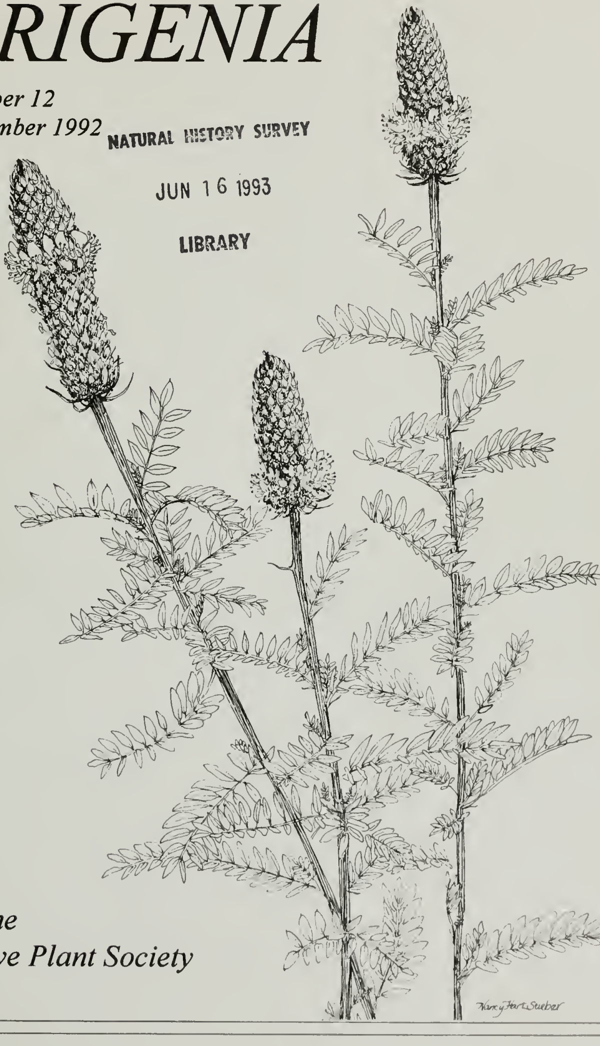
ERIGENIA

Number 12
November 1992



Journal of the
Illinois Native Plant Society

Erigenia

Number 12, November 1992

Editor: Elizabeth L. Shimp, U.S.D.A. Forest Service, Shawnee National Forest, 901 S. Commercial St., Harrisburg, IL 62946

Copy Editor: Floyd A. Swink, The Morton Arboretum, Lisle, IL 60532

Publications Committee: John E. Ebinger, Botany Department, Eastern Illinois University, Charleston, IL 61920
Ken Konsis, Forest Glen Preserve, R.R. 1 Box 495A, Westville, IL 61883
Kenneth R. Robertson, Illinois Natural History Survey, 607 E. Peabody Dr., Champaign, IL 61820
Lawrence R. Stritch, U.S.D.A. Forest Service, Shawnee National Forest, 901 S. Commercial St., Harrisburg, IL 62946

Cover Design: Christopher J. Whelan, The Morton Arboretum, Lisle, IL 60532

Cover Illustration: Nancy Hart-Stieber, The Morton Arboretum, Lisle, IL 60532

For Society membership information, write to: Lorna J. Konsis, Forest Glen Preserve, R.R. 1 Box 495A, Westville, IL 61883

The Illinois Native Plant Society is dedicated to the preservation, conservation and study of the native plants and vegetation of Illinois.

(ISSN 8755-2000)

Cover: *Petalostemum foliosum* Gray (synonym: *Dalea foliosa* (Gray) Barneby), leafy prairie clover, a federally endangered plant, was once widespread in northern Illinois but is now known from only four sites in one county.

This issue's cover illustration is a tribute to Floyd Swink for his many contributions to our understanding the flora of Illinois. Floyd's dedication to his work and his compassion for nature have influenced many of us to follow in his footsteps.

Woody Vegetation Survey of Barkhausen Woods, a Closed Canopy Sand Forest in Mason County, Illinois

David T. Coates, Sean E. Jenkins, and John E. Ebinger

Botany Department
Eastern Illinois University
Charleston, IL 61920

and

William E. McClain

Natural Heritage Division
Illinois Department of Conservation
Springfield, IL 62706

ABSTRACT

An inventory of the woody vegetation of a 4 ha section of a closed canopy sand forest in Mason County, Illinois gave a stand composition of 237.9 stems/ha (above 10 cm dbh), and a basal area of 16.3 m^2/ha. A total of 26 woody species were encountered, 3 were canopy trees, 14 were understory trees, and 9 were shrubs and vines. Black oak was the leading dominant with 77% of the basal area, 35% of the individuals, and with an importance value (IV) of 111.2 (out of 200). Black hickory ranked second (IV of 61.5), followed by blackjack oak (IV of 22.0). The more mesic species were not very common, restricted to the seedling and sapling layers, and a few individuals in a lower diameter class. Black oak and black hickory, however, dominate the seedling and sapling layer as well and the lower diameter classes, ensuring the future replacement of veteran trees.

INTRODUCTION

The vegetation of the inland sand deposits of Illinois was first studied by Gleason (1910), who listed the vascular plants and the plant associations. Later, Maier (1976) listed the vascular plants of Sand Ridge Forest in Mason County, Illinois, defined their habitats, assessed their abundance, and recorded flowering times. He found that many of the species and associations described by Gleason (1910) were either absent or scarce. He suggested a lowered water table and man's activities as possible explanations for these observations, stating that numerous plantings (particularly of exotics) and fencerows had decreased the amount of wind-blown sand, altering the delicately balanced successional processes.

Rodgers and Anderson (1979) studied the presettlement vegetation of Mason County, using General Land Office survey records. They found that prairie had been the dominant vegetation type, occupying 67.7% of the county. Savanna (14.4%) and forest (13.3%) occurred on most of the remaining land, while 4.6% of the area was covered by lakes and swamps. The dominant tree species in the presettlement forests and savannas were shade-intolerant, fire-tolerant oaks and hickories. In the closed canopy forests, tree densities were very high (263 trees/ha), the oaks and hickories were still the most numerous species, but more mesic, shade-tolerant, fire-sensitive tree species (*i.e.*, sugar maple, elms, black walnut) were also present.

Other studies in Mason County forests (Anderson and Brown 1983, 1986) determined the effect of fire in sand savannas and adjacent forests. They concluded that fire stabilized open forests, prairies, and savannas but tended to destabilize closed canopy forest systems, and that the absence of fire in the present century has made closed canopy forests more common. Recently Jenkins *et al.* (1991), determined the species composition and structure of Bishop's Woods, a closed canopy sand forest in Mason County, Illinois. They found *Quercus velutina* Lam. (black oak), *Carya texana* Buckl. (black hickory), and *Q. marilandica* Muenchh. (blackjack oak) were the most common, with lesser amounts of more mesic species.

The present study of a closed canopy sand forest on the Barkhausen Conservation Area was undertaken to determine the floristic composition and structure of the forest, to determine its similarity to other forests of the sand areas of Illinois, and to examine some of the environmental parameters that may be responsible for its present structure and composition.

DESCRIPTION OF THE STUDY AREA

Barkhausen Woods, 18.2 ha (45 acres) in size, is located 10 miles SW of Bath in the extreme SW corner of Mason County, Illinois (NW1/4, Sec. 19, T19N, R10W) in the Illinois River Section, Illinois River and Mississippi River Sand Areas Natural Division (Schwegman 1973). The woods is nearly flat, varying in elevation from 140-146 m above sea level, with a stabilized sand dune at the southern margin rising to about 6 m above the rest of the area. The soils are sandy and were developed from deep sand deposits laid down by glacial meltwaters during the Pleistocene (Willman and Frye 1970, Schwegman 1973, Maier 1976). This closed canopy oak-hickory forest was probably more open in the past, and presently shows no sign of logging or grazing. Donated to the Illinois Department of Conservation in the early 1960's, it is now called the Barkhausen Conservation Area.

MATERIALS AND METHODS

During the summer of 1989, a 4 ha section of the Conservation Area was divided into quadrats 25 m on a side. The number, size and species of all living and dead standing trees (above 10 cm dbh) were recorded for each of the 64 quadrats. The relative dominance, relative density, and importance value (IV) were then calculated for each species. IV determination follows the procedure developed by McIntosh (1957) and later by Boggess (1964), and is the sum of the relative density and relative dominance of a given species. The average diameter (cm), density (#/ha) in broad diameter classes; and basal area (m^2/ha) were also calculated for each species.

Nested circular plots of 0.0001, 0.001, and 0.01 ha in size were randomly located in each of the 64 quadrats. Seedlings under 40 cm in height were tallied in the 0.0001 ha plots; seedlings more than 40 cm in height but less than 2.5 cm dbh were recorded in the 0.001 ha plots; and saplings (2.5-10.0 cm dbh) were recorded in the 0.01 ha plots, and their densities (#/ha) determined. Nomenclature follows Mohlenbrock (1986).

Soil pits were randomly located within the woods to determine depth of the A horizon, and soil samples were taken to determine the pH and soil texture of both A and B horizons. The soil pH was measured using a Corning pH meter (Model 7). Soil texture was determined using the Bouyoucos Hydrometer Method (Bouyoucos 1962).

RESULTS AND DISCUSSION

A total of 26 woody species was recorded in the forest, of which 3 were canopy trees, 14 were understory trees, and 9 were shrubs and vines. The tree species encountered, along with their densities in broad diameter classes, basal area, relative values, importance values, and average diameters are listed in Table 1.

Black oak was first in importance (IV of 111.2) having the highest relative dominance (76.7), and ranked second in relative density (34.5). It was common in all diameter classes, 62% of the individuals exceeded 4 dm dbh, and it had the highest average diameter (41.3 cm dbh) of all species present. It also accounted for 77% of the total basal area in the woodlot, ranked first in the seedlings/ha, and second in saplings/ha (Table 1).

Black hickory, second in importance (IV of 61.5), had the highest relative density (Table 1). It was common in the lower diameter classes, with 81% of its individuals in the 1-2 dm class, and had the lowest average diameter of the overstory species (15.9 cm dbh). It ranked third in seedlings/ha and first in saplings/ha, accounting for 64% of the saplings encountered.

Blackjack oak ranked third with an IV of 22.0, being third in both relative dominance and relative density (Table 1). It was relatively common in the lower diameter classes and had an average diameter of 19.1 cm dbh. It ranked second in seedlings/ha, but very few saplings were encountered. This species had a clumped distribution, being found at the margins of openings, and associated with the stabilized dune at the southern edge of the forest.

The other tree species were of minor importance, accounting for a combined IV of 5.3. Most were found in the seedling, sapling, and 10-20 cm diameter class. Of these species *Catalpa speciosa* Warder ex Engelm. (catalpa) was the most common, followed by *Prunus serotina* Ehrh. (wild black cherry), and *Gleditsia triacanthos* L. (honey locust). These species were usually found in areas where past tree-falls had created canopy openings.

Multiple-stemmed trees (coppices) were relatively common, averaging 15.3 coppice trees/ha, 35.3 stems/ha, and a basal area of 2.0 m^2/ha. Blackjack oak accounted for 41% of the coppice growth with an average of 6.3 trees/ha and 2.5 stems/tree. Black oak accounted for 26% of the coppice growth but made up 65% basal area, with the average stem being 42.5 cm dbh. Black hickory accounted for 30% of the coppice growth but only accounted for 11% of the total basal area.

Tree mortality averaged 26.8 dead-standing trees/ha, with an average diameter of 33.6 cm dbh and a basal area of 2.7 m^2/ha. Black oak had the highest mortality with 18.5 trees/ha, and an average diameter of 39.3 cm dbh, accounting for 69% of the dead trees and 89% of the basal area. Blackjack oak, second in mortality with 5.8 stems/ha, had an average stem size of 20.7 cm dbh, while black hickory accounted for only 9% of the dead trees.

Nine shrubs were encountered in the understory and averaged 9235 stems/ha. *Toxicodendron radicans* (L.) Kuntze (poison ivy) at 4438 stems/ha, *Rubus allegheniensis* Porter (blackberry) at 2125 stems/ha, and *Cornus racemosa* Lam. (gray dogwood) at 1203 stems/ha were the most common, accounting for 84% of the total stems. These species were most common in canopy openings, and were usually clumped. *Ribes missouriense* Nutt. (Missouri gooseberry), *Rhus aromatica* Ait. (fragrant sumac), *Zanthoxylum americanum* Mill. (prickly ash), and *Rubus occidentalis* L. (black raspberry) were occasionally encountered.

The soils in the woodlot at the Barkhausen Conservation Area were extremely sandy and acidic. The A horizon throughout the area had an average depth of 7.8 cm and an average pH of 4.9, while the B horizon had an average pH of 4.6. Soil texture averaged 89.5% sand, 8.1% silt, and 2.4% clay in the A horizon,, while the B horizon averaged 92.5% sand, 5.4% silt, and 2.1% clay.

CONCLUSIONS

The results of this study indicate that Barkhausen Woods is similar to Bishop's Woods (Jenkins *et al.* 1991), another closed canopy forest in the Illinois River Sand Area Section. In both, the overstory was found to be dominated by black oak, black hickory, and blackjack oak, with mesic species being very uncommon in the overstory. Also, the stems/ha were nearly the same (237.9 for Barkhausen Woods, 247.5 for Bishop's Woods) as was the basal area (16.3 m^2/ha for Barkhausen Woods, 16.1 m^2/ha for Bishop's Woods). The major differences between the two woodlots were the importance of black hickory (22.6 in Bishop's Woods, 61.5 in Barkhausen Woods), and the absence of *Carya tomentosa* (Poir.) Nutt. (mockernut hickory) from Barkhausen Woods.

Both forests show some similarity to the closed canopy forests of the sand deposits of presettlement times. Rodgers and Anderson (1979) reported that the closed canopy forests associated with the sand deposits in Mason County were dominated by black oak (IV of 118.31), blackjack oak (IV of 18.35), and hickory spp. (IV of 21.81), with the remaining being mesic species. Barkhausen and Bishop's Woods have the same dominants as reported by Rodgers and Anderson (1979), but the more mesic species are mostly missing. Though present in small numbers in the understory, these species have not entered the canopy. This suggests that in the past these two forests were more open, and relatively recently, as a result of canopy closure, the more mesic species may be starting to increase in numbers. However, it is probable that the composition of these closed canopy forests will remain fairly stable in composition. Presently, the relatively shade-intolerant dominant species tend to reproduce themselves. Black oak and black hickory have a large number of individuals in the lower diameter classes, and have sufficient seedlings and saplings for the future replacement of veteran trees.

Studies suggest that savannas in the Midwest often owe their sustainment to periodic fires, since, in the absence of burning, savannas are rapidly converted to closed canopy forests (Muir 1913, Cottam 1949, Curtis 1959). In many forests in the Midwest there are widely spaced, large, open-grown trees that are surrounded by smaller, forest-grown trees (Anderson and Brown 1983, Henderson and Long 1984, Ebinger and McClain 1991). It is now generally believed that many closed canopy forests originated from savannas when periodic fires were stopped as Europeans settled the region (Cottam 1949, Curtis 1959, Rodgers and Anderson 1979, Anderson 1982). This suggests that the closed canopy forest at the Barkhausen Conservation Area was originally more open, and in the absence of fire or other disturbances, has developed a closed canopy.

LITERATURE CITED

Anderson, R. C. 1982. An evolutionary model summarizing the roles of fire, climate, and grazing animals in the origin and maintenance of grasslands. Pages 297-308 in J. Estes, R. Tyrl, and J. Brunken (eds.), Grasses and Grasslands: Systematics and Ecology. Univ. of Oklahoma Press, Norman, OK.

Anderson, R. C. and L. E. Brown. 1983. Comparative effects of fire on trees in a midwestern savannah and an adjacent forest. Bull. Torrey Bot. Club. 110:87-90.

Anderson, R. C. and L. E. Brown. 1986. Stability and instability in plant communities following fire. Amer. Jour. Bot. 73:364-368.

Boggess, W. R. 1964. Trelease Woods, Champaign County, Illinois: woody vegetation and stand composition. Trans. Ill. St. Acad. Sci. 57:261-271.

Bouyoucos, G. J. 1962. Hydrometer method improved for making particle size analyses of soils. Agron. Jour. 54:464-465.

Cottam, G. 1949. The phytosociology of an oak woods in southwestern Wisconsin. Ecology 30:271-287.

Curtis, J. T. 1959. The vegetation of Wisconsin. Univ. of Wisconsin Press, Madison, WI.

Ebinger, J. E. and W. E. McClain. 1991. Forest succession in the prairie of Illinois. Ill. Nat. Hist. Surv. Bull. 34:375-381.

Gleason, H. A. 1910. The vegetation of the inland sand deposits of Illinois. Ill. St. Lab. Nat. Hist. Bull. 9:23-174.

Henderson, N. R. and J. N. Long. 1984. A comparison of stand structure and fire history in two black oak woodlands in northwestern Indiana. Bot. Gaz. 145:222-228.

Jenkins, S. E., J. E. Ebinger, and W. E. McClain. 1991. Woody vegetation survey of Bishop's Woods, a sand forest in Mason County, Illinois. Trans. Ill. St. Acad. Sci. 84:20-27.

Maier, C. T. 1976. An annotated list of the vascular plants of Sand Ridge State Forest, Mason County, Illinois. Trans. Ill. St. Acad. Sci. 69:153- 175.

McIntosh, R. P. 1957. The York Woods. A case history of forest succession in southern Wisconsin. Ecology 38:29-37.

Mohlenbrock, R. H. 1986. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale and Edwardsville, IL.

Muir, J. 1913. The story of my boyhood and youth. Houghton Mifflin Co., Boston.

Rodgers, C. S. and R. C. Anderson. 1979. Presettlement vegetation of two prairie peninsula counties. Bot. Gaz. 140:232-240.

Schwegman, J. E. 1973. Comprehensive plan for the Illinois nature preserves system. Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Rockford, IL.

