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wildfire atlas of the northeastern and north central states

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FOREWORD

The atlas format used to display the information presented in this report is based on the mapping methodology used by the National Weather Service in "Climatic Atlas of the United States" (National Oceanic and Atmospheric Administration 1968). Most of the weather and climate patterns portrayed in that publication were developed only from data gathered at first-order weather stations. The same principle applies to the patterns portrayed in this paper inasmuch as they were developed solely from data recorded on the National Forests in the north central and northeastern States. Localized pattern variations are minimized using this mapping methodolgy and regional patterns become apparent. However, the characteristics that become apparent regionally also are applicable to the areas surrounding the geographical points from which the data are taken.

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WILDFIRE ATLAS OF THE NORTHEASTERN AND NORTH CENTRAL STATES

Donald A. Haines, Von J. Johnson, and William A. Main

INTRODUCTION

Forest fires are usually viewed in terms of local areas rather than in regional perspectives because of differences between areas in such fire essentials as fuel, weather, climate, and land use. This is accentuated by nonuniformity in State fire enforcement and protection policies as well as by differences in land ownership, both of which contribute to a lack of homogeneity among the social and administrative forces that foster a local perspective.

However, there are many similarities in forest fire activity and behavior or, at least, transitional patterns between areas--both spatially and temporally--that become apparent regionally. The objective of this paper is to visually display and describe in an atlas format these similarities or patterns using various measures of forest fire activity. Its contents might be useful to fire planners in the establishment of fire seasons and the prediction of peak activity periods as well as provide them with a seasonal guide for allocating fire fighting resources regionally and inter-regionally.

DATA SOURCE

This atlas is based on 10 years (1960-1969) of reports from the National Forests in the northeastern and north central States (fig. 1) that have uniform reporting procedures. Report forms used by State protec-

Figure 1.--*National Forests in the northeastern United States. The Wayne-Hoosier and the Huron-Manistee are combined protection units.*

tion agencies are not uniform; therefore, their records were not included.

Geographically, obviously, representation in our data is best in those sections where these Forests are concentrated, for instance, in the Upper Midwest. It is poorest along the eastern seaboard where only two National Forests are located. For some measures of fire activity, either the size of the sample or the reliability of the data posed problems. During this 10-year period, for example, there were only 65 fires reported on the Green Mountain National Forest and 69 on the White Mountain National Forest. Such numbers are simply too small to produce representative frequency distributions.

Our data are generally reliable except for two measures of fire activity--man-hours-to-control and fire cause. These might be questionable because of inaccuracies introduced by flaws in the design of the reporting forms as well as by differences in judgment among those filing the reports. However, the fire-activity data derived permitted statistical comparisons that provide an interpretive base for fire planning.

In an earlier report (Haines *et al.* 1973), we documented the difficulty inherent in comparing fire activity between protection areas. In this report, we account for differences in size of protected areas within each National Forest as well as for variations in numbers of fires and acreage burned (tables 1 and 2) by compiling much of the activity relative to the specific Forest.

Our data are presented as percents of total activity on each forest protection unit, or as percents of peak class. Using this "peak class" method, a value of 100 percent is assigned to the week of the year in which most fires occurred, and this value is used to calculate percentile values for the remaining weeks. This essentially normalizes the individual forest data and partially eliminates the problem of attempting to statistically compare fire activity in different protection areas when using an absolute number scale.

Not all of our summaries will be applicable to specific areas. Each fire manager must judge the similarities and differences between his area and nearby National Forests.

Table 1.--*Average annual fire activity on National Forests in the northeastern and north central States during the period 1960-1969.*

Protection Unit	Size of protected area[1]	Fires	Area burned	Fires ≥ 10 acres	Fire days[2]
	Thousand acres	*Number*	*Acres*	*Number*	*Number*
Allegheny	489.4	10	66	2	8.5
Chequamegon	863.6	10	45	1	9.0
Chippewa	1,246.5	39	404	5	25.1
Clark	1,537.1	212	2,677	34	97.3
Green Mountain	379.0	7	14	<1	6.0
Hiawatha (East)[3]	1,189.1	12	39	1	8.4
Hiawatha (West)[3]	1,189.1	18	87	1	15.1
Huron[3]	1,750.6	23	323	3	25.1
Manistee[3]	1,750.6	87	339	6	49.8
Mark Twain	1,005.7	140	1,557	24	74.3
Monongahela	1,191.4	22	179	3	18.1
Nicolet	.941.7	23	148	2	17.5
Ottawa	1,223.4	16	63	1	12.9
Shawnee	490.6	41	524	10	29.0
Superior	2,722.0	60	300	3	40.2
Wayne[3]	532.4	82	430	10	42.0
Hoosier[3]	532.4	29	502	8	22.2
White Mountain	788.1	7	13	<1	5.9

[1]1969 total protected acreage.
[2]A day having at least one reported fire.
[3]Combined as a single unit.

Table 2.--*Fire activity on National Forests in northeastern and north central States during the period 1960-1969*

Protection Unit	Peak seasons: Spring	Peak seasons: Fall	Total activity within peak activity seasons: No. of fires	Burned acreage	Man-hours to control	Fire acres ≥ 10 acres	Fire days[1]	Damages	Maximum fires/day: In season	Out of season
			Percent						*Number*	
Allegheny	3/19-5/27	9/24-12/9	87	84	63	88	86	87	3	2
Chequamegon	3/26-6/10	10/1-12/2	76	83	58	80	73	75	4	2
Chippewa	3/12-7/1	10/8-11/18	86	98	96	98	83	86	8	4
Clark	2/5-5/13	10/8-12/9	82	91	96	85	71	81	23	9
Green Mountain	4/9-11/25[2]		100[3]	100	100	100	100	100	3	0
Hiawatha (East)[4] Hiawatha (West)[4]	4/2-10/28[2]		96	81	100	74	96	96	9	5
Huron[4] Manistee[4]	3/26-9/2	10/1-10/28	93	92	94	94	91	93	12	6
Mark Twain	1/8-5/13	10/22-12/9	84	92	92	90	75	83	16	4
Monongahela	3/12-7/29	10/1-12/9	97	99	97	100	96	97	5	1
Nicolet	4/2-7/29	10/8-10/28	84	93	84	89	82	84	5	3
Ottawa	4/9-8/26	10/1-10/28	94	100	100	100	93	94	4	2
Shawnee	2/12-5/6	10/1-12/9	84	89	92	87	80	85	7	2
Superior	4/2-11/4[2]		99	99	100	97	99	99	6	1
Wayne[4] Hoosier[4]	1/22-5/13	10/8-12/9	93	96	92	96	89	93	10	4
White Mountain	4/30-10/21[2]		100[3]	100	100	100	100	100	3	0

[1]A day having at least one reported fire.
[2]Only one peak season.
[3]The small number of fires caused statistical distortion in defining seasons.
[4]Combined as a single unit.

VEGETATIVE COVER

Within the northeast and north central States, forest ground cover varies dramatically from large expanses of grassland to heavy conifer stands to rolling hills of hardwoods (Kuchler 1964, Braun 1950). The USDA Forest Service (1960) handbook lists 38 different fuel classification types on their fire reports that we grouped as follows: grass, conifer, hardwood, and other (usually slash or brush).

Over 50 percent of the fires reported in the northeastern and north central States burned in hardwood stands (fig. 2). These fires dominate in the lower Midwest and East which reflects the prevailing cover type in these areas. Grass fires are predominant through the upper Midwest, except in northeastern Minnesota where conifer fires dominate. However, conifer fires do account for a significant number of fires in other areas.

In terms of burned acreage (fig. 3), a somewhat different pattern emerges: for hardwood fuels, the percents in figure 3 are generally lower than the percents in figure 2; for grass fires, the percents are generally higher in figure 3 than those in figure 2. This can be attributed to the suppression techniques and the burning characteristics of grass fuels (especially high spread rates) which makes it difficult to limit grass fires to small areas.

We found the "average size" of grass fires to be large, for example, 6 acres on the Ottawa National Forest, 10 acres on the Superior National Forest, and 16 acres on the Chippewa National Forest. However, as a statistical measure, "average" is a poor description of fire size. One or two unusually large fires can distort such averages, especially when fire incidence is low.

The median is a better statistical reference (fig. 4). When we computed this term, we found that medians for grass fires were under ½ acre for the Ottawa National Forest, about 1 acre for the Superior National Forest, and 2 acres for the Chippewa National Forest.

In Missouri, Illinois, and Indiana, where slash-brush complexes are of special concern, the medians range as high as 4 or 5 acres as compared to averages that range as high as 24 acres. Medians are lowest on the Green Mountain National Forest and on the White Mountain National Forest where total fire numbers also are low.

The flammability of a fine fuel complex is influenced by the proportion of living to dead materials. Consequently, the phenological stage of herbaceous plants has become an integral part of fire danger rating systems. We used the three broad stages described by Nelson (1964) in which vegetation is considered as follows: (1) *cured* when a visual survey indicates that 75 percent or more is dead or dormant, (2) *transition* when 25 to 75 percent is dead or dormant, and (3) *green* when less than 25 percent is dead or dormant.

Figure 5 gives the median spring and fall week in which these stages occur. These median dates can only be viewed as approximations because of the relatively short period record and the limited number of observation stations.

Vegetation changes from the cured stage to the transition stage in late April in the southern forests and about a month later in northern forests (fig. 5A). When viewed broadly, this spring transition stage appears largely latitude dependent; if more detail were available, the isolines would present a more complex pattern, especially in mountain ranges. One to 3 weeks are usually required for living vegetation to move from the transition stage to the green stage (fig. 5B). The south to north "greening-up" pattern in figure 5A is also evident in figure 5B.

