graphics, NFDRS/CFDRS output, and numerical weather prediction output.

Found at <http://www.met.utah.edu/roman/>

* Occasionally, *Fire Management Today* briefly describes Websites brought to our attention by the wildland fire community. Readers should not construe the description of these sites as in any way exhaustive or as an official endorsement by the USDA Forest Service. To have a Website described, contact the managing editor, Hutch Brown, at USDA Forest Service, Office of the Chief, Yates Building, 4th Floor Northwest, 201 14th Street, SW, Washington, DC 20024, 202-205-0896 (tel.), 202-205-1765 (fax), hutchbrown@fs.fed.us (e-mail).

What Is Fire?
Eleven Ways of Seeing Fire

Students of Wildland Fire Ecology and Management

Editor's note: *As this article shows, wildland fire means much more to the wildland fire community—and to the human community in general—than the science of understanding it and the techniques of managing it.* Fire Management Today *welcomes broad perspectives on the meaning of wildland fire for both our ecosystems and our culture.*

1. As a young boy, I can recall the evenings spent around the campfires of the *indios* who worked my grandfather's ranch. From southern Mexico, they arrived to work the land, *México* by blood and history. At night, around fires in open fields, I listened to stories of buried treasure, ghosts and talking animal demons, and the good that once prevailed on the land. The light of fire gave these stories life, to be repeated again and again; they are no doubt being reborn today somewhere on the land. We are *cosas,* collections of things made up of experiences held together by reflection and thoughts that bind us to this good Earth. We are *hombres del país,* people of the country, of the land, of the soil, of the fires, and all that these imply. Fire begins with stories.

The article was compiled in fall 2002 by students and professors in a class on wildland fire ecology and management at the University of North Texas, Denton, TX. It was edited by two of the class's professors, Dwight Barry and Robie Robinson.

2. The alarm rings at 4:30 a.m. Finally! I'd lain down 6 hours earlier and probably managed to sleep for 3. But that's plenty. I throw my stuff together and pick up my friend. We drive through the dark, our conversation jumping back and forth, reflecting our excitement. As soon as I'd heard about the chance to burn, I'd called him to see if he wanted to go along. Where at? Austin. How big? Thirty-five acres. So we're going to drive a total of 10 hours for a 35-acre burn that may or may not happen? Yep. OK, I'm in. I knew he would be. It makes perfect sense; besides, it really isn't a question of yes or no anymore. It's in our blood, seductive. The world stops for fire. Fire is all consuming.

> The light of fire gives stories life, to be repeated again and again, reborn every day somewhere on the land.

3. Carbon—from the Latin word for charcoal—plays a dominant role in the chemistry of life. Carbon's atomic structure contains four electrons in its outer shell, but it can hold eight. This means that a carbon atom can share electrons with up to four other different atoms. In this sense, carbon has the ability to interact with, or "touch," many other elements, and it can form many different compounds of varied types, sizes, and shapes. Fire, too, has many points of contact—plants, wildlife, soil, air, water, people—and it often touches these points simultaneously. In chemistry, fire is used to alter the physical state of a substance. In wildlands, it is an essential ecological process. In agriculture, it is used to prepare sites for farming or grazing. In society, it is used to convert fuel to energy. It can be used to help foster growth and change. Fire is change that touches everything.

4. I can't cross a prairie or a wooded ridge without thinking of how a fire might move through it. The prairie wind driving over the hillside, lighting spots ahead of the flames, effective windspeed the same as 20 feet. Tallgrass and cured sunflowers head high, flame lengths maybe 25 feet and moving faster than you can run; stay out of the way of *that* headfire. The leaves of post oak, crunchy with frost, dried brown and still on the tree, ignite and float easily across the firelines, prescribed fire now wildfire. The tangles of greenbriar, green even in winter, burn poorly but scratch and nick at you, tying up your mobility, a brief moment of panic. You are no longer a tourist. Fire ties you into the land.

5. In military survival training—"Where the Weak are Killed & Eaten"—you are taught the nature of hunger, cold, heat, fatigue, pain, abandonment. And when evasion can no longer be sustained, you create fire. Fire for warmth, fire for a friend, fire for sanity.

Fire is art on the landscape. Trees silhouetted by the advancing Hayman Fire in Colorado. Photo: Steven Smith, Colorado Springs Fire Department, Colorado Springs, CO, 2002.

6. The heat of a grass fire is impossible to grasp unless you've cozied up to a prairie as the torch lights up the grass, the wind pushes the flames, and you feel the heat singe your face. I have seen running crown fires and trees torching like matchsticks only in movies and videos. I have never heard the sounds they say accompany that inferno, the sounds of approaching trains. I once torched an eastern redcedar tree on a prescribed fire; it exploded and reddened my face as I backed away. The firewhirls danced across a field of cedars we burned, tossing 30-foot flames and embers into the air. I'm not sure I ever want to hear the trains, but I know why people throw themselves from burning buildings. Fire is a source of terror and exhilaration.

