THE CENTRAL HARDWOOD FOREST

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Beyond the mountains
Lies a forest without end
Time is its boundaries

WHAT IS IT?

To begin the discussions of the Central Hardwood Forest, we need to define what it is and perhaps what it is not. One thing is certain: It is not easy to define in specific terms, except that it is the forest that occupies parts of central North America. Forest in this sense means the vegetation dominated in the upper canopy by trees covering a specific geographic area.

The Central Hardwood Forest is an aggregation of plant and animal associations that varies widely within a broad and diverse area. However, the forest has boundaries both physical and climatological, and the plant associations and their animal residents have some distinct commonalities. They exist side by side, they overlap, they intergrade, sometimes they are alike, and sometimes they are very different. And why shouldn't these associations have many similarities? They developed under the same general environmental pressures.

There are a number of classification schemes that serve to identify the boundaries of the Central Forest. Keep in mind that plant association boundaries and the ranges of the individual species that make up the association are not static, and are poorly defined because of environmental gradients and a general tendency toward integrating with neighboring associations. Even so, I find it useful to consider a grouping of E. Lucy Braun's 1964 forest regions to describe the Central Hardwood Forest. I include the following regions listed by Braun:

1. Mixed mesophytic
2. Western mesophytic
3. Oak-hickory
4. Beech-maple

These four major regions include 11 subregions. Braun includes the Oak-chestnut region in the central hardwoods, but I have not, primarily because this region is somewhat remote from "Central". For the same reason, I do not include Oak-pine. However, I do recognize that there are indeed close ecological affinities among the four regions I include and the two I exclude.

The boundaries of the Central Hardwood Forest are primarily climatic on the north, south, and west, and geologic on the east. Such a statement of distribution of the Central Hardwood Forest may be a little too simplistic. Geology, soils, even the age of land forms and the influence of man are all factors that affect the distribution of the Central Hardwood Forest. Composition and stand structure have been greatly altered by man's activities. Although climate is the most important causative factor in distribution, it is interesting to consider that climatic regimes only some 6,000 years ago encouraged different plant associations in the area now occupied by the central hardwoods. Relics of past associations that thrived under a colder climate are one of the fascinating characteristics of today's forest.

HISTORICAL PERSPECTIVE

At the time of the first European settlement, the eastern part of the Central Hardwood Forest was vast and essentially unbroken, except for the streams, lakes, swamps, and relatively small openings created by the original settlers, the Indians. The Indians lived for thousands of years in and off of the forest, never attained large populations, and had a relatively small effect on the forest. European settlers, too, took shelter and food from the forest, but they also took the land. Land that had the biggest trees was best for crops, and was cleared first--first the bottomlands, then the glacial till plains with the deep soils. Much of the cornbelt owes its existence to the hardwood forest. Later settlers and expanding families cleared progressively poorer sites to the point where land that was born poor geologically, and land that was too steep to sustain cropping under the existing farming practices, became so impoverished that it was abandoned. The abandoned land slowly returns to forest through natural succession or by being planted with conifers.

Today, the Central Hardwood Forest is a very diverse mixture of cover conditions, from the scattered small woodlots on low wet areas in the cornbelt to the essentially unbroken Oak-hickory forest stands in parts of the Ozarks. In spite of man and his plows, fires, saws, and livestock, a large part of the "original" forest area remains in trees, but the species mixtures have been greatly altered.

As far as we know, today's forest includes essentially all tree and shrub species found at the time of settlement.

In addition to clearing, there are other striking differences in appearance between the original forests and what we have now. Although the original forests were subject to influences such as tornadoes, wind storms, insect outbreaks, and fires that created diversity in stand ages, large trees were much more common. Species composition has changed. Burning, grazing, and many commercial cuttings have increased the proportion of the less tolerant tree species. More and more evidence is

accumulating to show that forest sites are capable of supporting a greater diversity of species. Areas considered to be on the xeric side are reproducing with mesophytic tree and shrub species. The area in oaks may be declining. The implications for management in such trends and the lessons learned from studies of natural areas suggest that we look carefully at ecological relations and site potential when silvicultural prescriptions are prepared.