Willman, H. B. and J. C. Frye. 1970. Pleistocene stratigraphy of Illinois. Ill. St. Geol. Surv. Bull. No. 94.

Table 1. Densities (#/ha), diameter classes, basal areas (m^2/ha), relative values, importance values, and average diameters of the tree species in Barkhausen Conservation Area, Mason County, Illinois.

Species	Seedlings #/ha		Saplings	Diameter Classes (dm) #/ha						Basal Area	Rel.	Rel.		Av. Diam.
	<40cm	40cm	#/ha	1-2	2-3	3-4	4-5	5+	Totals	m^2/ha	Den.	Dom.	IV	(cm)
Quercus velutina Lam.	2500	859	139	11.3	7.3	12.8	25.8	25.0	82.2	12.5	34.5	76.7	111.2	41.3
Carya texana Buckl.	1406	844	564	89.3	16.5	3.0	0.8	--	109.6	2.5	46.2	15.3	61.5	15.9
Quercus marilandica Muenchh.	2188	609	20	22.3	10.8	1.5	1.0	--	35.6	1.2	14.9	7.1	22.0	19.1
others*	1096	797	153	10.0	0.5	--	--	--	10.5	0.1	4.4	0.9	5.3	--
Totals	7190	3109	876	132.9	35.1	17.3	27.6	25.0	237.9	16.3	100.0	100.0	200.0	

* Includes *Catalpa speciosa* Warder ex Engelm., *Sassafras albidum* (Nutt.) Nees, *Diospyros virginiana* L., *Ulmus americana* L., *Tilia americana* L., *Celtis occidentalis* L., *Morus rubra* L., *Amelanchier arborea* (Michx. f.) Fern., *Prunus serotina* Ehrh., *Gleditsia triacanthos* L., *Juniperus virginiana* L., *Ulmus rubra* Muhl., *Fraxinus americana* L., and *Betula nigra* L.

Woody Vegetation Survey of Sullivan Woods, Moultrie County, Illinois

Sandra S. Baumgartner, Sean E. Jenkins, Michael A. Jenkins, and John E. Ebinger

Botany Department
Eastern Illinois University
Charleston, IL 61920

ABSTRACT

An inventory was completed of the woody vegetation at Sullivan Woods, a dry mesic upland forest located in the Grand Prairie Natural Division of east central Illinois, Moultrie County. This forest, which is dominated by *Quercus alba* L., *Carya ovata* (Mill.) K. Koch, *Acer saccharum* Marsh., and *Ulmus rubra* Muhl., has a stand composition of 252 stems/ha, with an average basal area of 24.6 m^2/ha. *Quercus alba* accounts for 37% of the individuals (above 10 cm dbh) and 64% of the basal area. The understory is dominated by *Ulmus rubra*, which accounts for nearly 50% of the seedlings and saplings.

INTRODUCTION

Sullivan Woods (Pogue Timber) is located in the Grand Prairie Section of the Grand Prairie Natural Division (Schwegman 1973). It is located immediately north of the Shelbyville moraine, the terminus of Wisconsin glaciation, and is about 2 miles northeast of Findlay, Moultrie County, Illinois. Sullivan Woods, which is managed by the U. S. Army Corps of Engineers, is on part of the land purchased in the mid 1960's as upland buffer for Lake Shelbyville, a reservoir and flood control project built on the Kaskaskia River.

The woods is probably typical of relatively mature forests associated with the uplands along major rivers located in the Grand Prairie Natural Division of Illinois. Though more open and lacking mesophytic woody species in presettlement time, these forests have become closed and now have a more diverse woody flora, primarily due to the cessation of fire (Rodgers and Anderson 1979, Ebinger 1986). Typically, these relatively dry forests still maintain the dominant oak/hickory component, but more mesic species are slowly invading (Boggess and Geis 1966, Newman and Ebinger 1985, Ebinger 1986). A detailed study of Sullivan Woods was undertaken to determine its woody composition and structure.

DESCRIPTION OF THE WOODS

Sullivan Woods, about 12 ha in size, is located in the extreme southeastern corner of Moultrie County, Illinois (NW1/4 Sec 36 T13N R5E). It is on the uplands surrounding the extensive valley system of the Kaskaskia River drainage. The topographic relief within the site does not exceed 10 m, and the area is relatively flat except for two shallow valleys, one that traverses the northern part of the woods and one at the western edge. The woods is well drained, and the small valleys are dry except immediately after a rain. The woods is bordered by a county road on the north, an abandoned road on the east, and a successional field on the south. Some cut stumps are found scattered throughout the woods. Also, the woods was probably grazed before being purchased about 25-30 years ago.

MATERIALS AND METHODS

A 5-ha section of the woodlot was divided into quadrats 25 m on a side (80 quadrats), and all living and dead-standing woody individuals above 10 cm dbh were identified and their diameters determined. From these data the density (stems/ha), basal area (m^2/ha), relative values, importance value (IV), and average diameter were calculated for each species. The determination of the IV follows the procedure used by McIntosh (1957) and later Boggess (1964), and is the sum of the relative density and the relative dominance of a given species.

The composition and density (stems/ha) of the woody understory were determined from nested circular plots 1/10,000, 1/1,000, and 1/100 ha in size. In the 1/10,000-ha plots small seedlings (<40 cm tall) were counted, in the 1/1,000-ha plots large seedlings (>40 cm tall but <2.5 cm dbh) were determined, and in the 1/100-ha plots the saplings (2.5-10 cm dbh) were tallied. Shrubs less than 40 cm tall were recorded in the 1/10,000-ha plots, while in the 1/1,000-ha plots the larger shrubs were tallied. Nomenclature follows Mohlenbrock (1986).

RESULTS AND DISCUSSION

A total of 17 canopy and 4 understory species were identified in the woods. The most common of these, along with their seedling and sapling densities (stems/ha), relative density, relative dominance, importance value (IV), average diameter, and the number of stems/ha in broad diameter classes are listed in Table 1. The common shrubs encountered and their densities (stems/ha) are listed in Table 2.

Of the species encountered, *Quercus alba* (white oak) ranked first with an IV of 101.3 (out of a possible 200), and had the highest relative density and relative dominance. This species accounted for 37% of the individuals and 64% of the basal area of the woodlot and had an average diameter of 43.6 cm. It was common in all diameter classes, and more than 80% of the stems exceeded 30 cm dbh. It also was fairly well represented in the seedling category, averaging 875 stems/ha (Table 1). Besides white oak, other oak species were occasional canopy components. *Quercus velutina* (black oak), which ranked sixth in importance with an IV of 6.4, was relatively common in the drier parts of the woods, while *Q. rubra* (red oak), eighth in importance (IV of 4.8), was mostly restricted to mesic valleys. In disturbed upland sites a few *Q. imbricaria* (shingle oak) were encountered. Though not particularly abundant, seedlings and saplings of all oak species were found throughout the woodlot (Table 1).

Carya ovata (shagbark hickory) ranked second in importance with an IV of 25.6. This species accounted for 14% of the density and 11% of the basal area of the woodlot. It was common in most diameter classes, and averaged 1,293 seedlings/ha and 31.3 saplings/ha. Other hickory species were also relatively common overstory components. *Carya glabra* (pignut hickory), which ranked fifth in importance (IV of 10.8), occurred in all diameter classes and had an average diameter of 37.4 cm. This species was well represented in the seedlings category with more than 3,000 stems/ha. *Carya tomentosa* (mockernut hickory) and *C. ovalis* (sweet pignut hickory) were found on the drier upland and ranked seventh and ninth in importance, respectively, while *C. cordiformis* (bitternut hickory) was rarely encountered, being restricted to the mesic valleys.

The relatively mesic species *Acer saccharum* (sugar maple) and *Ulmus rubra* (slippery elm) ranked third and fourth respectively in importance. Both were well represented in the 10-20-cm diameter class, while only a few individuals were present in the larger diameter classes. Slippery elm seedlings and saplings were extremely common throughout the woods and accounted for nearly half of the seedlings (14,593 stems/ha), and more than one-third of the saplings (368.8 stems/ha). Sugar maple, in contrast, accounted for only 825 seedlings/ha and 73.8 saplings/ha. Both species appear to be increasing in importance in the woods, as they are the most common species in the 10-20-cm diameter class. The remaining species in the woods had extremely low IV's and, individually, had little impact on forest structure.

Tree mortality was relatively low in the woods, averaging 13 dead-standing stems/ha with an average basal area of 1.07 m^2/ha. As expected, white oak had the highest mortality with 7.4 stems/ha. Black oak was second with 1.4 stems/ha, followed by shagbark hickory and slippery elm. A few cut stumps were present; most appeared to be of white oak, black oak, and black walnut. Coppice stems were uncommon in the woods.

Of the understory trees present, only *Cercis canadensis* (redbud) was relatively common, being represented in the 10-20-cm diameter class, and averaging 1,100 seedlings/ha and 71.3 saplings/ha (Table 1). The three other understory species, *Ostrya virginiana* (hop hornbeam), *Morus rubra* (red mulberry), and *Crataegus mollis* (red haw) were only rarely encountered. The shrub layer through the woods was relatively dense and averaged 15,877 stems/ha (Table 2). *Rubus allegheniensis* (blackberry), *Toxicodendron radicans* (poison ivy), *Symphoricarpos orbiculatus* (coralberry), and *Ribes* *missouriense* (Missouri gooseberry) were the most common shrub species found.

The data suggest that Sullivan Woods is in transition from a xeric oak/hickory forest to a more mesic forest in which sugar maple is increasing in importance. Oaks (particularly white oak) and hickories presently prevail in importance and are the common larger diameter trees (Table 1). They are also fairly common in the seedling and sapling categories and are represented in the smaller diameter classes. As a result, the oaks and hickories will continue to be an important component of the canopy, but sugar maple should increase significantly in importance due to its high gap-phase-replacement-potential, which will allow it to take advantage of canopy openings as the veteran trees die (Runkle, 1984). Slippery elm, though presently the most important species in the seedling, sapling and 10-20-cm diameter class, will probably not become an important canopy component due to Dutch elm disease, which will continue to limit its importance in the woods.

The layered structure of the understory suggests that the woods was heavily grazed before it was purchased as buffer for the reservoir. Also the presence of many thorny species in the relatively dense understory is an indication of a more open woods and of past grazing. The presence of cut stumps indicates that this woods was selectively cut just before purchase. The relatively even distribution of woody species, particularly white oak, in the 30+ cm diameter classes indicates a history of selective cutting throughout most of the past century. Since the cessation of grazing and cutting after protection in the mid 1960's, the forest canopy has closed, and a dense understory has developed.

Sullivan Woods is similar to the upland forest at the Rocky Branch Nature Preserve, Clark County, Illinois (Hughes and Ebinger 1973), and the upland forest at Walnut Point State Park, Edgar County, Illinois (Ebinger *et al.* 1977). These forests of the Grand Prairie Natural Division are on upland sites associated with rivers or large streams, have been disturbed in the past by cutting and grazing before protection, are dominated by white oak, have hickories as an important component, and have few mesic species except in the seedling, sapling, and smaller diameter classes. With canopy closure these woods are becoming more mesic, and sugar maple, slippery elm, American ash, and other shade-tolerant, fire-intolerant, mesophytic species will continue to increase in importance. Without management to keep the canopy open and to decrease the extent of the dense understory, Sullivan Woods, within the next 50 years, will become a maple/oak/hickory forest. As this occurs its woody composition will become similar to that found in Baber Woods Nature Preserve, Edgar County, Illinois, which is presently dominated by sugar maple (McClain and Ebinger 1968, Newman and Ebinger 1985).

LITERATURE CITED

Boggess, W. R. 1964. Trelease Woods, Champaign County, Illinois: woody vegetation and stand composition. Trans. Ill. St. Acad. Sci. 57:261-271.

Boggess, W. R. and J. W. Geis. 1966. Funk's Forest Natural Area, McLean County, Illinois: woody vegetation and ecological trends. Trans. Ill. St. Acad. Sci. 59:123-133.

Ebinger, J. E. 1986. Sugar maple, a management problem in Illinois forests? Trans. Ill. St. Acad. Sci. 79(1 & 2):25-30.

Ebinger, J. E., P. E. Phillippe, and L. R. Phillippe. 1977. Woody vegetation of an upland forest in Douglas County, Illinois. Castanea 42:285-293.

Hughes, J. T. and J. E. Ebinger. 1973. Woody vegetation survey of Rocky Branch Nature Preserve, Clark County, Illinois. Trans. Ill. St. Acad. Sci. 66(3 & 4):44-54.

McClain, W. E. and J. E. Ebinger. 1968. Woody vegetation of Baber Woods, Edgar County, Illinois. Amer. Midl. Nat. 79:419-428.

McIntosh, R. P. 1957. The York Woods. A case history of forest succession in southern Wisconsin. Ecology 38:29-37.

Mohlenbrock, R. H. 1986. Guide to the vascular flora of Illinois. Southern Ill. Univ. Press, Carbondale and Edwardsville, IL.

Newman, J. A. and J. E. Ebinger. 1985. Woody vegetation of Baber Woods: composition and change since 1965. Pages 178-180 in J. O. Dawson and K. A. Majerus, eds. Fifth Central Hardwood Forest Conference. Society of American Foresters Publication 85-05. Dept. of Forestry, Univ. of Illinois at Urbana-Champaign.

Rodgers, C. S. and R. C. Anderson. 1979. Presettlement vegetation of two prairie peninsula counties. Bot. Gaz. 140:232-240.

Runkle, J. R. 1984. Development of woody vegetation in treefall gaps in a beech-sugar maple forest. Holarctic Ecology 7:157-164.

Schwegman, J. E. 1973. Comprehensive plan for the Illinois nature preserves system. Part 2. The natural divisions of Illinois. Illinois Nature Preserves Commission, Rockford, IL.

Table 1. Densities (#/ha), diameter classes, basal areas (m^2/ha), relative densities, relative dominances, importance values (IV), and average diameters of the tree species in Sullivan Woods, Moultrie County, Illinois.

Species	Seedlings #/ha		Saplings #/ha	Diameter Classes(cm) #/ha						Basal Area m^2/ha	Rel. Den.	Rel. Dom.	IV	Av. Diam. (cm)
	<40cm	>40cm		10-20	20-30	30-40	40-50	50+	Total					
Quercus alba L.	750	125	3.8	7.6	10.0	20.0	24.0	30.8	92.4	15.7	36.7	64.6	101.3	43.6
Carya ovata (Mill.) K. Koch	880	413	31.3	8.4	7.6	12.4	6.2	0.8	35.4	2.8	14.0	11.6	25.6	29.8
Acer saccharum Marsh.	500	325	73.8	24.6	5.8	0.4	0.4	0.2	31.4	0.7	12.5	3.1	15.6	15.9
Ulmus rubra Muhl.	9630	4963	368.8	32.4	1.0	--	--	--	33.4	0.5	13.3	2.0	15.3	13.1
Carya glabra (Mill.) Sweet	3000	363	7.5	1.2	2.4	3.4	3.4	1.8	12.2	1.5	4.8	6.0	10.8	37.4
Quercus velutina Lam.	630	150	12.5	3.2	0.4	0.2	0.6	2.6	7.0	0.9	2.8	3.6	6.4	33.3
Carya tomentosa (Poir.) Nutt.	130	300	51.3	2.0	2.8	2.4	1.4	0.2	8.8	0.7	3.5	2.7	6.2	28.7
Quercus rubra L.	--	13	10.0	0.8	0.4	0.2	0.4	2.2	4.0	0.8	1.6	3.2	4.8	44.7
Fraxinus americana L.	880	475	25.0	5.0	0.2	--	--	--	5.2	0.1	2.1	0.4	2.5	14.5
Carya ovalis (Wang.) Sarg.	380	138	6.3	--	--	1.0	1.2	--	2.2	0.3	0.9	1.2	2.1	40.1
Prunus serotina Ehrh.	2000	338	46.3	4.0	0.6	--	--	--	4.6	0.1	1.8	0.3	2.1	13.9
Celtis occidentalis L.	130	175	10.0	2.8	0.2	--	--	--	3.0	0.1	1.2	0.2	1.4	12.9
Ulmus americana L.	130	163	47.5	3.0	--	--	--	--	3.0	0.1	1.1	0.2	1.3	12.6
Cercis canadensis L.	1000	100	71.3	2.6	--	--	--	--	2.6	0.1	1.0	0.1	1.1	11.2
Sassafras albidum (Nutt.) Nees	630	75	36.3	2.2	--	--	--	--	2.2	0.1	0.9	0.1	1.0	11.3
Others*	880	590	71.3	2.6	0.8	1.2	--	--	4.6	0.1	1.8	0.7	2.5	--
Totals	21,550	8706	873.0	102.4	32.2	41.2	37.6	38.6	252.0	24.6	100.0	100.0	200.0	

* Includes *Carya cordiformis* (Wang.) K. Koch, *Juglans nigra* L., *Ostrya virginiana* (Mill.) K. Koch, *Morus rubra* L., *Crataegus mollis* (Torr. & Gray) Scheele, and *Quercus imbricaria* Michx.

Table 2. Density (stems/ha) of seedlings and mature stems of shrubs in Sullivan Woods, Moultrie County, Illinois.

Species	Seedlings <40 cm tall	Mature Stems >40 cm tall
Rubus allegheniensis Porter	5750	700
Toxicodendron radicans (L.) Kuntze	4125	363
Symphoricarpos orbiculatus Moench	1250	363
Ribes missouriense Nutt.	1000	475
Cornus racemosa Lam.	250	200
Viburnum prunifolium L.	125	50
Corylus americana Walt.	125	38
Rosa carolina L.	1000	--
Euonymus atropurpurea Jacq.	--	38
Rubus occidentalis L.	--	25
Totals	13,625	2252

Additions to the Flora of Ford County, Illinois

Don Gardner

Rt 2 Box 110
Kempton, IL 60946

Organized in east central Illinois in 1859, Ford was the last county to be established in the state. One would have expected that during the past century and one half virtually all of the plant species within the county would have been documented. Such, however, is not the case.

