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Wilson Lake 2002 aquatic plant survey and water quality monitoring results

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Kusel, Wilson, Round Lakes Protection and Rehabilitation District

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Introduction

The report entitled *Management of aquatic plants in Wilson Lake 2001-2006* outlined a course of action for controlling Eurasian watermilfoil (*Myriophyllum spicatum*) in Wilson Lake. The management plan recommended aggressively treating Eurasian watermilfoil throughout the lake using Navigate ® (2,4D). This is the second aquatic plant management update following a large-scale Navigate ® treatment on the lake. This report presents the results of the aquatic plant survey and water quality monitoring done one year after treatment, and refines the recommendations for future management efforts.

History

During May 2000 a whole-lake aquatic plant survey was conducted on Wilson Lake to provide baseline data on the lake's plant community and the distribution of Eurasian watermilfoil. This survey involved collecting aquatic plants along 12 evenly spaced transects in the lake using a tethered rake (**Figure 1**). A total of 192 rake tows were made. All plants collected were identified to *genus* and *species* whenever possible.

The 2000 survey found a diverse aquatic plant community dominated by Eurasian watermilfoil. Eurasian watermilfoil was found throughout both lake basins, but occurred in dense beds totaling approximately 18 acres. Shortly after the survey, Eurasian watermilfoil was treated along the developed shorelines out to a distance of 150 feet – the maximum allowed by a regular permit. The area of this treatment totaled 7.75 acres.

During May 2001 lake residents and ABI staff mapped the remaining Eurasian watermilfoil growth. Dense Eurasian watermilfoil was found growing in three different areas of the lake –totaling 10.2 acres (**Figure 2.**) As directed by the management plan, a permit was sought from the Department of Natural Resources to treat these 10.2 acres. A large-scale treatment permit was issued on June 29^{th} and the treatment was conducted on July 11^{th}.

During September 2001 – three months after the large-scale treatment - another aquatic plant survey was done on Wilson Lake. This survey utilized the exact methods and designs of the earlier survey. This survey found that Eurasian watermilfoil had been effectively controlled. The percent frequency of Eurasian watermilfoil was 66.7% in the 2000 survey, but only 3.6% in the 2001 survey – a 95% decline (**Table 1**). The positive response of native plants was also noteworthy. Pondweeds (*Potamogeton spp.*) increased from 34.9% frequency to 63.5% frequency – an 89% increase. Other significant increases included bushy pondweed by 49% and water celery by 2000%. All species of rooted aquatic plants found in the 2000 survey were also found in the 2001 survey. Four additional species of plants – all *Potamogetons* – were found in 2001 that were not identified in 2000. Five types of algae that were found in 2000 were not found in 2001 – indicating an improvement in water quality. One negative finding was the presence of curly leaf pondweed - an invasive exotic plant that may reaches nuisance levels in lakes.

2002 Survey Results

Aquatic plant survey

The 2002 plant survey was conducted in June – one year after the large-scale treatment. The methods of the two previous surveys were duplicated. Results were similar to the 2001 survey, however Eurasian watermilfoil increased from 3.6% to 10.4% frequency (**Table 1**).

Data sets from the 2000 and the 2002 surveys were analyzed to determine whether differences between the surveys were statistically significant. Paired t-tests were run on the data using 95% confidence limits. A comparison of the dominant plant groups is given in **Table 2**. All of the dominant plant groups in the lake were found to have statistically significant changes. Eurasian watermilfoil decreased by 84%, bushy pondweed increased by 48.7%, musk grass increased by 23.8%, *Potamogeton* species increased by 66%, and *elodea* increased by 86.2%. It appears that native plants responded favorably to the treatment and were successful in re-colonizing areas of lakebed that had been dominated by Eurasian watermilfoil.

At lower rates, Navigate ® is typically selective to Eurasian watermilfoil. Non-target species found in Wilson Lake that are potentially susceptible to Navigate ® include northern watermilfoil, water stargrass, bladderwort, white water lily, spadderdock, water shield and coontail. Paired T-tests were also performed on the 2000 and 2002 data sets for these species (**Table 3**). The frequency of occurrence for all of these species was not significantly different from the pre-treatment survey. These results indicate that the Navigate ® treatments were highly selective to Eurasian watermilfoil.

Milfoil mapping

Plant distribution mapping conducted in 2002 did find substantial beds of Eurasian watermilfoil in Wilson Lake. Significant regrowth did occur in the center of the largest bed treated in 2001 (**Figure 2**). However most of the Eurasian watermilfoil found in 2002 occurred in areas where it was not previously found or treated (**Figure 3**). The area of the beds found in 2002 totaled 9.3 acres. This milfoil was treated with Navigate ® in July 2002.

