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ASSESSMENT OF EAGLE LAKE

A report to the
Eagle Lake Homeowners Association

prepared by

Lawrence W. Eichler, Laboratory Supervisor
and
John D. Madsen, Research Scientist

FWI Report #90-6
April 1990

Rensselaer Polytechnic Institute Troy, New York 12180-3590

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* For appendices, see Rensselaer Fresh Water Institute Lake Management Manual: Lake Assessment Appendices for 1989. FWI Report #90-3.

EXECUTIVE SUMMARY

Findings

1. The transparency and phosphorus concentration of Eagle Lake waters indicates that the lake should be classified as oligotrophic.

2. Water quality in Eagle Lake is currently adequate for the primary use of its' residents, namely recreation.

3. The low alkalinity of Eagle Lake makes it susceptible to acidification by precipitation, although it currently has sufficient capacity to neutralize acidic inputs.

4. The deeper waters of the lake (hypolimnion) show low dissolved oxygen concentrations and elevated nutrient levels during the latter part of summer stratification.

5. The one inlet tested was found to be contributing sediments, nutrients, and dissolved materials to the lake.

6. The steep slopes and coarse textured soils make erosion of sediments from the terrestrial portion of the lake's basin a serious concern.

7. Changes in lake water chemistry over the last seven years have been minor, however some depression in pH was observed in the Spring of 1982, possibly due to snowmelt waters.

8. A total of 28 submersed plant species were observed for Eagle Lake, of which 27 were found along the four transects studied. Of these species, dominant plants included Nitella sp., Potamogeton pusillus, P. robbinsii, and Elodea canadensis. Vascular plant species were found to a depth of 8 meters, and Nitella to a depth of 9 meters or more.

9. Eurasian Watermilfoil (Myriophyllum spicatum) was the 11^{th} most abundant species. Dense stands were found from 1.5 to 4.5 meters (4 to 14 feet) with scattered individuals from 0.5 to 5.5 meters (2 to 18 feet). Many fragments were also found at greater depths, but these would probably not survive. Eurasian Watermilfoil was found scattered around most of the lake. It occurs predominantly as scattered individuals or small clumps. However, small dense beds less than one acre in size were found in several locations.

10. Several area that as yet are only slightly to moderately infested with Eurasian Watermilfoil have the potential to support much larger dense beds. These include the outlet area, the shallow zone around the large island in the western end of the lake, and the large shallow bay at the eastern end with one of the inlets.

Recommendations

1. Although Eagle Lake is currently near neutral in pH, the buffering capacity of the lake is quite low. Without information on the pH of the lake in the spring, when the largest volumes of acid enter the lake, the full extent of the impacts of acid precipitation on Eagle Lake are unknown. Collection of pH and alkalinity data in the spring of the year should be encouraged by the lake association.

2. Steep slopes and coarse textured soils within the watershed of Eagle Lake make erosion a serious problem. Contact with the Essex County Soil and Water Conservation Service (see Appendix G) to review appropriate erosion control techniques (BMPs) is a necessary first step. Many techniques can be applied on an individual homeowner basis such as planting of erosion resistant species, maintenance of a green strip along the lakeshore, and altering the flow of runoff water to name a few.

3. Establishment of a lay monitoring program to continue data collection started by this assessment should be actively pursued. With some basic training, lake association members can collect information which can be used to signal any sudden shifts in water quality or aquatic plant populations. This information is crucial for rapid response and remediation activities.

4. Encouragement of an active lake association with ties to regional and state lake federations is an important step. A water quality committee could organize education, prevention, control and evaluation activities. A thorough review of your town's zoning and planning laws with respect to mitigations of stormwater and wastewater controls should also be considered. A number of the things which threaten the lake are more regional or national problems, such as acid precipitation, runoff of sediments, nutrients,

salt and corrosion products from area roads. Solutions for these problems will probably require political action.

5. An active aquatic plant management committee should develop and implement a long-term aquatic plant management plan, as part of an overall lake management plan. In addition to selecting and implementing control techniques, the committee should develop education, prevention, evaluation and monitoring activities.

6. Although an in-depth study of control alternatives should be performed, some initial suggestions for potential control techniques would be to utilize hand-harvesting on the scattered plant areas before they grow into dense beds, and benthic barrier (mats) on the small dense beds.

SECTION 1

BACKGROUND

Eagle Lake is located in the southern portion of Essex County in the Town of Eagle Lake. The lake's watershed, part of the Upper Hudson drainage, is located in the Adirondack Mountains. Elevations within the watershed range from 944 feet at the surface of the lake to 1860 feet above sea level (Table 1-1 and Figure 1-1).

The lake has a surface area of 420 acres and a steeply sloping watershed of 3452 acres (Mikol and Polsinelli, 1985). The lake has a maximum depth of 12.8 meters (42 ft.) and a mean depth of 5.8 meters (19 feet). Typical of lakes in the temperate region, it is dimictic, exhibiting both summer and winter thermal stratification. Located on the western margin of the lake is the only outlet. The lake is seperated into two distinct basins by a shallow, narrow channel which is confined by a highway bridge for NYS Route 73. The larger (surface area) and deeper portion of the lake lies to the east of this channel. The lake is best classified as oligotrophic which indicates that nutrients necessary for the growth of algae and subsequently the myriad of organisms that feed on these plants, are low.

Table 1-1. Physical Features of Eagle Lake. (Mikol and Polsinelli, 1985)

EAGLE LAKE - Eagle Lake, Essex County, New York.	
Latitude	43 degrees 52 minutes
Longitude	73 degrees 37 minutes
Topographic Quad. Map	Eagle Lake
Watershed	Upper Hudson
NYSDEC Pond Number	438
Mean Depth	5.8 meters (19 feet)
Maximum Depth	12.8 meters (42 feet)
Volume	9,847,320 cubic meters (7980 acre-feet)
Hydraulic Retention Time	1.4 years
Surface Area	170.0 hectares (420 acres)
Watershed Area	1397.6 hectares (3452 acres)
Shoreline Length	12.5 kilometers (7.8 miles)
Elevation Above Sea Level	288 meters (944 feet)
Water Quality Classification	B

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 with some glacial outwash deposits (T. Trevail, pers. comm.). Soil depths range from 10 to 40 inches over bedrock with some exposed bedrock outcrops. Slopes are steep (35-60%) and drainage in these deposits is rapid. Their ability to furnish lime, nitrogen and phosphorus to terrestrial plants via root uptake is poor. Excessive slope is the principle limitation to development within the basin. The rapid movement of water through these coarse textured soils reduces septic system performance and increases the hazard of groundwater contamination since sewage treatment is on an individual septic system basis.

Eagle Lake is a residential/recreational lake with boating, fishing and swimming the primary uses. Public access is available via a NYSDEC maintained boat launch ramp at the westernmost end of the lake. Evidence of small boat launching adjacent to the Route 73 bridge was also observed. The watershed is moderately populated, but areas of undeveloped shoreline with potential for residential use remain. Commercial land use on the shore of the lake is minimal.

A Bathymetric map is included as Figure 2-1. This map was generated by the NYSDEC (Mikol and Polsinelli, 1985).

The fisheries resources of Eagle Lake are characteristic of a two-story fishery with both warm-water and cold-water species present (Table 1-2). The species present indicate overall good water quality.

Historical data on water chemistry is included courtesy of NYSDEC (Table 1-3). Samples were collected in 1982 during May and August. Results of these samples indicate that Eagle Lake was moderately productive and chemical water quality was generally adequate for the intended use, namely water based recreation. Temporal trends in chemical water quality will be reviewed in relation to data generated during the present study.

Table 1-2. Fish Indigenous to Eagle Lake.*

Common Name	Classification
Smallmouth Bass	Micropterus dolomieu
Chain Pickerel	Esox niger
Northern Pike	Esox lucius
Brown Bullhead	Ictalurus nebulosus
Pumpkinseed Sunfish	Lepomis gibbosus
Brown Trout	Salmo trutta

* From: New York State Lakes, A Morphometric Atlas of Selected Lakes, Volume 1, Region 5. NYSDEC, Albany, NY. 1985. 81pp.

