

# LONG-TERM CHANGES IN TREE COMPOSITION IN A MESIC OLD-GROWTH UPLAND FOREST IN SOUTHERN ILLINOIS

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**Abstract**—The Kaskaskia Woods (Lat. 37.5 N, Long. 88.3 W), an old-growth hardwood forest in southern Illinois, has one of the oldest and best documented set of permanent plots with individual tree measurements in the Central Hardwood Region. In 1935, eight 0.101-ha plots were installed in a 7.4 ha upland area consisting of xeric oak-hickory and mesic mixed hardwoods communities. The soils are cherty silt loams of the Alford and Baxter soil series in which productivity depends largely on moisture availability. The Kaskaskia Woods has never been cleared; however, increment coring in 1965 revealed a majority of the trees were either more than 160 years old or 80 to 100 years old. The area was apparently heavily cut for railroad ties in the 1880s which left most of the yellow-poplar (*Liriodendron tulipifera* L.), hickory, and oaks less than 30 cm in DBH. An abrupt change in diameter growth rates suggests a partial cut took place in the 1910's when it was likely that white oak and hickory were cut for stave wood and handle stock. The area has not been subjected to fire, grazing, cutting, or silvicultural treatments since 1933 following purchase by the USDA Forest Service.

In 1935, all trees 4 cm DBH (1.3 m above ground) or larger were tagged and identified as to species, DBH, and total height. Subsequently, tagged trees in the plots have been remeasured for survival, and DBH in 1940, 1958, 1965, 1973, 1978, 1983, and 1997 as well as height in 1958 and 1978. Ingrowth, new trees 4 cm or larger DBH, were also tagged. Six camera points were established in 1935 and rephotographed in 1958 and 1998. Individual tree locations were mapped in 1973. In the late 1990's the plots were remonumented and all live trees retagged. We report on changes in density (trees per ha) and basal area ( $\text{m}^2 \text{ha}^{-1}$ ) by species composition from 1935 to the present. Importance values (IV-200), were computed by summing the percentage number of trees and percentage basal area for each species or species group.

Over the last 65 years there has been a relatively consistent and gradual increase in basal area from an initial  $22.7 \text{ m}^2 \text{ha}^{-1}$  to  $34.3 \text{ m}^2 \text{ha}^{-1}$  in 1997. During this period there have been relatively dramatic changes in species composition, and to a lesser degree, changes in density. By 1965, 479 of the 892 trees present in 1935 had died with ingrowth adding 448 new trees per ha. By

1997, 675 trees per ha had died leaving less than 25 percent of the original trees still alive. Tree density gradually declined to 788 trees per ha over the first 43 years and dropped more rapidly to 588 trees per ha during the last 20 years. The remaining trees tend to be large overstory trees with few saplings and poles in the understory.

The once dominant oaks (black, *Quercus velutina* Lam.; northern red, *Q. rubra* L.; and scarlet, *Q. coccinea* Muenchh.) and hickories (shagbark, *Carya ovata* (Mill.) K. Koch; mockernut, *C. tomentosa* (Poir.) Nutt.; pignut, *C. glabra* (Mill.) Sweet) have declined from 337 trees per ha in 1935 to less than 82 trees per ha at the present. Percentage basal area (of the total stand) for these species has dropped only slightly from 56.2 to 50.2 during the same period. The importance value (IV 200) for oak and hickory was 94.0 initially and showed a steady decline to 55.5 by 1997. The percentage of yellow-poplar basal area increased from 16.1 to 23.9 concurrently with a reduction in the number of trees (from 23.5 to 19.8 trees per ha) also reflecting the presence of massive but declining trees in the overstory.

Initially, the understory was dominated by shade-tolerant flowering dogwood (*Cornus florida* L.) and shade-intolerant sassafras (*Sassafras albidum* {Nutt.} Nees.) (247 trees per ha). By 1997, sassafras was extirpated and only 7 dogwood trees per ha remain. Black walnut, eastern redcedar, black cherry, red mulberry, and persimmon (*Juglans nigra* L., *Juniperus virginiana* L., *Prunus serotina* Ehrh., *Morus rubra* L., *Diospyros virginiana* L., respectively), present in 1935, were no longer found in the plots. In contrast, sugar maple (*Acer saccharum* Marsh.) has increased from 156 trees per ha and  $1.1 \text{ m}^2 \text{ha}^{-1}$  of basal area in 1935 to 346 trees per ha and  $6.9 \text{ m}^2 \text{ha}^{-1}$  in 1997. Over the same time period the IV 200 for sugar maple increased from 21.9 to 78.9 far exceeding any other species.

Over the course of the study, ingrowth has been primarily from shade tolerant species. Of the 637 ingrowth stems, 58.2 percent were sugar maple and 20.7 percent white ash (*Fraxinus americana* L.). Most (68.0 percent) of the sugar maple ingrowth remains alive whereas only 29.0 percent of white ash ingrowth survives. There are no surviving ingrowth trees of oak or hickory.

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Without a major disturbance for nearly 100 years, sugar maple has become the dominant species in the Kaskaskia Woods. It is likely that the coming decades will bring a

continuing decline or perhaps total loss of oak and hickory as well as other associated species in this southern Illinois forest.