1977

Aquatic Plant Communities of East-Central Illinois

Randolph Lee Vogel
Eastern Illinois University

PAPER CERTIFICATE #2

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

May 6, 1977
Date

I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because ______________________

____

____

______________________ Date

______________________ Author

pdm

AQUATIC PLANT COMMUNITIES

OF EAST-CENTRAL ILLINOIS

(TITLE)

BY

Randolph Lee Vogel

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY

CHARLESTON, ILLINOIS

1977

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING

THIS PART OF THE GRADUATE DEGREE CITED ABOVE

6 May 1977

DATE

May 6, 1977

DATE

AQUATIC PLANT COMMUNITIES

OF EAST-CENTRAL ILLINOIS

BY

RANDOLPH LEE VOGEL

B.S. in Botany, Eastern Illinois University, 1976

ABSTRACT OF A THESIS

Submitted in partial fulfillment of the requirements

for the degree of Master of Science in Botany at the Graduate School

of Eastern Illinois University

CHARLESTON, ILLINOIS
1977

Aquatic plant communities of east-central Illinois were studied during the late summers of 1971 and 1976. Frequencies, relative frequencies and frequency of dominance were calculated for the various taxa. At the pond level, changes in the flora over the 5-year span have taken place, usually consisting of the addition or subtraction of one species. Overall, however, it was found that the aquatic community has remained relatively static, as has the percentage of ponds lacking aquatic plants. Factors influencing distributions and sterility are discussed and it was concluded that all the factors play varying roles, but no one factor or combination of factors can be relied upon to determine distribution patterns. New county records for the east-central portion of the state are also recorded.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The author wishes to thank Dr. John E. Ebinger, whose guidance and assistance in the completion of this project was indispensable. The author also wishes to thank Dr. Wesley Whiteside and Dr. John Speer for their helpful suggestions in reviewing this thesis, and Dr. Fay Daily for her help in the identification of the members of the Characeae.

A special word of thanks is due my wife, Donna, whose patience and understanding made this task much more pleasant, and to my parents for all their help and guidance during the duration of my academic career.

INTRODUCTION

Aquatic vascular plants comprise a sizable portion of the flora of an area, possibly occurring in any relatively stable body of water. With the increase in recreational activity, people are becoming increasingly aware of their presence. Some of these aquatic plants choke our waterways, hampering boating and fishing and making recreational activities relatively impossible. As a result, many studies have been done concerning aquatic plants in the past 20 years. Physiological aspects, control procedures, habitat requirements, and distributions have all been treated. In Illinois, the majority of the work has been concerned with the distribution, by county, of the various species present, yielding reasonable information on their geographic distributions. Studies such as this can, however, be misleading as to the actual frequency of occurrence of the species. This paper is mainly concerned with presenting a more accurate picture of the aquatic vegetation in the east-central portion of Illinois, the distribution of many of the species, and the type of aquatic associations that exist.

With the exception of _Chara_ and _Nitella_ (Characeae), all plants included in this study are vascular angiosperms. The Characeae are rooted submersed plants that were included because they are relatively large, sometimes reaching a length of 7 dm, often forming a large portion of an aquatic community, at times existing as the dominant member. The aquatic angiosperms generally dominate the aquatic community, and are found as free floating, rooted emergent, or rooted submersed species.

All of the free floating members belong to the family Lemnaceae. The rooted emergent species with the majority of the plant body floating or emergent above the water are represented by the families Nymphaceae, Nelumbonaceae, Onagraceae, and Scrophulariaceae. The rooted submersed group makes up the majority of the flora comprising 7 families with 7 genera. These plants under normal water level conditions are rooted at the bottom of a pond and are totally submersed with the exception of 2 species of Potamogeton which have floating leaves. This group is by far the most commonly encountered, often forming extensive mats of submersed vegetation. Families represented are the Potamogetonaceae, Najadaceae, Halagoraceae, Ceratophyllaceae, Ranunculaceae, Hydrocharitaceae, and Pontederiaceae.

METHODS AND MATERIALS

A total of 197 aquatic habitats in 14 counties were sampled in east-central Illinois. A total of 95 of these aquatic habitats were north of the Shelbyville moraine in the counties of Champaign, Coles, Douglas, Edgar, Ford, Moultrie, and Piatt, while the remaining 102 locations were south of the moraine in the counties of Clark, Crawford, Cumberland, Effingham, Jasper, Richland, and Shelby. Lakes, streams, and gravel pits were examined, but because of their relative abundance, the majority of the sampling was done in small, warm-water ponds. All sites were studied during the late summer of 1971 by Dr. John E. Ebinger, and again during the late summer of 1976 by the present author. The purpose of sampling the habitats twice was to determine if changes in species composition and frequencies occurs over an extended period of time. All species present in each aquatic habitat were recorded and their abundance determined. From these data the composition of the plant communities was determined as well as the dominance of the various species present in the community. Notes were also taken at each location concerning the type of body of water, the depth at which the species were growing, and the size of the plant community.