The Illinois Natural History Survey (INHS) provided the author a list of 480 taxa for Ford County from the Illinois Plant Information Network (ILPIN) data base. Numerous species known to occur in Ford County were missing from this list. During 1990, a search for unrecorded species was initiated. Voucher specimens were collected and deposited at the Illinois Natural History Survey Herbarium. Some proved to be interesting native plants such as *Lathyrus palustris* L. (marsh vetchling), *Polygala sanguinea* L. (field milkwort), and *P. verticillata* L. (whorled milkwort). Others were previously overlooked exotic weedy species, such as *Malva neglecta* Wallr. (common mallow) and *Mollugo verticillata* L. (carpet weed). One, *Carex hirta* L., is an addition to the state flora. All fill a gap in information about the plants of Illinois.

It is quite likely that there are significant numbers of species not recorded in other Illinois counties by ILPIN. Interested individuals are encouraged to check the data base for their county and to document prospective county records.

Collected specimens should be pressed in printed or unprinted newspaper and, if available, dried between blotters and cardboard ventilators. Information concerning description of the location (township, range, section, etc.), habitat, collector(s), collection number, and date of collection should be recorded. After drying, the specimens can be delivered to one of the herbaria in the state, such as the Illinois Natural History Survey. The identification will be confirmed, the specimen placed on file, and the new information added to the ILPIN data base.

For those not familiar with the preparation of herbarium specimens there is an excellent description of the procedure in INHS Circular 55, "Observing, Photographing and Collecting Plants" by Dr. Kenneth R. Robertson. It is available from INHS, 607 E. Peabody Dr., Champaign IL 61820. Keep in mind that when collecting plant specimens, permission from private land owners is necessary. Permits are required by some agencies such as County Forest Preserve Districts and National Forests. To apply for permits to these types of agencies, write or call their supervisors for the proper referral or procedure.

The era is long past when adventurous plant hunters roamed the West, sending large collections of previously unidentified plants to herbaria in the East and in Europe. However, it is still possible to capture a bit of that sense of discovery. It is hoped that others will join the search and that new plant records will be added to the listings in other counties.

There follows a list of thirty-five plant species recently added to the ILPIN data base for Ford County. Taxonomy follows Mohlenbrock (1986) except for *Carex hirta* (Gleason, 1952), *Aster lanceolatus* var. *simplex* (Jones, 1989), and *Euphorbia dentata* (Swink and Wilhelm, 1979).

NEW FORD COUNTY PLANT RECORDS

HABITATS, LOCATIONS, COLLECTION DATES AND COLLECTION NUMBERS

Alliaria petiolata (Bieb.) Cavara & Grande
Shaded ditch margin, low but increasing population
SW 1/4 NE 1/4 Sec 6 T28N-R9E
5 May 1990
#3

Anemone cylindrica Gray
Embankment, abandoned railroad right-of-way, numerous in restricted area
NW 1/4 NE 1/4 Sec 29 T29N-R9E
13 June 1990
#12

Antennaria neglecta Greene
Mowed cemetery, large population
NW 1/4 Sec 15 T28N-R9E
23 Apr 1990
#1

Asclepias viridiflora Raf.
Ballast, abandoned railroad right-of-way, infrequent
NW 1/4 NE 1/4 Sec 29 T29N-R9E
23 June 1990
#14

Aster laevis L.
Operating railroad right-of-way, scattered among other prairie taxa
SW 1/4 SW 1/4 Sec 15 T25N-R9E
25 Oct 1990
#30

Aster lanceolatus Willd. var. ***simplex*** (Willd.) A.G. Jones
Dense population in hedgerow of *Maclura pomifera* (Raf.) Schneider
NW 1/4 NW 1/4 Sec 8 T28N-R9E
17 Sept 1990
#29

Carex annectens Bickn.
Old field, former pasture, numerous
SW1/4 NW1/4 NE1/4 Sec 6 T28N-R9E
5 June 1991
#94

Carex hirta L.
Roadside, ditch margin, single dense population
SEl/4 NE1/4 NW1/4 Sec 6 T28N-R9E
22 May 1991
#49

Dichanthelium acuminatum (Sw.) Gould & Clark
Old field, former pasture, frequent
NW 1/4 NE 1/4 Sec 6 T28N-R9E
18 June 1990
#13

Eleocharis verrucosa (Svens.) Harms
Old field, former pasture, numerous
SW1/4 NW1/4 NE1/4 Sec 6 T28N-R9E
24 May 1991
#48

Ellisia nyctelea L.
Farm woodlot, fertile soil, low population
NW1/4 NW1/4 Sec 8 T28N-R9E
7 May 1991
#53

Erysimum cheiranthoides L.
Stable ditch margin, thinly scattered
SW1/4 NW1/4 NE1/4 Sec 6 T28N-R9E
11 May 1991
#59

Euphorbia dentata Michx.
Limestone ballast on abandoned railroad embankment, infrequent
NW 1/4 NE 1/4 Sec 29 T29N-R9E
25 Aug 1990
#22

Euphorbia marginata Pursh
Disturbed margin of wooded former village landfill, infrequent
NW 1/4 NE 1/4 Sec 6 T28N-R9E
14 Aug 1990
#19

Galinsoga quadriradiata Ruiz & Pavon
Recently cleared farm building site, common
NE 1/4 NE 1/4 Sec 19 T28N-R9E
21 Aug 1990
#21

Hypoxis hirsuta (L.) Coville
Abandoned railroad right-of way, low population among prairie species
NW 1/4 NE 1/4 Sec 29 T29N-R9E
17 May 1990
#4

Ipomoea hederacea (L.) Jacq.
Disturbed field margin, common
SW1/4 NW1/4 NE1/4 Sec 6 T28N-R9E
7 Aug 1991
#172

Lathyrus palustris L.
Low area, abandoned railroad right-of-way, locally rare
NW 1/4 NE 1/4 Sec. 29 T29N-R9E
13 June 1990
#11

Lithospermum arvense L.
Disturbed ballast, abandoned railroad right-of-way, uncommon
NW 1/4 NE 1/4 Sec 29 T29N-R9E
28 Apr 1990
#2

Lonicera tatarica L.
Wooded former village landfill, frequent
NW 1/4 NE 1/4 Sec 6 T28N-R9E
26 May 1990
#7

Malva neglecta Wallr.
Former barnyard, common
NW 1/4 NE 1/4 Sec 6 T28N-R9E
11 Sept 1990
#25

Mollugo verticillata L.
Invasive on tilled soil, common
NW 1/4 NE 1/4 Sec 6 T28N-R9E
15 Aug 1990
#20

Physalis heterophylla Nees.
Cultivated field margin, common
SE1/4 NE1/4 NW1/4 Sec 6 T28N-R9E
8 June 1991
#112

Phytolacca americana L.
In hedgerow of *Maclura pomifera*, thinly scattered population
NW 1/4 NW 1/4 Sec 8 T28N-R9E
21 July 1990
#17

Polygala sanguinea L.
Old field, untilled former pasture, low population restricted to site
NW 1/4 NE 1/4 Sec 6 T28N-R9E
17 July 1990
#16

Polygala verticillata L.
Old field, untilled former pasture, locally rare
NW 1/4 NE 1/4 Sec. 6 T28N-R9E
14 Aug 1990
#18

Rosa multiflora Thunb.
Roadside ditch bank, common
E 1/2 SE 1/4 Sec 6 T28N-R9E
12 June 1990
#10

Sida spinosa L.
Cultivated farm field, common
NE1/4 NE1/4 Sec 8 T28N-R9E
8 Aug 1991
#173

Silene noctiflora L.
Wooded former village landfill, infrequent
NW 1/4 NE 1/4 Sec 6 T28N-R9E
26 May 1990
#5

Solanum americanum Mill.
Aggressively weedy on margin of tilled field, abundant
NW 1/4 Sec 8 T28N-R9E
8 Sept 1990
#24

Solanum dulcamara L.
Vining on *Lonicera tatarica* hedge row
SE 1/4 NE 1/4 NW 1/4 Sec 6 T28N-R9E
16 Sept 1990
#27

Solidago graminifolia (L.) Salisb.
Operating railroad right-of-way with other *Solidago* species
SW 1/4 SW 1/4 Sec 6 T28N-R9E
7 Sept 1990
#23

Sonchus asper (L.) Hill
Ditch bank, frequent
NW 1/4 NW 1/4 Sec 8 T28N-R9E
2 July 1990
#15

Sporobolus asper (Michx.) Kunth.
Dry slope on railroad right-of-way, thinly scattered population
SE 1/4 SW 1/4 NW 1/4 Sec 6 T28N-R9E
16 Sept 1990
#28

Sporobolus heterolepis (Gray) Gray
Prospect Cemetery, numerous on site among mesic prairie associates
SW 1/4 SW 1/4 SW 1/4 Sec 17 T23N-R9-10E
27 Oct 1990
#31

ACKNOWLEDGMENTS

Appreciation is given to W. Clark Ashby, William Hess, Kenneth R. Robertson, and Elizabeth L. Shimp for their thoughtful comments and suggestions on a version of this paper.

LITERATURE CITED

Gleason, Henry A. 1952. The New Britton & Brown Illustrated Flora of the Northeastern United States and adjacent Canada, vol. 1. New York Botanical Garden, N.Y. 482 pp.

Jones, Almut G. 1989. *Aster* and *Brachyactis* in Illinois. Illinois Natural History Survey Bulletin. vol. 34. 194 pp.

Mohlenbrock, Robert H. 1986. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale. 508 pp.

Swink, Floyd & Gerould Wilhelm. 1979. Plants of the Chicago Region. The Morton Arboretum, Lisle, IL. 922 pp.

Changes in Illinois' List of Endangered and Threatened Plant Species

James R. Herkert

Illinois Endangered Species Protection Board
524 South Second Street
Springfield, IL 62701

and

Glen Kruse

Illinois Department of Conservation
524 South Second Street
Springfield, IL 62701

ABSTRACT

During 1989 and 1990 the Illinois Endangered Species Protection Board reviewed and updated the Illinois list of endangered and threatened plant species. This review resulted in a number of status changes for plants, the results of which are summarized in this report. Thirty-five species were added to the list, 43 species were removed from the list, 6 species had their status changed from endangered to threatened, and 3 species had their status changed from threatened to endangered. The net decrease of 8 species brings the total of endangered and threatened plant species in Illinois to 356 (296 endangered and 60 threatened). Persons wishing to obtain a complete listing of Illinois endangered and threatened species should contact the Illinois Endangered Species Protection Board, 524 South Second Street, Springfield, Illinois 62701. A listing of some pertinent references is given at the end of this paper.

SPECIES ADDED TO THE LIST

There were three primary reasons for adding species to the list during the recent revisions. Fifteen species were newly discovered in Illinois. Seven species were either thought to be extirpated or of unknown status and had been recently rediscovered in Illinois. Thirteen species were added on the basis of the availability of new information on the status of particular species. Several types of new information were considered, including the new identification of previously collected specimens and new information on species declines or rarity within Illinois. A listing of the 35 species added to the list follows. The status of each species is also given as LE - listed as endangered or LT - listed as threatened. Primary reasons for addition are also given (ND = newly discovered in Illinois, NI = new information regarding species status within Illinois, RD = recently rediscovered within Illinois).

Species	Status	Reason
Amelanchier sanguinea (Pursh) DC.	LE	ND
Aster furcatus Burgess	LT	NI
Astragalus crassicarpus Nutt. var. *trichocalyx* (Nutt.) Barneby	LE	RD
Besseya bullii (Eat.) Rydb.	LT	NI
Boltonia decurrens (Torr. & Gray) Wood	LT	NI
Carex brunnescens (Pers.) Poir.	LE	ND

Carex canescens L. var. *disjuncta* Fern.	LE	ND
Carex chordorrhiza L. f.	LE	RD
Carex echinata Murr.	LE	NI
Carex tuckermanii Boott	LE	ND
Carex willdenowii Schkukr	LE	ND
Cimicifuga americana Michx.	LE	NI
Cirsium pitcheri (Torr. & Eat.) Torr. & Gray	LT	NI
Clematis occidentalis (Hornem.) DC.	LE	ND
Collinsia violacea Nutt.	LE	NI
Corydalis curvisiliqua Engelm. var. *grandibracteata* (Fedde) Ownbey	LT	RD
Corylus cornuta Marsh.	LE	ND
Cyperus grayioides Mohlenbr.	LT	NI
Cystopteris laurentiana (Weath.) Blasd.	LE	NI
Equisetum scirpoides Michx.	LE	RD
Equisetum sylvaticum L.	LE	ND
Erythronium mesochoreum Knerr	LE	ND
Gymnocarpium robertianum (Hoffm.) Newm.	LE	ND
Liatris scariosa (L.) Willd. var. *nieuwlandii* Lunell	LT	NI
Lonicera dioica L. var. *glaucescens* (Rydb.) Butters	LE	ND
Milium effusum L.	LE	RD
Mirabilis hirsuta (Pursh) MacM.	LE	NI
Opuntia fragilis (Nutt.) Haw.	LE	RD
Oxalis illinoensis Schwegman	LE	NI
Penstemon brevisepalus Pennell	LE	ND
Rosa acicularis Lindl.	LE	ND
Silphium trifoliatum L.	LE	ND
Tomanthera auriculata (Michx.) Raf.	LT	NI
Vaccinium oxycoccos L.	LE	ND
Valerianella chenopodifolia (Pursh) DC.	LE	ND

SPECIES REMOVED FROM THE LIST

There were four main reasons for removing plants from the state list. Twenty-seven species were removed because they are now believed to be extirpated from Illinois. Five species are now known to be too common within Illinois to warrant listing as either endangered or threatened. Ten species were removed from the list because further study indicated that the specimens were initially misidentified and the species are now not believed to occur in Illinois. One species was determined to be adventive. In some cases there were multiple reasons for removing plants from the list. For example, a plant in which recent collections were misidentified, and in which other collections were very old might be listed as EX/MI. RE indicates removed from endangered, RT removed from threatened. Primary reasons for delisting are also given (EX = extirpated within Illinois, TC = considered too common to remain listed, MI = misidentification, AD = adventive).

Species	Status	Reason
Aralia hispida Vent.	RE	EX
Aristida necopina Shinners	RE	EX/MI
Bacopa acuminata (Walt.) Robins.	RE	EX/AD
Baptisia tinctoria (L.) Vent.	RE	EX
Carex cumulata (Bailey) Fern.	RE	EX
Carex plantaginea Lam.	RE	EX
Cinna latifolia (Trev.) Griseb.	RE	EX
Cladium mariscoides (Muhl.) Torr.	RT	TC

Daucus pusillus Michx.	RE	EX/AD
Dodecatheon amethystinum Fassett	RE	TC
Eleocharis equisetoides (Ell.) Torr.	RE	EX/MI
Eleocharis parvula (Roem. & Schult.) Link	RE	AD
Equisetum palustre L.	RE	EX/MI
Fuirena scirpoides Michx.	RE	EX
Geum rivale L.	RE	EX
Glyceria canadensis (Michx.) Trin.	RE	EX
Gnaphalium macounii Greene	RE	EX
Habenaria hookeri Torr.	RE	EX
Hydrastis canadensis L.	RT	TC
Hypericum boreale (Britt.) Bickn.	RE	MI
Lycopus amplectens Raf.	RE	MI
Onosmodium molle Michx.	RE	EX
Oxalis grandis Small	RE	MI
Panax quinquefolius L.	RT	TC
Panicum hians (Ell.) Nash	RE	MI
Panicum mattamuskeetense Ashe	RE	MI
Panicum nitidum Lam.	RE	MI
Paspalum lentiferum Lam.	RE	EX/MI
Philadelphus pubescens Loisel.	RE	EX
Phlox carolina L. ssp. *angusta* Wherry	RE	EX/MI
Physostegia intermedia (Nutt.) Engelm. & Gray	RE	MI
Plantago heterophylla Nutt.	RE	EX
Polygonum bicorne Raf. (formerly *P. longistylum* Small)	RE	TC
Pyrola secunda L.	RE	EX/MI
Ranunculus ambigens Wats.	RE	EX/MI
Rhynchospora macrostachya Torr.	RE	EX/MI
Rorippa truncata (Jepson) Stuckey	RE	EX/AD
Scirpus microcarpus Presl	RE	EX
Scirpus pedicellatus Fern.	RE	EX
Solidago remota (Greene) Friesner	RE	MI
Stachys clingmanii Small	RE	MI
Valerianella intermedia Dyal	RE	MI
Woodwardia virginica (L.) Sm.	RE	EX

SPECIES WITH A CHANGE IN STATUS

Species Changed From Endangered To Threatened

Aristolochia serpentaria L. var. *hastata* (Nutt.) Duchartre
Carex atherodes Spreng.
Carex crawei Dewey
Cirsium carolinianum (Walt.) Fern. & Schub.
Polygonatum pubescens (Willd.) Pursh
Rubus pubescens Raf.

Species Changed From Threatened To Endangered

Asplenium resiliens Kunze

Planera aquatica (Walt.) J. F. Gmel.
Polanisia jamesii (Torr. & Gray) Iltis

NOMENCLATURAL CHANGES

Former name	New name
Betula lutea Michx. f.	*Betula alleghaniensis* Britt.
Fimbristylis baldwiniana (Schultes) Torr.	*Fimbristylis annua* (All.) Roem. & Schult.
Polygonum longistylum Small	*Polygonum bicorne* Raf. (later de-listed)
Scleria reticularis Michx.	*Scleria muhlenbergii* Steud.