7. The media portray wildland fire in terms such as destroyed, devastated, and devoured: "It's like a nuclear bomb up there." Biologists use such terms as cleansed, rejuvenated, and enhanced: "The modern tradition of firefighting gives rise to unhealthy forests." Firestorms engulf forests and towns in horrible conflagrations. Ranchers say fire is good for the cows, and my grandfather once read to me from the Bible where it says to burn the weeds in the fields to help the harvest. Fire is an essential ecological process, deeply entwined with the history of life on Earth. We evolved, as well as our habitats, hand in hand with fire. Fire continues to be an evolutionary force, on habitats and human minds, whether we choose to apply or withhold it.

8. Fire connects pieces of the cultural and natural world. Like a broad stroke of paint across a canvas, fire spreads across a landscape. From a distance, as in a Monet, the lines appear clearly formed. However, the closer you get, the forms become quick, short, and imprecise dabs of paint. The boundaries are blurred and the difficulty lies in teasing them apart. Walking the fireline, where fire has ebbed and crept, spilling across and brought up short, I see black ash merging into the golden sandy soil, a brown leaf, a dead wood rat, a boot print, all invisible from a distance. I stand back and watch the forest bloom from the collection of dabs. Fire is art on the landscape.

9. During part of the year, I spend my time checking the weather, hoping for the right combination of wind, humidity, and temperature, so that I can meet a prescription. During the other part of the year, I spend my time watching the weather so that I can see where wildfires might break out. During both times of the year, the weather tells me what kind of fire I might encounter and how hard it will be to control. For half the year, I am reintroducing fire into nature; and for the other half, I am taking it away. I set "good" fires and attack "bad" ones. Fire consumes my contradictions. Fire doesn't care about paradoxes.

10. The bagpipes began playing, the pictures of the men were displayed, and the television cameras panned across our crews of yellow and green spread across the grandstand. We fought to hold back the tears, thinking of these lives lost. Lives of two men we never knew, but bound to us by a connection, men who died doing what we were setting out to do. Fire brings death and sorrow—and connects a brother- and sisterhood stronger than you ever expected. Fire is family.

11. A South-Texas-born park ranger lights a cigarette and throws down the match onto a dry grassy pasture. It is his definition of prescribed fire. He watches it burn with the wind, smiles, and talks about the "old days." A college-trained natural resource manager talks of fire modeling, fire dynamics, and fire ecology. The old meeting the new—whom do you believe? ■

The Ying and Yang of Wildland Firefighting*

Jeff Connor

In 12 years of wildland firefighting, I had never seen anything like it. The sun was barely visible through the smoke, which was a strange yellowish-green, looking surreal in the early afternoon light. Glancing to the south, I saw flames from the approaching fire complex swirl up over the ridge. The fire beast was galloping hard in our direction, heading straight for the town.

Yellowstone in Flames

It was early September 1988, and my crew and I had been on the Yellowstone Fires for almost 3 weeks. The fires had been burning out of control since late June. This was the third fire we had fought.

A cold front, with winds better than 60 miles (97 km) per hour, was pushing the blaze towards Gardiner, MT. Mammoth Hotsprings, to the south, had already been evacuated. The folks driving by looked tired and scared.

Our job was to hold the line, keeping the fire from getting into town. We had six hand crews, including one hotshot crew, along with 10 engines. We were the last bastion. Hundreds of families were relying on us.

During my 24 years as a wildland firefighter, knowing that I had protected someone's home or community has always made my chest swell.

The gale made it hard to stand upright. The flames were eating through sagebrush and pine, drawing ever closer. Just when it looked like we would be swallowed up, the wind shifted. For the first time, I noticed clouds overhead, not smoke.

Clouds were flowing over the burning ridge south of town, like fog drifting in from the sea. The temperature dropped, and flakes of snow began to fall. It was the event Yellowstone had been praying for: The long season of fire was finally ending. Fires would continue to burn for a few more months, but not with the same intensity.

Relief—and Anger

Later that night, as snow blanketed the ground, the residents of Gardiner and Mammoth Hotsprings began to return. No homes had been lost and there was relief, but also anger. Many blamed the USDI National Park Service for what they saw as a park management fiasco.

In reality, the fires were no one's fault. Nature was doing what it does best in times of drought: burn. Whether started by lightning or by

A crew of firefighters snakes up the line to work on a large burnout operation on the Toolbox Fire, Fremont National Forest, OR. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2002.

