Aquatic vegetation of Pierz-Fish Lake

2001 to 2011

ID# 49-0024-00

Morrison County, Minnesota

Camp Ripley airplanes flying over Pierz-Fish Lake, 2011

Report by:
Donna Perleberg, Aquatic Plant Ecologist
Stephanie Simon, Aquatic Biologist

Minnesota Department of Natural Resources
Division of Ecological and Water Resources
Lakes and Rivers Program
1601 Minnesota Drive, Brainerd, MN 56401

Surveyors:
2011: Stephanie Simon, Michelle Dickson (Intern) and Sam Eininger (Intern)
2005: Donna Perleberg and Cody Peterson (Intern)
2002: Marilyn Emerson (DNR Fisheries Specialist) and Donna Perleberg
2001: Donna Perleberg, Marilyn Emerson and Jessica Fiedler (Intern)

Acknowledgements: We thank Eric Altena and Audrey Kuchinski for reviewing and providing helpful comments on earlier drafts of this report.

A note to readers:
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This report should be cited as:
Perleberg, D. and S. Simon. 2012. Aquatic vegetation of Pierz-Fish Lake (ID# 49-0024-00) Morrison County, Minnesota, 2001, 2005, 2011. Minnesota Department of Natural Resources, Division of Ecological and Water Resources, Lakes and Rivers Unit, 1601 Minnesota Drive, Brainerd, MN 56401. 24 pp.

Summary

Pierz-Fish Lake is a 170 acre, mesotrophic lake in central Minnesota. Aquatic vegetation surveys were conducted in August 2001 and August 2002 to assess native plant communities and in early June 2005 and May 2011 to assess the distribution and abundance of the non-native plant, curly-leaf pondweed.

A total of 32 native aquatic plant species were recorded including seven emergent, three floating-leaved, and 22 submerged plants. This is within the expected range for a central Minnesota lake with moderately clear water. Plants were found to a maximum depth of 19 feet but were most frequent in depths of ten feet and less. During the August 2001 survey, within the shore to 20 feet depth zone, 72% of the sample sites contained plants.

Mixed beds of yellow and white waterlilies occurred on the east and west shores and covered about eight acres. The most frequently occurring native submerged plants were coontail, muskgrass, wild celery, northern watermilfoil and a variety of native pondweeds.

The non-native submerged plant, curly-leaf pondweed, was first documented in Pierz-Fish Lake in 2001 but has been present in the region for decades. It was located during the summer 2001 and 2002 surveys but was most frequent during the spring 2005 and 2011 surveys when it occurred in 30% and 13% of the sample sites, respectively. Curly-leaf pondweed dominated the plant community in the spring of 2005 and was less frequent in 2011. Annual variations in the abundance of this non-native plant and native plants are likely influenced by environmental factors such as water clarity and snow depth.

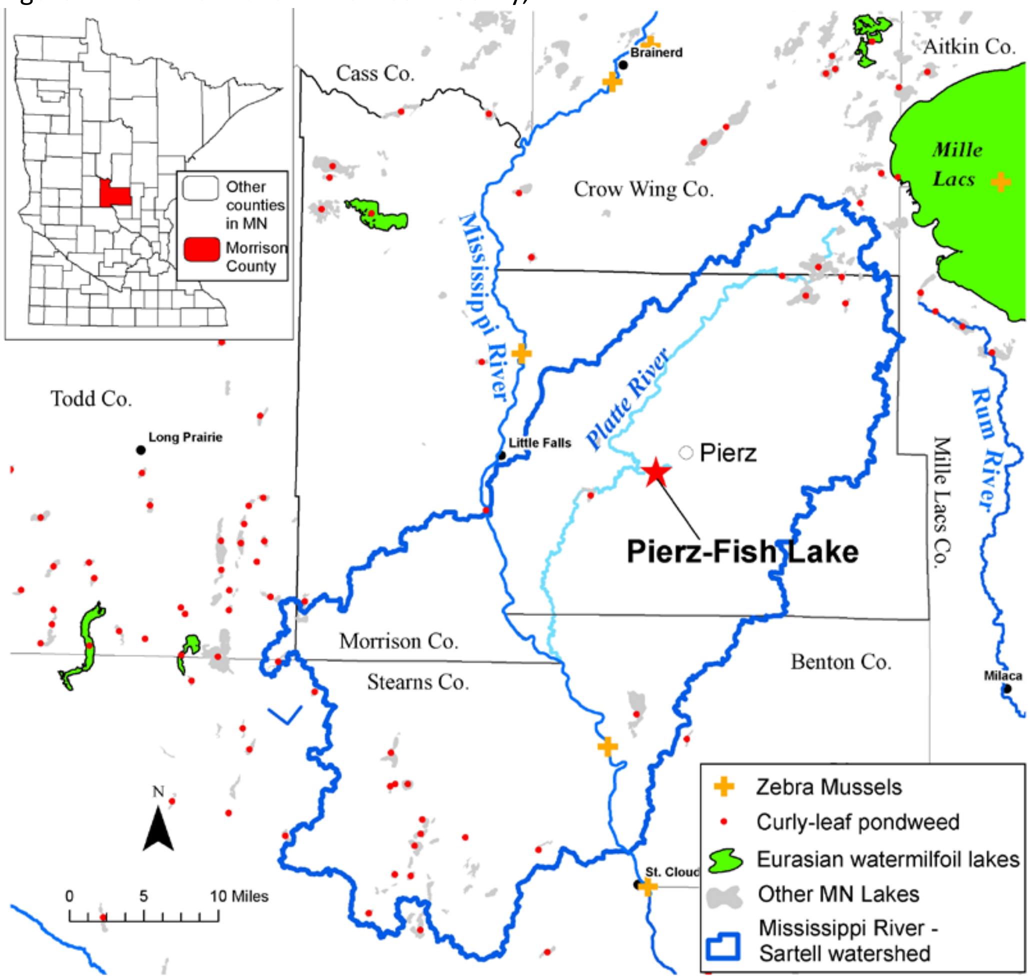
As of 2011, other non-native aquatic species such as zebra mussels and Eurasian watermilfoil have not been found in the lake but do occur in the watershed. To help mitigate against harmful effects of non-native species, it is important to protecting existing native plant beds and maintain good water quality through shoreland management practices.

Introduction

Lake description

Pierz-Fish Lake is located about two miles southwest of the city of Pierz in Morrison County, central Minnesota. It occurs within the Mississippi River-Sartell watershed and is indirectly connected to the Mississippi River via the Platte River (Figure 1).

Figure 1. Pierz-Fish Lake in Morrison County, MN.