ACKNOWLEDGMENTS

We are indebted to a great many people who helped in various ways during the Board's most recent list revision. In particular the field work of Marlin Bowles and his colleagues (Bowles *et al.* 1991), John Schwegman, and the Illinois Department of Conservation's Natural Heritage Biologists were particularly helpful in making list revisions. Technical Advisory Committee Members John Ebinger, Alfred Koelling, Robert Mohlenbrock, Kenneth Robertson, John Schwegman, and Paul Sorensen, Technical Advisory consultant Marlin Bowles, and Jean Karnes provided a great deal of assistance in developing list revision recommendations for the Board. Kenneth Robertson, John Taft, and Susan Lauzon provided helpful comments on earlier versions of the manuscript.

REFERENCES

Bowles, M.L., G. Wilhelm, and S. Packard. 1988. The Illinois status of *Liatris scariosa* (L.) Willd. var. *nieuwlandii* Lunell, a new threatened species for Illinois. Erigenia 10:1-26.

Bowles, M.L. 1991. Some aspects of the status and ecology of seven rare wetland plant species in the Chicago region of northeastern Illinois. Erigenia 11:52-66.

Bowles, M.L., J.B. Taft, E.F. Ulaszek, M.K. Solecki, D.M. Ketzner, L.R. Phillippe, A. Dennis, P.J. Burton, and K.R. Robertson. 1991. Rarely seen endangered plants, rediscoveries, and species new to Illinois. Erigenia 11:27-51.

Colin, G., L. Marty, P. Shildneck, and S. Tyson. 1987. New plant records for Illinois vascular plants. Transactions of the Illinois State Academy of Science 80:169-181.

Evert, E.F. 1988. New distribution records for the vascular flora of northern Illinois. Erigenia 10: 28-37.

Herkert, J.R. editor. Endangered and threatened species of Illinois: status and distribution, Volume 1 - Plants. Illinois Endangered Species Protection Board, Springfield, IL 158 pp.

Mohlenbrock, R.H. 1983. Additions to the illustrated flora of Illinois II. Ferns. Erigenia 3:23-52.

Mohlenbrock R.H. and L.R. Stritch. 1985. The genus *Penstemon* (Scrophulariaceae) in Illinois. Erigenia 6:5-16.

Peck, J.H. 1982. Ferns and fern allies of the driftless area of Illinois, Iowa, Minnesota, and Wisconsin. Contributions in Biology and Geology, Milwaukee Public Museum No. 53.

Robertson, K.R., W.E. McClain, and A.C. Koelling. 1983. First confirmation of *Erythronium mesochoreum* (Liliaceae) east of the Mississippi River. Castanea 48:146-150.

Schwegman, J.E. 1982a. Additions to the vascular flora of Illinois. Castanea 47:243-247.

Schwegman, J.E. 1982b. A new species of *Oxalis*. Phytologia 50:463-467.

Schwegman, J.E. 1984. *Scirpus mucronatus* and *Valerianella chenopodifolia* in Illinois. Transactions of the Illinois State Academy of Science 77:67-68.

Schwegman, J.E. 1990. Preliminary results of a program to monitor plant species for management purposes. Pages 113-116 *in* Ecosystem Management: Rare species and significant habitats. New York State Museum Bulletin 471.

Schwegman, J.E. 1991. New records for Illinois vascular plants. Erigenia 11:9-12.

Schwegman, J.E. and R.W. Nyboer. 1985. The taxonomic and population status of *Boltonia decurrens* (Torr. & Gray) Wood. Castanea 50:112-115.

Taft, J.B. and M.K. Solecki. 1987. *Carex brunnescens* in Illinois. Transactions of the Illinois State Academy of Science 80:345-346.

Taft, J.B. and M.K. Solecki. 1990. Vascular flora of the wetland and prairie communities of Gavin Bog and Prairie Nature Preserve, Lake County, Illinois. Rhodora 92:142-165.

Iliamna remota: An Illinois Native Returns Home

Larry R. Morrison[1]

110 Virginia Ave.
O'Fallon, Illinois 62269

Kankakee Mallow (*Iliamna remota* Greene) is a perennial herbaceous plant of the mallow family (Malvaceae). It grows to a height of six to seven feet; has leaves that are simple, alternate, lobed and toothed; and produces flowers that have five pale lavender-pink petals and a slightly sweet aroma. In Illinois, this mallow has been listed by the Illinois Endangered Species Protection Board as an endangered species and certified as such by Administrative Order of the Illinois Department of Conservation in April 1980. Nationally, the species is currently under review for listing under the federal Endangered Species Protection Act as in danger of extinction throughout its range.

In Illinois, this mallow occurs naturally at only one location, Langham Island in the Kankakee River, Kankakee County. It is also found at a few other scattered localities in the eastern United States. The current consensus among botanists, however, is that the locations other than the Kankakee site were probably started by plant lovers in the past, trying to expand the range of this rare and interesting species. One such non-Illinois location is along a railroad right-of-way in Botetourt County, Virginia.

A few years ago, a couple belonging to the Virginia Wildflower Preservation Society collected some Kankakee Mallow seeds from this Botetourt County site. My friends explained: "We would not normally take seeds from an endangered species but these plants had spread to a roadway where one plant had been run over and was beginning to wilt; therefore, we felt justified in taking one seed pod." They were able to get some of these seeds to germinate, and now have a flourishing colony of Kankakee Mallows in their wildflower garden in Roanoke, Virginia.

In January 1988, they sent me a handful of seeds and some very general instructions: "Plant now and winter in the ground." The Kankakee Mallow seed pod is a small, round receptacle which can be up to 1/2 inch in diameter. The pod is flattened on both ends, very hairy, and dark brown when ripe. The individual seeds are small (about 1/16 inch), dark brown, hard, and flat. Examined closely, they look like the beginning loop of a spiral.

At the time I was given these seeds, I knew very little about *Iliamna remota*, so I experimented with various techniques and garden locations, trying to discover an approach that would be successful. On January 16th, I sowed a quarter of the seeds (about four dozen) directly into several patches that I had prepared in different parts of the garden. Another quarter of the seeds was placed in plastic planting trays which were filled with a mixture of commercial potting soil and vermiculite. These trays were placed in a corner of the garden where they would not be disturbed. The remainder of the seeds were placed in the refrigerator as a back-up reserve.

The winter of 1988 was relatively mild, which may have affected the rate and time of germination, but on May 14th I noticed the first mallow seedlings in the plastic trays. There was a fairly good germination rate from the trays, resulting in about three dozen plants. On May 21st, the largest seedlings began producing their first true leaves and I transplanted the first plant directly into the garden in a location where it would receive full sun.

Over the next two weeks, I transplanted six other seedlings into the garden but under partial shade conditions. At the end of May, I offered the rest of the plants to the Missouri Botanical Garden with only one condition attached: If my own plants did not survive, I wanted at least one of the donated plants back. This offer was quickly accepted, even with my caveat. According to the latest information

[1]Dr. Morrison is an historian for the Air Force, but also very interested in our native flora.

that I have received (June 1992) the plants at the botanical garden were doing well and flowering.

On June 4th a few plants from seeds sown directly into my garden sprouted, but were promptly eaten by something. The transplanted seedlings adjusted well, but the one planted in full sun did the best. Throughout the summer there was only some slight insect damage: An occasional leaf edge eaten or the tracings left by a leaf miner. I had a fairly regular regimen of watering the garden because of the 1988 drought, so the lack of moisture should not have seriously affected the plants in my garden.

In early August I noticed flower buds appearing in the crown of the first plant, which was then about 2 1/2 feet tall. The first bloom opened on August 12th. The flower nearest the base of the plant opened first, with the others following in a set sequence of about one day after the preceding bloom faded. There was a total of five blossoms, all in the crown of the plant. Each one lasted about 2 1/2 days. I was surprised that any plant bloomed that first year, but the only one to bloom was the first seedling which had been transplanted into full sunlight. In the times I observed the plant, I did not see any flying insects visiting the blossoms, but small ants were often present, especially around the stamens clustered in the center of the flower. None of the flowers set seed that first year.

Despite early freezing temperatures and two inches of snow on November 20th, the mallows in 1988 were not killed until December 11th, when the temperature fell into the teens. That first year, none of the plants in my garden reached anywhere near the average height of five feet which they achieve in their native habitat. I assume this was because of the age of the plants rather than a reflection of the growing conditions. At the time the plants were killed by the freeze, the tallest plant was 29 inches, the shortest 11 inches. Interestingly, the size correlated exactly with the order the plants were transplanted; *i.e.*, the one transplanted first was the tallest; the last one was the shortest.

In early January 1989, I once again filled the plastic trays with a mixture of potting soil and vermiculite, sowed the reserve mallow seeds from 1988, and placed the trays in the same corner of the garden that had worked so effectively in 1988. Contrary to the experience of others, my germination rate was not as good the second year when less than half the seeds sprouted, but I still got several plants. I discovered later that in his work with *Iliamna remota*, John Schwegman has found that if the seeds are either scarified or soaked in warm water for 24 hours, there is a much better chance for germination.

In 1989, I put only one of the new plants in my own garden. I offered the rest to the Illinois Department of Conservation, hoping these plants might provide a little genetic diversity to the population on Langham's Island. A transfer of plants could never be arranged, but later the DOC did accept some seeds from my plants.

In corresponding with the Department of Conservation, I learned that the plan was not to intermix these non-Illinois origin plants with the ones on Langham's Island, but, instead, for comparison's sake, to grow representatives from the two populations near each other in a test plot.

By mid-February '89, perhaps because of the mild winter, small green rosettes were already appearing at the base of the mallow in the sunniest location of the garden. By late March all of the mallows were sending up new growth. In mid-April all the mallows seemed to be doing fine, but by the end of the month half of the older plants had died. I suspect that root rot brought about by heavy, wet, compacted soil caused this mortality. The other plants continued to do well.

The oldest plant, the one receiving full sunlight, always did the best. By mid-May, this plant had four stems, each about one foot tall, and already had small buds forming in the crown of each stem. On June 8th, four of the blossoms on the main stems opened. By the same time, the plant was also sending out lateral branches from these primary stems. Within a month, the other two-year-old plant was also flowering. Both plants bloomed prolifically all summer, often with six to eight flowers on the same branch open at once. By late summer, the number of new blossoms was greatly reduced, but one plant continued to bloom into early September.

At various times during the summer, these blossoms were visited by small bees and wasps, gnats, and ants. However, considering the large number of blooms available, a surprisingly small number actually produced seeds. I wonder if poor seed production contributes to the rarity of this species? I collected the first ripe seeds on August 14th; the last ripe pod in early October. The two flowering two-year-old plants produced a total of only 26 ripened seed pods for the year. I gave all of these seed pods to the Illinois Department of Conservation, so I do not know whether there were, indeed, any truly viable seeds produced from my plants in 1989.

As in 1988, there was some small damage to the leaves by leaf miners in 1989, but no major problems. Indeed, the plants did quite well, especially the one in full sun. By the end of the year, when killed by temperatures in the teens in early December, the longest stem of that plant was 73 inches tall.

Except for a brief, brutal cold spell (-16 degrees Fahrenheit) in December, the winter of 89-90 was a mild, but dry one. Several times in January, the temperature was over 60 degrees. By the end of January, all the mallows were sending up new growth. Those plants in the full sun had expanded tremendously, and even the most shaded plant had more than doubled the number of stems. The oldest, largest, and healthiest specimen even produced a small plant, I assume by underground runner, some ten inches from the parent plant.

With one major exception, the story of 1990 was very similar to the earlier two years. The first bloom opened on June 10th; all the older plants were blooming by the end of June; even the new runner-produced plant bloomed in late August. The plants bloomed all summer, with the last flower opening on September 22nd. As in past years, the plants suffered very little insect damage. The tallest plant was 82 inches high when hit by killing temperatures in early December.

The critical exception in 1990 was with the oldest, and heretofore largest and healthiest, plant. It grew and bloomed normally until mid-June when the leaves on one of the stems began to wilt. Initially, I thought it was simply a case of not enough water, but increased watering did not help. The leaves continued to wilt, eventually turned brown and withered completely, then the stem itself finally died. Over the next few weeks, this condition spread to all the other stems of this plant. I could find nothing in the literature about diseases which affect *Iliamna remota*, so I have no answer as to what caused the problem. I cut all the dead stems off at ground level, hoping this might act as a preventive measure for the plants close by. For whatever reason, the other Kankakee Mallows growing nearby were not affected in 1990, but the next year the plant produced by runner from the diseased plant exhibited some of the same symptoms. Two stems from this plant wilted and died in late May, and the other stems showed some of the early leaf wilting problems, but then recovered. The plant grew slowly in 1991, but did begin blooming in early June, and by July had apparently beaten the problem. All the other mallows remained healthy, and continued to expand the number of blooming stems.

By 1990, I had Kankakee Mallows growing in two different locations in my garden. At one site, the mallows were basically by themselves. At the other location, however, a Kankakee Mallow was merely one plant among a host of other summer-flowering perennials, such as Black-Eyed Susan, Purple Coneflower, Shasta Daisy, Butterfly Weed, Bee Balm, Painted Daisy, and Prairie Gayfeather. In both 1990 and 1991, the latter mallow, the one growing among other flowers, produced a much larger number of seed pods than the mallows growing by themselves. I have not conducted any scientific experiments, but my assumption is that pollinators were initially attracted to the showier plants, then visited the mallow flowers almost incidentally while in the area. The mallows standing alone, on the other hand, apparently did not have a large enough or attractive enough display, on their own, to attract a large number of pollinators in the first place, and thus had a smaller percentage of flowers pollinated.

Despite the deep compacted snow and ice which covered the garden for several days during the winter of 1990-91, by the end of February '91 new growth was already appearing at the base of all the mallows. Moreover, every plant had increased its number of stems. The healthy mallows followed the same basic growth and bloom patterns that they had experienced over the last three years, except they started blooming a little earlier in 1991. The first blooms opened on May 25th, and all the plants were flowering by June 7th. One plant was doing particularly well. By mid-June it had eight stems all over six feet tall, and with several lateral branches. At one point there were 18 blossoms open on one of these stems. By early July, when the initial draft of this article was written, there were even a few ripe seed pods ready. As in past years, the plants were finally killed by freezing temperatures in mid-winter.

In August 1992, when this final revision of this article was being prepared, the 1992 growing season had been a virtual repeat of the successful previous year. All the plants were doing well and producing seeds. Not only had the older plants grown additional stems from the old crowns, but three additional plants had been produced by underground runner. As before, the mallows growing with other, showier, plants were producing more seeds than those growing by themselves on the other side of the garden.

Based on my experiences, I assume that Kankakee Mallow, under normal conditions, would do well in any sunny garden with at least average soil. The only drawbacks to the plant for "normal" garden use are its height, and its tendency to look a little "weedy" by the end of the summer. However, its rarity, interesting blooms, and ease of cultivation more than make up for these weaknesses. More importantly, by growing a few plants in private gardens, we can help insure the species against extinction.

I cannot conclude without a brief comment regarding the ethics of seed collecting. Ideally, seeds should come from a friend or a seed exchange program that various organizations, such as the American Horticulture Society, run. If you must collect from the wild, do so very sparingly. The basic rule is do not overcollect. The Canadian Wildflower Society's guidelines, for example, state that no more than 10% of a wild seed crop should be collected. I think this figure is too high. It takes only a few people collecting their perceived 10% of the crop to wipe out a year's production. If you must collect from the wild, take just enough for your own immediate needs. Also you need to keep in mind that it is illegal to collect wild seeds from species on the federal endangered species list. For laws regarding the plants in your area, check with your local conservation officials.

REFERENCES

Schwegman, J. E. 1984. State of Illinois recovery plan for *Iliamna remota* Greene. Ill. Dept. of Cons., Springfield, IL. 20 pp.

Schwegman, J. E. 1988. The vascular flora of Langham Island, Kankakee County, Illinois. Erigenia 11:1-8.

Sherff, E. E. 1946. Notes on certain plants in the Gray's Manual range. Rhodora 48:89-98.

Sherff, E. E. 1949. Miscellaneous notes on dicotyledonous plants. Amer. J. of Bot. 36:499-511.

Strausbaugh, P. D. and E. L. Core. 1932. *Phymosia remota*. Rhodora 34:142-146.

Wadmond, S. C. 1932. *Phymosia remota* in captivity. Rhodora 34: 207-209.

Author's Addendum: Overall in 1990, I collected over 200 ripened seed pods. I offered additional seeds to the Illinois Department of Conservation but since I never received a reply to my letter, I assume that personnel there wanted no more non-Illinois origin mallow seeds. In both 1990 and 1991, I gave some seeds to friends, but still had seeds left over. I have also begun collecting seeds from 1992 and assume I shall have a continuous supply of seeds over the next few years. If anyone would like to try raising some Kankakee Mallows, just send me a stamped, self-addressed envelope. I shall share seeds as long as the supply lasts.

Status and Population Fluctuations of the Eastern Prairie Fringed Orchid [*Platanthera leucophaea* (Nutt.) Lindl.] in Illinois

Marlin Bowles and Robyn Flakne

The Morton Arboretum
Lisle, Ilinois 60532

and

Russ Dombeck

Northeastern Illinois University
Chicago, Ilinois 60625

ABSTRACT

Historically, the federal threatened eastern prairie fringed orchid [*Platanthera leucophaea* (Nutt.) Lindl.] reached its greatest abundance in Illinois, occurring in 33 counties throughout the northern two-thirds of the state. Most Illinois populations now occur in loess soils over glacial till or outwash in both upland and wetland habitats. Over a twelve-year period (1980-91), statewide censuses of all known populations ranged from 4 to 313 flowering plants, with plants appearing more consistently in wetland sites and during years of high rainfall. This suggests that wetland habitat may be critical in maintaining populations, and that long-term monitoring is needed to understand population dynamics better. Twenty-one populations are extant in Illinois, nineteen of which are in six Chicago-region counties. These populations represent a 75% decline in extant county records, and probably a far greater overall decline in total numbers of plants. Using an artificial viability index based on population size, habitat size, community successional stage, legal protection, and management needs, we concluded that only one Illinois population currently has high viability. Several other populations can be made highly viable through management and protection. We suggest that successful long-term management of Illinois populations will depend upon maintenance of late-successional prairie conditions, primarily through burning, and may also require artificial management for regeneration niches. Continued monitoring, both of populations and of individual plants, is needed to understand the interactions between prairie fringed orchids and their environment and to help guide management of this state endangered species.

