

Darrin Fresh Water Institute AT LAKE GEORGE

**BASELINE AQUATIC PLANT MONITORING: PRE-TREATMENT
FOR A SONAR[®] DEMONSTRATION PROJECT
AT EAGLE LAKE, NEW YORK**

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Summary

Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive exotic plant species, was reported in Eagle Lake, Essex County, New York in 1987. A survey of aquatic plants in Eagle Lake was completed in 1989 and indicated extensive growth of this nuisance species. Annual visual inspections from 1994 through 1998 confirmed that Eurasian watermilfoil had spread throughout Eagle Lake.

In 1996, an aquatic plant management program keyed to treatment of Eurasian watermilfoil with the herbicide Sonar was proposed for Eagle Lake. This program will be conducted under the auspices of the New York State Department of Environmental Conservation. A whole lake application of the herbicide Sonar is proposed for the spring of 1999.

As part of the aquatic plant management project, the effectiveness of Sonar for control of Eurasian watermilfoil and the impact of Sonar on native aquatic plants will be evaluated. Test plots of semi-permanent grids were established in each of the two sub-basins of the lake in 1996. Aquatic plant diversity and abundance was determined annually from 1996 through 1998 in these test plots. Historical data indicates that Eagle Lake supports a diverse assemblage of native plants, with 37 species reported. Twenty-three species were observed in the test plots in 1998. These baseline data will be used to document effects of the herbicide on native plants and Eurasian watermilfoil populations.

Future surveys are proposed immediately prior to herbicide treatment in the Spring of the year, 3 months and 1 year post-treatment. Coupled with pre-treatment survey data, the effectiveness of the herbicide for Eurasian watermilfoil control and the impact of the treatments on native aquatic plants can be evaluated.

Introduction

Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive exotic plant species, was reported in Eagle Lake, Essex County, New York in 1987. A survey of aquatic plants in Eagle Lake was completed in 1989 and indicated extensive growth of this nuisance species. Annual visual inspections from 1994 through 1998 confirmed that Eurasian watermilfoil had spread throughout Eagle Lake.

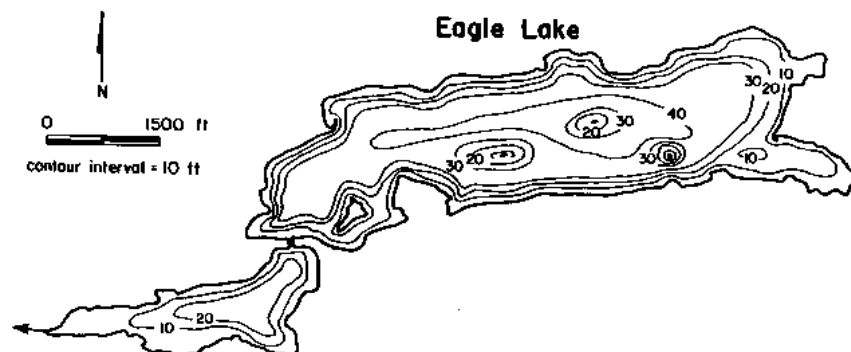
In 1996, an aquatic plant management program keyed to treatment of Eurasian watermilfoil with the herbicide Sonar was proposed for Eagle Lake. This program will be conducted under the auspices of the New York State Department of Environmental Conservation. A whole lake application of the herbicide Sonar is anticipated in the spring of 1999.

As part of the project, the effectiveness of Sonar for control of Eurasian watermilfoil and the impact of Sonar on native aquatic plants will be evaluated. An aquatic plant survey of Eagle Lake was conducted by the Darrin Fresh Water Institute and the New York State Department of Environmental Conservation. The focus of the survey and current report is the status of Eurasian watermilfoil in Eagle Lake, prior to herbicide application. Test plots were established in each of the sub-basins of the lake in 1996. Aquatic plant diversity and abundance were determined annually from 1996 through 1998. This baseline data will be used to document effects of the herbicide on native plants and Eurasian watermilfoil populations.

Background

Eagle Lake is located in the southern portion of Essex County in the Towns of Ticonderoga and Crown Point. The lake's watershed is located in the foothills of the

Figure 1. Depth (bathymetric) map of Eagle Lake



Adirondack Mountains in the Hudson River drainage system. Elevations within the watershed range from 944 feet at the surface of the lake to 1860 feet above sea level.

