Fire Management in Rocky Mountain National Park

PART II CURRENT FIRE REARCH

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INTRODUCTION

THE primary objective of the present fire research study at Rocky Mountain National Park is to determine the long-term effects of fires of differing intensities on vegetation establishment and succession within the park and high altitude areas of adjacent national forests. The study involves three areas of concentration as follows: (1) natural fire history, (2) field sampling on old fire sites, and (3) active fire studies.

The current study is being carried out with cooperative funding by the National Park Service, U.S. Forest Service-sponsored Eisenhower

Consortium, and the College of Forestry and Natural Resources at Colorado State University.

The areas selected for study were limited to the east side of the Park involving primarily the Big Thompson River drainage system. Elevations ranged from 8,800 ft. to upper treeline (10,800-11,500 ft.) in what is primarily the spruce (*Picea engelmannii*)- fir (*Abies lasiocarpa*) zone. At the lower elevations are occasional stands of ponderosa pine (*Pinus ponderosa*). Douglas-fir (*Pseudotsuga menziesii*) is found in mixture with both ponderosa pine and lodgepole pine (*Pinus contorta latifolia*).

Pure stands of lodgepole pine are found well up into the spruce-fir zone. Scattered patches of aspen (*Populus tremuloides*) on moist sites and stands of limber pine (*Pinus flexilis*) on drier sites are also found.

METHODS

Natural Fire History

Historic records in the Rocky Mountain National Park library were consulted as a source of information regarding the extent of fires, man-caused and natural, during the period since 1915 when the park was established. Public Land Survey records and Colorado national forest records (pre-1915) will be consulted for further reference to fires in the region of the park. Natural fire periodicity, extent, and locations were of interest, as well as site characteristics and vegetation types at the fire sites.

Increment cores, taken in conjunction with the vegetation survey, were used to date stands in which the study fires occurred. Each core was taken at a height of 4.5 feet on a dominant tree occurring at the site of each plot. Wherever possible, a lodgepole pine was chosen as the best indicator of the last major disturbance of the site by fire. Additional increment cores were taken in several lodgepole pine stands outside of the vegetation survey areas in order to gain a better picture of the extent and periodicity of prehistoric fire in the park. In these stands the fire dates were estimated from a combination of tree reproduction ages within the burn and interpretation of release evidence in the ring growth on residual old stand trees within and along the edge of the burn.

Field Sampling

Burns to be field-sampled were chosen on the basis of (1) known date of occurrence, (2) large enough and intense enough to markedly set back vegetation to an earlier stage of succession, (3) burn dates spread out to obtain successional sequence of vegetation over time, and (4) wide variety of physical site conditions. Color stereo aerial photographs of the selected burns were used to determine transect locations, directions, and interplot distances. The actual sampling involved three areas of interest in fire and vegetation modeling. These were physical site characteristics, woody fuels survey, and vegetation survey. All three were sampled at each plot site within the burns and at similar sites outside of the burns.

Physical site characteristics data collected involved elevation, slope percent and aspect, topographic position, soil parent material and A-horizon texture, and site index according to the dominant tree species. Included with physical site characteristics (due to their effect on insolation and fuels) were present and pre-burn vegetation type, present and pre-burn tree stocking, and present crown density.

The woody fuels survey was patterned after the planar intersect method developed by James Brown (1971). At each plot a 27.2-foot long planar transect was projected along a random direction. Data was collected on duff depths; number of intercepts of 10-hour, 100-hour, and <100-hour, timelag fuels; and number of snags less than and greater than 6 inches d.b.h. within 3.3 feet of each side of the transect.

The vegetation survey involved trees, shrubs, and herbaceous species. Three concentric plots were generated at each sample point as described by Barth (1970). Tree density and frequency was determined on the outside (20 milacre) plot, shrub frequency and relative density on the middle (5 milacre) plot, and herbaceous species frequency and relative density on the smallest (1 milacre) plot. The relative density was determined with a modification of the Braun-Blanquet density categories described by Barth (1970). Tree reproduction (less than 3 feet tall) density and frequency was also determined on the 1 milacre plot.

Active Fire Studies

Plans were made for study of active fires, should they occur. Data was to be collected on physical site factors, fire weather, fire danger rating according to the National Fire Danger Rating System (Deeming et al., 1972), fire rate of spread, consumption of woody fuels and duff, fuel inventory and moisture content, flame characteristics, and vegetation characteristics. Vegetation mortality would be determined after the fires. These studies were implemented to the degree possible on several small lightning fires which occurred during the two summers of the study.

PRELIMINARY RESULTS

Natural Fire History

Rocky Mountain National Park records dating back to 1915 reveal the following history of fire in the park. There have been a total of 441 forest fires reported. Of these, 94 were attributed to lightning, which burned a total of 979.064 acres. The size class distribution of these lightning fires is as follows: 81 Class A (0-.25 acres), 12 Class B (.26-9.0 acres), and 1 Class E (300-999 acres). The one Class E fire consumed 960 acres, leaving 19.064 acres to be allotted to the remaining 93 natural fires which occurred during the last 60 years. This gives us an average of 0.318 acres per year burned by 1.55 lightning fires per year (Table 1).

