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AQUATIC MACROPHYTES IN THE SHELBYVILLE MORAINE AREA OF EAST-CENTRAL ILLINOIS

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ABSTRACT

Aquatic macrophyte communities of warm water pond in the Shelbyville moraine area were studied during the summer of 1979. Frequency, relative frequency, and frequency of dominance were calculated for the taxa found. Species commonly encountered were *Chara globularis* Thuill., *Lemna minor* L., *Najas guadalupensis* (Spreng.) Magnus., *Potamogeton foliosus* Raf., and *P. pusillus* L. Tests for association between the various taxa revealed four positive associations, while no negative associations were shown.

INTRODUCTION

The present study was undertaken to determine the frequency, dominance, sociability, and degree of association of aquatic macrophytes of warm water pond in the Shelbyville moraine area of east-central Illinois. The area studied was chosen because of its glacial history, and because two distinct vegetation types occur here (Schwegman, 1973). The terminal Shelbyville moraine of Wisconsin glaciation extends across the southern part of Coles County and reaches only the extreme north-central part of Cumberland County. The topography and soils of the greater part of Cumberland County, therefore are largely determined by Illinois glaciation. (Smith et al, 1929). The area north of the moraine, in Coles and Douglas Counties, are for the most part flat to gently rolling and consist of dark-colored, poorly drained prairie soils (Hallbick and Fehrenbacher, 1971). The terminal moraine region is, in general, undulating to gently rolling, with light-colored timbered soils that are generally better drained.

MATERIALS AND METHODS

During the summer of 1979 a total of 98 water ponds were sampled for aquatic macrophytes. Of the habitats sampled, 33 are north of the moraine, (12 in Douglas and 21 in Coles County), 51 are located within the moraine in Coles County, with the remaining 14 being located south of the moraine in Cumberland County. At each pond the abundance of each taxon and the dominant species present was

determined. The nomenclature used follows Mohlenbrock (1975) and Ebinger and Vogel (1977).

From the data obtained the frequency, relative frequency, and frequency of dominance were calculated for each aquatic species using the following formulas.

$$\text{Frequency (\%)} = \frac{\text{Total habitats of occurence of a species}}{\text{Total habitats sampled}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Total habitats of occurence of a species}}{\text{Total habitats of occurence of all species}} \times 100$$

$$\text{Frequency of Dominance} = \frac{\text{Total habitats of occurence of a species as a dominant}}{\text{Total habitats of occurence of a species}} \times 100$$

The degree of association of each species was calculated using the procedure outlined by Poole (1974) for small sample size and for small cell totals using a 2 x 2 contingency table. This "exact test for independence" was used over the chi-square test for association to eliminate the bias resulting from small sample size. Also, by using this test, both positive and negative associations could be detected.

RESULTS AND DISCUSSION

A total of 22 aquatic macrophytes were found during the present study. These species are listed in Table 1 with the number of location in which each was found, their frequency and relative frequency north, south, and within the terminal moraine. For the purpose of this study, those taxa having relative frequencies greater than the mean within the three areas are considered common. This results in *Chara globularis*, *Lemna minor*, *Najas quadalupensis*, *Potamogeton foliosus* and *P. pusillus* being common north of the moraine (Rel. Freq. > 8); *L. minor*, *N. quadalupensis*, *N. minor*, *P. foliosus*, and *P. pusillus* being common on the moraine (Rel. Freq. > 7); and *L. minor*, *N. quadalupensis*, *P. foliosus*, and *P. nodosus* being common south of the moraine (Rel. Freq. > 8).

Most of the taxa were found throughout the study area. A few, however, occurred only north, or south of the moraine. During the present study *Chara inconnexa*, *Potamogeton pectinatus*, and *Ranunculus longirostris* were observed only on and north of the moraine, while *C. foliolosa*, *Jussiaea repens*, and *P. diversifolius* were found only on and south of the moraine (Table 1). Similar results were obtained by Dolbeare and Ebinger (1974), Ebinger and Volgel (1977), Mohlenbrock and Ladd (1978), and Vogel and Ebinger (1979).

A few of the taxa encountered exhibit a high frequency of dominance (Table 2). The reader is reminded that this figure is not only dependent on the number of times a species was found as a dominant, but also on the total number of times the taxon was found. If a species is encountered twice and is found as a dominant once, the accuracy of this figure is reduced due to the lack of a representative sample. In an effort to partially eliminate this bias, the frequency of dominance was calculated after the results from the three areas were combined. Of the common taxa, only *Najas minor* was the dominant species in over half of the locations in which it was found. This species, although it was never the only taxon present in a habitat, was

observed on many occasions to occur in such abundance as to completely fill the body of water, nearly to the exclusion of the other species present. Other common taxa with relatively high frequencies of dominance include *N. quadalupensis* (45%), *P. foliosus* (29%), and *P. pusilus* (29%).

