Silver Lake
Manitowoc County, Wisconsin
(Waterbody ID Code 67400)

1979, 2004, & 2005
Aquatic Plant Survey Results

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1.0 Introduction

Aquatic macrophytes (plants) surveys were conducted by the Wisconsin Department of Natural Resources on Silver Lake in Manitowoc County in 1979, 2004, and 2005 to assess the overall aquatic plant community present in the lake.

Silver Lake is located in the Township of Manitowoc Rapids, Manitowoc County (T19N, R23E, Sec 33 and 34). Silver Lake is a 69-acre seepage lake. The lake has two distinct basins; the west basin of the lake has a maximum depth of 43 feet and the east basin has a maximum depth of 33 feet.

This report presents the methods, results and discussion, and conclusions of the aquatic plant surveys.

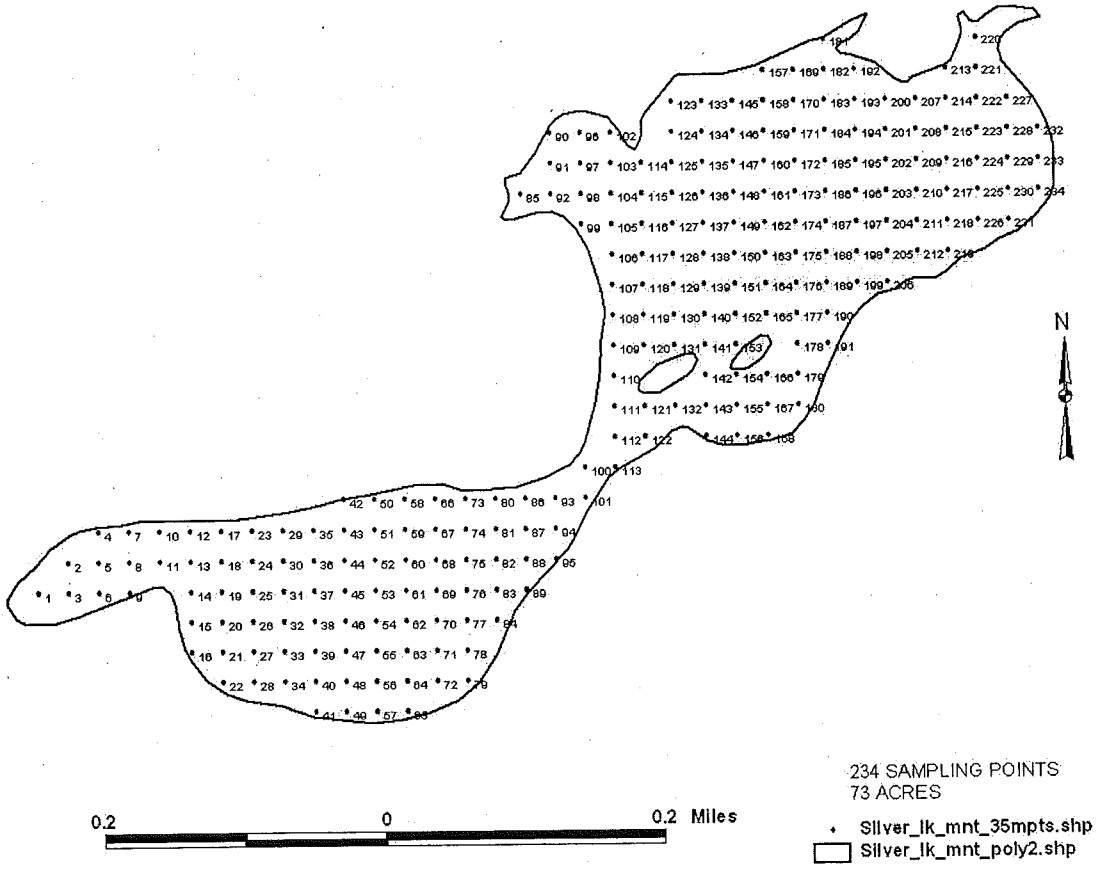
2.0 Methods

2.1 Sampling methods

The aquatic plant community of the lake was surveyed on August 8, 1979, August 17, 2004 and again on August 18, 2005. The exact survey methods for the 1979 survey are unknown. For the 2004 survey, fourteen random points were chosen along the perimeter of the lake. At each of these points, a transect line was laid perpendicular to shore going out into the lake for 45 meters. Along this transect, a 0.25 m^2 quadrat was placed every two meters for the first 12 meters, and every 3 meters out to 45 meters. Within this quadrat, percent cover for each species was estimated. Substrate and depth were recorded at the center of each quadrat. For the 2005 survey, the point intercept sampling method was used, as is recommended in the draft guidance on Aquatic Plant Management in Wisconsin (WDNR, 2005). A base map was developed with 234 sampling points (i.e., intercept points) established on a 35 x 35 meter grid (Figure 1). Latitude and longitude coordinates and sample identifications were assigned to each intercept point on the grid. A Garmin global positioning system (GPS) was used to navigate to intercept points. At

each intercept point, plants were observed visually or collected with a rake on a telescopic pole. All observed plants were identified and recorded on field data sheets. Water depth and sediment types at each intercept point were also recorded on field data sheets.

