Limnological Study of

Mid Lake, Oneida County

February 1992 - November 1992

Prepared by

Northern Lake Service, Inc.

400 North Lake Avenue

Crandon, Wisconsin 54520

June 10, 1993

Table of Contents

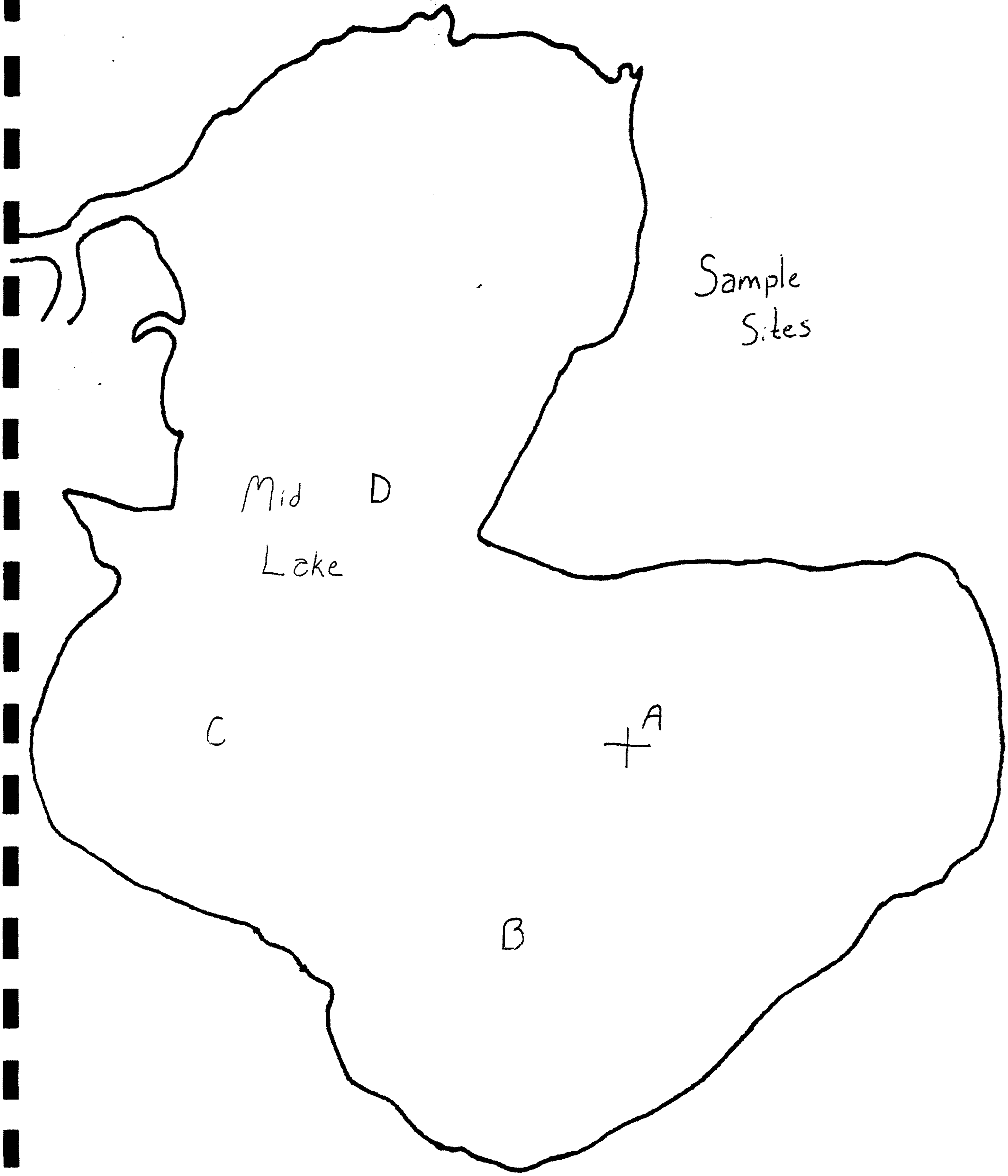
Introduction

The following is a description of and results from the planning-grant study of Mid Lake performed by Northern Lake Service between February 1992 and November 1992. The purpose of this study was to determine current water quality for comparison to past and future data and provide a basis for recommending improvement/preservation strategies.

Mid Lake is a 215 acre, spring-fed lake located in northern Oneida County (Sec.19, R39N, T7E). It has a maximum depth of 13 feet, 2.8 miles of shoreline and watershed of one square mile. Much of the northwestern corner of the lake is bordered by wetland. The remaining shoreline is quite heavily developed. Public access is provided by the Tomahawk thoroughfare.

Study

This study consisted of five visits to the lake. During the first visit on February 26, 1993, dissolved oxygen levels were measured at four points on the lake. (See sample site map.) No samples were collected at that time. On subsequent trips, a water sample was collected from a central location using a two-meter PVC sampler. The sample was composited, dispensed into sample bottles, and iced for transport to the laboratory. A portion of the sample was used for pH and conductivity determination immediately after sampling. Dissolved oxygen/temperature profiles were also


Sample
Sites
Mid
Lake
D
C
A
B

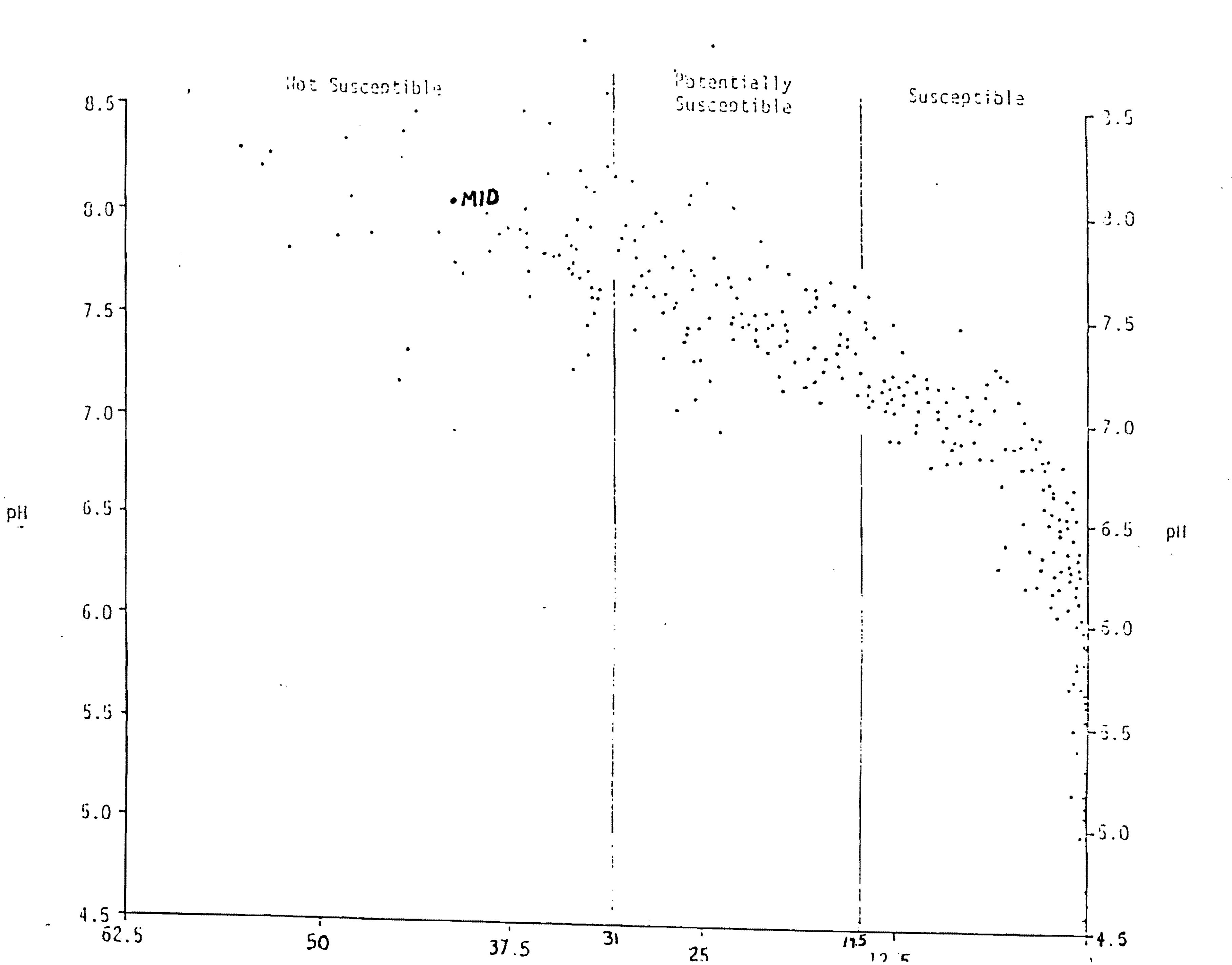
generated at the sample site. These activities were done May 6, June 10, August 3 and Nov 6. During the August 3 sampling, a general macrophyte survey was performed. For a description of this survey see appendix A.