The lake has a surface area of 420 acres and a steeply sloping watershed of 3452 acres (Mikol and Polsinelli, 1985). Eagle Lake has a maximum depth of 12.8 meters (42 feet) and a mean depth of 5.8 meters (19 feet). Located on the western margin is the only outlet, which is dammed and used to maintain the level of the lake. The lake bottom slopes rapidly away from the shoreline in most places, with limited areas for the growth of aquatic plants.

The lake is separated into two distinct basins (East and West) by a shallow, narrow channel which is confined by a highway bridge for NYS Route 73. Eagle Lake is a soft water, low alkalinity water body typical of many lakes in the Adirondack region of New York. It is dimictic, exhibiting both summer and winter thermal stratification. The lake is best classified as oligotrophic; nutrients necessary for the growth of algae and, subsequently, the myriad of organisms that feed on these plants, are low.

The surficial geology is primarily glacial till, a sand and gravel soil without exposed bedrock. The soil associations are Tunbridge-Lyman and Becket-Tunbridge deposits consisting of loam, fine sands and cobblestones. Drainage in these deposits is rapid and their ability to furnish lime, nitrogen and phosphorus to terrestrial plants is poor.

Eagle Lake is a residential/recreational lake with boating, fishing and swimming as the primary uses. Public access is available via a NYS DEC maintained launch ramp and the NYS Route 73 causeway.

Methods

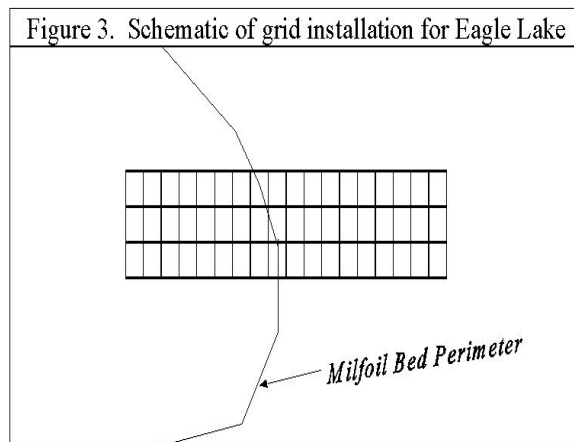
Two sites at Eagle Lake were selected for plant community composition analysis. One site was chosen for each sub-basin of Eagle Lake (Figure 2). Plant community composition was determined by relative percent cover of each species within a series of gridded plots installed at each location. Each grid consisted of 18 contiguous 1m² plots. Three grids were placed at each survey site for a total of 54 plots per survey site.

Figure 2. Map of sampling sites for Eagle Lake.



Grids were installed in September of 1996 at each sampling location. Divers trained in aquatic plant identification recorded percent cover by species for each square meter using a modified Daubenmire (1959; 1968) scale of percent cover. The grid systems were also surveyed in August of 1997 and 1998, as treatment had not yet occurred. All taxonomic nomenclature is based on Fassett (1957).

East Basin. The East Basin sampling site was located adjacent to a rocky outcropping at the eastern end of the lake. This area supports an extensive area of dense growth of Eurasian watermilfoil. Grids consisting of 54 contiguous 1m² plots were installed on September 17, 1996. Grids were installed such that approximately one half of the grid squares were within a dense growth area of Eurasian watermilfoil (Figure 3). The remainder of the grid squares covered areas dominated by native aquatic plants. Sediments in this area were a sand/silt mixture with a thin layer (~5 cm) of silt on the surface. Water depth ranged from 3 to 4 meters.



West Basin. The West Basin sampling site was located in a small bay on the southwestern shoreline of the lake. This area supports an extensive area of dense growth of Eurasian watermilfoil. Grids consisting of 54 contiguous 1m² plots were installed on September 17, 1996. Grids were installed such that approximately one half of the grid squares were within a dense growth area of Eurasian watermilfoil (Figure 3). The remainder of the grid squares covered areas dominated by native aquatic plants. Sediments in this area were mainly fine silt overlying

sandy soils. Water depth ranged from 2 to 4 meters.

