

Structure and Composition of Pin Oak/Swamp White Oak Flatwood Forests in Illinois

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ABSTRACT

Flatwoods with an overstory dominated by *Quercus palustris* Muenchh. (pin oak) and *Q. bicolor* Willd. (swamp white oak) are rare in Illinois. In this forest cover type these two oak taxa usually account for more than 75% of the basal area and density, and have a combined importance value of 140 to 190 out of a possible 200. Other tree species that are occasionally encountered include *Q. stellata* Wanh. (post oak), *Ulmus americana* L. (American elm), *Carya ovata* (Mill.) K. Koch (shagbark hickory) and *Diospyros virginiana* L. (persimmon). The woody understory contains seedlings and saplings of pin and swamp white oak, indicating a self-perpetuating community type as long as the hydrology does not change significantly.

INTRODUCTION

Flatwood forests are common throughout the midwestern United States. The forest cover type having post oak (*Quercus stellata* Wanh.) as the dominant species is referred to as Southern Flatwoods by White and Madany (1978). It is common throughout much of the Midwest from Ohio to Missouri, and is particularly abundant on the Illinois till plain (Braun 1950, Schwegman 1973, Fralish 1988, Coates et al. 1992, Taft et al. 1995). These flatwoods once covered approximately 2.25 million ha in southern Illinois (Telford 1926).

Occasionally associated with these post oak flatwoods are extremely wet sites where pin oak (*Quercus palustris* Muenchh.) and swamp white oak (*Q. bicolor* Willd.) dominate the overstory. This cover type, known as the *Quercus palustris*-(*Quercus bicolor*) Seasonally Flooded Forest Alliance by Drake and Faber-Langendoen (1997), shows similarity to

the SAF type 65, Pin Oak-Sweet Gum forest of Eyre (1980). These pin oak/swamp white oak flatwoods are uncommon in Illinois, occurring on extremely flat, wet soils with a claypan at or near the surface. This compact and impermeable soil layer impedes drainage and reduces root penetration. These flatwoods also have a unique herbaceous layer in which taxa of Cyperaceae and Poaceae dominate, but some forbs occur in low numbers. The present study was undertaken to determine the structure and composition of the woody overstory and understory of three pin oak/swamp white oak flatwoods.

DESCRIPTION OF THE STUDY AREA

The forests studied are located in the Effingham Plain Section of the Southern Till Plain Natural Division of Illinois. This section is a relatively flat plain, drained mostly by the Kaskaskia River, that was originally characterized by extensive prairie and post oak flatwoods prior to European settlement (Schwegman 1973).

The flatwoods examined were relatively undisturbed with no signs of a timber harvest, but there were indications of unsuccessful attempts to drain the areas. Of the three flatwoods, the Venedy site was the driest, road construction and ditches caused the site to lose surface water faster than at the other sites. Island Grove Flatwoods was the wettest, surface water remaining much later into the summer. Unlike the other sites, Schuetz Flatwoods contained some slightly elevated areas where post oak, and *Carya ovata* (Mill.) K. Koch (shagbark hickory) were common.

The three woods studied range from 2 to 4 ha in size, and are located on extremely level terrain. The soils are impervious silty clay loams to silt loams that usually have a claypan or fragipan at or near the surface (Bramstedt et al. 1992). Sometimes referred to as clay flats, these forests are seasonally wet with pooled water during the winter and spring, but relatively dry in summer and early fall. The soils have a shallow, perched water table, and surface run-off is slow or ponded. The surface and subsoil layers are usually strongly to very strongly acid with pH ranging from 3.5 to 5.0.

Venedy Flatwoods

Located at the edge of Mud Lake Road, this flatwoods is on the broad floodplain of the Kaskaskia River about 2.5 km N of Venedy, Washington County, Illinois (NE1/4 S22 T1S R5W). The soils are Hurst silt loam, a somewhat poorly drained soil characterized by a seasonally high water table that ranges from 30 to 90 cm below the surface, and a subsoil that is characterized by a firm layer of clay (Sabata et al. 1998).

Schuetz Flatwoods

Separated from a farm field by a drainage ditch on the west side, this flatwoods is located close to the Kaskaskia River about 2 km N of Venedy, Washington County, Illinois (NE1/4 S21 T1S R5W). The soil type is the wet phase of Birds silt loam, a poorly drained, frequently flooded, hydric soil characterized by extensive periods of ponding of water throughout the winter and spring. The seasonal high water table ranges from 15 cm above to 25 cm below the soil surface (Sabata et al. 1998).