During the past 60 years, therefore, the average natural fire in the park has consumed only 0.205 acres. If we consider only the 81 Class A fires which occurred during this period, consuming 1.814 acres, the average size was 0.022 acres. The average size of the 12 Class B fires (which consumed 17.25 acres) was 1.436 acres. Of 94 lightning fires since the park was formed, only five were greater than 1 acre in size and only one was greater than 5 acres. A frequency of 2 or less fires per year occurred over 78 percent of the time (Fig. 1).

Lightning fires in Rocky Mountain National Park are generally small in size and infrequent in occurrence. However, the potential for large fires is present as shown by the 960-acre fire that occurred in 1956. This fire reached most of its maximum size before the first

Table 1. Historic lightning fire occurrence in Rocky Mountain National Park.

Period	Size Class		
	A	B	E
1915–1919	2	—	—
20– 24	4	1	—
25– 29	2	—	—
30– 34	7	1	—
35– 39	6	1	—
40– 44	7	1	—
45– 49	6	—	—
50– 54	9	1	—
55– 59	7	2	1
60– 64	15	3	—
65– 69	7	1	—
70– 74	9	1	—
Total in 60 years	81	12	1
Area burned (acres)	1.814	17.25	960.0
Average size (acres)	0.022	1.438	
Average number per year	1.35	0.2	
Average number per five-year period	6.75	1.0	

suppression crews arrived on scene. Heavy rains may have been the greatest controlling factor next to topography. On the east side of the park, rocky terrain and discontinuous fuels, coupled with normally high fuel moisture contents, keep most lightning fires from becoming very large.

In spite of the low frequency and intensity of most natural fires in the park, extensive areas show evidence of past fires through evidence of charred wood, charcoal in and below duff, and vegetation patterns involving aspen and lodgepole pine stands. Age analysis of several lodgepole pine stands on the east side of the park indicate at least 18 fires greater than 10 acres in size over the period from 1605 to 1864. This gives an average period of 15.2 years between Class C or larger fires on the east side of the park. Fire frequency on any one point of ground is an average of 87.5 years, with a range of 39 to 184 years. This is based on 13 between-fire intervals found on 6 different burns studied. The period prior to the 1870's was selected as being least likely to have significant European man's influence on fire occufrence in the area of the park. To what extent American Indians affected fire occurrence in the area is not certain.

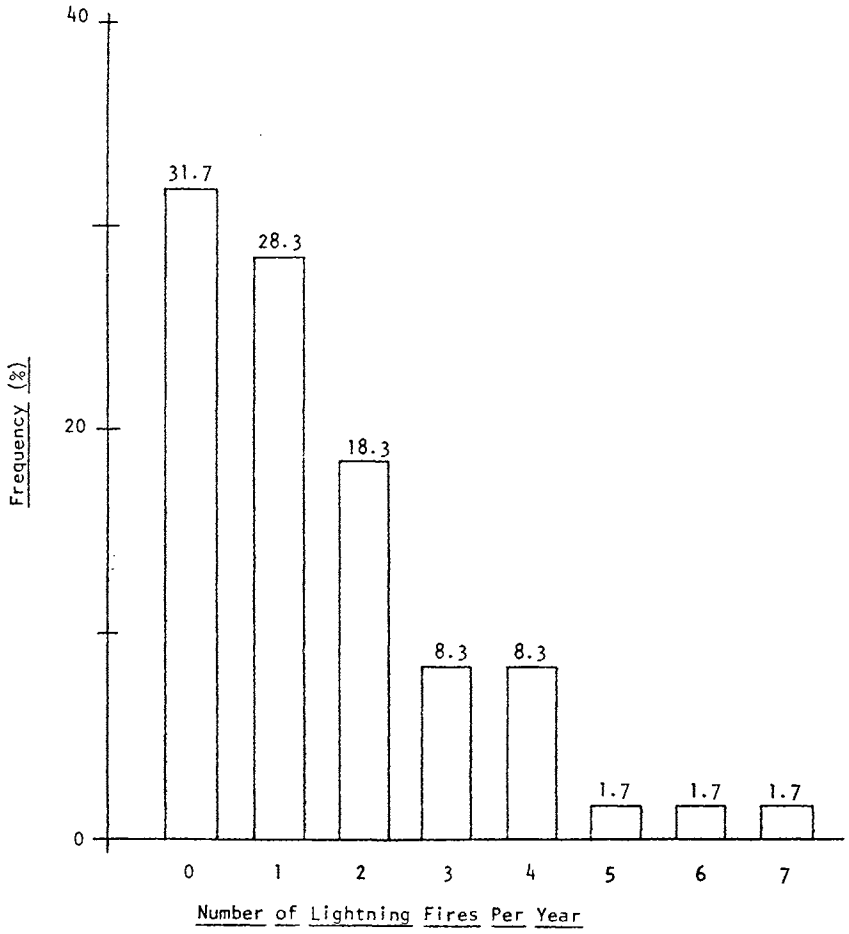

Fig. 1. Lightning fire occurrence.