Samples were analyzed by Northern Lake Service for alkalinity, chloride, chlorophyll α, nitrogen (Kjeldahl, ammonia, and nitrate + nitrite) and phosphorus. These parameters are described on the following pages and all data can be found in appendix B.

Survey Findings

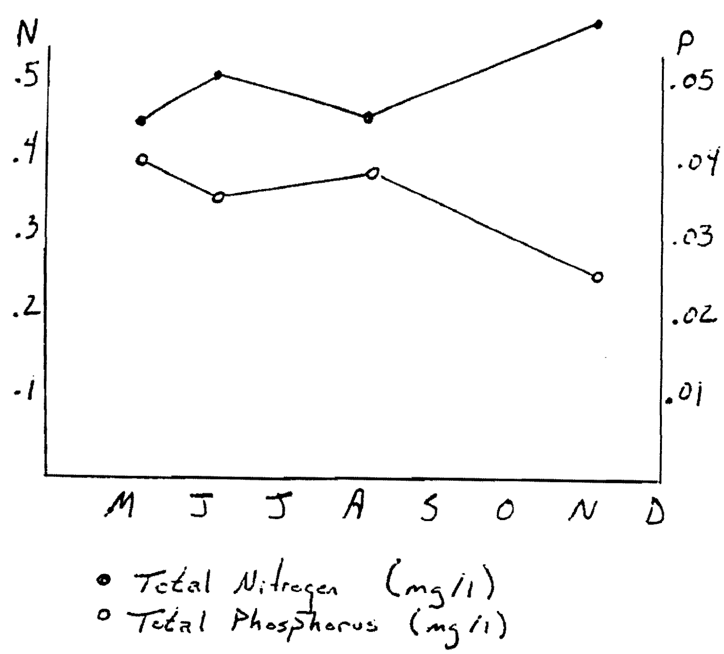
pH and Buffering Capacity: pH and total alkalinity or acid neutralizing capacity (ANC) are indications of a lake's susceptibility to the effects of acid rain. pH is the measure of acidity on a logarithmic scale from 1 to 14. A pH factor of 1 is most acidic, 14 most basic and 7 neutral. Alkalinity measures the ability of water to neutralize substances on the upper and lower ends of the pH scale. This process, called buffering, is performed by salts, mainly calcium carbonate salts. The more of these salts present, the higher the alkalinity and the more resistant to pH changes the water is. The pH on Mid Lake ranged from 7.6 to 8.7, indicating slightly basic conditions. Alkalinity was very stable, ranging from 40 mg/l to 44 mg/l, which indicates relatively good buffering potential. Figure 1 shows Mid Lake's position among area lakes in acid susceptibility based on these measurements.

ACID RAIN EFFECT SUSCEPTIBILITY
(from Greater Bass Lake Langlade County Feasibility Results;
Management Alternatives. by WDNR Bureau of Water Resources Management - Inland Lake Renewal Section; 1983, p17.)



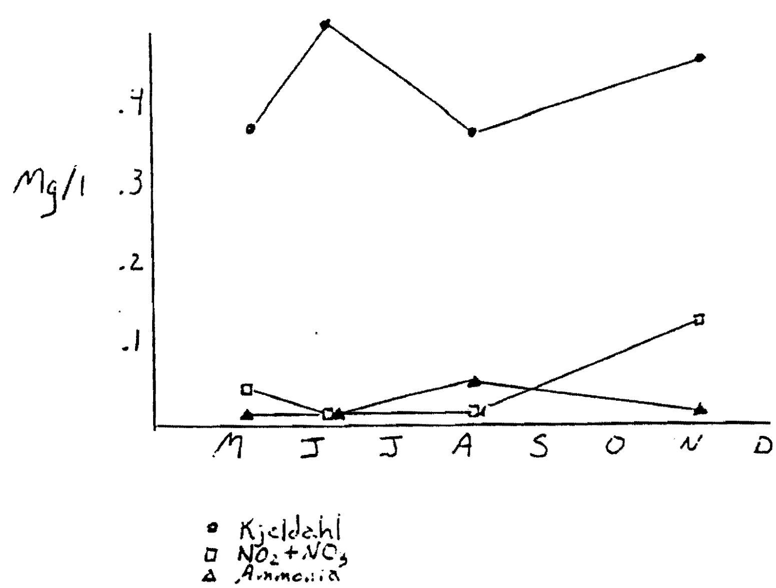
Nutrients: A nutrient is any element, ion or compound necessary for the growth and other life processes of an organism. Most nutrients are required in only trace amounts, but some, the macronutrients, are required in large enough amounts to dictate the productivity of a system. The macronutrients are carbon, nitrogen and phosphorus. Since carbon is so prevalent in a lake its levels do not get low enough to make it a limiting factor. (The limiting factor is the nutrient or energy source that exists in a quantity such that it dictates the extent of growth.) Therefore, nitrogen and phosphorus are considered the most important in terms of potential productivity of a lake.

The ratio of nitrogen to phosphorus fluxuates between 11:1 and 15:1 during the growing season. A ratio of 13:1 is generally considered the point below which nitrogen is the limiting factor and above which phosphorus is. Graph 1 shows nitrogen and phosphorus levels on Mid Lake during the study. (Note: On this graph nitrogen values are 10 times that of phosphorus.)



High productivity characterized by nuisance weed or algae growth can be expected when total phosphorus levels exceed 15 ug/l. Phosphorus levels in Mid Lake ranged from 26 to 41 ug/l during the study.

Nitrogen levels ranged from 0.44 mg/l to 0.59 mg/l. These values were consistent with many other lakes in this area. 75 to 100% of the total nitrogen consisted of organic nitrogen. One component of organic nitrogen is ammonia which can be an indicator of septic contamination. Ammonia levels were only above detection limits on one of the four sampling dates and even then it was not significant enough to indicate a problem. The inorganic portion of total nitrogen is made up of nitrate and nitrite. High levels of these compounds can indicate nutrient contamination from fertilizer or other man-made products. Nitrate + Nitrite levels were very low until late fall when it jumped to 0.13 mg/l. Graph 2 shows the nitrogen component levels during the study.

