

A CYPRESS SWAMP OUTLIER IN SOUTHERN ILLINOIS

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ABSTRACT.—Two areas of cypress swamp in Johnson County, southern Illinois, were sampled; one was old-growth and the other a cut-over stand. A comparison is made of the two areas from the standpoints of basal area and density of the tree species. Structural diagrams are presented for both areas. The cut-over and old-growth stands both support high basal areas, 241.8 and 273.0 sq. ft. per acre respectively. A cypress dominance factor is presented that is linearly related to the number of cypress "knees" per acre. The five most frequent species of vascular plants on both the fallen logs and lower tree bases are *Bidens discoides*, *Triadenum walteri*, *Lycopus rubellus*, *Boehmeria cylindrica*, and *Galium obtusum*. The logs had a total of 22 species, whereas the tree bases had only 16 species.

In the "First Report On A Forestry Survey," 1923, R. B. Miller indicated that cypress (*Taxodium distichum*) was a tree of considerable importance in Illinois. It was then and is now limited to the southern portion of the state, occurring in the river bottoms of the Mississippi near McClure, the Cache River, and the backwaters of the Ohio, being most abundant in Alexander, Pulaski, Massac, Union, and Johnson counties.

The original acreage of pure and mixed cypress forests in Illinois probably did not exceed 250,000 acres; the best forests were formerly found in the Cache River bottoms (Telford, 1926). As a result of logging and subsequent drainage of these swamps for agriculture this

community has been reduced to a few small scattered remnants.

This paper presents the ecology of Heron Pond, one of the last remaining old-growth cypress swamps. Heron Pond was so named because a large number of great blue herons nest there. American egrets also use the rookery at the western end of the pond. The pond is approximately in the center of section 30 of T 13 S, R 3 E, about 5 miles south of Vienna, the county seat of Johnson County. The pond, about 90 acres in size, receives flood water from the Cache River. The soil of Heron Pond is mapped as a Piopolis Clay, a poorly drained, acid, fine-textured soil, a silty clay loam (Fehrenbacher and Walker, 1964).

The average January temperature at New Burnside, 20 miles to the northeast, is 34.6° F., and the average July temperature is 78.6° F. The average rainfall is 45.1 in. and the length of the growing season is about 187 days (Fehrenbacher and Walker, 1964).

At the time of sampling, in late August and September of 1968, the water depth in the pond varied from 2 to 4 ft., and local residents indicate that the pond never dries up. The water has risen in recent years due to beavers constructing a dam across the pond outlet that drains into the Cache River. Several acres

of hardwoods have died as a result of this flooding. In some areas the beavers have removed large numbers of water tupelo (*Nyssa aquatica*). However, *Nyssa* is the only species greatly affected by the beavers.

Hardwoods along the north edge of the pond were cut to salvage them before permanent flood damage occurred. Various areas of the swamp have been lumbered at different times during the past 75 years.

METHODS

Within Heron Pond two areas with different histories were sampled. One was cut-over and the other was an old-growth stand, apparently never logged. The old-growth area was characterized by having a more continuous canopy, fewer fallen logs, and an absence of stumps. The cut-over stand had a more broken canopy, numerous stumps, a greater density of shrubs, and many fallen logs.

Six one-fifth acre circular quadrats were used to sample trees; no trees less than 3.5 in. (dbh) other than seedlings were encountered. Three quadrats were located randomly in the second-growth area; however, the uncut section was about an acre in size and irregular in shape, so that random placing of the plots was not possible. Here the three quadrats were located so that they did not overlap or extend into the cut-over area.

The herbaceous vegetation and small shrubs on fallen logs and lower tree trunks were sampled in 10 cm x 10 cm quadrats. The sampling plot was divided into four quadrants, and the herbaceous vegetation and shrubs on the two closest

trees in each sector were sampled. Only trees large enough to place four 100 cm² quadrats on their base without overlap were used. The quadrats were located on the trunks between the cardinal directions, at approximately the high water line, where the largest mass of plants occurred. On the fallen logs the quadrats were located at meter intervals the entire length of the log.

The taxonomic nomenclature follows that of Gleason, 1963.

RESULTS

All tree stems were measured at 4½ feet above the ground. The resulting basal areas are high and not comparable to other communities because of the buttressing of cypress. Other workers have measured above tree buttresses to make the basal areas comparable to other communities (Telford, 1926; Davis and Richards, 1934).

