Plankton and Benthos of Spicer Lake

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Introduction

Spicer Lake Nature Preserve was dedicated May 31, 1978, under the Indiana Nature Preserve Act of 1967, (Burns Indiana Statutes, 14-4-5; p. 433). The area was purchased by the nature Conservancy in junction with the South Bend Audubon Society and a federal grant to the Saint Joseph County Parks and Recreation Board. The Saint Joseph County Park and Recreation Board in cooperation with the Division of Nature Preserve of the Indiana Department of Natural Resources controls and operates the Spicer Lake Nature Preserve.

This kettle-hole swamp forest preserve, approximately 16 hectares, located in the extreme northwest corner of Saint Joseph County (Fig. 1), was recognized by Lindsey et al. (2) as an outstanding natural aquatic and terrestrial ecosystem. The circular Spicer Lake, 2 hectares

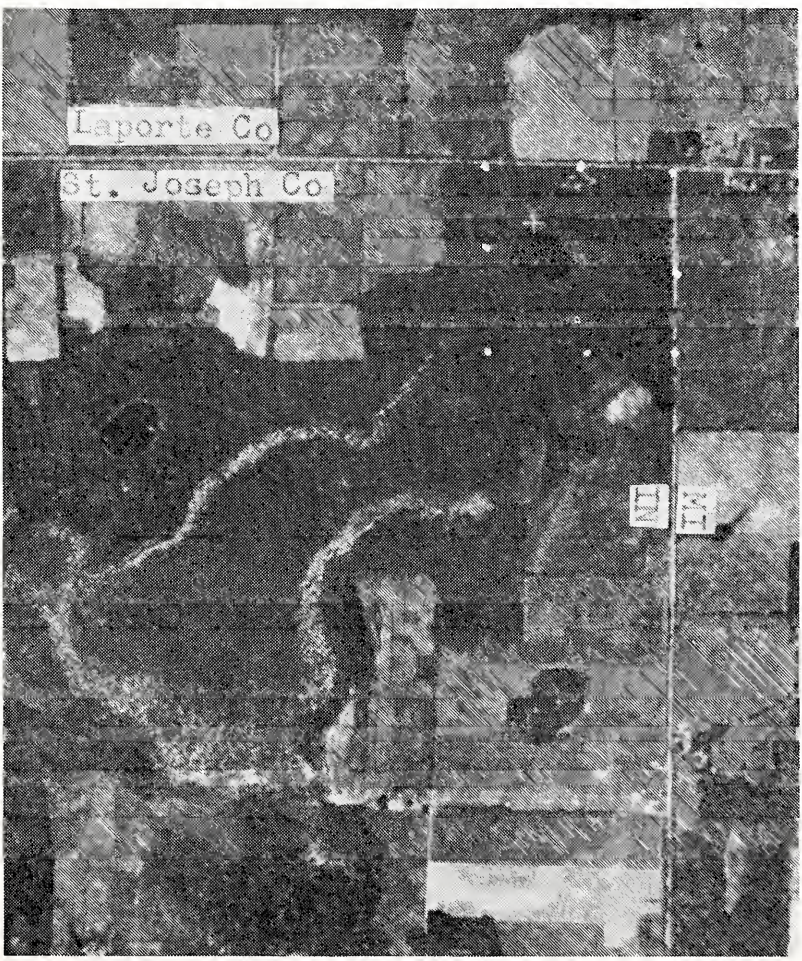

FIGURE 1. *Spicer Lake Nature Preserve (+ Spicer Lake)*

in area and a maximum depth of 6.1 m, is bordered by a uniform floating mat of vegetation 4 to 8 m wide (Fig. 2). The mat consists primarily of yellow pond lily, *Nuphar advena*, and swamp loosestrife, *Decodon verticillatus* var *laevigatus*. Dodder, *Cuscuta gronovii*, bladderwort, *Utricularia* and hornwort *Ceratophyllum demersum* are common in the floating mat.

This study pertains primarily to the plankton and benthos in the open water area from the inner edge of the floating mat to the center of the lake. Chemical analyses of the bottom materials from the center of the lake, light measurements and temperature—oxygen profiles are also included.

