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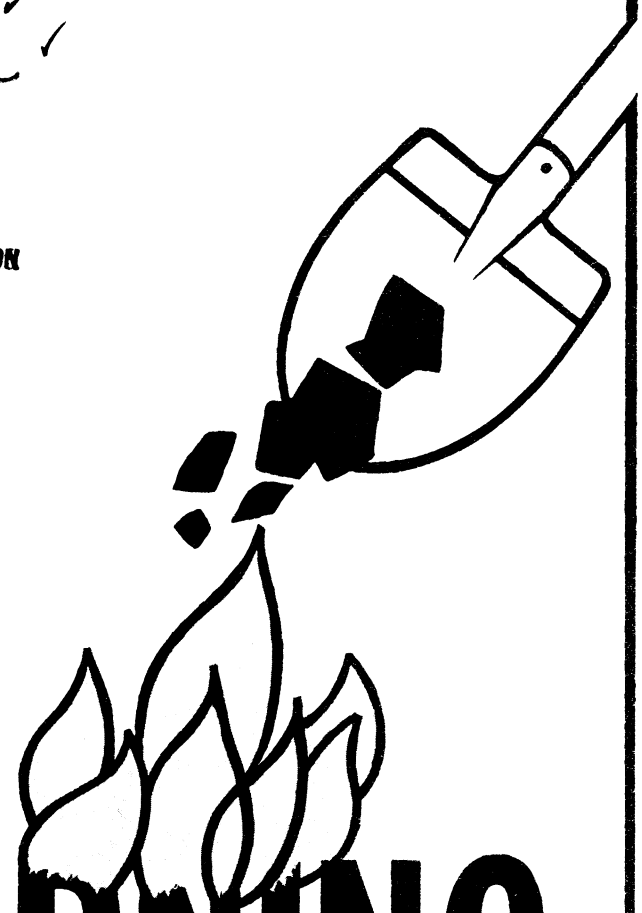

prescribed BURNING in the North Central States

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NORTH CENTRAL FOREST EXPERIMENT STATION
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PRESCRIBED BURNING IN THE NORTH CENTRAL STATES

Linda R. Donoghue and Von J. Johnson

We know that prescribed fire is used in the Lake States region, but we do not know to what extent. In an effort to find out, we began an annual survey in 1968 in Michigan, Minnesota, and Wisconsin and included Illinois and Ohio in 1972. This report summarizes 5 years' results.

HISTORY OF PRESCRIBED BURNING IN THE LAKE STATES

Prescribed fire has not been used extensively in the Lake States. This may be due in part to the region's fire history. The great fires of the latter 19th and early 20th centuries prompted intensive and highly effective prevention and suppression campaigns that discouraged prescribed burning. Although prescribed fire was proposed during this period, it was rejected in the belief that public misinterpretation and misunderstanding would cause more harm than good (Chapman 1947). A controversy, lasting nearly 20 years, developed over the relative merits of controlled fire versus total exclusion, following an early report by Chapman (1926).

The increased use of prescribed burning in the southern United States lent credibility to the idea of fire as a management tool. By 1939 prescribed fire in longleaf pine was officially recognized at the national level (Chapman 1947). As a result of southern success, managers began burning in other parts of the country. Research trials for silvicultural purposes and hazard reduction were conducted by the Lake States Forest Experiment Station beginning in the 1930's (Buckman 1964). In 1935 prescribed burning was advocated by game managers as a means of controlling forest encroachment into wildlife habitat in the Lake States (Smith 1947). In the early 40's Maissurow (1941) stressed fire's role in the perpetuation of yellow birch, hemlock, pines, and the intolerant hardwoods in northern Wisconsin. Within the decade burning for wildlife habitat improvement increased rapidly in Wisconsin and Michigan. During the 1950's, however, much of the burning in the other Lake States remained experimental, even though a few agencies accepted controlled burning as a commonplace management practice.

