Severn Sound

Environmental Association

Water Quality Status of Lake Couchiching 2003

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For
The Mnjikaning First Nation
The Corporation of the City of Orillia
The Corporation of the Township of Ramara
The Corporation of the Township of Severn

Foreword

This document reports on technical investigations conducted in Lake Couchiching during the spring, summer and fall of 2003 by Severn Sound Environmental Association. The project was conducted in partnership with the Mnjikaning First Nation, three municipalities bordering the lake and the Ministry of the Environment.

The report received technical review prior to its publication. This does not necessarily mean that the contents reflect the views and policies of the Mnjikaning First Nation, the municipalities or the Ontario Ministry of the Environment. The mention of trade names or commercial products do not necessarily constitute endorsement or recommendation for use.

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Acknowledgements

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Special thanks to the staff of Parks Canada, Trent Severn Waterway, Washago for providing vessel support for the project. Paula Madill, SSEA Ecosystem Technologist, conducted most of the field work for the investigation with Mike Sharpe. Analyses were conducted by Paula, Mike and Sabastian Fleischer of the Severn Sound Environmental Association.

Elaine Carney conducted the phytoplankton identification and biovolume determinations for the project. Sue Standke identified, enumerated and estimated biomass of zooplankton.

Executive Summary

The Severn Sound Environmental Association conducted a survey of water quality of Lake Couchiching during the ice-free period of 2003. The objectives of the survey were to:

1. Determine the current status of the Lake water quality and compare it to the previous 1997 sampling survey
2. Assess the Lake trophic status in relation to potential problems with use of the Lake as a source of drinking water

The survey was a joint project funded by the Mnjikaning First Nation, the City of Orillia, the Township of Severn, the Township of Ramara and supported by the Ministry of the Environment and the Trent Severn Waterway.

The approach for the survey was to take samples at some of the open water stations sampled during 1997 in order to measure change with time and to measure differences within the Lake at any one time. Water samples were collected at ten open water stations starting in June, 2003. During each sampling run euphotic zone composite samples of basic chemistry (DIC, DOC, major ions, hardness, conductivity), nutrients (total phosphorus, ammonia, nitrate, total Kjeldahl nitrogen, silcate), chlorophyll a and phytoplankton were collected. Water clarity was measured using a Secchi disc. Zooplankton were collected using a plankton net towed vertically through the water column at selected stations. Vertical profiles of temperature, dissolved oxygen, conductivity and pH were taken using a calibrated YSI 650 multiparameter meter (Sonde).

Based on the Secchi disk measurements, light penetrates to the bottom virtually everywhere in the Lake through most of the open water season. The Lake appears to be well mixed, based on temperature and basic chemistry, horizontally and vertically with the possible exception of sheltered nearshore areas. The basic chemistry has changed very little between 1997 and 2003 with the exception of sodium and chloride ions which increased from 16.0 and 27.4 mg/L to 19.3 and 33.9 mg/L respectively. The increase in these parameters since 1997 was most likely due to the continued effects of road salting in the Lake Simcoe watershed and within the immediate Lake Couchiching watershed. Total phosphorus concentrations were favourably low in 2003 with means at stations of approximately 10 ug/L, indicating that the Lake is moderately nutrient enriched or mesotrophic.

Phytoplankton are the microscopic plants that grow suspended in the water column in lakes. The highest total biovolume of phytoplankton over the ice-free period was found at station LC3 off the City of Orillia (366 mm^3/m^3, Table 5). Of those open water stations where individual samples were analyzed, highest total biovolume was found in spring (June 4th mean of 537 mm^3/m^3) and in the late summer (August 26th mean of 442 mm^3/m^3).

Over 60 species of algae were identified from all stations in Lake Couchiching during 2003. A

similar number was found in the 1997 survey. The total biovolume of the phytoplankton community in 2003 was generally similar to 1997. However, the proportion of blue-green algae was significantly higher in 2003 as compared to 1997 and a slight elevation in the proportion of dinoflagellates was noted. Unlike 1997, during late summer and fall of 2003, the phytoplankton community was dominated by the blue-green alga *Microcystis* spp.- making up over 70% of the total biovolume of the five stations sampled. This alga may impart a toxicity to the water when in high density and has been associated with the blue-green toxin microcystin, a substance of human health concern. The biomass of zooplankton in 2003 was almost twice that found in 1997 at Station LC5 (46.0 mg/m^3 in 2003 compared with 24.1 mg/m^3 in 1997). Unlike 1997, zebra mussel veliger biomass did not represent a significant proportion of total zooplankton biomass in 2003. The average biomass in 2003 was 0.18 mg/m^3 compared with 4.19 mg/m^3 in 1997.

