Darrin Fresh Water Institute
AT LAKE GEORGE

**AN AQUATIC PLANT SURVEY OF LAKE SUNNYSIDE
WARREN COUNTY, NEW YORK**

Prepared for

Warren County Soil & Water Conservation District
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EXECUTIVE SUMMARY

In 1999, an Aquatic Plant Survey of Lake Sunnyside was commissioned by the Warren County Soil and Water Conservation District and conducted by the Darrin Fresh Water Institute. The survey was conducted on August 30, 1999. The focus of the survey and current report are: 1) the status of the aquatic plant population of Lake Sunnyside, 2) the extent of Eurasian watermilfoil growth in Lake Sunnyside, and 3) aquatic plant management options for the future.

Findings

1. A total of 13 submersed plant species were observed in Lake Sunnyside in 1999. Of these species, the dominant plants were *Potamogeton robbinsii, Potamogeton amplifolius, Potamogeton pusillus, Heteranthera dubia, Potamogeton gramineus*, and *Myriophyllum spicatum.* This high diversity suggests a healthy aquatic plant population at the present time.

2. Eurasian watermilfoil (*Myriophyllum spicatum*) was the 7th most abundant species in Lake Sunnyside, by relative percent cover.

3. Eurasian watermilfoil was found from the waters edge to water depths of 5.0 meters (16 feet). Milfoil reaches its maximum abundance in water depths of 2.0 to 4.0 meters (6 to 13 feet), and currently covers a relatively limited area of the lake surface.

3. At the current time, dense growth of Eurasian watermilfoil covers 0.3 acres of the littoral zone of Lake Sunnyside or about 1% of the surface area of the lake. Scattered growth of Eurasian watermilfoil, however is found throughout the lake.

Recommendations

1. The Lake Sunnyside Association should consider the formation of an aquatic plant management committee, if one does not exist. This committee should review the recommendations contained in this report, and initiate aquatic plant management efforts.

2. The scattered populations of Eurasian watermilfoil could be managed via hand harvesting. The cost for hand harvesting would probably run several thousand dollars.

3. The dense growth areas can be managed with a combination of benthic barrier and suction harvesting. With less than an acre of milfoil beds, the cost of benthic barrier installation would be about $10,000.

4. The Lake Sunnyside Association could also consider the use of an herbicide such as fluridone (SONAR™). Low concentration, whole lake treatments are reported to be most effective for Eurasian watermilfoil control. Whole lake, herbicide treatment can also address scattered populations and dense growth of Eurasian watermilfoil simultaneously. The cost of this treatment would be about $10,000.

5. The Lake Sunnyside Association should post all public access areas with posters identifying Eurasian watermilfoil and urging all boaters to clean their boats prior to launching and upon retrieval. This will help prevent the spread of Eurasian watermilfoil from Lake Sunnyside as well as further introductions to Lake Sunnyside.

Introduction

Lake Sunnyside is situated in the Town of Queensbury, Warren County, New York. Surface elevation of the lake is 351 feet above mean sea level. The lake has a surface area of 25.7 acres and a shoreline length of 1 mile (Swart and Bloomfield, 1985). The current survey estimated the lake surface area to be 37 acres. Maximum depth is approximately 7.5 meters (25 feet). Lake Sunnyside is a perched, seepage lake with no apparent inlet or outlet. Typical of many lakes within our region, Lake Sunnyside is a kettle lake formed during the last glaciation approximately 15000 years ago. It lies within the drainage of Halfway Creek and ultimately the Saint Lawrence via Lake Champlain.

Soils are a mixture of glacial till and boulders underlain by bedrock. Sandy soils provide for rapid infiltration of runoff waters and limit septic system performance. All wastewater management in the Lake Sunnyside watershed is via septic system.

Lake Sunnyside is a member of the Citizens Statewide Lake Assessment Program (CSLAP). Data collected as part of this program can form the basis for comparison to historical data for water chemistry and aquatic vegetation.