Operational use of prescribed fire increased in the 1960's. This increase was largely due to preceeding research efforts that provided favorable information to land managers. Large amounts of technological and ecological information on fire effects were produced during the 60's by researchers such as Beaufait (1962), Chrosciewicz (1967), and Ahlgren (1970). Presently, the greatest usage of prescribed fire in the Lake States is for wildlife habitat management (Donoghue 1973, 1974). It is also used for such things as hazard reduction, planting site and seedbed preparation, insect and disease control, and hardwood regeneration.

THE SURVEY

A questionnaire was sent to all known users of prescribed fire in Minnesota, Wisconsin, and Michigan annually over a 5-year period from 1968 through 1972. In 1972 Ohio and Illinois were also included. Several agencies participated in the survey. They include the Minnesota, Wisconsin, Michigan, and Ohio Departments of Natural Resources; University of Minnesota; Forest Service; U.S. Bureau of Sport Fisheries and Wildlife; other U.S. Department of Interior agencies; and a few private landowners.

Unfortunately, there is no standard procedure for routinely reporting prescribed fires. The data used in this analysis are limited to the responses received from cooperating agencies and do not necessarily include all prescribed burning within the surveyed area. The analysis in some cases necessitated interpretation of the primary ages of burning slash, burning techniques, and purpose-of-burn.

NUMBER OF FIRES AND BURNED ACREAGE

The number of prescribed fires reported by participating agencies increased from 72 in 1968 to 115 in 1972. This trend may indicate either increased use of prescribed fire or more complete reporting response. The Minnesota Department of Natural Resources submitted almost half of the 444 reports received; the Wisconsin Department of Natural Resources submitted nearly one-fourth.

More burned acreage was reported during 1968 and 1970 than in other survey years. Although the number of fires increased through the reporting period, acreage burned did not always follow this trend. In some years more prescribed fires were conducted, but less acreage was burned per fire.

During the 5-year period 76,743 acres were prescribed burned (table 1). Wisconsin reported 22,570 acres or 29 percent of the total and the Forest Service 21,814 acres. Although less area was burned in Minnesota (14,187 acres), that State used fire for more purposes than other reporting agencies.

Prescribed burning reaches a peak in late April, decreases sharply to a low in early June, and gradually increases again to a second peak in late August (fig. 1). The increase of prescribed fires in late October is largely a result of acceptable burning conditions during 1972. Within the 5-year period burning began as early as February and continued into December. Monthly activity ranged from a low of 1 fire in February to 108 fires in August.

PURPOSE OF BURN

Many prescribed burns are designed to accomplish more than one objective. For instance, a prescribed fire always reduces the fuel accumulation, and with some modification, hazard-reduction burns can improve wildlife habitat. In addition, almost any prescribed burn improves access and visibility (Mobley et al. 1973).

Although more than one purpose was reported on 28 percent of the responses, only the primary purpose is shown in the following tabulation:

Primary Purpose	*Percent of Total Burns*
Wildlife habitat management	40
Site preparation	24
Seedbed preparation	23
Hazard reduction	7
Prairie grass regeneration	2
Experimental	2
Other[1]	2
	100

Ninety percent of the 22,570 acres reported by Wisconsin were prescribed burned for wildlife habitat management. The U.S. Bureau of Sport Fisheries and Wildlife (BSFW), other Department of the Interior agencies, and the State of Minnesota also burned large acreages for this purpose. Approximately 23 percent of the total reported burned by the Forest Service was for hazard reduction. Most burning for site and seedbed preparation was done by Minnesota, the Forest Service, and Wisconsin.

Burning results depend greatly upon weather and condition of vegetation. If we delineate the prescribed fire season on the basis of the phenological stage of the lower vegetation, then in the Midwest the spring burning season ends about the latter part of May, and summer season includes

[1] *Includes prescribed fire for natural area maintenance and disease control.*

June to mid-September. Fall season is from mid-September until winter snow. These are the times when low vegetation changes from transitional to the green stage in the spring and returns from green to transitional in the fall (Haines, Johnson, and Main 1974).