Based on water clarity, total phosphorus concentration and the biological indicators total phytoplankton biovolume and zooplankton community structure, the Lake trophic status has not changed appreciably from 1997 and can be considered nutrient poor (oligotrophic) to moderately enriched (or mesotrophic). The Lake appears to be at a similar condition to 1997 with the exception of the increased predominance of the blue-green alga *Microcystis* which may signify more enriched conditions than 1997. With respect to trophic status, the Lake offers a reasonably good source of water for communal treatment.

Water intake information was gathered for the seven communal water filtration plants operating on the Lake and operators were interviewed. The total capacity for water taking from all communal surface water intakes is 36,283 m^3/d with 27,276 m^3/d (or 75% of the total capacity) being taken by the City of Orillia. The shallow nature of the Lake dictates that most water intakes must be placed in relatively shallow water (approximately 2 m). The deepest intakes are for the City of Orillia, the Mnjikaning First Nations and the new Township of Severn - West Shore WFPs which are 5.4, 3.7 and 7 m deep respectively.

Use of the water intakes for sampling the trophic status of the raw water was evaluated. At present, only the City of Orillia WFP intake can be used on any day provided the sampling line pump is turned on ahead of sampling. The Township of Severn Plants and the Camp and Resort plants on the west shore can be used to sample raw water for trophic status on those days when water is being pumped. The Mnjikaning First Nations WFP intake can be used to sample raw water only when the system is not producing water for the reservoir as pre-treatment must be shut down to take the samples.

Chemistry and phytoplankton samples collected during 2003 were compared for an open Lake water column composite (station LC3) and the City of Orillia WFP raw water line (station LC0). The basic chemistry (conductivity, ions) and nutrient concentrations were similar between the open Lake station composite (LC3) and the water intake sampling line (LC0). The total biovolume of phytoplankton in the water intake line was less than half of that found in the water column. This is reasonable considering many of the common species of algae can at least partially regulate their vertical position in the water column in order to optimize their exposure to light.

Water intakes can be used to monitor open water quality with the recognition that the inlet structures do not sample the entire water column. This means that chemistry will be similar to open water but phytoplankton biovolume may be reduced from an open water composite sample depending on the depth of the intake.

The family of toxins called microcystins, produced by some blue-green algae, was noted as a human health concern by Health Canada (2002) and a Maximum Allowable Concentration (MAC) of 1.5 ug/L (as microcystin-LR) has been established by the Ministry of the Environment as a Drinking Water Quality Standard (MOE 2003). The rise in abundance of the blue-green algae *Microcystis* in the Lake through 2003, coincided with a seasonal increase in the concentration of microcystin-LR during 2003 in raw water. The microcystin-LR concentration in the raw water and in the open Lake was less than 1.5 ug/L. Although microcystin-LR was again measurable in the raw water in late summer of 2004, the treatment process at the City of Orillia WFP was successful in lowering the concentration of microcystin-LR to less than the detection limit of 0.05 ug/L.

Intense, earthy/musty taste and odour events in other lakes (such as Lake Ontario) have been linked to the compounds, geosmin and 2-methylisoborneol (MIB) which are produced in aquatic environments by cyanobacteria (blue-green algae) or mould-like, filamentous bacteria called actinomycetes (MOE 2003, Howell et al. 2001). MIB was found in low or non-detectable concentrations near or below the detection limit of the test with slightly elevated concentrations near the City of Orillia, during the 2003 survey. Geosmin was found in higher concentrations in the spring samples and declined only slightly in summer and early fall of 2003. No specific linkage to blue-green algae abundance was evident for the few sample results available.

Recommendations

1. Should the municipalities around the lake or other agencies wish to use intakes to monitor lake water quality, raw water sampling could be initiated at the City of Orillia water intake during the ice-free period of the year for trophic status parameters such as low level total phosphorus, nitrogens and phytoplankton as a minimum.

2. A survey of the main intakes (Orillia, West Shore, Mnjikaning First Nation, Washago) should be carried out in cooperation with the OMOE and other agencies to provide a bi-weekly monitoring of raw and finished water concentrations of MIB and geosmin and raw water biovolume of phytoplankton as a minimum through the ice-free period of a year. If possible, microcystin-LR should also be sampled as part of the same survey. The results of this sampling would serve as a basis for operational decisions on treatment options for taste and odour as well as potential toxins from the raw water

3. Consideration should be given by the operating authorities to install raw water sampling lines that extend beyond the pre-treatment chlorination for zebra mussel control at West Shore and Mnjikaning First Nation water filtration plants. For those plants where chlorination for zebra mussel control is not part of the pre-treatment (Sandcastle Estates

and Washago WFPs), raw water intake samples for trophic status should be collected only during periods when active pumping is taking place ahead of in-plant treatment processes.