Vegetation Assessment Methods

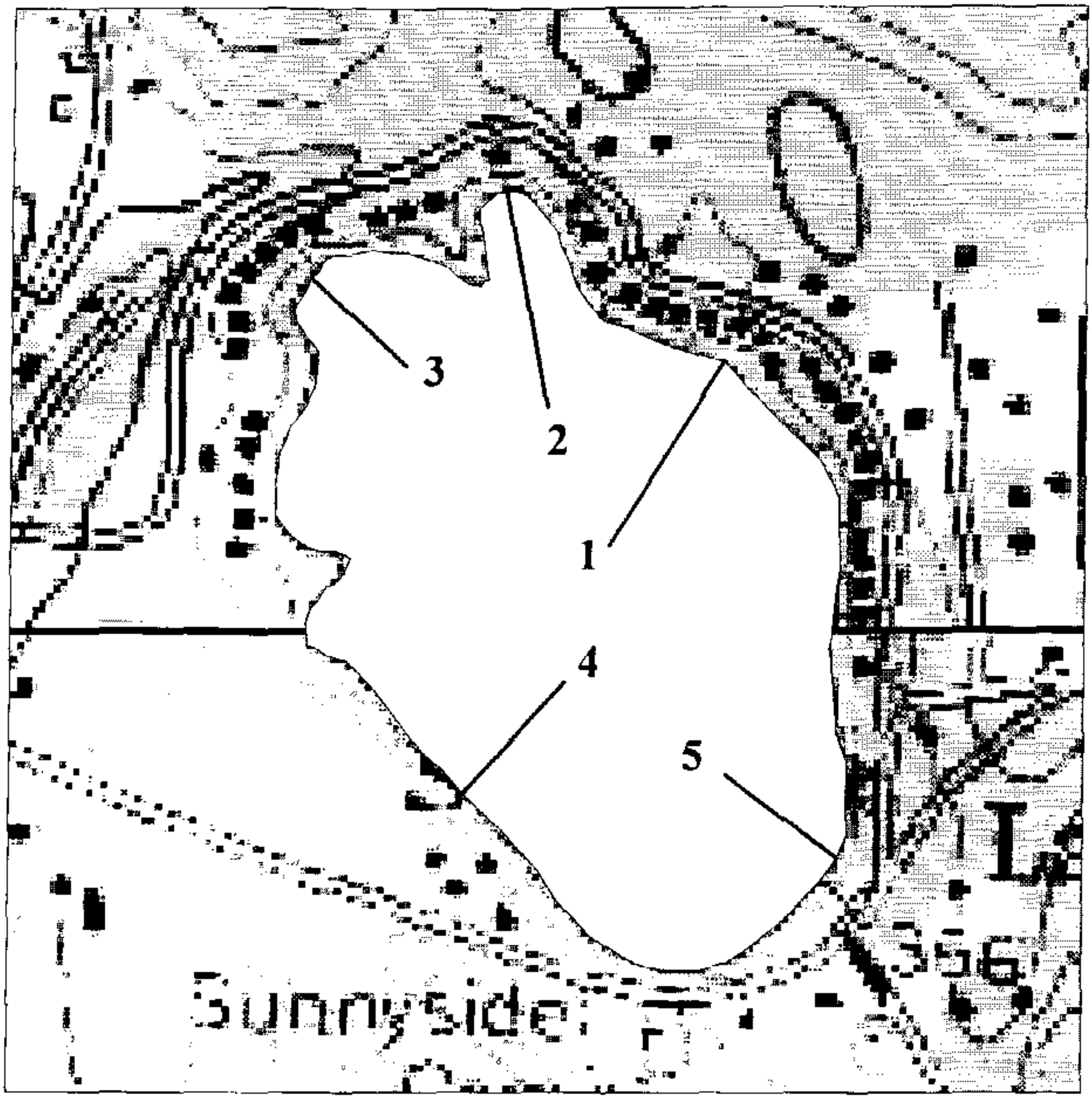
The location of scattered and dense Eurasian watermilfoil populations for the entire lake were recorded by divers trained in aquatic plant identification. To quantify the aquatic plant populations present in the lake, diver transects were located evenly around the lake. At each transect, all aquatic plant species and their relative abundance were recorded at one meter depth intervals using the following abundance classes: abundant (greater than 50% bottom cover), common (25 to 50% cover), present (15 to 25% cover), occasional (5 to 15% cover) and rare (less than 5% cover). This data provides both average depth distribution of plants, and an estimate of the relative abundance of all species in the lake.

In order to characterize the aquatic plant community of Lake Sunnyside, five sites were selected for transects (Figure 1 and Table 1). Sites were chosen to provide samples representative of the lake as a whole. Selection criteria included: water depth, degree of shoreline development, density of aquatic weed growth, and proximity to inlets and outlets.

Table 1. Diver survey transect site locations and physical characteristics.

Site Number	Site Name	Sediment Type	Bottom Slope
1	Kings	Sand to silt	gradual
2	Northeast Bay	Sand to silt	gradual
3	Northwest Bay	Sand to soft silt	gradual
4	West Shore	Silt and detritus	moderate
5	Pavilion	Silt and detritus	moderate

Figure 1. Transect location and number for Lake Sunnyside.



Aquatic Plants

A list of all submersed and floating-leafed aquatic plant species observed in Lake Sunnyside is given in Table 2. A total of 17 species were observed. Of these species, one is a macroscopic alga, or charophyte (*Chara/Nitella*), one was a wet terrestrial (*Lythrum*), three were emergent species (*Pontederia, Scirpus* and *Typha*) and the remaining 12 are submersed. Given the small size of Lake Sunnyside and its lack of connection to other lakes, the number of species observed indicates excellent diversity, typical of low-elevation Northeastern lakes (Madsen et al. 1989). For instance, Lake

George has 47 submersed species (RFWI et al., 1988) and 28 were observed in Lake Luzerne (Eichler and Madsen. 1990). In both of these lakes, this high diversity is threatened by further growth and expansion of Eurasian watermilfoil, which will have negative implications for the health of the lakes as a whole (Madsen et al., 1989; 1990). The composition of the species list for Lake Sunnyside is similar to that of other nearby lakes. For instance, all of the species observed in Lake Sunnyside have been noted for other regional lakes (Madsen et al., 1989). The presence of the exotic wet terrestrial Purple Loosestrife (*Lythrum salicaria*) may also be a threat to Lake Sunnyside. A list of all transect survey data is included as Appendix III.

Table 2. Aquatic plant species list for Lake Sunnyside.