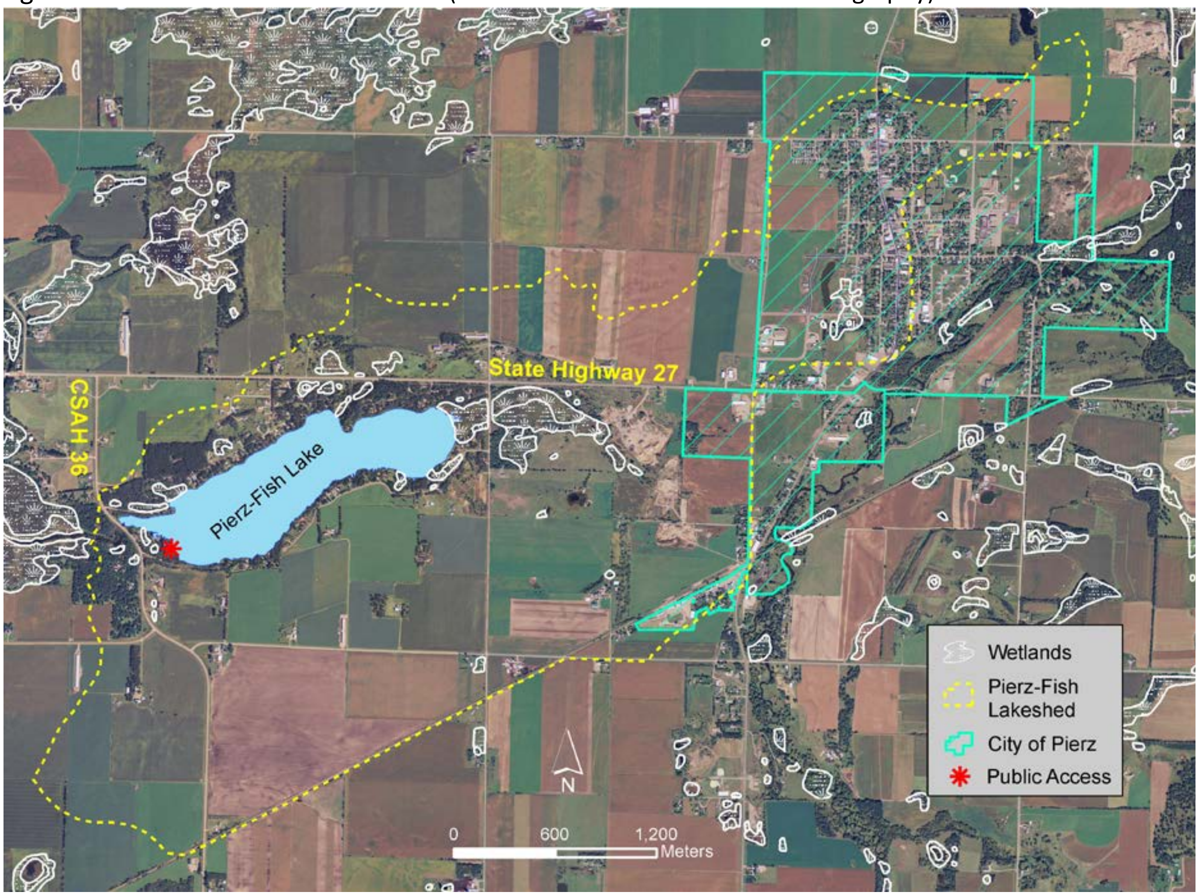
The lakeshed of Pierz-Fish Lake, or the land that drains directly to the lake, is primarily agricultural land and includes most of the City of Pierz (Figure 2). Pierz-Fish is a flow-through lake with an eastern inlet from a perennial wetland stream and a western outlet that leads to the Platte River.

With a surface area of 170 acres, Pierz-Fish Lake is the 13th largest lake in the county[1]. The elongated basin stretches about 1.25 miles in length and about 0.25 miles in width, with a total

[1] There are about 38 lakes in the county that are at least 50 acres in surface area.

shoreline length of about three miles. The eastern shore is adjacent to a wetland and the remaining shoreland is mostly upland and developed with residential homes. Trees have been retained on many lake lots but most understory vegetation has been converted to turf grass. There is a public access on the southwest shore.

Figure 2. Lakeshed of Pierz-Fish Lake. (Photo source: 2010 FSA Aerial Photography).



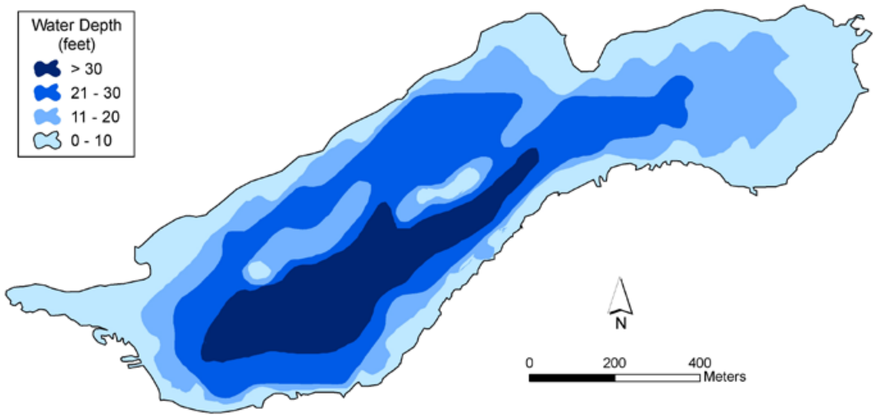
The maximum water depth is 34 feet and about one-third of the basin is less than 15 feet in depth (Figure 3). Water levels are fairly stable but may increase more than two feet above the mean following heavy precipitation (Appendix 1).

The trophic, or growth, status of Pierz-Fish Lake is characterized as mesotrophic, based on phosphorus (nutrients), chlorophyll a (algae concentration) and Secchi[2] depth (transparency). As a general rule, sunlight can penetrate to a depth of 1.7 times the Secchi depth (Scheffer 1998) and rooted aquatic plant growth is generally limited to that depth range. Secchi depth data from Pierz-Fish Lake are limited but clarity has ranged from "good" (3 to < 6 feet) to "excellent" (>12 feet) with increasingly clear water in recent years (Appendix 1). Based on

[2] The Secchi disc transparency measures the depth to which a person can see into the lake and provides a rough estimate of the light penetration into the water column. Water clarity is influenced by the amount of particles in the water column and can fluctuate seasonally and annually.

2005-2011 summer Secchi disk measurements alone, rooted aquatic plants are not expected to grow beyond the 12-20 feet[3] depth zone in Pierz-Fish Lake. Site conditions such as substrate, wave action and the specific types of plants present in a lake can further limit the maximum rooting depth.

Figure 3. Depth contours of Pierz-Fish Lake (based on 2011 data).



Historic native aquatic plant community

Previous aquatic plant surveys of Pierz-Fish Lake were conducted in August, 1972 and August, 1980 (MnDNR Lake files). These surveys did not include quantitative estimates of plant abundance but they provide good descriptions of the types and amounts of vegetation present. A total of 15 native aquatic plant species were recorded including three emergent, three floating-leaf, one free-floating and eight submerged species (Appendix 2). Emergent and floating-leaf plant beds were found scattered throughout the lake, and were abundant near the outlet and inlet. Submerged plants were reported to a depth of 12 feet and species that were described as "abundant" included coontail (*Ceratophyllum demersum*), flat-stem pondweed (*Potamogeton zosteriformis*), and bushy pondweed (*Najas flexilis*). Water celery (*Vallisneria americana*), broad-leaf pondweeds (*Potamogeton* spp.) and northern watermilfoil (*Myriophyllum sibiricum*) were described as "common" or "occasional" in abundance.

Non-native aquatic species in the watershed

Non-native aquatic species were not observed during historical surveys of Pierz-Fish Lake but several do occur in nearby lakes and rivers (Figure 1). The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*) has been present in Minnesota since at least the 1950's and has now been documented in most central Minnesota lakes (Figure 1). This plant is most commonly found in Spring and early Summer and if it was historically present in Pierz-Fish Lake, it may have died back by the time the August 1972 and/or the August 1980 surveys were conducted.

[3] From 2005 to 2011, the mean summer Secchi disk readings in Pierz-Fish Lake ranged from 7 to 12 feet. Aquatic plant growth is limited to depths 1.7 times the Secchi disk reading, or between 12 and 20 feet in this lake.