4. The open water survey should be repeated approximately every five years. As a minimum, the survey should include five open water stations (LC3, LC5, LC17, LC22 and LC15) and station LC12 near Washago. These stations should be sampled for basic chemistry, nutrients (including low-level total phosphorus OMOE Dorset protocol or equivalent), water clarity, chlorophyll a , microcystin-LR, MIB and geosmin. Phytoplankton should be sampled and analysed as individual samples at least at five open water stations listed above.

5. Use of the regular video monitoring record of the inspections and cleaning of intakes in conjunction with intake sampling of zebra mussel veligers should be carried out as a monitoring tool to assess changes in the population of attached adult mussels.

6. The raw water temperature, especially in early spring, should be documented along with samples of algae as abrupt changes in temperature may also be a factor in the production of taste and odour causing chemicals.

Introduction

The Severn Sound Environmental Association conducted a survey of water quality of Lake Couchiching during the ice-free period of 2003. The objectives of the survey were to:

1. Determine the current status of the Lake water quality and compare it to the previous 1997 sampling survey
2. Assess the Lake trophic status in relation to potential problems with use of the Lake as a source of drinking water

The Lake Couchiching Study Area

Lake Couchiching is located on the Trent-Severn Waterway in the Townships of Ramara, Severn and the City of Orillia. The Lake has a surface area of 45.4 km^2 (MNR 2001 NRVIS lake polygon) with a maximum depth of 12 m and a mean depth of 6 m (Kilgour et al.2000).

The main inflow to the lake passes from Lake Simcoe through the Atherley Narrows at the south end of the Lake. The immediate watershed of the Lake drains a relatively small area of approximately 64 km^2 (SSEA estimate based on Provincial digital elevation model) and includes several small streams discharging to the Lake. The land use in the immediate watershed includes rural and agricultural land, shoreline recreational and permanent dwellings, urban areas along the City of Orillia shoreline and near Cumberland Beach in Severn Township. The eastern coast of Ramara Township is made up of shoreline dwellings and several resorts. The Mnjikaning First Nations is also located along the eastern shoreline. The Lake outlet is at the north end comprising the Severn River branches and the Canal.

The Lake and its immediate watershed are underlain by limestone bedrock in the southern and western areas with Precambrian bedrock along the north and eastern areas. The immediate basin is located within the Simcoe Lowlands physiographic region and consists of a sand plain to the west and south, a drumlinized clay plain to the southeast, limestone plain on the east which changes to Precambrian Shield to the north (Chapman and Putnam, 1984).

Past Studies of Lake Couchiching

The Report of the 1997 (Kilgour et al. 2000) summarizes the open lake sampling surveys carried out in the past. The 1997 work provided a comprehensive base-line survey of open water quality (including basic chemistry, nutrients, chlorophyll a, taste and odour causing chemicals, phytoplankton, zooplankton and temperature and dissolved oxygen), sediment quality, benthos and water currents. The report concluded that Lake Couchiching could be considered nutrient poor (or oligotrophic) to moderately enriched (or mesotrophic) based on water clarity, total phosphorus concentrations and the biological community of the Lake (total phytoplankton biovolume, zooplankton, benthos).

The Report made three recommendations including: 1. Investigate two areas of local impairment of quality; 2. Implement appropriate management practices to minimize water quality impairment; and 3. Develop a monitoring program to track long-term changes due to the trophic status of the lake including periodic biological and chemical monitoring of the Lake.

Reports have also been produced through the Ministry of the Environment's Drinking Water Surveillance Program for the Orillia Water Filtration Plant (WFP) since 1996. The MOE Southwest Region conducted followup investigations of the areas of local impairment noted in the 1997 study. The City of Orillia has also done some analyses of chemicals known to cause taste and odour problems as part of the design considerations for treatment plant upgrades.

Water Treatment Plants using the Lake as a Source

The use of Lake Couchiching as a source of water supply has occurred for many years. The potential for taste and odour problems in the raw and finished water at WFPs due to algae or algae related problems has been noted in the past for water bodies in Ontario, including Lake Couchiching. The shallow nature of the Lake and the presence of algal blooms have occasionally imparted taste and odour problems in raw and finished water (KMP 1999). Past sampling of two compounds related to algae and known to cause taste and odour problems in other Ontario water bodies, Geosmin and 2-methylisoborneal (MIB), were found in samples of raw water from Lake Couchiching. The City of Orillia evaluated treatment options for taste and odour removal technologies for the Orillia WFP.

