# THE IMPORTANCE AND DISTRIBUTION OF HICKORY ACROSS VIRGINIA

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**Abstract—**The importance and role of hickory (*Carya* spp.) in the Oak-Hickory forest community complex has been studied over the last 70 years and questioned by several investigators. Until recently, there were virtually no species-level landscape-scale studies that accurately defined the role of hickory in these systems. Data from the USDA Forest Service, Forest Inventory and Analysis Program, were used to describe the distribution and compositional status of several hickory species across Virginia. Oak-Hickory was the predominant forest-type group in Virginia, covering 3 859 500 ha and accounting for 78 430 000 $m^2$ of basal area. A total of 1 880 live hickory trees (d.b.h. ≥ 12.7 cm) occurred and were measured on 51 percent of plots. Across all plots in the study, the average basal area of hickory was 1.2 $m^2$ $ha^{-1}$. On plots where hickory was present, basal area was 2.4 $m^2$ $ha^{-1}$. Mockernut (*Carya tomentosa* (Poir.) Nutt.) and pignut (*C. glabra* (Mill.) Sweet) hickory were the most prevalent hickory species measured. Mockernut (basal area = 0.5 $m^2$ $ha^{-1}$) and pignut (basal area = 0.5 $m^2$ $ha^{-1}$) were tallied on 29 and 30 percent of plots, respectively. Shagbark (*C. ovata* (Mill.) K. Koch) and bitternut (*C. cordiformis* (Wangenh.) K. Koch) hickory were also tallied, but they occurred less frequently. Hickory ranked in the top three species, by importance value, on 25 percent of all plots. This study sheds new light on the importance and species-level distribution of hickory in the Oak-Hickory forest complex at the landscape scale.

## INTRODUCTION

The Oak-Hickory complex is the largest forest vegetation association in the Eastern United States. This association covers approximately 32 869 000 ha from Virginia and Kentucky to East Texas and Oklahoma, with an additional 21 016 000 ha in the northeastern and north central States (Smith and others 2004). Currently it covers approximately 3 859 500 ha (60 percent) of all forest land in Virginia. Although the complex is typically more prevalent in the Piedmont, the Coastal Plain has also been characterized as potentially an Oak-Hickory climax (Oosting 1956, Vankat 1979). Others (DeWitt and Ware 1979, Ware 1992) have found that the vegetation of the Coastal Plain of Virginia is strongly similar to the southern mixed hardwood forest described by Quarterman and Keever (1962).

The composition of the vegetation of western Virginia is much like that of the Oak-Chestnut association defined by Braun (1950). Braun maintained that the vegetation of central Virginia belonged to the Oak-Pine forest complex. However, both she and Barrett (1962) noted a similarity between the Oak-Hickory of the East and the same association in the central region of the Eastern United States. Greller (1988) modified Braun's classification of the Piedmont vegetation to Oak-Pine-Hickory. Kuchler (1964) classified the Piedmont forest as Oak-Hickory-Pine, specifically acknowledging a difference between Oak-Hickory regions with and without a pine component.

The dominant genus in the Oak-Hickory association is oak (*Quercus*) and the binomial nomenclature suggests that hickory is second in dominance. However, some investigators have questioned whether hickory is of high enough importance to justify classifying large areas of the Eastern United States as Oak-Hickory. Monk and others (1990) concluded that hickory was not of great enough importance in oak-dominated forests to justify classifying large portions of eastern North America as such. Other studies have confirmed the lack of quantitative evidence for an Oak-Hickory type, especially on the Coastal Plain of Virginia (DeWitt and Ware 1979). Ware (1992) also concluded that hickory was of relatively low importance in the Piedmont of Virginia. In contrast, several studies found hickory to be of relatively high

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importance in Virginia, particularly in the northern part of the Piedmont, and in the central part of the Blue Ridge Mountains (Farrell and Ware 1991, Johnson and Ware 1982).

Quite often, studies of vegetation composition are limited in scale, and plot selection is therefore subjective and preferential. Preferential sampling emphasizes forest stands with unique characteristics, such as mature forests, or stands that have unusual features, such as rare species. In contrast, our approach utilized plots distributed systematically across Virginia. This allowed for the study of a wide range of stands across a variety of conditions and captured the most common stand conditions influencing vegetation across Virginia.