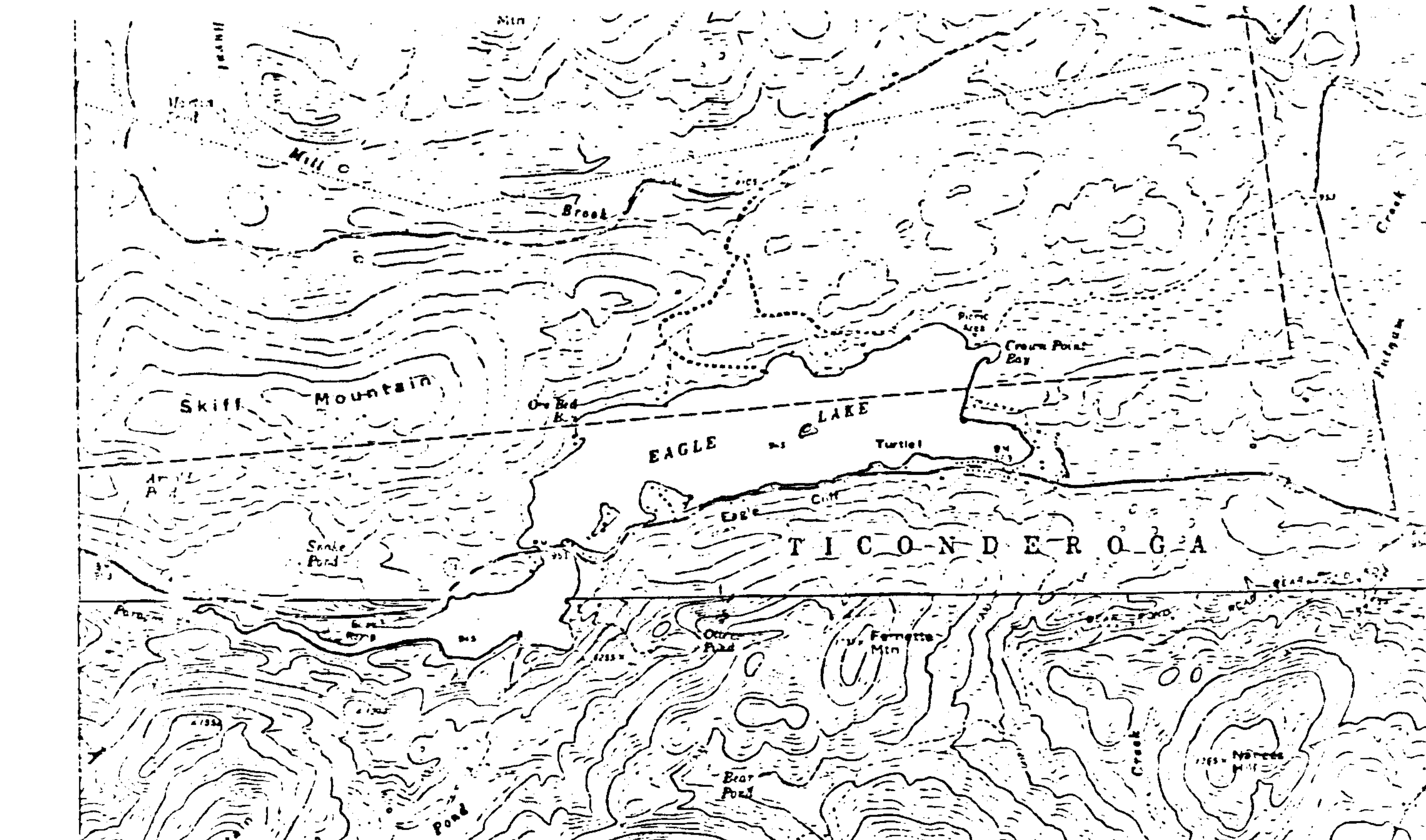
Table 1-3. Historical Water Chemistry for Eagle Lake*.

Historical Chemistry Data
EAGLE LAKE
Pond # 438
Watershed # 5

Date	ZSAMP	ZBOT	pH	Secchi	CHLA	TP	TFP	MRP
05/01/82	0.5	1.0	6.80			0.008		
08/11/82	1.0	11.5	7.60	9.3	2.1	0.007	0.003	-0.001
08/11/82	10.0	11.5	6.90		8.6	0.016	0.003	-0.001

Date	ZSAMP	ZBOT	TKN	SKN	NO3	NH4
05/01/82	0.5	1.0				
08/11/82	1.0	11.5	0.19	0.18	-0.05	0.011
08/11/82	10.0	11.5	0.25	0.24	-0.05	0.010

Figure 1-1. Topographic Map Showing Eagle Lake and its Watershed.



SECTION 2

METHODS

Water Quality

In order to characterize the chemistry of Eagle Lake water, four sampling sites were selected (Figure 2-1 and Table 2-1). Sites were selected to provide samples representative of the lake as a whole. Selection criteria include: water depth, degree of shoreline development,

Table 2-1. Chemical Water Quality Sampling Sites.

Site	Name	Location
1	Outlet	Samples were collected in the mouth of the outlet channel adjacent to the wetland area. A surface grab sample was taken. The maximum water depth at this site was 0.5 meters.
2	W. Midlake	Samples were collected in the central portion of the lake approximately 260 meters SW of the Rt. 73 bridge. A sample of the epilimnion was taken at 0.5 meters below the lake surface and a deep water sample was taken at 7.0 meters below the lake surface. Maximum water depth at this site was 7.78 meters.
3	E. Midlake	Samples were collected in the central portion of the lake approximately 200 meters west of the midlake island. A sample of the epilimnion was taken at 0.5 meters below the lake surface and a sample of the hypolimnion was taken at 11.0 meters below the lake surface. The maximum water depth at this site was 11.35 meters.
4	Inlet	Samples were collected from the inlet about 180 meters upstream from the lake shore and adjacent to a culvert under the access road. A surface grab sample was taken. Maximum water depth at this site was 0.2 meters.

density of aquatic weed growth, and proximity to inlets or outlets.

At each lake site, measurements were made of maximum water depth and water transparency by Secchi depth, conditions permitting (i.e., not greater than maximum depth). Temperature and dissolved oxygen (D.O.) were measured using a YSI Model 54 D.O./Temperature Meter. Determinations were made at 1 meter intervals for the entire water column. Also at each site, a surface water (epilimnion) sample at a predetermined depth (0.5 meter) was taken. At the midlake sites, a deep point sample from near the bottom of the lake and below the thermocline was collected to be representative of the hypolimnion of the lake.

Surface grab samples were collected by submerging an appropriate container below the surface of the water and then inverting it to fill in such a manner that the mouth of the bottle was as far as possible from the samplers arm and hand. Care was taken to avoid collecting portions of the surface film in these samples. Surface grab samples were collected at all sites. At the midlake sites, deep-water samples were also taken using a Van Dorn collection bottle which was lowered to the desired depth and remotely triggered to shut, thus collecting a sample of water at that depth.

All water samples were stored on ice until return to the laboratory. Immediately upon returning to the laboratory a portion of each sample was analysed for pH, specific conductance, orthophosphorus, total suspended solids and alkalinity. A separate portion, to be used for total phosphorus determination, was frozen until analysed. The remainder of each sample was filtered (0.4 um Nuclepore filter) and stored at 4° C until analysed for nitrate and ammonia concentrations. The analytical methods used for all determinations are listed in Appendix L.