In autumn, a more complex, reverse pattern appears. In the north, vegetation moves into the transition stage by mid- to late September, which means that vegetation is in the green stage an average of 18 weeks (fig. 5C). The north to south curing trend in the fall is not as pronounced as the "greening-up" pattern in the spring. For example, vegetation in southern Ohio and West Virginia shows some of the temporal curing characteristics of vegetation in the northern tier of forests. However, vegetation in southern Missouri, Illinois, and Indiana doesn't reach the transition stage until mid-October, which means that it is in green stage an average of 25 weeks

This annual vegetative cycle is completed with a return to cured condition in the north by mid-October and in the

Figure 2.--*Percent of fires that burned in four prevailing cover types.*

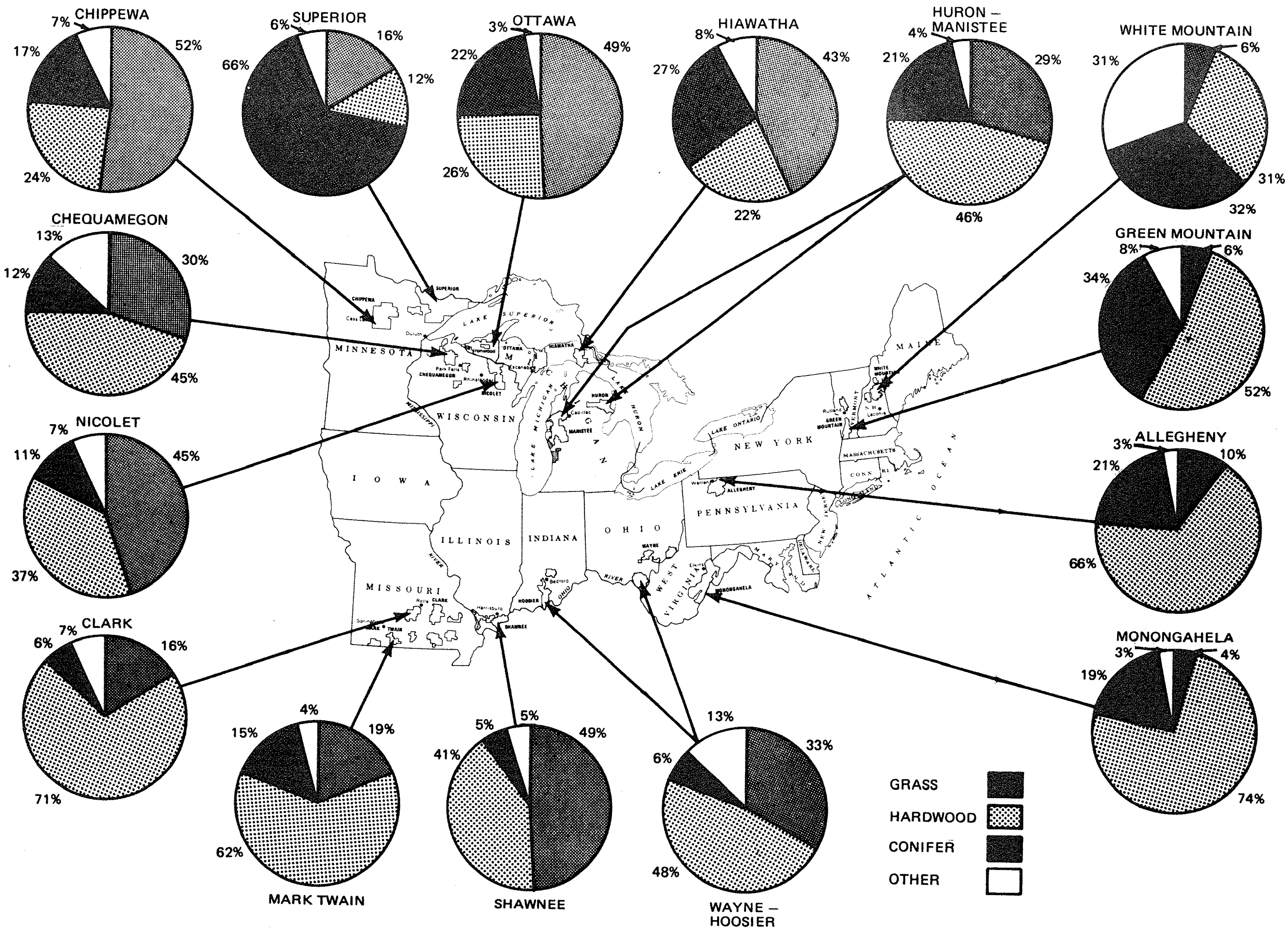


Figure 3.--*Percent of burned acreage in four prevailing cover types.*

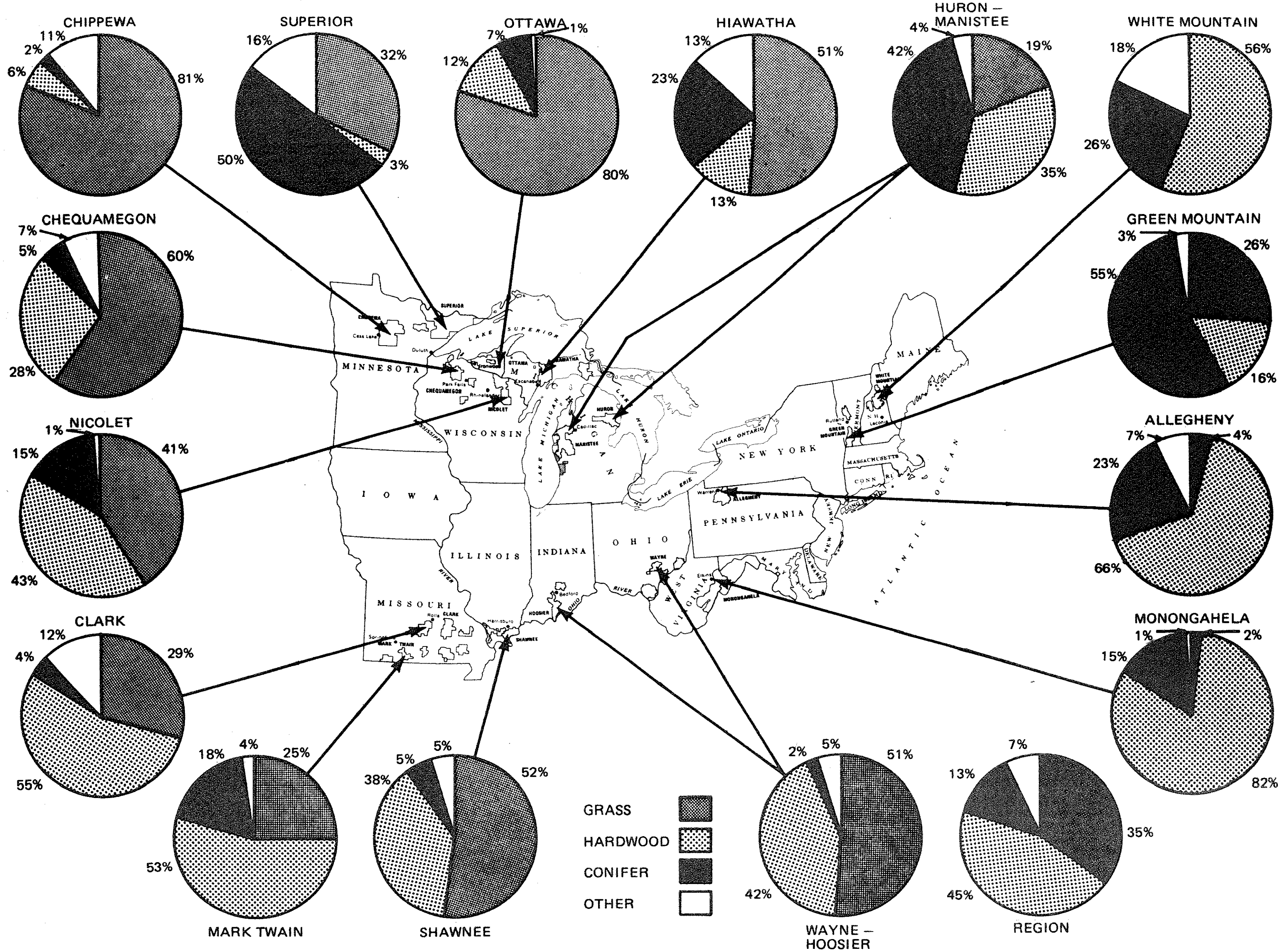
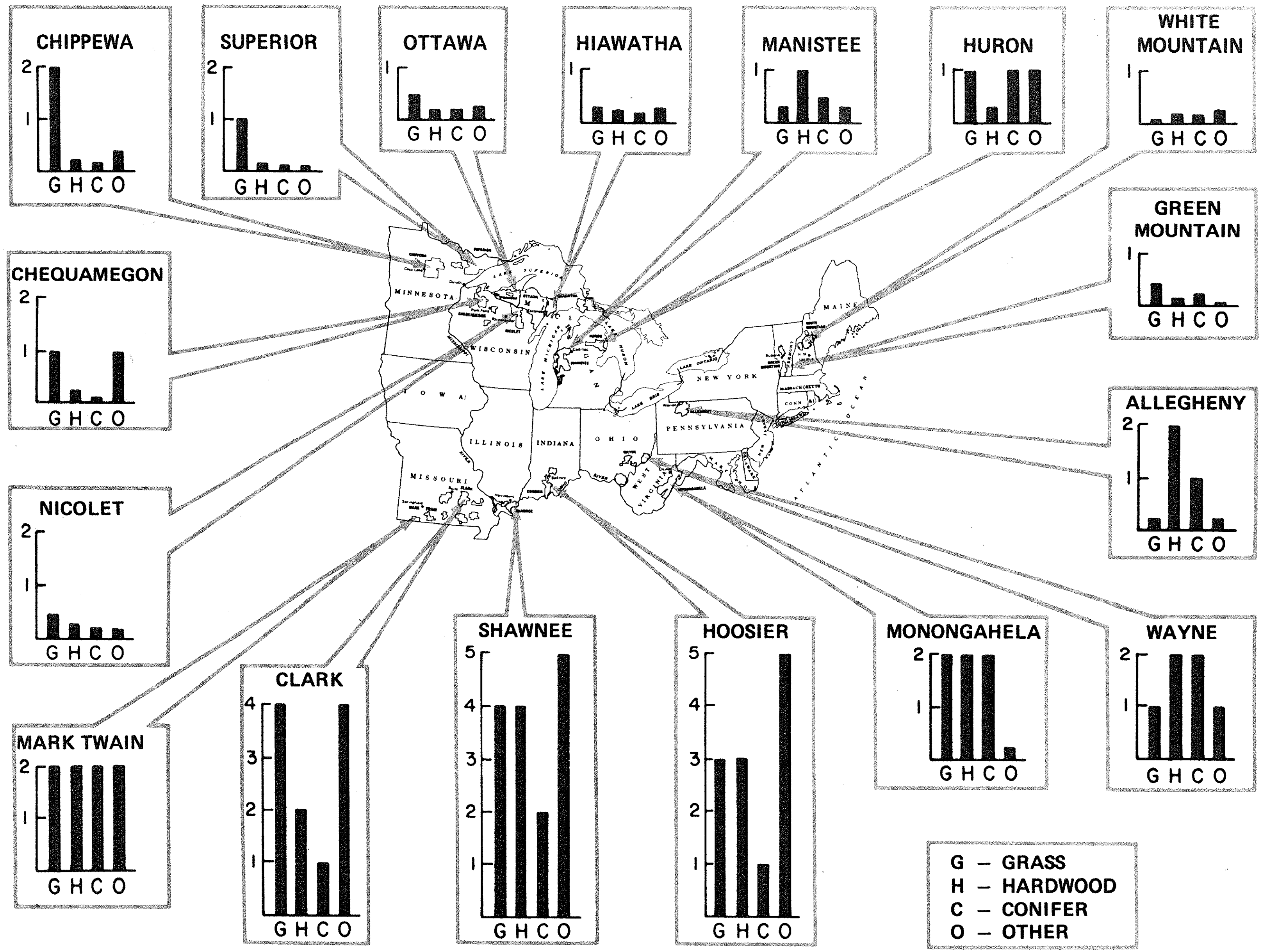