Prescribed burning for various purposes follows different seasonal patterns (table 2). Most burning took place during the spring. Wildlife habitat management, hazard reduction, and prairie grass regeneration burns were done primarily at this time. There was less

Table 1.--*A summary of reported prescribed burns in the North Central States, 1968-1972*

Agency	Purpose	Area Burned
		acres
USDA Forest Service	Hazard reduction	17,484
	Wildlife habitat management	510
	Site preparation	1,152
	Seedbed preparation	180
	Site and/or seedbed preparation	2,068
	Blueberry production	70
	Experimental	350
Minnesota Department of Natural Resources	Hazard reduction	256
	Wildlife habitat management	7,073
	Site preparation	2,744
	Seedbed preparation	3,082
	Blueberry production	121
	Natural area maintenance	235
	Disease control	387
	Prairie grass regeneration	136
	Experimental	153
Wisconsin Department of Natural Resources	Hazard reduction	386
	Wildlife habitat management	20,334
	Site preparation	1,377
	Seedbed preparation	122
	Prairie grass regeneration	351
Michigan Department of Natural Resources	Wildlife habitat management	1,725
	Site preparation	110
U.S. Bureau of Sport Fisheries & Wildlife	Hazard reduction	31
	Wildlife habitat management	9,662
	Experimental	303
Private landowners	Wildlife habitat management	120
	Site preparation	84
Other Department of the Interior agencies	Hazard reduction	372
	Wildlife habitat management	4,659
	Seedbed preparation	40
	Prairie grass regeneration	85
	Experimental	27
Ohio Department of Natural Resources	Wildlife habitat management	54
University of Minnesota	Experimental	570
Minnesota Department of Natural Resources in cooperation with Univ. of Minn.	Experimental	330
TOTAL		76,743

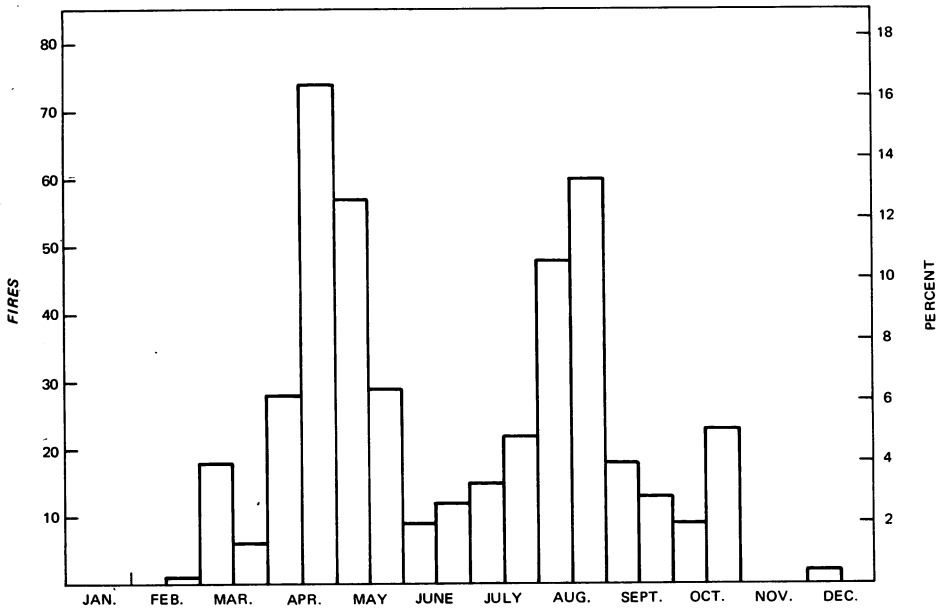

Figure 1.--*Total number and percent of prescribed fires by half-months, 1968-1972.*

Table 2.--*Primary purpose of prescribed fire by season*
(In percent)