Figure 1 shows the relationship between diameters at 4½ ft. and 7 ft. for 33 cypress trees measured in the study area. The relationship between the two variables is linear

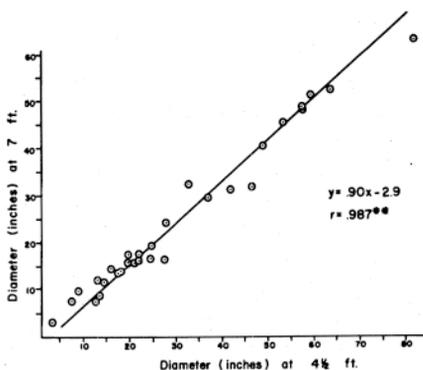


FIGURE 1. The relationship between 4½ ft. and 7 ft. diameters of cypress.

across a range of diameters from 3 to 83 in.; the correlation coefficient, .987, is highly significant. The basal areas at these two heights would not be related linearly, basal area being a function of the square of the radius. The diameter measurements taken at 4½ ft. in the quadrats were converted to 7 ft. diameters using the regression equation given in Figure 1.

In Table 1 the basal area per acre for both stands are given for all species at 4½ ft. and for cypress at 4½ and 7 ft. Stems per acre greater than 3.5 in. dbh is given, as well as an Importance Value based on relative density and relative dominance. The Importance Value has been scaled so that the sum of all I.V.'s equals 100. The basal areas determined for cypress at 7 ft. were used in the calculation of relative dominance and the calculation of total basal areas for both stands.

Both areas studied support high total basal areas per acre. The old-

growth stand has the highest with 273.0 sq. ft., compared to 241.8 for the cut-over area. These basal area measurements are higher than most Illinois communities; however, Schmelz and Lindsey (1965) reported 199 and 152 sq. ft. for portions of Beall Woods, south of Mount Carmel, Illinois, and the basal areas are not excessively high when compared with other cypress communities. For example, Wagner and Kurz (1962) found 300 sq. ft. per acre for a cypress stand in Louisiana. Similarly, Schmelz and Lindsey (1965) reported 228 sq. ft. for a cypress swamp in Indiana.

Cypress dominates both stands but is more important in the old-growth stand. Its Importance Value in the cut-over stand is 58.1 compared to 82.4 in the old-growth stand. The Importance Values of tupelo and Drummond's maple are respectively 36.3 and 5.6 in the cut-over area compared to 14.7 and 2.9 in the old-growth stand. Cypress

TABLE 1. A summary of some quantitative ecological measurements for the two study areas.

<i>Cut-over stand</i>				
	Cypress	Tupelo	Maple	Totals
Density/Acre	83.3	81.7	16.7	181.7
BA/Acre				
at 4½ ft.	271.3	66.6	4.3	342.7
at 7 ft.	170.3			241.8
Rel. Density	45.9	44.9	9.2	100.0
Rel. Dominance	70.4	27.6	2.0	100.0
(I.V. on the basis of 100)	58.1	36.3	5.6	100.0
<i>Old-growth stand</i>				
Density/Acre	93.3	31.7	6.7	131.7
BA/Acre				
at 4½ ft.	375.4	14.4	1.9	391.7
at 7 ft.	256.7			273.0
Rel. Density	70.9	24.0	5.1	100.0
Rel. Dominance	94.0	5.3	.7	100.0
(I. V. on the basis of 100)	82.4	14.7	2.9	100.0

not only has more basal area in the old-growth stand but a higher density as well.

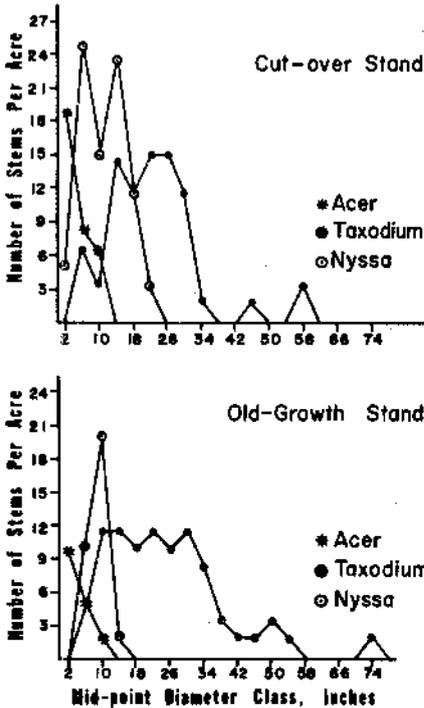


FIGURE 2. Structural diagrams for the old-growth and cut-over stands.