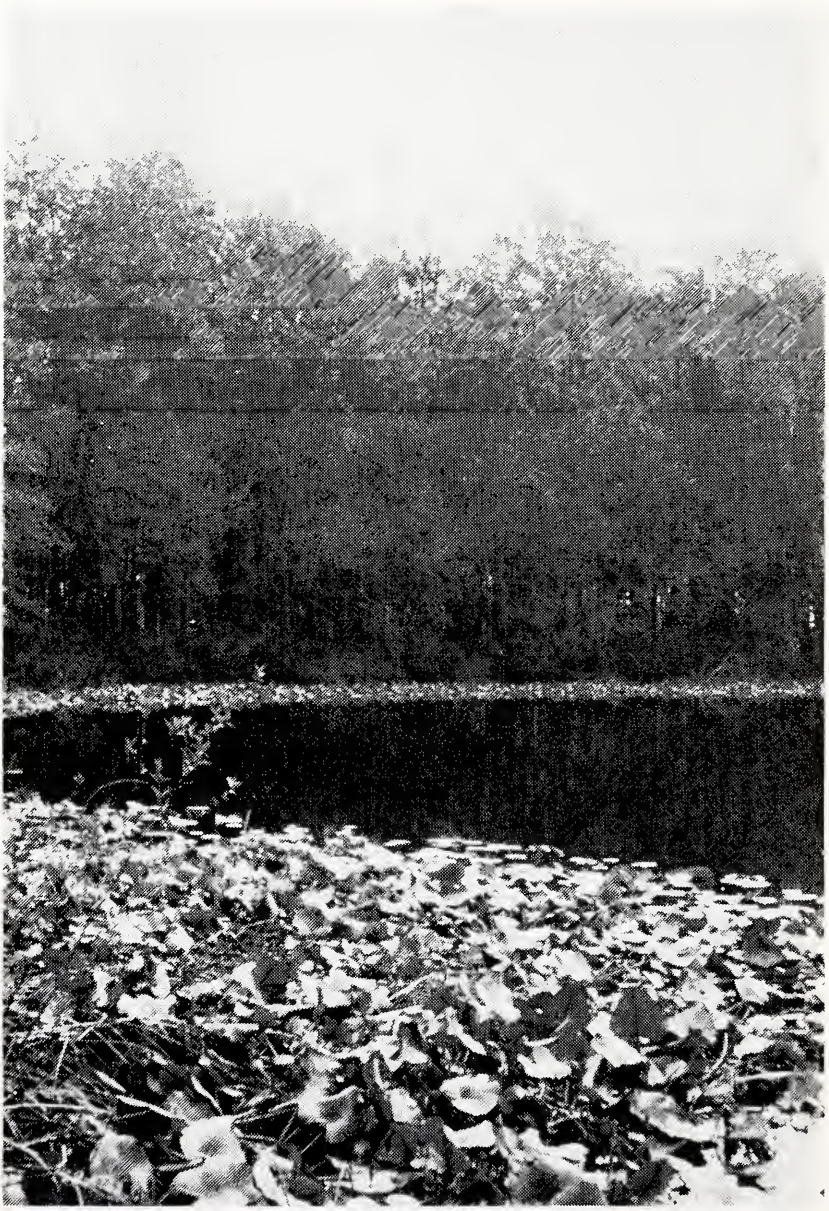

FIGURE 2. *Spicer Lake*

Methods

The plankton and benthos were collected eight times in 1978 from a deep and a shallow station. The deep water samples were from the center of the lake and the shallow from 1 m inward from the edge of the floating mat of vegetation. All samples were preserved in formalin and 3 ml of a 5% Rose-Bengal dye solution were added to aid in the identification of some invertebrates. Two 100 liter samples of water at each collection site were strained through a #10 mesh (153 μ aperture) net. The number of each species per/l of water was determined and recorded (Table 1). The benthos were collected with a Ponar grab sampler (0.0232 m^2), screened in the field through a #30 (0.52 mm aperture) brass sieve. In the laboratory the organisms were separated, identified and recorded in n/m^2 (Table 2). Nine grab samples were taken at each site on each collecting date.