Figure 4.--*Median size of fires (in acres) in four prevailing cover types.*



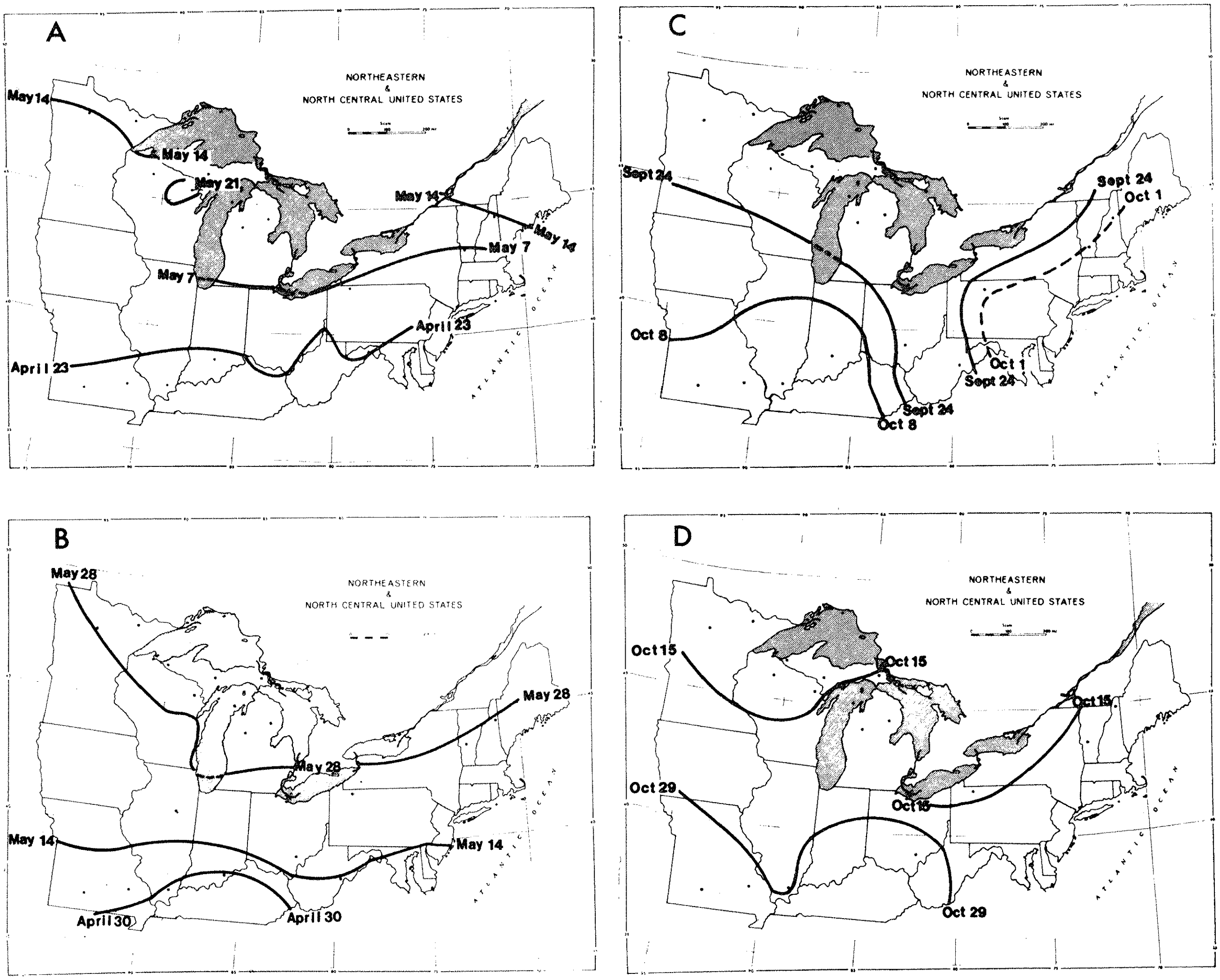


Figure 5.--*A. Median spring week when vegetation stage changes from cured to transition. B. Median week when vegetation stage changes from transition to green. C. Median fall week when vegetation stage changes from green to transition. D. Median week when vegetation stage changes from transition to cured.*

south by early November (fig. 5D). The lengths of time in this transition stage vary widely but are generally longer in the autumn than in the spring; the median periods range up to 7 weeks in some areas. This factor is reflected in the isoline pattern for the autumn.

The relation of this phenological cycle to fire occurrence is portrayed in figure 6 for the Mark Twain National Forest. The pattern is typical of northeastern forests that have well-defined spring and fall fire seasons. Vegetation is in the cured stage during the peak period of the spring season. Fire occurrence drops rapidly as vegetation enters the transitional stage. There is little fire activity during the summer because of the lush vegetation. In the fall, fire activity increases as the vegetation enters the transitional stage; it usually peaks shortly after the vegetation enters cured stage and then declines with the advent of winter conditions.

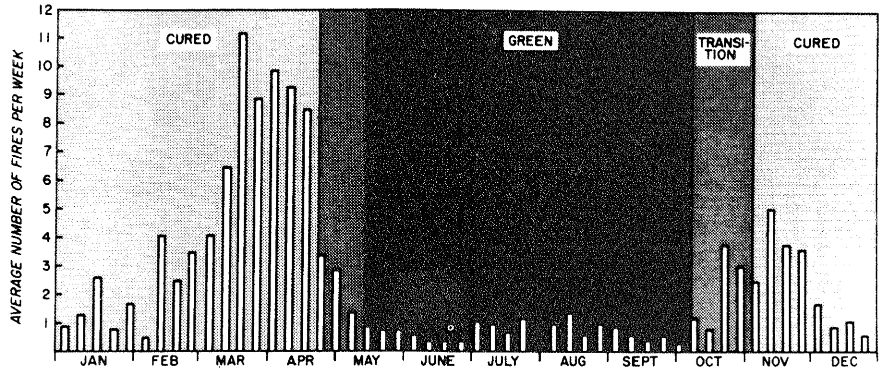


Figure 6.--*Average number of fires per week and seasonal vegetative stages on the Mark Twain National Forest.*

NUMBERS-OF-FIRES PROFILES

Three distribution forms are evidenced in figure 7: (1) symmetrical, (2) skewed, and (3) bimodel.

The *symmetrical* form is typified by the profile for the Superior National Forest. In general, fire numbers increase from spring until mid-year, then decrease until fall.

The *skewed* form is typified by the profiles for the Nicolet and the Ottawa National Forests. On these Forests, fire activity is dominant during the spring but distribution is erratic during the summer and fall.

The *bimodel* form is typified by the profiles for the National Forests in the southern tier of States. Fire activity peaks in both spring and fall. Spring activity ceases as vegetation begins the transition to the green stage and increases as the vegetation begins to cure in the fall (fig. 6). This phenomenon is amplified in hardwood forests during the summer months by the leafy canopies that reduce solar radiation at the forest floor, while permitting moisture to build up in the fuels.

