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WILDFIRE EFFECTS ON AN OAK-HICKORY FOREST IN SOUTHEAST MISSOURI

Robert M. Loomis, *Fire Control Scientist*
East Lansing, Michigan

ABSTRACT.--Plant community development was observed for 10 years after a fire had top-killed most trees in a southeastern Missouri oak-hickory forest stand. The forest was re-established by sprouts. Production of herbaceous plants and other potential wildlife food was abundant for 4 years before decreasing to a stable preburn condition.

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Many of the wildfires that occur in the North Central States burn oak-hickory forests. The amount of damage depends on the age and composition of the forest, the season of the burn, and the intensity of the fire. Sometimes only the ground vegetation or just the tops of the trees are killed, but other times the entire tree is killed. How a plant community responds after a fire would be useful knowledge for land managers to help them decide what action to take regarding salvaging timber, improving the stand, and providing food and habitat for wildlife. To find out how a stand did respond, the 10-year effects of a late spring fire on an oak-hickory community were studied.

THE STUDY

The fire occurred May 7, 1966, in Iron County, Missouri, in a fully stocked stand of predominantly large saplings. The dominant stand was a 23-year-old white oak-red oak-hickory stand (stand type 52 as described by the Society of American Foresters (1954)), which had developed following a fire in 1943. The soil was a Clarksville cherty silt loam (Miller 1976)[1] with a site index of 70 for black oak (Schnur 1937). The slope averaged about 15 percent and had an easterly aspect. The fire top-killed almost all trees, but left a few 23-year-old survivors and some older trees that had also survived the earlier fire.

Four plot point centers, three in the burned and one in the adjacent unburned area, were selected as representative of the area burned. Four sub-plots were located 7.9 m in cardinal directions from each plot center. The following information was gathered from each of the 16 sub-plots: (1) trees 1.5 cm dbh and larger that were intercepted using a 10-factor prism were tallied; (2) trees 30.5 cm or taller within a 4.6-m radius were tallied (height of only the tallest stem per single root system was measured, except after the 10th growing season when all heights were tallied); and (3) the annual production of trees, shrubs, vines, grasses, and forbs to a height of 1.5 m was estimated within 1.9 m^2. Annual

[1]*Miller, M. R. 1976. Personal communication, Missouri National Forests.*

production for woody plants included the foliage and new stems or branches ≤ 1.27 cm in diameter; current growth on old stems or branches was not included.

Moisture content was determined gravimetrically at 85 C. The green weight estimates were converted to ovendry.

Tree tallies were made 1, 2, 5, and 10 growing seasons after the 1966 fire, and production tallies were made 1, 2, 3, 4, 5, and 10 growing seasons after the fire. Estimates were made after major growth was completed--between mid-August and mid-October. The tree community was evaluated using the basic factors of frequency, density, and dominance--evaluation factors used by Curtis and McIntosh (1951).

RESULTS

Trees

The 1966 fire reduced the stand to 64 living stems and 1.1 m^2 of basal area per hectare. The surviving trees ranged from 10 to 46 cm dbh. Just before the 1966 fire, 79 percent of the stand was oaks and hickories (table 1). Surviving trees were almost all oaks.

The new tree stems developed primarily as basal sprouts of the top-killed trees. After the first growing season about 29,500 tree stems from 5,600 plants were growing per hectare. After 10 growing seasons the ratio had decreased from 5.3 stems per plant found the first year to 1.6 stems per plant. Height of the tallest stem for each plant for oaks, the major species, increased from 0.8 m after the first season to 2.9 m at the end of the fifth growing season. Following the 10th growing season when all stem heights were measured, heights for oaks averaged 6.3 m for the 8 cm dbh class, 5.9 m for the 5 cm class, 4.5 m for the 3 cm class, and 2.0 m for the less than 3 cm class. Oaks and hickories comprised 64 percent of the stand after 10 years (table 1).

Tree browse production reached a peak during the 3rd growing season (table 2), decreased markedly by the 5th growing season, and decreased further by the 10th growing season. Dogwood generally accounted for about one-half or more of the tree browse on the unburned area, and reached one-half on the burned area the 10th growing season. Estimated production of all oak species declined following the third growing season. Unburned stand production averaged about 117 kg per hectare.