The objectives of this study were to describe the current distribution and importance of hickory at the landscape scale across Virginia, and evaluate the temporal dynamics of hickory.

## METHODS

The study area was the State of Virginia. The land area of the State is 10 255 000 ha and approximately 62 percent of this is forested (6 412 000 ha). Virginia is bounded on the west by a mountainous region, which includes the Blue Ridge, the Ridge and Valley, and the Appalachian Plateaus. To the east of these mountains is the Piedmont, which ranges from rolling hills in the west to several nearly level basins in the east.  The easternmost part of the State lies on the Coastal Plain, which extends inland approximately 200 km from the coast and is defined by the eastern Atlantic shoreline and the rolling and dissected area where it meets the Piedmont to the west (Fenneman 1938). The elevation in Virginia ranges from sea level to just over 1737 m on Mount Rogers in the George Washington and Jefferson National Forest. Because of this wide range of topography, the State was divided into five regions that approximate the various physiographic provinces found in Virginia (fig.1).

Data for this study came from the forest survey conducted in Virginia between 1997 and 2001 by the USDA Forest Service, Southern Research Station, Forest Inventory and Analysis (FIA) program. Surveys such as this have been conducted since the early 1930's, under the direction of several legislative acts. The survey mission was to estimate forest area, timber volume, growth, removals, and mortality.

The survey used a two-phase sampling scheme on a hexagonal grid system to derive forest statistics (USDA 2004). Phase I consisted of photo-interpretation for the determination of forest area. Phase II consisted of measurements on sample plots to determine individual tree and forest stand parameters, with an intensity of one plot per 2430 ha. The plot design employed a fixed-plot composed of four circular subplots with a radius of 7.3 m spaced 37 m apart. The total sample area of these four subplots was 0.07 ha. Only live trees 12.7 cm in d.b.h. were included in the study.

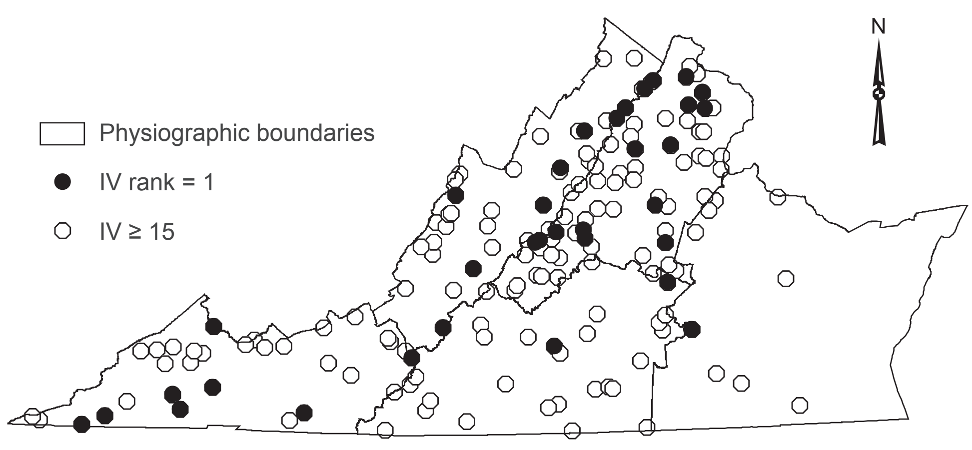


Figure 1—Plots where hickory ranked first in importance value (IV) or had an IV of  ≥ 15.

The total plot population was post-stratified based upon the following criteria: (1) each plot was internally homogeneous regarding stand size and forest type, (2) the plots were not artificially regenerated, (3) the plots showed no evidence of cutting since the previous survey (5-10 years previously), and (4) the plots were classified as either pole-size, or timber-size stands. Out of 3,037 forested plots, 1,168 met these requirements. The Coastal Plain was represented by 194 plots, the Piedmont by 416 plots, and the Mountains by 558 plots (table 1). The 2001 survey represents the first time that hickory data were collected by specific species in the FIA program in Virginia. Therefore, survey-to-survey comparisons of hickory importance can only be done at the genus level. Additionally, sample design differences between surveys preclude rigorous analysis of temporal trends.