In addition to grid surveys, diver swimover surveys were included at each site to evaluate the rare species which may not appear in the grids. At each location, all aquatic plant species and their relative abundance were recorded at one meter depth intervals using the following abundance classes: abundant (greater than 50% cover), common (25 to 50% cover), present (15 to 25% cover), occasional (5% to 15% cover) and rare (less than 5% cover). Centroid values for each of the abundance classes were used to develop overall community cover. These data provide average depth distributions of plants and an estimate of the relative abundance of all species within the survey area. Swimover surveys were conducted in September of 1996.

Aquatic Plant Populations

Aquatic plant species present and their relative abundance were recorded for two locations in Eagle Lake, Essex County, New York. A list of all submersed and floating-leaved aquatic plant species observed is given in Table 1. A total of 23 species were observed. Of these, one group is a macroscopic alga, or charophyte, typically of the genera *Chara* and *Nitella*, three are floating-leaved species (*Brasenia*, *Nuphar* and *Nymphaea*), three are emergent species (*Eriocaulon*, *Sparganium*, and *Pontederia*) and the remaining 16 species are submersed.

The large number of species observed indicates excellent species richness, typical of low-elevation Northeastern lakes (Madsen et al., 1989). For instance, Lake George has 47 submersed species (RFWI et al., 1988) and 33 were observed in Lake Luzerne in 1989 (Eichler and Madsen, 1990). In both of these lakes, this species richness is threatened by further growth and expansion of an exotic plant species, Eurasian watermilfoil, which will have negative implications for the health of the lakes as a whole (Madsen et al., 1989, 1990).

Surveys of aquatic plants in Eagle Lake were conducted in 1932 (NYS Conservation Dept., 1932), 1989 (Eichler and Madsen, 1990), and 1996-1998 (the current survey). The species lists for the three surveys are similar. Twenty six aquatic plant species were reported in 1932 and twenty seven in 1989. The current survey reported 23 species. Among the three surveys, a total of 37 species of aquatic plants are reported for Eagle Lake.

One major difference in the surveys is the absence of Eurasian watermilfoil in 1932. First reported in 1987, this species was listed in the top twelve species based upon relative abundance in 1989. Other differences in the three surveys generally are in the less common and emergent species which may have been intentionally excluded from the exclusively aquatic plant surveys of 1989 and 1998. American Three Square Sedge (*Dulichium arudinaceum*), for instance, is an extremely common emergent species. Generally associated with marshlands peripheral to the lake, this species was reported in 1932, but not in 1989 or 1998.

The composition of the species list for Eagle Lake was similar to that of other nearby lakes. For instance, all of the species observed in Eagle Lake have been noted for other regional lakes (Ogden et al, 1973; Madsen et al., 1989). Fifteen species are typical for a lake of this type in New York State (Taggett and Boylen, 1990).

One of the plant species observed (*Isoetes macrospora*) is on the New York State Rare Plant list (Mitchell, 1986; Clemants, 1989; Young, 1992). This species generally is found in deeper waters, to 4 meters in Eagle Lake, and thus is easily missed by surveys. Its presence on the rare plant list may be a result of lack of survey data rather than scarcity.