INTRODUCTION

Monitoring of rare plants has become an important stewardship activity within the last decade as attention has been focused on the status, management needs, and recovery planning for state and federal listed species (Palmer 1987). Although annual census counts lack the precision of demographic techniques, they can gauge short-term and long-term population fluctuations, especially in relation to changing environmental conditions. Here, we summarize 12 years of census data for Illinois populations of the state endangered (Illinois Endangered Species Protection Board 1990) and federal threatened (U.S. Fish and Wildlife Service 1989) eastern prairie fringed orchid (*Platanthera leucophaea*). The 1990-91 data were gatherered in conjunction with fieldwork for the preparation of the federal recovery plan for this species, which provides range-wide recovery guidelines based on population and habitat status and management needs.

A primary objective of recovery planning was to catalog extant populations of *Platanthera leucophaea*, project their likelihood for long-term survival, and provide recommendations for increasing the viability of populations. We provide this information for Illinois populations and examine the relationship between precipitation, hydrology, and flowering over time in Illinois. The appearance of flowering prairie fringed orchids is erratic, and reportedly related to precipitation, fire frequency, site hydrology, and plant community successional stage (Sheviak 1974, Bowles 1983). We therefore sought to determine if wetland sites consistently have more flowering plants than upland sites, and if growing season precipitation levels correlate over time with fluctuating numbers of flowering plants.

BACKGROUND

Distribution and status

Platanthera leucophaea and its western species pair *P. praeclara* are characteristic orchids of the tallgrass prairie region of eastern North America (Sheviak and Bowles 1986). *Platanthera leucophaea* ranged from the immediate Mississippi River drainage eastward across the Wisconsinan till plain in a narrowing pattern corresponding to the prairie peninsula of Transeau (1935). Disjunct populations occurred farther north and east in southern Canada, Maine, New Jersey, and Virginia wetland habitats (the species' range is mapped in Bowles 1983 and Sheviak and Bowles 1986). Illinois probably supported larger and more extensive presettlement populations of this orchid than any other state. Originally the species was known from tallgrass prairie in 33 counties across the northern two-thirds of the state, an area now almost completely converted to agriculture (Sheviak 1974, Bowles and Kurz 1981). Twenty-one prairie fringed orchid populations now remain in eight Illinois counties, a 75% decline in extant county records based on voucher specimens (Figure 1). The overall decline of numbers of plants in Illinois since settlement, however, probably reflects the loss of prairie habitat, of which less than .007% remains (White 1978).

Life history and ecology

When flowering, *Platanthera leucophaea* is one of the showiest prairie plants. Inflorescences of 30 or more fragrant white flowers usually overtop the prairie canopy, and pollination is by nocturnal hawkmoths (Family Sphingidae) as they ingest nectar from the flowers' long nectar spurs. Terrestrial orchids are well known for periodic dormancy, apparently during unfavorable conditions or environmental uncertainty (Calvo 1990). The irregular flowering of *P. leucophaea* may result from avoidance of drought stress or impact from grazing in its grassland habitat (Bowles 1983). Often many plants in *P. leucophaea* populations are vegetative (*i.e.*, without flowers), and some may be entirely dormant in an undergroud state. During periods of reduced growth or dormancy, especially during environmental stress, the plants may be supported by mycorrhizal nutrition. Plants develop flowering primordia during the growing season prior to flowering, thus dormancy or reduced vigor one year can have a carry-over effect on numbers of flowering plants in subsequent years. The orchid mycorrhizal relationship begins with seed germination, allowing the development of a chlorophyll-free protocorm that requires fungal nutrition for several years until a vegetative stage is reached; mycorrhizae are apparently maintained throughout the plant's life (Stoutamire 1974, Sanford 1974).

The eastern prairie fringed orchid requires full sunlight for optimum growth and flowering. Throughout much of its range, it inhabits mesic to wet circumneutral to calcareous tallgrass prairies (Sheviak 1974, Bowles 1983). Most extant Illinois populations occur in soils derived from loess deposits over glacial till or outwash, which characterize the Grand Prairie Natural Division of Illinois (Schwegman *et al.* 1973). In these habitats, populations occupy a continuum extending from mesic upland prairie to wet prairie along the borders of prairie potholes and watercourses. Plants in upland habitats appear to flower infrequently, probably only during seasons of relatively high precipitation. Secondary habitats include sand deposits of the Lake Michigan lake plain and sedge meadows, which are essentially restricted to the Northeastern Morainal Natural Division of Illinois (Schwegman *et al.* 1973).

Under stable conditions, *Platanthera leucophaea* appears to be long-lived. Case (1987) reported that plants survived and produced seeds for up to 30 years in a garden, and several extant Illinois populations survived for decades in cemetery prairies under mowing regimes that probably prevented reproduction by removing inflorescences or seed capsules. However, high population densities can occur in early- to mid-successional habitats compared to late-successional habitats (Bowles 1983). As these communities undergo succession, populations may decline and disappear. Prairie fringed orchids have been introduced from seed into formerly grazed successional prairie habitat in the Chicago region (Packard 1991), with flowering plants appearing five years after seed dispersal.

METHODS

Population and environmental data

In 1980, the senior author began to census annually flowering plant numbers in Illinois populations of *P. leucophaea*; more recently, populations also have been censused by volunteers coordinated through The Nature Conservancy. These census data were compiled for 1980-1990; all known Illinois *Platanthera leucophaea* localities were revisited during July 1991 and examined for successional changes since previous visits, along with other management needs. Locations of plant populations that had been previously mapped or marked, along with other potential habitats, were searched for flowering plants.

For comparing effects of hydrology on flowering, sites were divided into three classes along a **mesic** (n = 4 sites), **wet-mesic** (n = 5 sites), and **wet** (n = 3 sites) hydrological gradient. These sites were differentiated by field inspection according to their topographic position and characteristic vegetation types (*sensu* White 1978). The proportions of years with or without flowering populations were compared between mesic, wet-mesic, and wetland habitats by goodness of fit tests. The monthly precipitation for April-July of each year and their deviations from the 30-year norm were obtained from National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center monthly summary reports for northeastern Illinois, where most of the orchid populations occur. April-July rainfall was chosen because it represents the period during which soil moisture levels might effect emergence and growth of *Platanthera leucophaea*. As this orchid flowers by late June or early July, July precipitation would be more critical for perennating bud development and flowering during the subsequent season. Sequential nonrandomness in precipitation was tested for with the mean squared successive difference (MSSD) test (Ghent 1971). A Kendall rank correlation test was used to test for a significant relationship between total annual census numbers and departures of April-July rainfall from the 30-year norm. For this test, July rainfall was omitted from the 1991 data set, as it would not affect flowering during 1991.

Demographic data were collected from the largest Illinois population (~200 plants), which occurs in wetland habitat. Since 1985, flowering plants in this population have been permanently marked and their fates subsequently monitored. Only during the 1988 drought, when no flowering plants appeared, were the conditions of previously marked plants not monitored. Because unmarked vegetative orchids cannot easily be found, initial cohort data included primarily flowering plants. Development of a more precise assessment of population structure, including flowering, vegetative, and dormant states, will require long-term monitoring and differentiation between dormancy and mortality.

Estimating population viability

For the federal recovery plan, the likelihood of long-term survival was estimated by developing an **Artificial Viability Index** (AVI). The index is calculated from the formula **AVI** = $[\Sigma_{i-n} A_i + B_i + C_i + D_i + E_i]/15$. A-E represent population size, habitat size, degree of disturbance, protection status, and management needs, respectively. Appendix I presents the criteria for establishing the values for each variable. A and D range from 0-3; B,C, and E range from 1-3. Dividing by 15 adjusts the index range from 0.2-1.0. **Low AVI** values are <0.5, **moderate AVI** values range from 0.5-0.75, and **high AVI** values are 0.75-1.0. In most cases, management, protection, or restoration measures can be used to increase the value of each variable, and thus the **AVI**.

RESULTS

Hydrology and precipitation: effects on flowering

Site hydrology as interpreted by topographic position had a significant effect on flowering; wet sites had proportionally more (X^2=21.4, P<.001) years with flowering plants than either mesic or wet-mesic sites. Flowering plants were present 89% of the time in wet sites, but less than 40% of the time in both mesic and wet-mesic sites (Figure 2).

April-July precipitation appeared to an important factor affecting flowering plant census numbers between 1980 and 1991 (Figure 3). Precipitation was nonrandom and cyclic over time ($Z = 5.73$, $P<.0001$). High levels occurred in 1981-1983 and in 1990, intermediate levels occurred in 1980, 1984, 1987, and 1991, and low levels occurred in 1985-1986 and 1988-1989. The most severe growing-season drought in 50 years occurred in 1988. Flowering among orchid populations followed a similar pattern, with total census numbers ranging from 4 in 1988 to 313 in 1987 (Figure 3). There was an overall significant ($P = .0397$) Kendall rank correlation test between annual orchid census numbers and departures from mean rainfall. Census numbers were lowest in years corresponding to low precipitation, which suggests that low precipitation levels had immediate effects on flowering. This was most evident during the 1988 drought, which apparently affected the numbers of flowering plants for three years, even though precipitation was high during 1990. Less severely dry years appeared to affect the numbers of flowering plants in those years only, without the impact carrying over into subsequent years. For example, the highest annual census occurred in 1987, a year of moderate rainfall following two consecutive years in which precipitation and numbers of flowering plants were low, but not as severely low as in 1988.

Demographic monitoring revealed an unexpectedly high turnover of flowering plants in the Lake County wetland site (Figure 4). In 1987, there were over 100 flowering plants. The 1988 drought reduced flowering plants to near zero for two years, apparently forcing many into dormancy or vegetative condition. For example, 49 (33%) of the 148 plants found between 1985 and 1987 were relocated in 1989, but only two were flowering. In 1990, 40 (27%) of the 148 plants reappeared, but only four were flowering. Only four new plants were found in 1989, and 32 previously unmarked plants were found in 1990; 32 (88.9%) were flowering. Because flowering plants require about 5 years to appear from seed, these plants apparently had also survived the drought. In 1991, after six years of monitoring, only 30 (16%) of 184 marked plants were found to re-flower, while 100 (54.4%) were not found at all, and were either dormant or had died. Eighty-nine new plants were found in 1991; 70 (78.6%) were flowering, and had also apparently survived the 1988 drought.

<u>Population status and viability</u>

Twenty-one *Platanthera leucophaea* populations are now probably extant in Illinois. Nineteen of these populations occur in six Chicago-region counties, including two Cook County sites at which plants have been restored; single *P. leucophaea* populations occur in cemetery prairies in eastern and west-central Illinois counties. We considered populations in DuPage County and at Illinois Beach State Park as extant, although plants were not observed at either site in 1991 (Note: In order to protect orchid populations, site names will be provided only for Illinois Beach, where plants cannot be located without specific information). Plants were observed in the early 1980's at the DuPage County station, but altered site hydrology may have destroyed or severely reduced this population. Plants were observed at Illinois Beach as early as 1908 (Gates 1912), and have been reported as recently as the late 1970's. This population may now be very small or even ephemeral. A large population that occurs one mile north of Illinois Beach (in Wisconsin) could serve as a seed source for dispersal and periodic recolonization in Illinois. Excluding two sites on the Chicago Lake Plain, and three sites in sedge meadow, all Illinois populations occur in loess soils over glacial drift.

Only one Illinois population, in Lake County, ranks as highly viable (Figure 5). This station is in county ownership, and in part a state nature preserve. It contains a diversity of prairie habitats ranging from mesic to wet, and supports the largest and most extensive Illinois population of prairie fringed orchids. Ten Illinois sites rank moderate viability. One of these sites, also in Lake County, supports a population size similar to that of the highly viable site, but the habitat is smaller and contains only mesic conditions, and orchids appear less frequently. Illinois Beach was ranked moderately viable because of its extensive habitat and legal protection, although the orchid population status is unknown. Only three populations occur in habitats supporting communities ranked as grade "A" by the Illinois Natural Areas Inventory. These sites ranked moderately viable because they are legally protected, but small in size and in population numbers.

Other populations ranked moderate to low viability because of small population and habitat size, early successional stage, nonbinding protection, or management problems (Figure 6). Small population size was the most frequent problem, with only two of these sites supporting more than 50 plants. Population sizes can only be estimated, and in most of the moderate to low viability sites, especially smaller sites that do not include wetland habitat, far fewer than 50 plants were found. Thirteen of the Illinois populations, all of which are in the Chicago region, occur in formerly disturbed habitats. The long-term stability of these populations is unknown because of their potential to decline with successional change (see discussion). Only six of the Illinois populations, having less than 20% of the Illinois plants, occur on dedicated nature preserves. Most of the Illinois plants are concentrated on two unpreserved Lake County sites; the dedication of these sites as Illinois nature preserves would result in the protection of over 75% of all Illinois plants.

Management problems are the most serious threat to the long-term persistence of orchid populations. Many Illinois prairie or wetland remnants that support orchid populations are threatened by woody invasion fostered by fire suppression (Bowles 1983). Ongoing management, primarily prescribed burning, is needed to maintain all orchid habitats. Invasions by the exotic species purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus frangula*), and teasel *(Dipsacus laciniatus)* pose serious threats to orchid habitats in both Illinois and adjacent Wisconsin (Reinartz *et al.* 1987, Reinartz and Kline 1988, Solecki 1989, Bowles 1991). Although many habitats do not yet have purple loosestrife, its threat to all wetland communities is severe. Buckthorn invasion is also serious. Prescribed burning alone will not control these species; cutting, herbiciding, and pulling are also necessary.

DISCUSSION

Precipitation, hydrology, and flowering

Precipitation during the growing season appears to have a strong effect on the flowering and structure of *Platanthera leucophaea* populations. A severe drought affected even a wetland population, reducing flowering plant numbers to near zero for three successive years. However, some plants survived, and some flowered within two years. The effect of drought is apparently even more significant in upland habitat. Schwegman (1992) could not relocate two marked plants in an upland mesic site after the drought of 1988. A colony of 27 plants surveyed at the same site in 1982 has not reappeared after two drought cycles and, although other orchids occasionally appear at the site, this colony is presumably lost (M. Bowles and R. Nyboer, unpublished data). Because precipitation is stochastic, and the proportions of flowering, reflowering, vegetative, and dormant individuals depend on past climatic conditions and levels of reproduction, orchid populations may be in perpetual disequilibria.

Because drought years can limit flowering and reproduction, especially in drier sites, they can affect future population demography, and possibly cause local population extinction in homogeneous landscapes. If upland populations that decline or go extinct during droughts are adjacent to lowland populations that can survive droughts, the upland sites have a greater likelihood of being recolonized. Although long-term census data cannot explain the demography of such population dynamics, it can track population fluctuations in relation to precipitation cycles.

Orchid populations: management uncertainty in successional communities

Sheviak (1983) suggested that *Platanthera leucophaea* was extremely rare in the Chicago region, having not exploited prairie remnants in this area's low degree of agricultural activity. However, by the early 1980's, almost twenty populations had been discovered in a range of successional conditions, suggesting a dynamic state of colonization. Most populations are in prairie or wetlands that have been degraded by past overgrazing; orchids may have colonized these sites following grazing, or in some cases may have survived and spread after grazing.

The successional status of these populations presents a paradox and management challenge. As with many orchid species, prairie fringed orchids occur more frequently and with higher densities in successional communities, where they often decline as succession proceeds (Bowles 1983, Case 1987, Sheviak 1990). Although management for orchid species with early-successional conditions may maintain higher orchid numbers (Sheviak 1990), prairie management is most feasible and cost effective when it directs succession toward stable late-successional conditions, using prescribed burning to maintain climax species equilibria. The persistence of low-density orchid populations in late-successional presettlement prairie would have been facilitated by orchid longevity, the constancy and long-distance flights of hawkmoth pollinators, wind-dispersed seeds, and colonization of stochastic patch disturbances.

Small preserves often cannot maintain landscape disturbance regimes (Noss 1987) or populations of habitat-size-restricted vertebrates that may create regeneration niches (*sensu* Platt 1975). As a result, on smaller preserves artificial management may be needed to create regeneration niches for low-density plant species such as orchids. Where possible, land acquisition and community restoration should be used to build units that are large enough to support endogenous disturbances and that are more likey to be exposed to exogenous disturbances.

CONCLUSIONS

Although eastern prairie fringed orchid population dynamics may be complex, a strong correlation appears to exist between cyclic precipitation and the appearance of flowering plants. Likely, extreme drought suppresses flowering by inducing dormancy, and this effect carries over into subsequent years. However, long-term demographic monitoring and experimentation is needed to interpret the reactions of individual plants, and the effects of site hydrology, heterogeneity, and management on population viability. Two other factors, fire and reproduction, may also affect the appearance of flowering plants and were not assessed in this study. It is likely that prescribed burning enhances the appearance of flowering plants (Sheviak 1974, Bowles 1983); however, the effect may occur during years of intermediate to high precipitation, but not during drought years. Reproduction is known to have a carry-over effect on some orchids, with the cost of heavy fruit-set limiting plant vigor in subsequent years (*e.g.* Snow and Whigham 1989, but see Case 1987). As a result, heavy flowering and seed production in *Platanthera leucophaea* could interact with rainfall cycles and burning, either further reducing flowering in drought years, or damping flowering during years of high rainfall and prescribed burns.

Assessment of habitat viability through an artificial viability index (AVI) may be useful in guiding the preservation and management of orchid populations, and in selecting sites that represent the diversity of communities and habitats used by *Platanthera leucophaea* in Illinois.

