Fire Management In Grand Teton National Park

LLOYD L. LOOPE
Research Biologist, Office of the Chief Scientist, National Park Service, U.S. Department of the Interior, Washington, D. C. 20240
ROBERT P. WOOD
Resource Management Specialist, Grand Teton National Park, Moose, Wyoming 83012

INTRODUCTION

GRAND Teton National Park, in northwestern Wyoming, is a "natural area" of the National Park System with widely known outstanding scenic qualities, high levels of summer tourism, recreational use by local residents, and fire adapted vegetation. Much promise exists for carrying out a program of fire and vegetation management appropriate to a "natural area." Such a program was initiated in 1972, and progress is being made, but the greatest challenge remains for the future. Grand Teton illustrates a wide range of fire management problems, the solutions for which are not yet fully apparent.

Grand Teton was established as a 125,000 acre national park in 1929, encompassing central and southern portions of the Teton Range and piedmont lakes at the east base of the range. The park was enlarged to 310,250 acres in 1950, when the northern segment of the Teton Range and much of the valley known as Jackson Hole

was added. The vegetation of the park consists of a mosaic of forest and non-forest plant communities. The upland forests of the valley, Jackson Hole (elevation 6,500-7,000), are dominated by lodgepole pine *(Pinus contorta)*, Douglas-fir *(Pseudotsuga menziesii)*, or aspen *(Populus tremuloides)*. These species also occur at higher elevations in the Teton Range. Old-growth Engelmann Spruce *(Picea engelmannii)* stands occur in various localities along the base of the Teton Range. Spruce also occurs throughout the mountain range at elevations up to 10,000 ft., interspersed among forests dominated by subalpine fir *(Abies lasiocarpa)* and meadows. Whitebark pine *(Pinus albicaulis)* dominates open forests of many sites near timberline. Most of the non-forested area of Jackson Hole is dominated by big sagebrush *(Artemisia tridentata)*, interspersed with grasses and herbs.

Grand Teton has not traditionally been thought of as a "fire park." Between 1929 and 1971, less than 350 acres of vegetation burned, most of which (300 acres) burned following escape of fire from a cleanup operation along the shore of Jackson Lake Reservior. Lightning caused fires from 1929 through 1971 burned less than 30 acres. Of 384 fires in the park from 1929 through 1974, 39 percent were lightning-caused.

Little indication exists that National Park Service personnel or other individuals were concerned about possibly adverse ecological implications of fire control for management of Grand Teton as a natural area prior to the 1960's. Fire was regarded as an undesirable disturbance to the natural scene which could be prevented through public education, vigilant surveillance, and prompt attack. Major park developed areas which were built in the 1950's and 1960's were located within lodgepole pine forest because of the aesthetically attractive setting at the base of the Tetons. In the 1960's, as a result of involvement in a controversial mountain pine beetle control program in lodgepole pine forests of Grand Teton, the Park Service financed a study of forest communities of the valley by E. T. Oswald of Montana State University. Oswald's (1966) report contains the first published recognition of the cyclic occurrence of fire in the past in Grand Teton and the first questioning of the compatibility of attempted total fire suppression with management of Grand Teton

as a natural area. Taylor's (1969) work on fire ecology in Yellowstone National Park also stimulated much thought along these lines, as did the growing interest and research on the ecological role of fire in the Rocky Mountains and in other parts of the country.

Scientific investigations on the fire history and ecological role of fire in Grand Teton were initiated by the National Park Service in 1970. Progress to date is summarized by Loope (1971), Loope and Gruell (1973), and Gruell and Loope (1974).

INFLUENCE OF FIRE ON ECOSYSTEMS

Most ecosystem types of Grand Teton National Park are fire-influenced or fire-dependent. Within most of the Teton Range, large fires have been infrequent because of rugged topography and natural firebreaks, but numerous small lightning fires have occurred there. In the valley of Jackson Hole, tree-ring evidence indicates that few extensive areas have escaped fire for the past 200 years and that most areas last burned in the interval between 85 and 120 years ago. Tree-rings of fire-scarred 300 to 400 year old Douglas-firs document the occurrence of numerous fires in the 1600's and 1700's—well before the influence of white man in this area.