Basal area for genus and species was calculated for all plots. Given that trees are not distributed homogenously across the landscape, and therefore the plots, this can result in a standard deviation that equals, or exceeds the mean. Relative density (density of species or genus / total density in stems $ha^{-1}$) and relative dominance (basal area of species or genus / total basal area in $m^2$ $ha^{-1}$) were calculated and the mean of these two yielded relative importance values (IV), modified after Curtis and McIntosh (1951), for each genus and species on each plot. Unless otherwise noted, taxonomic nomenclature follows Little (1979). FIA includes red hickory (*C. ovalis* (Wangenh.) Sarg.) with pignut hickory.

Main effects of physiographic province and stand age were examined statistically using separate analysis of variance tests (ANOVA) via the general linear models procedure in SAS (SAS Institute Inc. 1999). Unless otherwise noted, all tests were considered to be significant at the 0.05 level.

## RESULTS

At the genus level, hickory was tallied on 596 plots, or 51 percent of all plots, ranking third in frequency (table 2). Average basal area of hickory across all plots was 1.2 $m^2$ $ha^{-1}$, and average density was 24 stems $ha^{-1}$. Oak was the most prevalent genus. It occurred on 86 percent of all plots and had an average basal area of 9.5 $m^2$ $ha^{-1}$ and an average density of 146 stems $ha^{-1}$. Maples (*Acer*) were the second most prevalent, occurring on 72 percent of all plots. This genus had an average basal area and density of 2.3 $m^2$ $ha^{-1}$ and 53 stems $ha^{-1}$, respectively.

Dominance of hickory varied significantly between physiographic provinces ($F = 13.6$, $p < 0.0001$). In the northern portion of the Piedmont, 66 percent of all plots had hickory. This area also had the highest average basal area of hickory, 1.9 $m^2$ $ha^{-1}$, as well as the highest average density, 38 stems $ha^{-1}$. In contrast, the Coastal Plain had the least hickory, with only 30 percent of plots having hickory and an average basal area of 0.6 $m^2$ $ha^{-1}$. Basal area of hickory also varied significantly by stand age ($F = 7.15$, $p < 0.0001$). Stands 25-50 years old had an average basal area of 0.9 $m^2$ $ha^{-1}$, while basal area averaged 1.4 $m^2$ $ha^{-1}$ in stands > 50 years old.

**Table 1—Average basal area and density for Virginia, by major physiographic province (for trees ≥ 12.7 cm d.b.h.)**

| Region | n (plots) | Basal area | | | Density | | |
|---|---|---|---|---|---|---|---|
| | | Avg | Min | Max | Avg | Min | Max |
| | | - - - - - $m^2$ $ha^{-1}$ - - - - - | | | - - - - - - stems $ha^{-1}$ - - - - - - | | |
| Coastal Plain | 194 | 26.4 | 1.3 | 56.2 | 474.2 | 59.5 | 1 293.7 |
| Southern Piedmont | 174 | 22.7 | 4.7 | 47.3 | 448.3 | 148.7 | 921.9 |
| Northern Piedmont | 242 | 23.2 | 4.5 | 50.5 | 382.7 | 74.4 | 877.3 |
| Northern Mountains | 299 | 21.8 | 2.1 | 39.9 | 415.1 | 119.0 | 847.6 |
| Southern Mountains | 259 | 23.8 | 3.0 | 55.4 | 430.5 | 104.1 | 803.0 |
| All regions | 1,168 | 23.4 | 1.3 | 56.2 | 426.6 | 59.5 | 1 293.7 |

**Table 2—Average basal area m²/ha-1 for the top 15 genera by major physiographic province for Virginia (for trees ≥ 12.7 cm d.b.h.)**