Jeff Connor is a natural resource specialist for the USDI National Park Service, Rocky Mountain National Park, Boulder, CO.

* The article is based on the introduction to the author's book *Making the Bear Dance: A Naturalist's Journey into the World of Wildland Firefighting* (St. Cloud, MN: North Star Press of St. Cloud, Inc., 2001). The book is a collection of firefighting stories from around the West.

human carelessness, the fires of Yellowstone were following a pattern thousands of years old. Only in the previous hundred years had people crowded into forests that evolved with fire and dared to imagine that fire played no role there.

The next day, as we left town, people waved and put grateful signs in windows. I felt proud to be part of the National Park Service. When a wildland fire becomes the bad guy, the villain burning homes, firefighters become heroes. During my 24 years as a wildland firefighter, knowing that I had protected someone's home or community has always made my chest swell. "Yes!" I think. "I am an American, a firefighter and proud of it!"

Of course, there is another side to the glittering coin. As a wall of flame a hundred feet (30 m) high races in my direction, I have found myself thinking, "What am I doing here?" I can't even count the number of times that we had to get out of the way and "let the big dog eat." Tears have come into my eyes knowing that we would probably not be able to save all the homes of the people who put their faith in us as they drove away.

Fuel Buildups

But seeing the smiles and tears of joy when families return to find their homes still standing has made it all worthwhile. Unfortunately, years of heavy fuel buildups have made such happy endings increasingly unlikely. The ying and yang of firefighting is partly this: By suppressing fire for so many decades, we have let fuels build up to dangerous levels.

Climate change has contributed to the danger. So has our love for building secluded homes in areas where fire is a natural part of the ecosystem. Defending such homes from the inevitable wildfires jeopardizes the lives of both homeowners and firefighters. It's then that firefighters are forced to jump in when they should be standing aside and letting fire do what it is supposed to do.

The Moran Fire leaves a patchwork of burns below the Teton Peaks on Jackson Lake, promising future landscape diversity on Wyoming's Grand Teton National Park. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 2000.

The ying and yang of firefighting is partly this: By suppressing fire for so many decades, we have let fuels build up to dangerous levels.

In much of the Greater Yellowstone area, building a home in the forest is like building on a beach exposed to hurricanes: The question is not whether disaster will strike, but when. As the Yellowstone Fires showed, great fires in ecosystems adapted to great fires do not get put out by firefighters, no matter how many millions of dollars are thrown at them and how many thousands of firefighters risk their lives to battle the beast. Yellowstone had experienced similar fires before, and it will see similar fires in the future. It's only a matter of time.

Hardship and Danger

A lack of sleep is what I hate most about firefighting. I am an 8-hours-a-night type of guy, but I rarely get more than 6 hours of sleep a night on a fire. I have gone for as long as 36 hours without sleep and for 48 hours with maybe an hour or two. The lack of sleep is cumulative and wears me down faster, the older I get. Being tired makes me more susceptible to colds and other complications, as well.

Little sleep, little food, sometimes little water—sore muscles, poison ivy or poison oak, red eyes—all are part of firefighting. I have wit-

nessed firefighters fall asleep standing up; vomit uncontrollably from breathing too much smoke, ash, and carbon monoxide; get burned from falling hot branches; and get knocked down by falling trees. It all comes with the territory.

For those who love the adrenaline rush, danger always lurks over the hill. I have been evacuated off a mountaintop by a helicopter, with a wall of flame not far behind. I've had to run to a safety zone a number of times. I have never had to deploy my fire shelter, but I have thought about it a couple of times. Once I was even shot at for building a fireline into someone's marijuana patch.

I have seen lightning blow up a tree as if it had been dynamited. I have seen it completely envelope a tree in a white ball of electricity, igniting its top. I have seen firsthand what lightning does to humans; I have great respect for it and also great fear, especially when caught in a storm above treeline on some mountaintop.

In many fire-prone areas, building a home is like building on a beach exposed to hurricanes: The question is not whether disaster will strike, but when.

I have often wondered why I do it. The stress of personal danger or worrying about my fire crew wears me down. I am now 52, and the older I get, the more I worry.

Sublime Beauty

But it's all part of the ying and yang of firefighting. Over the years, I have enjoyed traveling around the country battling the beast. I like seeing new mountain ranges, valleys, mesas, and plateaus. I've seen some of the wildest areas of the West, many square miles of open space without human dwellings, where fire-adapted vegetation and wildlife have developed over thousands of years.

The beauty of these places has left fond memories. Many times, I have watched the sun, clouded in smoke, setting behind a mountain or ridge with incredible displays of orange and violet. I've watched the sunrise shrouded in smoke the next morning. I've watched a full moon rise over a valley while I stood high on a ridge or mountaintop.