Table 1. Eagle Lake Aquatic Plant Surveys - 1932 thru 1998

<u>Species</u>	<u>Common Name</u>	<u>1998</u>	<u>1989</u>	<u>1932</u>
<i>Bidens beckii</i>	Water Marigold	X	X	X
<i>Brasenia schreberi</i>	Water Shield	X	X	X
<i>Ceratophyllum demersum</i>	Coontail	X	X	
<i>Charophytes</i>	Chara or Stonewort	X	X	
<i>Dulichium arudinaceum</i>	Three Way Sedge			X
<i>Eleocharis acicularis</i>	Spike Rush		X	X
<i>Eleocharis palustris</i>	Spike Rush			X
<i>Elodea canadensis</i>	Waterweed	X	X	X
<i>Eriocaulon septangulare</i>	Pipewort	X	X	X
<i>Heteranthera dubia</i>	Water Stargrass	X	X	
<i>Isoetes echinospora</i>	Quillwort			X
<i>Isoetes macrospora</i>	Quillwort		X	
<i>Juncus pelocarpus</i>	Dwarf Rush		X	
<i>Lobelia dortmanna</i>	Water Lobelia	X	X	X
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil	X	X	
<i>Najas flexilis</i>	Water Naiad	X	X	X
<i>Nuphar luteum</i>	Yellow Water Lily	X		X
<i>Nymphaea odorata</i>	White Water Lily	X	X	X
<i>Pontedaria cordata</i>	Pickerelweed		X	X
<i>Potamogeton americanus</i>	American Pondweed			X
<i>Potamogeton amplifolius</i>	Large Leaf Pondweed	X	X	X
<i>Potamogeton compressus</i>	Pondweed			X
<i>Potamogeton epihydrus</i>	Leafy Pondweed		X	X
<i>Potamogeton foliosus</i>	Leafy Pondweed	X		
<i>Potamogeton gramineus</i>	Variable Pondweed	X	X	X
<i>Potamogeton natans</i>	Pondweed			X
<i>Potamogeton perfoliatus</i>	Heart Pondweed	X		
<i>Potamogeton praelongus</i>	Large-leaf Pondweed	X	X	X
<i>Potamogeton pusillus</i>	Pondweed	X	X	X
<i>Potamogeton robbinsii</i>	Robbins' Pondweed	X	X	X
<i>Potamogeton spirillus</i>	Pondweed		X	
<i>Potamogeton vaseyii</i>	Vasey's Pondweed		X	
<i>Potamogeton zosteriformes</i>	Flat-stem Pondweed	X	X	
<i>Sagittaria graminea</i>	Arrowhead	X	X	X
<i>Sparganium sp.</i>	Bur-reed	X	X	X
<i>Utricularia vulgaris</i>	Giant Bladderwort			X
<i>Vallisneria americana</i>	Duck Celery	X	X	X

Grid Enumeration

The permanent grids were evaluated annually over a three-year period (1996 – 1998). Aquatic plant presence and relative abundance for all grids are included as Appendix I. The total number of species found within the grid systems ranged from 13 species in 1996 to 14 species in 1997 and 10 species in 1998. The number of species per square meter ranged from 1 to 5 with a mean of 2.5 (\pm 1.3 SD). Little difference was observed in the average number of species per square meter among survey years (Table 2).

Eurasian watermilfoil dominated the lake bottom in the area of the grids. At the West Basin site, 87% of the grid squares contained some milfoil in 1996. This percentage increased to 91% in 1997 and 1998. The East Basin site ranged from 96% in 1996 to 100% in 1997 and 94% in 1998.