| | | Region | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Coastal Plain | | Southern Piedmont | | Northern Piedmont | | Northern Mountains | | Southern Mountains | | All regions | |
| Genus | (plots) | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| *Quercus* | 999 | 5.7 | 6.2 | 7.6 | 7.4 | 8.9 | 8.1 | 13.3 | 7.2 | 10.0 | 8.1 | 9.5 | 7.9 |
| *Pinus* | 573 | 7.5 | 8.8 | 3.5 | 5.8 | 2.0 | 4.5 | 2.4 | 4.3 | 1.0 | 2.8 | 3.0 | 5.7 |
| *Liriodendron* | 578 | 2.5 | 4.4 | 4.0 | 5.4 | 4.6 | 6.0 | 0.8 | 2.4 | 3.2 | 5.3 | 2.9 | 5.0 |
| *Acer* | 837 | 3.3 | 5.4 | 2.0 | 2.6 | 1.6 | 2.7 | 1.8 | 3.0 | 3.1 | 3.5 | 2.3 | 3.6 |
| *Carya* | 596 | 0.6 | 1.4 | 1.3 | 2.0 | 1.9 | 2.8 | 0.9 | 1.8 | 1.3 | 2.0 | 1.2 | 2.1 |
| *Liquidambar* | 232 | 2.6 | 3.8 | 1.2 | 2.7 | 0.5 | 1.7 | 0.0 | 0.0 | 0.0 | 0.2 | 0.7 | 2.2 |
| *Nyssa* | 403 | 1.2 | 4.0 | 0.3 | 0.7 | 0.4 | 0.8 | 0.4 | 1.0 | 0.4 | 0.9 | 0.5 | 1.8 |
| *Fraxinus* | 227 | 0.5 | 1.9 | 0.3 | 1.0 | 0.6 | 1.6 | 0.3 | 1.0 | 0.5 | 1.5 | 0.4 | 1.4 |
| *Fagus* | 160 | 0.8 | 2.5 | 0.3 | 1.3 | 0.5 | 1.7 | 0.0 | 0.1 | 0.5 | 1.6 | 0.4 | 1.6 |
| *Betula* | 183 | 0.1 | 0.4 | 0.4 | 1.7 | 0.4 | 1.3 | 0.4 | 1.2 | 0.5 | 1.6 | 0.4 | 1.4 |
| *Robinia* | 173 | 0.0 | 0.3 | 0.1 | 0.6 | 0.3 | 1.0 | 0.3 | 1.1 | 0.5 | 1.3 | 0.3 | 1.0 |
| *Oxydendrum* | 218 | 0.1 | 0.3 | 0.5 | 0.9 | 0.0 | 0.3 | 0.1 | 0.4 | 0.5 | 0.9 | 0.2 | 0.7 |
| *Tilia* | 76 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.8 | 0.3 | 1.1 | 0.4 | 1.5 | 0.2 | 1.0 |
| *Juniperus* | 109 | 0.1 | 0.3 | 0.1 | 0.5 | 0.4 | 1.4 | 0.1 | 1.1 | 0.1 | 0.8 | 0.2 | 0.9 |
| *Prunus* | 126 | 0.1 | 0.4 | 0.1 | 0.4 | 0.2 | 0.6 | 0.1 | 0.7 | 0.3 | 1.4 | 0.2 | 0.8 |

SD = standard deviation.

Across the State, hickory ranked first, based on IV, on 34 plots (3 percent of all plots) (fig. 1). It ranked second on 125 plots (11 percent), and third on 134 plots (12 percent). Almost one-half of the plots where hickory ranked first were in the northern Piedmont (table 3), especially the north-western portion (fig.1). Hickory did not rank first in IV on any plot in the Coastal Plain. Oaks had the highest IV in 604 plots (52 percent), and the second and third highest IV in 186 (16 percent), and 88 (8 percent) plots, respectively.

Pignut hickory was the most frequently occurring hickory species, having been tallied on 351 plots. Mockernut was second, occurring on 340 plots. Both pignut and mockernut averaged 0.5 $m^2$ $ha^{-1}$ of basal area across all plots. In contrast, both shagbark and bitternut averaged 0.1 $m^2$ $ha^{-1}$ of basal area (table 4). Of the 94 species of trees tallied across all plots, 51 were leading dominants on at least one plot. Chestnut oak (*Quercus prinus* L.*)*, yellow-poplar (*Liriodendron tulipifera* L.*)*, and white oak (*Quercus alba* L.*)* were the leading dominants in 241 (21 percent), 190 (16 percent), and 133 (11 percent) plots, respectively (table 5). Mockernut, pignut, bitternut, and shagbark hickory, ranked first in 16 (1 percent), 13 (1 percent), 3 (< 1 percent), and 0 plots, respectively.