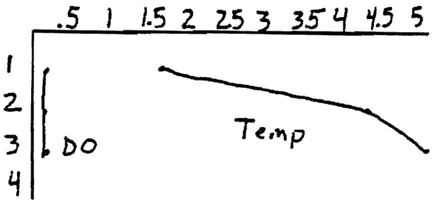


Dissolved Oxygen - Dissolved oxygen is critical to the survival of fish. In the spring, when a lake turns over, dissolved oxygen levels will be at or near saturation throughout the water column. Over the course of the summer, levels near the surface will fluctuate slightly with variations in temperature and mixing. In shallow, productive lakes such as Mid oxygen levels can be depleted very rapidly during the winter when production ceases but consumption continues. If oxygen levels are depleted enough,fish begin to suffocate causing a phenomenon called "winter kill". Total oxygen depletion also provides a more favorable environment for nutrient recycling from the sediments meaning more nutrients available for macrophyte or algae growth in the spring. The following page includes all dissolved oxygen/temperature profiles that were generated during the study. Numbers on the vertical axis are depths in meters. Those on the horizontal axis represent both temperature in °C and dissolved oxygen in mg/l or parts per million.

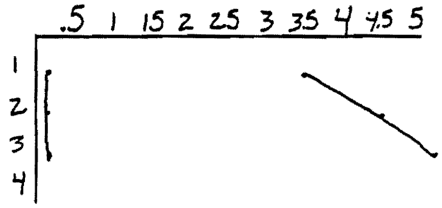
Chlorophyll

Chlorophyll α, a pigment found in algae, is used as an indicator of algal growth and is very often closely associated with water clarity and phosphorus levels. The following graph shows that relationship on Mid Lake.

A

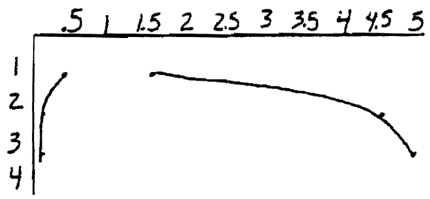


B

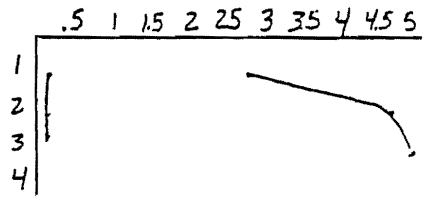


2/26/92

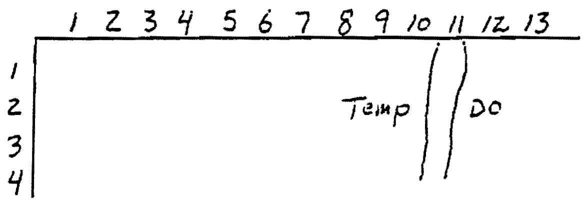
C



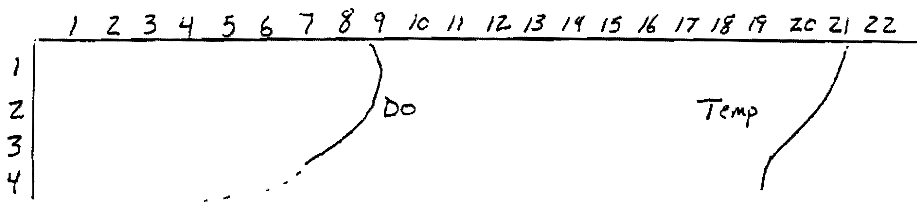
D



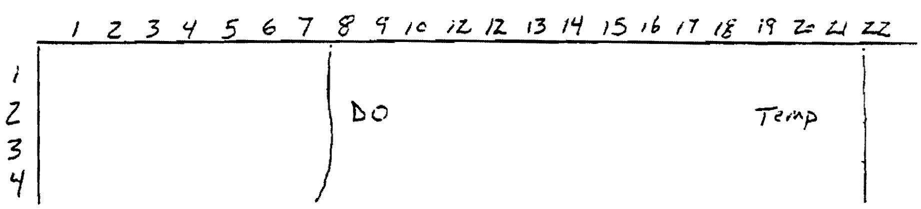
5/[illegible]/92



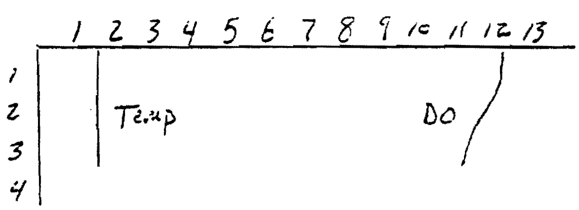
6/10/92

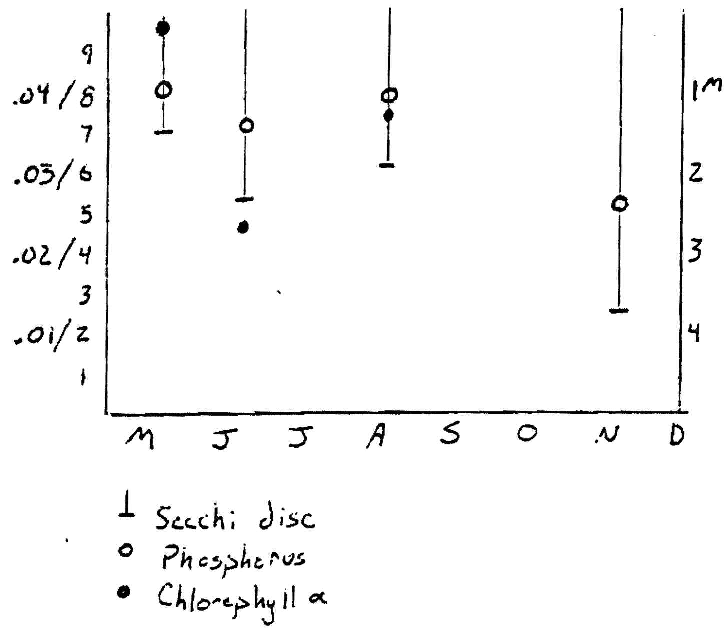


[illegible]/3/92



11/6/92





For complete chlorophyll results see appendix.

Macrophytes

Mid Lake maintained aquatic plant growth throughout the lake to its maximum depth of 13 feet with extensive growth occurring to 11 feet. Twenty-three different species were observed during the August 3 and 5, 1992 study. Of these, three are floating leaf plants, four are emergent, and the remaining 16 are submergent species. A separate report on this study, including field sheets, maps and species descriptions, is included here as appendix A.

Summary & Recommendations

As a lake ages and nutrients accumulate it becomes more productive or eutrophic. The rate of this process can be dramatically effected by the activities of man. The situation on Mid Lake is one of naturally high productivity probably moderately increased by man. The following two models use phosphorus chlorophyll α and Secchi depth to estimate water quality and trophic state (lake age). As the models show Mid Lake is quite eutrophic but not to the point that water quality is poor.

Trophic Level	Total Phosphorus	Secchi Disc	Chlorophyll
Eutrophic			
	20	2.0	8.5
Mesotrophic			
	10	4.0	2.3
Oligotrophic			

(Carlson, R.E., 1977, A trophic state index for lakes: Limnology and Oceanography, March, v. 22(2), p. 361-369)

Water quality index	Total Phosphorus (mg/l)	Chlorophyll α (ug/l)	Secchi (ft)
Excellent	<0.001	<1	<19.7
very good	.001-.010	1-5	9.8-19.7
good	.010-.030	**5-10**	6.6-9.8
fair	**.030-.050**	10-15	**4.9-6.6**
poor	.050-.150	15-30	3.3-4.9
very poor	>.150	>30	>3.3

(Lillie, R.A., and J.W. Mason, 1983, Limnological characteristics of Wisconsin lakes: Wisconsin Dept. of Natural Resources Technical Bulletin No 138, 1116 p.)

