

Change in Community Attributes Due to High Water Damage in Spicer Lake Nature Preserve, St. Joseph County, Indiana.

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The 16 ha Spicer Lake Nature Preserve is located in the extreme northwest corner of St. Joseph County, Indiana. Bordered by State Line Road on the north and County Line Road on the west, the preserve lies approximately 3.5 miles north of New Carlisle, Indiana (NW¼, SW¼, Sec. 10, T38N, R1W, New Carlisle, Indiana, 7.5' USGS Quadrangle). Lindsey et al. (3) formally recognized the area in 1969 as one of Indiana's 150 outstanding natural areas. Currently administered by the St. Joseph County Parks and Recreation Department, the area has long been recognized for its intrinsic value as representative of a natural ecosystem.

Spicer Lake lies within the southeastern boundary of the Valparaiso end moraine formed approximately 15,000 years ago by the Lake Michigan lobe of the Wisconsin Ice Sheet (6). Most of the preserve lies within a partially filled, level basin. Of the total 16 ha preserve areas, approximately 14.5 hectares are terrestrial. The major soil type (approximately 10 ha) is Houghton muck. Other soil types within the preserve include Palms muck, Washtenaw silt loam and Milford silty clay loam. These are all poorly drained soil types which have high year-round water tables within the preserve area (1).

The major plant communities within the study area are red maple swamp forest, a small sedge marsh and succession zones surrounding the open waters of Spicer Lake. The majority of our study was conducted in the undisturbed red maple forest which presently exhibits heavy understory growth of jewelweed (*Impatiens capensis* Meerb.) and beggars ticks (*Bidens* sp.) arising from a recent increase of light at the forest floor level. Red maple (*Acer rubrum*) dominates the canopy layer. A more detailed survey of the major plant types within the Spicer Lake Nature Preserve area can be found in Riemenschneider (4).

Spicer Lake lies within the headwater basin of Dowling Creek. In 1925 the Circuit Court established Sandmeir Ditch, a hand dug channel from Spicer Lake to Dowling Creek, as a legal drain. The main portion of the ditch extended approximately 2,440 m and was dug with 1.22 m of fall. Since its establishment, the ditch has not been maintained causing a slowing of drainage from the lake area.

During 1981 and 1982 increased precipitation caused extensive flooding of the Spicer Lake Nature Preserve. The objectives of our study were to describe the present forest community and to determine the impact of high water levels on the community and individual tree species.

Methods

Circular plots were used for the study with the plot coordinates being chosen from a random numbers table. A grid for the study area was established by using the north and west preserve boundary lines and the surveyor's mark in the intersection of State Line and County Line Roads as the 0 point. Those random points falling

within the lake area or within 30 meters of the study area edges were discarded. Plots were located using a pocket transit and 50 m tape measure. The locations of the plots sampled are shown in Figure 1.