In the profiles for the southern tier of forests there is a noteworthy west to east march toward progressively stronger, fall fire activity. For example, the profile for the Mark Twain National Forest displays an intense activity season in the spring and a much weaker activity season in the fall; 66 percent of the fires occurred in the spring season, 22 percent in the fall. On the Monongahela National Forest, however, only 38 percent of the fires occurred in the spring, 46 percent in the fall. This difference might be attributed to the drought that occurred in the eastern States during the early 1960's. It caused early fall curing of vegetation, which could well have extended the fall activity season in some areas. This drought might also be reflected by the spring-fall differences in the herbaceous stages in figure 5.

The drought began in areas of the Northeast during September 1961, developed extreme characteristics by the end of September 1964, and spread southward during 1965 (National Oceanic and Atmospheric Administration 1965). By the end of 1965, the drought was extreme in northern West Virginia, northern and eastern Virginia, Maryland, Delaware, New Jersey, eastern Pennsylvania, southwestern New York, and central and southern New England. In most of these areas, this severity persisted through the summer of 1966 but gradually diminished when widespread rainfall occurred in September and October of 1966. By the end of October, the drought was limited to south central Pennsylvania and smaller, isolated areas in the Northeast (National Oceanic and Atmospheric Administration 1966).

In the Eastern Ozarks, however, the drought remained mild to moderate during the period 1962-1965 (Haines *et al.* 1973). During 1963-1966, fires increased 20 percent on the Mark Twain National Forest, about 33 percent on the Clark and Shawnee, 50 percent on the Monongahela, and 90 percent on the

Wayne-Hoosier, as compared to the totals for 1960-1962 and 1967-1969 (table 3). However, these increases were not distributed proportionally throughout the entire year.

During the spring season, the annual percentage of fires was lower during the drought years throughout the entire southern tier of States. During the fall season, however, the annual percentages of fires were as much as 17 percent higher during the drought period on some forests.

Obviously, these figures do not fully support the hypothesis that drought caused the west to east march toward progressively stronger fall fire activity. In most areas drought appears to be the cause, but not in West Virginia where the percents of fall fires during the drought years matches the percents during nondrought years. We might be able to attribute this to the fact that we only had data for the one National Forest in West Virginia, which averaged 22 fires per year.

Data from State Forests in West Virginia support the hypothesis that drought was the cause here also. There was much more fire activity during the spring seasons than during the fall seasons on these State Forests, except during 1964 and 1965 when the drought was most severe.[1]

Another possible factor in this west to east shift may be differing social attitudes through the southern sector. In Missouri, for example, spring is customarily a favored time for burning woods (Haines *et al.* 1973). In Missouri, furthermore, debris burning and incendiarism have been traditional causes of wildfires. In West Virginia, the same social factors are predominant, but not to the same degree, nor as concentrated in the same seasonal pattern as in Missouri.

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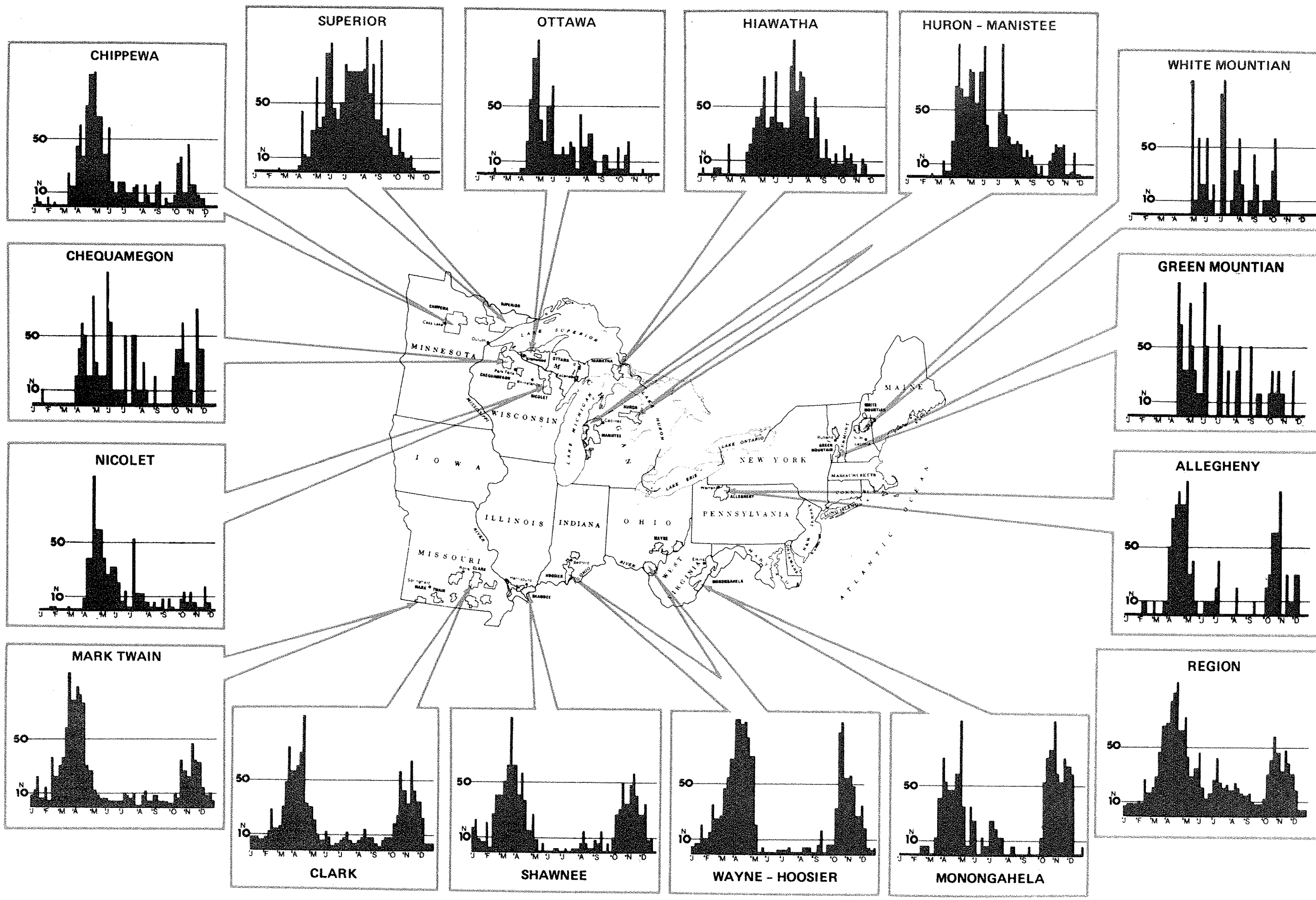
[1]*Personal correspondence with Asher W. Kelly, Jr., West Virginia Department of National Resources, 1973.*

Table 3.--*Annual fires that occurred in spring fire activity and in fall fire activity seasons during drought years (1963-1966) and nondrought years (1960-1962; 1967-1969) on National Forests in the north central and northeastern States*

Forest	Spring season		Fall season		Yearly average	
	Drought years	Nondrought years	Drought years	Nondrought years	Drought years	Nondrought years
	Percent				*Number*	
Mark Twain	65	67	18	17	155	129
Clark	50	53	32	29	249	186
Shawnee	40	66	40	23	48	36
Wayne-Hoosier	52	71	40	24	155	81
Monongahela	47	51	47	47	28	19

Figure 7.--*Distribution of numbers of fires expressed as a percent of the peak class (by week).* *See page 2.*