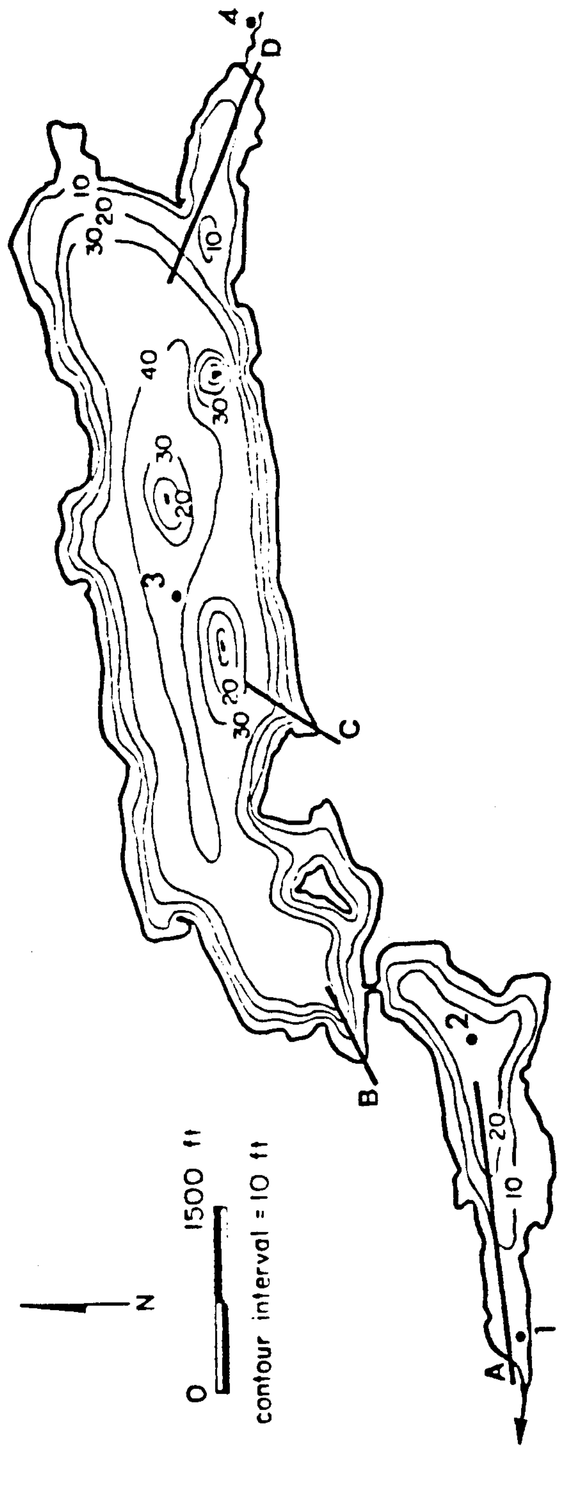
VEGETATION METHODS

The location of scattered and dense Eurasian Watermilfoil (Myriophyllum spicatum L.) populations for the entire lake were noted on a map. To further quantify the aquatic plant populations around the lake, four locations were located evenly around the lake for diver swim-over transects (Figure 2-1). Along each transect, the diver estimated the abundance of all aquatic plant species in each depth interval using the following abundance classes:

Class	Code	% Cover Range	Centroid
Abundant	A	greater than 50% cover	75%
Common	C	25% to 50% cover	37.5%
Present	P	15% to 25% cover	20%
Occassional	O	5% to 15% cover	10%
Rare	R	less than 5% cover	2.5%

In addition to using these abundance class data to evaluate plants at each transect, the abundance class data was summed for all transects using the centroid of the abundance class percent cover range. This data both provides average depth distributions of plants, and an estimate of the relative abundance of all species in the lake.

Figure 2-1. Map of sampling locations indicating chemical and vegetation transects on Eagle Lake.



SECTION 3

WATER QUALITY IN EAGLE LAKE

Samples were collected from Eagle Lake on September 13, 1989. At the time of sampling, the temperature of the upper waters of the lake (epilimnion) at the eastern mid-lake sampling site was between 18.9 and 19.8°C (66 - 68°F) and the lake was thermally stratified (Figure 3-1). It is apparent that the thermocline, a zone of rapid temperature change, occurred between 6 and 10 meters (20 and 33 feet) with the greatest changes between 8 and 9 meters depth. A drop in temperature from 15.0°C at 8 meters to 11.9°C at 9 meters meters was observed. The bottom temperature at this site was 10.3°C at 11 meters (36 feet). The west mid-lake site showed very weak thermal stratification (Figure 3-1). At this time, the thermocline in Eagle Lake was at or near the maximum depth of the west basin, therefore no thermocline was observed. A 2.7°C temperature difference was observed between the surface (19.9°C) and 7 meters (17.2° C) at this site where the bottom depth was 7.8 meters (see Appendix A for a discussion of stratification).

Oxygen levels in the surface waters of the lake were at or near saturation for both the east and west midlake sites. Reduced levels of oxygen in the hypolimnion (waters deeper than 9 meters) of Eagle Lake's east basin during the summer (see Figure 3-1) could control the type of organisms capable of utilizing this portion of the lake. The lack of oxygen in waters just above the bottom sediments is due to decomposition occurring in the deep waters and sediments. Bacterial activity in the sediments of the lake bottom consumes oxygen and once the lake is stratified, the deep waters are effectively cut off from the primary source of oxygen to a lake, the atmosphere.

The chemical constituents of primary concern for Eagle Lake residents would be those which promote the growth of algae and aquatic plants. These materials, notably phosphorus and nitrogenous compounds, are fertilizers in that they are present in the shortest supply relative to the amounts needed to sustain algal growth. Addition of one or both of these nutrients generally results in a reduction of water quality since the concentrations of these nutrients control the amount of plant and thus animal material capable of growing in the lake. Sources of nitrogen and phosphorus to the lake include: the atmosphere through rain, snow, etc., surface runoff of soils, septic system leachate, resuspension from the sediments of the lake, runoff of fertilizers from farm fields or lawns and gardens, and fecal material from domestic animals.

Phosphorus is generally considered to be the primary limiting nutrient to plant growth. The most readily available form of phosphorus for aquatic plants and algae is orthophosphorus. This nutrient was avaliable in the surface waters of Eagle Lake in a concentration of less than 1 part per billion (ppb). Records for 1982 compiled for NYSDEC also reported orthophosphorus (MRP) concentrations of less than 1 ppb. Total phosphorus concentrations listed in Table 3-1 indicate that the amount of phosphorus in the surface waters of Eagle Lake is low (6-9 ppb) and comparable to other area lakes. Total phosphorus concentrations reported for the surface waters of the lake in 1982 ranged from 7 to 8 ppb. At any one time, most of the phosphorus is probably tied up in the cellular material of the organisms in the lake. Concentrations of phosphorus entering the lake from the inlet (11 ppb) were slightly higher than those of the surface waters of the lake. Surface runoff of precipitation, the eroded soils that it carries and the other terrestrial materials that it collects (lawn fertilizers, septic materials, and pollutants) are frequently a major source of phosphorus to a lake. The extensive wetland system that the inlet drains provides an effective buffer. The luxuriant plant growth in these wetlands captures nutrients and removes suspended sediments before they can enter the lake.

Phosphorus concentrations in the deeper waters of the lake (midlake sites) were higher (12 to 26 ppb) than those of the surface waters. As the lake turns over in the fall, rapid algal growth may result from the phosphorus present in the deep waters being brought to the surface. Total phosphorus concentration reported for the deeper waters of Eagle Lake in 1982 was 16 ppb, which falls within the range of those currently reported.

The methods used to determine the amount of nitrogenous compounds in the lake water only measure materials not contained in living tissue or particulate material. Trace amounts of ammonia were found in the surface waters while no nitrate was detectable. Most of the nitrogenous material is probably bound up in living tissue (i.e. algae, plants, fish, etc.). The deeper waters of the lake had no measureable amounts of nitrate or ammonia (less than 0.01 mg/l). Results for 1989 are quite similar to nitrate and ammonia concentrations reported for 1982 by NYSDEC.

Alkalinity and pH records for Eagle Lake are listed in Table 3-1. The pH at the midlake surface sites was alkaline (above pH 7.00), while the deep-water sites were closer to neutral (pH near 7.00). The ability of a lake to neutralize additions of acid via acid rain or surface runoff is measured by alkalinity or the buffering capacity present in the lake water. The alkalinity of Eagle Lake ranged from 29.0 to 32.0 mg/L as $CaCO_3$ in the surface waters (epilimnion). This alkalinity value is low but as evidenced by the alkaline pH of the lake water, it presently has an adequate capacity to buffer any acids coming into the lake. The greatest amount of acid enters the lake during the spring when rapid melting of snow occurs. This is generally the time when the most acidic pH values (less than 7) are observed in lakes and streams. Since spring water samples were not included in this study, the effects of spring snowmelt on the pH of Eagle Lake remain to be determined. Spring pH values were recorded by NYSDEC in 1982. Slightly depressed pH (6.80) was reported in May when compared to summer surface water pH records.

Secchi depth is a simple measure of water transparency. Water transparency is controlled by the density of plankton, dissolved organic materials and the amount of fine grained silts and clays present in the water. Nutrient rich lakes, for example Saratoga Lake listed in Table 3-2 for comparison, generally have large numbers of plankton in the water which result in low transparency. Shallow lakes in areas where the soils are mainly fine clays and silts also have generally low Secchi depth readings due to constant resuspension of the fine sediments via wave activity. Water transparency in Eagle Lake as measured with a Secchi disk was 9.25 and 7.1 meters for the east and west midlake sites respectively. Secchi transparency in 1982 from data collected by NYSDEC, was 9.3 meters during the latter part of the summer. Transparency values in this range are indicative of good water quality and low algal productivity.