A number of actual and potential problems exist due to this situation. Extensive weed growth can limit recreational activities and adversely affect aesthetics. It also provides cover for small fish which is benificial to an extent but if it becomes too thick and widespread larger predators are not able to hunt effectively, and a large population of stunted panfish may result. During winter decomposing vegetation consumes oxygen. In a shallow lake, like Mid, which has extensive weed growth and not a lot of oxygen to begin with, depletion can be severe enough to stress or kill fish. This seemed to be occurring in the winter of 1991-92.

A number of different management strategies can be considered for Mid Lake. Both mechanical harvesting and chemical treatment are classic responses to a weed problem such as that on Mid.

Chemical treatment could be effective if done properly. If this were attempted, care should be taken to preserve some weed stands including the floating-leaf beds and native emergents. Table 1 shows the effectiveness of 5 currently-used herbicides on specific macrophytes. Further information on weed control chemicals in DNR published information sheets--PUBL-WR-135-90 through PUBL-WR-145-90 and <u>How to Identify and Control Water Weeds and Algae</u> 1976 James C. Schmidt. Drawbacks of chemical treatment include the possibility of residual effects on non-target members of the system--especially after long-term use. Also this method does not remove anything from the system. Nutrients are recycled and available for further weed growth.

Table 1. Common aquatic weed species and their responses to herbicides (modified from Pickerel/Crane Lake A Phase 1 Diagnostic & Feasibility Study 1992)

	Diquat	Endothal	2,4-...	Glyphosate (Rodeo)	Fluridone (Sonar)
EMERGENT SPECIES					
Sagittaria spp (arrowhead)	NO	NO	YES		YES
Scirpus spp (bulrush)	NO	NO	YES	YES	YES
Typha spp (cattail)	YES	NO	YES	YES	YES
Lythrum salicaria (purple loosestrife)				YES	
FLOATING SPECIES					
Brasenia schreberi (watershield)	*NO*	*YES*	*YES*		*NO*
Lemna minor (duckweed)	YES	NO	YES		YES
Nuphar spp (cowlily)	NO	YES	YES	YES	YES
Nymphaea spp (water lily)	NO	YES	YES	YES	YES
SUBMERGED SPECIES					
Ceratophyllum demersum (coontail)		YES	YES	YES	YES
Chara spp (stonewort)	NO[2]	NO[2]	NO[2]	NO[2]	
Elodea canadensis (elodea)	YES	?	NO		YES
Myriophyllum spicatum (milfoil)	YES	YES	YES	NO	YES
Najas flexilis (najad)	YES	YES	NO	NO	YES
Najas guadalupensis (southern najad)	YES	YES	NO		YES
Potamogeton amplifolius (large-leaf pondweed)	*?*	*YES*	*NO*		
P. crispus (curly-leaf pondweed)	*YES*	*YES*	*NO*		
P. natans (floating leaf pondweed)	*YES*	*YES*	*YES*		*YES*
P. pectinatus (sago pondweed)	*YES*	*YES*	*NO*		*YES*
P. illinoiensis (Illinois pondweed)					*YES*
Ranunculus spp (buttercup)	*YES*		*YES*		

YES Controlled
NO Not controlled
BLANK Information unavailable
? Questionable control
[2] controlled by copper sulfate

\macrochem.doc

Mechanical harvesting is very effective but also very labor and cost intensive. A modified harvesting method in which large strips are harvested may be successful on Mid Lake. This is a bit less labor intensive, provides clear boating lanes, and removes some nutrients from the system. It is also beneficial to the fishery by maintaining much cover but also creating long edges where larger predator fish can hunt.

Table 2 compares harvesting, chemical treatment and a number of other management tools.

Aerators may be considered to keep an area free of ice in the winter. This will lessen oxygen depletion and help maintain a healthier fish population.

Proper "common sense" practices can be as important as high tech rehabilitation efforts. These are low-tech, low-cost practices by lake residents and users to avoid accelerating the lake aging process. They include the following: Maintaining naturally vegetated "buffer zones" along the shore, carefully monitoring septic system performance, landscaping to decrease erosion, avoiding the use of chemical fertilizers, and operating motorized water craft slowly in shallow, heavily sedimented areas.

Finally, we recommend a long-term, self-help monitoring program. A simple program which can be an extremely effective indicator of changes in aging trends is regular Secchi disc readings. As the

Table 2

	Mechanical Harvesting	Aquatic Herbicides	Dredge	Rototill	SCUBA	Bottom Screens	Drawdown	Biological
Effect on Ecosystem	Remove plant material, some small fish	possible residual effects	removes littoral zone, disturbs sediments	disturbs sediments	removes aquatic vegetation	creates clear-cut	downstream water quality effects, possible fishery effects	needs research
Effective Large-scale	yes	yes - but possible residual effects	yes	yes	no - very labor intensive	no	yes	yes
Effective Small-scale	no - difficult to maneuver	yes	yes	no	yes	yes	no	no
Species Selective	no	yes - if applied properly	yes	no	yes	no	no	yes with fungi and insects
Removes Nutrients	yes	no	yes	no	yes	no	no	no
WDNR Acceptibility	high - minimul environmental impact	low - permit required	low - many environmental impacts	medium - prefer harvesting	high - proven effective in southern WI	high - for small areas, permit required	low - physical features of dam prevents drawdown	low - many unknowns
Public Acceptibility	high	medium - more public info needed	medium - many environmental impacts	medium - new technology	high - has been demonstrated to maintain channels up to 2 years	medium - effective but difficult to maintain	medium - depends on many factors, may have to coordinate with utility company	medium - more research and public info needed
Per acre cost	$200 to $600	$75 to $600	$15,000 to $20,000	$1500	varies depending on volunteers	$10,000 to $15,000	nominal	N/A

format taken from "Minnesota Aquatic Plant Control Draft Reconnaissance Report," August 1989 graph on page 6 showed, this measurement is often on indicator of nutrient levels. This should be done at regular intervals of about 2 weeks and can be used with or without annual nutrient analysis to track water quality for a minimal cost.

midre.doc

MACROPHYTE SURVEY

MID LAKE
ONEIDA COUNTY, WISCONSIN

PERFORMED BY: R.T. KRUEGER, T.R. PRIEBE AND J.L. GESKE

NORTHERN LAKE SERVICE, INC.
400 NORTH LAKE AVENUE
CRANDON, WISCONSIN 54520
AUGUST 3 AND 5, 1992

REPORT PREPARED:
AUGUST 26, 1992

Introduction

On August 3 and 5, 1992, a general macrophyte survey was conducted on Mid Lake, Oneida County by Northern Lake Service personnel. The survey was performed to determine density, distribution and diversity of aquatic vegetation. General observations were made throughout the lake, with depth and density recorded at 80 sampling stations. These stations represent intersection points on a grid 350 feet on the side.

Methodology

At each numbered station a 10 foot circle is visualized and divided into four quadrants. Macrophytes are then collected, identified, and ranked as follows: 1 if present in 1 quadrant, 2 if present in 2 quadrants, etc... A ranking of 5 signifies complete or near complete dominance by one species, occupying a significant portion of the water column. If a species is observed growing outside the circle, it is given a "p" for present. Species receiving only this designation are not considered when relative frequency, average density, and depth to growth are calculated, but are included on the species list. If a specimen cannot be identified to species it is referred to by the generic name followed by "sp" ("spp" indicates the presence of more than one unidentified species of the given genus.) Water depth, depth to vegetation, percent open water, and bottom type (if depth permits) is also recorded at each station.