The structural diagram, Figure 2, shows that both cypress and water tupelo are even-aged populations. The few very large individuals in the cut-over area are hollow and were apparently by-passed by the loggers. This area has more tupelo and maple in the smaller size classes than does the old-growth stand. Only the maple has the "J shaped" curve characteristic of all-age populations.

In Figure 3 the relationship between the number of "knees" per acre and the cypress dominance factor is shown. The "knees" were tallied in each of the six quadrats. Connected knees were counted individually if they were separated above the water level. The cypress dominance factor is the square root of the product of the average tree basal area (dbh) and the density of cypress trees per acre. The square root of the product was used to achieve linearity for regression purposes. The correlation coefficient, .91, is significant at the .05 level.

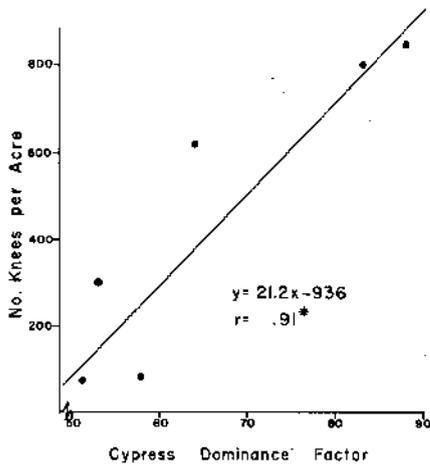


FIGURE 3. The relationship between the cypress dominance factor and the number of knees per acre.

Because the number of "knees" increases as the number and size of the cypress trees become greater, the two variables, average tree basal area and density, could be expected to be related to the density of "knees." Combining these two variables into a single expression yields

a term that has a better predictive value than either of the two variables independently. The relationship between the number of "knees" and the average basal area and density might be expected to exist for cypress in a wide range of habitats. However, the regression equation given in this paper probably will not be functional in other habitats. The number of "knees" is also a function of the habitat, and habitat differences are not considered in the equation.

The quadrat frequencies for the herbaceous vegetation and shrubs on the tree bases and on the fallen logs is given in Table 2. Mosses of various species have the highest

frequencies on the tree trunks and on the fallen logs. *Bidens discoidea*, *Triadenum walteri*, *Lycopus rubellus*, *Boehmeria cylindrica*, and *Gallium obtusum* are the five most frequent species of vascular plants on both the fallen logs and the tree bases. However, the fallen logs have a somewhat richer flora with 22 species being present compared with 16 for the tree bases.

Dodder (*Cuscuta cuspidata*) was found only on logs and was usually parasitizing *Triadenum walteri*.

Chi square tests were used to determine species preferences for N.E., S.E., S.W., or N.W. sides of the trees. However, none were found to be significantly associated with any

TABLE 2. Quadrat frequencies and species list for plants growing on tree bases and fallen logs.

Species	Frequency (172 Quadrats) on buttresses (16 species)	Frequency (60 Quadrats) on fallen logs (22 species)
Moss spp.	94.2	98.3
<i>Bidens discoidea</i>	55.2	41.7
<i>Triadenum walteri</i>	31.4	58.3
<i>Lycopus rubellus</i>	27.9	43.3
<i>Boehmeria cylindrica</i>	14.5	41.7
<i>Gallium obtusum</i>	12.2	48.3
<i>Rosa palustris</i>	5.2	13.3
<i>Scutellaria lateriflora</i>	4.1	Present only*
<i>Itea virginica</i>	4.1	21.7
<i>Cuscuta cuspidata</i>		11.7
<i>Cyperus</i> sp.		5.0
<i>Rhus radicans</i>	Present only	3.3
<i>Impatiens biflora</i>	" "	1.7
<i>Carex</i> sp.		1.7
<i>Parthenocissus quinquefolia</i>	Present only	
<i>Smilax</i> sp.	" "	
<i>Rubus</i> sp.		Present only
<i>Vitis</i> sp.		" "
<i>Lobelia cardinalis</i>		" "
<i>Cyperus esculentus</i>		" "
<i>Cyperus erythrorhizos</i>		" "
Seedlings:		
<i>Ulmus</i> sp.	Present only	Present only
<i>Acer rubrum</i> var. <i>Drummondii</i>	" "	" "
<i>Taxodium distichum</i>	" "	" "

* These plants grow on the logs or buttresses, but never occurred in a quadrat.

aspect of the tree. For the five most frequent species, occurring on the tree bases, chi square tests were used to examine the preference of these species for substrate. Only *Triadenum walteri* showed a significant positive preference (.001 level), occurring more frequently on cypress than on Drummond's red maple or water tupelo.