Specific conductance is a measure of the total dissolved ions present in the water. Conductivity values in the surface waters ranged from 113 to 120 umhos. Samples taken from the hypolimnion, waters deeper than seven meters, exhibited higher conductivities than other locations with a value of 125 umhos at the time of sampling. Conductivities in this range are generally considered indicative of moderate amounts of dissolved ions present in the water. Conductivity values for the inlet of Eagle Lake (295 umhos) were substantially higher than surface water values.

Sedimentation via runoff of soils and terrestrially derived materials can have a major impact on lake water quality. The general "filling in" of a lake by these materials has the consequence of providing additional areas for the growth or aquatic plants, providing a variety of nutrients to encourage their growth, and leading to a general warming of the lake. Substantial amounts of nutrients are also contributed to the lake by these runoff materials increasing the overall productivity.

One way of measuring the amount of solid materials present in water is Total Suspended Solids (TSS). The levels of suspended solids in the waters of Eagle Lake was quite low with a range from 0.33 to 1.63 milligrams per liter (Table 3-1). Suspended solids generally include soil particles, plant and animal plankton and a variety of terrestrially derived materials. Elevated levels of these materials generally indicate either a very productive lake or substantial additions of materials eroding from the watershed of the lake.

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 Eagle Lake, 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 in the lake. The ability of the lake waters to neutralize inputs of acid from precipitation is currently adaquate, however this is one aspect of lake water quality which may require closer monitoring.

Eagle Lake is a moderately productive lake in terms of rooted aquatic plants, a condition which may impact on the desired use of the lake. The level of productivity of suspended algae in the lake is low to moderate as evidenced by the high transparency. Productivity of both suspended algae and rooted aquatic plants is tied to the availability of nutrients or fertilizers in the lake water and sediments. An extensive discussion of nutrients and their relationship to plant production is included in Appendices A and B.

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 in Eagle Lake 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 lake association in developing an educational program for your members, we have included basic information as Appendices to this report.

Prevention. Reduction of nutrients within Eagle Lake should 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 gravelled areas for slow dispersal of the water.

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. Septic system failure is likely to occur when the systems are:

1) built in fill over an old wetland or natural drainage area whose water table is near the surface of the soil.

2) not of sufficient size to handle normal and peak loading rates.

3) located where the depth of soil present over bedrock is less than six feet.

4) located less than 50 feet from the shore of a lake or a stream.

5) located in soils with extremely high permeability or steeply sloping ground resulting in too rapid a movement of liquid through the system.

6) receiving excessive amounts of undigestable or slowly digested materials (i.e. plastics, bone or eggshells) without frequent pumpout.

7) older than 30 years and have never been upgraded.

Extreme septic system failures may be observed as clogged toilets and drains or puddling of water on the surface of the ground near the location of the septic leaching device of the system. Puddling is most likely to occur when the soils are quite wet primarily during the spring of the year and after periods of heavy rain in the summer. Surface pooling of water is also most common at high water usage times of day, generally in the morning. Septic inputs directly into the lake generally result in excessive growth of dense filamentous mats of algae near the point where the sewage enters 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 basin 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. 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 cleanout this area can be maintained fairly easily. Your local Soil Conservation Service representative (Appendix H) 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 (Appendix C). Control of nutrient inputs from the terrestrial part of the lake basin has been discussed in the previous section. In-lake controls (Appendix J), are frequently costly, large scale projects requiring permits from state and local agencies. Considering the good water quality, in-lake controls for nutrient reduction as probably not warranted at present.

Monitoring and Evaluation. Continued monitoring of Eagle Lake water quality by your association is desirable. A chemical assay program as extensive as that presented in this report is not necessary on an annual basis. Lake Association members in conjunction with their water quality committee can make certain measurements that will prove useful in observing any long-term trends in water quality. The Fresh Water Institute currently assists the Lake George Association in operating a Lay Monitoring Program on Lake George. A similar program could be beneficial to Eagle

Lake. Association members are provided with Secchi disks and thermometers to record the transparency and temperature of the lake once per week during the summer months. At the end of the year, the data is gathered and compared to results from previous years to provide a measure of any significant changes in water clarity.

On a three of five year basis, more complete chemical assays and observations of the lake may be advisable. These analyses will act as a "report card" to determine how sucessful control techniques have been. Collection of samples can be done by lake association members and then analysed by consulting laboratories (Appendix E) or an assessment similar to that contained in this report can be contracted to consultants.

Findings

1. The transparency and phosphorus concentration of Eagle Lake waters indicates that the lake should be classified as oligotrophic.

2. Water quality in Eagle Lake is currently adequate for the primary use of its' residents, namely recreation.

3. The low alkalinity of Eagle Lake makes it susceptable to acidification by precipitation, although it currently has sufficient capacity to neutralize acidic inputs.

4. The deeper waters of the lake (hypolimnion) show low dissolved oxygen concentrations and elevated nutrient levels during the latter part of summer stratification.

5. The one inlet tested was found to be contributing sediments, nutrients, and dissolved materials to the lake.

6. The steep slopes and coarse textured soils make erosion of sediments from the terrestrial portion of the lake's basin a serious concern.

7. Changes in lake water chemistry over the last seven years have been minor, however some depression in pH was observed in the Spring of 1982, possibly due to snowmelt waters.

Recommendations

1. Although Eagle Lake is currently near neutral in pH, the buffering capacity of the lake is quite low. Without information on the pH of the lake in the spring, when the largest volumes of acid enter the lake, the full extent of the impacts of acid precipitation on Eagle Lake are unknown. Collection of pH and alkalinity data in the spring of the year should be encouraged by the lake association.

2. Steep slopes and coarse textured soils within the watershed of Eagle Lake make erosion a serious problem. Contact with the Essex County Soil and Water Conservation Service (see Appendix G) to review appropriate erosion control techniques (BMPs) is a necessary first step. Many techniques can be applied on an individual homeowner basis such as planting of erosion resistant species, maintenance of a green strip along the lakeshore, and altering the flow of runoff water to name a few.

3. Establishment of a lay monitoring program to continue data collection started by this assessment should be actively pursued. With some basic training, lake association members can collect information which can be used to signal any sudden shifts in water quality or aquatic plant populations. This information is crucial for rapid response and remediation activities.

4. Encouragement of an active lake association with ties to regional and state lake federations is an important step. A water quality committee could organize education, prevention, control and evaluation activities. A thorough review of your town's zoning and planning laws with respect to mitigations of stormwater and wastewater controls should also be considered. A number of the things which threaten the lake are more regional or national problems, such as acid precipitation, runoff of sediments, nutrients, salt and corrosion products from area roads. Solutions for these problems will probably require political action.

Table 3-1. Chemical Water Quality Characteristics of Eagle Lake.

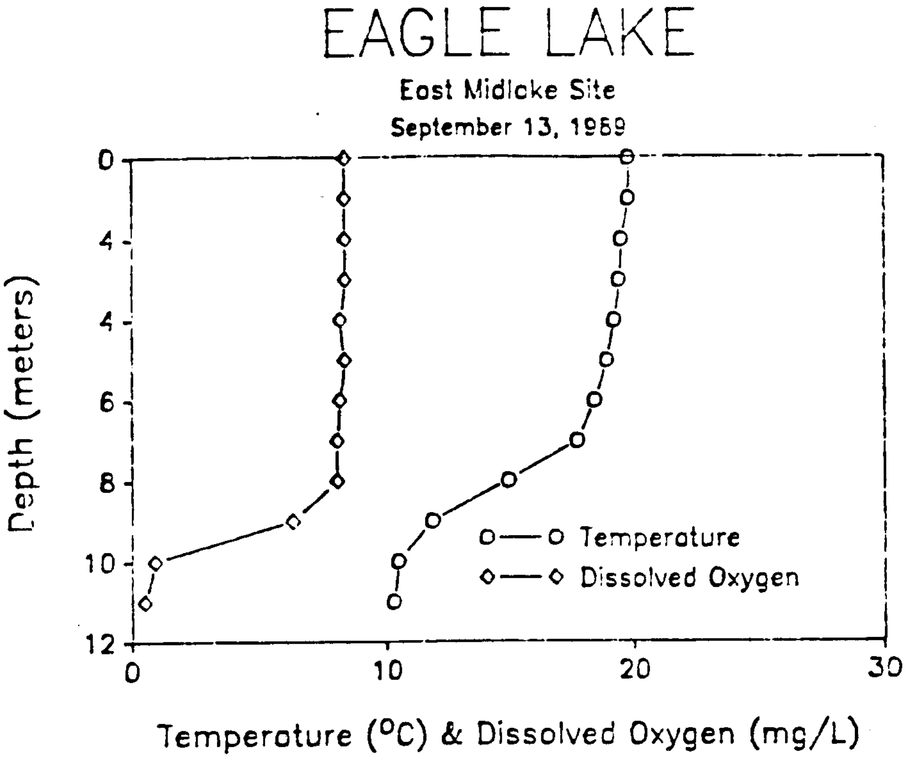
EAGLE LAKE
Samples Collected SEP 13 1989