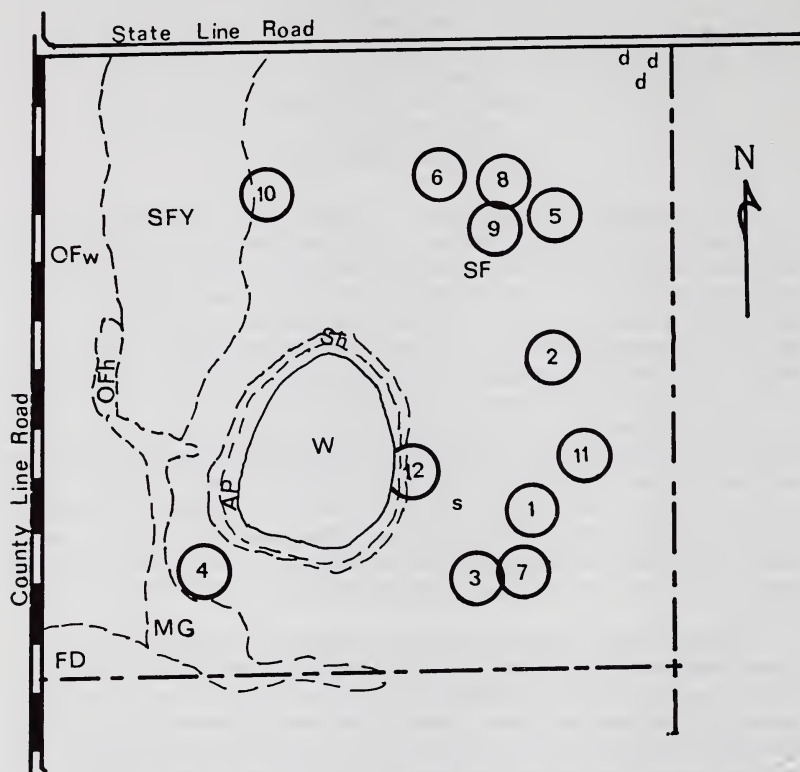


FIGURE 1. Location of 12 circular, 0.1 ha random plots and plant communities in Spicer Lake Nature Preserve, St. Joseph County, Indiana. Symbols indicate plant communities as follows: AP, pond lily - swamp loosestrife; FD, upland forest; MG, sedge marsh; OFh, herbaceous old field; OFw, woody old field; SF, old swampforest (s - Swampy, d - drier), SFY, young swamp forest; and Sh, shrub.

Each plot was marked in the center and at each cardinal point with a fiberglass rod and a flag bearing the plot number. Each plot had a radius of 17.84 meters. Plots were inventoried during the period from fall 1983 through fall 1984, and all the standing stock with a dbh equal to or greater than 5 cm was recorded. Both live and dead stock were recorded in order to determine high water impact through comparisons of statistics for alive and dead individuals. Also, data collected prior to flooding in the southern one-half of the preserve provided an additional reference. The species, status (alive or dead), and dbh were recorded for each individual. The field data were transcribed to a computer disk for storage and analysis.

Results and Discussion

The summary statistics for the 12 random plots inventoried are shown in tables 1 through 3. The statistics given are for alive (Table 1), dead (Table 2) and combined (Table 3) species.

TABLE 1. Community parameters for living individuals 5+ cm dbh in twelve random quadrats in Spicer Lake Nature Preserve, St. Joseph County, Indiana.

Species (1)	D1	B1	Vegetation attributes (2)			F2	IV
			F1	D2	B2		
Acru	230.8	13.7	100.0	47.7	85.9	29.5	54.4
Fagr	0.8	0.0	8.0	0.2	0.0	2.4	0.8
Fram	0.8	0.0	8.0	0.2	0.0	2.4	0.8
Frni	42.5	0.3	50.0	8.8	2.0	14.7	8.5
Litu	0.8	0.0	8.0	0.2	0.0	2.4	0.9
Nysy	1.7	0.1	8.0	0.3	0.4	2.4	1.0
Prse	6.7	0.3	33.0	1.4	1.8	9.7	4.3
Saal	16.7	0.6	33.0	3.4	4.1	9.7	5.8
Ulmu	188.3	0.9	91.0	37.9	5.7	26.8	23.5
Total	484.2	15.9					

1. Acru, *Acer rubrum*; Fagr, *Fagus grandifolia*; Fram, *Fraxinus americana*; Frni, *Fraxinus nigra*; Litu, *Liriodendron tulipifera*; Nysy, *Nyssa sylvatica*; Prse, *Prunus serotina*; Saal, *Sassafras albidum*; Ulmu, *Ulmus americana* and *U. rubra*.

2. Attributes are: D1, density in numbers per meters squared; B1, basal area in meters squared per ha; F1, frequency in percent; D2, relative density; B2, relative basal area; F2, relative frequency; IV, importance value.

TABLE 2. Community parameters for standing dead individuals 5+ cm dbh in 12 random quadrats in Spicer Lake Nature Preserve, St. Joseph County, Indiana.

Species (1)	Vegetation attributes (2)			Percent total stems (3)	
	D1	B1	F1	Density	Basal Area
Acru	80.8	6.1	91.0	26	31
Frni	12.5	0.1	41.0	23	25
Prse	89.2	5.6	50.0	93	95
Quru	1.7	0.1	16.0	100	100
Saal	5.8	0.2	16.0	26	22
Ulmu	13.3	0.1	49.0	7	10
Totals	203.3	12.2		3Q	43

1. Acru, *Acer rubrum*; Frni, *Fraxinus nigra*; Prse, *Prunus serotina*; Quru, *Quercus rubra*; Saal, *Sassafras albidum*; Ulmu, *Ulmus americana* and *Ulmus rubra*.

2. Attributes are: D1, density in number per meters squared; B1, basal area in meters squared per ha; F1, frequency in percent.

3. The two columns under this heading represent the percent of standing stems or standing basal area that was dead at time of inventory.