Managing for the persistence of *Platanthera leucophaea* may be complex. Only a few Illinois populations now exist on essentially undisturbed prairie habitats, and these small populations may decline with attrition. Many Illinois populations occur at higher densities in early-successional communities, but populations in these habitats may also decline with advancing succession. This presents a management paradox for *P. leucophaea*. Prairies are usually managed for succession toward stable climax conditions, but disturbance and successional conditions seem best to promote high orchid densities. In addition, small preserves do not afford landscape disturbance processes. These dilemmas may be best resolved by managing for regeneration niches in small preserves, or increasing preserve sizes.

ACKNOWLEDGMENTS

The twelve years of population data could not have been accumulated without the assistance of a multitude of people and organizations, particularly Randy Nyboer and John Schwegman (Illinois Department of Conservation), Steve Packard (The Nature Conservancy), Mary Kay Solecki (Illinois Nature Preserves Commission), Dan Brouillard and volunteers (Lake County Forest Preserve District), Wayne Lampa (DuPage County Forest Preserve District), Wayne Schennum and Ed Collins (McHenry County Forest Preserve District), Jack White, and members of the Nature Conservancy's Volunteer Stewardship Network. This paper was reviewed and considerably improved by Rick Hootman, Pat Kelsey, and Chris Whelan (The Morton Arboretum).

LITERATURE CITED

Bowles, M.L. 1983. The tallgrass prairie orchids *Platanthera leucophaea* (Nutt.) LIndl. and *Cypripedium candidum* Muhl. ex Willd.: some aspects of their status, biology, and ecology, and implications toward management. Natural Areas Journal 3(4)14-37.

Bowles, M.L. 1991. Some aspects of the status and ecology of seven rare wetland plant species in the Chicago region of Northeastern Illinois. Erigenia 11:52-66.

Bowles, M.L. and D. Kurz. 1981. Unpublished report to the U.S. Fish and Wildlife Service on the Illinois status of *Platanthera leucophaea*. Natural Land Institute, Rockford, IL.

Calvo, R.N. 1990. Four-year growth and reproduction of *Cyclopogon cranichoides* (ORCHIDACEAE) in south Florida. American Journal of Botany 77:736-741.

Case, F.W. 1987. Orchids of the western Great Lakes region, revised edition. Cranbrook Institute of Science Bulletin 48, Bloomfield Hills, MI.

Gates, F.C. 1912. The vegetation of the beach area in northeastern Illinois southeastern Wisconsin. Bulletin of the Illinois and State Laboratory of Natural History Volume IX, Article V.

Ghent, A.W. 1971. Theory and application of several tests of sequential nonrandomness. The Biologist 53:169-214.

Illinois Endangered Species Protection Board. 1990. Checklist of endangered and threatened animals and plants of Illinois. Illinois Department of Conservation, Springfield.

Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. Natural Areas Journal 7:2-13.

Packard, S. 1991. Restoration of the prairie fringed orchid by seed broadcast. Unpublished report by the Nature Conservancy, 79 W. Monroe, Chicago.

Palmer, M.E. 1987. A critical look at rare plant monitoring in the United States. Biological Conservation 39:113-127.

Platt, W.J. 1975. The colonization and formation of equilibrium plant species associations on badger disturbances in a tall-grass prairie. Ecological Monographs 45:285-305.

Reinartz, R.A., J.W. Popp, and M.A. Kuchenreuther. 1987. Purple loosestrife (*Lythrum salicaria*): its status in Wisconsin and control methods. University of Wisconsin-Milwaukee Field Station Bulletin 20(1):25-35.

Reinartz, J.A. and V. Kline. 1988. Glossy buckthorn (*Rhamnus frangula*), a threat to the vegetation of the Cedarburg Bog. University of Wisconsin-Milwaukee Field Station Bulletin 21(2):20-35.

Sanford, W.W. 1974. The ecology of orchids. Pages 1-100 *In*: C.C. Withner, ed. the Orchids: Scientific Studies. John Wiley and Sons, New York.

Schwegman, J. 1992. Illinois 1991 endangered and threatened plant status. Illinois Department of Conservation, Springfield.

Schwegman, J.E., G.D. Fell, M. Hutchison, G. Paulson, W.M. Shepherd, and J. White. 1973. Comprehensive plan for the Illinois Nature Preserves Commission. Part II. - The natural divisions of Illinois. Illinois Nature Preserves Commission, Springfield.

Sheviak, C.J. 1974. An introduction to the ecology of the Illinois Orchidaceae. Illinois State Museum Scientific Paper 14.

Sheviak, C.J. 1983. United States terrestrial orchids: patterns and problems. Pages 49-60 *in* E.H. Plaxton (ed.), North American terrestrial orchids, Symposium II, proceedings and lectures, Southfield, MI. Michigan Orchid Society.

Sheviak, C.J. 1990. Biological considerations in the management of temperate terrestrial orchids. Pages 194-196 *in*: R.S. Mitchell, C.J. Sheviak, and D.J. Leopold, eds., Ecosystem management: rare species and significant habitats. Proceedings of the 15th annual Natural Areas Conference. New York State Museum Bulletin No. 471.

Sheviak, C.J. and M.L. Bowles. 1986. The prairie fringed orchids: a pollinator-isolated species pair.

Rhodora 88:267-290.

Snow, A.A. and D.F. Whigham. 1989. Costs of flower and fruit production in *Tipularia discolor* (Orchidaceae). Ecology 70:1286-1293.

Solecki, M.K. 1989. The viability of cut-leaved teasel (*Dipsacus laciniatus* L.) seed harvested from stems: management implications. Natural Areas Journal 9:102-105.

Stoutamire, W.P. 1974. Terrestrial orchid seedlings. Pages 101-128, *In*: C.C. Withner, ed. the Orchids: Scientific Studies. John Wiley and Sons, New York.

Transeau, E.N. 1935. The prairie peninsula. Ecology 16:423-437.

U.S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants; determination of threatened status for *Platanthera leucophaea* (eastern prairie fringed orchid) and *Platanthera praeclara* (western prairie fringed orchid). Federal Register 54:39857-39862.

White, J. 1978. Illinois natural areas inventory technical report. Volume I: survey methods and results. Illinois Natural Areas Inventory, Urbana.

Zar, J.H. 1974. Biostatistical analysis. Prentice Hall, Inc. Englewood Cliffs, NJ.

Platanthera leucophaea (Nutt.) Lindl.
Illustration reproduced by permission from R.S. Mitchell and C.J. Sheviak. 1981. *Rare plants of New York State.* Bulletin No. 445 of the New York State Museum.

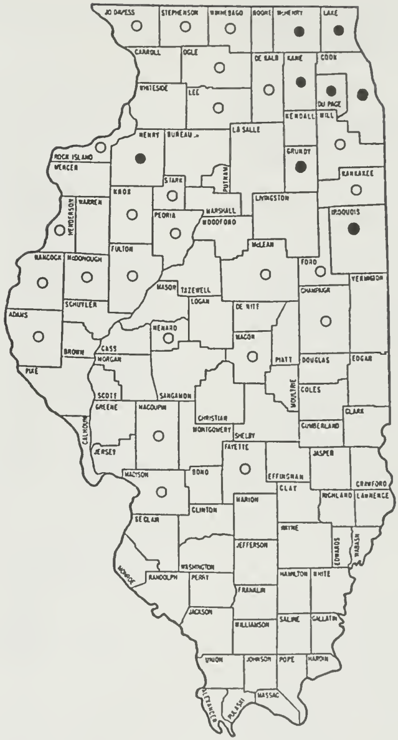


Figure 1. Illinois distribution of *Platanthera leucophaea* by counties. Closed circles indicate one or more extant populations. Open circles indicate historic records for which populations can no longer be found.

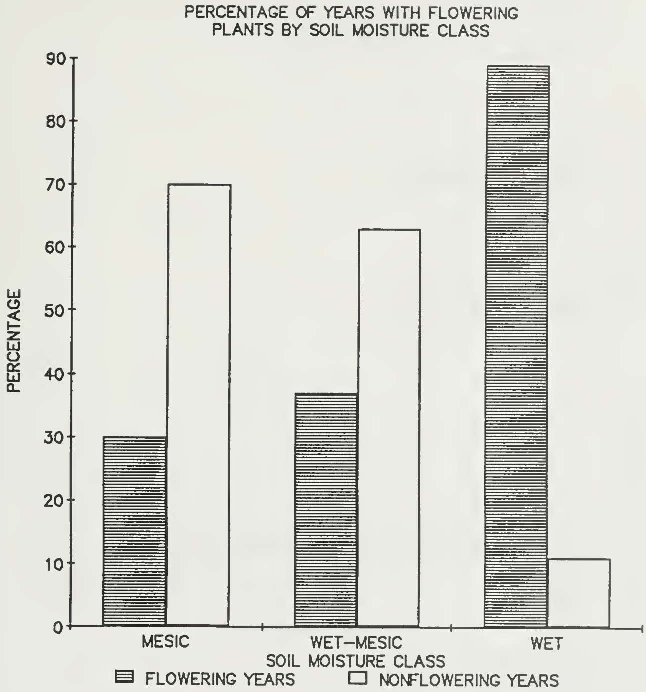


Figure 2. Percentage of years between 1980-1991 in which flowering *Platanthera leucophaea* populations were censused in mesic (n = 4 sites), wet-mesic (n = 5 sites), and wet (n = 3 sites) habitats. See text for habitat classification methods.

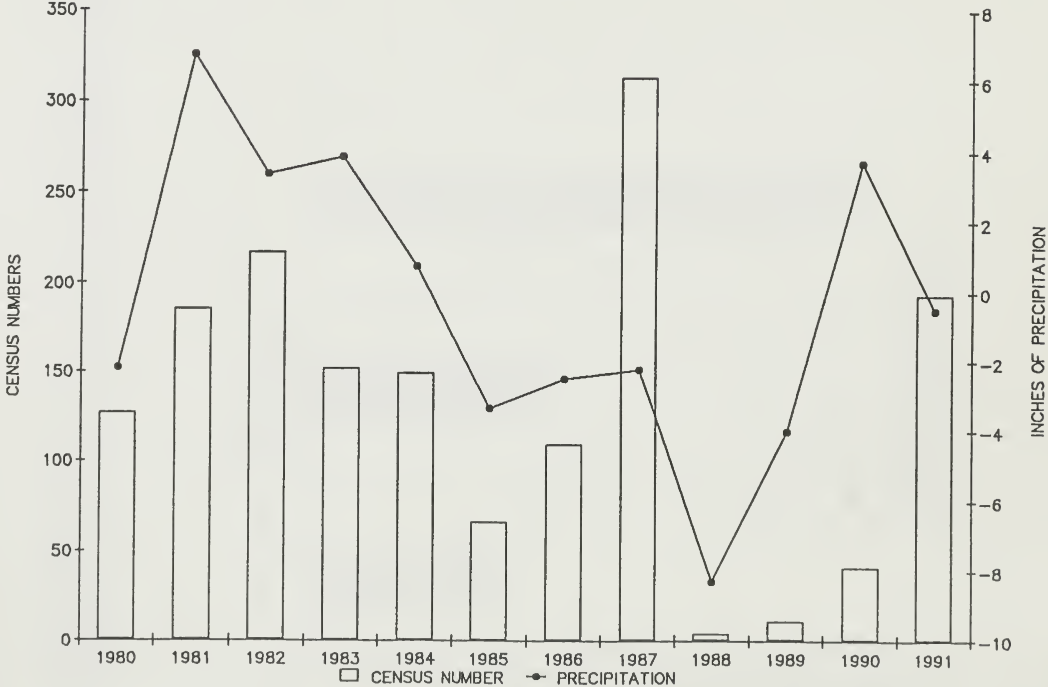


Figure 3. Relationship between precipitation and flowering among 19 *Platanthera leucophaea* populations over time. Inches of rainfall represent the April-July annual departure from the 30-year norm established by the National Oceanic and Atmospheric Administration.

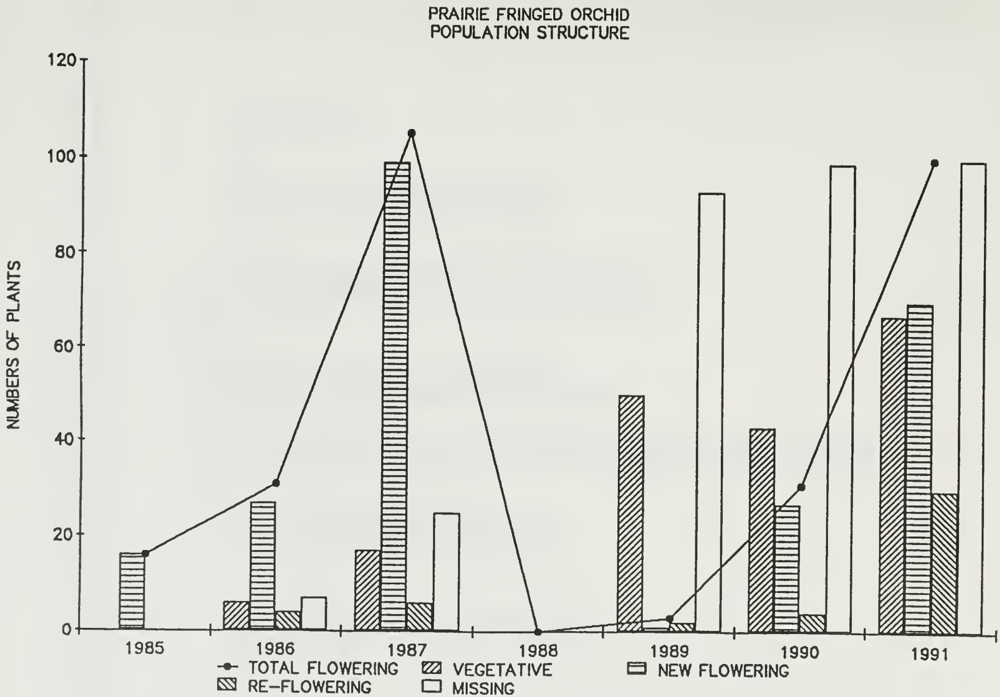


Figure 4. Comparisons of *Platanthera leucophaea* population structures before and after severe drought. Only flowering plants were monitored in 1988. Data collected from wetland habitat in Lake Co., IL.

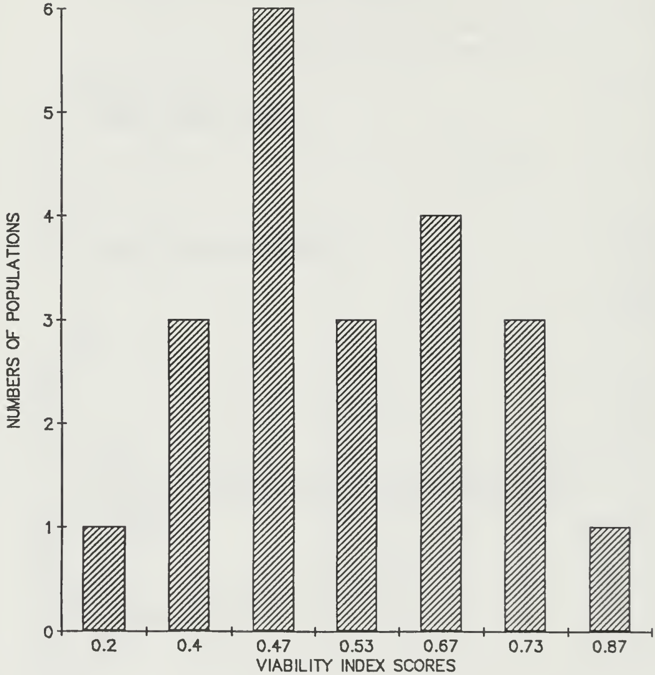


Figure 5. Distribution of 21 Illinois *Platanthera leucophaea* populations in relation to their Artificial Viability Index (**AVI**) scores. Low **AVI** values are <0.5, **moderate AVI** values range from >0.5-0.75, and **high AVI** values are >0.75-1.0. See text for calculation of index scores.

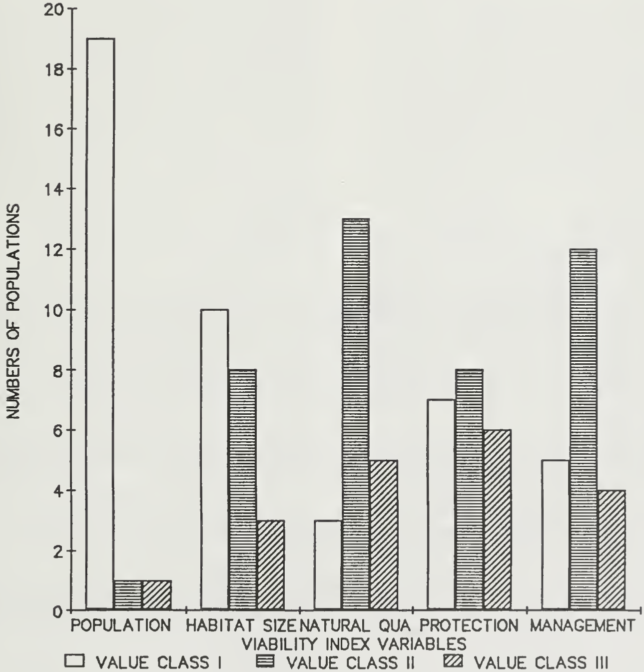


Figure 6. Distribution of 21 Illinois *Platanthera leucophaea* populations in relation to the five variables used to calculate Artificial Viability Index (AVI) scores. See Appendix I for methods used to quantify each value class.

Appendix I. Determination of Artificial Viability Index (AVI). AVI = $[\Sigma_{i\text{-}j} A_i + B_i + C_i + D_i + E_i]/15$. AVI ranges from 0.2-1.0, and is arbitrarily divided into three groups. Low viability = <0.5; moderate viability = >0.5-0.75; high viability = >0.75-1.0.