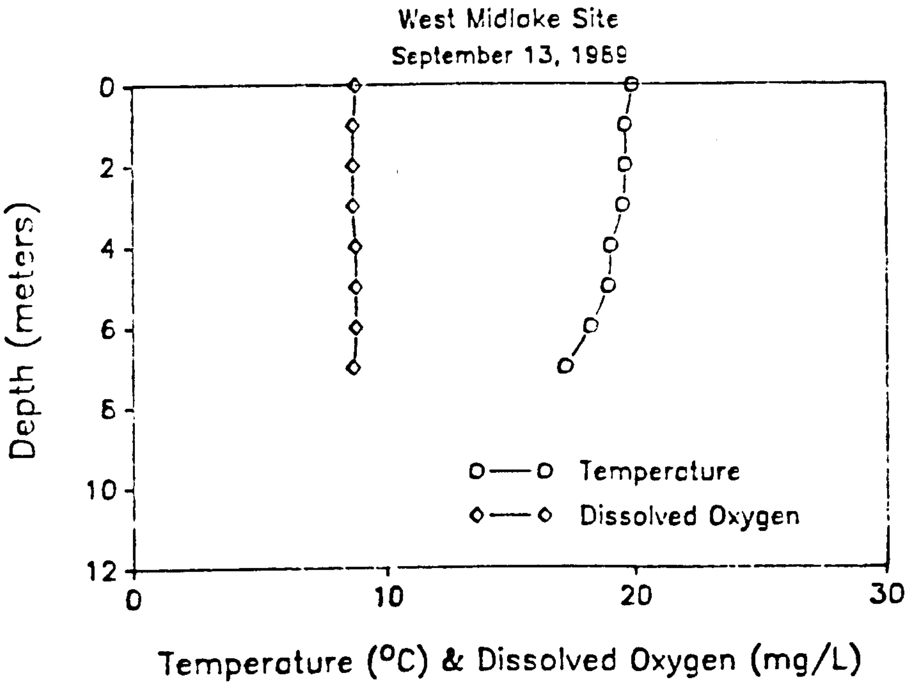
Site	Depth (m)	pH	Cond. (umhos)	Alk.	TSS (mg/l)	Secchi (m)	OP (ug/l)	TP (ug/l)	TFP (ug/l)	DO (mg/l)	Nitrate (mg/l)	Ammonia (mg/l)
Inlet	0.5	6.99	295	89	0.7		2	11	4		lt 0.01	0.1
E. Midlake	0.5	7.79	120	32	0.33	9.25	lt 1	6	3		lt 0.01	0.01
E. Midlake	11.0	6.88	125	37			6	26	7	1	lt 0.01	lt 0.01
W. Midlake	0.5	7.89	113	29	0.96	7.1	lt 1	6	3		lt 0.01	0.02
W. Midlake	7.0	7.14	117	32	1.63		2	12	3	6.6	lt 0.01	lt 0.01
Outlet	0.5	6.86	117	29	0.65		lt 1	9	2		lt 0.01	lt 0.01

Table 3-2. Surface Water Chemistry for Selected Lakes.

Lake	Secchi Transparency (meters)	Alkalinity (ppm as $CaCO_3$)	Total Phosphorus (ppb)
Lake George, NY New York	8.0	26.0	5
Eagle Lake New York	8.0	30.0	7
Lake Luzerne New York	4.7	17.5	8
Galway Lake New York	2.7	64.0	23
Saratoga Lake New York	2.2	77.0	100

Figure 3-1. Dissolved Oxygen and temperature profiles for Eagle Lake.





SECTION 4

VEGETATION IN EAGLE LAKE

The topics addressed in this section are the the status of the submersed vegetation of the lake in the summer of 1989, including that of Eurasian Watermilfoil, and potential plant management strategies. First, the plant species observed will be discussed. Second, the results of the semi-quantitative vegetation transects will be examined, followed by a summarization of this data in terms of plant relative abundance and depth distribution. Third, the distribution patterns of Eurasian Watermilfoil will be discussed, noting how this distribution may be related to its introduction, and indicating some future areas of concern. Finally, management alternatives will be discussed with regard to development of a vegetation management plant, as a component of an overall lake management plan.

Submersed Plant Species in Eagle Lake

A list of all submersed and floating-leaved aquatic plant species observed in Eagle Lake is given in Table 4-1, totaling 28 species. Of these species, two are macroscopic algae, or charophytes (*Chara* and *Nitella*), two are floating-leaved species (*Brasenia* and *Nymphaea*), one has emergent leaves (*Pontederia*) and the remaining 23 are submersed. This list does not include marsh species, such as found on the lower basin, but only those within the lake. The large number of species observed indicates excellent diversity, typical of low-elevation Adirondack lakes (Madsen *et al*. 1989). For instance, Lake George has 47 submersed species (RFWI *et al*., 1988) and 19 were observed in Lake Luzerne (Eichler and Madsen, 1990a). In each 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 lake as a whole (Madsen *et al*., 1989, 1990).

One important factor to account for during the permitting process of an aquatic plant management program is the occurrence and abundance of rare plant species that might be affected by a given management technique. *Isoetes macrospora* was the only plant observed that is on the New York State Rare Plant list (Mitchell, 1986; Clemants, 1989). However, the placement of this species on the rare plant list is more due to the lack of appropriate observations, or searches, for this species, than its actual rarity. Since it tends to occur in deep water habitats, it is difficult to find during casual observation, often requiring SCUBA to find. We have observed this species in many regional lakes including Lake George (Madsen et al., 1989), Lake Luzerne (Eichler and Madsen, 1990a) and Galway Lake (Eichler and Madsen, 1990b).

The composition of the species list for Eagle Lake was very similar to that of other nearby lakes. For instance, all of the species observed in Eagle Lake have been noted for Lake George (RFWI et al., 1988).

Vegetation Transects

The locations of the four transects examined are indicated in Figure 2-1. We selected sites that had both shallow and moderately steep slopes, with and without dense Eurasian Watermilfoil stands.

Observations for Transect A are indicated in Table 4-2. This location was a shallow zone adjacent to a small wetland at the outlet of the lake, near the public boatlaunch. In the shallow wetland zone (0-1 m), Brasenia schreberi, Najas flexilis, and Potamogeton gramineus were abundant. From 2 to 5 meters, Najas flexilis, P. amplifolius, P. praelongus, P. pusillus, and P. robbinsii shared dominance. Despite being near a boatlaunch and at the outlet of the lake, only rare, scattered individuals of M. spicatum were observed. However, given the shallow and productive habitat this site offered, it is very susceptible to dense growth of M. spicatum. Also, due to its shallowness and proximity to a major access point of the lake, the nuisance created by such a dense growth would be considerable.

Observations for Transect B are shown in Table 4-3. This small bay had considerable dense growth of Eurasian Watermilfoil, yet also had a relatively steep slope and a considerable depth range. Intuitively, it would not be as good a habitat for dense Eurasian Watermilfoil growth, but a dense bed was found here. The growth of Eurasian Watermilfoil at this location was part of a more extensive network of dense growth in the area adjacent to the highway on both the northern and southern lobes of the lake. The dense bed growth of Eurasian Watermilfoil extended from 1.5 meters to 4.5 meters of depth. In shallower zones (0-2 meters), Eriocaulon septangulare formed a dense, low-growing mat. Beyond the Eurasian Watermilfoil dense bed, a mixed low-growing community of Ceratophyllum demersum, Elodea canadensis, and Nitella sp. grew to depths up to 8 meters. Occasional fragments of Eurasian Watermilfoil were found from 5 to 7 meters, but the potential viability of these fragments is in question.