The non-native submerged plant, Eurasian watermilfoil (*Myriophyllum spicatum*) has not been found in the Mississippi River-Sartell watershed but does occur in three lakes within 35 miles of Pierz-Fish Lake (Figure 1): Mille Lacs (Aitkin County), Lake Alexander (Morrison County) and Little Birch Lake (Todd County). Non-native zebra mussels (*Dreissena polymorpha*) occur in the Mississippi River and Mille Lacs (Figure 1).

Objectives

Pierz-Fish Lake was surveyed in August 2001 and August 2002 to assess the native plant communities. Curly-leaf pondweed was confirmed in the lake in 2001 and because this plant reaches its maximum growth in late-Spring and early Summer, surveys were conducted in June 2005 and May 2011 to assess its abundance. Specific survey objectives included:

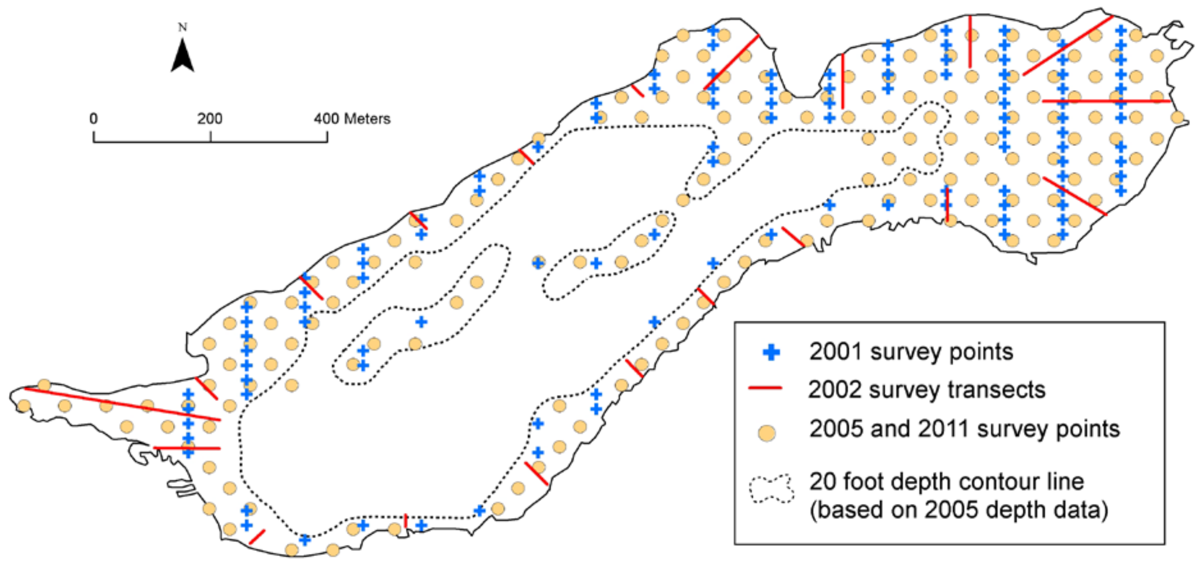
1. Record the aquatic plant species that occur in the lake
2. Describe the distribution of plants throughout the lake and by water depth
3. Estimate the abundance and distribution of commonly occurring species
4. Describe changes that may be occurring in the plant communities

Methods

Survey methods differed due to specific Program objectives and as Geographic Positioning System (GPS) technology became more advanced. Because sample number was different in some years, the data may not be directly comparable between years but it does provide general information that can be compared.

In 2002, plants were sampled along 15 transects that were placed at equal distance around the shoreline (approximately 250 meters apart) and extended from shore to open water (Figure 4). Surveyors boated along the transect and recorded the all species found within about 10 feet of

Figure 4. Vegetation survey sites.



either side of the boat and described their general abundance as “abundant”, “common” or “rare”. Species abundance was estimated by calculating the percent of transects on which each species was found.

Table 1. Sample number by water depth.

Water depth interval (ft)	Survey Year			
	2001	**2002**	**2005**	**2011**
0 to 5	49	n/a	65	69
6 to 10	24		28	33
11 to 15	13		24	23
16 to 20	21		41	36
Total 0-20 ft	107	20	158	161
21 to 25	7	n/a	5	9
total	114	20	163	170

In 2001, 2005 and 2011, sampling occurred at discrete sample stations and water depth data was recorded at each station. In 2001, the transects were placed about 100 meter apart and individual sample stations were established at 25 meter intervals along each transect (Figure 4). In 2005 and 2011, sample stations were established along a 50 meter by 50 meter grid (Figure 4). Survey waypoints were created using a Geographic Information System (GIS) computer program and downloaded into a handheld GPS receiver. The GPS unit was used to navigate the boat to each sample sites and one side of the boat was designated as the sampling area. At each site, water depth was recorded in one-foot increments using a measured stick in water depths less than seven feet and an electronic depth finder in depths greater than seven feet. Surveyors recorded all plant species found within a one square meter sample site at the pre-designated side of the boat. A double-headed, weighted rake, attached to a rope was used to survey vegetation not visible from the water surface (Figure 5). Any additional plant species found outside of sample sites were recorded as “present” in the lake but these data were not used in frequency calculations. Plant identification followed Crow and Hellquist (2000) and Flora of North America (1993+) and nomenclature followed MnTaxa (2011).

Figure 5. Survey rake.

For the 2001, 2005 and 2011 data, frequency of plant occurrence was calculated as the number of sites in which plants occurred divided by the total number of sample sites. Frequency was calculated for the entire area from shore to 20 feet and sampling points were also grouped by water depth and separated into four depth zones for analysis (Table 1). Individual frequency values were also calculated for each species (see example in Appendix 3).

Substrate sampling

In 2011 surveyors used standard substrate classes (Table 2) to describe the substrate in water depths less than seven feet. If more than one substrate type was found, surveyors recorded the most common type. Surveyors attempted to record a substrate description at the shore side of each row of points. If a sample site occurred near

Table 2. Substrate classes

boulder	diameter >10 inches
rubble	diameter 3 - 10 inches
gravel	diameter 1/8 - 3 inches
sand	diameter < 1/8 inch
silt	fine material with little grittiness
marl	calcareous material
muck	decomposed organic material

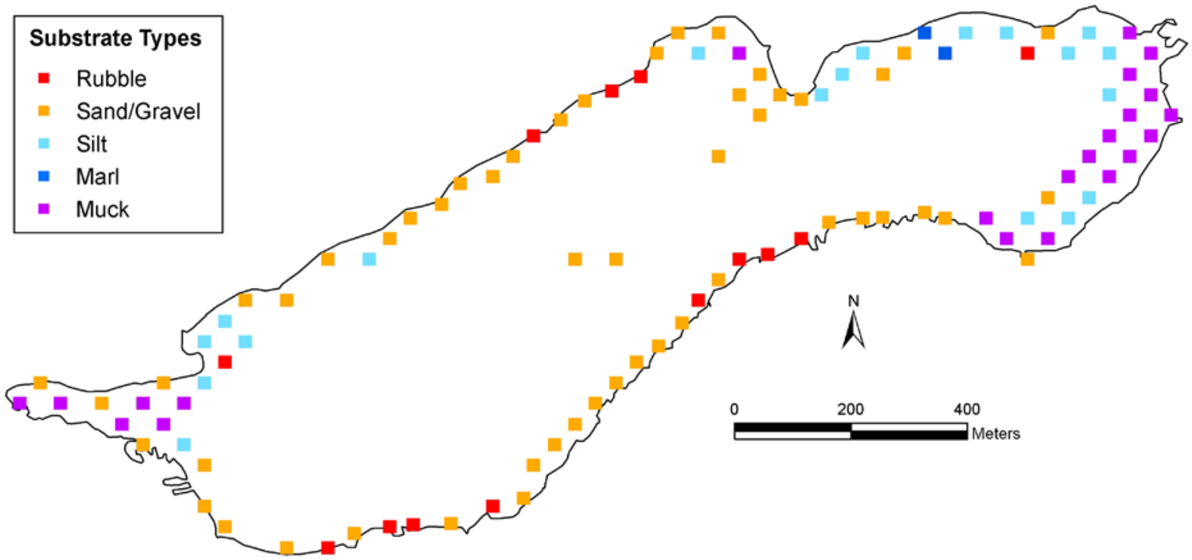
shore but in water depths greater than seven feet, surveyors collected depth and vegetation data and then motored into shallower water and recorded the substrate type adjacent to the actual survey point.