Bottom type descriptions are as follows: D=detritus, G=gravel, H=hard, clay like, M=muck, R=rocks, S=sand.

Survey Findings

Macrophyte growth was extensive almost throughout Mid Lake. Of the 80 stations sampled, only three supported no growth. Five more supported very sparse growth. These eight stations were the only stations 12 feet or deeper. The remaining 72 station supported at least one species to a ranking of 3. Fifty-nine stations supported at least one species at a 4 ranking. The macrophyte community was found to be quite diverse, with 23 species collected. Of these, three are floating-leaf plants, four are emergents and 16 are submergent species.

Floating leaf vegetation occupies about one percent of the surface of Mid Lake. It occurs in several small scattered beds along the north and west shores, and one large bed in a bay on the west shore. These beds consist of *Nymphea sp., Nuphar variegatum,* and to a lesser extent, *Polygonum natans*.

Emergent vegetation also occupies about one percent of Mid Lake in small scattered beds. The beds consisted of *Typha latifolia* (cattails), *scirpus* sp. (bullrushes), and *Lythrum alatum* (purple loostrife).

Submergent vegetation occupied approximately 95 percent of the lake to a depth of 12 feet. *Potamogeton zosterformis* was the most prevalent species, present at 72 of 80 stations. It was collected in water from 3 to 13 feet deep. *Ceratophyllum demersum* was present at 60 stations and also had the highest average density at 3.0. *Elodea canadensis* and *Potamogeton praelongus* were also present at more than 50 percent of the sample sites. Five additional species, *Lemna trisulca, Myriophyllum exalbescens, Potamogeton amplifolius, P. richardsonii, P. robbinsii* were present at 20 to 40 stations.

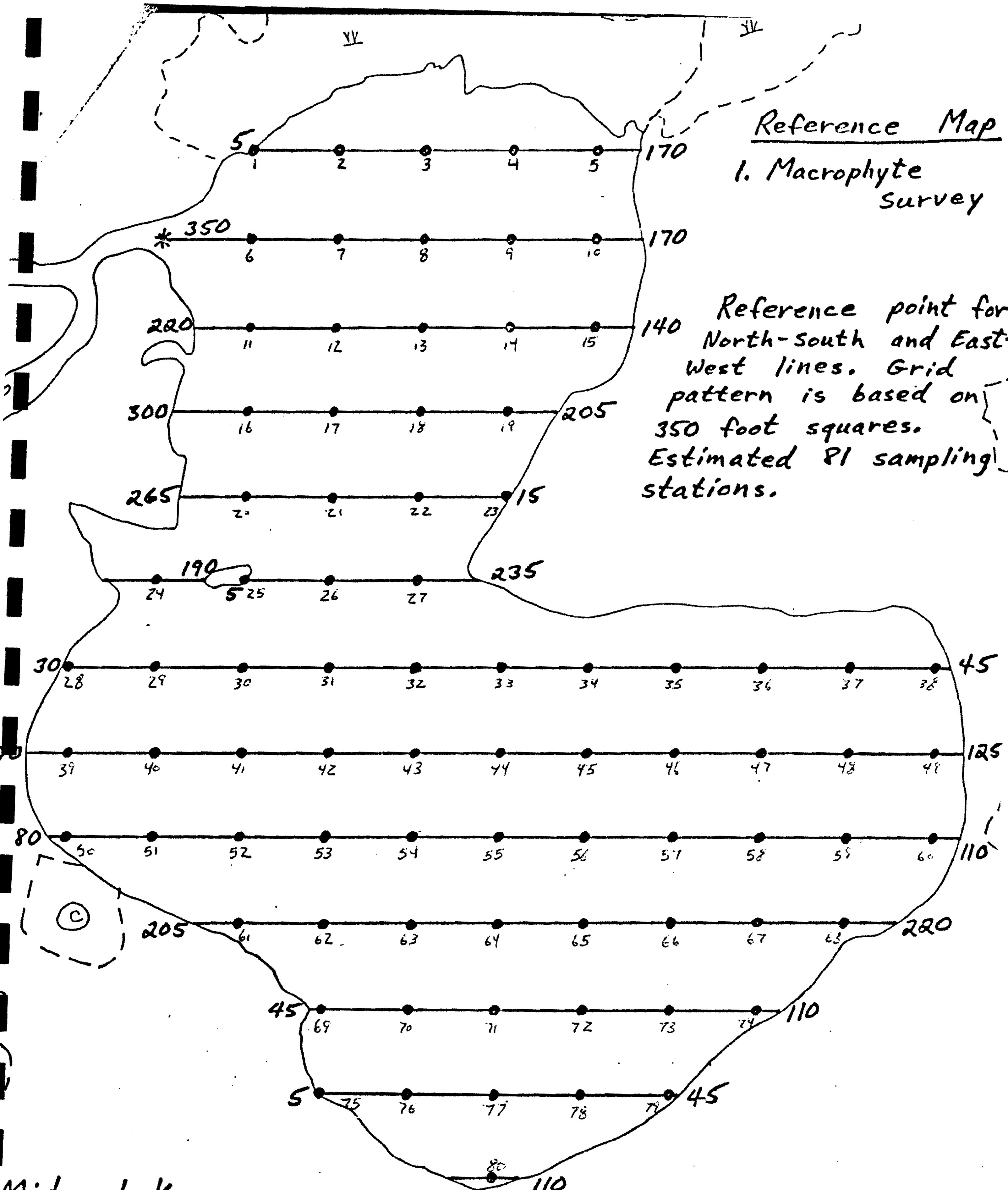
Most stations exhibited good diversity. All but the seven deepest stations mentioned above supported at least three different species. Nearly half of the stations supported over five species. The most diversity was exhibited at station 50 where 12 different species were collected.

The average depth to vegetation was approximately three feet overall, but varied significantly in different sections of the lake. In the southern section (station 28-38 south), the average was 3.6 while in the northern lobe, it was only 2.1 feet. Plant growth was also slightly more dense in this area.

midmacro.doc

Reference Map

1. Macrophyte survey



* Reference point for North-South and East-West lines. Grid pattern is based on 350 foot squares. Estimated 81 sampling stations.

Mid Lake
Oneida Co.
Scale: 1" = 500'