Within the Central Forest, there is a great deal of diversity, in both the overstory and understory. The Central Forest associations exist because of the physiologic and genetic characteristics of the individual species, their compatability or incompatability with other species, and specific environmental factors. The major external factors are related primarily to site quality. Soil depth, structure, moisture holding capacity, fertility, and internal drainage are some of the more definitive factors that are responsible for wide variations in species occurrence within the Central Forest. Slope and aspect are also strongly related to species occurrence and are, in turn, integrators of soil and moisture characteristics of the site.

Site diversity and resultant plant diversity is distinctive in the Central Hardwood Forest. Forest types may change sharply within relatively short distances. For example, in the hill country, going from a small stream bottom to a ridge top no more than 500 to 800 feet distant, you may often see 10 to 20 tree species in the overstory and a wealth of understory plants. Species might range from silver maple (*Acer saccharinum* L.) to chestnut oak (*Quercus prinus* L.). Sites would range from moist to dry, and at least three or four recognizable forest types would be encountered. Unless there were abrupt physical changes such as imperfectly drained soil, bluffs, or benches, there would be no sharp boundaries between the forest types.

The most striking example of species diversity that I have personally experienced is the Pine Hills area of southern Illinois. Within a half mile, you can start in swamp and end up on a small prairie knoll on the ridgetop overlooking the Mississippi River. Along the way, you may encounter 40 commercial tree species.

Most plant species in the Central Hardwood Forest have a relatively broad range of tolerance to limiting edaphic factors. Thus the convenient "types" freely integrate on natural moisture gradients such as uniform slopes. I support the view that, with the exception of wet or very dry sites, the frequency of occurrence for many central hardwoods is fortuitous within a wide range of site quality; fortuitous from the standpoint of seedbed conditions, seed source, canopy openings, advance understory development, and relative growth rates of competing plants.

THE CENTRAL FOREST TODAY

There are no Forest Resource Evaluation survey units whose boundaries coincide with the Central Hardwood Forest. I have used the latest data on the states included in the four Braun regions I mentioned earlier to describe current conditions broadly. Because the Forest Service survey data is so extensive, only figures for entire states are included, except for the northwestern part of Arkansas and the southern half of the lower peninsula in Michigan. Outliers in adjacent states and Canada, and the Oak-hickory forests in Oklahoma and Texas, are not included. Thus, in addition to parts of Arkansas and Michigan, the data presented here include the states of Iowa, Missouri, Illinois, Indiana, Kentucky, Ohio, Tennessee, and West Virginia.

There are 82 million acres of forest land in the Central Hardwood Forest (Table 1). While the percentage of land area that is forested ranges from 7 percent in Iowa to 77 percent in West Virginia, the average for all states is 31 percent. According to Forest Survey, the major central hardwood types break down as follows: 61 percent Oak-hickory,[1/] 9 percent Maple-beech-birch, 9 percent Elm-ash-cottonwood, and 7 percent Oak-pine.

Table 1. Area in the Central Hardwood Forest by State
(in thousands of acres)

State	Total forest land	Total nonforest land	Total land	Percentage forested
Arkansas [a/]	9,656.4	5,597.5	15,253.9	63
Illinois	3,871.3	31,923.9	35,795.2	11
Indiana	3,964.3	19,196.8	23,161.1	21
Iowa	2,620.0	33,241.0	35,861.0	7
Kentucky	12,160.8	13,344.0	25,504.8	48
Michigan [b/]	2,857.1	11,663.2	14,520.3	20
Missouri	15,296.0	28,952.0	44,248.0	35
Ohio	6,405.3	19,846.0	26,251.3	24
Tennessee	13,136.3	13,338.6	26,474.9	50
West Virginia	11,940.2	3,473.6	15,413.8	77
Total	81,907.7	180,576.6	262,484.3	31
Percent	31	69	100	

a/ Data for the two northwestern units (Ozark and Ouachita) only.
b/ Data for Unit 4 (southern Lower Peninsula) only.