Results and Discussion

Physical Characteristics.—Light penetration in the open water was a major limiting factor. A white disk, 20 cm in diameter disappeared from sight at about 1 m depth throughout most of the year. The range of measurements varied from .8 m to 1.5 m. The open water always appeared dark brown to blackish. Mudminnows could be identified to depths of less than .5 m. The circular, kettle-hole lake is surrounded by a swamp forest with red maple, *Acer rubrum*, as the predominant species in the canopy layer. Wave action on the lake was limited to small ripples even when the southwest prevailing winds were strong. Several temperature-oxygen profiles were taken during the study and no well defined thermocline was established. Temperature measurements in the upper 1 m usually varied less than 2°C. From the 1 m to 3 m level the temperature dropped 4-6 degrees per/m. The decline in temperature from 3 m to the bottom was a uniform, gradual gradient of 3-4 degrees per/m. For example in September the temperature reading in °C were: surface, 23; 1 m, 21; 2 m, 16; 3 m, 10; 4 m, 7; 5 m, 5; 6 m, 5. Consistently, the oxygen content of the water was reduced dramatically at the 1 to 2 m depth. The O_2 (ppm) in the upper .5 m ranged from 8.4 to 5.4. At 1 m depth the highest reading was 3.8 and the lowest was 0.2. At the 2 m depth the oxygen content ranged from 1.8 to 0.2 and then reduced gradually to bottom readings of 0.1 to zero.

The depth of the water near the inner edge of the floating mat of vegetation varied from 3 to 4 meters and dropped rather abruptly to 5 and 5.5 m toward the center of the lake. The maximum depth in a few areas was 6.1 m. All bottom materials in the open waters areas appeared uniform. The materials were very fine, gray to black and rather cohesive. Almost 100% of the materials could be screened through a #30 brass sieve when washed for a considerable period of time. Six chemical analyses of bottom samples from the center of Spicer Lake were conducted in the laboratory (Table 3).

Plankton.—The significance of limited light penetration in Spicer Lake was reflected in the primary producer level of the plankton. In the 4 major taxa, Pyrrhophyta, Chrysophyta, Cyanophyta and Chloro-

TABLE 1. *Plankton (# per liter; D, deep; S, shallow)*

TAXA	Spring Apr.-May		Jun.		Summer Jul.		Aug.		Fall Sep.-Oct.	
	S	D	S	D	S	D	S	D	S	D
Algae										
Ceratium hirundinella	18	13	15734	8219	5	3	8	235	248	2613
*Oscillatoria**	7213	7500	6500	8410	4980	5080	4700	7000	1480	1300
*Dinobryon**	135	280	25	10	—	5	1	3	—	—
Desmids	37	10	8	7	15	15	11	1	4	1
Diatoms*	20	28	24	48	12	10	5	12	60	78
Zygnematales*	25	1	30	5	7	5	10	7	—	—
Cladocera										
Bosmina	2	—	16	34	—	—	—	—	—	—
Alona guttata	—	—	2	—	—	—	—	—	—	—
Daphnia	2	—	—	—	—	—	—	—	—	—
Copepoda										
Diaptomus oregonensis	12	18	40	14	1	7	1	4	—	—
Cyclops	19	22	—	—	—	—	1	—	—	—
Harpacticoida	2	—	—	—	—	—	—	—	—	—
Nauplii	65	46	246	146	—	2	1	—	—	—
Rotatoria										
Filinia	—	—	14	12	—	—	7	4	5	42
Testudinella	—	—	18	2	—	—	—	—	—	—
Polyarthra	1199	850	—	—	2	4	—	—	13	111
Synchaeta	49	25	—	—	—	—	—	—	—	—
Trichocerca	—	—	5	2	—	—	—	—	—	—
Asplanchna	2	4	—	—	—	2	3	4	3	5
Brachionus havanaenis	—	—	7	5	—	—	—	—	—	16
Keratella cochlearis	115	89	29	14	—	—	—	4	27	167
Kellicottia longispina	4	2	45	14	3	2	3	4	3	—
Platyias quadricornis	—	1	5	20	—	—	1	4	3	—
Mytilina	—	—	3	—	—	—	—	—	—	—
Lecane	2	1	—	—	—	—	—	—	—	—
Monostyla	2	1	—	2	—	—	—	—	—	—
Stalked sp.	—	—	83	30	—	—	1	—	—	—

* units of 10 cells

TABLE 2. *Benthos (#1 m²)*

	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
Diptera								
Tendipedidae								
Tendipes _____	—	450	1550	105	28	50	60	160
Culicidae								
Chaoborus _____	*	50	60	35	450	350	50	750

* Exuviae

phyta only *Ceratium hirundinella* and *Oscillatoria* (chiefly or entirely one species) were consistently frequent in the samples (Table 1). *Ceratium hirundinella* was very abundant in June and *Oscillatoria* was common in the spring and summer months. *Dinobryon* appeared mainly in the spring collection. The desmids, mostly *Closterium* and *Pleurothaenium* were consistently present in small numbers in the spring and summer plankton. Many taxa of diatoms were collected but no one species appeared in great numbers. The Zygnematales representatives, *Zygnema* and *Spirogyra*, seemed to be related to the floating mat area where these genera were abundant.