The distribution of the individual hickory species varied by physiographic province. Both pignut and mockernut hickory were most abundant in the northern Piedmont, while shagbark tended to be more abundant in the southern part of the mountains. Bitternut hickory was nearly equally distributed between the Mountains and the northern Piedmont. Pignut hickory reached its highest average basal area of 0.9 $m^2$ $ha^{-1}$ in the northern Piedmont.

Mockernut hickory ranked first on four plots in the northern Piedmont and on five in the southern Piedmont and was the only hickory to rank first on a plot on the Coastal Plain. Pignut hickory ranked first on six plots in the northern Piedmont and on four in the northern Mountains. Bitternut hickory ranked

**Table 3—Importance value rankings for genera ranking third or greater in at least 30 plots across Virginia, by major physiographic province (for trees ≥ 12.7 cm d.b.h.)**

| | Region | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coastal Plain | | | Southern Piedmont | | | Northern Piedmont | | | Northern Mountains | | | Southern Mountains | | |
| | IV rank | | | | | | | | | | | | | | |
| Genus | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | number of plots | | | | | | | | | | | | | | |
| *Quercus* | 57 | 37 | 20 | 77 | 26 | 17 | 108 | 43 | 28 | 223 | 44 | 11 | 139 | 36 | 12 |
| *Acer* | 21 | 31 | 25 | 11 | 31 | 25 | 13 | 23 | 41 | 24 | 65 | 53 | 31 | 77 | 55 |
| *Pinus* | 57 | 38 | 16 | 28 | 26 | 19 | 19 | 27 | 13 | 22 | 79 | 29 | 9 | 25 | 11 |
| *Liriodendron* | 20 | 15 | 25 | 37 | 22 | 29 | 52 | 43 | 22 | 7 | 11 | 15 | 37 | 32 | 25 |
| *Carya* | 0 | 8 | 15 | 3 | 24 | 13 | 15 | 42 | 35 | 8 | 34 | 36 | 8 | 17 | 35 |
| *Liquidambar* | 19 | 31 | 30 | 6 | 14 | 13 | 4 | 10 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Nyssa* | 6 | 4 | 9 | 0 | 5 | 7 | 0 | 5 | 15 | 1 | 20 | 44 | 0 | 2 | 9 |
| *Fraxinus* | 4 | 3 | 6 | 3 | 2 | 5 | 4 | 8 | 12 | 2 | 4 | 6 | 4 | 6 | 10 |
| *Betula* | 0 | 2 | 1 | 3 | 2 | 1 | 5 | 9 | 9 | 2 | 7 | 18 | 6 | 4 | 9 |
| *Oxydendrum* | 0 | 1 | 3 | 0 | 8 | 8 | 1 | 1 | 0 | 0 | 3 | 5 | 0 | 16 | 30 |
| *Fagus* | 4 | 8 | 8 | 1 | 3 | 3 | 4 | 5 | 7 | 0 | 0 | 0 | 4 | 8 | 4 |
| *Robinia* | 0 | 0 | 1 | 1 | 2 | 1 | 5 | 1 | 3 | 3 | 4 | 6 | 4 | 7 | 10 |
| *Juniperus* | 0 | 1 | 1 | 1 | 1 | 2 | 4 | 10 | 5 | 2 | 2 | 1 | 2 | 2 | 2 |
| *Tsuga* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 6 | 10 | 3 | 4 | 7 |
| *Prunus* | 0 | 0 | 3 | 0 | 1 | 2 | 1 | 2 | 5 | 2 | 1 | 4 | 1 | 6 | 2 |

IV = importance value.

first on one plot in the northern part of the Piedmont and first on two plots in the Mountains. Shagbark hickory did not rank first on any plot across the State, but ranked second on four plots.

## DISCUSSION

Because this study was based on sample plots that were systematically located, with minimal post-stratification, the data represent the current status of vegetation across the landscape and emphasize characteristics of the common types of vegetation across Virginia. This is a departure from most vegetation studies in which a small area with unique characteristics is selected and studied. Such select studies are important but they do not portray the average state of vegetation across a large area.