1/ Forest Service Resource Evaluation types.

Species composition of the dominant overstory varies greatly along an east-west gradient. Mixed mesophytics dominate in West Virginia, but the forests in the Missouri Ozarks are almost exclusively Oak-hickory. White oaks dominate the Central Forest sawtimber/poletimber stands, and account for 25 percent of the total hardwood volume (Table 2). A closely related species group, the red oaks, are next in importance, making up 21 percent of the volume.

Table 2. Hardwood growing stock volume on commercial forest land in the Central Hardwood Forest

Species	Volume (millions of cubic feet)	Percentage
White oaks	13,693.6	25
Other hardwoods	12,136.9	22
Red oaks	11,332.2	21
Hickories	6,296.3	12
Yellow-poplar	3,644.1	7
Red maples	2,501.0	5
Sugar maple	2,220.1	4
Beech	1,599.8	3
Black walnut	675.8	1
Total	54,099.8	100

The Central Hardwood Forest contains approximately 136 billion board feet of sawtimber. Although this is a tremendous timber volume and a valuable resource, the quality of merchantable-size trees is not good. On the average, only 13 percent of the trees are high quality or grade 1, while grade 2 and grade 3 average 20 percent and 50 percent respectively. Many of the low-quality-grade trees will eventually improve as they grow larger, but the primary problem is a long history of frequent uncontrolled burning and past practices of cutting the best trees and leaving the culls and low-quality trees. The veneer and lumber industries are faced with diminishing supplies of high-quality trees.

Quality is not the only problem: according to the most recent survey figures, 18 percent of the region is poorly stocked with forest trees.

So the Central Forest covers a vast area--more than twice the size of Illinois. The forest is a tremendously valuable asset for timber, recreation, water, and wildlife, but it has the potential for much greater quantity and quality production of all goods and services. Past practices have badly degraded the forest for more than 200 years, but most areas

still have the capacity to grow more and better trees, shrubs, and herbaceous plants. Most foresters would agree that rather extensive treatment with existing technology could double wood production within the next 20 to 30 years.

THE FUTURE OF THE CENTRAL FOREST

A number of factors will influence the future of the area and their interactions are diverse and complex. Ownership patterns are changing. Most of the forest land has long been in private ownership, but the number of absentee owners is increasing. The new breed of owners have a variety of reasons for owning forest land; often they are not production-oriented. This does not mean that they will not be interested in harvesting forest crops. Opportunities for income must be linked with technical assurances of improved future stands without destroying other attributes that the owners value.

Converting the forest to crop and pasture land has been going on at various rates for nearly 200 years on the eastern edge of the central region. There have been periods of large-scale abandonment of marginal farm lands that subsequently reverted to forest. In fact, in some areas, forest land acreage has actually increased. The acreage in forest land in the central region has remained relatively stable, but during the past 10 years, new pressures have emerged. Urban expansion, superhighways and transmission lines, clearing for pasture, improved economics in farming, and rural immigration have given new impetus to removing the forest. How much area is being converted in the entire region is not known. In Missouri, especially at the prairie interface, the impact over the last 13-year period between surveys was significant. From 1959 to 1972, 1-1/2 million acres of forest land were converted to pasture, wooded pasture, or cropland. During the same period, nearly a half million acres reverted to forest cover. Considering population increases and the world food situation, we can expect continued decline in the size of the Central Hardwood Forest. The rate of decline should be very modest, unless population problems remain unresolved. The forest has retreated to its stronghold in the rocky hills and mountains, to the floodplains and swamps. These are formidable bastions, even for modern farm equipment. Of course, if there is coal under the forests, they are no match for draglines and bulldozers. Practically all land being stripmined is reclaimed with grass, not trees. In the long run, this trend alone may significantly reduce the area forested.