Plant material was collected using a long-handled rake, as most was easily accessible from the shore. When needed, however, chest waders were employed for collection of specimens otherwise inaccessible. All specimens from a particular location were placed in a plastic bag with a slip of paper bearing the county and the number of the site. Later the specimens were pressed, dried, identified, and deposited in the Stover Herbarium at Eastern Illinois University (EIU) with some duplicate material of the genus Chara being sent to Dr. Fay Daily of Indianapolis. The taxonomic nomenclature used in this paper follows Mohlenbrock (1976) and Stotler (1968).

The data obtained were considered to be analogous to quadrat data since each aquatic habitat was treated as though it was a single plot. From these data the frequency and the relative frequency were calculated for each species. Frequency of a species is defined as the total number of aquatic habitats of occurrence of a species expressed as a percentage of the total number of aquatic habitats examined. Relative frequency of a species is defined as the total number of aquatic habitats of occurrence of a species expressed as a percentage of the total number of aquatic habitats of occurrence of all species. Relative frequence, therefore, adds up to 100% for all species combined (Lind and Cottam, 1969).

Frequency of dominance was also calculated for species occurring as dominant members of communities. Frequency of dominance is defined as the total number of times of occurrence as a dominant for a species expressed as a percentage of the total number of times of occurrence. Dominance was determined through visual inspection of a pond, where one member of the community occurred in great numbers with the other members interspersed. At times, no dominance was recorded for a particular pond where the species complement was relatively uniform in numbers and size of the colonies. Occasionally, two different species were found as dominants in the same pond. A double ring was sometimes formed where one species would form a complete ring out to approximately

3m, where another species occupying the deeper water would then form a second ring. Two separate portions of a pond may also be dominated by two different species, with one occurring in a shallow end, growing on a flat, and the other growing along the steeper slopes of the pond bottom.

RESULTS AND DISCUSSION

A great deal of literature is available concerning the distribution of aquatic plants in Illinois. The only extensive study was undertaken by Winterringer and Lopinot (1966) who described and illustrated most of the aquatic species and included a general distribution for each. A few monographs of Illinois aquatic plants have also been completed. These include a revision of the Alismales by Mohlenbrock and Richardson (1967), a study of the Lemnaceae by Weik and Mohlenbrock (1968), and a revision of the Haloragaceae and Hippuridaceae by Meyer and Mohlenbrock (1966).

Many regional studies have also been completed, particularly in southern Illinois. Distributional records for southern Illinois aquatic plants were compiled by Mohlenbrock, Dillard and Abney (1961), and Fore, Stookey and Parsons (1965), while the aquatics of strip mines were studied by Lewis and Peters (1955) and Bell (1956).

Many incidental reports of aquatic plants also exist from southern Illinois. Aquatic plants have been recorded in swampy-area studies conducted by Mohlenbrock (1959) and by Anderson and White (1970). Mohlenbrock (1962) and Stookey, Fore and Mohlenbrock (1964) treated them in floristic studies of the Devil's Kitchen area in Union and Williamson counties, while Ashby and Kelting (1963) and Mohlenbrock and Voight (1965) included some aquatic species in studying the vegetation of the Pine Hills Field Station in southwestern Illinois. Other studies mentioning aquatic plants include county-record reports by Windler (1966), notes on the flora of the southern tip of Illinois by Schwegman and Mohlenbrock (1966) (1968), a floristic study of Lake Murphysboro State Park by Mohlenbrock (1967), plant communities of Horseshoe Lake by Koelling (1968), and a survey of fresh water springs by Hopkins (1969).

For the remainder of the state there is very little literature concerned with aquatic vascular plants with most of the studies mainly in conjunction with county checklists. Dobbs (1963) in a floristic study of Henry County included them, as did Wunderlin (1966) in studying the flora of the Mississippi Palisades State Park in Carroll County, and Dolbeare (1974) in a study of plants from western Illinois. New county records are also reported by Dolbeare (1967) in a study of Gray's Lake; by Swink (1969) in a listing of plants from the Chicago region; by Myers (1972) in an annotated index for the Illinois flora; and by Ebinger (1967) and Parker, Rayhill and Ebinger (1969) in studies of the flora of Coles County. New state records have been reported by Fore and Mohlenbrock (1966) and Winterringer (1966). The most recent work completed concerning county distribution records is a statewide study of common vascular hydrophytes by Dolbeare and Ebinger (1974).