At the consumer level, 14 taxa of Rotatoria were identified (Table 1). The populations were similar to those collected in a bog pond in Minnesota (1) where 29 taxa were collected. However, only one species, *Brachionus havanaenis*, in the common genus *Brachionus* appeared in Spicer Lake as compared to six species in the Minnesota pond. Six genera, namely *Filinia*, *Polyarthra*, *Asplanchna*, *Keratella*, *Kellicottia* and *Platyias* were found in most collections. Only *Polyarthra* and *Keratella* were represented in large numbers.

Cladocerans were very sparse in Spicer Lake. *Bosmina* was common in June. *Daphnia* and *Alona guttata* appeared sporadically in the open water collections (Table 1). *Alona guttata* and other shallow water species were identified in collections taken at random from the floating mat area.

Diaptomus oregonensis was taken in most collections, in particular the spring and early summer samples. A species of *Cyclops* was common in spring and remained in very small numbers the remainder of the year. A few harpacticoids appeared in shallow water and samples taken from the floating mat area contained considerable numbers in the spring.

TABLE 3. *Bottom Sample Chemical Analyses*

Parameters	*Method*	*Results*
Volatile Solids	Gravimetric	15.8%
Ammonia Nitrogen	Distillation and Colorimetric	23 mg/g
Kjeldahl Nitrogen	Digestion and Colorimetric	26.9 mg/g
Total Phosphorus	Digestion and Colorimetric	60 mg/g dry wt.
Iron	A. A.	13 mg/g
Lead	A. A.	<0.03 mg/g
Zinc	A. A.	0.14 mg/g

No plankton was found in the winter collection. The total population of plankton from the open water of Spicer Lake was very limited due to low light penetration. As stated above, several taxa of plankton were associated with the floating mat of vegetation. The mat is no doubt the most productive area of the lake.

Benthos.—The macrobenthos were limited to two genera of Diptera (Table 2). *Tendipes* (Tendipedidae) was present consistently in the collections and a significant peak population appeared in May. *Chaoborus* (Culicidae) was common in the samples and a peak population was reached in October. Annelida appeared very sporadically in the collections. No macrobenthos were taken in the winter collections. However, many exuviae of *Chaoborus* accumulated beneath the ice. In March 1978 the winter cover consisted of layers of solid ice and mixtures of ice and snow which totaled 60-70 cm. There were numerous air pockets and fine organic and inorganic materials were frozen in the winter cover. The absence of light seemed apparent. The water was dark brown and the odor indicated stagnant conditions. No direct O_2 measurements of the water (4-6°C) was taken but the complete void of algae suggested very little or no oxygen.

Summary and Conclusions

The populations of plankton and benthos in the open water area of Spicer Lake were small and limited in the number of significant taxa. Predominant plankters included two producers, *Ceratium hirundinella* and *Oscillatoria;* the crustacean, *Diaptomus oregonensis,* and two rotifers, *Polyarthra* and *Keratella cochlearis.* The benthos were represented primarily by *Tendipes* and *Chaoborus.*

The dark color of the water restricted the depth of light penetration, consequently, productivity in the open water was limited. The reduced depth of the photic zone and the absence of wave action were major factors contributing to the very low O_2 content below the 1 to 2 m depth.

A complete chemical analysis of the water is planned to determine what factors limited the light penetration. Also it is apparent that the extensive floating mat area is the most productive facet of the Spicer Lake ecosystem. A very diverse population of algae and invertebrates inhabit the mat zone. The green frog, *Rana clamitans malanota,* and the Central mudminnow, *Umbra limi* are the top predators. Thus, a study of the biotic impact of the floating mat on the Spicer Lake ecosystem is essential. Research is in progress on the ecology of the mudminnow, which is perhaps the only fish in the lake at the present time.

Literature Cited

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Acknowledgments

This study was supported by a grant from the Indiana Academy of Science. Also, I wish to thank Victor Riemenschneider for his assistance in the field work and the professional help related to the history and botanical aspects of the study. Thanks to Gregory Prezbindowski for the chemical analyses and to others who helped with field collections and gave suggestions: Geza Csapo, Hein family, Robert Fischgrund, Richard Jensen, David Sever and Larry Stewart.