Most of the forests of Virginia, and, therefore, our plot population, have experienced varying degrees of disturbance since settlement in the 1600s (Williams 1989). Since pine (*Pinus*) and yellow-poplar were both of relatively high importance in the survey data, it is likely that a large proportion of the plots were early to mid-successional. Additionally, the high frequency of pine, especially loblolly pine (*P. taeda* L.), suggests that some plots may have been artificially regenerated. However, some plantations were likely too old and broken up to be identified as such during data collection.

Stands on the Coastal Plain were predominately Oak-Pine, with relatively little hickory present. This agrees closely with Dewitt and Ware (1979) who found that none of the hickory species were of a high dominance in stands on the Coastal Plain.

Our data also showed that stands in the Mountains and Piedmont, and especially the northern Piedmont, had more hickory than those on the Coastal Plain. Farrell and Ware (1991) found the same to be true of

**Table 4—Top 35 species for basal area, Virginia (for trees ≥ 12.7 cm d.b.h.)**

| Common name | Scientific name | n (plots) | Basal area Avg | SD |
|---|---|---|---|---|
| | | | - - $m^2$ $ha^{-1}$ - - | |
| Chestnut oak | *Quercus prinus* L. | 518 | 3.41 | 5.60 |
| Yellow-poplar | *Liriodendron tulipifera* L. | 578 | 2.87 | 4.96 |
| White oak | *Q. alba* L. | 555 | 2.13 | 3.67 |
| Red maple | *Acer rubrum* L. | 773 | 1.95 | 3.34 |
| Northern red oak | *Q. rubra* L. | 477 | 1.55 | 3.26 |
| Loblolly pine | *Pinus taeda* L. | 157 | 1.18 | 4.28 |
| Scarlet oak | *Q. coccinea* Muenchh. | 354 | 0.97 | 2.19 |
| Virginia pine | *P. virginiana* Mill. | 277 | 0.88 | 2.75 |
| Black oak | *Q. velutina* Lam. | 380 | 0.85 | 1.93 |
| Sweetgum | *Liquidambar styraciflua* L. | 232 | 0.72 | 2.21 |
| Pignut hickory | *Carya glabra* (Mill.) Sweet | 351 | 0.52 | 1.24 |
| Mockernut hickory | *C. tomentosa* (Poir.) Nutt. | 340 | 0.50 | 1.30 |
| Eastern white pine | *P. strobes* L. | 144 | 0.46 | 1.97 |
| American beech | *Fagus grandifolia* Ehrh. | 160 | 0.40 | 1.58 |
| Blackgum | *Nyssa sylvatica* L. | 379 | 0.39 | 1.10 |
| White ash | *Fraxinus americana* L. | 173 | 0.33 | 1.23 |
| Southern red oak | *Q. falcata* var. *falcata* Ell. | 154 | 0.33 | 1.62 |
| Sugar maple | *Acer saccharum* Marsh. | 131 | 0.30 | 1.34 |
| Black locust | *Robinia pseudoacacia* L. | 173 | 0.27 | 0.99 |
| Sweet birch | *Betula lenta* L. | 153 | 0.26 | 0.99 |
| Sourwood | *Oxydendrum arboreum* (L.) DC. | 218 | 0.23 | 0.66 |
| Pitch pine | *P. rigida* Mill. | 102 | 0.21 | 1.06 |
| Shortleaf pine | *P. echinata* Mill. | 86 | 0.19 | 1.39 |
| American basswood | *Tilia americana* L. | 76 | 0.17 | 0.98 |
| Black cherry | *Prunus serotina* Ehrh. | 121 | 0.16 | 0.83 |
| Eastern redcedar | *Juniperus virginiana* L. | 109 | 0.16 | 0.94 |
| Eastern hemlock | *Tsuga canadensis* (L.) Carr. | 64 | 0.16 | 1.17 |
| American sycamore | *Platanus occidentallis* L. | 53 | 0.12 | 0.87 |
| Green ash | *Fraxinus pennsylvanica* Marsh. | 59 | 0.11 | 0.77 |
| Shagbark hickory | *Carya ovata* (Mill.) K. Koch | 90 | 0.10 | 0.45 |
| Bitternut hickory | *C. cordiformis* (Wangenh.) K. Koch | 55 | 0.10 | 0.63 |
| Cucumbertree | *Magnolia acuminata* L. | 82 | 0.09 | 0.50 |
| Willow oak | *Q. phellos* L. | 42 | 0.09 | 0.74 |
| American holly | *Ilex opaca* Ait. | 89 | 0.07 | 0.40 |
| Sassafras | *Sassafras albidum* (Nutt.) Nees | 73 | 0.07 | 0.49 |

SD = standard deviation.