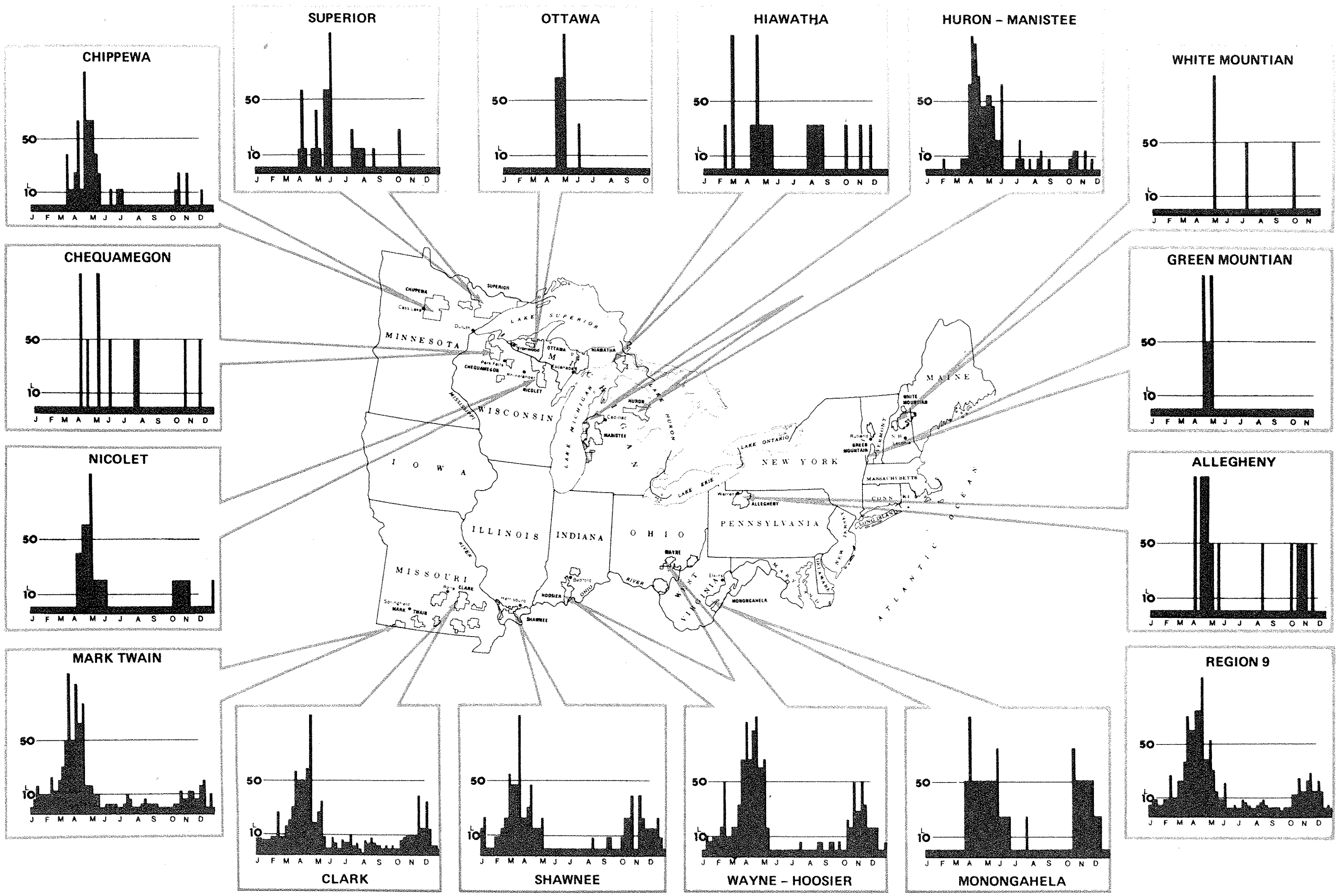


NUMBERS OF FIRES $\geq$ 10 ACRES PROFILES

Profiles of fire numbers alone as shown in figure 7 do not present the complete wildfire story. Consequently, we also compiled profiles for numbers of fires $\geq$ 10 acres (fig. 8), burned acreage (fig. 9), and man-hours-to-control (fig. 10). These profiles are erratic because we did not have sufficient data from most forests, but we can still draw meaningful information from them.

They indicate that large fires ($\geq$ 10 acres) are more of a spring season phenomena than are total fires. This appears contradictory considering that the major drought of the 1960's caused a higher percent of total fires during the fall season than during the spring. Historically, the great fires of the Region have occurred in the fall, usually following record droughts (Haines and Sando 1969).

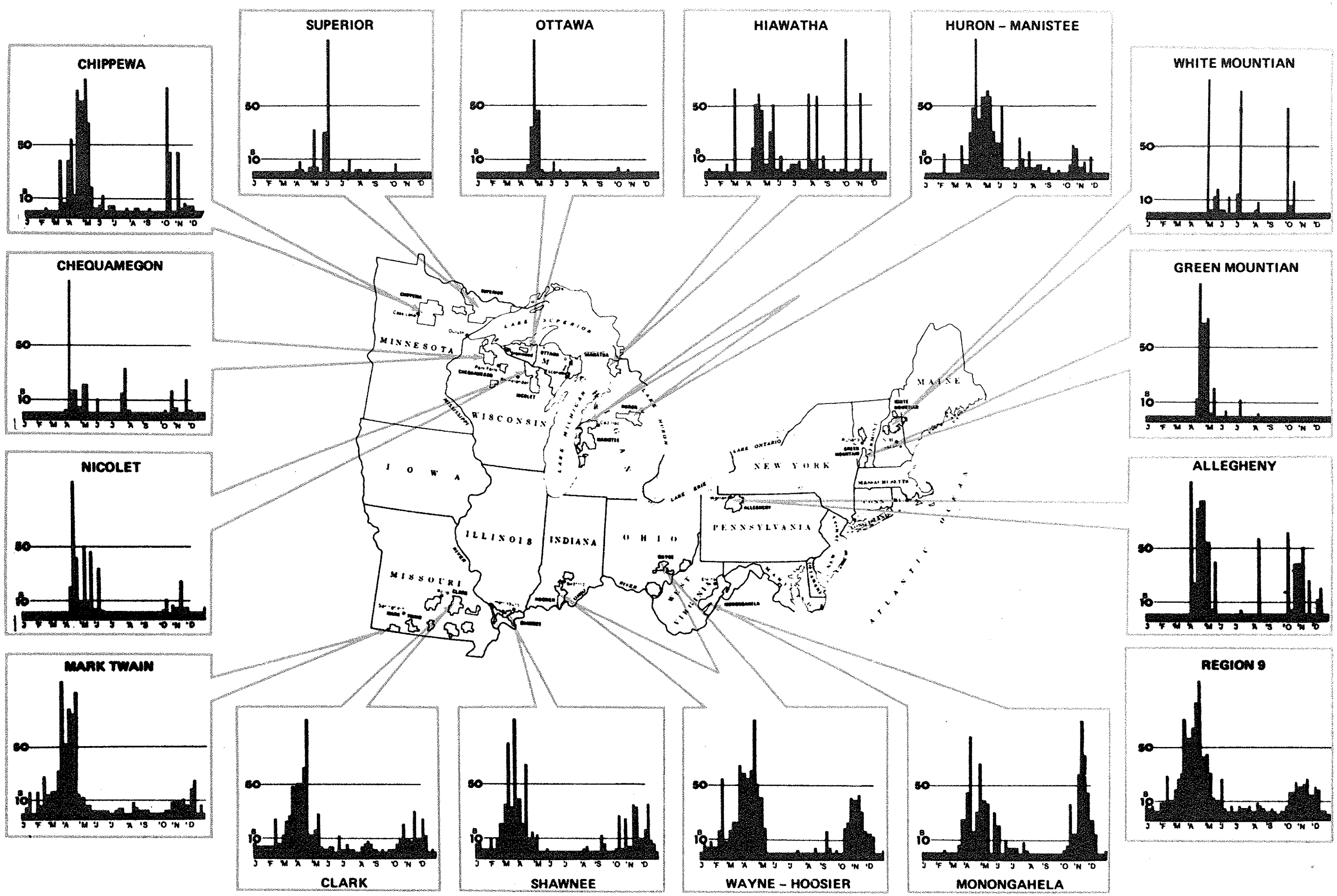
Figure 8.--*Distribution of numbers of large fires expressed as a percent of the peak class (by week). See page 2.*



ACREAGE BURNED PROFILES

The profiles shown in figure 9 indicate that the greatest acreage is also burned in the spring. Most of the forests having a moderate number of summer fires have low summer burned acreage which indicates, as do the profiles in figure 8, that there is little real danger of catastrophic fires during the summer season. During the summer, green vegetation acts as a heat sink; this keeps a fire's propagation-intensity rate low. Furthermore, higher humidities and low windspeeds near the ground also modify microclimate conditions during the summer.

Figure 9.--*Distribution of burned acreage expressed as a percent of the peak class (by week). See page 2. Individual fires of over 300 acres were assigned that value in order to balance the profiles.*