A comparably steep site without Eurasian Watermilfoil was examined at Transect C (Table 4-5). The diversity at this site was considerably higher than at Transect B. Dominant species from 0 to 2 meters included B. schreberi, E. septangulare, and Vallisneria americana. A very diverse community with no clear dominants was found from 2 to 7 meters, but some important species were Isoetes macrospora, P. amplifolius, and V. americana. From 6 meters and beyond, Nitella sp. was dominant. Some fragments of M. spicatum were found at this site, but they had not established. Again, it is unlikely that fragments deeper than 5 meters will establish and survive.

Observations along Transect D are recorded in Table 4-5. At this location, scattered clumps of Eurasian Watermilfoil had developed, but as yet had not formed any large dense beds. Eurasian Watermilfoil occurred as scattered plants from 0.5 to 4 meters, with scattered fragments appearing from 5 to 8 meters. Although the large number of fragments observed at great depths may not translate into growth at these depths, the observation of large numbers of fragments may indicate that existing plants in the lake are producing large numbers of autofragments (self-made stem fragments) that are capable of dispersing the plant around the entire lake (Kimbel, 1982).

In the shallow zone at Transect D (0-2 m), dominant species included E. canadensis, E. septangulare, H. dubia, N. flexilis, and P. gramineus. From 2 to 5 meters, a highly diverse community was observed, including several Potamogeton species. From 5 to 7 meters, P. robbinsii and P. pusillus were common, and from 6 to 8 meters Nitella sp. was common.

The depth distribution and total relative abundance of all aquatic plants in Eagle Lake is shown in Table 4-6. These species are ranked in order of abundance in Table 4-7. The abundance of species observed in Eagle Lake was very similar to that for Lake George (RFWI et al., 1988; Madsen et al., 1989).

The depth distribution of the eleven most common species is displayed in Figure 4-1. From this graph, the most typical dominants for each depth interval can be summarized. From 0-1 meter, typical species include P. gramineus and E. septangulare. Heteranthera dubia is most common from 1 to 2 meters. The maximum depth distribution of Eurasian Watermilfoil (2 to 4 meters) coincides with the peak in distributions of P. pusillus, P. robbinsii, Najas flexilis, and P. amplifolius. Plants from deeper areas include Nitella sp. and E. canadensis. The majority of plant species did not occur beyond 5 meters, but several species were found at depths of up to 8 meters.

Eurasian Watermilfoil in Eagle Lake

Scattered Eurasian Watermilfoil was found throughout most of the lake (Figure 4-2). These many scattered locations were undoubtedly due to the dispersal of fragments from the few dense stands in the lake. Small dense beds were located in several areas of the lake, including along the north shore and adjacent to two small rock islands. Larger areas of dense growths were found near the highway causeway, in the area around the large island at the western end of the lake, and at the entrance to the large bay at the eastern end of the lake. These three areas have the potential to expand into substantially larger, nuisance growths. Of particular concern in the near future is the shallow areas surrounding the large island, and the large shallow bay at the east end of the lake.

Of the areas currently without large dense growths, the southern basin is particularly susceptible to dense growths of Eurasian Watermilfoil. This area should be monitored carefully. The extensive areas along the northern shore of the lake with either small dense beds or scattered plants will probably not grow into large infestations, only because the slope of this shore is considerable. Therefore, these areas do not present an immediate concern. However, Eurasian Watermilfoil control throughout the lake will ensure that locations will not remain to recolonize areas of the lake that are susceptible to extensive growth.

Since the densest areas of growth were close to the highway causeway, and only a few scattered plants were found near the public boatlaunch, it is likely that the point of introduction was actually near the highway rather than at the public boatlaunch. We did note a small boatlaunch near the causeway, which could have been a potential point of introduction.

Management of Eurasian Watermilfoil in Eagle Lake

Although lake residents all want immediate action, the first step in addressing Eurasian Watermilfoil problems in Eagle Lake 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 reintroductions. Although Appendices B and C have (Eichler et al. 1990) more information on a plant management plan, some specific components to address are:

Education
Prevention
Implementation of Controls
Evaluation and Monitoring

Education. To develop support for management efforts, and to gather volunteers to assist with the program, education of lake-users and homeowners is imperative. Homeowners and lake users must know about Eurasian Watermilfoil and how to prevent further introductions and spread (Appendix C). One fact is becoming plain - in these times of tight money, the only way to protect your lake is to band together and do it as a lake association.

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, nonpoint pollution control, erosion management and encouraging the reintroduction and growth of native plants.

Implementation of Controls. A wide variety of control techniques are available, none of which provides a perfect solution. All techniques have advantages and drawbacks (Appendix C). Each location with Eurasian Watermilfoil must be assessed individually, and a control techniques 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 (See Appendix H). The permits for aquatic plant control within the Adirondack Park are administered by the Adirondack Park Agency, so more restrictions apply than are generally true elsewhere in the state.

Some recommendations for specific control techniques that might be suitable would be to treat the scattered plant areas by hand picking of Eurasian Watermilfoil, either through the use of divers and snorkelers, or by wading in depths up to 1 meter. Permits for this activity would probably be more readily obtained than others. For more dense locations, other techniques should be considered.

For instance, dense beds in Lake George were managed using benthic mats. These mats are quite effective, and give control for long periods of time. Since none of the dense beds in the lake are currently very large, benthic matting should not be either prohibitively expensive nor cause appreciable impacts to the deepwater vegetation or spawning fish populations.

Other possibilities for managing dense beds might include diver-operated suction harvesting or rotovating. Currently, dense locations of Eurasian Watermilfoil are localized, so more drastic measures such as drawdown or chemical control are probably not yet warranted. Chemical control is not completely beyond the realm of possibility, given that Eagle Lake is a class B lake, and not used for drinking water. Chemical treatment is not recommended for waters used as a diffuse drinking water supply.

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 the 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 a echolocation unit ("fish/depth locator") to map the height and area of dense beds during the summer. The Fresh Water Institute will cooperate with lake associations by identifying plant samples (Appendix G). 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 also 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 28 submersed plant species were observed in Eagle Lake, of which 27 were found along the four transects studied. Of these species, dominant plants included Nitella sp., Potamogeton pusillus, P. robbinsii, and Elodea canadensis. Vascular plant species were found to a depth of 8 meters, and Nitella to a depth of 9 meters or more.

2. Eurasian Watermilfoil (Myriophyllum spicatum) was the 11th most abundant species. Dense stands were found from 1.5 to 4.5 meters (4 to 14 feet) with scattered individuals from 0.5 to 5.5 meters (2 to 18 feet). Many fragments were also found at greater depths, but these would probably not survive. Eurasian Watermilfoil was scattered around most of the lake. It occurred predominantly as scattered individuals or small clumps. However, several small dense beds of areas less than one acre were found.

3. Several area that as yet are only slightly to moderately infested with Eurasian Watermilfoil have the potential to support must larger dense beds. These include the outlet area, the shallow zone around the large island in the western end of the lake, and the large shallow bay at the eastern end.

Recommendations

1. An active aquatic plant management committee should formed to develop and implement a long-term aquatic plant management plan, as part of an overall lake management plan. In addition to selecting and implementing control techniques, the committee should develop education, prevention, evaluation and monitoring activities.

2. An active lay monitoring program should be initiated that would include monitoring for Eurasian Watermilfoil.

3. Although an in-depth study of control alternatives should be performed, some initial suggestions for potential control techniques would be to utilize hand-harvesting on the scattered plant areas before they grow into dense beds, and benthic barrier (mats) on the small dense beds.

Table 4-1.

MACROPHYTE SPECIES PRESENT IN EAGLE LAKE

SCIENTIFIC NAME	COMMON NAME
Bidens beckii	Water Marigold
Brasenia schreberi	Water Shield
Chara spp.	Chara
Ceratophyllum demersum	Coontail
Eleocharis acicularis	Spike Rush
Elodea canadensis	Waterweed
Eriocaulon septangulare	Pipewort
Heteranthera dubia	Water Star Grass
Isoetes macrospora	Quillwort
Juncus pelocarpus	Rush
Lobelia dortmanna	Water Lobelia
Myriophyllum spicatum	Eurasian Milfoil
Nitella spp.	Muskgrass
Najas flexilis	Naiad
Nymphaea spp.	Water Lily
Pontedaria cordata	Pickerelweed
Potamogeton amplifolius	Large-leaved Pondweed
Potamogeton epihydrus	Leafy Pondweed
Potamogeton gramineus	Variable Pondweed
Potamogeton praelongus	Pondweed
Potamogeton pusillus	Pondweed
Potamogeton robbinsii	Robbins Pondweed
Potamogeton spirillus	Spiral Pondweed
Potamogeton vaseyii	Pondweed
Potamogeton zosteriformis	Flat-stemmed Pondweed
Sagittaria graminea	Arrowhead
Sparganium spp.	Bur-reed
Vallisneria americana	Duck Celery

Table 4-2.