**Table 5—Importance value rankings for species ranking third or greater in at least 10 plots across Virginia, by major physiographic province (for trees ≥ 12.7 cm d.b.h.)**

| | Region | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coastal Plain | | | Southern Piedmont | | | Northern Piedmont | | | Northern Mountains | | | Southern Mountains | | |
| | IV rank | | | | | | | | | | | | | | |
| Species | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | number of plots | | | | | | | | | | | | | | |
| Chestnut oak | 3 | 0 | 0 | 21 | 7 | 6 | 31 | 7 | 11 | 123 | 52 | 28 | 63 | 38 | 19 |
| Red maple | 21 | 32 | 25 | 16 | 23 | 22 | 12 | 23 | 23 | 19 | 27 | 34 | 28 | 46 | 30 |
| Yellow-poplar | 25 | 12 | 17 | 42 | 24 | 20 | 63 | 33 | 15 | 12 | 9 | 7 | 48 | 25 | 17 |
| White oak | 30 | 12 | 9 | 31 | 17 | 15 | 36 | 31 | 18 | 26 | 27 | 19 | 10 | 15 | 13 |
| Northern red oak | 1 | 4 | 2 | 2 | 3 | 10 | 9 | 20 | 12 | 24 | 34 | 29 | 15 | 18 | 16 |
| Scarlet oak | 0 | 5 | 6 | 2 | 13 | 3 | 3 | 10 | 9 | 19 | 32 | 26 | 17 | 13 | 17 |
| Virginia pine | 7 | 13 | 6 | 18 | 9 | 11 | 18 | 14 | 8 | 4 | 12 | 11 | 2 | 4 | 4 |
| Sweetgum | 20 | 34 | 19 | 7 | 11 | 13 | 6 | 7 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Black oak | 2 | 5 | 5 | 0 | 2 | 5 | 5 | 8 | 8 | 6 | 19 | 20 | 6 | 11 | 15 |
| Loblolly pine | 53 | 29 | 15 | 5 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mockernut hickory | 1 | 1 | 5 | 5 | 8 | 10 | 4 | 13 | 17 | 3 | 3 | 8 | 3 | 2 | 10 |
| Pignut hickory | 0 | 3 | 5 | 0 | 3 | 5 | 6 | 10 | 22 | 4 | 5 | 15 | 3 | 3 | 8 |
| Blackgum | 2 | 1 | 6 | 0 | 4 | 5 | 0 | 3 | 10 | 4 | 9 | 21 | 0 | 4 | 1 |
| White pine | 0 | 0 | 0 | 2 | 3 | 1 | 3 | 3 | 3 | 16 | 12 | 13 | 5 | 6 | 2 |
| White ash | 1 | 1 | 2 | 2 | 2 | 1 | 4 | 9 | 13 | 4 | 3 | 0 | 4 | 6 | 9 |
| American beech | 7 | 5 | 8 | 2 | 3 | 1 | 6 | 7 | 4 | 0 | 0 | 0 | 8 | 5 | 4 |
| Sourwood | 0 | 2 | 1 | 0 | 9 | 8 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 8 | 20 |
| Sweet birch | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 5 | 11 | 3 | 4 | 9 | 5 | 3 | 7 |
| Sugar maple | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 8 | 6 | 2 | 10 | 10 | 11 |
| Southern red oak | 3 | 4 | 14 | 1 | 3 | 6 | 4 | 3 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| Black locust | 0 | 0 | 1 | 1 | 1 | 2 | 5 | 1 | 2 | 4 | 3 | 3 | 6 | 8 | 5 |
| Pitch pine | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 13 | 14 | 0 | 2 | 7 |
| Eastern redcedar | 0 | 1 | 0 | 1 | 1 | 0 | 8 | 6 | 2 | 2 | 3 | 2 | 3 | 1 | 2 |

IV = importance value.

the northern Piedmont, especially sites located on geologic belts of Triassic age. In that study, hickory seemed to be associated with soils of high Ca and Mg. We found that in the Mountains, plots where hickory ranked first or had an IV of ≥ 15 tended to cluster along the Blue Ridge (fig.1). On plots in the Shenandoah National Park, Stephenson and others (1991) found that hickory ranked third for IV. Additionally, Johnson and Ware (1982) found hickory to be of rather high importance in the central Blue Ridge. They surmised that hickory was playing a major role in the replacement of American chestnut (*Castanea dentata* Mill.) in this area.