Results and Discussion

Shoal Substrates

The shoal substrates of Pierz-Fish Lake included hard substrates of sand, gravel, and rubble along the northwest and southeast shores (Figure 6). Softer substrates of silt, marl, and muck were found along the shallow western and eastern bays (Figure 6).

Figure 6. 2011 shoal substrates



Types of plants recorded

Between 2001 and 2011, a total of 32 native aquatic plant species (types) were recorded in Pierz-Fish Lake including seven emergent, three floating-leaved, and 22 submerged and/or free-floating plants (Appendix 2). Submerged plants included macroalgae[4] (*Chara* sp.) and a diversity of rooted, flowering plants. The non-native submerged plant, curly-leaf pondweed (*Potamogeton crispus*) was first documented in the lake in 2001 and was present during all three subsequent surveys.

General plant distribution and abundance

In all survey years, plants were distributed around the shoreline but were more frequently found in shallow areas such as the eastern and western shores (Figure 7). Plants were also

[4] Algae are the smallest forms of plants that occur in Minnesota lakes. They include "macroalgae", large colony forming plants that resemble rooted plants, and "microalgae" that include filamentous and planktonic forms.

present on the shallow sandbars in the center of the lake. Along the southern shore, where water depth increases rapidly, few vegetated areas were found. Mixed beds of white (*Nymphaea odorata*) and yellow (*Nuphar variegata*) waterlilies occurred along the west and east shore and covered about eight acres.

Maximum depth of plant growth ranged from 15 feet in 2002 to 19 feet in 2001 but in all years, vegetation was sparse beyond the 15 feet depth (Figure 8). In August 2001, within the 0-20 feet depth zone[5], 72% of the sample sites contained plants compared to 60% in June 2005 and

Figure 7. Vegetated sites, 2001, 2005 and 2011.

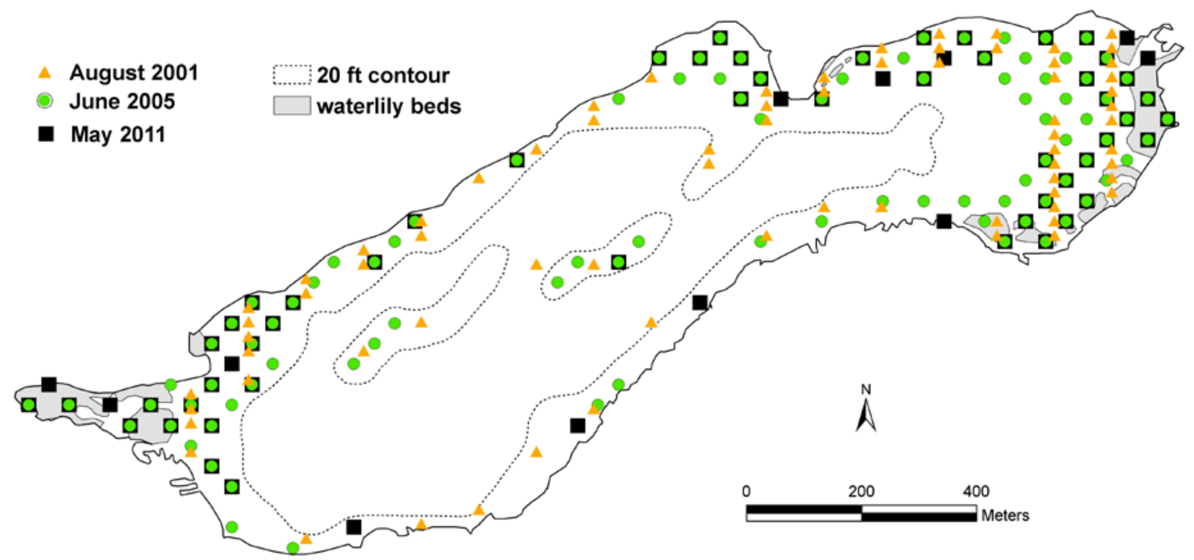
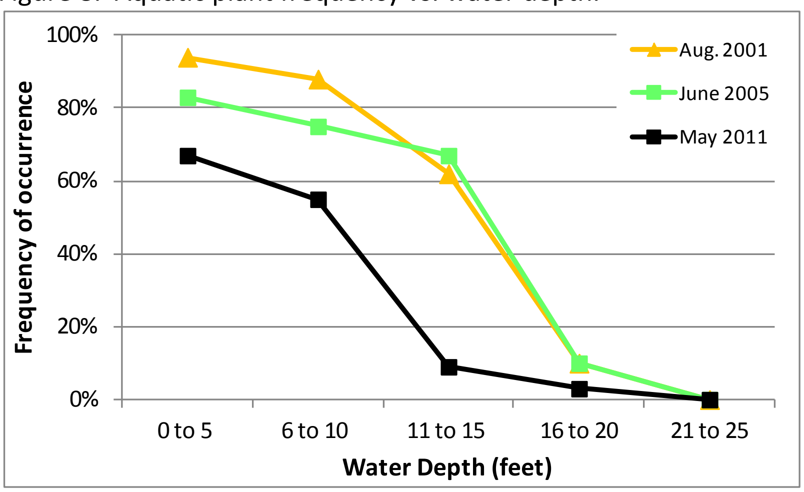


Figure 8. Aquatic plant frequency vs. water depth.



[5] The zone from shore to 20 feet included vegetation and sample sites within this depth interval were used to calculate frequency of occurrence values.

42% in May 2011. This difference is most likely due to the time of year each survey was conducted; as expected, fewer plants were found during the Spring 2005 and 2011 surveys because native plants had not yet reached their maximum growth. Additionally, high water levels during the Spring 2005 and 2011 surveys may have further limited plant growth.

Commonly occurring plant species

The August 2001 survey provides the best information on native submerged plant abundance and species that were common[6] included coontail (*Ceratophyllum demersum*), muskgrass (*Chara* sp.), wild celery (*Vallisneria americana*), northern watermilfoil (*Myriophyllum sibiricum*), several native pondweeds (*Potamogeton* spp.), and water stargrass (*Heteranthera dubia*). Most of these species require relatively good water clarity and were most frequent in the 0-10 feet depth zone where maximum light is available (Figure 9). Coontail and muskgrass, which can grow where less light is available, were also common in deeper water.

The non-native plant, curly-leaf pondweed, was present during all surveys, but as expected, was most frequent during the Spring 2005 and 2011 surveys. In 2005, it was the dominant species, occurred in 30% of the sample sites, and was common to depths of 15 feet. In 2011, curly-leaf was found in 13% of the sample sites and did not dominate at any depth. In all survey years, curly-leaf pondweed was found on the eastern side of the lake and during Spring surveys it also was found on the western shore (Figure 10).

Change in aquatic plant communities

The types and amounts of aquatic vegetation that occur within a lake are influenced by a variety of factors including water clarity, water chemistry, depth, substrate type, and wave activity. Within any given year, the composition and/or abundance of the plant community can vary in response to water clarity, water depth, and other environmental factors. Individual growth patterns of species also vary. Determining why plant communities change can be complicated because multiple factors may be involved.