Sometimes I've seen wildlife behave as if nothing is happening while the forest burns nearby. At other times I have witnessed wildlife running in panic from a wall of flame. Once, a bear with its back smoldering from fallen ash ran down the fireline, scattering firefighters left and right. Most of the time, the wildlife gets away, but not always. I have found burned carcasses.

Some fires display incredible behavior. I've seen firewhirls 50 to 100 (15-30 m) feet high dance across a burning meadow, hissing, whistling, and scattering burning debris, starting hundreds of small spot fires. These minitornadoes of flame have mesmerized me into a dream state, beckoning me to dance with them. Once, late at night, looking down from a hilltop into a valley of about 5,000 acres (2,000 ha), I saw everything below me on fire—thousands of small fires, like the campfires of some giant army bivouacked in the valley below.

While on a fire at night in California, I once heard a strange humanlike whistle coming from a dense stand of burned-over woods. I investigated and found a 50-foot (15-m) tree burned through the middle, leaving a hollow core from the base of the trunk to the burned-out top. Hot coals inside

The Eightmile Lookout is peacefully outlined against distant smoke from the Missionary Ridge Fire, San Juan–Rio Grande National Forest, CO. Photo: Mark Roper, USDA Forest Service, San Juan–Rio Grande National Forest, Pagosa Ranger District, Pagosa Springs, CO, 2002.

were sucking wind into the bottom and pushing heated air out the top, creating a loud whistle that could be heard from far away.

Death and Rebirth

Walls of flame licking at the starlit sky above have left me with the sensation of heaven and hell coming together. Sometimes I envision fire as the force of evil fighting the forces of good, the ultimate battle between life and death. But death always brings new life—the phoenix of the forest rising from its own ashes. Within a year, the blackened landscape often glows with wildflowers, ferns, and grasses. Seedlings emerge from the ashes, drawing life from the fiery death of their progenitors.

I can vividly recall huge trees hundreds of years old, with sunlight beaming through the needles in smoke-filled rays. I stood at the base of those trees, borrowing some of their energy before continuing to battle the fire beast burning nearby.

Once, on a fire in Idaho while descending from a mountaintop, I passed through a magnificent grove of old firs and pines. Far from any roads or trails, I was probably the first human to pass in many years. Fire raced up the mountain on the opposite ridge, and I had to walk quickly because of the danger. But I wanted to linger under the canopy of those beautiful trees.

Sadly, I returned to find that fire had passed through the grove, destroying the ancient trees. I knew deep in my heart that other trees would replace them, growing equally tall and beautiful. But that would be far in the future.

If fires were allowed to burn as they once did, perhaps the fire that took that magnificent grove might have stayed on the ground, leaving the trees only slightly scarred.

If fires were allowed to burn as they once did, perhaps the fire that took that magnificent grove might have stayed on the ground, leaving the trees only slightly scarred. When such a forest is in an ecological balance with fire, many of the older trees can survive episodes of burning.

Brothers and Sisters

Firefighting—"the good, the bad, and the ugly" of it—I have experienced it all. Thousands of others have, too. We are all brothers and sisters, bonded together by danger.

I have enjoyed the camaraderie of my fellow firefighters. I've worked side by side with people of all races—American Indian, Hispanic, Asian, black, and white. Joined by fire, we've shared smiles and laughter, games and sports, and the pleasure of chatter over dinner after a hard shift on the fireline. Covered with dirt and ash and reeking of smoke, we've chatted about the day or told stories of past battles with the beast, both won and lost.

Looking back over the past 24 years, I think about the many times firefighters have been in the news getting our proverbial 15 minutes of fame. I have to admit that my chest has swelled a few times over the years.

So, if I had to do it all over again, would I? Without hesitation. ■

Wildland Fire Investigation Standards

Paul T. Steensland

More than 100,000 wildfires rage in the United States each year, destroying millions of acres of wildland resources and hundreds of structures in the wildland/urban interface. Property losses and suppression costs are staggering. In 2000, Federal agencies spent more than $1 billion to suppress fires, most of which were caused by either negligence or arson.

Determining the cause of a fire affects the success of a fire prevention program and determines accountability. When negligence is identified, the responsible party might be liable for fire suppression costs and property damage. Identifying and apprehending those who commit criminal acts is of vital public interest.

Specialized Standards

Certified Fire Investigator (CFI) programs help to increase the credibility of fire investigators. These programs establish minimum professional standards and consistent scientific methodology to conduct fire investigations. They lack, however, a set of standards specialized for wildland fire investigators, whose job is significantly different from a structure fire investigator. Directions for conducting wildland fire investigations are often vague, job descriptions are few, and the training curriculums are jumbled.