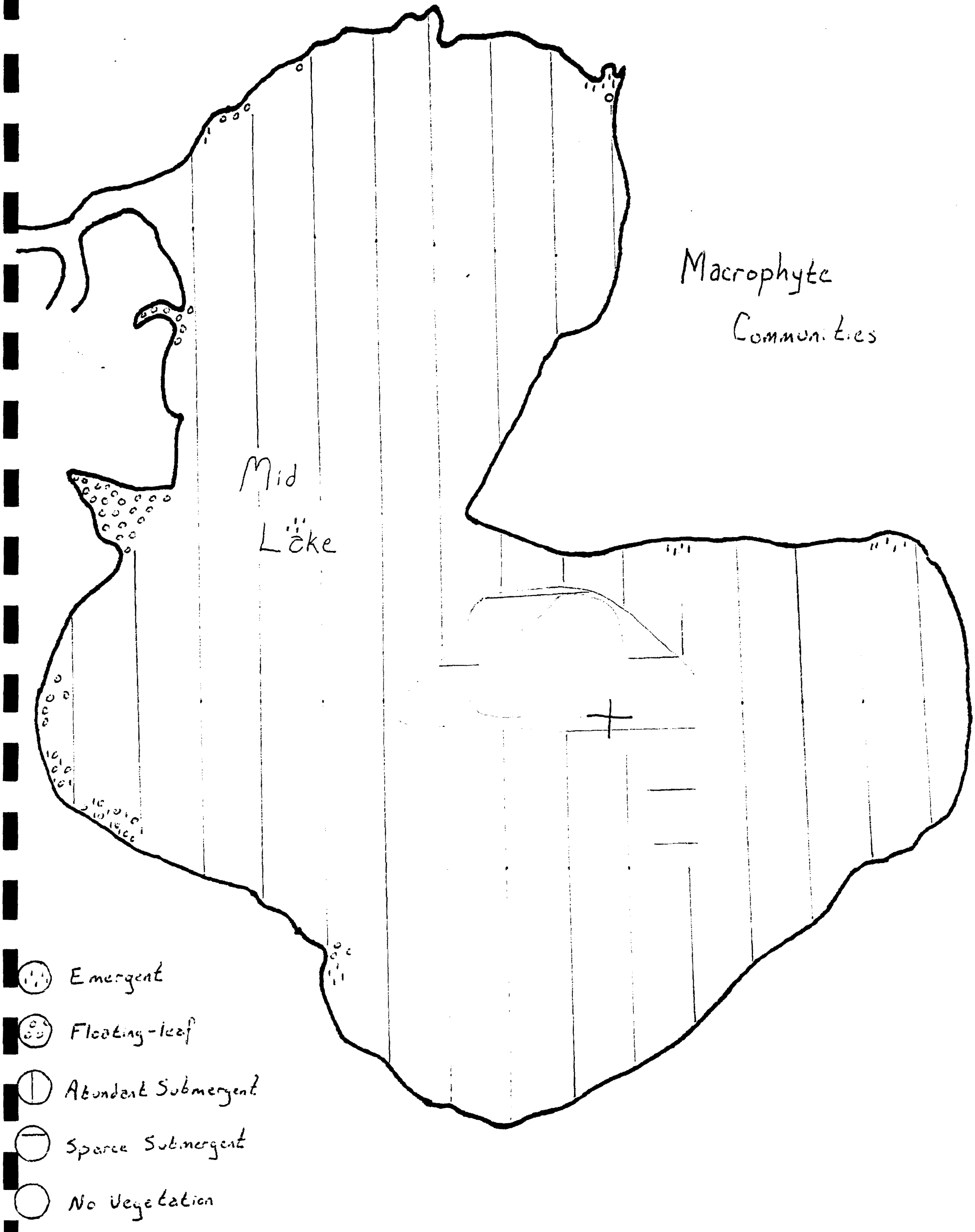
MID LAKE MACROPHYTE SPECIES LIST

Species (common name)	Relative Frequency(%)	Average Density	Depth of Growth(ft.)
Ceratophyllum demersum (coontail)	75.0	3.0	3.5 - 11
Chara (muskwort)	5.6	2.0	4 - 5.5
Elodea canadensis (American elodea)	53.8	2.6	3 - 12
Lemna trisulca (star duckweed)	48.8	2.8	3 - 8.5
Lythrum sp. (purple loosestrife)	p	--	--
Megalodonta beckii (water marigold)	2.5	2	3 - 5.5
Myriophyllum exalbescens (northern milfoil)	35.0	1.6	4 - 8.5
Najas flexilis (slender naiad)	1.3	3	5.5
Nuphar variegatum (yellow water lily)	2.5	1	3 - 4
Nymphaea sp. (white water lily)	2.5	2	3 - 4.5
Pontedaria cordata (pickerel weed)	p	--	--
Polygonum natans (water smartweed)	p	--	--
Potamogeten amplifolius (large leaf pondweed)	43.8	2.3	3.5 - 9
P. praelongus (white stem pondweed)	57.5	2.0	3 - 11
P. robbinsii (Robbin's pondweed)	25.0	1.7	3 - 11
P. richardsoni (Richardson's pondweed)	36.3	1.9	3.5 - 11
P. sp.	7.5	1.3	4 - 10
P. zosteriformes (flat-stem pondweed)	90.0	2.4	3 - 13
Ranunculus longirostris (stiff water crowfoot)	2.5	1.5	3 - 4.5
Sagitaria cristata (stubby wapato)	1.3	1	3

MID LAKE MACROPHYTE SPECIES LIST

Species (common name)	Relative Frequency(%)	Average Density	Depth of Growth(ft.)
Scirpus sp. (bulrush)	p	--	--
Typha latifolia (cattail)	p	--	--
Vallisneria americana (eelgrass, wild celery)	5.0	2.8	3 - 5

Note: p=present, but not found at any numbered station.


Macrophyte
Communities
Mid
Lake
Emergent
Floating-leaf
Abundant Submergent
Sparce Submergent
No Vegetation

MID LAKE

Ceratophyllum demersum - Coontail; leaves 1 - 3.5 cm long, whorled on stems, palmately divided and serrated on one side; leaves crowded at tips of stems giving "coontail" effect.

Chara sp. - Muskwort; rigid, often brittle algae growing to 1 ft.; "leaves" simple, whorled around stems; plants reddish brown, yellow or green; strong musty smell when crushed.

Elodea canadensis - American elodea; leaves 1-2 cm long by 1.5-3 mm whorled on stems in groups of 3's or 4's; whorls about 0.5-1 cm apart; stem thin, light colored and brittle; flowers, with extremely thin white petiole, float on surface.

Lemna trisulca - Star Duckweed; small (≈ 7 mm) spatula-shaped segment connected to one another by "stalk" portion; each segment with one tiny root; plants often form large, tangled, sinking mats.

Megalodonta beckii - Water marigold; submerged leaves somewhat stiff finely dissected and crowded at the nodes; nodes 2-4 cm apart; stems ≈ 4 mm diameter; flower daisy-like, held above the water and very rare.

Myriophyllum exalbescens - Northern water milfoil; submerged leaves to 3 cm long, in whorls of 3,4, or 5, dissected into 6-10 pairs of thin segments from a central axis; flower small on a spike held above the water; floral bracts very small.

Naja flexilis - Slender naiad; leaves 1-3.5 cm long, opposite on stems, tapering to a slender pointed tip; leaf bases clasping; stems slender, flexible; plant extremely limp out of water.

Nuphar variegatum - Yellow pond lily, spatterdock; leaves large (to 50 cm) oval, basal lobes rounded; stem stout, attached to leaf between basal lobes; flowers large (to 10 cm), yellow spherical.

Nymphaea odorata - White water lily; leaves large (to 40 cm) nearly circular; basal lobes pointed; stem stout attached to leaf between basal lobes; flower large (to 20 cm) with 25-50 waxy white petals surrounding yellow center.

Polygonum natans - Water smartweed; leaves to 10 cm, oval to elliptical, floating, glossy; petioles ≈ 3 cm; stipules unite forming papery tube; flowers small, pink, crowded into spike.

Pontedaria cordata - Pickerel weed; leaves large (to 30 cm) heart-shaped, held upright above water; flowers numerous ≈ 2 cm, usually purple, held above water in a spike-like arrangement (to 10 cm).

Potamogeten amplifolius - Large-leaf pondweed; leaves to 20 cm, folded along midrib and recurved (banana-shaped); plants often turning brown; flowers on dense spike (to 8 cm) held above the water; stipules rigid, persistent (to 4 cm); often with elliptical floating leaves.