Species	Common Name	Abundance
Bidens beckii	Water Marigold	Rare
Chara/Nitella	Muskgrass	Rare
Eleocharis sp.	Spike Rush	Rare
Elodea canadensis	Waterweed	Present
Heteranthera dubia	Water Stargrass	Present
Isoetes echinospora	Quillwort	Rare
Lythrum salicaria	Purple Loosestrife	Rare
Myriophyllum spicatum	Eurasian watermilfoil	Common
Najas flexilis	Water Naiad	Rare
Pontedaria cordata	Pickerelweed	Rare
Potamogeton amplifolius	Broad-leaf Pondweed	Dominant
Potamogeton gramineus	Variable Pondweed	Dominant
Potamogeton pusillus	Pondweed	Present
Potamogeton robbinsii	Robbins Pondweed	Dominant
Potamogeton spirillus	Pondweed	Rare
Scirpus subterminalis	Bulrush	Rare
Typha sp.	Cattail	Rare

One important factor to account for during the permitting process for any aquatic plant management program is the occurrence and abundance of rare plant species that might be affected by a given management technique. One of the plant species observed (*Bidens (Megalodonta) beckii*) is on the New York State Rare Plant list (Mitchell, 1986; Clemants. 1989). It's presence on the rare plant list may be a result of lack of survey data rather than its scarcity.

Aquatic plant survey data for all transects is included as Appendix II. Transect one was located adjacent to the King residence on the east side of the lake (see Figure 1). In the shallow zone (0-1 m), water stargrass (*Heteranthera dubia*) was the most abundant. From 1 to 3 meters, Broad-leaf Pondweed (*Potamogeton amplifolius)* was dominant. Beyond 3 meters depth, Robbins Pondweed (*Potamogeton robbinsii*) dominated the plant community. forming a low growing carpet over the lake bottom. Scattered growth of Eurasian watermilfoil (*Myriophyllum spicatum*) was observed throughout the survey area.

The sandy shoreline at transect 3 sloped gradually to the edge of the lake. Robbins Pondweed dominated at all water depths. In shallower zones (0-2 meters), Water stargrass shared dominance. Beyond a depth of 2 meters, Broad-leaf Pondweed (*Potamogeton amplifolius)* was common.

A flat sloped site with sand near shore (0 - 1 meter depth) changing to sand and silt in deeper water was examined at Transect 3. Dominant species from 1 to 4 meters included *Potamogeton amplifolius*, *Potamogeton gramineus* and *Potamogeton robbinsii*. Eurasian watermilfoil showed scattered growth from 2 to 4 meters depth.

Observations along Transect 4 indicated that the bottom slope was moderate and sediments were primarily debris-covered sand near shore to a sand and silt mixture in deeper waters. The dominant species from 0 to 2 meters were *Potamogeton robbinsii*, *Potamogeton pusillus* and *Heteranthera dubia*.

Transect 5 was a moderate sloped site, with sandy sediments dominant. In the shallow zone, less than 1 meter, the dominant species was *Potamogeton robbinsii*. Beyond a depth of 1 meter the plant community was very diverse. Eurasian watermilfoil growth was dense from 3 to 4 meters.

The depth distribution and cumulative percent cover, listed in alphabetical order, for all aquatic plants in Lake Sunnyside is shown in Table 3. These species are ranked in order of abundance in Table 4. The majority of species occur between the waters edge and 4 meters. The littoral zone or area where rooted plants can grow has a maximum depth of about 6 meters. A limited number of specimens of *Elodea canadensis* and *Potamogeton robbinsii* were also found beyond 6 meters depth. These species are capable of growth under very limited light conditions, however, the plants observed probably drifted into deep water from shallower areas. While able to survive, they are unlikely to grow in this location.

The depth distribution of the ten most common species is displayed in Figure 3. From this graph, the most typical dominants for each depth interval can be summarized. The dominant species was *Potamogeton robbinsii*. Other typical species in shallow waters (0 - 1 m) included *Heteranthera dubia* and *Elodea canadensis*. In the deeper end of this range (1 - 2 meters depth), *P. amplifolius*, and *P. gramineus* were common species. In water depths of 2-3 meters, *Potamogeton amplifolius* and *P. pusillus* were also common. Beyond 3 meters depth, *Potamogeton robbinsii* and *Elodea canadensis* were the most common. No plants were found in depths greater than 7 meters. Eurasian watermilfoil (*Myriophyllum spicatum*) reached its greatest densities in 1 to 4 meters depths.

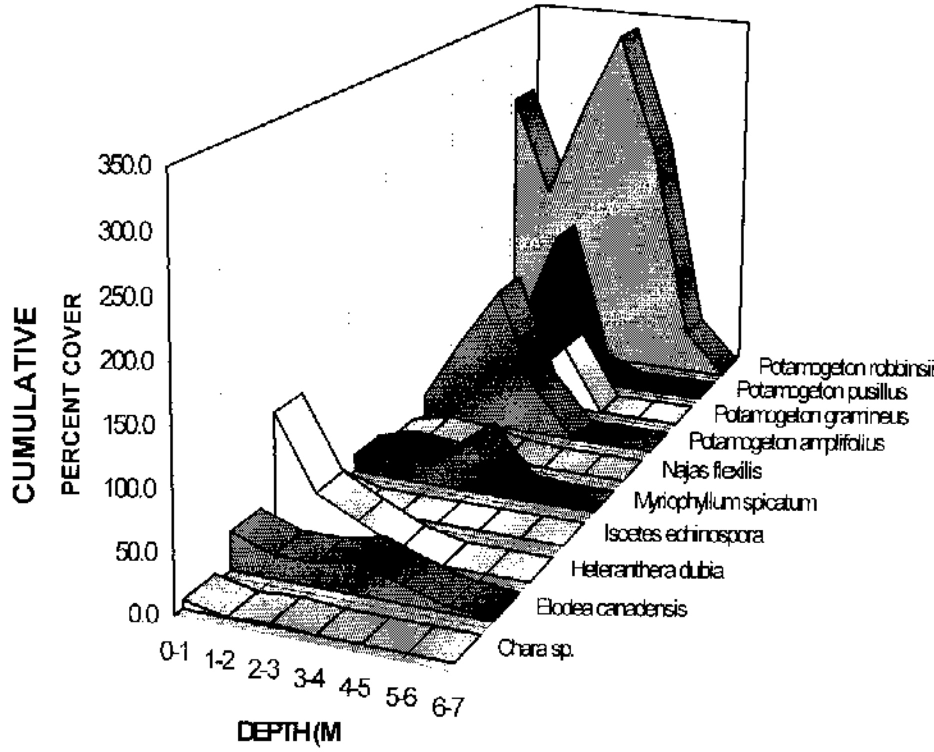
Table 3. Cumulative Percent Cover for All Species and All Depth Intervals