Purpose	Seasons		
	Spring (Last snow to May 31)	Summer (June 1 to Sept. 15)	Fall (Sept. 16 to first snow)
Wildlife habitat	26	10	4
Site preparation	9	12	4
Seedbed preparation	4	16	2
Hazard reduction	5	1	([2])
Prairie regeneration	2	0	([2])
Other[1]	2	2	0
TOTAL	48	41	11

[1]Includes burns for experiment purposes, training, and disease control
[2]Less than 1 percent

activity in the summer, although most seedbed-preparation burns took place during this season. Prescribed burning for site preparation, experimental purposes, natural area maintenance, and disease control also occurred primarily during the summer months. Little fall burning was reported.

FUELS

The fuels burned were divided into four main groups:

Fuel Group	*Percentage of Total Burns*
Conifer	57
Grass	17
Hardwood	14
Brush	6
Fuels not reported	6

More than half the prescribed burns were ignited in coniferous fuel, primarily jack pine, black spruce, or balsam fir. Most

slash was burned when 1 or 2 years old, even though slash age ranged from current to 10 years old.

The type of fuel burned varied with the time of year (table 3). During the spring most prescribed fires were in hardwood, brush, and grass fuels. Burning in coniferous fuels took place largely during the summer months. In most cases the fuel type burned and the purpose of the burn were directly related. For example, most burning for wildlife habitat improvement took place in hardwood, brush, and grass fuels during the spring. Prescribed fires for site and seedbed preparation were conducted primarily in coniferous fuels during the summer.

Table 3.--*Primary fuels burned by season*

(In percent)

Fuels	Season		
	Spring (Last snow to May 31)	Summer (June 1 to Sept. 15)	Fall (Sept. 16 to first snow)
Conifer	21	31	7
Hardwood	11	3	1
Brush	5	2	1
Grass	10	6	2
TOTAL	47	42	11

WEATHER

Relative humidity, temperature, insolation, and rainfall are important elements to consider in controlled burning. These factors influence fuel moisture and combined with air mass stability and wind speed, largely determine rate-of-spread and fire intensity.

After a rainfall heavy fuels and duff require several days of drying weather to reduce their moisture content to the point where they will be consumed. Fine fuels dry more quickly and may require only 1 or 2 drying days for a successful burn (Sando and Dobbs 1970). Forty percent of the burns were conducted 3 to 5 days after the last rain, regardless of fuel type (fig. 2). A few fires were not started in hardwood and brush fuels until 20-25 days after the last reported rain. Maximum air temperatures reported during prescribed burning ranged from 28° F to 91° F. Approximately three-fourths of the reported prescribed fires were conducted on days with maximum air temperatures ranging from 60° F to 89° F.

Fine fuels respond quickly to changes in humidity, whereas larger pieces of slash may require days or weeks to adjust to variations in humidity (Beaufait 1966). Reported relative humidity during burning ranged from a low of 15 percent to a high of 85 percent (fig. 3). Humidities reported most often during burning fell between 41 and 50 percent. Seventy-five percent of the prescribed fires took place on days with humidities between 31 and 60 percent.

Wind is critical during a prescribed burn. Both velocity and directional changes can have significant effects on fire behavior. As one might suspect, prescribed burning decreased as windspeeds increased; less than 1 percent of the burns were made with windspeeds in excess of 26 mi/h.

Fire weather forecasts supply information needed to determine smoke management and fire behavior. Requests for special fire weather forecasts generally increased over the course of the survey period. In 1968, forecasts were requested for about a quarter of the prescribed fires. By 1971 special forecasts were used for 50 percent of the burns and remained close to this level in 1972.