Explanations concerning distribution patterns of aquatic plants are very numerous and diverse. A few of these factors are discussed below.

pH: Crawford (1942) states that water acidity is the decisive factor influencing aquatic plant development in strip lakes in Central Missouri, and Moore and Clarkson (1967) in a stream study in West Virginia also cite pH as a factor influencing distributions. Wiedman (1975), however, in studying strip mine ponds found that pH differences were not of significant enough magnitude to play a major role.

CONDUCTIVITY: Swindale and Curtis (1957) in studying aquatic plants in Wisconsin lakes found a direct correlation between conductivity and plant distributions. It was found that as conductivity increased, there was also an increase in the number and variety of species encountered. Wiedman (1975) also reported conductivity as a factor important in distribution patterns, while Welch (1952) states that the richer the water is in electrolytes, the greater will be the productivity.

SUBSTRATE: Sculthorpe (1967) states that water chemistry alone will not influence distributions and that this must be tied to substrate variations in physical textures. Sandy and gravelly soils are generally considered not conductive to aquatic plant growth. Swindale and Curtis (1957) states that as substrate progresses from sand to silt and organic matter, the plant diversity and size of the community will increase.

TURBIDITY: Turbidity affects plant growth through reduction of light reaching the plants. Heaton (1951) states that turbidity causes a further reduction of light penetration and thus inhibition by coating of the leaves in aquatic plants. Mills, Starrett, and Bellrose (1966) in studying the Illinois River found that increased turbidity over the past 70 years has negatively affected the distribution and abundance of the aquatic flora.

POLLUTION: Industrial waste and sewage pollution have been cited as factors influencing aquatic plant distributions or total lack of vegetaion. Stuckey and Wentz (1969), in a study of pollution effects on the Ottawa River in Ohio, report that as early as 1900 the submersed aquatics had begun to decline in numbers. Stuckey (1971) also mentions pollution as a factor influencing the changes in the flora of Put-In-Bay Harbor of Lake Erie in Ohio.

All of these factors play varying roles in aquatic plant distributions. The endless variety of variables and the intricate interplay between them makes hard and fast rules concerning distribution tendencies virtually impossible. No factor or combination of factors can be relied upon as definite determinants as to what will or will not be found in a given body of water.

County distributions can be extremely misleading in determining how common various aquatic species are in the state. Dolbeare and Ebinger (1974) show that some taxa such as Potamogeton pectinatus and Potamogeton nodosus are well-distributed throughout the state, but the present study indicates they are rarely encountered in more than 1 or 2 ponds in any particular county. In contrast, other species such as Najas guadalupensis and Potamogeton foliosus occur very frequently, being found in as many as 50% of the aquatic habitats visited in any one county (Table 1).

Table 1 shows the frequency and relative frequency of the various aquatic species encountered during the present study. Taxa showing a relative frequence number greater than 7 were considered to be common. These species are Chara globularis, C. foliolosa, Lemna minor, Najas guadalupensis, Najas minor, Potamogeton diversifolius, P. foliosus, P. pusillus, and Jussiaea repens. At least in the east-central portion of the state, four of these species exhibit definite north-south distribution tendencies, with Jussiaea repens, Najas minor, and Potamogeton diversifolius occurring more commonly south of the moraine and Chara globularis more commonly encountered north of the moraine (Figure 1).

Dolbeare and Ebinger (1974) show that these species exhibit similar statewide distribution patterns, with only scattered localities occurring outside of the general range.

Many ponds examined exhibited changes in the flora between 1971 and 1976, usually consisting of the addition or subtraction of one species. It appears that environmental factors are constantly changing in these ponds to facilitate a successional cycle. The frequency and relative frequency figures for 1976 (Table 1) for the most part tend to be slightly lower overall than those obtained from 1971. The most probable reason for this is that a severe drought occurred during the summer of 1976, drastically lowering water levels in many of the ponds examined. Looking at an overview, however, it is found that the frequency of occurrence has remained relatively static.

A large complement of the ponds contained no aquatic vegetation whatsoever. In 1971, 24% were sterile with 29% being sterile in 1976. It is suspected that these figures will remain relatively static also, with the discrepancy again probably due to the drastic summer drawdown as a result of the drought. Very riled waters with unstable substrate conditions due to wading livestock invariably proved sterile, as did ponds with very steep slopes, for obvious reasons. It is also a common practice of many pond owners to periodically poison the ponds with copper sulfate. In many cases this fact was substantiated through personal communication. Some ponds encountered were in conjunction with feed lots, subjecting them to vast amounts of raw sewage run-off. The extreme algal blooms in these ponds prevented higher plant growth with the occasional exception of the Lemnaceae.