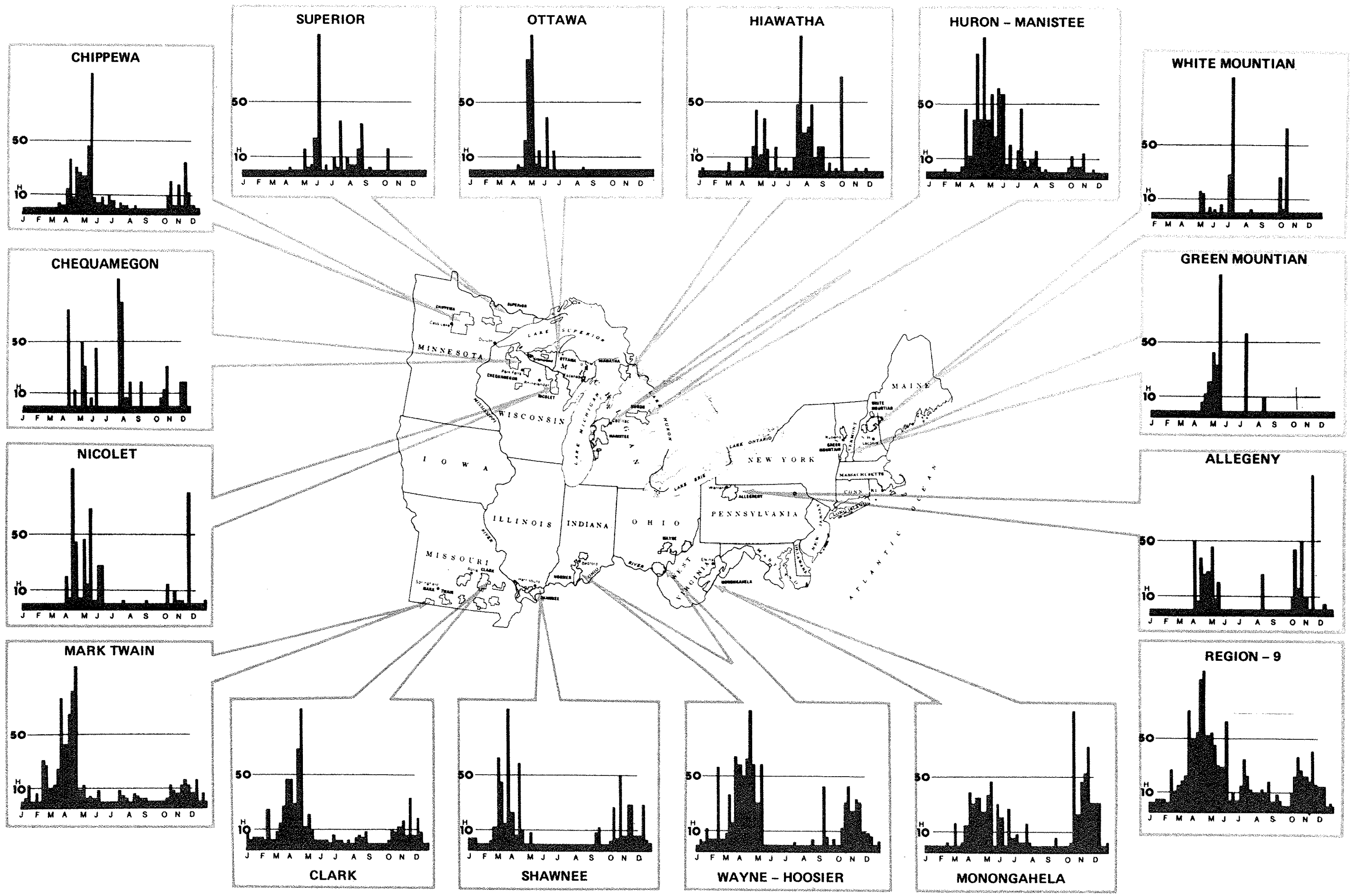


MAN-HOURS-TO-CONTROL PROFILES

The profiles for man-hours-to-control (fig. 10) have a somewhat lower reliability factor than the profiles for numbers of fires, burned acreage, or large fires. Availability of the fire fighting resource may be a manager's prime manning consideration, although he also may have any number of other reasons for sending a given number of men or equipment to a fire. It isn't possible to pinpoint fires that were over-manned from the records.

The profiles for man-hours-to-control do not always conform to the profiles for burned acreage and large fires. For the Hiawatha National Forest, for example, the greatest number of man-hours occurs in July and August along with peak fire numbers. For the Mark Twain and the Clark National Forests, man-hour profiles are aligned more closely with large fire and burned acreage activity. Specific reasons for these variations are not clear. Perhaps it indicates that some units, such as the Hiawatha National Forest, concentrate their resources upon initial attack because large fires are not normally a problem on that Forest (table 1 and fig. 4).

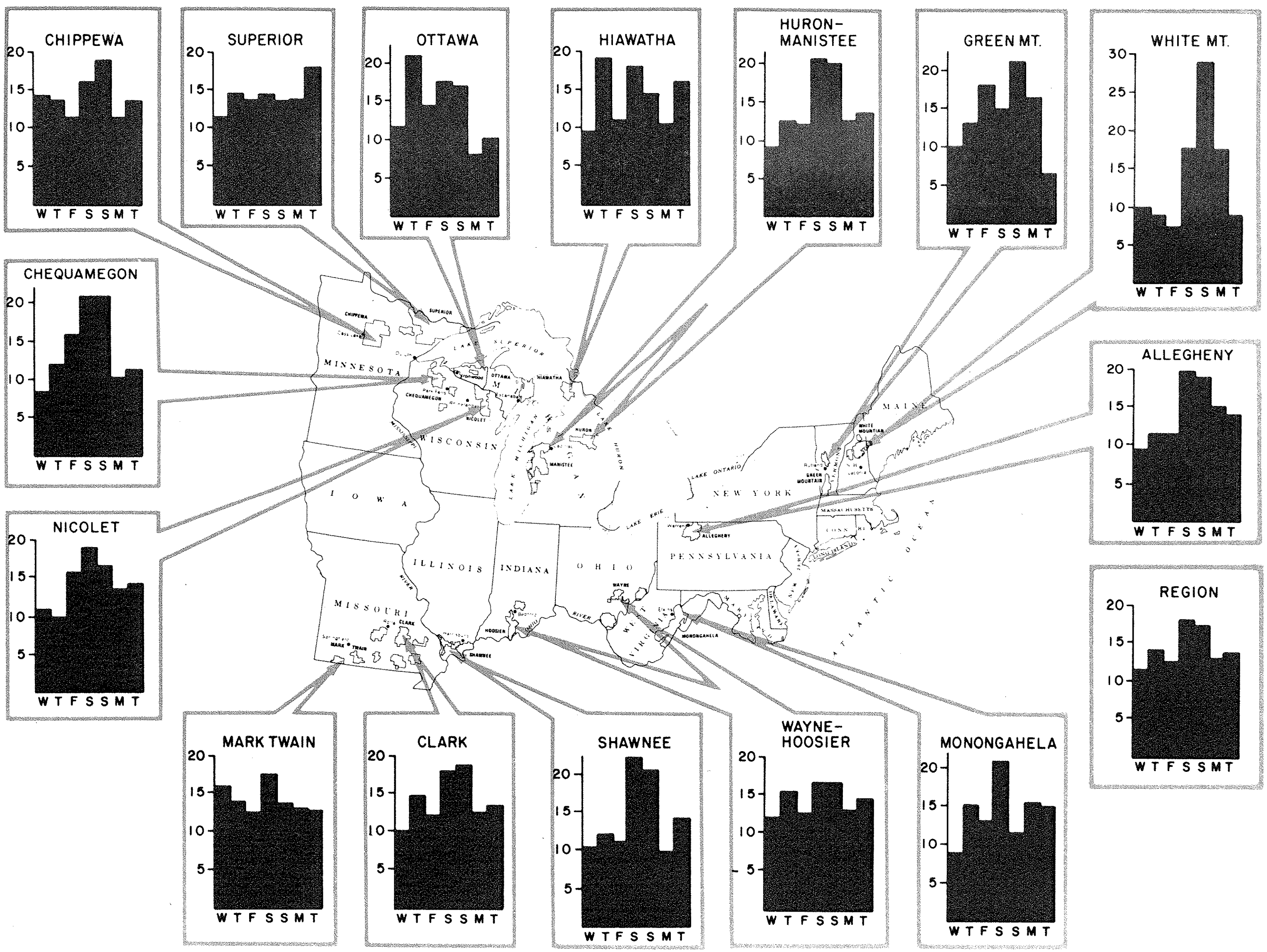
Figure 10.--*Distribution of man-hours-to-control expressed as a percent of the peak class (by week). See page 2. Individual fires of over 100 man-hours were assigned that value in order to balance the profiles.*



DAY-OF-WEEK PROFILES

Haines *et al.* (1973) reported that forest use is one of the most critical influences on day-of-week fire numbers--perhaps the most crucial. They showed that heavy recreational activity produced an increase in weekend fires on the Clark National Forest, although there were no such increases on nearby State Forests in Missouri, where other uses dominated. These findings are reflected in the profiles shown in figure 11. Managers should be alert to other day-of-week patterns as they relate to fire cause.

Figure 11.--*Percent of fire numbers by day-of-week. Week begins on Wednesday, thereby keeping weekend days in a cluster.*



FIRE CAUSE

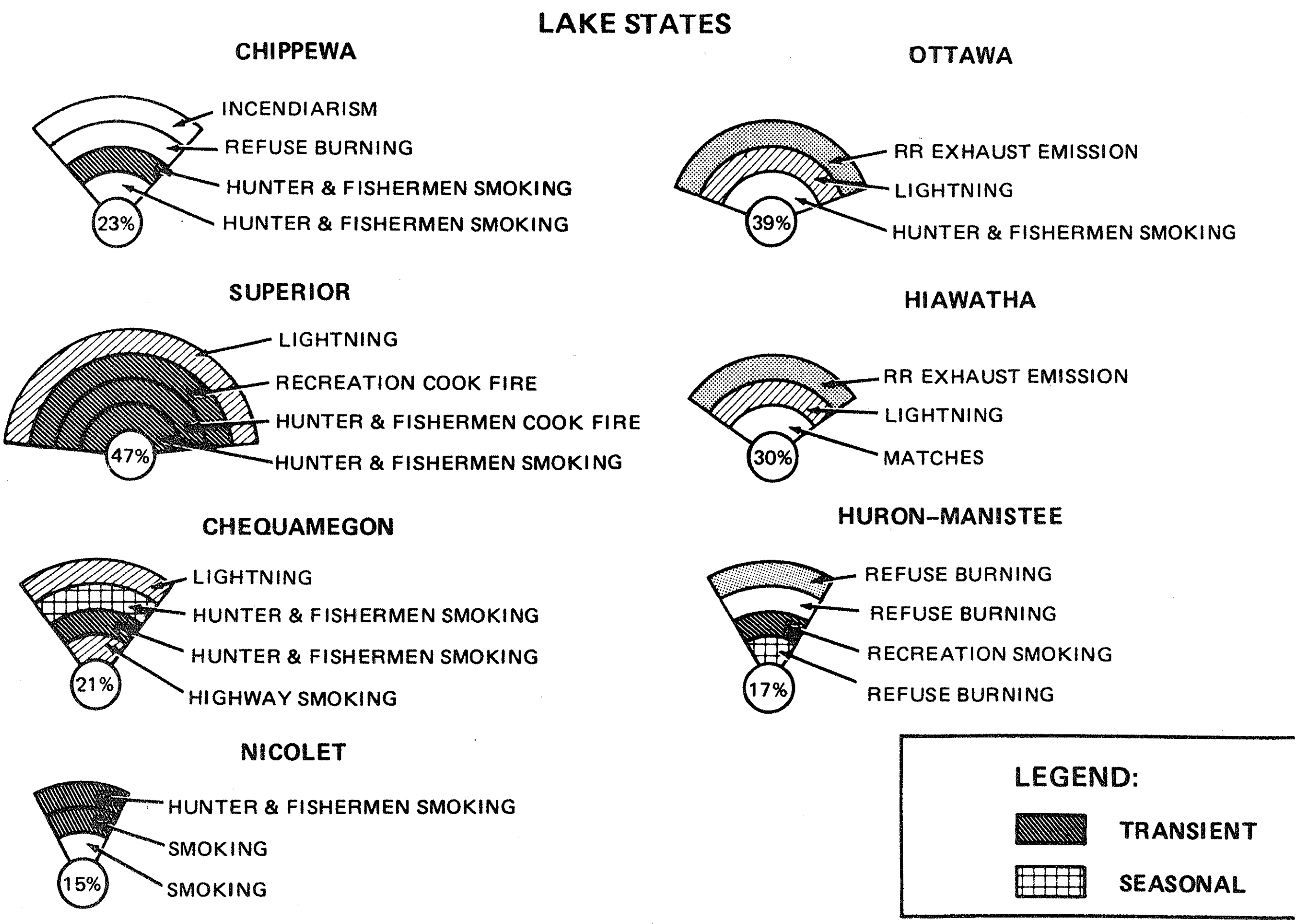
Most tabulations of fire-cause data are extremely limited in scope. From these tabulations, one can recognize the number of lightning fire starts vs. those caused by human activity, but further detail often is sparse. Categorization generally follows some sequence identifying people or their activity. Deriving information from such categories is difficult because it is almost impossible to devise a simple one- or two-word designator that fully describes activities coupled with the parties responsible.