Species	Depth Interval (m)							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	Total
Bidens beckii	7.5	17.5	20.0	5.0				50.0
Chara sp.	7.5		2.5					10.0
Elodea canadensis	32.5	20.0	20.0	27.5	15.0	5.0	2.5	122.5
Heteranthera dubia	105.0	42.5	25.0	7.5				180.0
Isoetes echinospora	10.0							10.0
Myriophyllum spicatum	15.0	25.0	17.5	45.0	2.5			105.0
Najas flexilis	5.0	12.5	10.0	2.5				30.0
Potamogeton amplifolius	20.0	80.0	132.5	42.5				275.0
Potamogeton gramineus		80.0	22.5	60.0				162.5
Potamogeton pusillus	17.5	52.5	145.0	15.0				230.0
Potamogeton robbinsii	262.5	170.0	262.5	337.5	225.0	40.0	2.5	1300.0
Average	96.5	100.0	131.5	108.5	48.5	9.0	1.0	0.9

Table 4. Cumulative Percent Cover for All Species and All Depth Intervals Listed In Order of Abundance.

Species	Depth Interval (m)							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	Total
Potamogeton robbinsii	262.5	170.0	262.5	337.5	225.0	40.0	2.5	1300.0
Potamogeton amplifolius	20.0	80.0	132.5	42.5				275.0
Potamogeton pusillus	17.5	52.5	145.0	15.0				230.0
Heteranthera dubia	105.0	42.5	25.0	7.5				180.0
Potamogeton gramineus		80.0	22.5	60.0				162.5
Elodea canadensis	32.5	20.0	20.0	27.5	15.0	5.0	2.5	122.5
Myriophyllum spicatum	15.0	25.0	17.5	45.0	2.5			105.0
Bidens beckii	7.5	17.5	20.0	5.0				50.0
Najas flexilis	5.0	12.5	10.0	2.5				30.0
Chara sp.	7.5		2.5					10.0
Isoetes echinospora	10.0							10.0

Figure 2. Depth distribution of the aquatic plant species in Lake Sunnyside.



Eurasian Watermilfoil in Lake Sunnyside

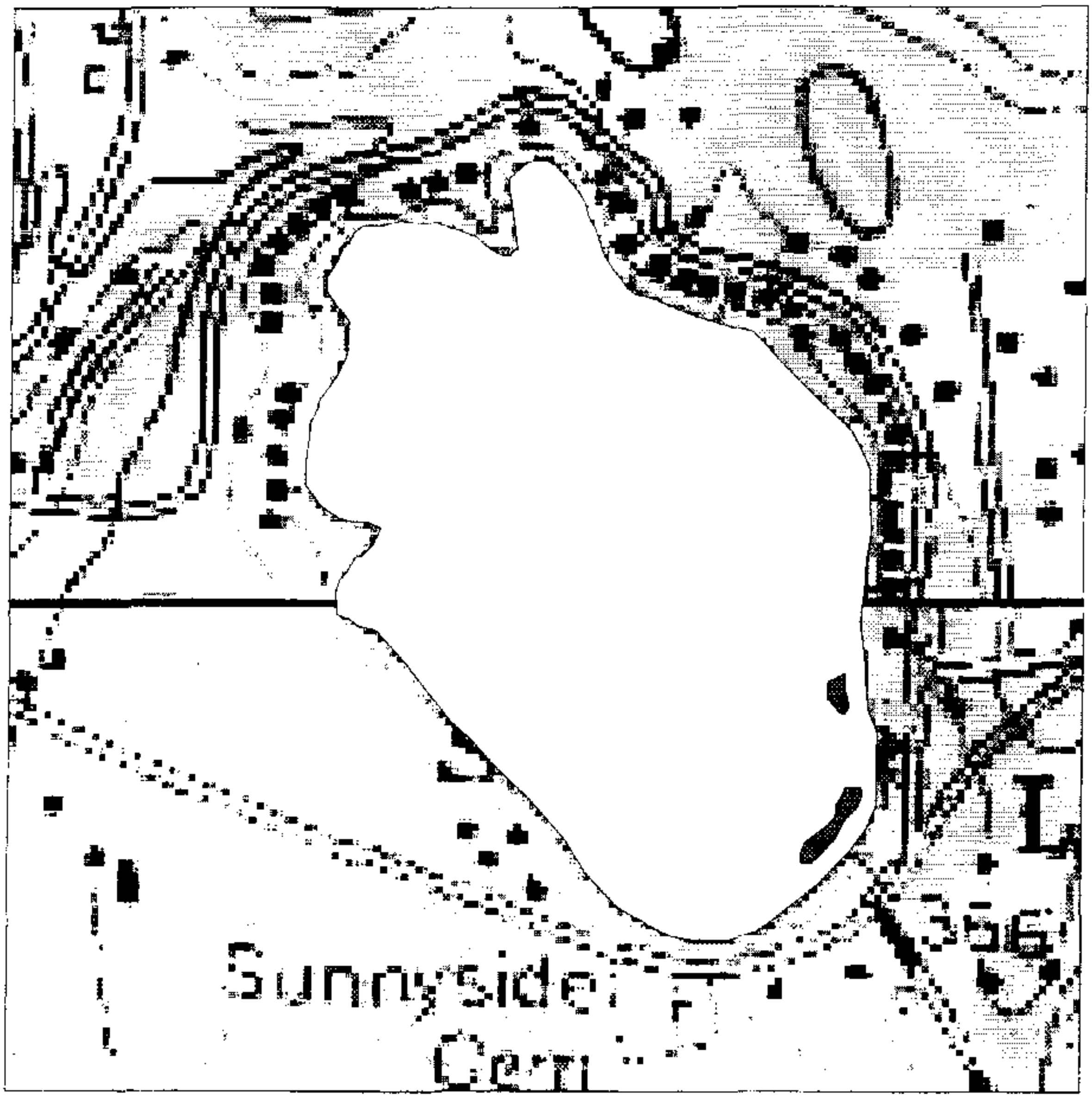
Only two species were observed to grow to the lake surface creating a potential nuisance. One was a native species known as Variable Pondweed (*Potamogeton gramineus*). This species produced patches of dense growth in 3 to 10 feet of water along the margin of the lake. The other potential nuisance species was Eurasian watermilfoil (*Myriophyllum spicatum*).