Lodgepole pine seedlings generally become established rapidly after fire and form dense stands. When these stands reach an age of about 80 years, they become highly vulnerable to attack by a native insect—the mountain pine beetle. Under a normal fire regime, only a relatively small percentage of lodgepole stands would be vulnerable to mountain pine beetle attack at one time. But due to the rarity of fire occurrence since 1900, virtually all lodgepole stands in the park were at a susceptible stage simultaneously in the 1960's when buildup of mountain pine beetle populations occurred. As many as 45 percent of the trees in many areas of the park were killed. The beetle populations have now declined in the park, but we are left with very hazardous forest fuel accumulations in the lodgepole forests because of the many dead trees. For any particular locality, such a fuel accumulation is probably in no way unnatural. However, the occurrence of this situation throughout the lodgepole forests of the

park is probably unprecedented and clearly threatens human developments—many of which are located within the lodgepole ecosystem.

Aspen is a species which appears to be fire dependent in Jackson Hole (Gruell and Loope, 1974). Most existing stands in the valley regenerated following fires of the late 1800's. Without fire and with current levels of browsing by elk and moose, aspen is reproducing poorly in most of Jackson Hole. When aspen stands reach an age of 80 to 100 years, they deteriorate rapidly. Some stands have already been essentially lost. Many stands could perhaps still be saved through returning the stands to early succession with fire, but without fire most stands will either be lost or reduced to a shrub community. When an aspen stand is lost, its characteristic assemblage of plants and animals goes with it.

Tree ring evidence and rates of fuel buildup suggest that Douglas-fir forests of Grand Teton had fires at 25-75 year intervals in the past. Although some crown fires must have occurred in this vegetation type, most were probably surface fires which spared old thick-barked trees. Lack of fire for nearly a century or more has resulted in stagnated dense stands of young trees in the understory of trees several centuries old and in fuel buildups which may be unprecedented, resulting in a threat to the fire-resistent mature Douglas-fir.

Engelmann spruce forests located along the east base of the Teton Range exist there because of relatively moist conditions, favorable soils, and a long interval between fires. In favorable sites, spruce regenerates following fire and may form mixed stands with lodgepole pine. Since few lodgepoles survive beyond the age of 200 years, an almost pure stand of spruce exists when the stand escapes fire for this length of time. Spruce reproduction virtually ceases after stand canopy closure. The magnificent forests of old-age spruce (200-400 years old and 2-4 ft. in diameter) eventually start to decline and become very susceptible to windthrow.

Tremendous fuel buildups result, predisposing the stands to fire, which can occur only with unusually dry conditions.

Sagebrush-dominated areas burned periodically in the past. In the absence of fire, sagebrush cover has greatly increased in many

such areas. Sagebrush cover of 50 percent to 90 percent exists on some productive sites which undoubtedly had higher productivity of grasses and herbs under the periodic influence of fire.

Other park ecosystems, including subalpine fir forests, whitebark pine stands, and willow bottoms, have also been shaped by fire's influence.

INITIAL STEPS IN MANAGEMENT OF FIRE AND VEGETATION IN GRAND TETON

The natural ecological role of fire in Grand Teton National Park is now fairly clear—at least in broad outline. The most pressing problem is to manage the park taking this into account. Additional ecological research is desirable and is in progress, but the critical needs at this point seem to be: (1) to determine how application of fire can best be accomplished to provide for perpetuation of natural ecosystems while simultaneously providing for visitor safety and protection of private property; 2) to perfect methods of applying fire to ecosystems and to apply them; and 3) to communicate to the public the need for the fire management program and to apply fire in such a manner that the program is socially and politically acceptable.

In order to initiate progress toward satisfying the above needs, a Fire-Vegetation Management Plan was prepared in 1972 which specified that lightning fires would be allowed to burn within a 125,000 acre zone in the Teton Range. In 1972, the only lightning fire which occurred within this zone lasted less than 24 hours before being extinguished by precipitation. In 1973, again only one lightning fire occurred in the natural zone. It started following a dry thunderstorm on July 12, was active until about September 15, and resulted in a burned area covering 5 acres of spruce-fir forest understory. Most of this acreage burned during the last week in August.