Study Approach

The approach for the survey was to take samples at nine of the open water stations sampled during 1997 in order to measure change with time and to measure differences within the Lake at any one time. An additional station was added in the area west of Chief's Island in order to represent the open area off the west coast of the Lake. Seasonal sampling was carried out to obtain sufficient samples to represent the ice-free period of the year. We sampled the same period (June to October) as in 1997 with sampling runs approximately three weeks apart. Sampling in 2003 ended in early October rather than in late October for the 1997. Sample and analysis methods for indicators of trophic status between the two years were similar (see below). Euphotic zone composite samples were collected for chemistry, chlorophyll a and phytoplankton. Profiles of temperature and oxygen were taken at deeper water stations so as to assess differences within the lake and between survey years as described below.

Information was gathered about the water intakes for significant communal water filtration plants using Lake Couchiching in order to assess the potential value of the intakes in monitoring of the Lake. The MOE Inspection Reports and Monitoring Reports of each Water Treatment System were reviewed and operators were contacted for details of each water intake.

The questions that the survey was designed to answer include:

- What changes in the trophic status of the Lake have taken place since the 1997 survey?
- What is the relation of phytoplankton (especially blue-green algae) to potential taste and odour problems in drinking water supplies?
- Are the algae of concern (those that pose a potential for taste and odour problems with water supplies or potential to impart toxins to the water) growing on the Lake bed or in the water column?
- Are the blue-green algae producing measurable concentrations of toxins such as microcystin that could adversely influence drinking water supplies?
- What are the seasonal concentrations of taste and odour indicator chemicals geosmin and MIB?

Methods

Field Measurements

Sampling locations were selected to correspond with most of the open water stations used in the 1997 survey with an additional sampling location (LC22) along the west side of Chief's Island (Figure 1, Table 1).

Some of the open water stations corresponded to the general vicinity of water intakes. LC3 corresponded to the Orillia water intake. Station LC17 corresponded to the vicinity of the Mnjikaning First Nations water intake. Station LC12 corresponded to the vicinity of the Washago WFP intake. Only the Orillia WFP was equipped with a separate raw water sampling line that extended to the inlet structure which operated by an independent pump. Samples were collected from the raw water sample line from the Orillia WFP on three occasions to compare with station LC3. Water samples were collected on one occasion at the Mnjikaning First Nations wet well for comparison with the open water quality. However, in order to sample raw water ahead of treatment additions, a prearrangement for shut down of zebra mussel pre-chlorination and pH adjustment was required and sampling was carried out in the wet well to obtain a raw water sample.

Water sampling was conducted at each station starting in and during each run included euphotic zone composite samples of basic chemistry (DIC, DOC, major ions, hardness, conductivity), nutrients (total phosphorus, ammonia, nitrate, total Kjeldahl nitrogen, silcate), chlorophyll a and phytoplankton. Water clarity was measured using a Secchi disc. Vertical profiles of temperature, dissolved oxygen, conductivity and pH were taken using a calibrated YSI 650 multiparameter meter (Sonde).

In addition to the nutrients and basic chemistry, a limited number of samples for taste and odour causing chemicals and microcystins were collected in specially prepared amber glass containers and submitted to the MOE Laboratory for analysis of geosmin, 2-methyisoborneal (MIB) and microcystin-LR and other microcystins. These samples were kept cool and dark while in transit to the Laboratory.

The individual euphotic zone composite samples of phytoplankton were preserved with Lugol's solution. Zooplankton samples were collected with a 14 cm diameter plankton net consisting of a 60 cm cylindrical section followed by a 40 cm conical section fitted with a Shapiro-style, low pressure collecting cup. The net had 80 μm mesh size. The net was towed vertically at a rate of approximately 0.5 m/s from the bottom to the surface. Samples were preserved with buffered formalin (6%).

Laboratory Analyses

Water chemistry was analyzed at MOE Laboratory Services Branch for all parameters and for low level total phosphorus at MOE Dorset Laboratory using standard MOE Analytical Methods.

Phytoplankton samples were settled and archived by MOE EMRB staff and were provided to the contractor, Elaine Carney. Individual samples from five open water stations (LC3, LC5, LC15, LC17 and LC22) for each sampling run were identified to genus and biovolume estimated using standard MOE methods in order to assess seasonal changes in phytoplankton community structure in the Lake. Individual aliquots of samples from the other five open water stations (LC1, LC12, LC14, LC19 and LC21) were recombined into a single composite sample from each station for identification to genus and biovolume estimated using standard MOE methods. In addition, phytoplankton samples from the Orillia WFP intake were examined for comparison with LC3.