A fairly high degree of sociability is exhibited by most of the taxa commonly encountered. Even those taxa that exhibit a high frequency of dominance were found to occur more often with one or more other species than as the only species present (Table 2). In most instances this sociability was fairly random, as few definite associations were found. Tests for associations between the various taxa revealed only 4 positive associations ($P < .05$). No significant negative associations were found. Those taxa showing positive associations are *Potamogeton foliosus* with *Chara globularis; P. pusillus* with *P. nodosus;* and *Najas minor* with *N. quadalupensis* and *P. pusillus*.

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Table 1. Frequency, relative frequency, and number of locations of aquatic macrophytes observed north, south, and on the Shelbyville Moraine in east-central Illinois.

SPECIES	NORTH			MORAINE			SOUTH		
	Total Locations	Frequency (%)	Relative Frequency	Total Locations	Frequency (%)	Relative Frequency	Total Locations	Frequency (%)	Relative Frequency
FREE-FLOATING SPECIES									
Lemna minor L.	9	27	18	9	18	11	7	50	23
Spirodela polyrhiza (L.) Schleiden.	—	—	—	2	4	3	—	—	—
SUBMERSED SPECIES									
Ceratophyllum demersum L.	1	3	2	—	—	—	—	—	1
Chara fdiolosa Muhl.	—	—	—	1	2	1	2	14	7
Chara globularis Thuill.	5	15	10	5	10	6	2	14	7
Chara inconnexa T. F. Allen.	1	3	2	—	—	—	—	—	—
Chara vulgaris L.	—	—	—	1	2	1	—	—	—
Chara zeylanica Klein ex Willd.	3	9	6	4	8	5	1	7	3
Myriophyllum exalbescens Fern.	—	—	—	2	4	2	—	—	—
Najas guadalupensis (Spreng.) Magnus.	5	15	10	11	22	13	4	29	13
Najas minor All.	1	3	2	8	16	10	1	7	3
Potamogeton crispus L.	—	—	—	1	2	1	—	—	—
Potamogeton diversifolius Raf.	—	—	—	—	—	—	2	14	7
Potamogeton foliosus Raf.	11	33	22	20	39	24	3	21	10
Potamogeton nodosus Poir.	4	12	8	—	—	—	3	21	10
Potamogeton pectinatus L.	2	6	4	3	6	4	—	—	—
Potamogeton pusillus L.	5	15	10	10	20	12	2	14	7
Ranunculus longirostris Godr.	1	3	2	—	—	—	—	—	—
Zosterella dubia (Jacq.) Small.	—	—	—	1	2	1	—	—	1
EMERGENT SPECIES									
Jussiaea repens L.	—	—	—	4	8	5	2	14	7
Nelumbo lutea (Willd.) Pers.	—	—	—	1	2	1	1	7	3
Nymphaea tubersoa Paine.	1	3	2	—	—	—	—	—	—

Table 2. Frequency of dominance and sociability of submersed aquatic macrophytes in the Shelbyville Moraine area in east-central Illinois.

SPECIES	Total locations	Total as dominant	Frequency of Dominance (%)	Only species present	Found with one other species	Found with two other species	Found with three or more species
Ceratophyllum demersum L.	1	—	—	—	—	—	1
Chara foliolosa Muhl.	3	1	33	—	—	3	—
Chara globularis Thuill.	12	2	17	2	4	4	2
Chara inconnexa T. F. Allen.	1	1	100	—	—	—	1
Chara vulgaris L.	1	1	100	—	—	—	1
Chara zeylanica Klein ex Willd.	8	1	13	—	1	2	5
Myriophyllum exalbescens Fern.	2	2	100	—	—	1	1
Najas guadalupensis (Spreng.) Magnus.	20	9	45	2	3	7	8
Najas minor All.	10	6	60	—	2	2	6
Potamogeton crispus L.	1	—	—	—	—	—	1
Potamogeton diversifolius Raf.	2	1	50	1	—	1	—
Potamogeton foliosus Raf.	34	10	29	7	12	7	8
Potamogeton nodosus Poir.	7	1	14	—	1	2	4
Potamogeton pectinatus L.	5	2	40	1	—	—	4
Potamogeton pusillus L.	17	5	29	3	4	4	6
Ranunculus longirostris Godr.	1	1	100	—	1	—	—
Zosterella dubia (Jacq.) Small.	1	—	—	—	—	—	1