Water quality monitoring

Water quality parameters where analyzed on Wilson Lake during April and June of 2002. Results are given in **Tables 4.1** and **4.2**. Parameters analyzed in the field included: Secchi depth, pH, dissolved oxygen profiles and temperature profiles. During April water samples were also collected and sent to the State Lab of Hygiene for analysis of Chlorophyll *a*, nitrate + nitrite and total phosphorus concentrations.

Total phosphorus, Chlorophyll *a* and Secchi depth are often used as trophic state indicators for lakes. Trophic state is commonly referred to as the "age" of a lake, however trophic state is not exclusively a function of time. Instead trophic state is more a function of nutrient inputs. Human influences such as urban and agricultural runoff, failing septic systems, lawn fertilizers and other nutrient sources can accelerate the aging process of lakes. In a relatively short period of time, lakes may change from *oligotrophic* (young) or *mesotrophic* (middle aged) to *eutrophic* (old). Characteristics of these three trophic states are shown in **Table 5**.

Wilson Lake has many of the characteristics of a eutrophic lake: shallowness, dense aquatic plant growth and heavy accumulations of organic sediments. The water quality parameters shown in **Table 5** however, rank Wilson Lake as oligotrophic. The exceptional water quality found during this survey is likely the result of two things: 1) the reduction in Eurasian watermilfoil density, and 2) the use of a whole-lake aeration system.

Prior to the large-scale milfoil treatment, Wilson Lake experienced heavy planktonic algae blooms. These algae blooms were the indirect result of dense Eurasian watermilfoil growth. Eurasian watermilfoil attains tremendous biomass – much greater than that of native plants. In doing so, Eurasian watermilfoil cycles more nutrients from the bottom sediments. When the plant dies back in fall, these nutrients are released into the water column where they can spur seasonal algae blooms. A reduction of Eurasian watermilfoil then, should be apparent in reduced total phosphorus and chlorophyll *a* readings, and increased Secchi readings.

Properly designed aeration systems can abate and even reverse the lake aging process – resulting in dramatic water quality improvements. Aeration systems can prevent thermal stratification, allow benthic microorganisms to flourish and compete with algae for food, and prevent anoxic phosphorus release from bottom sediments. The dissolved oxygen and temperature profiles recorded for Wilson Lake demonstrate the effectiveness of the aeration. Dissolved oxygen profiles shown in **Figure 4** indicate oxygen concentrations at saturation for all but a six-inch layer along bottom in April. During June oxygen concentration are at or above saturation throughout the entire water column. Likewise, the temperature profiles shown in **Figure 5** indicate that no thermal stratification occurs in the lake. Both of these profiles are very characteristic of oligotrophic lakes.

Conclusions and recommendations

It appears that Navigate ® has been an effective tool for controlling Eurasian watermilfoil in Wilson Lake. It also appears that the treatments have been highly selective to Eurasian watermilfoil, and that negative impacts to native aquatic plants did not occur. Therefore Navigate ® should continue to be used to control Eurasian watermilfoil in Wilson Lake.

Because so much of Wilson Lake is ideal habitat for Eurasian watermilfoil, and because the plant can be found in scattered throughout the lake, it may be necessary to "chase" the milfoil around the lake – treating the plant as it re-occurs. This trend was seen in the 2002 survey when large patches of Eurasian watermilfoil were found in areas where it had not been seen before. Active monitoring of the aquatic plant community will continue to be the most effective means of preventing Eurasian watermilfoil from again reaching nuisance levels.

While curly leaf pondweed commonly reaches nuisance proportions in many parts of the state, this exotic plant occurs in many Waushara County lakes without reaching nuisance levels. Nonetheless the status of this plant should be actively monitored in Wilson Lake as well.

It is apparent that native aquatic plants have responded favorably to reductions in Eurasian watermilfoil. One of these plants, bushy pondweed, has become something of a nuisance in itself. Bushy pondweed is an annual plant. It is one of the first to recolonize disturbed areas. In Wilson Lake these disturbed areas are the places where Eurasian watermilfoil has been controlled. In time though, bushy pondweed may give way to more desirable perennial plants such as *Potamogetons*.

If control of bushy pondweed, or other native plants is needed in future seasons, several management techniques may be successfully used. New Natural Resource (NR107) rule changes allow lakeshore property owners to rake areas of lakebed frontage as wide as 30 feet without permits. Weed raking may be effective for swim areas and around boat docks. If aquatic plants become too dense for raking, treatments with non-selective herbicides such as Reward ® may be most appropriate. However DNR lake specialists expressed concern over the impacts of widespread use of this management approach and did not approve permits in 2002. If maintenance of boating

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channels is needed in mid lake areas, aquatic plant control may be best accomplished by using a mechanical weed harvester. A weed harvester should only be set to make shallow cuts so that sufficient plant growth remains to maintain water quality and habitat values. Care should also be taken to avoid cutting any regrowth of Eurasian watermilfoil, as this encourages spreading of the plant. DNR permits will also be required for using a weed harvester.