Paul Steensland is the senior special agent and wildland fire investigation specialist for the USDA Forest Service. He cochairs the National Wildfire Coordinating Group's Wildland Fire Investigation Working Team.

Identifying and apprehending those who commit criminal acts is of vital public interest.

Australian fire investigators conducting an origin determination on a fire near Nelson Bay, New South Wales, Australia. The New South Wales Rural Fire Service has developed a team of 80 fire investigators to determine the origin and cause of wildfires since 2000. They have helped police determine the cause of many wildfires, playing a key role during recent severe fire seasons. Photo: Richard Woods, New South Wales Rural Fire Service, Australia, 2002.

In January 2000, a group of wildland fire investigators brought the shortcomings of the existing CFI program to the attention of the National Wildfire Coordinating Group (NWCG). The NWCG consists of representatives from Federal, State, and local wildland fire management agencies; the National Fire Protection Association; and the New Zealand and Australian fire services. Congress established the NWCG to coordinate wildland fire standardization issues. Chartered teams identify and resolve issues concerning wildland fire management.

The investigators' presentation highlighted the need to establish professional standards and consistent methodology for wildland fire investigations. Since skills and knowledge required to investigate a wildland fire differ from a structure fire investigation, the NWCG agreed that existing CFI programs needed revision to address the specific needs of the wildland fire management community. They accepted the proposal to establish a professional standard and accompanying training curriculum tailored for wildland fire investigators.

In May 2000, the NWCG chartered the Wildland Fire Investigation Team (see the sidebar). The team began preparing a set of draft standards for wildland fire investigation certification. The drafts were peer reviewed, and the team evaluated about 160 written comments, which were used to draft proposed standards. The NWCG approved the standards at its October 2001 meeting.

Existing certification programs needed revision to address the specific needs of the wildland fire management community.

Three-Tiered Certification

The standards are performance based and progressively tiered to allow for certification at each level—Wildland Fire Investigator, type 3 (entry level) to type 1.

Type 3 Certification. Investigators will have the minimum skills needed to conduct origin and cause determination investigations successfully. Specific required skills include knowledge of:

- Fire behavior,
- Fire ignition sources and factors,
- Burn pattern interpretation, and
- Basic investigation methodology and techniques.

Type 2 Certification. Investigators must have an intermediate knowledge needed to develop complex civil and criminal cases successfully. Besides increased knowledge of fire behavior and of origin and

Members of the Wildland Fire Investigation Working Team

The team chartered by the NWCG to establish a professional standard and training curriculum for wildland fire investigators has representatives from the:

- Bureau of Indian Affairs;
- Bureau of Land Management;
- California Department of Forestry and Fire Protection (representing the Western States Fire Managers Association);
- Federal Law Enforcement Training Center;
- Florida State Fire Marshal (representing the National Association of State Fire Marshals);
- Minnesota Department of Natural Resources (representing the International Association of Arson Investigators and the Great Lakes Forest Fire Compact);
- National Park Service;
- New South Wales Rural Fire Service, Australia;
- Oregon Department of Forestry;
- South Carolina Forestry Commission;
- Tennessee Valley Authority;
- USDA Forest Service, Law Enforcement and Investigations;
- Saskatchewan Environmental Resource Ministry;*
- Alberta Sustainable Resource Development;*
- Victoria Country Fire Authority, Australia; and
- New Zealand Rural Fire Authority.

* Canadian members also represent the interests of the Canadian Interagency Forest Fire Center and their national training and resource management working groups. They are working to create a wildland fire investigation standard for Canada.

The point of origin on the 83,000-acre (34,000-ha) Jasper Fire in South Dakota. Investigators use color-coded flagging to mark areas of fire progression. Following a month-long investigation, Forest Service investigators successfully identified the arsonist, who was later convicted and sentenced to 25 years in prison. Photo: Luke Konantz, USDA Forest Service, Rocky Mountain Region, Grand Junction, CO, 2000.

cause determination, required knowledge includes:

- Civil and criminal processes,
- Investigation strategies for serial arson cases, and
- Investigation methodologies beyond preliminary origin and cause determination.

Type 1 Certification. Investigators must have the advanced skills and knowledge necessary to serve as an incident commander for a complex investigation organization associated with major civil and criminal investigations.

At each level, the participant completes a position task book, written proficiency exam, and training session. Additional training for developing different skills at each level will be recommended.

New standards are performance based and progressively tiered to allow for certification at each of three levels of proficiency.

Improved Training

Now that the standards are complete, development of the accompanying training courses and task books is underway. The working team, with the help of the NWCG, is revising the existing Wildfire Origin and Cause Determination course. The team hopes to finish the additional type 2 and type 1 certification levels by late 2004 or early 2005.