Frequency of dominance was included in this paper (Table 2) as an index of the competitive abilities of the various taxa. It must be cautioned that these figures should be treated in conjunction with the figures from Table 1. A species which was encountered twice and occurred as a dominant once will most likely not yield an accurate figure due to a lack of a representative sample. Some species such as Najas guadalupensis, however, are well represented and show a high degree of competitive ability. Ceratophyllum demersum is a species which was rather infrequent in occurrence, but when conditions were conducive for its growth, it exhibited a high competitive ability. It was also found that although some species are equally prevalent both north and south, the frequency of dominance indicates more capability for competing in one zone or the other. An example of this is Potamogeton pusillus with a 50% frequency of dominance in the north and a 13% frequency of dominance in the south. Explanations for this are probably similar to those presented for distribution patterns. Najas minor is also a species worthy of mention. This taxa was first reported in Illinois by Fore and Mohlenbrock (1966). It is a Eurasian species which is now well represented in the southern half of Illinois. It tends to be very competitive, occurring frequently as a dominant, forming very dense mats of submersed vegetation. The rapid spread of this plant could indicate that it may become a serious problem in our water systems.

COUNTY RECORDS

Although the distribution of aquatic plants is fairly well-known, a few county records were found during the present study that are not listed in Dolbeare and Ebinger (1974), Jones and Fuller (1955), or Winterringer and Evers (1960). These species are listed below, followed by the county and collecting data of each specimen.

Lemna minor L. CHAMPAIGN: Spring Lake W of Mahomet, _Vogel 608_ (EIU). FORD: Small stream 4 mi. W of Sibley, _Vogel 630_ (EIU). RICHLAND: Pond 4 mi. E of Calhoun, _Vogel 694_ (EIU).

Lemna obscura (Austin) Daubs. RICHLAND: Pond 1 mi. N of Olney, _Vogel 719_ (EIU). SHELBY: Pond 4 mi. N of Herrick, _Vogel 870_ (EIU).

Ludwigia palustris (L.) Ell. JASPER: Pond 4 mi. NE of Wheeler, _Vogel 680_ (EIU).

Myriophyllum exalbescens Fern. CHAMPAIGN: Gravel pit 3 mi. SW of Mahomet, _Vogel 613_ (EIU).

Najas gracillma (A. Br.) Magnus. JASPER: Pond 4 mi. NE of Wheeler, _Vogel 680_ (EIU).

Nelumbo lutea (Willd.) Pers. CUMBERLAND: Pond 1 mi. N of Maple Point, _Vogel 774_ (EIU).

Potamogeton crispus L. DOUGLAS: Pond 3 mi. N of Hindsboro, _Vogel 737_ (EIU).

Potamogeton pusillus L. CHAMPAIGN: Gravel pit 3 mi. SW of Mahomet, _Vogel 610_ (EIU). CRAWFORD: Lake 2 mi. E of Stoy, _Vogel 789_ (EIU).

Wolffia columbiana Karst. EFFINGHAM: Pond 6 mi. N of Effingham, _Vogel 878_ (EIU).

Wolffia papulifera Thompson. CRAWFORD: Pond at Oak Glen Golf Course, _Vogel 795_ (EIU). DOUGLAS: Spring Lake W of Camargo, _Vogel 725_ (EIU). EDGAR: Pond 4 mi. S of Kansas, _Vogel 582_ (EIU).

Wolffia punctata Griseb. RICHLAND: Pond 1 mi. N of Olney, Vogel 721 (EIU).

Zosterella dubia (Jacq.) Small. SHELBY: Pond 5 mi. E of Strasburg, Vogel 857 (EIU).

LITERATURE CITED

Anderson, R. C. and J. White. 1970. A cypress swamp outlier in Southern Illinois. Trans. Ill. St. Acad. Sci. 63:6-13.

Ashby, W. C. and R. W. Kelting. 1963. Vegetation of the Pine Hills Field Station in Southwestern Illinois. Trans. Ill. St. Acad. Sci. 56:188-201.

Bell, R. 1956. Aquatic and marginal vegetation of strip mine waters in Southern Illinois. Trans. Ill. St. Acad. Sci. 48:85-91.

Crawford, B. T. 1942. Ecological succession in a series of stripmine lakes in Central Missouri. M. A. Thesis, Univ. of Missouri, Columbia, Mo. 134 pp.

Dobbs, R. J. 1963. Flora of Henry County, Illinois. Natural Land Institute, Rockford. 350 pp.