Island Grove Flatwoods

This flatwoods is located at the south edge of a large grove of timber in the headwaters region between Dietrick Creek and Island Creek, 5 km NW of Wheeler, Jasper County, Illinois (SE1/4 S31 T8N R8E). The soil, Racoon silt loam, is poorly drained and subject to ponding and occasional flooding from March through June in most years. The organic content is low, and the subsoil is a firm silty clay loam to a depth of 1.5 m (Bramstedt et al. 1992).

MATERIALS AND METHODS

During the summer of 1998, a one ha section of each of the two flatwoods in Washington County was surveyed, while in 1999 a 2 ha section of the Island Grove Flatwoods was surveyed. In each woods, the entire flatwoods was surveyed, except for a 15 to 30 m buffer around each area to reduce edge effect. Each area was divided into quadrats 25 m on a side for ease in surveying. In each quadrat all living and dead-standing woody individuals 10.0 cm dbh and above were identified and their diameters recorded. From these data, the living-stem density (stems/ha), basal area (m^2/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Determination of the IV follows the procedure used by McIntosh (1957), and is the sum of the relative density and relative dominance (basal area). Dead-standing stem density (stems/ha), basal area (m^2/ha), and average diameter was also determined.

Woody understory composition and density (stems/ha) were determined using nested circular plots 0.0001, 0.001, and 0.01 ha in size, randomly located at 20 meter intervals along line transects within the study areas. A random numbers table was used to determine the number of meters the center point of the nested circular plots was located to the right (odd numbered plots) or to the left (even numbered plots) of the transect line. Four additional 0.0001 ha circular plots were located 7 m from the center point along cardinal compass directions. In the 0.0001 ha plot, seedlings (<50 cm tall) and all shrubs were counted; in the 0.001 ha circular plots small saplings (>50 cm tall and <2.5 dbh) were recorded; and in the 0.01 ha circular plots large saplings (2.5-9.9 cm dbh) were tallied. Nomenclature follows Mohlenbrock (1986).

RESULTS AND DISCUSSION

All three study areas were similar in overstory composition. Pin oak dominated and was found in all diameter classes. In the three stands studied this species had between 99 and 152 stems/ha, a basal area between 9.72 and 19.11 m^2/ha , and IV's between 80.8 and 130.1 (Table 1). Swamp white oak ranked second in all three stands (IV's between 41.3 and 89.2), with 46 to 100 stems/ha, and basal areas between 5.36 and 11.16 m^2/ha . Of the remaining overstory taxa, post oak and American elm (*Ulmus americana* L.) were occasionally encountered. Post oak, which was not found at Island Grove Flatwoods, was represented by only 7 stems/ha at Venedy Flatwoods, but at Schuetz Flatwoods had an IV of 38.3, 36 stems/ha and a basal area of 5.42 m^2/ha . American elm, was not encountered at Venedy Flatwoods, but was represented by many small diameter individuals at the other two stands (Table 1). Few other tree species were encountered, all being represented by one or two individuals.

Tree mortality was relatively low, but highly variable. In the three stands examined, dead-standing stems ranged from 16-52 stems/ha, with the basal area ranging from 1.01-3.02 m²/ha (Table 2). At all sites, pin oak dominated the dead-standing category. Average diameter of the dead-standing pin oak trees varied from 27.2 to 30.4 cm dbh on the three sites. The density of dead-standing individuals at Island Grove Flatwoods (52 stems/ha) may be the result of prolonged flooding in recent years.

Because woody seedlings and saplings had a low density, the understory appeared open in all three stands (Table 3). Both pin oak and swamp white oak seedling were found in many plots, sometimes in fairly high numbers, and a few saplings were also present. The presence of oak saplings as well as the number of individuals of these species in the lower diameter classes indicate their continued importance in these flatwoods. Other understory taxa were found in low numbers, and will probably not become important in the overstory as long as the hydrology of the sites does not change appreciably.

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Table 1. Density by diameter class (stems/ha), basal area (m²/ha), relative density, relative dominance, importance value and average diameter of the woody species at three pin oak/swamp white oak flatwoods in Illinois.