Management of aquatic plants in Wilson Lake 2001-2006 recommends conducting annual aquatic plant surveys. These surveys will be valuable in assessing changes in the plant community and identifying management needs. The next survey should be scheduled in May or June 2003. The Lake District should again apply for funding from the DNR's Lake Planning Grant Program to help pay for this survey.

For lake management activities anticipated for 2002, such as follow-up milfoil treatments and weed harvesting, applications for DNR permits should be made in advance. Completing and submitting applications during February and March will allow these activities to be done in a timely manner.

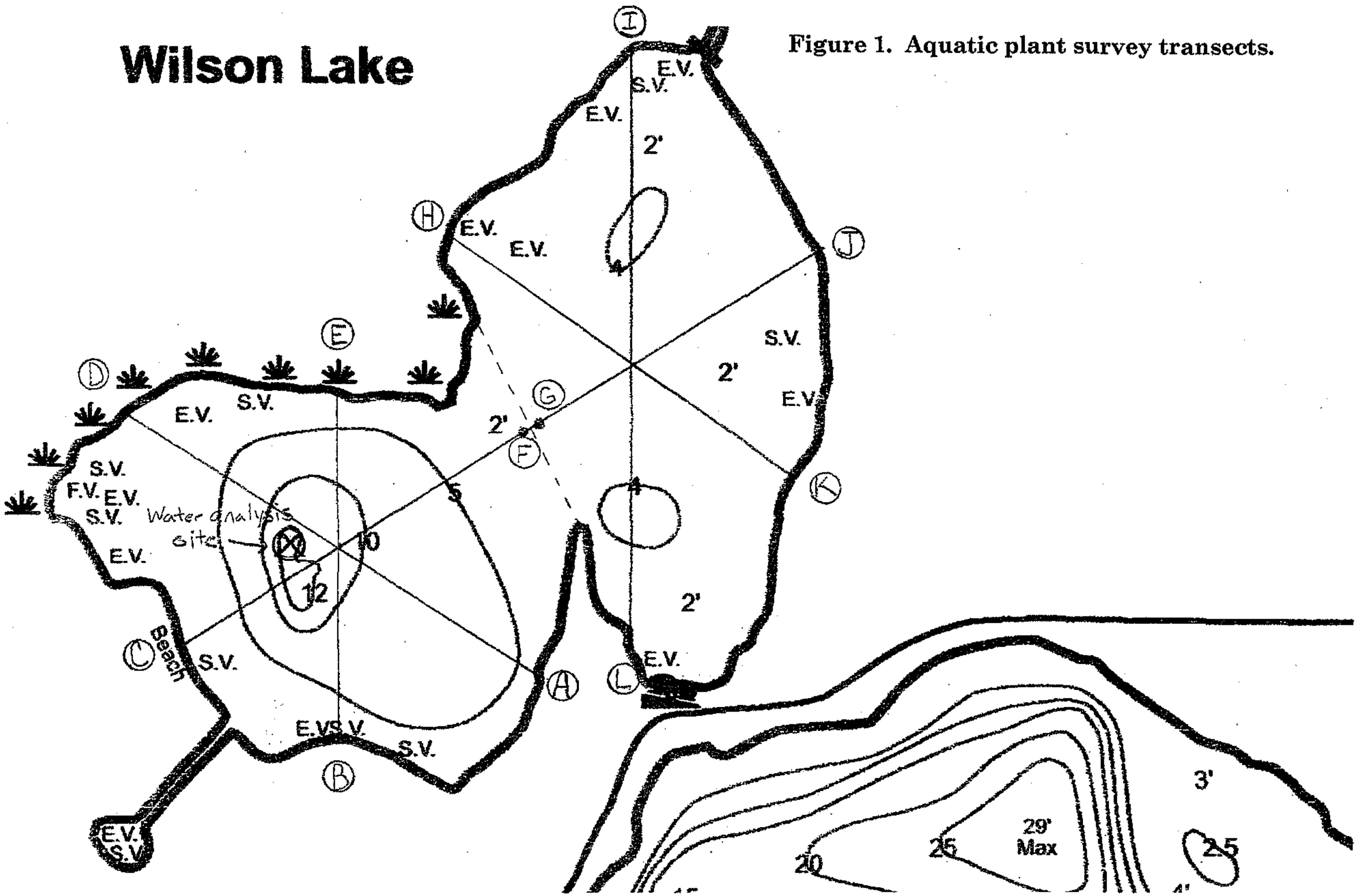

Figure 1. Aquatic plant survey transects.