	VALUE		
Variable	(0[1]-1[4])	(2)	(3)
A. Population size[1]	small <50 plants	medium >50-100 plants	large >100 plants
B. Habitat size[2]	small <2 hectares (<5 acres)	medium >2-20 hectares (>5-50 acres)	large >20 hectares (>50 acres)
C. Degree of past disturbance/successional stage of natural community[3]	heavy/early-successional	moderate/mid-successional	light/late successional
D. Protection/status[4]	none/informal	formal	legal
E. Management needs[5]	severe	moderate	low

[1]Based on recent census data and current habitat conditions. These data represent flowering plants only, and may represent <100% of total populations. Values of 0 are given to small populations that appear in jeopardy or have not been relocated.

[2]Habitat size takes into account only those areas of the site that support, or have the potential to support, prairie fringed orchid populations.

[3]Assumes that populations may not be maintained at existing levels as succession advances from recently or severely disturbed to late-successional plant communities.

[4]None = private ownership with no protection (value = 0); informal = private ownership, without legally binding protection; formal = private or public ownership with formal but not legal protection; legal = private or public ownership with legally binding protection.

[5]Includes threats such as exotic species invasion (*e.g.* glossy buckthorn and purple loosestrife), surrounding land use (*e.g.* drainage, development, pollution), development threats (on private tracts), and fire protection/brush invasion.

Technical Comments on the Proposed Revisions to the 1989 Wetland Delineation Manual[1]

Gerould Wilhelm

The Morton Arboretum
Lisle, Illinois, 60532

On 10 January 1989, the U.S. Environmental Protection Agency, U. S. Army Corps of Engineers, Department of Agriculture Soil Conservation Service, and Department of Interior Fish & Wildlife Service adopted an interagency document entitled "Federal Manual for Identifying and Delineating Jurisdictional Wetlands." It provided guidance for identifying and delineating wetlands for various purposes, most particularly for determining wetlands under the jurisdiction of the Clean Water Act, Section 404 regulatory program. On 14 August 1991, this same interagency consortium proposed a revision to the 1989 manual [Federal Register 56(157):40446-40480]. At that time, there was a request for public comments on the proposal, which comments were to have been submitted by 15 October 1991.

The 1989 manual was quite detailed, and with the exceptions discussed below, its use generally enabled an accurate delineation of wetland. The 1991 proposed revision continues to rely on the determination of the presence of hydric soils, hydrophytic vegetation, and evidence of hydrology as essential parameters. Page 40446 presents the following goal: *Of paramount importance . . . is to maintain and improve the scientific validity of our delineation methods.* Immediately following this stated goal six concerns having to do with the 1989 manual are listed. These concerns essentially imply that the application of the 1989 manual delineates too much wetland. The revision proposes to make the visible manifestation of hydrology requisite during the drier months of the year, a restriction which essentially limits the term "wetland" to permanent water bodies. It is my opinion that such a reliance on hydrology is not a scientifically valid approach to wetland definition. Certainly, hydrology is a *driving force* in wetland development, but when water is no longer present, proof of the length of its tenancy becomes problematic. While there were technical, scientifically-based problems with the 1989 manual, they are not addressed adequately in the proposed revision. These problems persist, with the added problem of the impracticality of having to prove hydrology during the growing season.

As in the 1989 manual, vegetational analysis still relies appropriately on the National Wetland Categories for species, as described by Reed (1988), where plants are categorized as obligate wetland inhabitants, upland inhabitants, or facultative to either side of the hydrological gradient. Some fundamental misconceptions are carried over from the 1989 manual regarding community classification, species dominance, and the inclusion of non-native species in the delineation calculations.

Another problem with the 1989 manual, made much worse by the proposed revision, is the attempt to find a single definition of a wetland that encompasses the estuaries of southern Florida and those in the prairies of Illinois. One reason the National Wetland Categories (Reed, 1988) are valid wetland indicators, when applied appropriately, is the division of the United States into physiographic regions with each species being evaluated on its autecology in each region. A similar strategy should be explored for wetland definition. Indeed, while the proposed revision accepts the valid notion that in various biomes individual species vary in their likeliness to grow in wetlands, it seems illogical to

[1]This paper is an edited and revised rendering of a letter which the author submitted to Gregory Peck, U.S.E.P.A., Washington, DC, in response to a request for public comments on the proposed revisions to the 1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands.

assume that a wetland definition would not be more accurate if it were more specific to each region.

Neither the 1989 manual nor the proposed revision addresses another important aspect of wetland identification: wetland mitigability. The structure and function of some wetlands are easily replicated using current expertise and technology, while others are of such complex synecological character that routine mitigations are unable to reproduce their viability. An assessment of the degree of mitigability regarding a target wetland should be made at the time of delineation in order to aid regulators in determining terms of permit approval. If such assessments were made, many permits could be handled quickly and expeditiously, while in other cases the applicant would know immediately that permit approval could be problematic.

HYDROLOGY

Evidence of the occupancy of water on a site is important, but the duration or amplitude of occupancy is difficult to determine when water is absent. One of the guidelines in the proposed revision governing the measurement of wetland hydrology states that soil saturation must persist *for 21 or more consecutive days during the growing season* or sustain *inundation for 15 or more consecutive days.* Growing season and indicators of wetland hydrology are both problematic criteria.

Growing Season. As defined in the proposed revision, the growing season is . . . *the interval between 3 weeks before the average date of the last killing frost in the spring to 3 weeks after the average killing frost in the fall.* Growing season is defined arbitrarily by a parameter based upon the average frost-free days, with a 3-week extension period at each end. In the central Great Lakes Region, the attempt to define a wetland as having a fundamental relationship to the "growing season" is untenable. If the logic of the proposed revision is followed, soil hydration outside the growing season is considered irrelevant.

Since the point of wetland delineation is to identify correctly those areas which receive standing water or chronic soil hydration, criteria should be designed which are helpful toward that end. The proposed revision attempts to establish criteria, which when adhered to, are inconsistent with accurate wetland delineation. Wetlands are characterized not by annual crop plants but by plants native to a region. Therefore, attentiveness to growth and maturation patterns of the native plants in a given region is informative with regard to growing season definitions. The growing season as it is defined by the proposed revision is about 2 months shorter than is expressed in nature.

According to the National Climatic Data Center, from 1951-1980, in the Chicago region, there was a 50% probability that a late spring freeze would occur after 3 May and that an early fall freeze would occur before 10 October. May 3rd is in the 18th week of the year, so the beginning of the growing season as defined by the proposed revision would occur 12 April, the 15th week. October 10th is in the 40th week of the year, so the end of the growing season would fall in the 43rd week. According to the criterion in the proposed revision, the Chicago region's growing season is 28 weeks in duration. This parameter does not encompass the growing season of native flowering plant species.

In the Chicago region, there are 1570 native vascular plants (Swink & Wilhelm, 1979).[2] Flowering periods of 1252 of these, including grasses and sedges, have been documented. It has been recorded over the past decades, for example, that *Actaea pachypoda* (White Baneberry) has been in anthesis during the period 30 April to 4 June. In the case of most species, these dates are the extremes of flowering and were not recorded in the same year. Presumably, in any given year, any plant species is likely to be in bloom near the midpoint of its phenological range. In the case of *A. pachypoda,* the early date falls in the 17th week of the year and the late date in the 22nd week. The midpoint in the flowering period of *A. pachypoda* is week 19.5 or 13 May.

Fifteen Chicago region species have their midpoint blooming ranges in the 5 weeks prior to the beginning of the growing season as defined by the proposed revision, the earliest blooming midpoint falling in week 10 (8-14 March). It stands to reason that spring growth begins normally at least a week earlier, week 9 (1-7 March). None of the species of the Chicago region have midpoint blooming ranges after the 43rd week, but nine have midpoint ranges

[2]The Chicago region, as defined by Swink & Wilhelm (1979) includes 3 counties in southeastern Wisconsin, 11 in northeastern Illinois, 7 in northwestern Indiana, and 1 in southwestern Michigan.

after the 40th week. Since these species must then have time to mature fruit, an additional 2 or 3 weeks of nutrient movement is necessary. The practical end of the growing season then falls during week 45, 2 weeks after the end of the growing season as defined by the proposed revision.

When the 6 additional weeks of spring are added to the 2 additional weeks of fall, the documented growing season of native vascular plants in the Chicago region is 8 weeks longer than that defined for this region by the proposed revision. The actual growing season begins with the 9th week and ends during the 45th week in our region. Clearly, the 3-week criterion used in the proposed revision has no scientific basis in defining either the beginning or the end of the growing season in this region.

Also, the new manual would presume that soil inundation or saturation is not important prior to or after the growing season or that the effects do not differ materially from soils in unsaturated lands. However defined, the criterion in the proposed revision is that, in order to meet the definition of wetland, an area must be . . . *inundated for 15 or more consecutive days, or saturated from surface water or from ground water to the surface for 21 or more consecutive days during the growing season.*

In the Chicago region, as in much of the prairie biome, microbial activity is evident in anaerobic respiration that can occur any time during the year when the ground is unfrozen. Since the whole point of wetland delineation is to identify wetlands, land areas where water accumulates, arbitrary parameters such as growing season circumscription are superfluous. Even if the growing season were more rationally defined, there would be no scientific basis in ignoring the effects of anaerobic activity and nutrient movement on soil morphology during the dormant months.

Wetland Hydrology Indicators: On page 40452 of the proposed revision, four wetland hydrology indicators are listed, only one of which must be present. While this appears to be an expansive suite of options, in practice it is cumbersome and contradictory, and application can give counterintuitive results. Numbers 1 and 2 are not real options.

Number 1: A minimum of 3 years of hydrologic records collected during years of normal rainfall and correlated with long-term hydrologic records for the specific geographical area that demonstrates the area meets the wetland hydrology criterion. Three years of hard hydrologic data almost never exist in the Chicago region, and no developer I have ever worked with would be willing to finance such a study or defer his development plans that long. In practice, it is a wholly impracticable option, though if such a data set were to exist already for a site it would be unwise to ignore it.

Number 2: Examination of aerial photography for a minimum of 5 years [which] reveals evidence of inundation and/or saturation in most years [3 of 5, 6 of 10] and correlated with long-term hydrologic records for the specific geographical areas demonstrate that the area meets the wetland hydrology criterion. In those instances where photographs show such standing water, it is impossible to tell when it got there and how long it will remain at any given topographic level. Rain gauge data on midwestern thunderstorms from Wheaton, Illinois or O'Hare Airport in Chicago are useless in determining actual rainfall patterns even in nearby areas. So correlations are impossible. Again, in practice, this is a wholly impracticable option, though if such data were to exist already for a site it would make sense to utilize it.

Number 3: One or more primary hydrologic indicators, which when considered with evidence of frequency and duration of rainfall or other hydrologic conditions, provide evidence sufficient to establish that an area is inundated for 15 or more consecutive days or saturated from surface water or from groundwater to the surface for 21 or more consecutive days during the growing season in most years, are materially present.

- *a.* *Surface water inundation.*
- *b.* *Observed free water at the surface in an unlined bore hole.*
- *c.* *Water can be squeezed or shaken from a soil sample taken at the soil surface.*
- *d.* *Oxidized stains along the channels of living roots.*
- *e.* *Sulfidic material within 12 inches of the soil surface.*

f. *Specific plant morphological adaptation/responses to prolonged inundation or saturation: pneumatophores, prop roots, hypertrophied lenticels, a[e]renchymous tissues, and floating stems and leaves of floating-leaved plants growing in the area, and buttressed trunks or stems.*

With respect to items "a-c," I have never had the opportunity during a routine wetland determination to spend the time to defer delineation so that I could actually observe that portion of the wetland border which remained under water for 15 days or saturated for 21 even in one year, much less "most years." During a wetland delineation attempt at the West Chicago Prairie in September, 1991, on a morainic region west of Chicago, evidence of items "d-f" were searched for in well-documented, undisturbed wet prairie and sedge meadow plant communities; none could be found. There is no scientific basis for expecting these features to be present in such communities.

*Number 4: If none of the indicators in items 1, 2, or 3 is [*sic*] present, one or more of the following secondary hydrologic indicators should be used in conjunction with corroborative information that supports a wetland hydrology determination. These secondary indicators may only be used in conjunction with other corroborative information that indicates wetland hydrology.*

a. *Silt marks that indicate inundation.*
b. *Drift lines.*
c. *Surface-scoured areas.*
d. *Other common plant morphological adaptations/responses to hydrology; shallow root systems and adventitious roots.*

In undisturbed midwestern prairie wetlands and minerotrophic fens and sedge meadows, items "a-c" are not likely to be seen. Such wetlands are prevailingly ombrotrophic or minerotrophic, so evidence of surface flows laden with sediments are irrelevant factors. Occasionally evidence from item "d" can be present, but by no means routinely.

The attempts to define wetlands uniformly across physiographic provinces and to keep hydrology as a discrete criterion lead naturally to absurd conclusions. In practice, the proposed revision excludes most natural wetlands of the Prairie Biome from wetland status. The fact that this region receives 80-100 cm of precipitation per year over every square centimeter suggests that water must go somewhere. Actually, the two features which do corroborate hydrology in the Midwest, soils and vegetation, have been singularly excluded from consideration. Soils and vegetation resident on a site have a chemical and genetic imprint which transcends our ability to think up all the ways of discerning a pattern of hydrology.

VEGETATION

One of the most serious problems with the 1989 manual, and which persists in the proposed revision, is the inclusion of weed (non-native) species in the vegetational analyses. Another is an attempt to define "dominant species." The requirement to discriminate wetland plant communities does not lead to spurious results, necessarily, but it is irrelevant in determining wetland borders. The only relevant information in delineation is that which discriminates the wetland from the upland, the area which delineates the jurisdictional wetland.

The analytical protocol described by the manual, which is far too involved to recapitulate or summarize here, does not do well in defining the wetland border. Trying to identify plant communities by the method described is essentially subjective, since the plant communities are chosen in an entitative process, then described by a transect. There are well-known ordination techniques which can define plant communities, if that is the goal. Following the wetland manual, even if the plant community is chosen well, the data treatment tends to average any variation in it, and still the wetland border remains unaddressed. For all that, the method is unnecessarily complicated and can be far too time-consuming in diverse wetlands, and assessments are overly influenced by "dominant" species. A much simpler, more reliable, alternative is presented below as the various issues are explored.

Native *versus* Adventive Species: With the exception of a couple hundred rare waifs and scarcely spontaneous exotics, there are 2083 species of vascular plants which comprise the spontaneous flora of the Chicago region. Of these, 513 (25%) are known to be weeds (adventives) from Eurasia or from districts remote from the Chicago region. Adventive species have been in the area less than 1.5% as long as the natives, and their adaptation is to an altogether different ecological context. The presence of these adventive species informs us little about the wetness or dryness of a site. Since they are adapted primarily to the agricultural, well-drained arable soils of the Northern Hemisphere, the extent of their presence reveals more of a disturbance history and post-settlement land use. The remaining 1570 species are believed to be native to the region. The adaptability of these native species to wet or to dry ground can be regarded as a more profound indicator, inasmuch as each of these elements played a role in some presettlement plant community. Each one has been adapting to some facet of local hydrologic gradient throughout much of the Holocene.

If the goal is to determine site wetness based upon vegetation, then the use of native species as indicators is a strong measure. Table 1 shows the difference between the proportion of native and adventive species in each National Wetland Category. The more even distribution of native species among wetland plant categories reflects adaptation of native vegetation communities to gently variable hydrologic gradients typical of undulating topographies. The weed flora indicates a history primarily of disturbed, well-drained soils. An immense amount of experience locally has shown that when adventive species are incorporated into an analysis of wetness, results can be spurious.

Dominant Species: Problems also can arise when the focus is on dominant species. The problem is that dominant species have no fundamental significance as indicator plants. Not only are dominant species usually larger physically when compared to associated species and likely to be more obvious along the transect, they also tend to change with the season. Because calculation of dominance includes an estimate of basal area or cover, the results can also vary with the vicissitudes of annual climatic variation.

Small, or less easily identified, species are frequently excluded or their presence de-emphasized. *Solidago altissima*, a FACU species, can be shown to dominate disturbed wetland areas in the Chicago region in late summer, and when it does, the wetland area can appear as non-wetland. If, however, interstitial species such as *Amphicarpa bracteata* (FAC), *Bidens frondosa* (FACW), *Carex brevior* (FAC), *C. granularis* (FACW+), *C. lanuginosa* (OBL), *Geum canadense* (FAC), and *Polygonum coccineum* (OBL) are included as equal indicators, the area is shown to be populated predominantly by hydrophytic species; it is likely that the *Carex* species would have been dominant in spring. Similar confusions can work in reverse, where a mesophytic area might appear at some time to be dominated by a hydrophyte.

Each species, large or small, easily identified or not, has a long genetic memory of where it grows. Since all species grow in habitats to which they are suited, each species present in an area or in a sampling quadrat provides information equally about the wetness of the spot upon which it grows. When all *native* species identifiable in an area are analyzed together, reliable indices of wetness are obtainable.

Sampling Transect. The National Wetland Category defines the estimated probability of a species to occur in wetlands. The wetland categories included in the hydric to xeric range, *OBL* to *UPL* (see Table 1), can be expressed as 11 coefficients of species wetness, where:

$OBL = -5$, $FACW+ = -4$, $FACW = -3$, . . . $FAC = 0$, . . . $UPL = 5$

This is essentially the same scale as presented in the 1989 manual, but with values given to the +/- categories described by Reed (1988) as well. Values on the wet side of *FAC* are given negative numbers so that a transect, when graphed, displays wetland portions of the transect on the negative *y* axis (Figure 1).

When transects are laid out along the hydrologic gradient (catena), quadrats can be placed at regular intervals. An inventory of the species present in a quadrat is taken, the native species discriminated, and their coefficients of species wetness summed and divided by the number of species. When these quadrat wetness coefficients of each 3 quadrats are averaged sequentially, vegetational representations of the catena are produced. Inclusion of metrics such as cover and density warps wetness values much in the same way calculations of dominance do; simple species presence gives the more accurate measure.