Field Sampling

Sampling of vegetation, woody fuels survey, and collection of general site information was carried out on five old burns within the park and on one burn several miles north of the park in the Roosevelt Na-

tional Forest. The ages of the burns were as follows: Cub Lake, 2 years; Comanche, 8 years; North Fork, 18 years; Butterfly, 45 years; Boulder Brook, 74 years; and Trail Ridge, 108 years. Two hundred thirty-one plots were established, 131 within the burns and 100 in similar sites immediately adjacent to the burns.

Analysis of the data is incomplete. The only results ready at this time concern the vegetation survey. One hundred seventy-seven species were noted in the plots. These species include 7 trees, 26 shrubs, 111 forbs, and 33 grasses, sedges, and rushes. Peak species diversity (62 species) occurred on the 8-year-old Comanche burn on the Roosevelt National Forest. The data on species distribution has not yet been broken down by stand type or physical site factor gradients. This will be done in the near future.

Active Fire Studies

Six lightning fires occurred during the last two summers. In 1973 two were observed, the Junction Fire (250 sq. ft.) in July and the Chance Fire (80 sq. ft.) in August. The Junction Fire lasted 5 days in spite of daily rain and sometimes hail. The Chance Fire lasted only 1 day after moderate rain and sleet from the thunderstorm that spawned it almost put it out.

In 1974 four lightning fires were observed in the Park, but only three were allowed to burn. The fourth one in early September which occurred in the "high risk zone," too close to private property, was suppressed at two trees in size. The Rim Fire and Chiquita Fire both started in heavy thunderstorm activity the evening of June 16th. The Chiquita Fire was observed for ½ hour from a distance of a few miles until it disappeared in a heavy rain shower. Since no sign of it showed up the next morning or thereafter, no attempt was made to locate it on the ground. The Rim Fire, however, lasted for 38 days and burned a little over ⅔ of an acre in spruce-fir forest at the 10,800-ft. level just below timberline on Trail Ridge. The west-facing 65 percent slope had many rocky outcrops and discontinuous fuels which prevented major spread of the fire. On this fire, activity peaked each day between 1600 and 2400 hours. Steady wind speeds at the ground (fuel) surface of at least 5-6 miles per hour were needed to produce

any active flaming. Rolling embers and creeping smouldering fronts along downed logs and branches were the principal means of spread on this burn.

On July 8th a lightning fire started on a rocky ledge on the side of Flattop Mountain overlooking Bear Lake. Two limber pines were killed, with the total area covered of 33 square feet. This fire smouldered and flared for 3 days before going out. Again, rocky terrain and discontinuous fuels limited spread of this fire.

FUTURE RESEARCH NEEDS

Natural Fire History

The knowledge of fire history is important to both research and management planning. More stand age and composition analysis is needed to document fire history throughout the park. The ponderosa pine savanna at lower elevations is highest priority for study although Wild Basin, the northeast, and west sides of the park also need more study in both lodgepole pine and spruce-fir forests. Along with this, a long-term fire occurrence map should be compiled to aid both future fire management planning and decision making, along with visitor interpretation and education.

Sediment analysis, as described by Swain (1973), of some of the permanent lakes in the park may be valuable in determining prehistoric fire history in the park.

Ecological Succession

A study of plant succession by systematic vegetation sampling should be continued on the more significant fires in the park, whether natural or man-caused. This would increase the resources manager's knowledge of fire effects on vegetation re-establishment and succession and, indirectly, on wildlife populations.

Wildlife studies in relation to fire history are needed to improve management decisions in the future and also aid in ecological interpretation. Use of prescribed fire in vegetation management may prove to be a useful tool in affecting the distribution and size of ungulate populations in the park.

The effects of fire on soil-water relationships and nutrient cycling in local communities is another area in need of study.

Local weather patterns need to be more carefully studied and understood in order to aid the fire manager in his decision making. This data is important in predicting both fire behavior effects and possible air pollution problems.

Active Fire Study

The study of active fires has the highest priority in future research funding.

All fires which are allowed to burn within the park will be studied with particular attention to fire behavior in relation to local topography, weather conditions, vegetation, and fuel supply. Subsequent effects on vegetation and animal life will then be carefully monitored and correlated with the forces which operated during the life of the fire. Again, this information will improve resource management decisions in the future.

In order to conduct active fire behavior studies, it now appears that prescribed fire will be needed. This is considered primarily for study of fire behavior in the ponderosa pine savanna stands at lower elevations since they mostly occur in the moderate to high risk management zones. It will probably also have to be used at higher elevations in order to make data collection practical. Naturally caused lightning fires do not appear to be dependable enough in Rocky Mountain National Park for concentrated research effort.

Basic Resource Inventory

A long range research objective is the parkwide inventory of all ecosystems utilizing the gradient analysis technique. When computerized this data would be available for modeling and predicting wildlife behavior as well as for many other management and administrative decision making needs.

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