Dolbeare, B. L. 1967. A recent collection of _Bidens beckii_ Torr. in Illinois. Trans. Ill. St. Acad. Sci. 60:197.

__________. 1974. Plant collections of Rollo T. Rexroat. Trans. Ill. St. Acad. Sci. 66 (3 & 4):81-93.

__________ and J. Ebinger. 1974. Distribution of the common vascular hydrophytes in Illinois. Trans. Ill. St. Acad. Sci. 67:402-417.

Ebinger, J. E. 1967. Additional fern, fern-allies and monocots to the flora of Coles County, Illinois. Trans. Ill. St. Acad. Sci. 60:194-196.

Fore, P. L. and R. H. Mohlenbrock. 1966. Two new naiads from Illinois and distribution records of the Naiadaceae. Rhodora 68:216-220.

__________, D. G. Stookey, and J. D. Parsons. 1965. New distributional records of aquatic vascular plants from Southern Illinois. Trans. Ill. St. Acad. Sci. 58:27-38.

Heaton, J. R. 1951. The ecology and succession of a group of acid and alkaline strip-mine lakes in Central Missouri. M. A. Thesis, Univ. of Missouri, Columbia, Mo. 143 pp.

Hopkins, C. E. O. 1969. Vegetation of fresh-water springs of Southern Illinois. Castanea 34:121-145.

Jones, G. N. and G. D. Fuller, 1955. Vascular plants of Illinois. University of Illinois Press, Urbana. xii+593 pp.

Koelling, A. C. 1968. The plant community at Horseshoe Lake. The Living Museum (Ill. St. Museum) 30:36,39.

Lewis, W. M. and C. Peters. 1955. Physico-chemical characteristics of ponds in the Pyatt, Desoto, and Elkville strip mined areas of Southern Illinois. Trans. Amer. Fisheries Soc. 84:117-124.

Lind C. and G. Cottam. 1969. The submersed aquatics of University Bay: a study in eutrophication. Amer. Midl. Nat. 81(2):353-369.

Meyer, M. W. and R. H. Mohlenbrock. 1966. The Illinois species of the Haloragaceae and Hippuridaceae. Trans. Ill. St. Acad. Sci. 59:149-162.

Mills, H. B., W. C. Starrett, and F. C. Bellrose, 1966. Man's effect on the fish and wildlife of the Illinois River. Ill. Nat. Hist. Ser. Bio. Notes. No. 57. 24 pp.

Mohlenbrock, R. H. 1959. A floristic study of a Southern Illinois swampy area. Ohio Jour. Sci. 59:89-100.

__________. 1962. A floristic study of the Devil's Kitchen Area, Williamson and Union Counties, Illinois. Castanea 27:101-131.

__________. 1967. A floristic study of Lake Murphysboro State Park, Illinois. Trans. Ill. St. Acad. Sci. 60:409-421.

__________. 1975. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale and Edwardsville. 494 pp.

__________, G. E. Dillard, and T. S. Abney. 1961. A survey of Southern Illinois aquatic vascular plants. Ohio Jour. Sci. 61:262-273.

__________ and J. W. Richardson. 1967. Contributions to an Illinois flora. No. 1. Order Alismales. Trans. Ill. St. Acad. Sci. 60: 259-271.

__________ and J. W. Voight. 1965. An annotated checklist of vascular plants of the Southern Illinois University Pine Hills Field Station and environs. Trans. Ill. St. Acad. Sci. 58:268-301.

Moore, J. A. and R. B. Clarkson. 1967. Physical and chemical factors affecting vascular aquatic plants in some acid stream drainage areas of the Monongahela River. Proc. W. Vir. Acad. Sci. 39: 83-89.

Myers, R. M. 1972. Annotated Catalog and Index for the Illinois Flora. Western Illinois University. Series in the Biological Sciences. 10:1-64.

Parker, H. M., Susan Mueller Rayhill, and J. E. Ebinger. 1969. Additions to the flora of Coles County, Illinois. Trans. Ill. St. Acad. Sci. 62:375-379.

Schwegman, J. and R. H. Mohlenbrock. 1966. Botanical field studies in the southern tip of Illinois. Trans. Ill. St. Acad. Sci. 59: 369-372.

Sculthorpe, C. D. 1967. The biology of aquatic vascular plants. Edward Arnold (Publishers) Ltd. London. 610 pp.

Stookey, D. G., P. L. Fore, and R. H. Mohlenbrock. 1964. Primary aquatic succession and floristics of Devil's Kitchen Lake, Illinois. Castanea 29:150-155.

Stotler, R. E. 1968. The Characeae of Illinois. Amer. Midl. Nat. 79:225-239.