Data from the Summer 2001 and 2002 surveys indicate that the number and types of plant species found in Pierz-Fish Lake were within the expected ranges for lakes in central Minnesota. Higher numbers of plant species are found in lakes with higher clarity and more undeveloped shorelines, and fewer plant species are found in lakes with lower clarity and/or extensive shoreline development. Water clarity, specifically Spring-time water clarity, appears to be increasing in Pierz-Fish Lake and if this trend continues plant growth may expand into deeper water and turbidity intolerant species may increase in abundance.

Data from the Spring 2005 and Spring 2011 surveys indicate that the curly-leaf pondweed population was lower in 2011 than in 2005, though it is not known if this trend will continue. The amount of snow and ice cover on lakes impacts the amount of sunlight reaching the lake in

[6] For this report, commonly occurring species are defined as those that occurred in more than 10% of the sample sites in at least one year.

Figure 9. Frequency of common submerged plants by water depth interval.

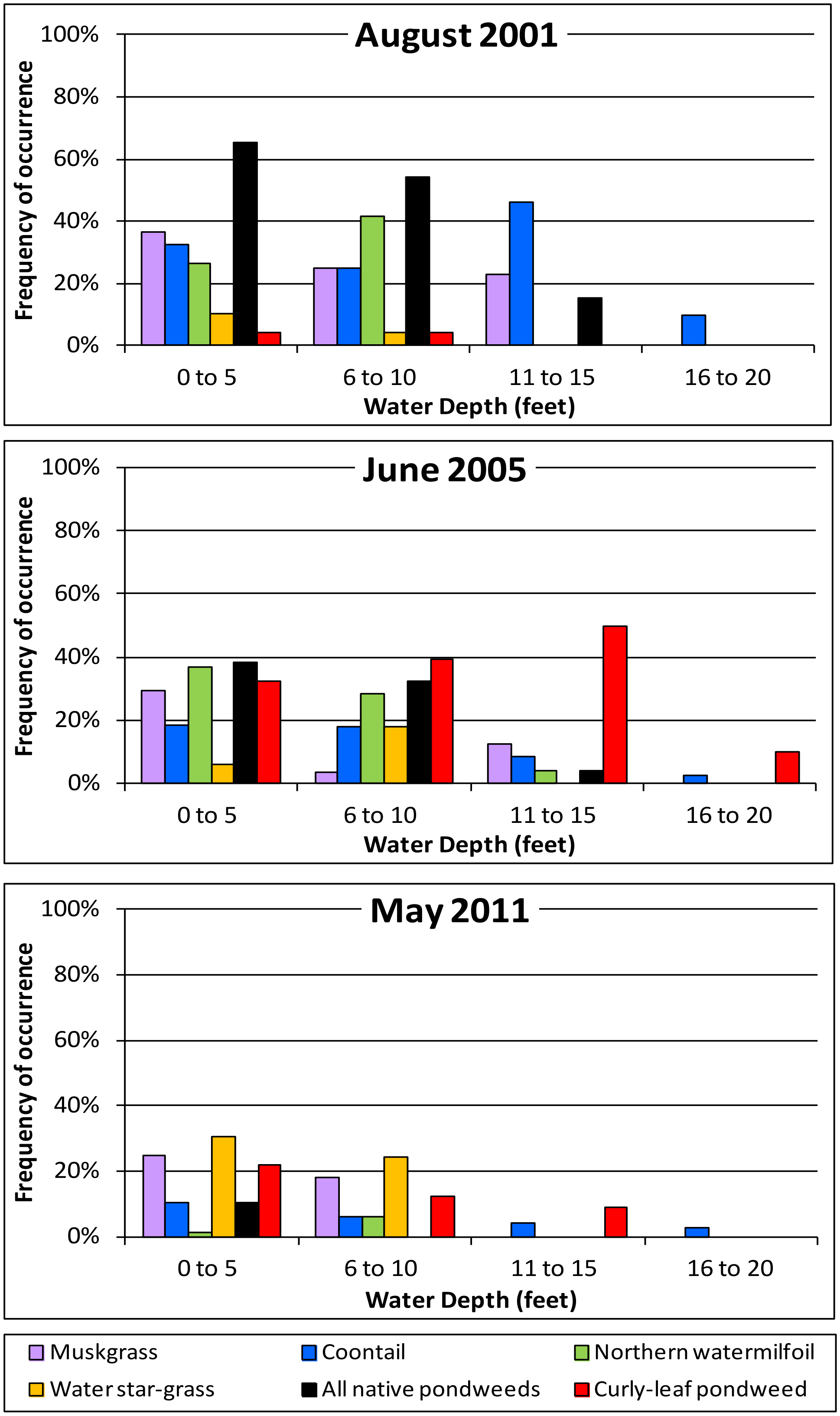
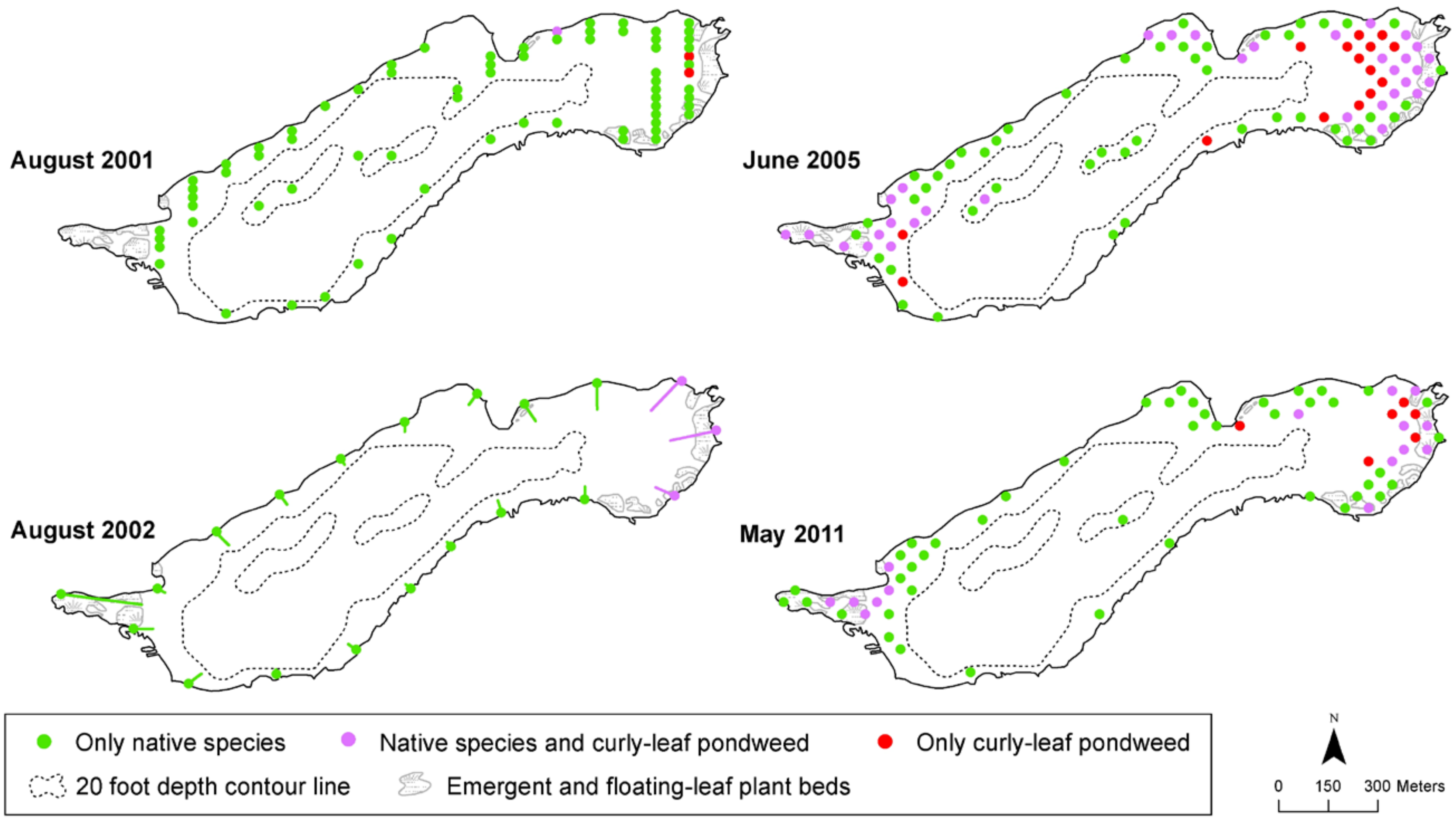