Another unknown in the future of the Central Forest is the influence of acid precipitation. With the great amount of industrialization in the region and the suggestion from preliminary data that the pH of precipitation in some areas is surprisingly low, we cannot overlook the potential impact of acid precipitation on the soil, water and forest vegetation. This is an area where we simply must put more research attention. We do not have enough data over time to determine whether we are faced with a serious problem or not, but we cannot ignore the implications.

Another factor that could have a significant impact on the Central Forest is the impending shift of forest production from the West to the East. Private holdings of old-growth western timber are practically gone. In the future, western forest industries will be stabilized upon second-growth timber resources. Production pressure for softwood timber will increase in the South. The eastern hardwood forests are presently growing more wood than is being used. For example, in the Central Forest, removals of growing stock are only 52 percent of growth. Sawtimber removals are 71 percent of growth. This ratio varies from state to state (Table 3). Removals in Indiana, Iowa, and Missouri reflect to some degree accelerated land conversion during the period between the last two surveys.

Utilization problems, traditions, scattered inventories, harvesting problems on steep lands, lack of markets, and demands for other uses are barriers to increased timber use of the eastern forests. Increased research and extension of technology could make a substantial improvement in the drain/growth ratio in a relatively short time if markets developed. Better markets in the Central Hardwood Forest could shorten the time needed to develop a more productive, healthier forest, capable of producing more timber, more wildlife, and better recreation opportunities.

Finally, a word on forest management, the First Central Hardwood Conference, and a quality environment. How do they relate? I have tried to define the Central Hardwood Forest; what it was, what it is, and what it might be. Forest land owners and forest managers have an opportunity to improve greatly a vast natural resource that can supply a wealth of useful products, large numbers of jobs, profit, beauty, and a quality environment for people and wildlife. We have the technology and expertise to make substantial improvements in managing and protecting the forest, but we must extend this knowledge to others. Moreover, we need more information to solve problems that remain unanswered and block progress. We need practical, economical treatments, based on information produced by scientific methods. As we discuss our research, let us ask ourselves how it will help restore or maintain the productivity, the usefulness, and the beauty of the Central Hardwood Region for the good of the people who will live in and near it.

LITERATURE CITED

Braun, E. L. 1964. Deciduous forests of eastern North America. Hafner Pub. Co., New York. 596 pp.

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Table 3. Annual net growth and removals of growing stock and sawtimber on commercial forest land for all species in the Central Hardwood Forest by state.

State	Growing Stock			Sawtimber		
	Growth	Removals	Removals as percentage of growth	Growth	Removals	Removals as percentage of growth
	--- thousand ft^3 ---		%	--- thousand ft^3 ---		%
Arkansas a/	249,600	165,600	66	713,600	565,200	79
Illinois	85,120	30,130	35	208,780	175,300	84
Indiana	95,074	64,900	68	225,846	345,037	153
Iowa	48,211	57,200	119	105,783	182,490	173
Kentucky	319,350	139,575	44	907,136	426,047	47
Michigan b/	67,400	38,888	58	238,060	179,241	75
Missouri	179,544	169,822	95	363,485	542,016	149
Ohio	132,800	70,500	53	422,000	209,500	50
Tennessee	509,100	216,400	43	1,428,200	819,600	57
W. Virginia	473,500	166,100	35	823,000	433,100	53
Total	2,159,699	1,119,115	52	5,435,890	3,877,531	71

a/ Data for the two northwestern units (Ozark and Ouachita) only.

b/ Data for unit 4 (southern Lower Peninsula) only.

ABOUT THE AUTHOR

F. Bryan Clark received a B.S. in forestry from Purdue University in 1949, a M.S. in forestry from the University of Missouri in 1954, and a Ph.D. in botany from Southern Illinois University in 1968. He spent most of his professional career in various research assignments in the Central States Forest Experiment Station and the North Central Forest Experiment Station. He has specialized in the areas of strip mine reclamation, silviculture, and regeneration of hardwoods. Currently, he is the Director of the Northeastern Forest Experiment Station and Forest Sciences Board Chairman of the Society of American Foresters.

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