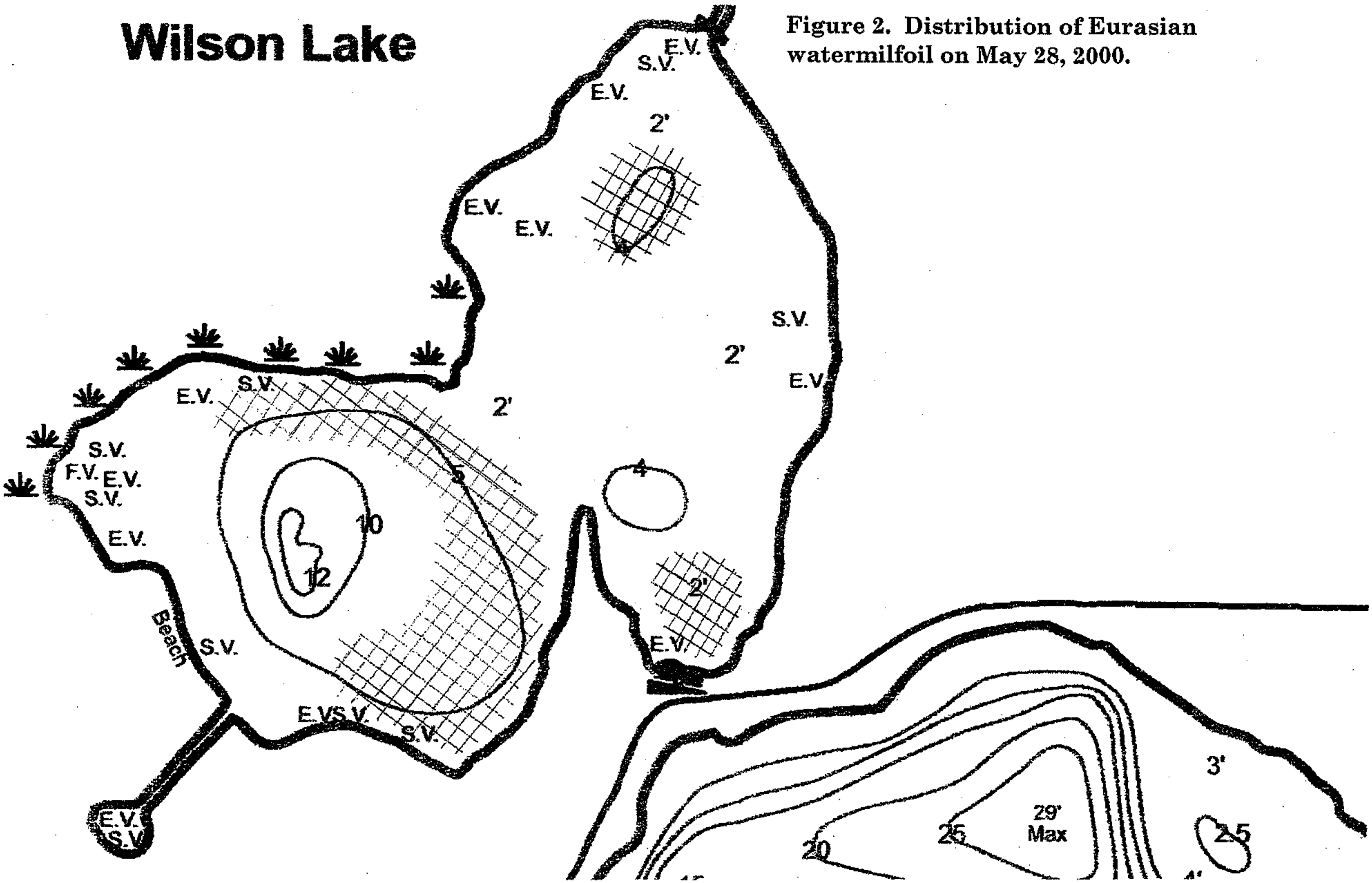

Figure 2. Distribution of Eurasian watermilfoil on May 28, 2000.