EAGLE LAKE VEGETATION DATA: TRANSECT A

SPECIES	DEPTH INTERVAL (METERS) 0-1	1-2	2-3	3-4	4-5	5-6
B. beckii			C	C	C	C
B. schreberi	A					
E. canadensis	P	R	P	P	P	P
M. spicatum	R	R			R	
Nitella					C	C
Nymphaea	C					
N. flexilis	A	R	P	P	A	
P. amplifolius	R	R			A	P
P. epihydrus	C					
P. gramineus	A		C			
P. praelongus		R	A	C	A	
P. pusillus	C		A	A	A	P
P. robbinsii	R	R	A	A	A	P
P. zosteriformis	R				C	
S. graminea	R	R	P			

ABUNDANCE CODES:

LETTER	LABEL	PERCENTAGE RANGE
A	ABUNDANT	>50%
C	COMMON	25-50%
P	PRESENT	15-25%
O	OCCASSIONAL	5-15%
R	RARE	<5%

Table 4-3.

EAGLE LAKE VEGETATION DATA: TRANSECT B

SPECIES	DEPTH INTERVAL (METERS) 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
B. beckii			P		P			
B. schreberi	C	C						
C. demersum			P	C	C	C	C	C
E. canadensis	R	P		P	C	C	C	P
E. septangulare	A	A						
H. dubia	P	C	C					
M. spicatum	R	P	A	A	P	R	R	
Nitella			A		C	C	C	C
N. flexilis	P				C			
Pontederia cordata	C							
P. amplifolius			P	C	C			
P. gramineus	P		P					
P. pusillis	O	P	P					
P. robbinsii	P	P	P	P				
S. graminea	P	C	C					
V. americana	P	C						

ABUNDANCE CODES:

LETTER	LABEL	PERCENTAGE RANGE
A	ABUNDANT	>50%
C	COMMON	25-50%
P	PRESENT	15-25%
O	OCCASSIONAL	5-15%
R	RARE	<5%

Table 4-4.

EAGLE LAKE VEGETATION DATA: TRANSECT C

SPECIES	DEPTH INTERVAL (METERS) 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
B. beckii	R	P							
B. schreberi	A	C							
Chara				P					
E. acicularis		P	P						
E. canadensis	P		P		P	P	P	P	
E. septangulare	A	A	C						
H. dubia	C	P							
I. macrospora				C					
J. pelocarpus	C								
M. spicatum	R		R	R			R	R	
Nitella	C		P		P	P	P	A	A
Nymphaea	P								
N. flexilis		P		C					
Pontederia cordata	P								
P. amplifolius	O		C	C					
P. epihydrus	R								
P. gramineus	C	P	P	P	P	P			
P. pusillus	P	P	P	C	P	P			
P. robbinsii	C	P	P	P					
P. vaseyii		P							
P. zosteriformis			C		P	P			
S. graminea		C	P						
V. americana	A	P	C	C	P	P			

ABUNDANCE CODES:

LETTER	LABEL	PERCENTAGE RANGE
A	ABUNDANT	>50%
C	COMMON	25-50%
P	PRESENT	15-25%
O	OCCASSIONAL	5-15%
R	RARE	<5%

Table 4-5.

EAGLE LAKE VEGETATION DATA: TRANSECT D

SPECIES	DEPTH INTERVAL (METERS) 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
B. beckii		P	P	P	C			
Chara	O	R	C	C	C			
C. demersum							C	P
E. canadensis	C	A	P		P	C	C	P
E. septangulare	A	A	P					
H. dubia	C	A	P	C	P			
L. dortmanna	C							
M. spicatum	P	P	P	C		R	R	R
Nitella				C	A		C	C
N. flexilis	A	C	C	A	C	P		
P. amplirfolius		P	C	C	P			
P. gramineus	A	P	C	C				
P. praelongus		P	C	C	P			
P. pusillus	P	P	C	C	C	A	C	
P. robbinsii	R	P	C	C	C	A	C	
P. spirillus	O	P		P				
P. vaseyii	O							
P. zosteriformis	P	P	P	P				
Sagittaria graminea	P	C						
Sparganium	R	P						
V. americana		P	C	C				

ABUNDANCE CODES:

LETTER	LABEL	PERCENTAGE RANGE
A	ABUNDANT	>50%
C	COMMON	25-50%
P	PRESENT	15-25%
O	OCCASSIONAL	5-15%
R	RARE	<5%

Table 4-6.

Relative abundance of species observed in Eagle Lake

	DEPTH INTERVAL (m)									
SCIENTIFIC NAME	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOTAL
B. beckii	1	10	19	14	24	9	0	0	0	9
B. schreberi	47	19	0	0	0	0	0	0	0	7
Chara spp.	3	1	9	9	0	0	0	0	0	2
C. demersum	0	0	5	9	9	9	25	19	0	9
E. acicularis	0	5	5	0	0	0	0	0	0	1
E. canadensis	20	24	15	10	24	29	25	13	0	18
E. septangulare	56	56	14	0	0	0	0	0	0	14
H. dubia	24	33	14	9	5	0	0	0	0	10
J. pelocarpus	9	0	0	0	0	0	0	0	0	1
L. dortmanna	9	0	0	0	0	0	0	0	0	1
M. spicatum	7	11	24	29	6	1	3	2	0	9
Nitella spp.	9	0	24	9	43	24	32	50	75	21
N. flexilis	43	15	14	33	38	5	0	0	0	16
Nymphaea spp.	5	0	0	0	0	0	0	0	0	1
P. cordata	14	0	0	0	0	0	0	0	0	2
P. amplifolius	3	6	24	28	33	5	0	0	0	11
P. epihydrus	10	0	0	0	0	0	0	0	0	1
P. gramineus	52	10	29	14	5	5	0	0	0	13
P. praelongus	0	6	28	19	24	0	0	0	0	8
P. pusillus	22	15	38	38	33	29	13	0	0	21
P. robbinsii	16	16	38	38	28	24	13	0	0	19
P. spirillus	3	5	0	5	0	0	0	0	0	1
P. vaseyii	3	5	0	0	0	0	0	0	0	1
P. zosteriformis	6	5	14	5	14	5	0	0	0	5
S. graminea	11	29	19	0	0	0	0	0	0	7
Sparganium spp.	1	5	0	0	0	0	0	0	0	1
V. americana	24	19	19	19	5	5	0	0	0	10

Table 4-7.

Relative abundance of plant species in Eagle Lake ordered by rank of total abundance.

SCIENTIFIC NAME	DEPTH RANGE (m) 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	TOTAL
Nitella spp.	9	0	24	9	43	24	32	50	75	21
P. pusillus	22	15	38	38	33	29	13	0	0	21
P. robbinsii	16	16	38	38	28	24	13	0	0	19
E. canadensis	20	24	15	10	24	29	25	13	0	18
N. flexilis	43	15	14	33	38	5	0	0	0	16
E. septangulare	56	56	14	0	0	0	0	0	0	14
P. gramineus	52	10	29	14	5	5	0	0	0	13
P. amplifolius	3	6	24	28	33	5	0	0	0	11
V. americana	24	19	19	19	5	5	0	0	0	10
H. dubia	24	33	14	9	5	0	0	0	0	10
M. spicatum	7	11	24	29	6	1	3	2	0	9
B. beckii	1	10	19	14	24	9	0	0	0	9
C. demersum	0	0	5	9	9	9	25	19	0	9
P. praelongus	0	6	28	19	24	0	0	0	0	8
B. schreberi	47	19	0	0	0	0	0	0	0	7
S. graminea	11	29	19	0	0	0	0	0	0	7
P. zosteriformis	6	5	14	5	14	5	0	0	0	5
Chara spp.	3	1	9	9	0	0	0	0	0	2
P. cordata	14	0	0	0	0	0	0	0	0	2
P. spirillus	3	5	0	5	0	0	0	0	0	1
E. acicularis	0	5	5	0	0	0	0	0	0	1
P. epihydrus	10	0	0	0	0	0	0	0	0	1
J. pelocarpus	9	0	0	0	0	0	0	0	0	1
L. dortmanna	9	0	0	0	0	0	0	0	0	1
P. vaseyii	3	5	0	0	0	0	0	0	0	1
Sparganium spp.	1	5	0	0	0	0	0	0	0	1
Nymphaea spp.	5	0	0	0	0	0	0	0	0	1

Figure 4-1. Depth distribution of the twelve most common aquatic plant species in Eagle Lake. MS, Myriophyllum spicatum; HD, Heteranthera dubia; VA, Vallisneria americana; PA, Potamogeton amplifolius; PG, P. gramineus; ES, Eriocaulon septangulare; NF, Najas flexilis; EC, Elodea canadensis; PR, P. robbinsii; PP. P. praelongus; NSP, Nitella spp.

