NETTIE HART MEMORIAL WOODLAND, ILLINOIS: PRESENT COMPOSITION AND CHANGES IN COMMUNITY STRUCTURE

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ABSTRACT.—An inventory of the woody vegetation of Nettie Hart Memorial Woodland in Champaign County, Illinois, has been conducted at approximately 10-year intervals from 1965 to 1995. Over this 30-year span, white oak, black oak, and northern red oak remained the most prominent components of the overstory community. At present, white oak and black oak are the major dominants. Northern red oak is decreasing in importance, while silver maple, American elm, slippery elm, and black cherry have all gained prominence. The hickory species have remained relatively stable since 1965.

Hart Memorial Woodland is a 13-ha woodland located along the Sangamon River near Mahomet in Champaign County, Illinois. The woodland was probably selectively harvested sometime during the period 1834 to 1854 (Johnson and Bell 1975). Since that time the woodland has re-mained relatively undisturbed. Hart Memorial Woodland is a xerophytic upland streamside forest within the Prairie Peninsula of east-central Illinois as described by Braun (1950). Stream systems were the major migratory pathways of woody species into Illinois prairies after glaciation (Gleason 1923).

There are two general types of upland forests in east-central Illinois: those occurring along major streams and rivers, and those extending into the prairie or isolated from other main bodies of timber. Upland sites bordering streams in east-central Illinois have been occupied by forest vegetation for a sufficient period of time to allow the development of alfisols distinct from the predominant mollisols (Boggess and Geis 1967). In other central Illinois forests, oak and hickory species are being replaced by the more shade tolerant mesic species such as sugar maple (*Acer saccharum* Marsh.) (Boggess and Geis 1967, Boggess and Bailey 1962, Edgington 1991).

Hart Memorial Woodland is unique regionally in that it is one of only a few that has been regularly inventoried since 1965 when acquired by the University of Illinois. This has provided a direct means of documenting vegetational changes through repeated sampling of permanent plots. The first inventory of Hart Memorial Woods was completed in 1965 (Root and others 1971). The second inventory was completed in 1977 (Johnson and others 1978). The third inventory was completed by Edgington in 1987 (unpublished). The most recent inventory of the woodland was completed in 1995 and will be used to describe the current species composition and structure and contrast these stand characteristics with those of the past.

STUDY AREA

Hart Memorial Woodland is located at 40º 14′ north latitude and 88º 21′ west longitude, Champaign County, IL. Elevation change is 9.4 m from the bottomland to the upland with a general slope of 30 degrees in the transition. The Sangamon River runs along the east border of the woodland and is subject to periodic flooding. Two small intermittent streams intersect the woodland.

The uplands of Hart Memorial Woodland consist mainly of Alfisols that developed in loess under the influence of forest vegetation. These soils are moderately well drained to well drained. The bottomland soils consist of Mollisols developed in stratified loamy alluvium on flood plains or low terraces of large streams under prairie

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vegetation. These soils are somewhat poorly drained to poorly drained (Mount 1982).

METHODS

Sampling and analysis procedures follow those of Root and others (1971). The forest is divided into fifty-two 50 m² (0.25 hectare) permanently marked blocks. Each of the 52 blocks is divided into quadrants by extending diagonal lines from the permanent corner markers resulting in a total of 208 plots. In each quadrant, the diameter of each stem greater than 6.4 cm diameter at breast height (dbh) was measured to the nearest 2.5 cm and recorded by species. The dbh of dead standing trees was also tallied and identified when possible.

Nested, square subplots of 5 m² and 2 m² were systematically located in quadrant 1 of each of the 52 blocks. Stems greater than 1.3 cm dbh (saplings) were measured in the 5 m² subplot and recorded by species and diameter classes of 2.5 cm and 5.0 cm. In the 2 m² subplot, all stems less than 1.3 cm dbh (seedlings) were measured and recorded by species. Height classes of less than 30.5 cm and greater than 30.5 cm, were used to differentiate the seedling sizes.