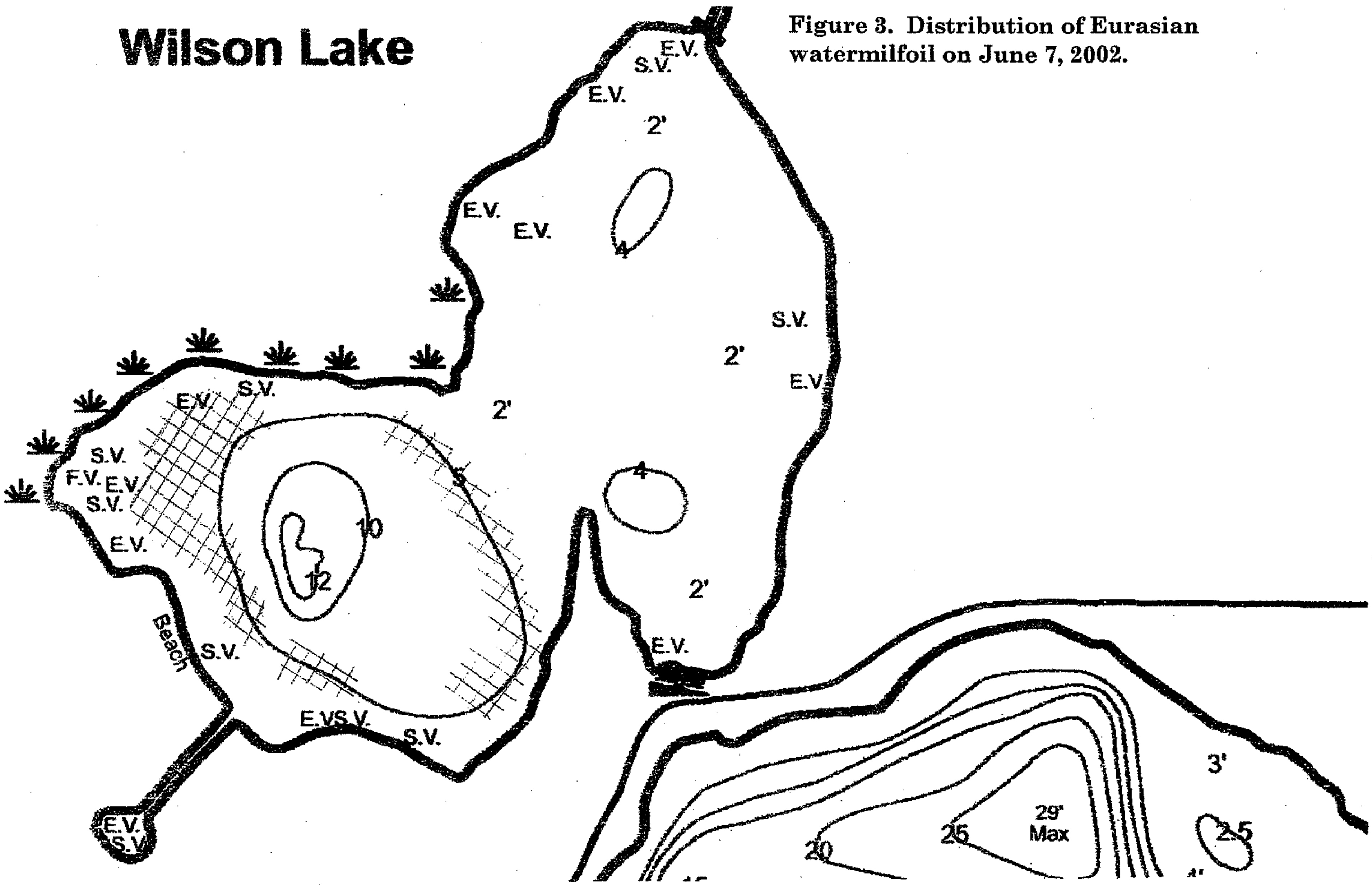

Figure 3. Distribution of Eurasian watermilfoil on June 7, 2002.