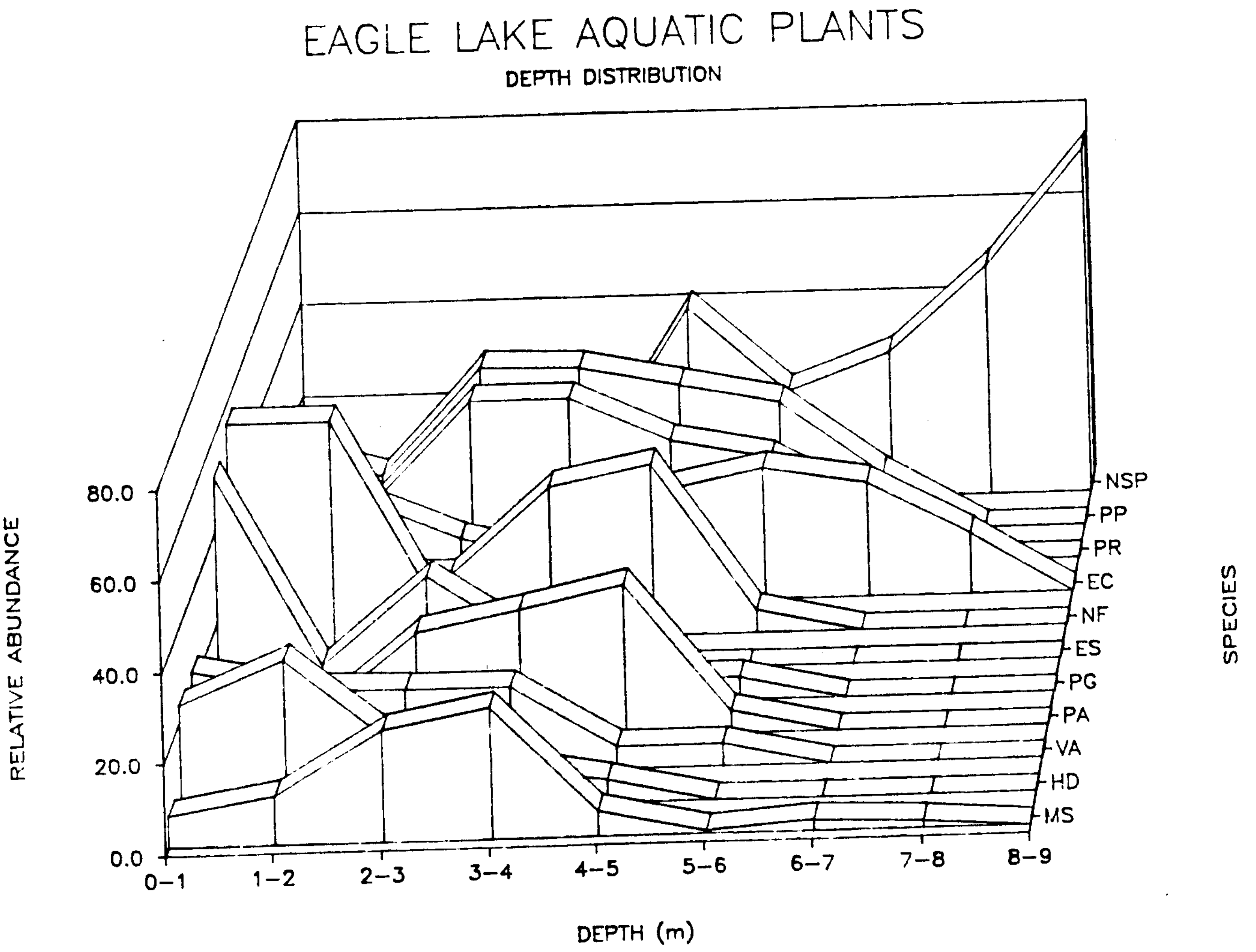
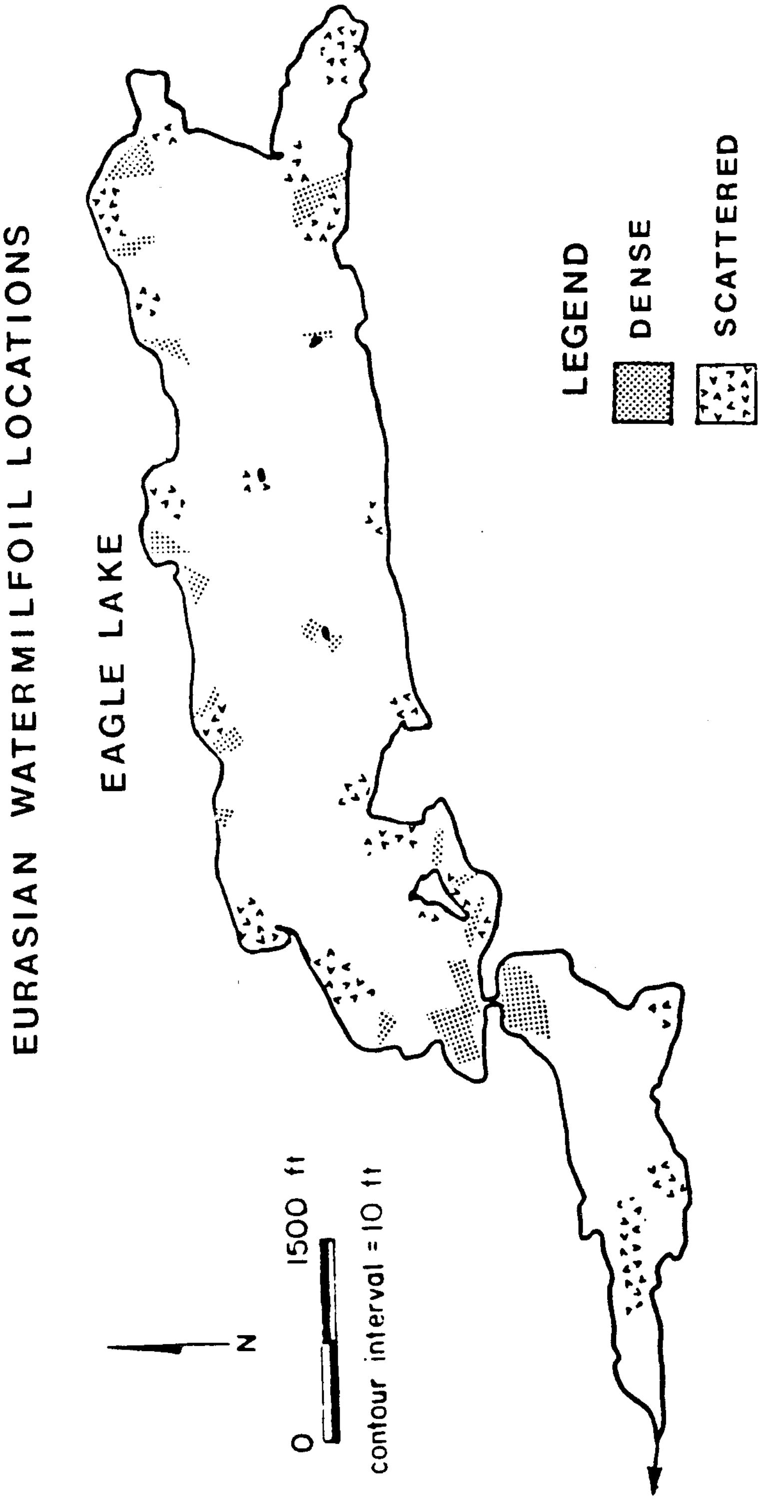


Figure 4-2. Location of dense and scattered Eurasian Watermilfoil populations in Eagle Lake.



SECTION 5

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SECTION 6

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