Figure 1. 2005 Silver Lake sampling points



2.2 Data analysis methods

A macrophyte distribution map was created from the 1979 survey data and included on page 19 in the Silver Lake Feasibility Study Results and Management Alternatives report (WDNR, 1985).

The 2004 transect survey data were summarized on a one-page document and included methods, location of transects, a species list by transect, and frequency of occurrence by transect and quadrat.

The 2005 point intercept data were used to estimate frequency of occurrence, average number of species per site, and total number of sites with vegetation.

A floristic quality assessment (FQA) was also applied to the 2004 and 2005 aquatic vegetation species list using the methodology of Nichols (1999). FQA is a rapid assessment metric used to assist in evaluating the floristic and natural significance of a given area. Examination of the floristic quality index within the context of statewide and regional trends was used to provide an overall evaluation of the floristic quality of Silver Lake. A coefficient of conservatism (C) value was assigned to each species present. Conservatism is the estimated probability that a plant is likely to occur in a landscape that is believed to be relatively unaltered from presettlement conditions. As disturbance occurs less conservative species become more predominant. The C value ranges from 0-10 with 10 being assigned to species most sensitive to disturbance.

3.0 Results and Discussion

3.1 Survey Results

Aquatic macrophyte species identified in Silver Lake are summarized in Table 1. The 1979 macrophyte survey results summarized in the 1985 Silver Lake Feasibility Study Results and Management Alternatives report says, "the distribution of aquatic plants appears sparse and diversity very low. Cattails, sedges, and rushes were present around

the shoreline but submergent plants were nonexistent both in the shallow, near shore zone and in deeper areas. *Numphar,* [yellow water lily] a floating leaf species, was present but sparse. The intensive algal blooms and the feeding activities of the carp and bullhead populations lower the water clarity, thereby reducing light penetration to the extent that macrophytes are not able to grow".

In 2004, a total of three species of aquatic plants were observed in Silver Lake including two submergent, and one floating-leaf species **(Appendix A)**. Potamogeton *foliosus* (leafy pondweed) was the most frequently occurring species in Silver Lake (21.4 percent of sample points). Nuphar *variegata* (spatterdock) and Stuckenia *pectinata* (sago pondweed) were the next most frequently occurring species at 7.1 percent of sample points. No exotic invasive species were found in the lake.

In 2005, a total of four species of aquatic plants were observed in Silver Lake including two submergent, one emergent, and one floating-leaf species. *Nuphar variegaae* and *Potamogeton foliosus* were the most frequently occurring species in Silver Lake (1.3 percent of sample points) in 2005. *Chara sp.* was the next most frequently occurring species at 0.4 percent of sample points. Bulrush (*Schoenoplectus sp)* was observed in small patches along the southeast shore. Filamentous algae commonly covered rocky substrate and woody debris throughout the lake. No exotic invasive species were found in the lake.

Table 1. Silver Lake aquatic plant species list

1979	2004	2005	Species C Values
Cattails			1
Sedges			~5
Bulrush		Bulrush	5
Yellow water lily	Spatterdock	Spatterdock	6
	Leafy pondweed	Leafy pondweed	6
	Sago pondweed		3
		Chara	7

The number of aquatic species (three in 2004 and four in 2005) found in Silver Lake is below the state and regional median of 13 and 14 respectively (Nichols, 1999) **(Table 2)**. The FQA completed for the Silver Lake aquatic vegetation indicates a mean native species coefficient of Conservatism (C) of 5 in 2004 and 6 in 2005. Nichols (1999) found that the median C for lakes in the North Central Hardwoods and Southeastern Till Plains lakes and flowages (NCSE) region, in which Silver Lake is located, was 5.6. Silver Lake therefore, appears to have relatively average mean coefficient of conservatism. The FQA of the plant community in Silver Lake was 8.7 in 2004 and 12 in 2005, which is below the 20.9 average for lakes in the NCSE region. This suggests that the plant community has been subject to more disturbance than the average lake in the region and state.

Table 2. Floristic Quality Assessment

	Number of species	**Average Conservatism**	**Floristic Quality Index**
Wisconsin Lakes	13	6	22.2
NCSE Region	14	5.6	20.9
Silver Lake – 2004	3	5	8.7
Silver Lake - 2005	4	6	12

It is significance that no plants were found at 97 percent of all sampling points. In general, a more abundant and diverse aquatic plant community would greatly benefit fish and other aquatic life for the lake as a whole and also help protect the near shore areas from wave action and sediment resuspension.