Figure 4. Wilson Lake Dissolved Oxygen Profiles 2002

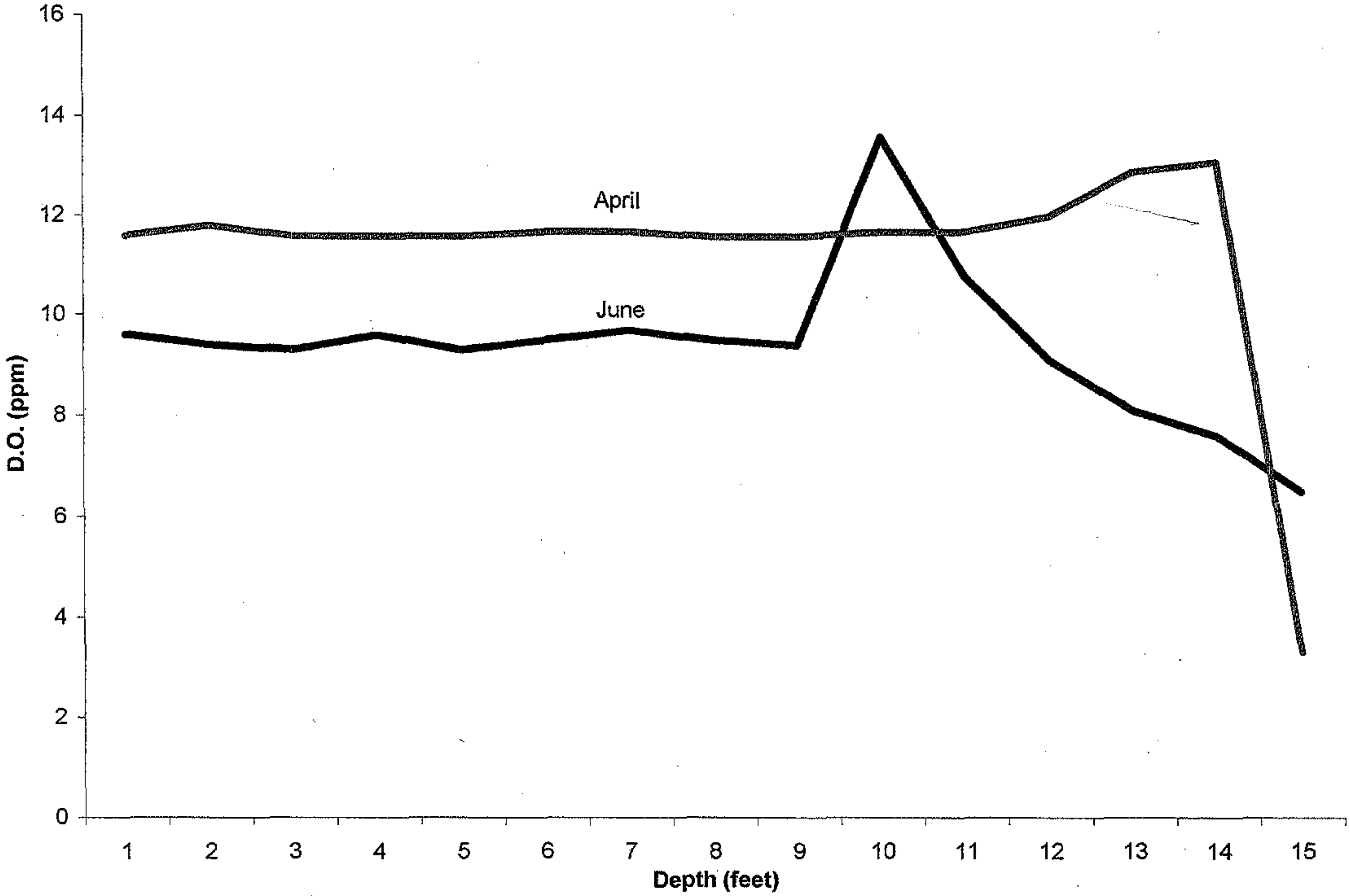

Figure 5. Wilson Lake Temperature Profiles 2002

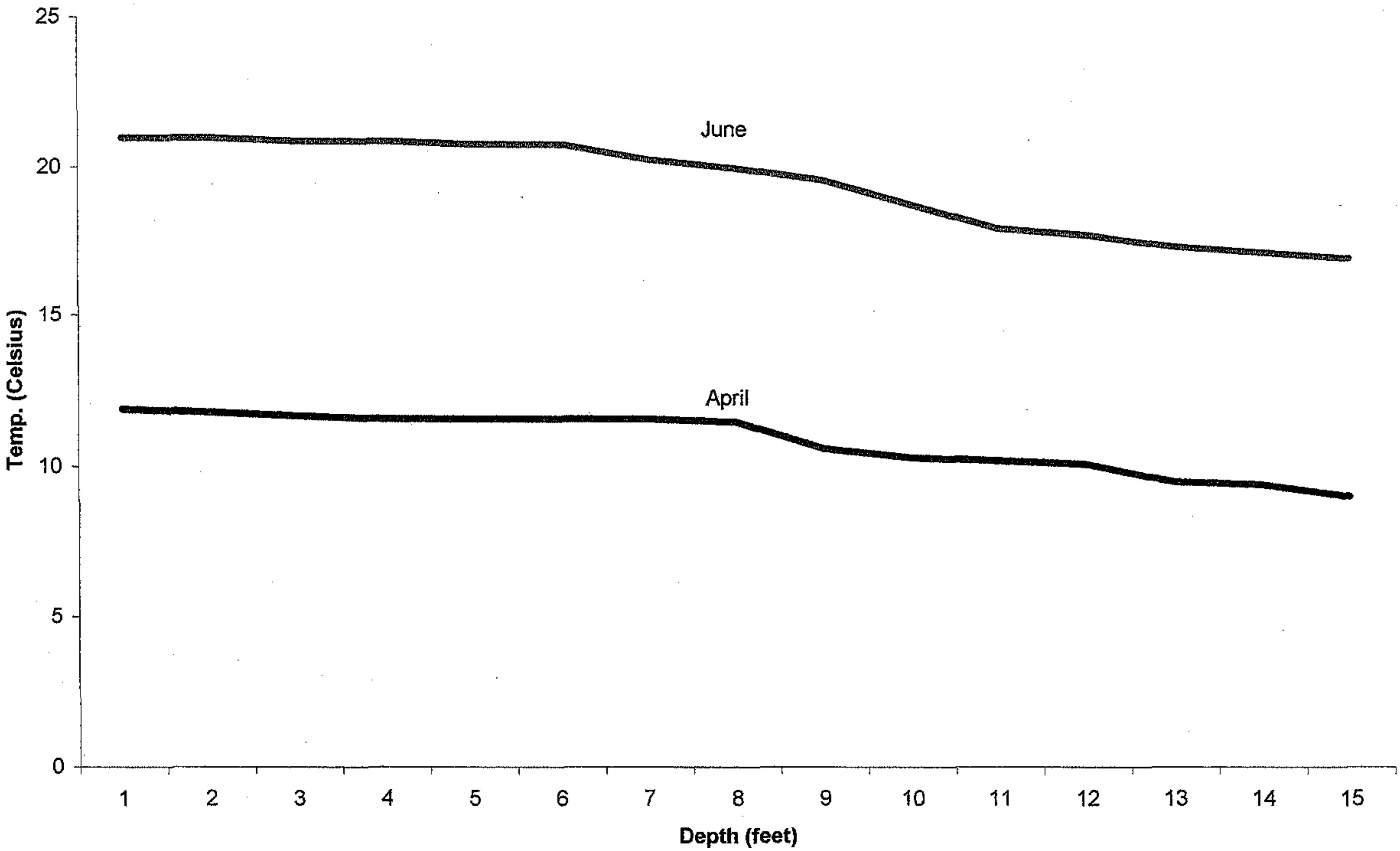

Table 1. Comparison of three year's aquatic plant survey data from Wilson Lake.

Species Common name	Scientific name	2000 Percent Frequency	2001 Percent Frequency	2002 Percent Frequency
Eurasian Water Milfoil	*Myriophyllum spicatum*	66.7	3.6	10.4
Bushy Pondweed	*Najas flexilis*	39.6	58.9	58.9
Musk Grass	*Chara spp.*	39.1	46.4	48.4
Illinois Pondweed	*Potamogeton illinoensis*	20.3	17.7	25.5
Common Waterweed	*Elodea canadensis*	10.9	9.9	20.3
Flatstem Pondweed	*Potamogeton zosteriformis*	10.4	9.4	11.5
no plants found		7.8	13.5	2.6
Coontail	*Ceratophyllum demersum*	7.3	10.9	7.3
Northern Water Milfoil	*Myriophyllum sibericum*	6.3	2.6	0.0
White Water Lily	*Nymphaea odorata*	5.2	6.8	7.3
Watershield	*Brasenia schreberi*	3.6	1.0	4.2
Small Pondweed	*Potamogeton pusillus*	3.1	2.1	0.0
Stonewort	*Nitella spp.*	2.6	0.0	0.0
Water Stargrass	*Zosterella dubia*	2.6	1.6	2.1