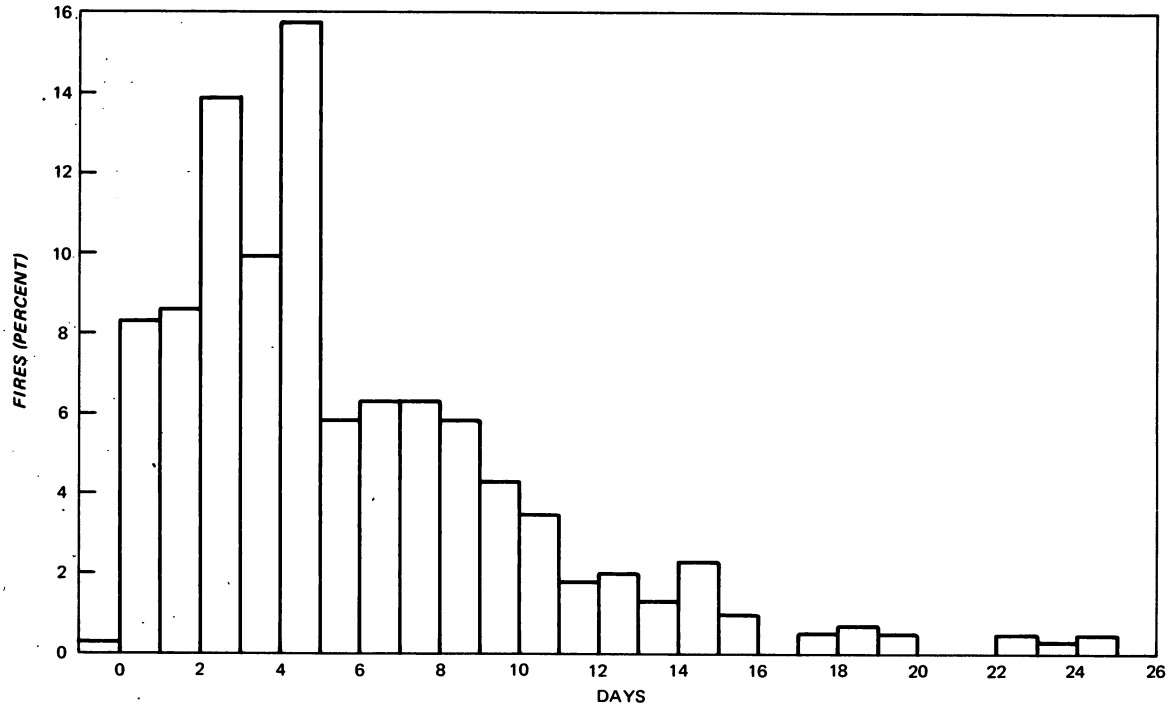

Figure 2.--*Percent of burns from day of last rain.*

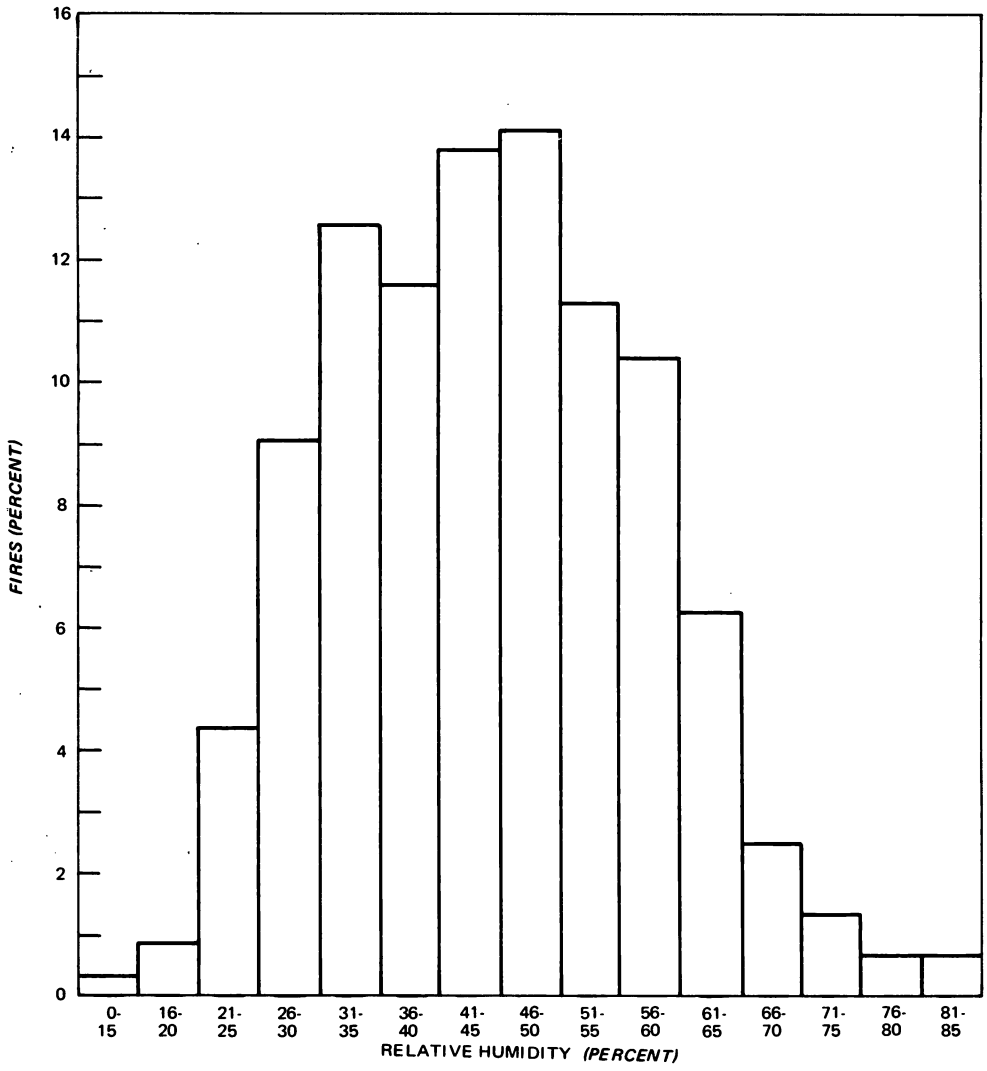

Figure 3.--*Relative humidity at fire start.*

OTHER ASPECTS

The time of day largely determines burning conditions. Daily variation in conditions is as important as seasonal change in scheduling fires. Three-fourths of the reported prescribed fires were started between 11:00 a.m. and 3:00 p.m., although burns began as early as 8:30 a.m. and as late as 8:30 p.m. Nearly one-third of the burns were set between noon and 1:00 p.m. Most prescribed fires were completed in 1-2 hours. About 77 percent of the reported prescribed fires were finished in times ranging from one-half hour to 4 hours.

Ignition crews should be equipped with devices that provide rapid, controlled lighting of fire along predetermined routes. The drip torch was the preferred ignition tool (81 percent) in the North Central States.

A combination of firing techniques was the decided preference on most of the fires, with the strip head-fire the single preferred technique (22 percent). Strip back-fires (12 percent), flank-fires (5 percent), and checkerboard spotting (2 percent) were also used by some managers.

Cost-per-acre varied with the purpose of burn (fig. 4). The cost for site-preparation, seedbed, and hazard-reduction burns follow the same general pattern with a few exceptions. Slightly less than half the site-preparation burns generated costs ranging from $5 to $10 per acre, while costs reported most often for seedbed and hazard fires ranged from $1 to $5 per acre. The low cost of hazard-reduction fires ($.01 to $.50) was a result of large acreages burned per fire.