Figure 10. Presence of native plants vs. curly-leaf pondweed in Pierz-Fish Lake.



winter months and in turn, can affect plant growth beneath the ice. Aquatic plant species differ in their strategies for surviving winter and therefore respond differently to changes in snow and ice cover. Curly-leaf pondweed is well adapted to low temperatures. In late Spring it forms a dormant "turion", or seed-like structure, that acts as a Summer dispersal mechanism for the plant. The plant can germinate under the ice and gains a competitive advantage in Spring when it is one of the first plants to reach maturity. However, curly-leaf pondweed can be negatively impacted by heavy snow and ice cover which reduced the amount of light it receives through the ice. Curly-leaf pondweed annual abundance may fluctuate in response to annual snow cover.

By contrast, many native submerged species are dormant during the winter and overwinter by a hardy rootstalk, winter buds or in an "evergreen", dormant vegetative form. Their Spring growth is delayed until water temperatures increase, thus reducing the probability that new shoots will be killed by cold temperatures or heavy snow cover. Winter survival for many of these species is independent of winter light regime and plants resume growth when water temperatures increase through the summer. The specific response of native plants to heavy snow cover is influenced by the individual species winter dormancy strategy.

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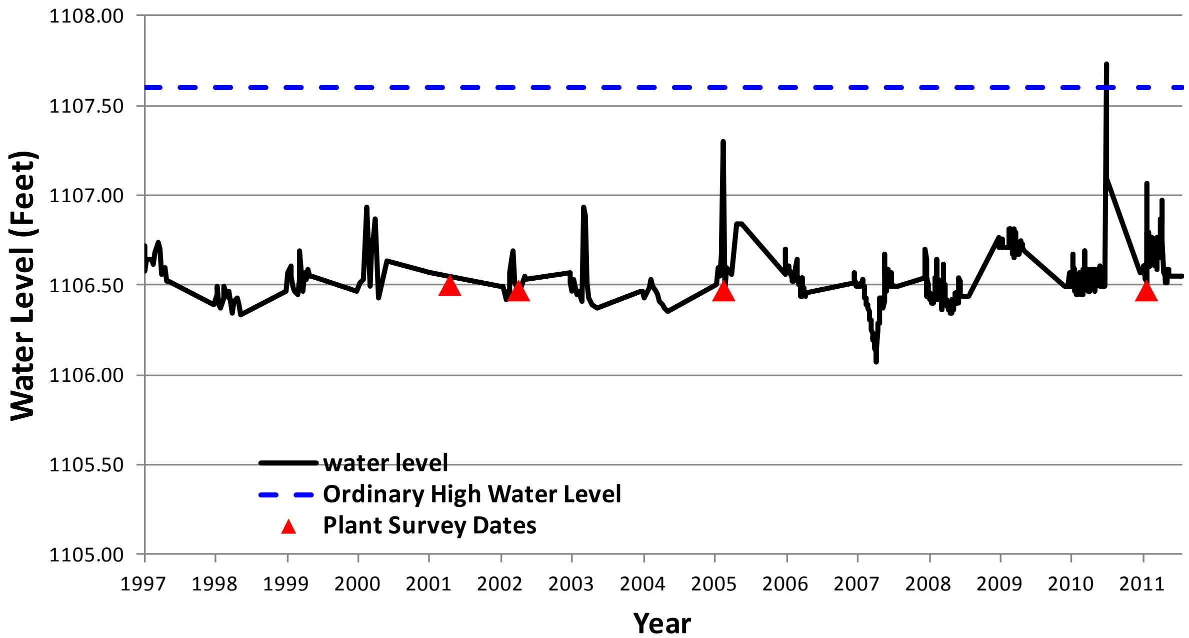
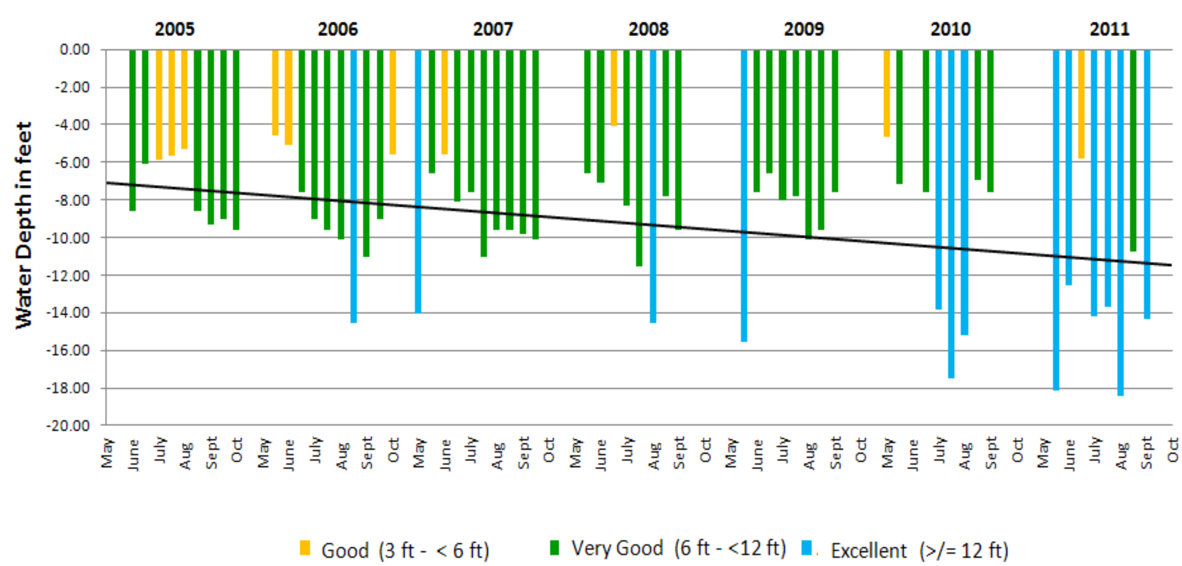
Appendix 1. Water levels and clarity of Pierz-Fish Lake.

Water levels on Pierz-Fish Lake, 1997-2011.