Main and Haines (1973) attempted to increase the amount of meaningful information in fire-cause tabulations by cross indexing various classes of people and their activities. This method produced the more specific fire-cause combinations shown in figure 12. The percent of total fire starts accounted for by the listed combinations is given in the hubs.

On most National Forests, any one cause combination accounted for less than 5 or 6 percent of the total. However, some units showed as much as 20 to 25 percent or more of their activity in a single combination. Only the dominant combinations were included in figure 12.

The combinations produced some recurring patterns. For example, in Missouri,

Figure 12.--*Fire cause by class of people and activity. The more dominant the cause combination, the further its position from the center of the hubs. The percent of total fire starts accounted for by the listed combinations is given in these hubs.*

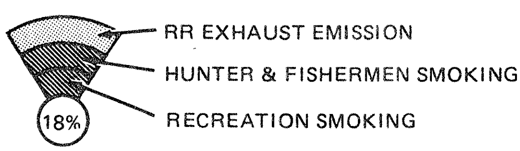


Indiana, and Ohio, one recurring combination is incendiarism (pyromania). However, pyromania is an unfortunate classification label because it implies that the investigator is competent to make medical judgments. This inappropriate type of reporting results from application of the term "incendiarist," which is among the confusing terminology required in the standard format in fire report forms.

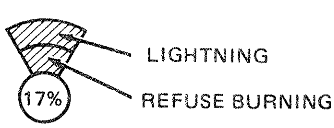
Main and Haines (1973) show that fire cause is a diversified problem. Local incendiarism is the most pressing prevention riddle. They conclude that prevention efforts might well be concentrated on groups that are both highly identifiable and relatively cohesive, such as hunters and fishermen who are licensed. Their data indicate hunters and fishermen represented more of a fire problem during the period of their study than all other combinations of recreationists. Moreover, their study also identified local people as the primary group responsible for fires.

EASTERN STATES

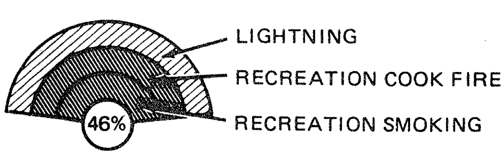
ALLEGHENY

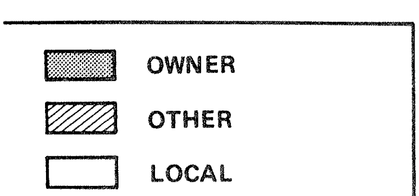


GREEN MOUNTAIN



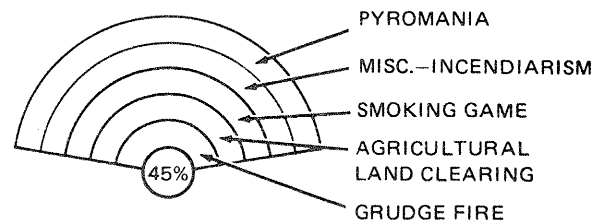
WHITE MOUNTAIN



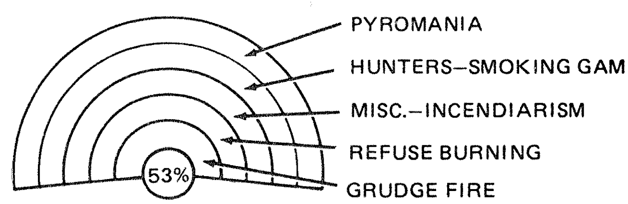


SOUTHERN TIER STATES

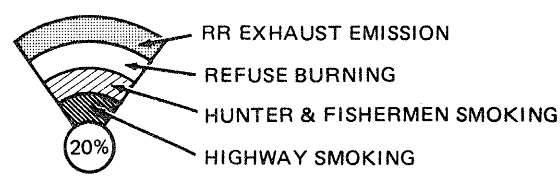
MARK TWAIN



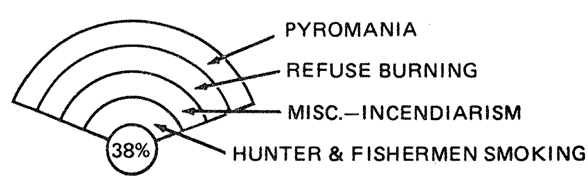
CLARK



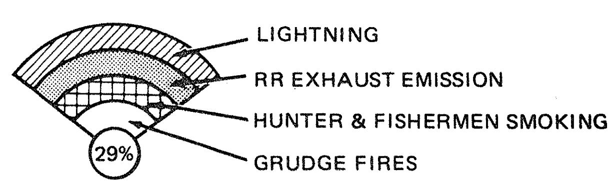
SHAWNEE



WAYNE-HOOSIER



MONONGAHELA



PEAK ACTIVITY SEASONS

The term "fire season" might be interpreted in a number of ways. For example, in the USDA Forest Service Glossary (1956), it is defined as, "the period or periods of the year during which fires are likely to occur, spread, and do sufficient damage to warrant organized fire control." However, interpreting what is meant by terms such as "likely" or "damage" poses problems.

Some organizations arbitrarily select a specific date in the spring to start their fire season and end it after the first good snowfall in the fall. Some fire seasons are fixed by legislative decree. Other organizations base their season on various past records. For example, an arbitrary percentage of total fires might be included to define the calendar date limits of the season; 90 percent is currently being used as a planning base in many USDA Forest Service Regions.

Obviously, a fire season is determined to a large degree by operational concerns. Therefore, we attempted a somewhat different conceptual term "peak activity season." Our profiles, especially the profile tabulated from numbers-of-fires data (fig. 7), are based on such seasons. A peak activity season begins during the week fires total 10 percent of the number of fires expected for the worst week of the year. Seasons end on the same basis. When the number of fires drop below 10 percent of the amount experienced during the worst week, a season is over.

It is easiest to establish peak activity seasons for forests having many fires, such as those in Missouri. It is more difficult for forests having few fires, such as those in the New England States, where the peak activity seasons we defined begin when the first fire is reported and end when the last fire is reported (table 2).

In operational usage, the peak-activity-season designation might be modified by considering other factors. It's obvious, for example, that fires occurring in early spring or late fall sometimes do minimal damage because of seasonal weather, fuel, or soil conditions. Therefore, we examined the percent of other measures of fire activity that occurred within the peak activity seasons (table 2). In 12 of the 15 protection units, the percent of annual burned acreage was equal to or greater than the percent of total fires within these seasons. This also applies to another measure of activity--number of man-hours-to-control. Furthermore, 13 of the 15 protection units had at least as great a percent of large fires ($\geq$ 10 acres) as numbers of fires within season. Operationally, therefore, the peak activity seasons shown in table 2 also include an acceptable percent of the other important measures of fire activity.

A plot of the beginning weeks in which fire numbers were $\geq$ 10 percent of peak activity produced the map shown in figure 13. There is a northward progression in the spring as snow disappears, temperatures rise, and outdoor activity increases. This progression commences along the southern tier in January, and moves northward during February, March, and into April. This indicates when to begin weather measurements, when to be concerned about fires, and when to be alert to weather systems that produce high fire danger.

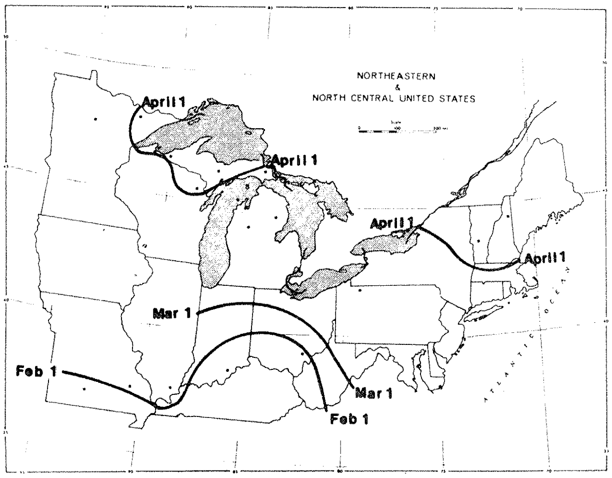


Figure 13.--*First week in which fire numbers are $\geq$ 10 percent of peak activity week.*

We also tabulated the difference in weeks of the seasonal starts based on three other measures of fire activity--large fires, burned acreage, and man-hours to control--from the seasonal starts based upon numbers of fires. This showed that large fires occur at $\geq$ 10 percent of their peak week activity about the same time to 1 week later than the start of the seasons shown in table 2. Seasons based on burned acreage lag about

1 week and seasons based on man-hours-to-control lag an average of 1 to 2 weeks after the seasons shown in table 2.