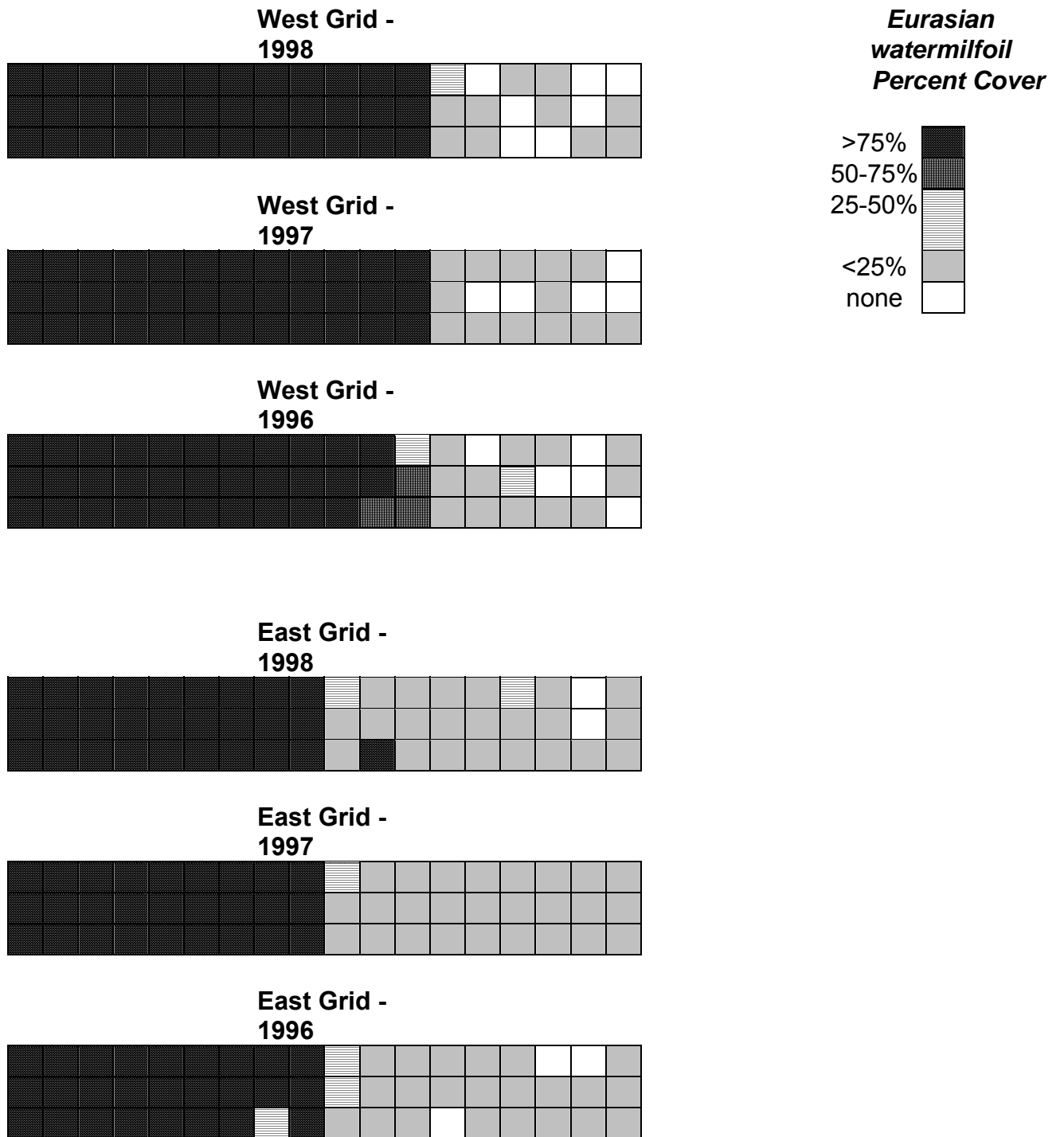
The sub-grids located within the dense growth areas of Eurasian watermilfoil (Sub-Grid #'s 1 & 2) generally produced fewer species per square meter than the sub-grids dominated by native plants (grid #3). The loss of aquatic plant species diversity under a Eurasian watermilfoil canopy is a frequently reported phenomena (Madsen et al., 1991; Boylen et al., 1999).

Table 2. Grid information for Eagle Lake.

Grid Site	Sub-Grid #	Average number of species per m ²			Average number of species per grid (54 m ²)		
		1996	1997	1998	1996	1997	1998
East	1	1.3	1.5	1.0	5.3	6.0	4.0
East	2	3.4	3.1	2.1			
East	3	3.2	3.8	3.5			
West	1	2.7	2.6	1.3	5.7	5.7	4.0
West	2	2.6	1.8	1.4			
West	3	2.8	3.7	3.1			

Average percent cover data for all grid squares is provided in Appendix I. Relative percent cover of Eurasian watermilfoil is included as Figure 4. The extent of dense growth of Eurasian watermilfoil has remained relatively constant in the grid system over the past 3 years in Eagle Lake.

Figure 4. Relative percent cover of Eurasian watermilfoil in the grids.



Diver Swimover Survey

Diver swimover surveys were designed to include less common plants which may not show up in the grid surveys. These surveys also cover a wider range of water depths and sediment types, thus assuring a more complete picture of the aquatic plant species present in the survey area.

Table 3. Percent cover for the west basin diver swimover survey.