Azolla mexicana and *Spirodela polyrhiza*, floating aquatics, formed a dense cover over the surface of the water during August and September of 1968. On September 28, 1968, a circular can with the bottom removed was used to harvest *Ceratophyllum demersum*, a submerged aquatic, in five locations. The total area harvested was 363 sq. in. The average dry weight of *Ceratophyllum* was 44.16 grams per sq. meter.

Three shrubs were prominent in the cypress swamp, the button bush (*Cephalanthus occidentalis*), Virginia-willow (*Itea virginica*), and the swamp rose (*Rosa palustris*). The button bush formed a dense cover in some areas, but was never found on tree bases or on fallen logs, whereas the Virginia-willow occurred on logs, tree bases and in the water.

Reproduction by the trees was slight and limited to the fallen logs and swollen bases of tupelo and cypress. No tupelo seedlings were encountered, but a few *Taxodium* seedlings were found on fallen logs and tree buttresses. Drummond's red maple never grew directly in the water and was always restricted to fallen logs or old stumps. Even the largest maple trees did not grow directly in the water. It is questionable whether the cypress seedlings

found on stumps, logs and swollen trunks are able to attain canopy positions; red maples are able to reach tree size starting from these substrates.

DISCUSSION

The occurrence of trees, floating and submerged aquatics, epiphytes on the tree bases, and floating logs resembling vegetated islands makes the cypress swamps an interesting habitat ecologically.

Structurally the forest of Heron Pond is simple with the two dominant tree species being even-aged populations. Neither cypress nor water tupelo are able to germinate directly in the water so that large numbers of seedlings can get started only when the water recedes. Similarly, the seedlings are unable to withstand complete submergence (Demaree, 1932).

The structural diagrams suggest that the cypress populations in both areas might have originated about the same time. However, the cut-over area had some of the larger individuals selectively cut, suggested by the pattern of stumps. This disturbance may have permitted the tupelo present in the stand to be released, accounting for larger numbers and greater size of tupelo. Fallen logs and stumps would have provided suitable substrates for Drummond's maple to become established.

The importance of maple in a cypress swamp might be expected to increase after a disturbance such as cutting or as the canopy begins to break up, so that there are more fallen logs and stumps available for seed germination and lessened com-

petition for light and space.

The largest tree sampled was 74 in. (dbh); the largest cypress tree in Heron Pond measures 83 in. (dbh). Voigt and Mohlenbrock (1964) quote Brendel (1881) who indicates that the largest tree he ever measured in Illinois was a bald cypress 2.1 meters in diameter (82.6 in.), indicating that some trees in Heron Pond are as large as those in the primeval forest of Illinois.

Taxodium is an initial tree in deep swamps that occasionally have low water levels. According to Matton (1915) trees in virgin cypress stands were commonly 400 to 600 years old. He also states that old-growth stands of cypress have slow growth rates, while younger stands grow at rates comparable to other bottomland hardwoods with trees reaching diameters of 21 in. in one hundred years. This suggests that numerous trees in Heron Pond are older than a century, and that if undisturbed *Taxodium* will retain dominance for several centuries. But, with cutting of the cypress, water tupelo and red maple will increase in importance.

Kurz and Demaree (1934) indicate that the best development of "knees" and buttresses occur where air and water act together on wood-forming tissues. However, work done in Indiana has shown that "knees" develop on cypress trees grown on a wide range of sites, some of which experience little or no inundation. "Knees" were considered to be an inherent characteristic of the species (DenUyl, 1962).

The cypress dominance factor was found to be linearly related to the number of "knees" per acre, with

the number of "knees" increasing as the number of cypress trees increase or as they get larger. However, the relationship would have to be determined for each habitat, as the number of "knees" is related to the site conditions.

Koelling (1968) indicates that *Bidens discoidea* and *Lycopus rubellus* are common herbaceous plants on buttressed tree bases in southern Illinois swamps. In this study they were the first and third most frequent species of vascular plants on the buttresses. Fallen logs have a richer flora than the buttresses perhaps because they offer a somewhat more favorable environment, due to the rich moss growth and the moist decaying wood that are favorable for the germination and growth of herbaceous plants.

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