As is shown by the importance values given in tables 1 through 3, red maple and elm (*Ulmus* sp.) clearly dominated the plots sampled. As indicated by the frequency data in table 3, red maple was present in all plots sampled while elm occurred in 91 percent of the sampled plots. Other species occurring in over half the plots include black ash (*Fraxinus nigra*) and wild black cherry (*Prunus serotina*). Individuals

TABLE 3. Combined community parameters for all standing stems 5+ cm dbh in 12 random quadrats in Spicer Lake Nature Preserve, St. Joseph County, Indiana.

Species (1)	D1	B1	Vegetation attributes (2)				IV
			F1	D2	B2	F2	
Acru	311.7	19.8	100.0	45.3	70.4	26.3	47.4
Fagr	0.8	0.0	8.0	0.1	0.0	2.1	0.7
Fram	0.8	0.0	8.0	0.1	0.0	2.1	0.7
Frni	55.0	0.4	58.0	8.0	1.4	15.3	8.2
Litu	0.8	0.0	8.0	0.1	0.0	2.1	0.8
Nysy	1.7	0.1	8.0	0.2	0.2	2.1	0.9
Prse	95.8	5.9	50.0	13.9	20.9	13.2	16.0
Quru	1.7	0.1	16.0	0.2	0.2	4.2	1.5
Saal	22.5	0.9	33.0	3.3	3.2	8.7	5.0
Ulm	196.7	1.0	91.0	28.6	3.7	24.0	18.8

1. Acru, *Acer rubrum*; Fagr, *Fagus grandifolia*; Fram, *Fraxinus americana*; Frni, *Fraxinus nigra*; Litu, *Liriodendron tulipifera*; Nysy, *Nyssa sylvatica*; Prse, *Prunus serotina*; Quru, *Quercus rubra*; Saal, *Sassafras albidum*; Ulmu, *Ulmus americana* and *Ulmus rubra*.

2. Attributes are: D1, density in number per meters squared; B1, basal area in meters squared per ha; F1, frequency in percent; D2, relative density; B2, relative basal area; F2, relative frequency; IV, importance value.

of beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), tuliptree (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), red oak (*Quercus rubra*) and sassafras (*Sassafras albidum*) were present in less than half the plots. Red oak occurred only in the dead stem calculations.

Comparison of our data to the pre-flood data shown in table 4 indicates that a drop in basal area has occurred for red maple since the flooding period. In the pre-flood data a basal area of 19.9 was shown versus the 13.7 basal area shown in our study. However, even though there is a drop in the basal area, the change in densities indicates that the red maple is replacing itself with individuals in the lower size classes. Pre-flood density for red maple was 196.4 compared to a density of 230.8 in our study. Elm is showing much replacement also. Although there is a decrease in the basal area of this species since the point quarter study, a large increase is seen in its density. Pre-flood density for elm was 19.2 compared to the density 188.3 shown in our study.

TABLE 4. Community parameters for 14 random point quarter plots collected in 1979 in Spicer Lake Nature Preserve, St. Joseph County, Indiana.

Species (1)	D1	B1	Vegetation attributes (2)				IV
			F1	D2	B2	F2	
Acru	196.4	19.9	92.8	71.9	75.8	54.2	67.3
Fram	4.8	0.3	7.1	1.8	1.0	4.2	2.3
Frni	23.9	1.3	28.6	8.8	4.9	16.7	10.1
Prse	19.2	2.2	14.3	7.0	8.4	8.3	7.9
Quru	4.8	0.3	7.1	1.8	1.1	4.2	2.3
Saal	4.8	0.5	7.1	1.8	2.0	4.2	2.6
Ulm	19.2	1.8	14.3	7.0	6.9	8.3	7.4

1. Acru, *Acer rubrum*; Fram, *Fraxinus americana*; Frni, *Fraxinus nigra*; Prsu, *Prunus serotina*; Quru, *Quercus rubra*; Saal, *Sassafras albidum*; Ulmu, *Ulmus americana* and *Ulmus rubra*.

2. Attributes are: D1, density in numbers per meters squared; B1, basal area in meters squared per ha; F1, frequency in percent; D2, relative density; B2, relative basal area; F2, relative frequency; IV, importance value.

Of the major species within the study area, wild black cherry exhibited the greatest damage due to flooding. It originally occurred in half the plots sampled, but exhibited an almost 100 percent die-off and, as shown in table 2, formed the largest density of the dead species even though it is present almost entirely within the northeast sector of the preserve. This area, besides being better drained, also suits the wild black cherry's preference to soil which is deep (2).