Zooplankton analysis was carried out through the contractor, Sue Standke, using methods consistent with other MOE identification and enumeration methods (see Gemza 1995, and the ZEBRA software system).

Survey Data Analysis

Spatial variation with time and depth during 2003 were examined for field measurements of temperature, dissolved oxygen, and Conductivity using five deep water stations (LC3,LC5, LC15, LC17,LC22). Horizontal variation of temperature, dissolved oxygen, basic chemistry and nutrients were examined using all lake stations sampled.

Historical comparison of water quality between 1997 and 2003 was carried out for two common open water stations (LC5 and LC15). Seasonal differences in water chemistry, phytoplankton and zooplankton were examined between 1997 and 2003 for station LC5.

Individual phytoplankton sample results from stations LC3, LC5, LC15, LC17 and LC22 as well as the Orillia water intake (LC0) were used for detailed analysis of temporal patterns. Results from all sites sampled were assessed for spatial differences. Temporal (between 1997 and 2003 and within 2003) and spatial variation of species composition were examined.

Results

Water Quality

Water clarity as indicated by Secchi disk visibility in Lake Couchiching was generally good with the Secchi disk visible on the lake bed at most stations less than 4 m throughout the year. Water clarity at stations deeper than 4 m (LC15, LC17, LC22, LC3 and LC5) was related to cloud cover and turbidity in the water column on the sampling date. The mean Secchi disk visibility ranged from a mean of 3.7 m on June 4th to 6.0 m on June 24th (a clear, sunny day, Table 2). Taking the euphotic zone as twice the Secchi disk depth (i.e. the depth to which light penetrates down into the Lake), light penetrates to the bottom virtually everywhere in the Lake through most of the year.

Surface (at 1 m) temperatures rose quickly in the spring to over 20 ^{o} C by June 24th with the peak temperature of 23.1 ^{o} C throughout the Lake by August 6th with the exception of LC19. Station LC19 was significantly cooler on three sample dates, probably representing cooler inflow from Lake Simcoe. All stations, except LC19, had mean survey temperatures within 0.5 ^{o} C, suggesting near complete horizontal mixing. Vertical temperatures at the deep water stations (LC15, LC17, LC22, LC3 and LC5) were uniform suggesting complete mixing of the water column with the possible exception of localized deep holes.

The dissolved oxygen concentration was uniform from surface to bottom at all open water stations. Concentrations were at or near saturation for the temperatures encountered. This is to be expected with near complete mixing of the Lake and light penetration virtually everywhere in Lake Couchiching.

Conductivity is a measure of the total dissolved material in the water column. The conductivity was relatively uniform throughout the Lake (mean station values between 326 and 333 uS/cm) with the exception of LC19 which had a higher mean value (355 uS/cm). This station was reflecting the higher conductivity from Lake Simcoe and the local area of Atherley. Field values of pH in the water column of the Lake at all stations ranged between 8.5 and 8.6 (mean 8.5) through the survey with the exception of LC19 (mean survey pH 8.3).

Total phosphorus is an important nutrient that controls the growth of aquatic plants in lakes. Over the sampling survey the mean of all stations was lower in the spring (8.2 ug/L) and rose to a high of 11.2 ug/L by Aug 6th with an overall range of 6.6 to 13.4 ug/L. The MOE water quality guideline for lakes is 10 ug/L suggesting that the Lake has a concentration associated with low levels of algae growth.

Ammonia and nitrate concentrations were low with ammonia concentration ranging between less than 0.005 and 0.050 mg/L and nitrate values ranging between less than 0.005 and 0.020 mg/L at all stations sampled (Appendix 1).

The ratio of total nitrogen to total phosphorus (the N:P ratio) provides an indication of conditions for plant growth in the water. A ratio of 10 to 12 is generally found in highly enriched water where plant growth is limited by light or by factors other than phosphorus. As the ratio increases growth conditions are increasingly dependent on total phosphorus. Lake-wide N:P ratios varied seasonally from 50 in spring sampling dates to a minimum of 38 by August 6th . Values increased again in the August 26th and October 1st sampling. Stations across the open waters of the lake were similar.

Silica is used by a group of algae called diatoms in the construction of their outer shell (or frustule). The concentration of silica is depleted in the water column of lakes with heavy growths of diatoms, usually in the spring, and then increase later in the season once major growths have declined. The minimum concentration in 1997 was 0.34 mg/L as compared to 0.52 mg/L in 2003.

A historical comparison of water chemistry data from station LC 5 was made between 1997 and 2003. The basic chemistry has changed very little between the two surveys with the exception of sodium and chloride ions which increased from 16.0 and 27.4 mg/L to 19.3 and 33.9 mg/L respectively (Table 3). The increase in these parameters since 1997 was most likely due to the continued effects of road salting in the Lake Simcoe watershed and within the immediate Lake Couchiching watershed.