Table 1.--*Composition of a southeast Missouri oak-hickory stand before and after fire*

BEFORE FIRE[1]

Species	Freq.[2]	Trees[3]	Basal Area[4]
		No./hectare	*m^2/hectare*
Quercus alba	11	1451	6.2
Quercus velutina	10	539	6.0
Quercus coccinea	7	625	2.7
Carya spp.	3	514	.5
Sassafras albidum	1	378	.2
Cornus florida	1	378	.2
Juglans nigra	1	17	.5
Morus rubra	1	42	.2
Total	35	3944	16.5

10 GROWING SEASONS AFTER FIRE[5]

Species	Freq.[2]	Trees[3]	Basal area[4]
		No./hectare	*m^2/hectare*
Quercus alba	11	2385	2.5
Quercus velutina	12	1078	1.4
Quercus coccinea	10	813	.6
Quercus imbricaria	3	37	.0
Carya spp.	11	737	.3
Sassafras albidum	12	976	.3
Cornus florida	9	660	.2
Morus rubra	8	304	.1
Nyssa sylvatica	6	242	.1
Rhamnus spp.	6	126	.1
Acer rubrum	3	153	.1
Prunus serotina	5	64	.0
Celtus occidentalis	2	52	.0
Ostrya virginiana	1	101	.1
Prunus americana	2	64	.0
Crataegus spp.	1	37	.0
Juglans nigra	1	12	.0
Diospyros virginiana	1	12	.0
Viburnam spp.	1	12	.0
Total	105	7865	5.8

[1]Tree tally based on 10-factor prism intercept of trees 1.5 cm d.b.h. and larger that were present before the May 7, 1966, fire for 12 sub-plots.

[2]Number of occurrences per 12 possible.

[3]Convert No./ha to No./acre by multiplying by 0.405.

[4]Convert m^2/ha to ft^2/acre by multiplying by 4.355

[5]Tree tally includes all trees 30.5 cm or taller but excludes fire-residual trees (survivors of the May 7, 1966, fire)--all within twelve 4.6-m radius sub-plots.

Shrubs and Vines

Rhus, primarily the dwarf sumac (*Rhus copallina*), were abundant on the burned area soon after the fire; it was not found on the unburned area. After the 10th

Table 2.--*Ovendry weight of potential wildlife food production in a southeast Missouri oak-hickory stand in a burned and in an adjacent unburned stand*[1]

(In kilograms per hectare)[2]

Vegetative material	Burned Stand Growing Seasons After Fire						Unburned Stand Growing Seasons After Fire					
	1	2	3	4	5	10	1	2	3	4	5	10
Trees	407	494	1297	850	252	92	47	79	212	113	123	124
Shrubs and vines	155	342	758	629	200	113	5	4	4	Trace	Trace	2
Total Browse	562	836	2055	1479	452	205	52	83	216	113	123	126
Grasses and sedges	118	281	287	147	27	24	3	4	7	2	Trace	1
Forbs	390	393	385	200	56	58	1	6	12	2	Trace	9
Total herbaceous	508	674	672	347	83	82	4	10	19	4	Trace	10
Total browse and herbaceous	1070	1510	2727	1826	535	287	56	93	235	117	123	136

[1]Includes the current season's growth of new branchwood, stems, foliage, and fruit within 1.5 m of the ground.

[2]Convert kg/ha to lb/acre by multiplying by 0.892.

growing season there were still 3,500 *Rhus* and 1,200 *Corylus* stems per hectare.

Shrubs and vines provided the most abundant browse by the third growing season (table 2). Production decreased markedly by the fifth growing season.

Grasses and Sedges

Grasses and sedges were most productive the second and third seasons (table 2). They had decreased markedly by the 5th season, but did not change again by the 10th season. Grasses and sedges were sparse on the unburned area.

Forbs

Only 20 of the 34 forb genera identified on the burned plots after the first growing season remained after the 5th growing season and only 19 remained after the 10th. Only seven genera were found on the unburned plot. The high production of annuals such as *Acalypha, Ambrosia, Cassia, Croton,* and *Erechtites* during the first 2 years quickly became negligible.

The production of perennials such as *Aster, Cimicifuga, Desmodium, Galium, Monarda, Potentilla, Solidago,* and *Strophostyles* was high through the fourth season. Some production of perennials continued through the 10th growing season, but the plants were generally small and poorly developed. Five genera of perennials--*Aster, Desmodium, Galium, Lespedeza,* and *Solidago*--were common on the unburned area.