The range of the high water impact is also evident through calculations of the percentage of dead standing stock for the major species. Red oak shows the highest percentage of standing dead stock at 100%, followed by wild black cherry with 93.0%, red maple with 25.9%, sassafras with 25.9% and black ash with 22.7%. The one exception among the major species is elm which shows a standing dead stock of 6.8%. However, elm is represented primarily in the lower size classes and has increased since the flooding period. Also interesting is that of the live standing stock 83 percent is represented in the 10 cm or under size classes. The percentage still alive of the total stems then drops to 55 percent or less for size classes of 20 cm and above.

Schmeltz and Lindsey (5) reported that past disturbance is indicated by major deviations from a straight line in a log of number of individuals versus size class graph. The density versus size class graph for Spicer Lake (Figure 2) indicates at least one major disturbance in the past. High water, as indicated in present study, is only one of several factors that may explain past disruptions in community structure.

From studies conducted on other natural areas in Indiana it can be noted that the Spicer Lake Nature Preserve exhibits a species distribution common to systems of similar type. This is evident when one compares the data from our study to data collected on the L. Bender Preserve in central Indiana, a preserve which is also swamp forest on muck soil (3). Since the study area exhibits a common species distribution, high water onset in areas of similar soil structure would probably result in similar selected species die-off and replacement.

Summary

Flooding of the Spicer Lake Nature Preserve located in St. Joseph County, Indiana has caused some selected species die-off. The species most affected by the flooding was the wild black cherry. Also showing a large amount of damage from the flooding was red maple. Other species within the study area exhibited selected changes in their attributes.

Acknowledgments

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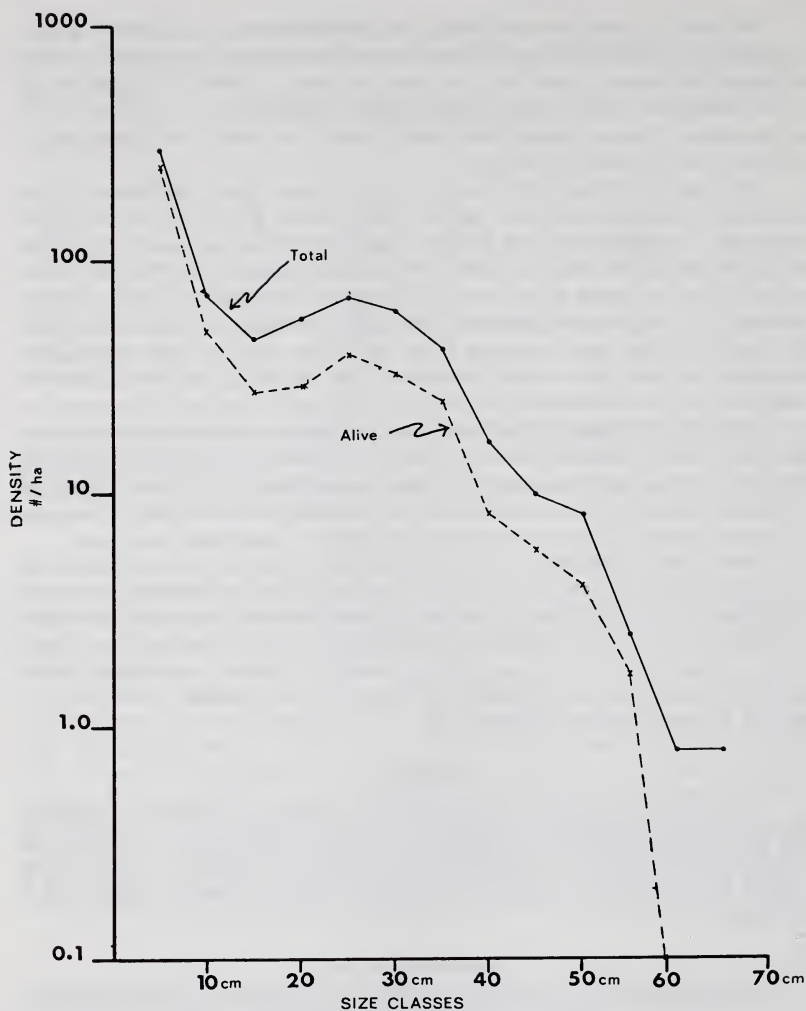


FIGURE 2. Density distribution of standing woody individuals equal to or greater than 5 cm dbh in Spicer Lake Nature Preserve by 5 cm size classes. Total includes both the alive and dead stems while lower curve represents alive stems.

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