Eurasian watermilfoil plants were found throughout the littoral (area of rooted aquatic plants) zone of Lake Sunnyside (Figure 3). The depth distribution of Eurasian watermilfoil (see Table 3) indicates that this species is present from the water's edge to a depth of 5 meters. Eurasian watermilfoil reached its maximum abundance in waters of 2 to 4 meters depth. At the current time, Eurasian watermilfoil is only a minor component of the overall aquatic plant population of Lake Sunnyside, however certain areas of dense growth do exist.

Two areas supporting dense growth of Eurasian watermilfoil were observed (see Figure 3). The largest area of dense growth of Eurasian watermilfoil was located at the southeast margin of the lake adjacent to the area that was once the Lake Sunnyside Pavilion. The other area of dense growth was found on the east side of the lake adjacent to a small shoal area. The dense bed at the south end of the lake was estimated to be approximately 150 feet long and 30 feet wide. The other dense bed of Eurasian watermilfoil was on the southeast side of the lake. This bed was approximately 120 feet long and 45 feet wide. Estimates of dense growth area were made visually, and only represent an approximation of the extent of dense growth. The majority of dense growth of Eurasian watermilfoil was observed in water depths of 2 to 4 meters (6 to 13 feet).

One area with a substantial amount of suitable habitat for dense milfoil growth is the cove at northeast end of the lake. This area harbors scattered milfoil plants at the current time and should be watched closely for expansion. It is also likely that the two areas currently supporting dense growth of milfoil will continue to expand.

Figure 3. Extent of Eurasian watermilfoil growth in Lake Sunnyside.



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Appendix I. Water Quality Management Options

Water quality management is generally keyed to maintenance or improvement of an accustomed use rather than what is best for a lake from a purely environmental standpoint. In the case of Lake Sunnyside, maintenance of the lake for recreational uses such as swimming, sailing and fishing is the desired goal. The principal threat to these uses at present is excessive growth of non-native aquatic plants and algae in the lake.

Lake Sunnyside has moderate productivity in terms of rooted aquatic plants, a condition which is desirable in light of the desired use of the lake. Productivity of both suspended algae and rooted aquatic plants is tied to the availability of nutrients or fertilizers in the lake water and sediments.

Maintenance or reduction in the density of aquatic plants and algae, from a water quality standpoint, revolves around reduction of the amount of nutrients present in or added to the lake. A management plan to reduce nutrient concentrations draining into the lake from the shoreline areas should include the following basic components.

EDUCATION
PREVENTION
IMPLEMENTATION OF CONTROLS
MONITORING AND EVALUATION

Education. In order to develop support for lake management, area residents need to understand the need for and the justification of activities relative to water quality management. They need to understand how their actions may effect the use of the lake and how they can get assistance to remedy any real or perceived problems. Education can provide understanding and enlist support for programs to improve water quality. In order to assist your association in developing an educational program for your members. a number of regional organizations exist, including:

- New York State Department of Environmental Conservation
- Warren County Cooperative Extension Service (4-H)
- Warren County Soil and Water Conservation District
- Area Universities and Colleges
- Queensbury Planning and Zoning Department

These agencies will provide speakers and technical assistance in developing and implementing water quality protection and management plans.

Prevention. The protection of water quality will start with prevention of excess nutrients from entering the lake. Nutrients enter the lake in three ways; directly with precipitation, through runoff of waters from the lake's watershed and via resuspension from the sediments of the lake. Little can be done to reduce the amount of nutrients falling directly on the lake as precipitation, at least on the local level. Substantial reductions in the nutrients carried by runoff waters can be accomplished by local residents at the grass roots level. Reduction of nutrients coming into the water column of the lake via resuspension from the sediments will generally require in-lake control.