P. praelongus - White-stem pondweed; stems stout often whitish and zig-zag; leaves to 20 cm often with conspicuous white midvein, clasping; leaf tips rounded into boat-shape which splits when pressed; stipules paper-like persistent ≈ 5 cm long; spike dense to 6 cm long.

P. richardsonii - Richardson's pondweed; leaves to 10 cm, often with conspicuous white midvein, wavy leaf margins, clasping stems tapering to slender tip; stipules blunt, not persistent; stem usually white; floral spike to 3 cm.

P. robbinsii - Robbin's pondweed; leaves strongly two ranked (plant resembles a fern under water), stiff, ≈ 10 cm x 5 mm; stipules not persistent; stem slightly flattened usually un-branched.

P. zosteriformis - Flat-stem pondweed; leaves linear to 20 cm x 5 mm; stem to 5 mm wide, strongly flattened slightly winged, limp; stipules to 3 cm; peduncle to 5 cm often curved.

Ranunculus longirostris - white water buttercup or crowfoot; leaves finely dissected; petiole absent or very short with clasping sheath at base; flowers 1-2 cm wide with white pedals surrounding yellow center.

Sagittaria cristata - leaves in basal rosette, stiff, ≈ 10 cm x 2 cm and to 4 mm thick, pointed; stems and flowers often absent.

Scirpus sp. - Bulrush; stems simple, rigid, linear, erect to 2 m, round, mostly hollow; flowers spraying out from side of stem near the end (actually end of stem with bract).

Typha latifolia - Cattail; leaves sword-like to 2 m, stiff; stem to 3 m stiff, erect; flowers tiny crowed into large (to 20 x 5 cm) cigar-like spike.

Vallisneria americana - Eel grass, wild celery; leaves ribbon-like to 1 m x ≈ 1.5 cm wide; flowers, white ≈ 1 cm, floating on long, slender, spirally stem.

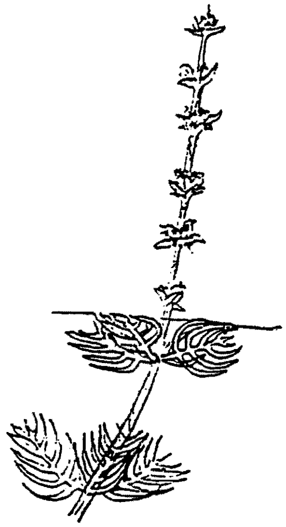
(These definitions have been written with regard to the species and variations of species found in Mid Lake, Onieda County. It should not be relied upon as a key, especially on other lakes.)

REFERENCES

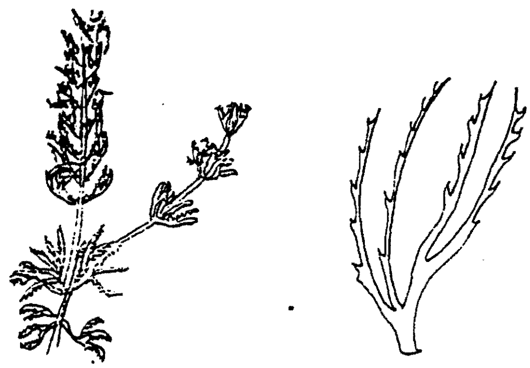
Fassett, Norman C., A Manual of Aquatic Plants, 1957, Revision appendix by Eugene C. Ogden, pp. 405, University of Wisconsin Press, Madison.

Lopinot, Alvin C. and Glen S. Winterringer, Aquatic Plants of Illinois, 1966, pp. 140, Department of Registration and Education, Illinois State Museum Division and Department of Conservation, Division of Fisheries.