After the training packages and task books are complete, the NWCG will distribute them to all member agencies. Like other national interagency fire management positions contained in the Wildland and Prescribed Fire Qualification System Guide (PMS 310–1), agencies that want to certify personnel will establish their own certification programs following NWCG standards and procedures.

Professional standards and a peer-reviewed methodology for wildland fire investigations are long overdue. The NWCG certification program will help ensure that investigations are conducted using consistent standards that take advantage of the most current scientific and technical information available. For more information, see the NWCG Website at <http://www.nwcg.gov> or contact the author at psteensland@fs.fed.us (e-mail). ■

Fifth Annual Franklin Awards Ceremony

April J. Baily

The Franklin Awards recognize outstanding efforts by State partners in ensuring that all citizens enjoy the benefits of the USDA Forest Service's Cooperative Fire programs. The Forest Service's Fire and Aviation Management Staff annually awards the prestigious Franklin Award to acknowledge State programs that do an exceptional job in reaching underserved communities. The award was established in 1999 and is named for Benjamin Franklin, the founder of America's volunteer firefighting force.

Each year, four categories are considered for award:

- Volunteer fire assistance,
- State fire assistance,
- Management of Federal excess personal property, and
- Overall excellence in reaching underserved communities (through a special Director's Award).

Awards are not necessarily given for each category every year. In 2003, the award was given in a single category.

Volunteer Fire Assistance Award

The 2003 award was presented on September 15, 2003, at the National Association of State Foresters' annual awards luncheon in Portland, OR. Sally Collins, Forest Service Associate Chief, and Joel Holtrop, Deputy Chief for State and Private Forestry, presented the award.

Figure 1—*Jim Hull (center), Texas State Forester, receives the 2003 Franklin Award from Sally Collins, USDA Forest Service Associate Chief; and Joel Holtrop, Deputy Chief for State and Private Forestry. The award acknowledges the Texas Forest Service's outstanding outreach in volunteer fire assistance. Photo: USDA Forest Service, Portland, OR, 2003.*

The Volunteer Fire Assistance Award was designed to help small communities improve or begin fire protection. It is given to the State that demonstrates the best outreach to help underserved communities improve fire protection. The winner of the Franklin Award for outstanding outreach in volunteer fire assistance was the Texas Forest Service.

The Texas Forest Service was created in 1915 as an integral part of The Texas A&M University System. It is mandated by law to "assume direction of all forest interests and all matters pertaining to forestry within the jurisdiction of the state."

The Rural Volunteer Fire Department Assistance Program receives grants from the Forest Service, through Volunteer Fire Assistance, and from the Texas State legislature. Through joint Federal/State funding, the Texas Forest Service provided more than $11 million in grants to rural Texas volunteer fire departments. This effort is particularly successful considering today's decreasing budgets and increasing populations.

April Baily is the Federal Excess Personal Property Program officer for the USDA Forest Service, Fire and Aviation Management, Washington, DC, and the general manager of Fire Management Today.

In the first 9 months of operation, the program provided cost-share grants to more than 468 volunteer fire departments to purchase 160 fire trucks, 31 slip-on modules, 561 items of fire equipment, 227 items of rescue equipment, 99 dry hydrants, and 112 training tuitions.

On April 13, 2003, James Elder, Fire Chief for the Simms District Volunteer Fire Department, expressed his appreciation to the Texas Forest Service, stating, "We … would like to express our appreciation for the grant, for our bunker gear, computer, and training. … [T]his is the first time we have ever been able to fully clothe our personnel in complete protective equipment."

Nomination Guidelines and Judging Criteria

Nominations address the following questions:

- What specific outreach initiatives has the State Forester instituted to ensure that underserved communities participate in the cooperative programs? (Evaluated on a scale of 1 to 3, ranging from a one-time initiative to an ongoing underserved community effort.)
- What underserved community benefited from the cooperative programs and how did the State Forester encourage the participation? (Evaluated on a scale of 1 to 6, ranging from limited participation—such as by a single community—to extensive participation—such as by a county or counties).
- What are the tangible and intangible effects of the cooperation? (Evaluated on a scale of 1 to 3, ranging from limited effects—such as a single school education program—to extensive effects—such as countywide dry hydrants).

We gratefully acknowledge the outstanding efforts of all States to ensure fire protection for all Americans.

Judges evaluate the answers, taking into account any statistics, news stories, pictures, and other supporting materials.

Each entry receives a score ranging from 3 to 12 points. Entries with a score of 5 or less are eliminated. The Director's Award is presented only to entries with the best overall effort in at least two areas.