Total forb production did not change the first three growing seasons (table 2). By the fifth season, production had greatly decreased but was stable.

Forb production was negligible on the unburned plot.

Deer and Turkey Food

Production of preferred deer and turkey foods were estimated on the basis of Murphy and Ehrenreich (1970). Peak production occurred the third season after fire for both of these game species foods (fig. 1). Production decreased sharply from the 3rd to the 5th season, and more slowly from the 5th to the 10th season. There was very little production of these preferred foods on the unburned area.

CONCLUSIONS

Top-killed trees of oak-hickory stands will usually re-establish themselves by sprouting. Thus, the major timber loss was 23 years of growth on the stand. To manage for optimum sawtimber volume and quality it would have been advisable to cut all residual trees because they tend to become large-crowned due to their dominant positions and produce low-quality sawtimber. They also suppress the new stand. But the scattered surviving trees are of special value for wildlife. Because these trees develop large crowns, they often

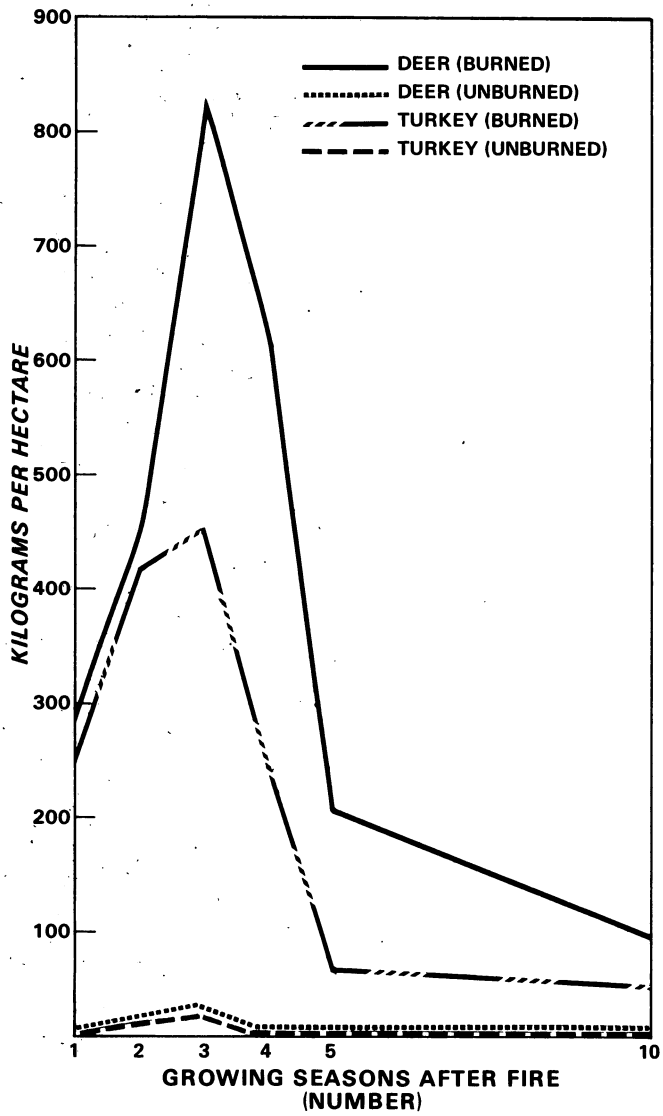

Figure 1.--*Estimated production of preferred deer and turkey food for a burned and for an unburned oak-hickory stand in southeast Missouri. (Based on preferred foods lists presented by Murphy and Ehrenreich (1970).)*

produce excellent nut crops. They are also potential den and nesting trees, provide different food, and lend esthetic diversity to the area.

Wildlife food was produced in large quantities for 4 years on the burned area. Thereafter, production greatly decreased, but it was still well above that on the unburned area.

Fire effects on an oak-hickory plant community should generally follow those observed in Iron County, Missouri. However, a similar fire may have different effects if the soil and site conditions, stand composition, age, or density are different. Whether effects of a fire in an oak-hickory stand are beneficial or destructive depends on the objectives and priorities of land management.

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