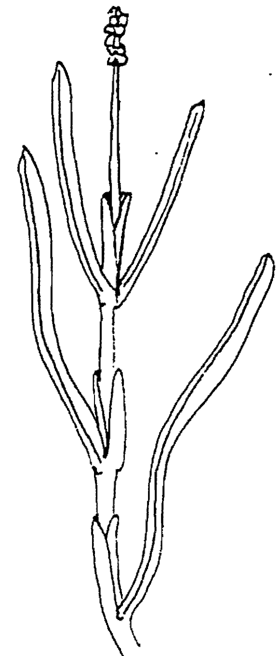
/midspe.doc



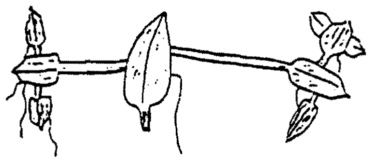
…riophyllum exalbescens



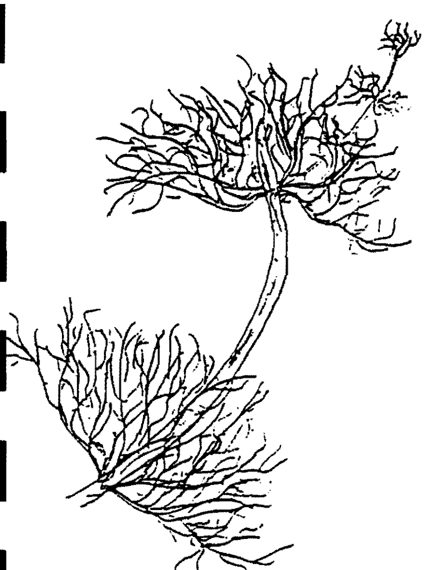
Ceratophyllum demersum



Potamogeten zosteriformis

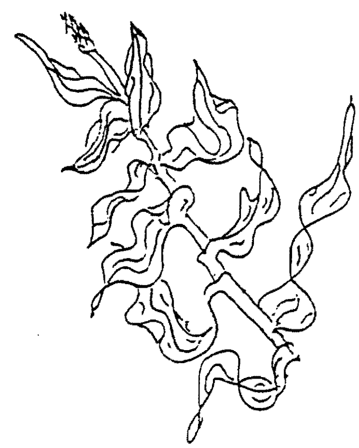


Lemna trisulca

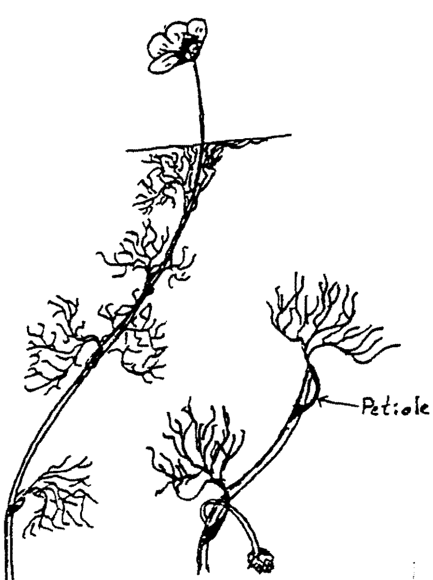


…egalodonta beckii

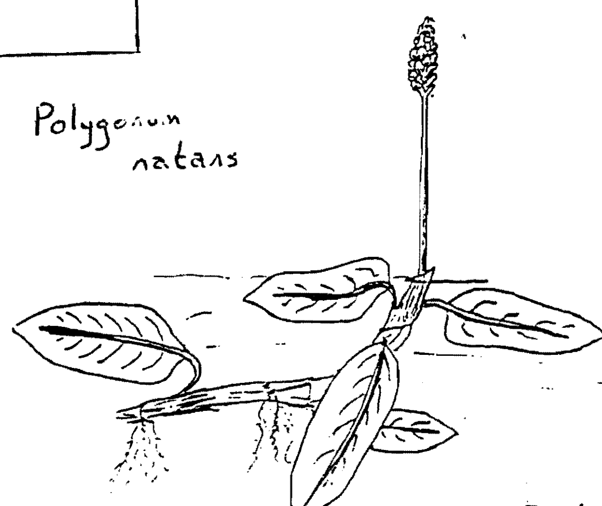
Najas flexilis



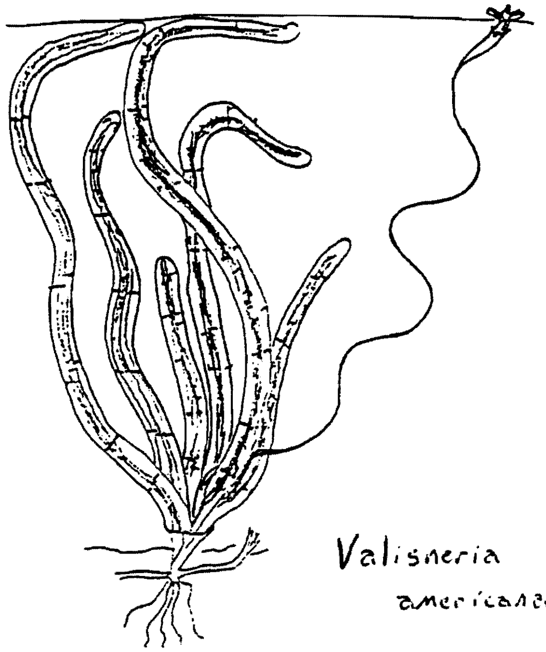
Potamogeten richardsonii



Ranunulus
longirostris trichophyllus

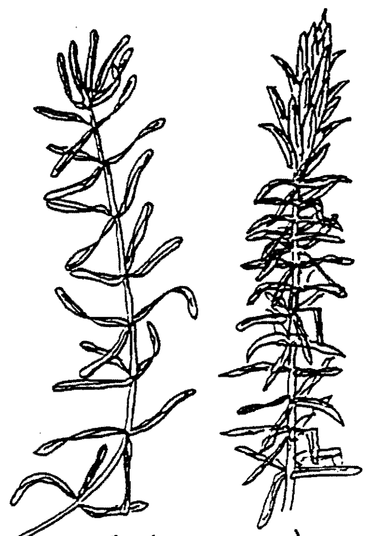


Polygonum natans

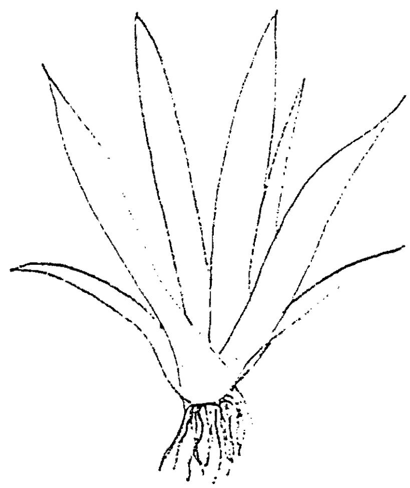


Valisneria americana

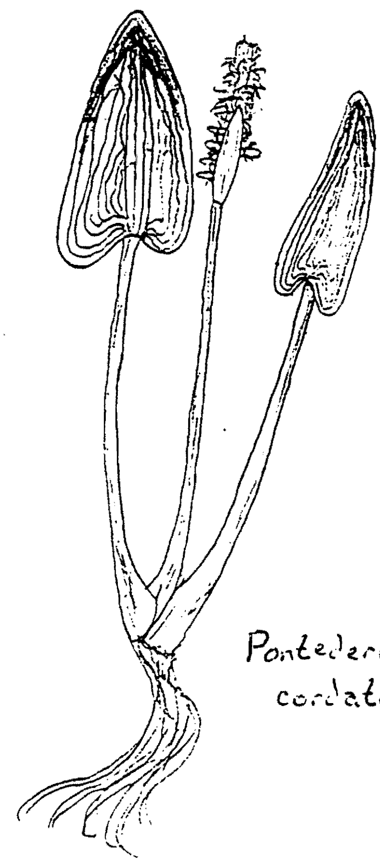
Potamogeten amplifolius



Elodea canadensis

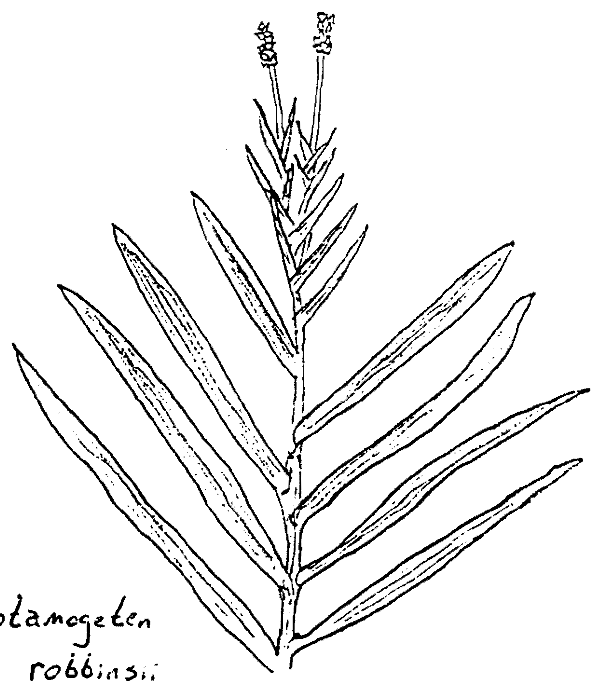


Sagiteria cristata



Pontederia cordata

Chara sp.



Potamogeten robbinsii

Potamogeten

MID LAKE CHLOROPHYLL RESULTS

Date	CCα	Pheo α	TCα	TCb	TCc
5/06/92	9.93	3.54	12.47	-0.272	1.19
6/10/93	4.98	1.62	6.01	0.726	1.39
8/03/92	7.46	1.10	8.33	0.870	1.58

Key
CCα = Corrected α
Pheo α = Pheophytin α
TCα = Trichromatic chlorophyll α
TCb = Trichromatic chlorophyll b
TCc = Trichromatic chlorophyll c
units = ug/l

MID LAKE DISSOLVED OXYGEN/TEMPERATURE RESULTS

Depth Taken	5/6/92	6/10/92	8/3/92	11/6/92
0.1 meters	11.1/10.6°	8.8/21.2°	7.7/21.6°	12.1/1.7°
1 meters	11.1/10.4°	9.0/20.9°	7.8/21.6°	12.0/1.7°
2 meters	10.9/10.2°	8.6/20.2°	7.8/21.6°	11.5/1.7°
3 meters	10.9/10.1°	7.1/19.2°	7.7/21.6°	11.1/1.7°
4 meters	3.5 bottom	3.75 bottom	7.3/21.6°	3.5 bottom
			4.25 bottom	

Dissolved oxygen units: mg/l
Temperature units: °C

MID LAKE ANALYTICAL RESULTS

Parameter	Units	5/6/92	6/10/92	8/3/92	11/6/92
Alkalinity	mg/l	42	44	40	42
Chloride	mg/l	3	10	3	5
Chlorophyll α	ug/l	9.93	4.98	7.46	--
Conductivity	umho@25C	118	114	100	99
pH	s.u.	7.7	8.1	8.7	7.6
Kjeldahl-N	mg/l	0.39	0.53	0.38	0.46
NO2+NO3	mg/l	0.05	<0.05	<0.05	0.13
Ammonia-N	mg/l	<0.05	<0.05	0.07	<0.05
Tot. Phosph.	mg/l	0.041	0.036	0.039	0.026
Secchi disc	feet	4.9	7.7	6.0	12.0
Secchi disc	meter	1.5	2.3	1.8	3.7