Figure 1 shows an example of a vegetation transect compared to topography. The transect traverses an undulating mesophytic prairie/wet prairie/sedge meadow complex. Note that the wetland border is slightly higher on the catena to the right where the slope is much gentler and probably less easily drained. The correlation between hydrophytic vegetation calculated in this way and hydric soils is remarkable only if one is surprised to discover that native plants do not grow randomly across the landscape, that they sort themselves with others into time-honored niches with disarming regularity.

When a series of transects is laid out in this fashion along the catena, the borders of the wetland can be associated with those areas of the x axis on the graph where the line intersects 0 on the y axis. The type of community is of little interest to the developer, stratum ranking is unnecessary, and complicated statistical calculations are superfluous. Neither is there a need to rely upon questionable formulations such as species dominance or to depend upon individual indicator species. Reliance upon such factors and the failure to exclude weeds can lead to frustrating results when attempting to correlate wetland plant communities with hydric soils.

It is probable that all of these factors lead the writers of the proposed revision to the spurious conclusion that there are . . . *certain difficulties in identifying wetlands from a purely botanical standpoint* . . . In fact, in almost all cases, a rational analysis of the vegetation can provide a very robust circumscription of wetland. Certainly, taken together with the soil characteristics, very accurate inferences can be made concerning the extent to which water has lain in the area.

Figure 2 shows the difference in wetland border deterimination when adventives are included in the calculations. In this case, the quadrats were at 4-meter regular intervals, so the transect shows that there was a 10-12 meter difference between the use of natives only *versus* natives with adventives. The transect was taken on a gradual slope where the soil changed from somewhat poorly drained to hydric. The point at which the native vegetation line drops below 0 is the most reliable correlative datum with the soil. A transect as described by the manual, depending perhaps on dominance assessment during a particular year or time of year, might have concluded that the site had no wetland, yet hydric soil was the prevailing substrate. There are occasions when no native species are present, and under such circumstances the mean coefficient of wetness value will be 0. Soil alone then becomes the most reliable feature; in our experience such areas usually are not wetland.

WETLAND MITIGABILITY

In connection with Section 404 of the Clean Water Act and its administration by the U.S. Army Corps of Engineers, two aspects of wetlands are emerging as important: definition and mitigability. Many wetlands in the prairie biome today consist largely of monocultures of either Reed Canary Grass or Cattails. Large tracts of moist ground and sediment-laden river bottoms have become dominated by weedy trees, under which very little else grows. The seeds of these weedy species are ubiquitous, and because they are responsive to wide tolerances in basin engineering, restoration of such wetlands often can be achieved, but their long-term diversity is very limited. Conversely, a few of our remaining wetlands are remnants of natural systems, wet prairies, sedge meadows, and fens which provide habitats for hundreds of rare native species of plants and animals. The seeds of most of these plants are not available commercially, and little is known about their propagation or autecology. Impacts on wetlands which contain significant numbers of such species are inevitable and, consequently, *irreversible and irretrievable*. It is, therefore, important to determine the extent to which impacts on individual wetlands are mitigable.

It long has been recognized that a native flora displays varying degrees of tolerance to disturbance, as well as varying degrees of fidelity to specific habitats (Braun-Blanquet 1932). Many species, regarded as "conservative" (Wilhelm & Ladd 1988), are floristic elements which, through millennia, have become supremely adapted to niches determined by a specific set of biotic and abiotic factors. These factors include local edaphics and extremes of drought, humidity, inundation, fire, temperature, faunal interactions, *etc*. Although these factors in the aggregate have changed over time, the changes have been gradual enough and buffered sufficiently by system complexity to allow gene pools to adapt. When changes occur rapidly, as they have in the postsettlement period, both species diversity and populations of conservative species on a given tract are diminished in accordance with the severity of the changes.

Species conservatism, the degree of faithfulness a native plant displays to a specific habitat or set of environmental conditions, is the basis for the natural area assessment rationale (Wilhelm & Ladd 1988), describing a conservatism scaler spectrum of 0-10 for native species, with 0 coefficients assigned to the weediest species and 10 values assigned to very conservative species. The natural quality of an area is reflected by its richness in conservative species.

Five hundred thirty-four native species, about 34% of the native flora (322 hydrophytes) were given a coefficient of species conservatism, outside of the philosophical spectrum, of 15 or 20 for the Chicago region flora (Swink & Wilhelm 1979). Such values were given to species which the authors regarded as very rare or extirpated in the region. Typically, such species occupied plant communities which either were very rare locally to begin with or whose habitats have been very susceptible to post-settlement disturbances. A few natural wetland communities, such as bogs and fens, have high concentrations of species with values of 15 and 20.

About 11% of the native flora, including 99 hydrophytes, were given values from 0 to 3. Species in this category essentially comprise the New World analogues to the Old World "camp-following" weeds. It is believed that these are the species which exploited the compacted, disturbed, nutrient-rich soils of Indian villages, buffalo wallows, and the like. Such species played only minor roles in stable natural communities. Today, along with Eurasian weeds, they occupy more than 99% of the land in the region which is not paved over or farmed.

The remaining 55% of the native flora, 867 species (493 hydrophytes), is comprised of variously conservative species; those species were given values from 4-10, depending on their fidelity to stable native conditions. Most of the natural plant communities of the Chicago region are characterized by their inhabitance by conservative species.

Generally, the more disturbance an area has suffered since European settlement, the more likely it is to be populated prevailingly by species with values at the low end of the conservatism range. In disturbed areas, attrition of conservative elements occurs even as less conservative elements, already suited to the changes, broaden their genetic diversity and adaptation to an array of disturbed conditions. The conservative elements, supplanted in place, have neither refugia, effective migration routes, nor the time to adapt or relocate. Rather, their populations are depleted repeatedly until their ultimate extirpation.

To obtain a qualitative evaluation of a wetland site, the indices can be applied in the manner described by Swink & Wilhelm (1979) and Wilhelm & Ladd (1988).[3] According to Swink & Wilhelm, indices obtained for areas in the Chicago region are applied as follows:

> *"If the Natural Area Rating Index of a given area is 35 or 40, one can be relatively certain that there is sufficient native character to be of rather profound environmental importance in terms of a regional natural area perspective. Areas which rate in the 50's and higher are of paramount importance; such areas are extremely rare, probably occupying less than 0.02 per cent of the total land area in the Chicago region. Areas which rate less than 35 can usually be assumed to have suffered significantly from abuse or degradation."*

Many wetlands today are clearly in the latter category in that they have indices significantly lower

[3] The Natural Area Index is derived by summing the coefficients of conservatism of all the species in a unit area and dividing the sum by the number of species, yield a mean coefficient of conservatism. That mean value is multiplied by the square root of the number of species to yield the index.

than 35. Generally, the lower the index of a particular wetland, the more capable we are technically of re-establishing it or mitigating its loss with equivalent conservatism, amenities, or function.

It is yet to be demonstrated that stable natural communities, with indices in the high 30's, can be established *de novo* routinely and that such communities can be sustained at that quality level. Certainly, most open ground today, left to "succeed" on its own, is incapable of obtaining such quality. Today, the species involved in site recolonization are mostly those which have been given values of 0 to 3. Species involved in stable, diverse constellations, those given values of 4 or higher, are either absent from the region, or their populations are too disparately distributed to coalesce into any complex natural community. Such community coalescence potentials are further retarded by the fact that any succession today must take place in a universe of species that consists partly of adventive elements. Even when rich "mixes" of "pure live seed" of native species are sowed on a site, the chronic absence of fire and excessive amounts of surface runoff waters in contemporary wetland ecosystems render these plants unsuccessful in competition with non-native elements.

In the application of mitigation technologies in the Chicago region, certain ecological limitations must be kept in mind. In the modern era, there are for the most part, only about 150 native wetland species available for the spontaneous recolonization of open ground. These species have a mean value of about 2.5. This means that the highest index likely to be measured is about 30. In order to achieve higher ratings, the planting of conservative species must be prescribed. In today's restoration efforts, the planting of 60 conservative species, with a value of 4 or higher, is considered a rich planting. Present in any community is a cohort of non-conservative elements, so if the planted community can be made to consist of plants with a mean value of 4.0, a cohort of 100 species would be needed to achieve an index of 40. The highest index which has been achieved to date is 39, from 139 native species with a value of 3.34.[4]

The problem with getting conservative native plants to grow on a site is that most of our natural communities require specific hydrologies, water qualities, and soil pH levels, and they often require annual fire. Such conditions are yet beyond the technical capabilities of most engineers and plantsmen today. For most Chicago region natural wetland communities, the likelihood that each could be restored in a contemporary mitigation effort is remote.

I realize that most regions of the country have not approached their flora with this in mind. That does not mean, however, that these same relationships do not exist elsewhere or that they can be ignored simply because it is complicated and would require attention. Each region must find a rational way to codify its flora such that land custodians and resource agencies can determine the magnitude and reversibility of proposed impacts. Any manual which deals with wetland delineation in the context of the Clean Water Act must acknowledge that all wetland is not equal in its quality, function, and replaceability.

LITERATURE CITED

Braun-Blanquet, J. 1932. Plant sociology, the study of plant communities. Translated, revised, and edited by G. D. Fuller and H. S. Conard. Stechert-Hafner, New York.

Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: national summary. U.S. Fish Wildl. Serv. Biol. Rep. 88(24).

Swink, F. and G. Wilhelm. 1979. Plants of the Chicago region. The Morton Arboretum, Lisle, Illinois.

Wilhelm, G. and D. Ladd. 1988. Natural area assessment in the Chicago region. Trans. 53rd North American Wildl. & Nat. Res. Conf. 361-375.

[4]One of the wet prairie restorations at the Des Plaines River Wetland Demonstration Project in Wadsworth, Illinois.

Table 1. Definitions of National Wetland Categories, along with the percent of Chicago region native (1570) and adventive (513) species in each Category.

Native Flora	Weed Flora	Wetland Category	Symbol	Definition
27.9%	3.7%	**Obligate Wetland**	**OBL**	Almost always occurs in wetlands under natural conditions (est. greater than 99% probability).
16.3%	5.6%	**Facultative Wetland**	**FACW**	Usually occurs in wetlands, but occasionally found in non-wetlands (est. 67-99% probability).
14.1%	13.3%	**Facultative**	**FAC**	Equally likely to occur in wetlands or non-wetlands (est. 34-66% probability).
14.4%	18.7%	**Facultative Upland**	**FACU**	Occasionally occurs in wetlands, but usually occur in non-wetlands (est. 1-33% probability).
27.3%	58.7%	**Upland**	**UPL**	Almost never occurs in wetlands under natural conditions (est. less than 1%).

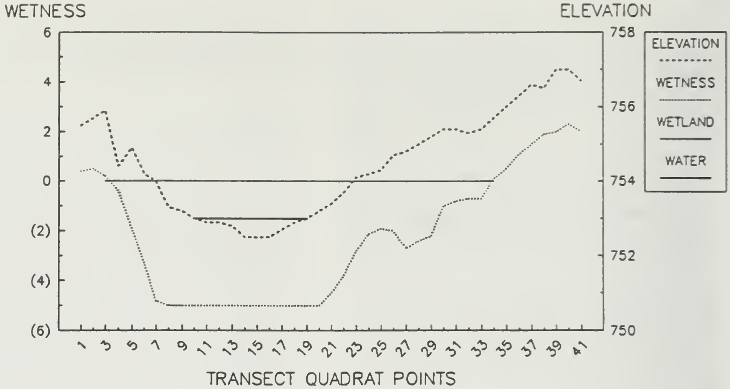


Figure 1. West Chicago Prairie. Transect consists of 41 quadrats 4 meters apart. Correlation between mean wetness coefficients (dotted line) per quadrat and topography (dashed line), shown in ft above mean sea level. The dark solid line is the normal water level. The lighter line, between quadrats 3 and 34, delineates the hydrophytic vegetation, and corresponds to the wetness axis rather than the elevation axis. (Unpublished data from Wayne Lampa, Du Page County Forest Preserve District, Du Page County, Illinois.)

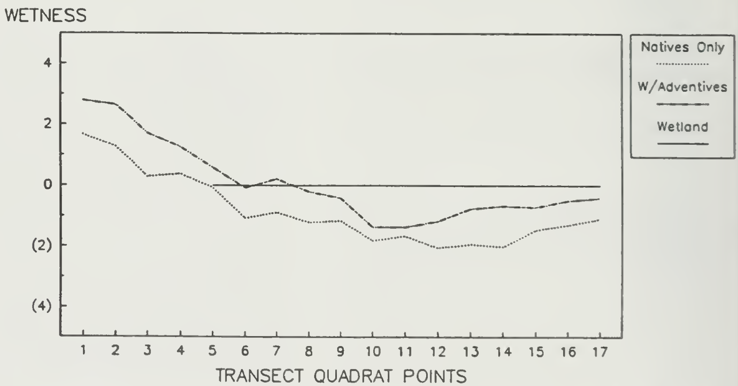


Figure 2. Disturbed wetland area in Du Page County, Illinois. Transect showing the disparity in hydrophytic vegetation assessment which can result when adventive species are included in the calculations. The dotted line shows native species only; the dotted-chained line shows the same transect, but with adventive species included. The solid line indicates the actual extent of wetland.

Book Review

Swink, Floyd. 1990. The key to the Vascular Flora of the Northeastern United States and Southeastern Canada. vi + 513 + 11 unnumbered + xii pages. Plantsmen's Publications, Box 1, Flossmoor, IL 60422. Paper. $21.95 + 3.00 shipping and handling.

The key is unique: it is a long dichotomous key that goes on and on for 513 pages of small type. The area it covers is that of *Gray's Manual* (1950). Nomenclature is of that work, too, but supplemented, when needed, by "more modern" names.

Two sections make up most of the book. The first (pages 1-82) is a key to families. The second (83-513) has keys to genera of the families and to species of the genera. Used throughout is alphabetical arrangement, the familial and generic names appearing, intermixed, in dictionary-like order. Common names equated to scientific names appear, too, alphabetically. The keys are detailed, so that when one arrives at an identification, one has gone through prose that, collectively, gives a description of the plant. Closing the book are a list of "localized species" not in the key and an excellent glossary.

Floyd Swink has been for many years the senior taxonomist at Morton Arboretum near Chicago. Probably no person in eastern North America (except maybe the late Julian Steyermark) is better acquainted with local flora.

Keying out a plant with *The Key* is a bit tedious, like the same process in *Gray's Manual*, but, with care, one can identify the plant in hand. Anyone with the patience to use *The Key* will find the work most valuable. I recommend it. *--John W. Thieret, Department of Biological Sciences Herbarium, Northern Kentucky University, Highland Heights, KY 41099*

Reprinted with permission from *SIDA* 15(1):110. 1992.

Editor's Note

When we changed ***Erigenia's*** format (Number 11, March 1991), we thought it would be nice to produce covers that could deliver special messages to individuals who, for example, were devoted to a particular project or had influenced others in the field of botany. We started presenting "silent tributes" with our last issue, and have decided to make these tributes known, beginning with this issue. Nancy Hart-Stieber, the artist responsible for the Mead's milkweed and leafy prairie clover drawings, has donated a great deal of time to the Illinois Native Plant Society in creating these drawings. We have received numerous requests from all over the nation for the Mead's milkweed drawing to be reproduced in magazines, newspaper articles, bulletins for threatened and endangered species, and thank-you cards for outstanding accomplishments in natural areas work. We expect the same for the leafy prairie clover after the release of this issue. We applaud Nancy for her excellent work and thank her for being so giving.

On the front inside cover of this and following issues, you will find tributes to those whom we'd like to thank for their contributions to Illinois' native flora. We would also like to share with you the "silent tribute" that went with the Mead's milkweed drawing.

The Mead's milkweed cover illustration is a tribute to Robert F. Betz for his hard work and perseverance in saving and restoring Illinois prairie. Bob's efforts in Illinois' Mead's milkweed project is greatly appreciated.

Harbinger-of-Spring OR Pepper and Salt
Erigenia bulbosa

Spring Beauty
Claytonia virginica

Guidelines for Manuscripts Submitted to *Erigenia* for Publication

Manuscripts pertaining to the native flora of Illinois and adjacent states, natural areas, gardening/landscaping with native plants, new distribution records, threats to native species, and related topics are accepted for publication. At least one author must be a member of the Illinois Native Plant Society, otherwise a $25.00 fee will be charged. Non-technical papers from the membership are encouraged. Authors will be charged $15.00 per printed page to help defray the costs of publication. Black and white photos are also accepted. Cost of each photo to the author is $20.00. These charges may be waived upon written request to the editor. Book reviews and art work will be published at no charge when space permits.

Manuscripts submitted to *Erigenia* for publication should be double-spaced throughout except for Literature Cited or References. Three copies must be submitted; photo copies of original manuscripts are acceptable during the review process. Pages should be numbered, and tables and figures should be numbered consecutively. Longer articles should follow as much as possible this general format: abstract, introduction, materials and methods, results, discussion, summary, acknowledgments, and literature cited. Titles of journals should be spelled out completely. The style for citing literature is that of the most recent issue of *Erigenia*. All measurements should be expressed in metric units with English equivalents when appropriate.

Each manuscript received will be reviewed by three or more members of the editorial board or outside reviewers. After review, authors will be notified of the acceptance or rejection of manuscripts. Accepted articles will be returned to authors for revision. *Erigenia* is prepared on a Personal Computer using WordPerfect 5.1. If a manuscript is prepared on a word processor, the editor will furnish the author with basic instructions to simplify program conversions.

Manuscripts and inquiries should be sent to:

Elizabeth L. Shimp
U.S.D.A. Forest Service
Shawnee National Forest
901 S. Commercial St.
Harrisburg, IL 62946

Printed on Recycled Acid-free Paper

Illinois Native Plant Society
Forest Glen Preserve
R.R. # 1, Box 495A
Westville, IL 61883

ADDRESS CORRECTION REQUESTED

ERIGENIA | *November 1992*

Contents