The 1972 management plan recognized that in much of the park, allowing lightning fires to burn is not feasible at present and probably will not be feasible in the foreseeable future because of considerations relating to hazard to human safety, visitor facilities, and private

property. Critical analysis of the situation suggests that if fire is going to play an ecological role in most valley areas of the park in the near future, it is going to have to be prescribed fire—used under safe burning conditions with careful planning and preparation. It does appear technically feasible to use prescribed fire to simulate the ecological effects of a natural fire regime in areas of the valley where fire as a purely natural force cannot be allowed to influence ecosystems. Recognizing prescribed fire as an ecologically attractive alternative to natural fires, two small prescribed burns were planned, starting in 1972, for whenever proper burning conditions occurred. One of these planned prescribed burns included 20 acres of Douglas-fir forest. The other included a 100-acre tract of aspen and sagebrush vegetation. No attempt at burning was made in 1972 because of moist conditions throughout late-July and August. Moderately dry conditions were attained in late-August of 1973, and an attempt was made to burn the aspen-sagebrush area on August 28. Forty acres of sagebrush burned in a hot fire, but the fire did not carry into the green understory of the aspen stand. Smoke dispersal, as forecasted, was excellent. The fire received coverage from the local press, but adverse public reaction was minimal.

The Fire-Vegetation Management Plan was updated during the winter of 1973-74, based on an additional 2 years of research and experience, to attempt to provide a desirable course of action for the 5-year period 1974-78. This most recent plan calls for continuation of management of the 125,000 acre zone in the Teton Range as a natural fire zone. An additional zone of 22,000 acres west of the Snake River is designated as an area where lightning fires in sagebrush vegetation can be allowed to burn at the discretion of a fire management committee. In the remainder of the park (163,000 acres), all fires will be suppressed, except for small prescribed burns in each of four major fire-influenced ecosystem types—aspen (70 acres), sagebrush (up to 300 acres), Douglas-fir (20 acres), and lodgepole pine (50 acres)—during the next 5 years. As stated in the plan, the primary purposes of these initial prescribed burns are:

1) to initiate the return of fire to as natural a role as possible in portions of the park where lightning fires cannot be allowed to run their course; 2) to serve as demonstration areas where park visitors

can observe biotic succession following fire and weigh the merits and disadvantages of returning fire to various park ecosystem types; 3) to serve as research areas where a better understanding of biotic succession following fire can be gained; and 4) to provide experience in prescribed burning for National Park Service personnel, to improve their understanding of fire behavior in the area, and to test the feasibility of such operations in Grand Teton.

THE 1974 FIRE SEASON

The summer of 1974 provided a test of the Fire-Vegetation Management Plan, especially with regard to public acceptance. Three fires occurred in the natural fire zone. A fire in the drainage of

Table 1. 1974 Waterfalls Canyon Fire—Fire Log Summary.

Date	Fire Size	Notes
7/17/74	— —	Last lightning before fire discovered
7/19	— —	Fire discovered
7/20	280 sq. ft.	4 spots covering ¼ acre
7/22	4,500 sq. ft.	Lightning struck tree toppled causing spot fires
7/24	9,000 sq. ft.	Upslope burning on ground
7/26	6 acres	
7/27	35 acres	Cold front moved in from north
7/28	68 acres	
7/29	80 acres	
7/30	180 acres	Strong north winds
7/31	180 acres	.12 inches precipitation
8/2-8/14	180 acres	A total of .88 inches of precipitation fell on 9 days during this period.
8/18	200 acres	Moderate winds
8/26	230 acres	
9/6	230 acres	Fire moving upslope
9/8	500 acres	High winds, fire ran north 3¼ miles
9/11	1,050 acres	Cold front. Very strong winds, first south, then north.
9/11		Snow (.14 inches of precipitation)
9/12		Rain (.13 inches)
9/16	1,650 acres	North wind
9/18	1,900 acres	Fire burned into wind
9/19	2,000 acres	
9/21	2,500 acres	Cold front, north winds
9/22	2,600 acres	
9/26	3,500 acres	Strong southerly winds
9/27	3,500 acres	.15 inches precipitation
10/3	3,500 acres	.28 inches precipitation
10/6	3,700 acres	Date of last spread. A few hot spots into November.

Table 2. Monthly precipitation at Park Headquarters (Moose, Wyoming), May–September, in inches (Mean annual precipitation=20.58 inches).