Reductions of the amount of impermeable surfaces adjacent to the lake (paved roads and driveways, sidewalks, etc.) will slow the flow of rainwater to the lake by forcing it to percolate through soils prior to entering the lake. Soils act as a natural filter removing much of the nitrogen and phosphorus compounds before the water reaches the lake. Eliminating stormwater drains emptying directly into the lake is also helpful. The drains may be redirected to small graveled areas for slow dispersal of the water. Sediment traps can be installed in roadside drainage ditches to capture the larger grained sediments and debris before it enters the lake.

Sewage from failing or improperly located septic systems can be a major source of nutrients to a lake. In a properly maintained and located septic system, solid material is allowed to settle in the septic tank where microorganisms can decompose it into water-soluble material. The water-soluble components (leachate) are allowed to pass into lateral drainage fields where the liquid slowly percolates into adjacent soils. In the soil, chemical reactions and bacteria remove the nitrogen and phosphorus compounds from the water and convert it to insoluble material, cellular material and gaseous material. Thus, in a properly operating system nitrogen and phosphorus are removed or reduced before the water finally percolates back to the lake. In a system which is not operating properly, insufficient time is available for complete removal of nitrogen and phosphorus compounds before the leachate reaches the lake.

Eroding soils carry considerable amounts of nutrients into the lake. Soils generally contain much greater amounts of nitrogen and phosphorus compounds than lake-water. If soils are stabilized by good vegetation cover, only small amounts of nutrients are washed into the lake. If large areas of timber are logged or if roads and developments are improperly designed, large scale erosion of soils frequently results. Soil erosion may be controlled in several ways by: 1) maintaining or planting effective ground cover vegetation (e.g. Crown Vetch) in erosion prone areas, 2) restricting the amount of acreage that may be logged at any one time and the time of year when logging operations occur, 3) providing guidelines on road construction within the area and methods that contractors use to develop property, and 4) maintenance of a vegetated area along the shoreline. Considerable amounts of soils are deposited in the lake by streams and drainage ditches. Some of the soils may be kept out of the lake by minimum adjustments to the stream bed to reduce the water velocity in the stream prior to entry into the lake. Reduced water velocity in the stream will cause the bulk of the suspended soils to be deposited in the low velocity area and with occasional clean-out this area can be maintained fairly easily. Your local Soil Conservation Service representative can provide valuable assistance in determining the extent of erosion problems and suggesting methods for soil conservation.

The runoff of fertilizers applied to lawns and gardens can frequently add nitrogen and phosphorus to a lake. There are a number of "common sense" methods for reducing the inputs from these sources. Don't fertilize early in the spring or at other times when soils are saturated from a recent rainstorm. Try to apply small amounts of fertilizer more frequently (i.e. twice per year add one-half the amount usually applied once per year). Don't locate vegetable gardens or other gardens that you plan to fertilize heavily close to the lake. Don't fertilize immediately before a rainstorm is forecast.

Implementation of Controls. A number of control techniques are available, however each has advantages and disadvantages. Control of nutrient inputs from the terrestrial part of the lake basin has been discussed in the previous section. In-lake controls are frequently costly, large scale projects requiring permits from state and local agencies. Considering the good water quality, in-lake controls for nutrient reduction are not warranted at present.

Monitoring and Evaluation. Monitoring of runoff areas by your association is desirable. In addition to the plant survey presented in this report association members in conjunction with their water quality committee can make certain observations and measurements that will prove useful in observing any long-term trends in water quality. Membership in the Citizens Statewide Lake Assessment Program (CSLAP) sponsored by the New York State Department of Environmental Conservation and the NYS Federation of Lake Associations (NYS FOLA) can also provide volunteer assisted water quality monitoring a very little cost.

On a three to five year basis, more complete chemical assays and observations of the lake are advisable. These analyses will act as a "report card" to determine how successful control techniques have been. Collection of samples can be done by lake association members and then analyzed by consulting laboratories or with the assistance of state agencies (CSLAP). Aquatic plant assessments similar to that contained in this report can be contracted for. Water quality is representative of not only the chemical condition of the lake water but also the plant and animal communities present. Understanding how these components interact is critical for effective lake management.

Appendix II. Management of Eurasian Watermilfoil in Lake Sunnyside

Although lake residents all want immediate action, the first step in addressing Eurasian watermilfoil problems in Lake Sunnyside is to develop a long-term aquatic plant management plan as a component of an overall lake management plan. A long-term plan is needed, since it is unlikely (if not impossible) that Eurasian watermilfoil can be eradicated from the lake. Even if eradication were to be accomplished, continued vigilance would be necessary to prevent any future re-introductions.

Some specific components to address in any aquatic plant management plan are:

Education
Prevention
Implementation of Controls
Evaluation and Monitoring

Education. Education of lake-users and homeowners is imperative to develop support for management efforts, and to gather volunteers to assist with the program. Homeowners and lake-users must have a basic understanding of nuisance aquatic plants such as Eurasian watermilfoil and how to prevent further introductions and spread. One fact is becoming clear, in these times of limited funding opportunities, the only way to protect your lake is to join forces and do it as a lake association. In addition to educational materials, surveys also provide insights into the issues and priorities of the lake-users. Periodic surveys of property owners and recreational users can define the needs of any management program. The surveys also indicate the level of support or resistance for management efforts; information which is critical to the permitting process for management efforts.

Prevention. Once control has been successful, efforts must be made to prevent reintroduction, and slow the spread of Eurasian watermilfoil. Also, preventive efforts will help to curtail the spread of this plant to other lakes; both as an altruistic measure to keep other lakes from experiencing these problems, and to minimize sources of plants for potential reintroduction of exotic species. Prevention efforts might include education, non-point pollution control, erosion management and encouraging the reintroduction and growth of native plants.