Phytoplankton

Chlorophyll a is a green pigment found in all growing plants. The chlorophyll a concentration provides an indication of the biomass of algae in the water column. Generally, in the Severn Sound area (Sherman 2002) and in many inland lakes (Dillon, et al. 1986), chlorophyll a concentrations of 5 ug/L or greater are associated with nuisance algae growths which interfere with swimming use. Values of chlorophyll a ranged from 0.2 to 6.6 ug/L throughout the Lake during 2003 with the highest mean value of 2.5 ug/L at station LC19. Seasonally, a low Lake-wide mean of 0.4 ug/L was measured on June 24th and a maximum Lake-wide mean concentration of 2.6 ug/L was found on August 6th (Table 4).

Phytoplankton are the microscopic plants that grow suspended in the water column in lakes. The highest total biovolume of phytoplankton over the ice-free period was found at station LC3 off the City of Orillia (366 mm^3/m^3, Table 5). Of those open water stations where seasonal samples were analyzed, highest total biovolume was found in spring (June 4th mean of 537 mm^3/m^3) and late summer (August 26th mean of 442 mm^3/m^3).

Over 60 species of algae were identified from all stations in Lake Couchiching during 2003. A similar number was found in the 1997 survey. A comparison was made for four common stations on an annual basis and for Station LC5 on a seasonal basis between years (Table 5, Figure 2). The phytoplankton community had similar total biovolumes with the exception of LC12 where a higher biovolume was found in 2003 than in 1997. The proportion of blue-green algae was much higher in 2003 as compared to 1997 and a slight elevation in the proportion of

dinoflagellates was noted.

During the spring of 2003, the phytoplankton community was dominated by the dinoflagellate *Peridinium* and the chrysophyte *Uroglena* (both genera representing approximately 70% of the total biovolume). Both of these algae when found in moderate growths impart the odour of cucumbers to the water and a fishy odour when abundant. During 1997 the chrysophyte *Dinobryon* sp. dominated in the spring. Increases (or pulses) of the diatoms *Cyclotella* and *Fragilaria* were noted occasionally at some stations through the summer. Station LC19, near the Atherley Narrows, has a larger proportion of filamentous green algae that would normally be found near or attached to the Lake bed or structures in shallow water. These algae were likely swept to the vicinity of LC19 by currents through the channel.

During late summer and fall 2003, the phytoplankton community is dominated by the blue-green alga *Microcystis* spp.- making up over 70% of the total biovolume of the five stations sampled. A sub-set of the samples were examined to identify *Microcystis* species and more than 90% of the *Microcystis* found was *M. aeruginosa*. This species of algae may impart a toxicity to the water when found in high density (see below). Despite the high proportion of *Microcystis*, the total biovolume was still low and was not at a level associated with taste and odour problems. Although the blue-green coloured *Microcystis* colonies were visible as specks in the water during late summer, growths in the open water were never noted as extensive scums or surface accumulations often termed "algae blooms" .

Filamentous algae were relatively sparse in the open waters with the exception of some nearshore areas such as LC19. The macrophyte green alga *Chara* spp. (commonly known as musk grass) was noted at all stations and, where visible from the surface, appeared to be the dominant macrophyte in the open water areas. This alga grows in beds close to the Lake bottom on a variety of substrates including exposed bedrock. It also has a characteristic skunky-garlic odour.

Zooplankton

Zooplankton are small crustaceans or "water fleas" that live suspended in the water column, either grazing on the suspended algae and other particles or feeding on other small animals. Of the four main groups of zooplankton examined in the open waters of the Lake over 25 species were identified (Appendix 3 and 4). Species richness (the number of species per sample) was highest at stations LC5 and LC17 (19 species per sample) and lowest at LC21 (10 species per sample). Of the four major groups examined, calanoid copepods had the highest numbers and biomass followed by cyclopoid copepods, non-Daphnid cladocerans and then Daphnids. Cladocerans were the most diverse group present in the community with 16 different species. Seasonally, the calanoids dominated the zooplankton biomass through the year. With Daphnids showing a peak in late August and non-Daphnids having a peak in spring and in mid-summer. This pattern was similar to 1997 with the exception that biomass was much higher in June and lower in mid-summer of 1997 than in 2003 (Figure 3).