	Mean	1973	1974
May	1.78	.57	1.56
June	2.13	1.88	1.70
July	.68	2.33	.19
August	1.16	.82	.88
September	1.69	2.08	.42

Buster Creek started on July 17 in subalpine fir-Engelmann spruce forest (elevation 7,900 ft.) and went out within a week, burning less than 0.1 acre. A fire started in Waterfalls Canyon on July 17 in an old-growth spruce forest (elevation 6,800 ft.) near Jackson Lake and expanded to a perimeter enclosing 3,700 acres before being declared out when snow covered the area. A Leigh Canyon fire was a "sleeper" discovered on September 10, which burned 5 acres of subalpine fir (elevation 7,500 ft.) and was extinguished by snow on October 9.

Development of the Waterfalls Canyon fire is summarized in Table 1. This fire started very near the location of the 1973 fire which burned 5 acres over a 2-month period. The summer of 1974 was unusually dry in northwestern Wyoming. Precipitation data from Park Headquarters at Moose (Table 2) show that precipitation in 1974 was below normal for each of the months from May through September and was 42 percent of normal for the July-September period, whereas 1973 was a near normal year.

The 1974 Waterfalls Canyon fire burned primarily in old-growth spruce forest along Jackson Lake, but spread to subalpine fir stands up to an elevation of 9,000 ft. in September, after curing of herbaceous vegetation occurred. At no time was the fire's behavior unpredictable or was the fire uncontrollable, since major runs occurred only over a period of a few hours. Major runs were the result of very strong winds or heavy fuel loading. A major windstorm in November, 1973, had blown down many trees in the area. A suppression plan was formulated for this fire as it approached the natural fire zone boundary on the north in late September. No major control problem was anticipated and work would have consisted of ground forces

(one crew) cooling hotspots backed by a helicopter bucketing water. No suppression effort took place, however, since the fire stopped when it reached north-facing exposures south of the zone boundary.

This fire created some controversy since it was in a highly-visible area. An estimated 100,000 visitors were aware of its presence. Interpretive activities were adjusted to allow Park Ranger/Naturalists to spend the day at points of visitor concentration to answer questions and to explain the fire management plan. These interpretive activities were carried out until October 12. Although a majority of visitors expressed curiosity or tentative approval, a significant number of visitors and local residents voiced opposition. Major concerns of the critical segment of the public dealt with the fire's presumed aesthetic impact and its effects on wildlife, air and water quality, and vegetational succession rates and patterns following fire. The fire received extensive coverage by the local and national press.

No prescribed burns were carried out in the Park during 1974.

THE FUTURE

The National Park Service plans to continue its program of restoring fire to as natural role as possible in Grand Teton. The 1974 Waterfalls Canyon burn will provide excellent opportunities for explaining fire's impacts and natural role to the public. Research will be carried out to document ecosystem changes resulting from fire and the processes of biological succession.

Information and experience gained from 1974 and the remaining 4 years of implementing this plan and ecological research carried out during this period will be invaluable toward formulation of a more comprehensive plan after the end of the fire season in 1978. The new plan must address several essential points:

1. What action, if any, should be taken to reduce the fire hazard to developed areas in the lodgepole pine forests along the western side of the valley?
2. Are the "natural fire zones" realistic? Should their boundaries be modified? Can these zones be extended to encompass more of the park?

3. What future should prescribed burning have in the management of Grand Teton National Park? Should prescribed burning be used to simulate as nearly as possible the natural fire regime in areas where lightning fires cannot be allowed to run their course for reasons of safety and economics? Should other types of manipulation be used to reinitiate new stands of vegetation? Or should the concept of maintaining natural ecosystems be abandoned altogether?

Implementation of the 1974-78 Fire-Vegetation Management Plan is only an initial step toward restoration of fire to a near-natural role in Grand Teton. Although about 40 percent of the park is contained within zones where fires are allowed to burn, continued fire suppression is called for, and is necessary, in critical fire-influenced ecosystems. The two most immediately critical specific problems related to fire management in Grand Teton are the rapid decline of aspen in the absence of fire and the hazardous fuel situations in lodgepole pine stands. The present fire management plan is not intended to confront either of these situations. Proposed prescribed burns are scarely of more than negligible acreage.