That hickory was correlated with stand age is not surprising, given that it is a late-successional species (Burns and Honkala 1990). A cursory examination of data for stands > 75 years old showed that hickory was nearly equal in relative dominance to pine, yellow-poplar, and maple. While basal area was correlated with stand age and physiographic province, there is the possibility that these two independent variables are correlated, as stands in the Mountains and in the northwestern portion of the Piedmont tend to be older than stands elsewhere.

The question of whether hickory is important enough to be carried in the binomial name is a complex issue. Several complicating factors should be considered. First, it must be ascertained whether the classification system being used is based on current vegetation or some potential vegetation scheme. Braun (1950) visualized how the forest vegetation would appear after the erosion cycle was complete, and Kuchler's (1964) work was based on potential natural vegetation. Both maintained hickory as an indicator in the type name. Also, much of the work on the eastern forest types and associations has been done post-chestnut blight. Prior to the blight, much of what is now called Oak-Hickory was classified as Oak-Chestnut-Yellow-poplar (Shantz and Zon 1924). While oak has proliferated in the absence of American chestnut, it is doubtful that all species have stabilized completely in filling the vacated niche.

Second, forest typing and classification systems are complex and subjective. Baker (1950) outlines a number of problems: (1) type boundaries may be vague, (2) extensive unlisted or unrecognized mixtures of species may occur, (3) some types are judged too unimportant, or local, to be worthy of recognition, and (4) it is difficult to judge whether a type is a phase of another type because of a shift in the ranking of species importance. In addition, existing guides and manuals do not explain fully how to assign type names to sample data. Workers are thus left with much flexibility in deciding on classifications of their data.

Third, classification schemes at the macro level cannot address all the variations found in ecosystems at the micro level. By necessity, they have to be collapsed into a manageable naming system. Some of the questions raised by the hickory issue most likely are due to the process of taking forest stands of a highly variable and complex nature and arbitrarily placing them into predetermined forest types. However, classifications for the macro scale have to be simpler than those for the micro scale in order to be manageable and useful.

Our data suggest that hickory is present in sufficient numbers to be maintained as a component in the binomial naming convention, at least for the Mountains and northern Piedmont. This is especially true when the importance values of the hickories at the landscape scale, and trends through time are considered. Over the past 20 years, the density of hickory has remained fairly stable, and there have been small increases (10-15 percent) in volume. Other species, however, have not remained quite so constant. Both Virginia pine and shortleaf pine have been losing ground in Virginia over the past several decades. Over just the last 20 years, Virginia pine volume has decreased by 24 percent and that of shortleaf by 35 percent (Thompson and Johnson 1992). Perhaps the hickories are not as widespread or dominant as believed and the Oak-Hickory type name has become a catch-all assigned to all of the forest stands that are highly variable in species composition. However, a suitable replacement has not been suggested.

Braun (1950) recognized that Oak-Hickory communities occur throughout the deciduous forest and surmised that rather than one, there are three: (1) Ozarkian Oak-Hickory, (2) Piedmont (or eastern) Oak-Hickory, and (3) white oak. She suggested that their distribution was bimodal, being centered both in the Ozarks and in the Piedmont. She believed that the best development of the Oak-Hickory forest type was found in the Ozark upland. Future work comparing the importance of hickory in the structure and composition of the Ozark forests with those in the Piedmont will further clarify the role of hickory in the eastern deciduous forest. Follow-up studies that investigate the seedlings and saplings of this area will provide insight into the future composition of these forests. Furthermore, a closer examination of the Blue Ridge and the Piedmont of Virginia may provide further information regarding the forces that drive the distribution and importance of hickory.

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