Leptodiaptomus minutus and *Skistodiaptomus oregonensis* (Figure 4A) were dominant calanoid copepods found during 2003. Their combined biomass dominated the zooplankton throughout the survey. *Leptodiaptomus minutus* is associated with good water quality and is more abundant in 2003 than it was in 1997. The dominant cyclopoid copepods were *Diacyclops bicuspidatus thomasi* and *Mesocyclops edax* with *Diacyclops* more abundant in the early part of the survey and *Mesocyclops* more abundant in the late part of the summer.

Bosmina longirostris was the most abundant cladoceran zooplankton species with highest numbers and biomass found at LC22 (over 13,000 /m^3, 4.7 mg/m^3) in spring (Figure 4B). *Bosmina longirostris*, one of the smallest cladocerans present, often dominates nutrient enriched waters. The Daphnid species, with larger body size, are better represented in more nutrient poor waters. *Daphnia galeata mendotae* a Daphnid species often associated with moderately enriched waters was the next most abundant cladoceran in the Lake with relatively high peaks in biomass occuring in late August at all open water stations (48 mg/m^3 at Station LC15). During the 1997 survey *Daphnia retrocurva* was more abundant than *D. galeata mendotae* . In 2003, *D. retrocurva* was much less abundant than *D. galeata mendotae*. *Diaphanosoma birgeii* was the next most abundant cladoceran with biomass peaking in mid-summer at less than 10 mg/m^3.

The invasive exotic zebra mussel (*Dreissena polymorpha*) has been introduced into the Great Lakes and inland waters of Ontario since the early 1980s. The mussel settles on hard surfaces and filter feeds by syphoning particles from the water column. The mussel has a free living larval form that becomes part of the zooplankton for a significant part of the summer season. The zooplankton net with mesh size of 80 u will also sample the later stages of the veliger larvae for most of the season until they settle as young adults. According to Kilgour et al. (2000) zebra mussels were noted in the Lake in 1992 and based on comments from water plant operators, were infesting the Lake in 1997 and were common up to 2002. The highest density of veliger larvae in 2003 was found at Station LC12 (with peak of 21,000 per m^3 , Table 6). Biomass was much lower in 2003 than in 1997 with peak biomass of less than 1 mg/m^3 in 2003 at LC5 compared to a peak of more than 14 mg/m^3 in 1997 (Figure 5). The peak biomass of zebra mussel veligers occurred during late June of 2003 in the open water stations (Table 6) and during July in the shallower LC12. Unlike 1997 zebra mussel veliger biomass did not represent a significant proportion of total zooplankton biomass in 2003. The average biomass in 2003 was 0.18 mg/m^3 compared with 4.19 mg/m^3 in 1997. Use of the regular video monitoring record of the inspections and cleaning of intakes in conjunction with intake sampling of zebra mussel veligers should be carried out as a monitoring tool to assess changes in the population of attached adult mussels.

Overall the biomass of zooplankton in 2003 was almost twice that found in 1997 at Station LC5 (46.0 mg/m^3 in 2003 compared with 24.1 mg/m^3 in 1997).

Trophic status of Lake Couchiching

Based on water clarity, total phosphorus concentration and total phytoplankton biovolume, the Lake trophic status has not changed appreciably since 1997 and can be considered nutrient poor (oligotrophic) to moderately enriched (or mesotrophic) (Table 7). The shallow nature of the lake provides ample light climate for the growth of rooted aquatic plants. However, relatively few plants were observed over the open waters due, most likely, to lack of muddy substrate. The Lake appears to be at a similar condition to 1997 with the exception of the increased predominance of the blue-green alga *Microcystis* which may signify more enriched conditions than 1997. The veliger of the zebra mussel *Dreissena polymorpha* was also reduced from the population found in 1997. With respect to trophic status, the Lake offers a reasonably good source of water for communal treatment.

Water intake assessment

There are seven communal water intakes using Lake Couchiching including the West Shore WFP that is currently under construction. The total capacity for water taking from all communal surface water intakes is 36,283 m^3/d with 27,276 m^3/d (or 75% of the total capacity) being taken by the City of Orillia. Not included are the private water intakes located along the shoreline properties in the Lake.

Due to the almost complete mixing of the water column and the uniform quality of the open Lake, the open water quality generally represents the raw intake quality for basic chemistry. However, local conditions such as sheltering, sediment, nutrient sources or pollution sources could influence the raw water quality in the vicinity of those intakes that are near shore or in deeper water and consequently the raw water quality entering the water treatment system. Models exist that link these local conditions with wind and current speed and direction as well as the magnitude and strength of discharges to impingement on water intakes. These models can help to establish the size and shape of areas that could adversely effect the quality of water near intakes. Establishing these "protection zones" would contribute to a more comprehensive protection plan to reduce the risk of pollution events affecting raw water at intake locations and ensuring that changes to existing discharges or new discharges are planned with the protection of the water supply as a priority.