Stuckey, R. L. 1971. Changes of vascular aquatic flowering plants during 70 years in Put-In-Bay Harbor, Lake Erie, Ohio. Ohio Jour. Sci. 71(6):321-342.

__________ and W. A. Wentz. 1969. Effect of industrial pollution on the aquatic and shore angiosperm flora in the Ottawa River, Allen and Putnam Counties. Ohio Jour. Sci. 69(4):226-242.

Swindale, D. N. and J. T. Curtis. 1957. The phytosociology of large submerged plants in Wisconsin lakes. Ecology 38:397-407.

Swink, F. 1969. Plants of the Chicago region. Morton Arboretum. xxii+445 pp.

Weik, K. L. and R. H. Mohlenbrock. 1968. Contributions to a flora of Illinois. No. 3. Lemnaceae. Trans. Ill. St. Acad. Sci. 61: 382-399.

Welch. P. S. 1952. Limnology. McGraw-Hill Book Co., Inc., New York. 538 pp.

Weidman, J. A. 1975. Aquatic plant communities of Vermillion County, Illinois. M. S. Thesis, Eastern Illinois University, Charleston. 36 pp.

Windler, D. R. 1966. Notes on the flora of several Illinois counties. Trans. Ill. St. Acad. Sci. 59:85-86.

Winterringer, G. S. 1966. Aquatic vascular plants new for Illinois. Rhodora 68:221-222.

__________ and R. A. Evers. 1960. New records for Illinois vascular plants. Ill. St. Mus. Sci. Pap. Ser. 11:x+135.

__________ and A. C. Lopinot. 1966. Aquatic plants of Illinois. Ill. St. Mus. Popular Sci. Ser. 6:1-142.

Wunderlin, R. P. 1966. The vascular flora of the Mississippi Palisades State Park, Carroll County, Illinois. Trans. Ill. St. Acad. Sci. 69:134-148.

TABLE 1

	1976						1971					
	North of Moraine			South of Moraine			North of Moraine			South of Moraine		
	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq
POTAMOGETONACEAE												
Potamogeton crispus L.	2	7	4	-	-	-	2	6	4	-	-	-
Potamogeton diversifolius Raf.	-	-	-	6	16	9	-	-	-	6	22	11
Potamogeton foliosus Raf.	7	36	20	7	16	9	7	50	28	7	37	20
Potamogeton nodosus Poir.	3	4	3	3	3	2	3	6	4	4	7	3
Potamogeton pectinatus L.	7	11	6	2	2	1	6	10	5	2	4	2
Potamogeton pusillus L.	6	11	10	6	15	9	5	10	5	3	6	3
CERATOPHYLLACEAE												
Ceratophyllum demersum L.	3	5	3	1	2	1	4	5	3	3	3	2
HALORAGACEAE												
Myriophyllum exalbescens Fern.	3	5	3	-	-	-	2	4	2	1	1	1
Myriophyllum pinnatum (Walt.) BSP.	-	-	-	-	-	-	-	-	-	1	1	1
NELUMBONACEAE												
Nelumbo lutea (Willd) Pers.	1	1	1	1	1	1	1	1	1	-	-	-
NYMPHAEACEAE												
Nuphar luteum L.	2	2	1	2	2	1	2	3	2	2	2	1
Nymphaea tuberosa Paine.	1	1	1	1	1	1	1	1	1	1	1	1
ONAGRACEAE												
Jussiaea repens L.	2	4	3	6	16	10	2	4	2	6	14	7
Ludwigia palustris (L) Ell.	1	1	1	4	10	6	1	1	1	3	4	2
RANUNCULACEAE												
Ranunculus longirostris Godr.	2	2	1	-	-	-	4	5	3	-	-	-
SCROPHULARIACEAE												
Bacopa rotundifolia (Michx.) Wetlst.	-	-	-	3	3	2	-	-	-	4	6	3
CHARACEAE												
Chara braunii Gmel.	-	-	-	1	2	1	-	-	-	1	2	1
Chara contraria A. Br. ex Kutz.	2	5	3	-	-	-	2	4	3	-	-	-

TABLE 1 (Cont'd)