Hardstem Bullrush	*Scirpus acutus*	2.1	0.5	0.0
Green Algae spp.	*Lynbya spp.*	1.0	0.0	0.0
Horse Hair Algae	*Pithophora spp.*	1.0	0.0	11.5
Green Algae spp.	*Spirogyra spp.*	1.0	0.0	0.0
Water Celery	*Valisneria americana*	1.0	20.8	2.6
Green Algae spp.	*Cladophora spp.*	0.5	0.0	0.0
Spadderdock	*Nuphar variegata*	0.5	0.5	1.0
Floating Leaf Pondweed	*Potamogeton natans*	0.5	4.2	3.1
White-stem Pondweed	*Potamogeton praelongus*	0.5	0.5	4.7
Bladderwort	*Utricularia vulgaris*	0.5	1.6	1.0
Variable Pondweed	*Potamogeton gramineus*	0.0	20.3	0.0
Clasping Pondweed	*Potamogeton richardsonii*	0.0	5.2	0.0
Sago Pondweed	*Potamogeton pectinatus*	0.0	3.1	0.0
Curly Leaf Pondweed	*Potamogeton crispus*	0.0	1.0	9.9
Needle Rush	*Eleocharis acicularis*	0.0	0.0	0.5
Water Thread Pondweed	*Potamogeton diversifolius*	0.0	0.0	3.1
Water Moss	*Drepanocladus spp.*	0.0	0.0	0.5

2000 survey date: May - pre large-scale milfoil treatment.
2001 survey date: September - 3 months after treatment.
2002 survey date: June - one year after treatment.