Frequency, density, and basal area were calculated for each species. Seedling and sapling frequencies were expressed as percentages of occurrence on 52 sample plots. Importance values for all tree species were developed from the sum of the relative density and relative basal area (McIntosh 1957). Nomenclature follows Mohlenbrock (1975).

RESULTS

A total of 31 woody species were tallied in 1995. These 31 species accounted for a total of 7,484 trees or 576 stems/hectare. The top 13 species are listed in table 1, along with their density and basal area, by diameter class and are ranked by their importance value.

The total basal area of the woodland was found to be 402.74 m² or 30.98 m²/ha. White oak (*Quercus alba* L.), black oak (*Quercus velutina* L.), and northern red oak (*Quercus rubra* L.) accounted for 68 percent of the total basal area. White oak ranked first in importance value and accounted for 148.51 m² or 36 percent of the total basal area (table 1). The majority of this (65 percent) came from the 31 to 60 cm diameter class. Black oak ranked second in importance value followed by northern red oak. Silver maple (*Acer saccharinum* Marsh.) ranked fourth in importance value and in basal area with 35.58 m². The species was well represented in all diameter classes.

Table 1.—*Subplot densities and percent frequencies of Hart Memorial Woodland, 1995*

Common name	Seedlings <1.27cm		Saplings >1.27cm	
	#/ha	Freq.	#/ha	Freq.
White oak	47	2	15	4
Slippery elm	2,740	38	109	19
American elm	1,586	8	146	21
Green ash	289	8	7	2
Black cherry	482	8	69	13
Sassafras	193	4	15	4
Hackberry	0	0	15	4
Bitternut hickory	961	25	7	2
Mockernut hickory	96	4	62	10
Shagbark hickory	47	2	30	6
Boxelder	47	2	0	0
Eastern redbud	0	0	7	2
Shingle oak	0	0	7	2
Dogwood spp.	193	6	7	2
Other	1,154	8	0	0
Total	7,836		497	

Slippery elm (*Ulmus rubra* L.) and American elm (*Ulmus americana* L.) ranked fifth and sixth in importance value and accounted for 33.50 m² of basal area collectively (table 1). The majority of this was attributable to trees in the smaller diameter classes (7 to 15 cm and 16 to 30 cm). Green ash (*Fraxinus pennsylvanica* Marsh.) ranked seventh in importance value followed by black cherry (*Prunus serotina* Ehrh.). The majority of the green ash trees were in the 7 to 15 cm and 16 to 30 cm diameter classes with the majority of black cherry being in the 7 to 15 cm diameter size class.

The seedling density of all species combined was 7,836 seedlings/hectare and sapling density was 497 saplings/hectare (table 2). The elm species accounted for 55 percent of the seedling density and 51 percent of the sapling density. Bitternut hickory (*Carya cordiformis* Wang.) accounted for 12 percent of the seedlings. Black cherry accounted for 14 percent of the sapling density. Other seedlings and saplings were green ash, sassafras (*Sassafras albidum* (Nutt.) Nees.), dogwood (*Cornus* spp.), mockernut hickory (*Carya tomentosa* Poir.), and shagbark hickory (*Carya ovata* Mill.). Boxelder (*Acer negundo* L.) occurred only in the seedling size class and hackberry (*Celtis occidentalis* L.) was only in the sapling size class. Of the oak species, only white oak was in the seedling and sapling size class.

Table 2.—*Number of trees, basal area (m^2), and importance values by diameter class of Hart Memorial Woodland, 1987-1995*