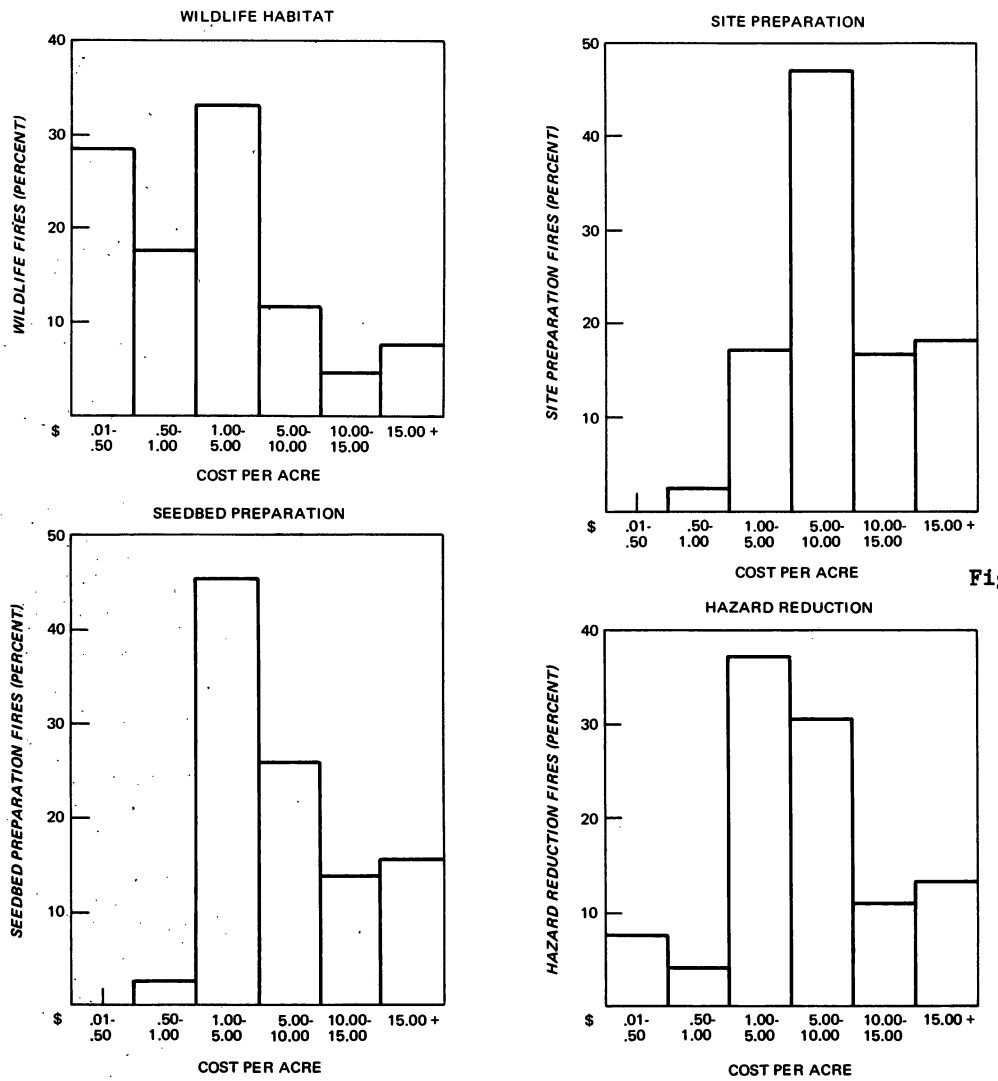

Figure 4.--*Cost-per-acre by primary purpose of burns.*

Expenditures reported for wildlife-habitat burns resulted in a different distribution, having lower overall costs per burn. Nearly three-fourths of the fires ranged in cost from $.01 to $5.00 per acre. These lower values were due to the large acreage burned per fire.

None of the fires escaped control. Seventy-four percent of the prescribed fires were reported as successfully accomplishing a primary objective. Twenty-four percent of the burns were a partial success, while the remaining 2 percent failed to accomplish the desired results. We must realize, however, that the ultimate success of a burn might not be determined for some time. Therefore, the immediate results do not always indicate the final effects of the fire.

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1975. Prescribed burning in the North Central States. North Cent. For. Exp. Stn., St. Paul, Minn. 8 p., illus. (USDA For. Serv. Res. Pap. NC-111)

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