The spring season (based on fire numbers) peaks in mid-March in the extreme south and sometime in April through most of the rest of the north central and northeastern States (fig. 14). In general, the peak fire period occurs 2 to 3 weeks before the cured-to-transitional change in vegetative stages (fig. 5A). Distributions on the Superior and the Hiawatha National Forests were not included in this analysis because of their symmetrical patterns. Nor did we attempt to continue the isolines through the eastern half of the Region because of our meager data.

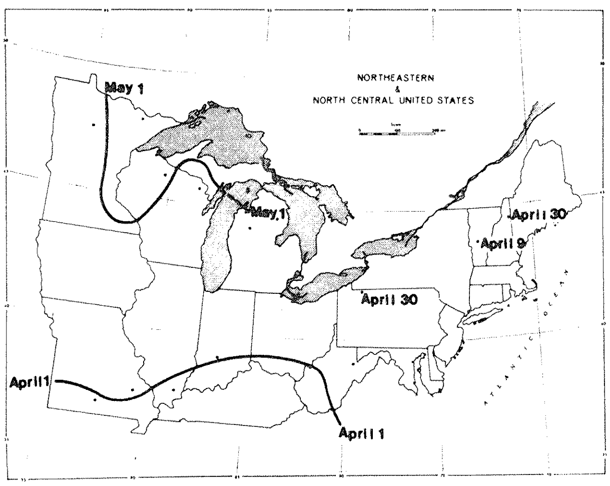


Figure 14.--*Week of maximum spring season fire numbers.*

The fall activity season ends in late October in the north central Lake States and the extreme Northeast but not until early December through much of the southern tier (fig. 15).

On the average, fires are first reported between 2:15 and 2:30 p.m. in the north central and northeastern States. Two-thirds of the fires were first reported between 11 a.m. and 6:30 p.m. Nine out of 10 fires were first reported between 8 a.m. and 8 p.m. There was little change in these times over the course of the year, although after mid-September, fires do tend to occur a bit earlier in the afternoon.

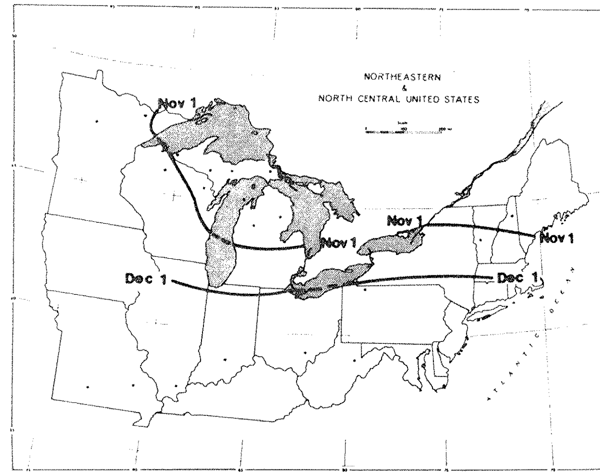


Figure 15.--*Last week in the fall with fire numbers still* $\geq$ *10 percent of peak activity.*

USE OF ATLAS INFORMATION

Figure 16 shows a combined profile of predicted fire danger and reported fire activity for the Clark National Forest. Both are displayed as percents of peak class (see page 2). With the combined profile we can visually gauge the effectiveness of various fire danger rating systems by comparing their predictive features to annual fire activity.

The predictions (Schroeder *et al.* 1964) are based on application for delineated regions throughout the United States of the Wildland Fire Danger Rating System (USDA Forest Service 1962). This application was for the period 1950-1960 and its predictions were based on a Fire Load Index above 16 as separating critical from noncritical fire-danger days.

The data compiled for the observed fire activity (fire-days) also represent the period 1950-1960 with a fire-day defined as a day having at least one fire. The profile generally patterns the profiles derived from the 1960-1969 data for the Clark National Forest (figures 7 to 10). However, it also shows a secondary fire peak in September, which might be attributed to the moderate to extreme drought that affected the area from 1952-1955 (Haines *et al.* 1973).

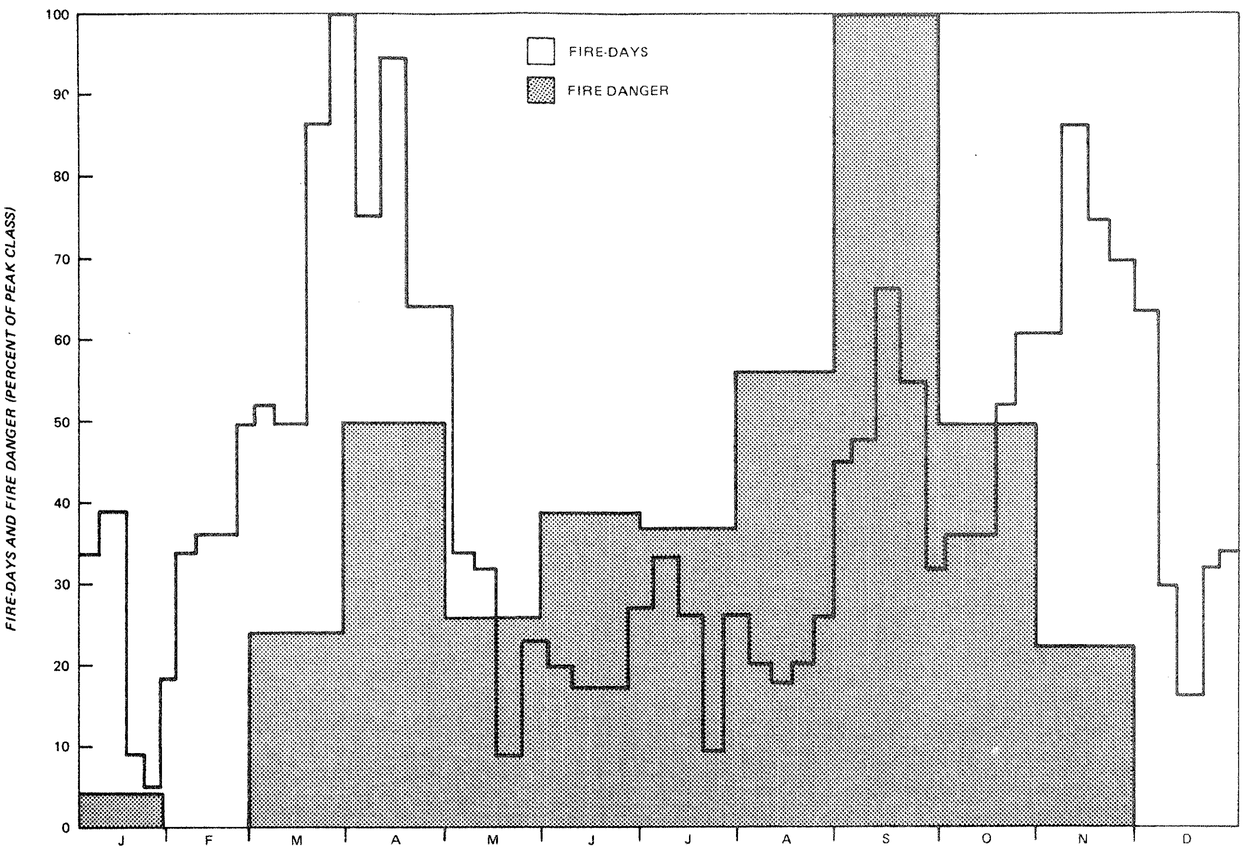


Figure 16.--*A comparison of fire-days and fire danger for the Clark National Forest. Data are presented as a percent of peak class.* *See page 2.*

This observed secondary fire peak corresponds in time to the Wildland Fire Danger Rating System's prediction of maximum fire danger to occur during September. However, observed fire activity on the Clark National Forest was much greater during the spring and fall fire seasons than it was during this September anomalous period.

Therefore, this is an example of one use where the accuracy of predictions derived from the Wildland Fire Danger Rating System might be challenged. In Missouri, the System is lacking because it doesn't employ a hardwood fuel model. The foliage of oak-hickory forests and herbaceous vegetation both influence the fire potential. Although solar radiation during March and April is almost equal to that during August and September, the measured radiation on forest floors is 20 percent less during March and April because there are more cloudy days during the spring. Despite this, the fire potential is greater during the spring season because the leafless condition of the trees permits more of the available solar radiation to filter through to the litter and slash. Also in the spring the quantity of fuels is at its peak because the oaks have completely shed their dead foliage.

Moreover the Wildland Fire Danger Rating System fails to provide for seasonal variability of man-caused risks, which are key factors in Missouri where incendiarism and debris-burning are the known leading causes of fire. The risk from such fires are extremely high in the spring. Den-tree fires by hunters pose a major risk in the fall.

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Describes patterns of forest fire activity across the northeastern and north central United States. Gives average dates of greening and curing of herbaceous plants, median size of fires in various fuels, and annual profiles of peak fire activity. It also examines combinations of major fire cause and day-of-week activity.

OXFORD: 431.1:431.3:435.2(084.4)(74/77). KEY WORDS: fire danger rating, herbaceous stage, fire season, national forests.

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