Source: MN Department of Natural Resources

Secchi disc readings on Pierz-Fish Lake 2005-2011. (increasing trend line shown in black)



Source: MN Pollution Control Agency, Citizen Lake Monitoring Program

Appendix 2. Aquatic and wetland plants of Pierz-Fish Lake, 1972-2011

Submerged plants

	Common Name	Scientific Name	Aug 1972	Aug 1980	Aug 2001	Aug 2002	June 2005	May 2011
	Muskgrass	*Chara* sp.			24	O	15	14
	Quillwort	*Isoetes* sp.				R		
Monocots	Canada waterweed	*Elodea canadensis*			1	O	4	5
	Water star-grass	*Heteranthera dubia*			5	C	6	18
	Bushy pondweed	*Najas flexilis*	A	A	10	A	1	
	Large-leaf pondweed	*Potamogeton amplifolius*	C		1		1	
	Curly-leaf pondweed (I)	*Potamogeton crispus*			3	O	30	13
	Fries' pondweed	*Potamogeton friesii*					1	
	Snail-seed pondweed	*Potamogeton spirillus*			5			
	Narrow-leaf pondweed	*Potamogeton* sp.				O	6	2
	Variable pondweed	*Potamogeton gramineus*					1	
	Illinois pondweed	*Potamogeton illinoensis*			14	C	3	1
	River pondweed	*Potamogeton nodosus*	P	P				
	White-stem pondweed	*Potamogeton praelongus*			4	O	6	1
	Clasping leaf pondweed	*Potamogeton richardsonii*	O	O	12	C	2	
	Flat-stem pondweed	*Potamogeton zosteriformis*	A	A	9	O	5	
	Sago pondweed	*Stuckenia pectinata*			14	O	5	
	Wild celery	*Vallisneria americana*	C	C	22	A	9	
Dicots	Coontail	*Ceratophyllum demersum*	A	A	26	C	13	7
	Northern watermilfoil	*Myriophyllum sibiricum*	O	C	20	C	21	2
	White water buttercup	*Ranunculus aquatilis*					1	1
		Total number of taxa	8	7	16	15	18	10

Free-floating plants

Common Name	Scientific Name	Aug 1972	Aug 1980	Aug 2001	Aug 2002	June 2005	May 2011
Star duckweed	*Lemna trisulca*					1	1
Lesser duckweed	*Lemna* sp.	R		1	O	p	
Greater duckweed	*Spirodela polyrhiza*			1	C	p	
Watermeal	*Wolffia* sp.				O		
	Total number of taxa	1	0	2	3	3	1

Floating-leaved plants

Common Name	Scientific Name	Aug 1972	Aug 1980	Aug 2001	Aug 2002	June 2005	May 2011
White waterlily	*Nymphaea odorata*	C	C	3	O	3	P
Yellow waterlily	*Nuphar variegata*	O		4		4	P
Floating-leaf smartweed	*Persicaria* sp.	P	P		O		
	Total number of taxa	3	2	2	2	2	2

In-lake Emergent plants

Common Name	Scientific Name	Aug 1972	Aug 1980	Aug 2001	Aug 2002	June 2005	May 2011
Needlegrass	*Eleocharis acicularis*			1			
Spikerush	*Eleocharis* sp.				O		
Horsetail	*Equisetum fluviatile*				P		
Arrowhead	*Sagittaria* sp.	P	P		O		1
Bulrush	*Schoenoplectus* sp.				R		
Burreed	*Sparganium* sp.	P	P				1
Broad-leaved cattail	*Typha latifolia*	O	O		O		P
Narrow-leaved cattail	*Typha* sp.						
	Total number of taxa	3	3	1	5	0	3

Shoreland plants

Common Name	Scientific Name	Aug 1972	Aug 1980	Aug 2001	Aug 2002	June 2005	May 2011
Swamp milkweed	*Asclepias incarnata*			Not assessed	P	Not assessed	Not assessed
Beggartick	*Bidens cernua*				P		
Broad-leaf sedge	*Carex* sp.	P			P		
Sedge	*Carex comosa*				P		
Chufa nut grass	*Cyperus* sp.				P		
Jewelweed	*Impatiens* sp.				P		
Blue flag iris	*Iris versicolor*				P		
Water horehound	*Lycopus americanus*				P		
Purple loosestrife (I)	*Lythrum salicaria*				P		
Smartweed	*Persicaria* sp.				P		
Reed canary grass (I)	*Phalaris arundinaceae*				P		
Swamp five finger	*Potentilla palustris*	P	P				
Great water dock	*Rumex* sp.				P		
Skullcap	*Scutellaria* sp.				P		
Water parsnip	*Sium suave*				P		
	Total number of taxa	2	1	0	14	0	0

I = introduced
P = present in lake, O = occasional, C= common, A= abundant

<u>For 2002 transect survey:</u>
A = present on at least 50% of transects <u>and</u> described as “common” or “abundant” on most transects.
C = present on at least 50% of transects <u>but</u> described as “occasional” or “rare” on most transects
O = present on 10-45% of transects and described as “occasional” or “rare” on most transects
R = present on only 1 transect (5%) and described as “rare”

Historical Surveys:
1972 (August 8-9): Jerome Sevada (lead surveyor), MN DNR Fisheries
1980 (August 4-7): Lloyd Anderson (lead surveyor), MN DNR Fisheries

Appendix 3: Frequency of Occurrence

For Point-Intercept Surveys, frequency of occurrence was calculated as the percent of sites, within a specific depth zone, where a plant species was detected. Unless otherwise noted, frequency values were calculated for the 0-20 feet depth zone.

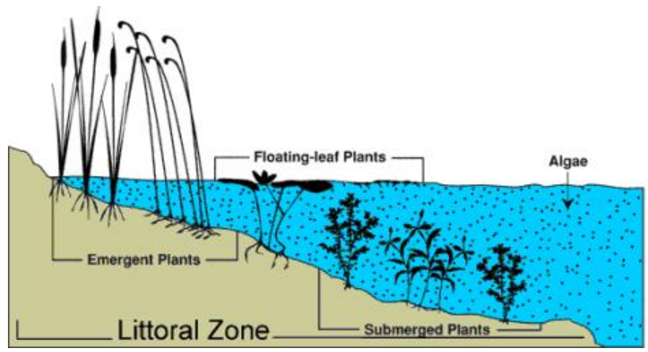
Example:
In Pierz-Fish Lake there were 107 sample sites in the 0-20 feet depth zone.
Coontail occurred in 28 sites.
Frequency of Coontail in 0-20 feet zone = (28/107)*100 = 26%

Appendix 4. Amounts and types of aquatic plants in Minnesota lakes

Within a lake, types and amounts of aquatic plants are influenced by a variety of factors including water clarity, water chemistry, water depth, substrate, and wave activity. Deep or wind-swept areas may lack aquatic plant growth, whereas sheltered shallow areas may support an abundant and diverse native aquatic plant community. The annual abundance, distribution and composition of aquatic plant communities may change due to environmental factors, predation, the specific phenology of each plant species, introductions of non-native plant or animal species and human activities in and around the lake.

Aquatic plants can be divided into four groups or "life forms" based on whether the main portion of the plant occurs above, on, or below the water surface. These life forms: emergent, floating-leaved, free-floating and submerged plants (Figure 1), often favor certain water depth zones around the lake but overlap occurs with one life form grading into another. Each life form group has unique functions and values.

Figure 1. Forms of aquatic plants found in Minnesota lakes.



Emergent plants, like cattails and bulrush, are rooted in the lake bottom with most of their leaves and stems extending above the water surface. Floating-leaf plants, such as waterlilies, are also anchored in the lake bottom with leaves and flowers that float on the water surface. Root systems of these plants form extensive networks that take up nutrients and help consolidate and stabilize bottom substrate. Beds of floating-leaf and emergent plants also help buffer the shoreline from wave action, offer shelter for insects and young fish, and provide shade for fish and frogs. These beds also provide food, cover and nesting material for waterfowl, marsh birds and muskrat. Floating-leaf and emergent plants are most often found in shallow water to depths of about 6 feet and may extend lake-ward onto mudflats and into adjacent wetlands.