Diver Swimover	Depth (m)								Cumulative % cover	Average % cover	Mean % cover
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8			
Charophytes	2.5	2.5	10	10	75	37.5	37.5	37.5	212.5	26.6	26.6
Potamogeton robbinsii			2.5	37.5	37.5	75	2.5	2.5	157.5	19.7	26.3
Myriophyllum spicatum		2.5	37.5	75	2.5	2.5			120	15	24
Najas flexilis	2.5	10	10	37.5	20	2.5	2.5		85	10.6	12.1
Potamogeton amplifolius		10	20	37.5	2.5				70	8.75	17.5
Potamogeton pusillus			2.5	10	20	20	2.5		55	6.88	11
Potamogeton gramineus	10	20	10	10	2.5				52.5	6.56	10.5
Elodea canadensis	2.5	10	10	10	2.5	2.5	2.5	2.5	42.5	5.31	5.31
Potamogeton praelongus			10	20	2.5				32.5	4.06	10.8
Vallisneria americana		2.5	10	10	2.5				25	3.13	6.25
Bidens beckii			2.5	10	2.5	2.5			17.5	2.19	4.38
Heteranthera dubia	10	2.5	2.5	2.5					17.5	2.19	4.38
Lobelia dortmanna	10	2.5							12.5	1.56	6.25
Ceratophyllum demersum		2.5	2.5	2.5					7.5	0.94	2.5
Eriocaulon septangulare	2.5	2.5							5	0.63	2.5
Sparganium sp.	2.5	2.5							5	0.63	2.5

average percent cover is based on all depth intervals surveyed
 mean percent cover is based on only the depth intervals where the species occurred

At the west basin site (see Table 3), charophytes were the most common species. These macroalgae were present throughout the depth ranges surveyed and dominated the plant community beyond a depth of 4 meters. Another deep water species, *Potamogeton robbinsii*, ranked second in abundance, reaching its maximum abundance in depths of 5 to 6 meters. Eurasian watermilfoil, *Myriophyllum spicatum* ranked third and reached maximum abundance in water depths of 2 to 4 meters. Within this depth range, no other species achieved a cover rating in excess of 50%. A total of sixteen species were observed at this site during the 1996 survey.

Table 4. Percent cover for the east basin diver swimover survey.

Diver Swimover	Depth (m)								Cumulative % cover	Average % cover	Mean % cover
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8			
Myriophyllum spicatum	2.5	10	75	75	2.5				165	20.6	33
Charophytes	2.5	2.5			20	75	20	2.5	122.5	15.3	20.4
Potamogeton robbinsii		2.5	2.5	20	75	10	2.5		112.5	14.1	18.8
Najas flexilis	2.5	20	10	2.5	2.5	2.5	2.5		42.5	5.31	6.07
Potamogeton pusillus		2.5	2.5	10	20	2.5			37.5	4.69	7.5
Potamogeton praelongus			10	20	2.5				32.5	4.06	10.8
Vallisneria americana		20	10						30	3.75	15
Bidens beckii			2.5	10	10	2.5			25	3.13	6.25
Potamogeton gramineus	2.5	2.5	10	2.5	2.5				20	2.5	4
Nymphaea odorata		20							20	2.5	20
Elodea canadensis	2.5	2.5	2.5	2.5	2.5	2.5	2.5		17.5	2.19	2.5
Potamogeton amplifolius		2.5		2.5	2.5				7.5	0.94	2.5
Ceratophyllum demersum		2.5	2.5	2.5					7.5	0.94	2.5
Potamogeton zosteriformes		2.5	2.5	2.5					7.5	0.94	2.5
Sagittaria graminea	2.5	2.5							5	0.63	2.5
Brasenia schreberi	2.5	2.5							5	0.63	2.5
Eriocaulon septangulare	2.5								2.5	0.31	2.5
Nuphar luteum				2.5					2.5	0.31	2.5

average percent cover is based on all depth intervals surveyed

mean percent cover is based on only the depth intervals where the species occurred

For the east basin site (see Table 4), Eurasian watermilfoil, *Myriophyllum spicatum* dominated and reached maximum abundance in water depths of 2 to 4 meters. Charophytes ranked second with maximum abundance in depths of 5 to 6 meters. *Potamogeton robbinsii* ranked third in abundance, reaching its maximum abundance in depths of 4 to 5 meters. A total of 18 species were observed at this site during the 1996 survey.

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APPENDIX I. Aquatic Plant Survey Data

All percent cover values are centroid or median values of observed ranges.