A call letter is sent to all State Foresters in January of each year. The Forest Service welcomes all nominations, which must be postmarked by May 31, and look forward to honoring the efforts of our State partners as they continue to help communities in need.

For more information, please visit <http://www.fs.fed.us/fire/partners/franklin/fa.htm>. ■

NASA Honors Texas Forest Service Incident Management Team

Amanda Fazzino

On October 3, 2003, the National Aeronautics and Space Administration bestowed one of its highest awards, the Public Service Medal, on three members of the Texas Forest Service. Paul Hannemann, Mark Stanford, and Charles "Boo" Walker were recognized for their leadership roles in the Columbia space shuttle recovery efforts.

Following the shuttle disaster on February 1, 2003, an incident management team was quickly assembled. Stepping out of their customary roles in fire protection, Stanford served as incident commander, Hannemann as deputy incident commander, and Walker as aviation manager. Together, they managed and coordinated 3 months of air and ground searches across 2,400 square miles (6,200 km^2) of East Texas. The effort involved 45 aircraft, more than 25,000 volunteers, and more than 16 government agencies.

Charles "Boo" Walker, Paul Hannemann, and Mark Stanford stand before the neutral buoyance lab in the Johnson Space Center, Houston, TX. The lab has the largest indoor pool in the world, used by astronauts to prepare for working with zero gravity. Photo: James Blair, NASA Photography, Johnson Space Center, 2003.

It marked the first time that a State wildland agency has taken the lead in a Federal emergency recovery effort. In addition to their leadership role, Texas Forest Service personnel plotted shuttle material using geographic information systems; developed an incident database for reported material and remains; operated the National Shuttle Material Reporting Hotline; secured the command posts; supported the media; and located, collected and stored shuttle material. ■

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Guidelines for Contributors

Editorial Policy
Fire Management Today (*FMT*) is an international quarterly magazine for the wildland fire community. *FMT* welcomes unsolicited manuscripts from readers on any subject related to fire management. Because space is a consideration, long manuscripts might be abridged by the editor, subject to approval by the author; *FMT* does print short pieces of interest to readers.

Submission Guidelines
Submit manuscripts to either the general manager or the managing editor at:

USDA Forest Service
Attn: April J. Baily, F&AM Staff
Mail Stop 1107
1400 Independence Avenue, SW
Washington, DC 20250-1107
tel. 202-205-0891, fax 202-205-1272
e-mail: abaily@fs.fed.us

USDA Forest Service
Attn: Hutch Brown, Office of the Chief
Yates Building, 4th Floor Northwest
201 14th Street, SW
Washington, DC 20024
tel. 202-205-0896, fax 202-205-1765
e-mail: hutchbrown@fs.fed.us

Mailing Disks. Do not mail disks with electronic files to the above addresses, because mail will be irradiated and the disks could be rendered inoperable. Send electronic files by e-mail or by courier service to:

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Attn: Hutch Brown, 2CEN Yates
201 14th Street, SW
Washington, DC 20024

If you have questions about a submission, please contact the managing editor, Hutch Brown.

Paper Copy. Type or word-process the manuscript on white paper (double-spaced) on one side. Include the complete name(s), title(s), affiliation(s), and address(es) of the author(s), as well as telephone and fax numbers and e-mail information. If the same or a similar manuscript is being submitted elsewhere, include that information also. Authors who are affiliated should submit a camera-ready logo for their agency, institution, or organization.

Style. Authors are responsible for using wildland fire terminology that conforms to the latest standards set by the National Wildfire Coordinating Group under the National Interagency Incident Management System. *FMT* uses the spelling, capitalization, hyphenation, and other styles recommended in the *United States Government Printing Office Style Manual*, as required by the U.S. Department of Agriculture. Authors should use the U.S. system of weight and measure, with equivalent values in the metric system. Try to keep titles concise and descriptive; subheadings and bulleted material are useful and help readability. As a general rule of clear writing, use the active voice (e.g., write, "Fire managers know…" and not, "It is known…"). Provide spellouts for all abbreviations. Consult recent issues (on the World Wide Web at <http://www.fs.fed.us/fire/planning/firenote.htm>) for placement of the author's name, title, agency affiliation, and location, as well as for style of paragraph headings and references.

Tables. Tables should be logical and understandable without reading the text. Include tables at the end of the manuscript.

Photos and Illustrations. Figures, illustrations, overhead transparencies (originals are preferable), and clear photographs (color slides or glossy color prints are preferable) are often essential to the understanding of articles. Clearly label all photos and illustrations (figure 1, 2, 3, etc.; photograph A, B, C, etc.). At the end of the manuscript, include clear, thorough figure and photo captions labeled in the same way as the corresponding material (figure 1, 2, 3; photograph A, B, C; etc.). Captions should make photos and illustrations understandable without reading the text. For photos, indicate the name and affiliation of the photographer and the year the photo was taken.