Extensive efforts are currently underway to restore the aquatic ecosystem of Silver Lake. The goals of the restoration project are to improve water clarity, restore an ecological balance of fish habitat and water quality, and to restore a balanced mix of desirable fish to the lake. In 2001, an earthen berm was constructed to separate Silver Creek from Silver Lake to reduce the amount of phosphorus entering the lake. In 2003, all the fish in the lake were eradicated using the fish toxicant rotenone. In 2004, the lake was treated with aluminum sulfate to reduce the amount of phosphorus available in the lake for algae

growth. Desirable fish species stocking also began in 2004 and will continue for several more years.

3.2 Aquatic Invasive species

Although no aquatic invasive species were found during these surveys, control of invasive species should be a primary lake management concern if they become established. Eurasian watermilfoil and curly-leaf pondweed are two common invasive aquatic macrophyte species in Wisconsin, and would be the most likely exotic species to colonize Silver Lake in the future. Invasive species such as these have the ability to out-compete native plants and reduce species diversity. They can form dense stands that are a nuisance to humans and provide low-value habitat for fish and wildlife.

4.0 Conclusions

Historically and currently, the aquatic plant community of Silver Lake is below average quality and quantity. No aquatic plants were observed in 97 percent of the sample points in Silver Lake during the 2005 survey. The general lack of near-shore submergent, emergent and floating-leaf aquatic plants is a significant indication of the status of Silver Lake's plant community. Spatterdock and leafy pondweed were the dominant species within the Silver Lake plant community followed by *Chara sp.* and sago pondweed in 2004 and 2005. No aquatic invasive species were found in the lake; nonetheless, management efforts should be initiated as soon as possible should invasive species become established.

5.0 References

Borman, Susan, Robert Korth, and Jo Temte. 1997. *Through the Looking Glass – A Field Guide to Aquatic Plants.* Wisconsin Lakes Partnership, University of Wisconsin, Stevens Point.

Fasset, Norman C. 1940. *A Manual of Aquatic Plants.* University of Wisconsin Press, Madison.

Nichols, Stanley A., and James G. Vennie. 1991. *Attributes of Wisconsin Lake Plants.* Wisconsin Geological and Natural History Survey.

Nichols, Stanley A. 1999. *Floristic Quality Assessment of Wisconsin Lake Plant communities with Example Applications.* Journal of Lake and Reservoir Management. 15(2):133-141.

Wisconsin Department of Natural Resources. 2005. *Draft Aquatic Plant Management in Wisconsin.*

Wisconsin Department of Natural Resources, Bureau of Water Resources Management. 1985. *Silver Lake Manitowoc County Feasibility Study Results and Management Alternatives.*

6.0 Appendix

Appendix A. 2004 aquatic plant survey results

Lake Name	**Silver Lake**
Date	08/17/2004-8/18/2004
Transects Sampled	14

Methods:
Fourteen random points were chosen along the perimeter of the lake. At each of these points, a transect line was laid perpendicular to shore going out into the lake for 45meters. Along this transect, a 0.25 m^2 quadrat was placed every two meters for the first 12 meters, and every 3 meters out to 45 meters. Within this quadrat, percent cover for each species was estimated. Substrate and depth were recorded at the center of each quadrat.

Species List

Common Name	Scientific Name
Spatterdock	*Nuphar variegata*
Leafy pondweed	*Potamogeton foliosus*
Sago pondweed	*Stuckenia pectinata*

Transect Number

1	2	3	4	5	6	7	8	9	10	11	12	13	14
x													
		x				x		x					
		x											

("x" indicates that the species was present in the transect)

Frequency of Occurrence

By Quadrat	By Transect
0.4%	7.1%
4.0%	21.4%
0.4%	7.1%

Locations of transect:

	Latitude	Longitude
1	44.07051	-87.73275
2	44.07093	-87.73742
3	44.07174	-87.73044
4	44.06670	-87.73882
5	44.06848	-87.73953
6	44.07273	-87.73525
7	44.07084	-87.73111
8	44.06824	-87.73730
9	44.07030	-87.73302
10	44.06877	-87.73499
11	44.07078	-87.73141
12	44.07124	-87.73748
13	44.07151	-87.73064
14	44.06618	-87.73927

Please note - These are results of general aquatic plant work by DNR Research Bureau to understand the effects of lakeshore development and watershed development on aquatic plant communities. Silver Lake is one of about 30 lakes we've worked on around the state, and was chosen because it met the physical criteria (size, lake type, depth, etc) that we used to generate a list of potential study lakes. We should note, that while we did complete an aquatic plant survey for the lake, the method we used to collect the data does not conform to statewide aquatic plant monitoring protocol. So, the data should be used to provide general information on aquatic plants, but shouldn't be used for replacing the type of plant survey that

statewide aquatic plant monitoring protocol. So, the data should be used to provide general information on aquatic plants, but shouldn't be used for replacing the type of plant survey that might be required for permitting a specific management action.