Submerged plants have stems and leaves that primarily grow underwater but they may also form flowers, fruits and some leaves that emerge above or float on the water surface. Submerged plants are typically anchored to the lake bottom but some species do drift freely with the currents. This group includes non-flowering plants such as large algae, mosses, and fern-like plants, and flowering plants that may produce flowers above or below the water surface. Submerged plants may form low-growing mats or may grow several feet in the water column with leaf shapes that include broad ovals, long and grass-like, or finely dissected. Submerged plants release oxygen into the water column, compete for nutrients with microscopic algae, and provide food and shelter for a variety of invertebrates, fish, amphibians and other wildlife.

Free-floating plants are the smallest of Minnesota's lake plants and include small flowering plants that are commonly known as "duckweeds" as well as microscopic algae. Different survey methods are required to assess microscopic algae and they are not included in this report. Duckweeds are present in many Minnesota lakes and if present in sufficient amounts, they can accumulate into mats and create a shade barrier along protected shorelines. As their name implies, they are also an important food source for waterfowl.

Plant species richness is a term used to describe the total number of plant species present in a lake and it can be used to help describe the general health of the waterbody. In Minnesota, plant species richness can range from zero (un-vegetated lakes) to more than 40 species in a lake[7]. Species richness is generally higher in high clarity lakes than in turbid lakes and more species are usually found in moderately fertile lakes than in nutrient poor lakes. Therefore, lakes of north central Minnesota are often among the "richest" in terms of numbers of plant species. Water quality changes that result in lower clarity may also result in the loss of some plant species, or a lower species richness. However, caution must be used when comparing historical and present survey data because of differences in how the surveys were conducted. For example, if a current MNDNR plant survey locates more species than found during an historical "one-day" survey, it may be due to the more extensive sampling that occurs during current surveys. If fewer species are located during current surveys, it may indicate a true decline in the plant species richness of the lake.

Aquatic plant communities provide critical fish and wildlife habitat and other lake benefits. (Click here for more information on: value of aquatic plants).

For information on the laws pertaining to aquatic plant management: MnDNR APM Program.

[7] These values are from a review of MNDNR lake vegetation surveys.

Appendix 5. Common aquatic plants of Pierz-Fish Lake

Figure 1. Bed of muskgrass

Algae are primitive forms of plants that do not form true roots, flowers or vascular tissue. They range in size from single cell to giant seaweed. Freshwater algae that live in Minnesota lakes include tiny, free-floating planktonic algae, filamentous algae, and macroalgae. Macroalgae often resemble rooted plants and provide similar habitat and water quality benefits and were therefore included in this survey.

Muskgrass (*Chara* sp.; Figure 1) is a large algae that is common in many hard water Minnesota lakes. This plant resembles higher plants but does not form flowers or true leaves, stems and roots. Muskgrass grows entirely submerged, is often found at the deep edge of the plant zone (Arber 1920), and may form thick "carpets" on the lake bottom. These beds provide important habitat for fish spawning and nesting. Muskgrass has a brittle texture and a characteristic "musky" odor. It is adapted to a variety of substrates and is often the first species to colonize open areas of lake bottom where it can act as a sediment stabilizer.

Figure 2. Coontail

Coontail (*Ceratophyllum demersum*; Figure 2) is the most common submerged flowering plant in Minnesota lakes. It grows entirely submerged and is adapted to a broad range of lake conditions, including turbid water. Coontail is a perennial and can over-winter as a green plant under the ice and then begins new growth early in spring. Because it is only loosely rooted to the lake bottom it may drift between depth zones (Borman et al. 2001). Coontail provides important cover for young fish, including bluegills, perch, largemouth bass and northern pike. It also supports aquatic insects beneficial to both fish and waterfowl.

Figure 3. Northern watermilfoil

Photo by: Andrew Hipp (UW Madison-Wisc State Herbarium)

Northern watermilfoil (*Myriophyllum sibiricum*; Figure 3) is a native, submerged plant. It is a rooted perennial with finely dissected leaves. Particularly in depths less than 10 feet, this plant may reach the water surface. It spreads primarily by stem fragments and over-winters by hard rootstalks and winter buds. Northern watermilfoil is not tolerant to turbidity and grows best in clear water lakes. For information on how to distinguish the native northern watermilfoil from the non-native, Eurasian watermilfoil, click here: identification.

Pondweeds (*Potamogeton* spp. and *Stuckenia* spp.) are one of the largest groups of submerged plants in Minnesota lakes. These plants are rooted perennials and their rhizomes may form mats on the lake bottom that help consolidate soil (Arber 1920). Pondweeds have opposite, entire leaves and form "cigar-shaped" flowers that emerge above the water surface. Many pondweed species overwinter as hardy rhizomes while other species produce tubers, specialized winter buds, or remain “evergreen” under the ice. Seeds and tubers of pondweeds are an important source of waterfowl food (Fassett 1957). The foliage of pondweeds is food for a variety of marsh birds, shore birds and wildlife and provides shelter, shade and spawning sites for a range of fish species (Borman et al. 2001). Pondweeds inhabit a wide range of aquatic sites and species vary in their water chemistry and substrate preferences and tolerance to turbidity. There are over 20 species of pondweeds in Minnesota and they vary in leaf shapes and sizes. Depending on water clarity and depth, these plants may reach the water surface and may produce flowers that extend above the water. Some pondweeds may also form floating leaves.

Figure 4. Flat-stem pondweed

Figure 5. White-stem pondweed

Pondweeds can be grouped by their leaf shape and size. Ribbon-leaf pondweeds are plants with long, narrow, grass-like leaves. This group includes flat-stem pondweed (*Potamogeton zosteriformis*; Figure 4). Broad-leaf pondweeds are often referred to as “cabbage” by anglers and include large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*P. illinoensis*), clasping-leaf pondweed (*P. richardsonii*), white-stem pondweed (*P. praelongus*; Figure 5), and variable pondweed (*P. gramineus*). Narrow-leaf pondweeds, such as sago pondweed (*Stuckenia pectinata;* Figure 6), fries’ pondweed (*Potamogeton friesii*), and snail-seed pondweed (*Potamogeton spirillus*) have very narrow, almost needle-width leaves.

Figure 6. Sago pondweed

Water star-grass (*Heteranthera dubia*; Figure 7), is a narrow-leaved plant that has freely branched stems, alternate leaves, and no prominent mid-vein. It produces a yellow flower later in the summer. Water star-grass is found in a variety of depths, and can grow in turbid water. It is a good food source for waterfowl and good cover for fish.

Figure 7. Water star-grass

Photo Source: Gary Fewless, UW Green Bay

Curly-leaf pondweed (*Potamogeton crispus*; Figure 8) has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in more than 750 Minnesota lakes (Invasive Species Program 2011).

Figure 8. Curly-leaf pondweed

Like many submerged plants, it is perennial but it has a unique life cycle that may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall. Winter foliage is produced and continues to grow under ice (Wehrmeister and Stuckey 1978). Curly-leaf reaches its maximum growth in May and June, when water temperatures are still too low for most native plant growth. In late spring and early summer, curly-leaf plants form structures called "turions" which are hardened stem tips that break off and fall to the substrate. Turions remain dormant through the summer and germinate into new plants in early fall (Catling and Dobson 1985).

The foliage of curly-leaf pondweed does provide some fish and wildlife habitat, but it may also create problems in some lakes, or in areas of some lakes. During its peak growth in spring, curly-leaf may reach the water surface at certain depths and create dense mats. These dense growths may compete with native vegetation and can also cause problems for recreational lake users.