Diameter class (cm)	7 to 15		16 to 30		31 to 60		61 to 90		>91		Total		IV
	No.	BA	No.	BA	No.	BA	No.	BA	No.	BA	No.	BA	
1995 SURVEY:													
White oak	37	0.52	328	16.31	595	97.08	89	33.84	1	0.77	1,050	148.51	37.0
Black oak	1	0.00	6	0.37	246	51.26	85	32.65	2	1.81	340	86.10	21.4
Northern red oak	8	0.07	5	0.27	56	11.44	63	25.94	3	2.20	135	39.92	9.9
Silver maple	290	2.71	164	6.54	68	9.86	28	11.91	5	4.56	555	35.58	8.9
Slippery elm	1,698	14.24	165	5.73	14	1.79	0	0.00	0	0.00	1,877	21.77	5.7
American elm	870	6.04	81	3.27	19	2.42	0	0.00	0	0.00	970	11.73	3.0
Green ash	59	0.55	46	2.03	27	4.49	6	2.35	0	0.00	138	9.42	2.4
Black cherry	664	5.26	72	2.34	14	1.76	0	0.00	0	0.00	750	9.37	2.4
Black walnut	47	0.51	37	1.76	31	4.94	2	0.74	0	0.00	117	7.95	2.0
Sassafras	713	5.12	23	0.72	0	0.00	0	0.00	0	0.00	736	5.84	1.5
Hackberry	95	0.84	37	1.47	14	2.36	3	1.12	0	0.00	149	5.78	1.5
Bitternut hickory	53	0.45	20	0.94	19	2.68	2	0.71	0	0.00	94	4.78	1.2
Bur oak	9	0.07	0	0.00	3	0.59	5	2.35	0	0.00	17	3.01	0.7
All other species[1]	446	3.50	73	2.95	33	5.03	4	1.51	0	0.00	556	12.99	3.3
1995 Totals	4,990	39.89	1,057	44.70	1,139	195.70	287	113.12	11	9.34	7,484	402.74	
1987 SURVEY:													
White oak	61	0.85	418	23.32	631	100.68	69	25.44	1	0.69	1,180	148.20	37.5
Black oak	2	0.02	9	0.56	316	63.28	70	26.88	0	0.00	397	90.74	22.9
Northern red oak	9	0.07	10	0.49	92	18.22	59	23.72	1	0.69	171	43.19	10.9
Silver maple	366	3.34	126	5.07	62	9.86	21	8.76	3	2.61	578	29.64	7.5
Slippery elm	1,622	12.38	95	3.22	9	0.91	2	0.77	0	0.00	1,728	17.28	4.6
Green ash	101	0.87	51	2.14	28	4.32	10	3.82	0	0.00	190	11.14	2.8
American elm	708	4.90	67	2.88	16	1.76	0	0.00	1	0.77	792	10.20	2.7
Black cherry	712	5.18	54	1.85	14	1.87	0	0.00	0	0.00	780	8.90	2.3
Black walnut	59	0.55	31	1.22	32	4.76	3	1.26	0	0.00	125	7.79	2.0
Sassafras	852	5.54	21	0.66	0	0.00	0	0.00	0	0.00	873	6.20	1.7
Hackberry	101	0.87	32	1.30	14	2.08	2	0.71	0	0.00	149	4.95	1.3
Bitternut hickory	33	0.27	19	0.84	12	1.86	1	0.37	0	0.00	65	3.34	0.9
Bur oak	1	0.01	5	0.22	3	0.45	5	2.36	0	0.00	14	3.04	0.8
All other species	349	2.84	69	2.76	37	5.52	3	1.15	0	0.00	458	12.26	3.1
1987 Totals	4,976	37.67	1,007	46.53	1,266	215.55	245	95.05	6	51.37	7,500	396.87	
1977 SURVEY:													
White oak	102	1.47	595	29.16	601	96.34	49	19.50	1	0.79	1,348	147.27	40.8
Black oak	4	0.03	7	0.42	266	50.90	53	19.43	0	0.00	330	70.78	19.5
Northern red oak	4	0.03	37	2.13	203	35.88	56	23.31	1	0.88	301	62.22	17.2
Silver maple	212	1.94	68	2.81	52	9.67	11	4.60	4	3.92	347	22.94	6.4
Slippery elm	864	5.96	59	2.23	9	1.33	1	0.48	0	0.00	933	10.01	2.9
Green ash	29	0.29	18	0.90	29	5.79	4	1.47	0	0.00	80	8.44	2.3
Black cherry	490	3.34	34	1.46	14	1.82	0	0.00	0	0.00	538	6.62	1.9
American elm	399	2.82	52	1.93	6	0.79	0	0.00	0	0.00	457	5.54	1.6
Mockernut hickory	36	0.33	24	1.08	20	2.91	1	0.34	0	0.00	81	4.65	1.3
Black walnut	25	0.22	9	0.49	25	3.37	1	0.34	0	0.00	60	4.42	1.2
Hackberry	89	0.80	26	1.11	13	1.69	1	0.36	0	0.00	129	3.98	1.1
Shagbark hickory	105	0.80	32	1.32	9	1.00	0	0.00	0	0.00	146	3.12	0.9
Sassafras	377	2.15	19	0.63	0	0.00	0	0.00	0	0.00	396	2.78	0.8
All other species	166	1.45	28	1.15	31	4.73	6	2.53	1	0.84	232	10.70	3.0
Total	2,902	21.63	1,008	46.81	1,278	216.22	183	72.37	7	6.43	5,378	363.47	