Aspen stands are deteriorating rapidly. A stand may be largely intact for 80-90 years and then completely "break up" within a 10 year period. By the time only a few healthy trees remain in a stand, potential for successful regeneration following fire may have been lost. A strong possibility exists that considerable potential for regenerating aspen stands is being lost through each year of inaction or inability to act. Proper burning conditions—sufficiently dry conditions to run fire through an aspen stand (especially one on a north-facing slope)—may be attained only rarely (once in 5-10 years, perhaps). Obtaining approval from the public may take too much time for a successful operation in such circumstances. The current approach is to burn one small (70 acre) aspen stand whenever conditions permit, demonstrate benefits, and once public confidence has been gained, embark on an extensive program of prescribed burning to regenerate aspen. Unfortunately, by the time public confidence is gained and the full-scale program is undertaken, many stands may be irretrievably lost.

From the standpoint of fire hazard to human developments, as

well as that of alteration of the natural fire regime, the 30,000 acres of lodgepole pine forest in the park east of the Teton Range presents a formidable problem. Under natural conditions, this forest type probably burned at 50 to 150 year intervals. The present age of this forest ranges from 90 to about 200 years. Virtually all of this forest has been substantially affected by mountain pine beetle within the past 15 years and fuel loading is high. Major blowdowns in November, 1973, and June, 1974, contributed significantly to the fuel load in portions of the area. Major park concession-operated developments are located within this zone, as are some private inholdings. The promise of feasibility of prescribed burning to reduce fuel hazard in the near future appears extremely low. When sufficiently dry conditions exist for burning to accomplish significant fuel reduction, danger of escape of prescribed fire in this vegetation type is high.

This situation obviously presents a dilemma to the manager of a "natural area." The only satisfying solution within the framework of natural area management may be government acquisition of all inholdings, removal of all potentially vulnerable non-expendable concessioner and National Park Service facilities, and use of prescribed fire to break up continuous fuel accumulation and to produce a somewhat natural vegetation mosaic. Even if this could be accomplished, it is doubtful that lightning fires could be used to produce a natural fire regime, because of danger of spread to areas outside the Park. The present approach of the National Park Service is to recognize the problem, but to continue to suppress all fires to the extent possible.

Paradoxically, although lodgepole pine's ecology is tied so closely with the fire cycle, the alteration of natural ecological conditions through fire suppression may be less of a concern in lodgepole than in other ecosystems (such as aspen) where fire probably can be successfully suppressed indefinitely. Lodgepole forests because of their tendency to accumulate highly flammable fuel, are very likely to burn sooner or later, even with modern suppression efforts. What we don't know is whether fire dependent biota will suffer irreversibly from temporary alteration of the vegetational mosaic to older age classes. In ecosystems where continued fire suppression is neces-

sary and can be successful, we can be certain that fire-dependent biota will suffer irreversibly.

SUMMARY

Grand Teton's fire management program attempts to restore fire to as natural a role as possible in a "natural area" unit of the National Park System where fire has a major natural role, where fire suppression has been remarkably successful in this century, and where considerable human encroachment exists. The program calls for allowing lightning fires to burn in natural fire zones encompassing almost half the park and for continued suppression of fires in the remainder of the park as dictated by considerations of human safety and protection of property. Limited prescribed burning in representative examples of major fire-influenced ecosystem types will be carried out during a 5-year period to explore the feasibility of a possibly much more comprehensive program of fire and vegetation management in the future.

LITERATURE CITED

Gruell, G. E. and L. L. Loope, 1974. Relationships among aspen, fire and ungulate browsing in Jackson Hole, Wyoming. U.S. Dep. Agric., Forest Serv., Intermountain Region. 33 p.

Loope, L. L. 1971. Dynamics of forest communities in Grand Teton National Park. Naturalist 22(1) :39-47.

Loope, L. L. and G. E. Gruell. 1973. The ecological role of fire in the Jackson Hole area of northwestern Wyoming. Quaternary Research 3(3) :425-443.

Oswald, E. T. 1966. A synecological study of the forested moraines of the valley floor of Grand Teton National Park, Wyoming. Unpublished Ph.D. thesis, Montana State Univ., 101 p.

Taylor, D. L. 1969. Biotic succession of lodgepole pine forests of fire origin in Yellowstone National Park. Ph.D. Dissertation. Univ. Wyoming. 320 p.