Table 2. Dominant aquatic plant species data by transect (top row: 2000 survey; bottom row: 2002 survey) with analysis of percent change and statistical significance*.

	transect																
Species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**total**	**% Change**	**increase/ decrease**	**t-value**	**statistically significant**
Eurasian Watermilfoil	9	7	10	12	13	8	12	12	12	11	7	15	128	84.4	decrease	9.6	yes
	3	1	0	0	5	4	2	1	1	1	2	0	20				
Bushy Pondweed	3	5	1	2	5	0	10	5	11	13	8	13	76	48.7	increase	-3.25	yes
	7	6	1	4	5	8	16	11	14	10	15	16	113				
Musk Grass (Chara)	6	7	10	4	4	8	4	4	5	6	9	8	75	23.8	increase	-2.28	yes
	4	8	14	4	6	9	7	4	9	11	7	10	93				
Potamogeton spp.	1	4	7	3	8	0	10	8	6	4	9	7	67	66.0	increase	-3.97	yes
(Pondweeds)	11	7	7	9	15	5	12	8	9	8	8	12	111				
Common Waterweed	1	1	0	2	2	0	5	1	1	1	0	3	17	86.2	increase	-2.27	yes
(Elodea)	7	6	3	7	5	2	3	1	1	0	1	2	38				

* Paired two sample for means t - test; 95% Confidence limit, df = 11, t = 2.20

Table 3. Transect data for plant species listed as suseptible to 2,4D (top row: 2000 survey; bottom row: 2001 survey) with analysis of percent change and statistical significance*.

Species	A	B	C	D	E	F	G	H	I	J	K	L	total	% Change	increase/ decrease	t-value	statistically significant
Eurasian Watermilfoil	9	7	10	12	13	8	12	12	12	11	7	15	128	84.4	decrease	9.60	yes
	3	1	0	0	5	4	2	1	1	1	2	0	20				
Coontail	2	0	6	3	0	0	0	0	1	2	0	0	14	0	same	0.00	no
	4	4	0	3	0	2	0	0	1	0	0	0	14				
Northern Water Milfoil	2	1	8	0	0	1	0	0	0	0	0	0	12	100.0	decrease	1.51	no
	0	0	0	0	0	0	0	0	0	0	0	0	0				
White Water Lily	0	0	0	2	0	0	0	2	2	2	0	2	10	40.0	increase	-0.77	no
	0	0	1	1	0	0	0	4	6	0	0	2	14				
Watershield	0	0	0	2	0	0	0	4	1	0	0	0	7	16.6	increase	-0.02	no
	0	0	0	2	0	0	0	1	4	0	0	1	8				
Water Stargrass	0	0	4	0	0	0	0	0	1	0	0	0	5	20.0	decrease	0.17	no
	0	0	0	4	0	0	0	0	0	0	0	0	4				
Spadderdock	0	0	0	0	0	0	0	0	1	0	0	0	1	100.0	increase	-1.00	no
	0	0	0	0	0	0	0	1	1	0	0	0	2				
Bladderwort	1	0	0	0	0	0	0	0	0	0	0	0	1	100.0	increase	-1.00	no
	0	0	0	0	0	0	0	1	1	0	0	0	2				

* Paired two sample for means t - test; 95% Confidence limit, df = 11, t = 2.20

Table 4.1 April 15, 2002 water quality parameters for Wilson Lake.

Parameter	Result	Unit
Secchi depth	14	feet
pH	8.4	
Chlorophyll a	<1	ug/l
Nitrate + Nitrite (as N) - Surface	60	ug/l
Total Phosphorus - Surface	10	ug/l
N / P Ratio - Surface	6 : 1	
Nitrate + Nitrite (as N) - Bottom	75	ug/l
Total Phosphorus - Bottom	21	ug/l
N / P Ratio - Bottom	3.6 : 1	

Dissolved Oxygen & Temperature Profiles

Depth	*D.O. mg/l*	*Temp. C*
0	11.6	11.9
1	11.8	11.8
2	11.6	11.7
3	11.6	11.6
4	11.6	11.6
5	11.7	11.6
6	11.7	11.6
7	11.6	11.5
8	11.6	10.6
9	11.7	10.3
10	11.7	10.2
11	12	10.1
12	12.9	9.5
13	13.1	9.4
14	3.3	9.0

Table 4.2 June 7, 2002 water quality parameters for Wilson Lake.

Parameter	Result	Unit
Secchi depth	8	feet
pH	8.4	

Dissolved Oxygen & Temperature Profiles

Depth	*D.O. mg/l*	*Temp. C*
0	9.6	21.0
1	9.4	21.0
2	9.3	20.9
3	9.6	20.9
4	9.3	20.8
5	9.5	20.8
6	9.7	20.3
7	9.5	20.0
8	9.4	19.6
9	13.6	18.8
10	10.8	18.0
11	9.1	17.8
12	8.1	17.4
13	7.6	17.2
14	6.5	17.0

Table 5. Wilson Lake water quality data compared to trophic classification categories for natural lakes.

Trophic Class	Total Phosphorus (ug/l)	Chlorophyll a (ug/l)	Secchi Depth (feet)
Oligotrophic	0	3	14
	5	4	12
	10	5	10
	15	6	8
Mesotrophic	20	7	7
	25	8	6
	30	9	5
Eutrophic	35	10	4
	40	12	3
	45	14	2
	50	16	1
Wilson Lake (ave.)	15.5	<1	11