[2] See Appendix 1 for a list of “all other species” in Hart Memorial Woodland, 1995.

Shingle oak (*Quercus imbricaria* Michx.) was present in the sapling size class.

The 1995 inventory recorded 339 dead standing trees, or 26 stems/hectare. American elm and slippery elm accounted for 47 percent of the dead standing trees. The majority of these trees were in the 7 to 15 cm and 16 to 30 cm diameter classes.

DISCUSSION

Prior to 1995 three other inventories were conducted at Hart Memorial Woods. Raw data from the 1965 inventory were not available so comparisons were made with the inventory values derived by Root and others (1971). Table 1 lists importance values of each diameter class of the top 13 ranked species since the 1977 inventory. The species are ranked from highest to lowest by importance values from each inventory.

White oak, black oak, and northern red oak have had the highest importance values in all inventories (fig. 1). They have remained the dominant species with a combined basal area of 274.53 m^2 in 1995. This is similar to the 245.35 m^2 of basal area in 1965 measured by Root and others (1971) as well as the 280.27 m^2 measured in 1977 by Johnson and others (1978) and the 282.13 m^2 of basal area obtained by Edgington in 1987 (unpublished).

In the last three inventories, white oak accounted for over 50 percent of the total basal area. The majority of this basal area was in the 31 to 60 cm diameter class for all three inventories. Although white oak has decreased in number of stems in the 7 to 15 cm and 16 to 30 cm diameter classes, it remains the only oak species well represented in these diameter classes. White oak has increased in number of stems and basal area in the 61 to 90 cm diameter class due to recruitment from the 31 to 60 cm diameter class.

Black oak accounted for 86.1 m^2 of basal area in 1995; the majority of this basal area is in the 31 to 60 cm diameter class. However, compared to 1977, black oak has decreased in number of stems in the 31 to 60 cm diameter class, but has increased in the 61 to 90 cm and 91+ cm diameter classes. Since 1977, black oak has increased in total basal area with a net gain of 15.32 m^2.

In 1995, northern red oak accounted for 39.92 m^2 of basal area. The majority of this basal area was in the 61 to 90 cm diameter class. Northern red oak has shown a steady decrease

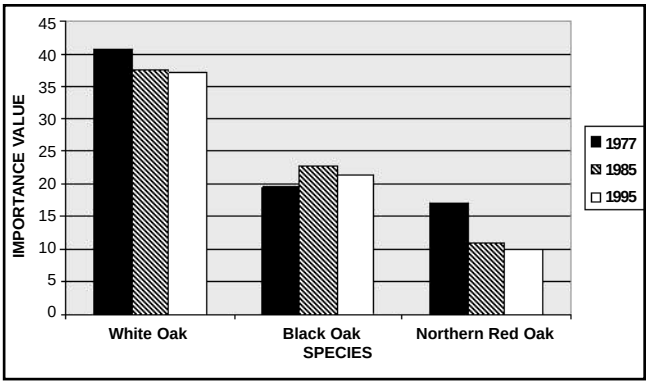

Figure 1.—*Three tree species with the highest importance values in Hart Memorial Woodland*.

in number of stems and basal area in all diameter classes except for the 61 to 90 cm and 91+ cm diameter classes. Since 1977, northern red oak has decreased in total number by more than 55 percent. White oak may begin to increase in importance due to its high number of total stems as the large northern red oaks and black oaks die.