Species	Diameter Classes (cm)						Total #/ha	Basal Area m ² /ha	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
	10-19	20-29	30-39	40-49	50-59	60+						
Venedy Flatwoods, Washington County, Illinois (NE1/4 Sec 22 T1S R5W)												
Pin Oak	9	28	38	21	8	5	109	11.96	52.9	49.4	102.3	35.3
Swamp white oak	12	18	23	18	9	9	89	11.16	43.2	46.0	89.2	37.1
Post oak	--	--	2	4	1	--	7	1.09	3.4	4.5	7.9	43.9
Persimmon	1	--	--	--	--	--	1	0.02	0.5	0.1	0.6	13.7
Total	22	46	63	43	18	14	206	24.23	100.0	100.0	200.0	
Schuetz Flatwoods, Washington County, Illinois (NE1/4 Sec 21 T1S R5W)												
Pin oak	16	33	24	10	13	3	99	9.72	35.3	45.5	80.8	32.7
Swamp white oak	43	35	13	5	3	1	100	5.36	35.7	25.1	60.8	23.6
Post oak	6	9	8	3	4	6	36	5.42	12.9	25.4	38.3	39.2
American elm	24	1	--	--	--	--	25	0.31	8.9	1.5	10.4	12.4
Shargbark hickory	5	1	3	--	--	--	9	0.41	3.2	1.9	5.1	22.0
Persimmion	8	--	--	--	--	--	8	0.12	2.9	0.5	3.4	13.3
Others (2 species)	3	--	--	--	--	--	3	0.03	1.1	0.1	1.2	--
Totals	105	79	48	18	20	10	280	21.37	100.0	100.0	200.0	
Island Grove Flatwoods, Jasper County, Illinois (SE1/4 Sec 31 T8N R8E)												
Pin oak	10	32	46	39	19	6	152	19.11	58.5	71.6	130.1	37.8
Swamp white oak	8	7	12	9	6	4	46	6.29	17.7	23.6	41.3	38.4
American elm	43	3	--	--	--	--	46	0.71	17.7	2.6	20.3	13.5
Shagbark hickory	6	5	1	--	--	--	12	0.42	4.6	1.5	6.1	20.7
Others (4 species)	2	1	1	--	--	--	4	0.15	1.5	0.7	2.2	
Totals	69	48	60	48	25	10	260	26.68	100.0	100.0	200.0	

Table 2. Density (stems/ha), basal area (m²/ha), and average diameter of the dead-standing species at three pin oak/swamp white oak flatwoods in Illinois.

Species	Average Density (stems/ha)	Basal Area (m ² /ha)	Diameter (cm)
Venedy Flatwoods, Washington County, Illinois			
Pin oak	12	0.87	27.2
Swamp white oak	4	0.14	19.3
Totals	16	1.01	
Schuetz Flatwoods, Washington County, Illinois			
Pin oak	14	1.30	30.4
Swamp white oak	5	0.19	20.5
Post oak	2	0.39	48.5
Totals	21	1.88	
Island Grove Flatwoods, Jasper County, Illinois			
Pin oak	27	2.11	28.9
Swamp white oak	9	0.62	27.8
American elm	16	0.29	14.6
Totals	52	3.02	

Table 3. Density (stems/ha) of the woody seedlings (<50 cm tall), small saplings (>50 cm tall <2.5 cm dbh), and large saplings (2.5-9.9 cm dbh) at three pin oak/swamp white oak flatwoods in Illinois.

Species	Seedlings	Small Saplings	Large Saplings
Venedy Flatwoods, Washington County, Illinois			
Swamp white oak	--	56	11
Green ash	667	--	--
Pin oak	333	167	28
American elm	--	--	28
Black cherry	--	56	--
Totals	1000	279	67
Schuetz Flatwoods, Washington County, Illinois			
Swamp white oak	1111	111	56
Sassafras	333	--	50
Green ash	333	278	17
Pin oak	333	167	17
American elm	111	222	72
Black cherry	111	278	33
Others	111	56	101
Totals	2443	1112	346
Island Grove Flatwoods, Jasper County, Illinois			
Swamp white oak	480	--	--
Green ash	240	40	12
Pin oak	5280	720	8
American elm	--	120	208
Others	880	40	16
Totals	6880	920	244