	1976						1971					
	North of Moraine			South of Moraine			North of Moraine			South of Moraine		
	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq	No. of Cos.	% Freq	Rel Freq
Chara foliolosa Muhl.	3	5	3	6	17	9	2	3	2	6	14	7
Chara globularis Thuill.	5	14	8	1	2	1	4	10	5	2	2	1
Chara inconnexa T F Allen.	1	2	1	-	-	-	3	3	2	-	-	-
Chara zeylanica Klein ex Willd.	1	1	1	1	1	1	-	-	-	1	1	1
Nitella flexilis (L) Ag.	-	-	-	-	-	-	-	-	-	1	1	1
HYDROCHARITACEAE												
Elodea nuttallii (Planch) St. John.	1	1	1	1	1	1	1	1	1	1	2	1
LEMNACEAE												
Lemna minor L.	6	17	10	5	11	7	5	21	12	4	16	8
Lemna obscura (Austin) Daubs.	-	-	-	2	3	1	-	-	-	-	-	-
Spirodela polyrhiza (L.) Schleiden.	2	3	2	2	3	2	3	5	3	3	4	2
Wolffia columbiana Karst.	2	2	1	2	2	1	3	3	2	1	1	1
Wolffia papulifera Thompson.	3	4	3	1	2	1	2	2	1	1	2	1
Wolffia punctata Griseb.	-	-	-	1	1	1	-	-	-	1	1	1
NAJADACEAE												
Najas flexilis (Willd.) Rostk. & Schmidt.	1	3	2	-	-	-	1	1	1	1	1	1
Najas gracillima (A. Br.) Magnus.	-	-	-	2	2	1	-	-	-	2	4	2
Najas guadalupensis (Spreng.) Magnus.	5	10	6	6	14	8	6	13	7	5	15	8
Najas minor All.	1	3	2	6	20	11	2	4	2	6	14	7
PONTEDERIACEAE												
Zosterella dubia (Jacq.) Small.	-	-	-	1	1	1	-	-	-	-	-	-
			100			100			100			100

TABLE 2

	1976	
	North	South
	% dominance	% dominance
CHARACEAE		
Chara contraria A. Br. ex. Kutz.	20	-
Chara foliolosa Muhl.	60	35
Chara globularis Thuill.	15	-
Chara zeylanica Klein ex. Willd.	100	-
LEMNACEAE		
Lemna minor L.	6	9
Lemna obscura (Austin) Daubs.	-	33
NAJADACEAE		
Najas flexilis (Willd.) Rostk. & Schmidt.	33	-
Najas guadalupensis (Spreng.) Magnus.	33	57
Najas minor All.	-	50
POTAMOGETONACEAE		
Potamogeton crispus L.	14	-
Potamogeton diversifolius Raf.	-	6
Potamogeton foliosus Raf.	3	19
Potamogeton nodosus Poir.	-	33
Potamogeton pusillus L.	50	13
HALORAGACEAE		
Myriophyllum exalbescens Fern.	80	-
NYMPHAEACEAE		
Nuphar luteum L.	50	50
ONAGRACEAE		
Jussiaea repens L.	-	13
CERATOPHYLLACEAE		
Ceratophyllum demersum L.	40	50