Evaluation and Implementation of Controls. A wide variety of control techniques are available, none of which provides a perfect solution. All techniques have advantages and drawbacks. Each location with Eurasian watermilfoil must be assessed individually, and a control technique selected that will work under those conditions.

The vegetation management committee must study the control options and decide on a suitable group of control techniques. Do not rely solely on consultants to decide for you. One important consideration generally neglected is that these techniques will have to be approved through a permitting process, so select techniques that will be acceptable to the permit administrator. The permits for aquatic plant control within the Adirondack Park are administered by the Adirondack Park Agency, outside the park the NYS Department of Environmental Conservation is the permit administrator.

Aquatic plant management options fall into 4 major groups:

Physical - lake level drawdown, hand harvesting or benthic barrier

Mechanical - harvesters, dredges and rakes

Chemical - herbicides

Biological - pathogens, herbivores and parasites

Of these four categories, only biological, physical and chemical means offer the possibility of long-term reductions in Eurasian watermilfoil growth for Lake Sunnyside. There are currently two viable biological control options: 1) grass carp, a plant eating fish, is approved in New York State and 2) herbivorous insects which include a weevil and an aquatic moth larvae (caterpillar). Grass carp are not particularly suitable for Lake Sunnyside since they are completely non-selective in their feeding habits, and tend to prefer native vegetation. Herbivorous insects are experimental at the current time, but appear to have potential for long-term control of Eurasian watermilfoil.

Mechanical controls, while they may be useful in a long-term maintenance program, do not generally eliminate the target plant species from a given area, but simply reduce its abundance to allow recreational use. While raking and harvesting (cutting) can provide some relief for lakeside residents, longer-term control of Eurasian watermilfoil is generally desired. Mechanical harvesting can also have a side effect of spreading plant fragments during the process of cutting. These fragments may start new populations or increase the density of existing populations. Given the small number of dense growth areas of Eurasian watermilfoil in Lake Sunnyside, we do not feel that this technique is applicable.

Lake level drawdown, a physical control technique, lowers lake water levels in the winter in order to freeze the plants. This technique has had some success on Eurasian watermilfoil control in area lakes, for example, Galway Lake in Saratoga County, NY. The lack of a lake outlet structure on Lake Sunnyside, however, will not allow a lake level reduction.

Benthic barriers, fabric stretched over the lake bottom to smother plants, also have been successful for Eurasian watermilfoil control. The limited areas of Lake Sunnyside dominated by Eurasian watermilfoil, make this technique viable, though costly. Benthic barriers typically cost from $15,000 to $25,000 per acre, installed. Significant cost savings can be achieved by the use of non-typical barrier materials such as belt press cloths, sand and others in place of commercially available benthic barrier materials. Benthic barriers are only recommended for areas of dense growth of Eurasian watermilfoil, primarily due to environmental considerations due to their totally non-selective nature for aquatic plant control. Cost also becomes a factor when large areas are to be managed by this technique.

The availability of a suction harvester from East Caroga Lake, or possibly Lake George, makes this a viable plant management option. With the limited areas of dense growth of Eurasian watermilfoil in Lake Sunnyside, suction harvesting may prove effective. Suction harvesting is essentially an automated hand harvesting procedure. Divers scoop up the roots and plants of Eurasian watermilfoil and feed them into a suction hose. The hose transports the plants and their associated sediments to a mesh basket at the surface, where the sediments are allowed to wash out and settle to the lake bottom. This form of management is labor intensive, but has the advantage of being very selective for the removal of Eurasian watermilfoil with little impact to native plant species present. Costs for this technique are on the same order as benthic barrier per unit area.

Chemical or herbicide application offers a possible alternative for Eurasian watermilfoil control in Lake Sunnyside. The limited extent of Eurasian watermilfoil growth in Lake Sunnyside, however, probably excludes herbicides from consideration. While herbicide application is often inexpensive on a per acre basis, when compared to physical plant controls, the time and costs associated with acquiring a permit for herbicide application frequently make this technique more costly. There are a number of herbicides on the market which are used for Eurasian watermilfoil management. The most commonly used and/or recommended include Aqua-Kleen (2,4-D) and Sonar (fluridone). New York State requires that these chemical herbicides be applied by a licensed applicator. The lake association may wish to contact an applicator and get cost estimates on various applications. The information contained in this survey should allow for fairly specific price quotations. All herbicides contain label restrictions for applications rates, proximity to drinking water intakes, contact restrictions for swimming, and toxicity for species other than those targeted. The applicator should be able to provide this type of information. Contacting several applicators in order to get the best price and possibly differing points of view is recommended.

Management Option	Cost per Acre	Limitations
Lake Level Drawdown	$0	non-selective, limited to depth of outlet structure
Hand Harvesting	$30,000	limited to low density growth labor intensive
Suction Harvesting	$20,000	limited to moderate density growth labor intensive
Benthic Barrier	$20,000	non-selective labor intensive
Herbicide	$2000	public perception moderate selectivity
Grass Carp	$400 - $500	non-selective, turbidity
Insects	$400 - $500	some selectivity experimental

Monitoring and Evaluation. These two activities are similar in execution, but somewhat distinct in purpose. The vegetation committee should coordinate a lay monitoring program of lake-users to observe lake areas for the presence and spread of Eurasian watermilfoil in the lake. In addition, these individuals might help in posting boat launches and even inspecting boats and interviewing owners about the Eurasian watermilfoil problem.