Electronic Files. See special mailing instructions above. Please label all disks carefully with name(s) of file(s) and system(s) used. If the manuscript is word-processed, please submit a 3-1/2 inch, IBM-compatible disk together with the paper copy (see above) as an electronic file in one of these formats: WordPerfect 5.1 for DOS; WordPerfect 7.0 or earlier for Windows 95; Microsoft Word 6.0 or earlier for Windows 95; Rich Text format; or ASCII. Digital photos may be submitted but must be at least 300 dpi and accompanied by a high-resolution (preferably laser) printout for editorial review and quality control during the printing process. Do not embed illustrations (such as maps, charts, and graphs) in the electronic file for the manuscript. Instead, submit each illustration at 1,200 dpi in a separate file using a standard interchange format such as EPS, TIFF, or JPEG, accompanied by a high-resolution (preferably laser) printout. For charts and graphs, include the data needed to reconstruct them.

Release Authorization. Non-Federal Government authors must sign a release to allow their work to be in the public domain and on the World Wide Web. In addition, all photos and illustrations require a written release by the photographer or illustrator. The author, photo, and illustration release forms are available from General Manager April Baily.

Contributors Wanted

We need your fire-related articles and photographs for *Fire Management Today*! Feature articles should be up to about 2,000 words in length. We also need short items of up to 200 words. Subjects of articles published in *Fire Management Today* include:

- Aviation
- Communication
- Cooperation
- Ecosystem management
- Equipment/Technology
- Fire behavior
- Fire ecology
- Fire effects
- Fire history
- Fire science
- Fire use (including prescribed fire)
- Fuels management
- Firefighting experiences
- Incident management
- Information management (including systems)
- Personnel
- Planning (including budgeting)
- Preparedness
- Prevention/Education
- Safety
- Suppression
- Training
- Weather
- Wildland–urban interface

To help prepare your submission, see "Guidelines for Contributors" in this issue.

Photo Contest Announcement

Fire Management Today invites you to submit your best fire-related photos to be judged in our annual competition. Judging begins after the first Friday in March of each year.

Awards

All contestants will receive a CD–ROM with all photos not eliminated from competition. Winning photos will appear in a future issue of *Fire Management Today*. In addition, winners in each category will receive:

- 1st place—Camera equipment worth $300 and a 16- by 20-inch framed copy of your photo.
- 2nd place—An 11- by 14-inch framed copy of your photo.
- 3rd place—An 8- by 10-inch framed copy of your photo.

Categories

- Wildland fire
- Prescribed fire
- Wildland-urban interface fire
- Aerial resources
- Ground resources
- Miscellaneous (fire effects; fire weather; fire-dependent communities or species; etc.)

Rules

- The contest is open to everyone. You may submit an unlimited number of entries from any place or time; but for each photo, you must indicate only one competition category. To ensure fair evaluation, we reserve the right to change the competition category for your photo.
- An original color slide is preferred; however, we will accept high-quality color prints, as long as they are accompanied by negatives. Digitally shot slides (preferred) or prints will be accepted if they are scanned at 300 lines per inch or equivalent. Digital images will be accepted if you used a camera with at least 2.5 megapixels and the image is shot at the highest resolution or in a TIFF format.
- You must have the right to grant the Forest Service unlimited use of the image, and you must agree that the image will become public domain. Moreover, the image must not have been previously published.
- For every photo you submit, you must give a detailed caption (including, for example, name, location, and date of the fire; names of any people and/or their job descriptions; and descriptions of any vegetation and/or wildlife).
- You must complete and sign a statement granting rights to use your photo(s) to the USDA Forest Service (see sample statement below). Include your full name, agency or institutional affiliation (if any), address, and telephone number.
- Photos are eliminated from competition if they have date stamps; show unsafe firefighting practices (unless that is their express purpose); or are of low technical quality (for example, have soft focus or show camera movement). (Duplicates—including most overlays and other composites—have soft focus and will be eliminated.)
- Photos are judged by a photography professional whose decision is final.

Postmark Deadline

First Friday in March

Send submissions to:

Madelyn Dillon
CAT Publishing Arts
2150 Centre Avenue
Building A, Suite 361
Fort Collins, CO 80526

Sample Photo Release Statement

Enclosed is/are _____ (*number*) slide(s) for publication by the USDA Forest Service. For each slide submitted, the contest category is indicated and a detailed caption is enclosed. I have the right to grant the Forest Service unlimited use of the image, and I agree that the image will become public domain. Moreover, the image has not been previously published.

Signature _____ Date _____

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