FIG. 1

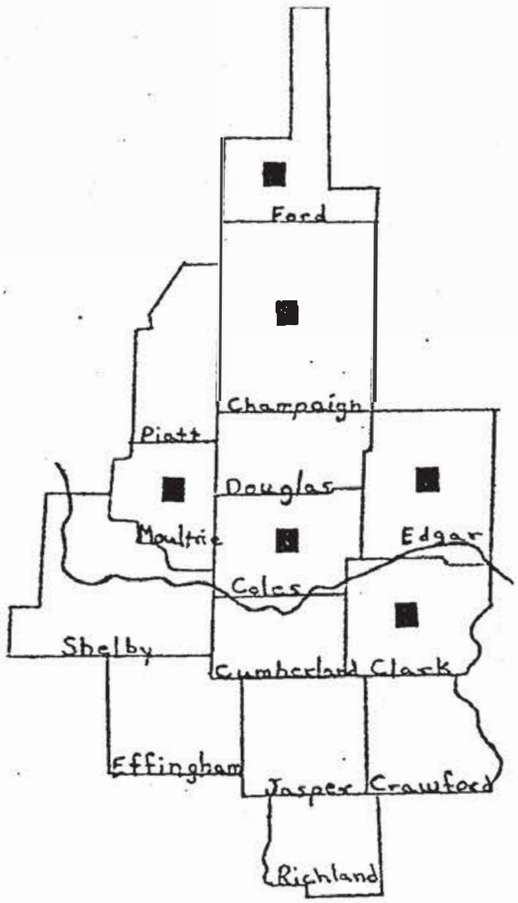

Fig. 1A. Chara globularis

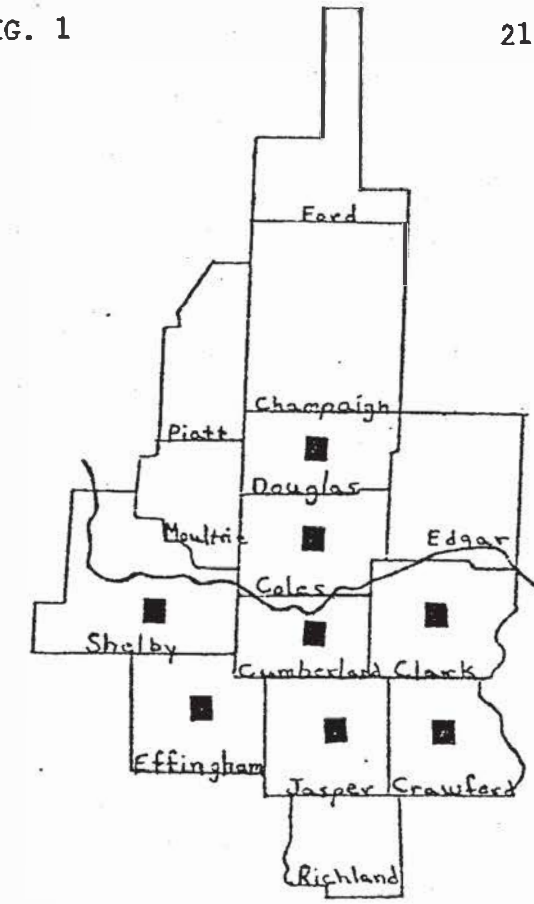

Fig. 1B. Jussiaea repens

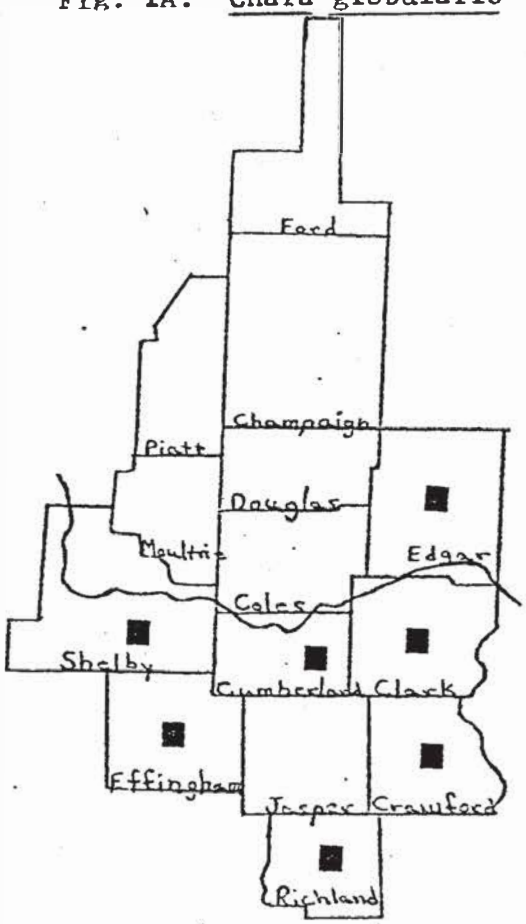

Fig. 1C. Najas minor

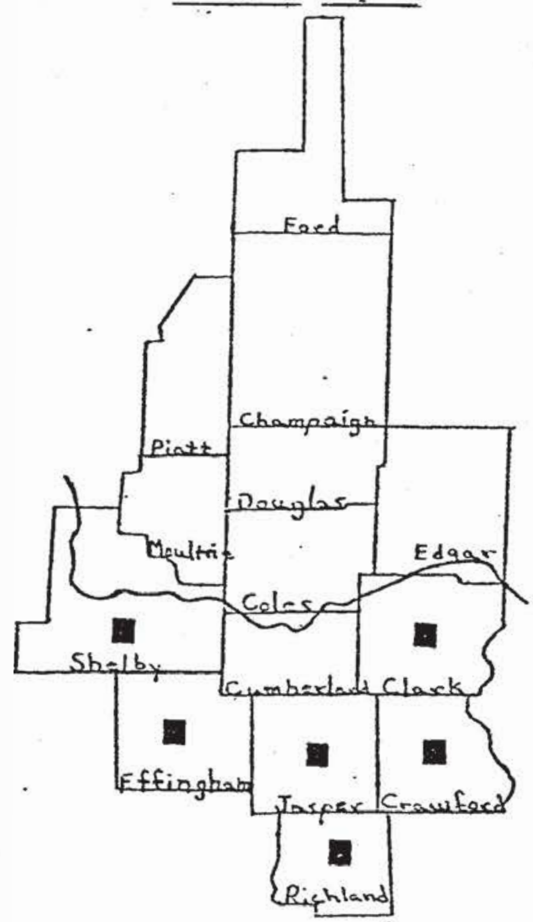

Fig. 1D. Potamogeton diversifolius