Silver maple has increased in number of stems since 1977 with the greatest increase occurring in the 16 to 30 cm diameter class. The importance value of silver maple has remained fourth in rank, but it has increased by an average of 1.25 per inventory since 1977. Since total numbers have increased and 1.94 ha of Hart Woods is a bottomland woodland, silver maple is likely to continue its slow increase.

Slippery elm and American elm have maintained stable importance values in the smaller diameter classes although neither species has attained diameters greater than 61 cm due to high mortality of smaller individuals. It does not appear that either species will form an important component of the future overstory, presumably due to the prevalence of Dutch elm disease and phloem necrosis in the region and the consequent mortality of young trees. With the elm species comprising more than 50 percent of the seedling and sapling recruitment, it seems likely that they will have a negative effect on the regeneration of shade intolerant species such as the oaks and hickories.

The hickory species have maintained their importance, collectively, but have remained a small component of the overstory. They remain an important component in the smaller diameter classes, but only bitternut hickory has increased in importance in diameter classes above the 7 to 15 cm class. There are high numbers of

seedlings and saplings of hickory spp. so their importance may begin to increase in the smaller diameter classes. Unless more hickories grow to reach the middle diameter classes, any canopy gaps created will likely be filled by other species. The hickories will probably remain a minor component of the overstory for some time since there are only two hickories with a dbh greater than 61 centimeters.

Sassafras has maintained importance in the sapling stage and has increased since 1977 in the 7 to 15 cm diameter class, as well as the 16 to 30 cm diameter class. Sassafras is classified as intolerant of shade at all ages (USDA Forest Service 1965). The presence of sassafras suggests that the stand was more open at one time. Those sassafras that have established a position in the canopy are expected to maintain their position in the canopy. Due to its intolerance, sassafras recruitment is expected to be suppressed without the creation of canopy gaps.

Hart Memorial Woodland will likely continue to be dominated by white oak and black oak into the near future. Oak regeneration may continue to be suppressed lacking future disturbance. Northern red oak is declining in importance and may continue to do so due to poor seedling and sapling recruitment. Whether white oak will gain importance by filling canopy gaps created by mortality of large northern red oak and black oak can be predicted due to its greater longevity. Silver maple may increase in importance in the flood plain portion of the site as it continues to have high recruitment into larger diameter classes.

The current inventory indicates a continuing trend towards white oak and black oak dominance, which is in contrast to other nearby forests that show a shift towards more mesic species, especially sugar maple. The total absence of sugar maple from the forest is in marked contrast to the situation in other forests of east central Illinois as described by Boggess and Geis 1967, Boggess and Bailey 1962, and Edgington 1991. The reason for the absence of sugar maple in Hart Memorial Woodland is not known. Continued inventories will be necessary in order to further document species composition and changes in community structure of Hart Memorial Woodland.

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APPENDIX 1

Reference to "all other species" measured in Hart Memorial Woodland, 1995.

Common name	Scientific name
Mockernut hickory	*Carya tomentosa* (Poir.) Nutt.
Honeylocust	*Gleditsia triacanthos* L.
Shagbark hickory	*Carya ovata* (Mill.) K. Koch.
American basswood	*Tilia americana* L.
American sycamore	*Platanus occidentalis* L.
Boxelder	*Acer negundo* L.
Hawthorn spp.	*Crataegus* spp. L.
Eastern redbud	*Cercis canadensis* L.
Shingle oak	*Quercus imbricaria* Michx.
Ironwood	*Ostrya virginiana* (Mill.) K. Koch.
White ash	*Fraxinus americana* L.
Pawpaw	*Asimina triloba* L.
Mulberry spp.	*Morus* spp. L.
Kentucky coffeetree	*Gymnocladus dioicus* (L.) K. Koch.
Eastern cottonwood	*Populus deltoides* Marsh.
Osage-orange	*Maclura pomifera* L.
Ohio buckeye	*Aesculus glabra* Willd.
Dogwood spp.	*Cornus* spp. L.