Monitoring the lake would include consistent visual inspections of areas of the lake, using snorkeling or SCUBA, for the presence and spread of Eurasian watermilfoil. One technique for quantifying areas with dense Eurasian watermilfoil is to use an echolocation unit ("fish/depth locator") to map the height and area of dense beds during the summer. Currently the Citizens Statewide Lake Assessment Program (CSLAP) collects information on the aquatic plants in a number of New York State lakes. Coordination with the efforts of this program should be encouraged. These monitoring activities should be part of an overall lake monitoring program.

Evaluation activities are designed to examine specific control programs and techniques, as well as assessing the rate of Eurasian Watermilfoil regrowth or recolonization and the need for repeated control at a given location. This may be done by lay monitors, or contracted with consultants.

An ongoing effort in prevention, education, evaluation and monitoring will greatly facilitate gathering information and making decisions on future management directions.

Findings

1. A total of 13 submersed plant species were observed in Lake Sunnyside in 1999. Of these species, the dominant plants were *Potamogeton robbinsii, Potamogeton amplifolius, Potamogeton pusillus, Heteranthera dubia, Potamogeton gramineus*, and *Myriophyllum spicatum*. This high diversity suggests a healthy aquatic plant population at the present time.

2. Eurasian watermilfoil (*Myriophyllum spicatum*) was the 7th most abundant species in Lake Sunnyside, by relative percent cover.

3. Eurasian watermilfoil was found from the waters edge to water depths of 5.0 meters (16 feet). Milfoil reaches its maximum abundance in water depths of 2.0 to 4.0 meters (6 to 13 feet), and currently covers a relatively limited area of the lake surface.

3. At the current time, dense growth of Eurasian watermilfoil covers 0.3 acres of the littoral zone of Lake Sunnyside or about 1% of the surface area of the lake. Scattered growth of Eurasian watermilfoil, however is found throughout the lake.

Appendix III. Aquatic Plant Survey Results for Lake Sunnyside.

Lake Sunnyside Aquatic Plant Survey Date:8/30/99
Site: T-1

Species	Depth Interval (m) 0-1	1-2	2-3	3-4	4-5
Bidens beckii	2.5	10.0	10.0		
Chara sp.					
Elodea canadensis	10.0	2.5	2.5	10.0	10.0
Heteranthera dubia	75.0	20.0			
Myriophyllum spicatum	2.5	10.0	2.5	2.5	2.5
Potamogeton amplifolius	10.0	37.5	75.0		
Potamogeton gramineus			10.0	20.0	
Potamogeton robbinsii	37.5	10.0	37.5	75.0	75.0
Potamogeton pusillus	2.5	20.0	20.0		

Lake Sunnyside Aquatic Plant Survey Date:8/30/99
Site: T-2

Species	Depth Interval (m) 0-1	1-2	2-3	3-4	4-5
Chara sp.	2.5				
Elodea canadensis	2.5	2.5	2.5	2.5	
Isoetes echinospora	10.0				
Bidens beckii	2.5	2.5	2.5	2.5	
Myriophyllum spicatum	2.5	2.5	2.5	2.5	
Najas flexilis	2.5	10.0	10.0	2.5	
Heteranthera dubia	10.0	10.0	10.0		
Potamogeton gramineus			2.5	2.5	
Potamogeton robbinsii	75.0	37.5	75.0	75.0	
Potamogeton amplifolius		2.5	10.0	37.5	
Potamogeton pusillus	2.5	10.0	10.0	2.5	

Lake Sunnyside Aquatic Plant Survey
Site: T-3

Species	Depth Interval (m)						
	0-1	1-2	2-3	3-4	4-5		
Chara sp.	2.5		2.5				
Bidens beckii			2.5				
Elodea canadensis		2.5	10.0	2.5	2.5	2.5	2.5
Myriophyllum spicatum			2.5	2.5			
Heteranthera dubia			2.5	2.5			
Potamogeton amplifolius		2.5	37.5	2.5			
Potamogeton gramineus		75.0					
Potamogeton robbinsii		10.0	37.5	75.0	75.0	37.5	2.5
Potamogeton pusillus		2.5	2.5				

Lake Sunnyside Aquatic Plant Survey
Site: T-4

Species	Depth Interval (m)					
	0-1	1-2	2-3	3-4	4-5	
Bidens beckii	2.5	2.5	2.5			
Elodea canadensis	10.0	2.5	2.5	10.0	2.5	2.5
Heteranthera dubia	10.0	10.0	2.5	2.5		
Myriophyllum spicatum		2.5				
Najas flexilis	2.5	2.5				
Potamogeton gramineus		2.5				
Potamogeton pusillus	10.0	10.0	75.0	2.5		
Potamogeton robbinsii	75.0	75.0	75.0	75.0	75.0	2.5

Lake Sunnyside Aquatic Plant Survey
Site: T-5

Species	Depth Interval (m)				
	0-1	1-2	2-3	3-4	4-5
Bidens beckii		2.5	2.5	2.5	
Chara sp.	2.5				
Elodea canadensis	10.0	10.0	2.5	2.5	
Heteranthera dubia	10.0	2.5	10.0	2.5	
Myriophyllum spicatum	10.0	10.0	10.0	37.5	
Potamogeton amplifolius	10.0	37.5	10.0	2.5	
Potamogeton gramineus		2.5	10.0	37.5	
Potamogeton pusillus	2.5	10.0	37.5	10.0	
Potamogeton richardsonii					
Potamogeton robbinsii	75.0	37.5	37.5	37.5	