The raw water quality monitoring samples collected to date as required under the Ontario Safe Drinking Water Act provide little information that is useful for assessing trophic conditions in the Lake. The parameters required and sampling frequency for raw water quality under this program are designed to assess bacterial contamination and turbidity in raw water. If intakes are to be used for monitoring Lake trophic conditions, both the sampling lines and any pre-treatment must be taken into account as well as additional water quality parameters. Several water filtration plants depend on the production pumps to provide raw water samples at the same time as bringing water in for treatment. Using the intake for collecting raw water samples for monitoring Lake quality depends on several conditions including the following:

1. A raw water sampling line ahead of all pre-treatment for zebra mussels using chlorine or other pre-adjustments of water such as pH adjustment, should be installed.
2. Where pre-treatment is not practiced, the raw water samples can be collected only after the pumps have been running sufficiently to clear the length of the intake (i.e. bring in fresh raw water that represents the Lake source).
3. The sample must be taken from a flowing pipe or sample line off a flowing pipe and not from a wet well.

The communal water intakes were reviewed for location, distance from shore and depth as well as usefulness as a potential sampling location for raw water monitoring of the Lake (Table 8). The shallow nature of the Lake dictates that most water intakes must be placed in relatively shallow water (approximately 2 m). The deepest intakes are for the City of Orillia, the Mnjikaning First Nations and the new Township of Severn - West Shore WFPs which are 5.4, 3.7 and 7 m deep respectively. The evaluation of each of the communal intakes is summarized as follows (see also Table 8 and Figure 7).

Mnjikaning First Nation

The Mnjikaning First Nation Water Treatment Plant was constructed in 1996 as a full water treatment plant and has been recently (2001) upgraded to include more reservoir capacity, pH adjustment using CO_2 and a SCADA system. The intake extends 100 m from the wet well near shore. A marker buoy is moored at the end of the intake off Station LC17. The intake structure is located in approximately 3.7 m of water (elevation 216.2 m to the top of the intake structure). It is fitted with a pre-chlorination diffuser for zebra mussel control. It has a cylindrical intake structure of 1.2 m diameter with vertical screens to prevent debris from entering. The intake does not have a functioning sample intake for raw samples ahead of chlorination for zebra mussels, pre-chlorination and CO_2 addition. However, by prior arrangement, chlorination can be shut off to permit raw water sampling from the intake sample tap at the plant. The raw sampling tap is behind the wet well of the lift station and is not considered ideal for purposes of monitoring open water conditions. Should the First Nations make modifications to the intake in the future, it is recommended that a raw water sampling line that extends beyond intake pre-chlorination at the inlet structure be installed.

YMCA Geneva Park Conference Centre

The YMCA Geneva Park Water Treatment Facility was first constructed in 1962 and has been upgraded most recently in 2000 and currently provides full treatment for a rated capacity of 1,280 m^3/d. The 200 mm diameter intake extends 45 m into the Lake. The intake structure is located in 2 m depth and consists of a riser in the intake pipe fitted with a removable guard and screen. No zebra mussel control with chlorine is practised. The inlet structure is inspected and cleaned annually.

Camp Wahanowin

The seasonal water system operates from spring to fall and provides full treatment for a rated capacity of approximately 214 m^3/d. The twin 50 mm intake extends approximately 60 m into the Lake. The intake structure is located in 2 m depth and includes a screen of 22 mm mesh. Although used seasonally, the intake remains in-place year round. No zebra mussel control with chlorine is practised.

Ontario Educational Leadership Centre

The water supply serving the Centre was taking water from the Lake but has been replaced with a drilled well supply as of April 2003. The intake is no longer used.

Township of Severn - Washago Water Treatment Plant

The Washago Water Treatment Plant, constructed in 1984, provides full treatment for a rated capacity of 544 m^3/d. The 200 mm diameter polyethylene intake extends 18 m into the Lake. The intake structure consists of a PVC lid and screen with 22 mm dia holes located in 2.1 m depth. No zebra mussel control (using chlorination) is practised. The intake structure is cleaned and the intake is backwashed each fall prior to camera inspection. Raw water is collected from a tap located behind the main pumps in the water plant building and prior to pre-chlorination and alum addition. Samples can be collected when the pumps are running.

Township of Severn - Sand Castle Estates Water Supply Works

Sandcastle Estates Water Supply Works, constructed in 1986, is operated by the Township of Severn to provide full treatment for a rated capacity of 388.8 m^3/d. The Plant has a stainless steel intake extending 400 m into the Lake. The intake structure consists of a stainless steel lid and screen with 22 mm holes located in 2.2 m depth. No zebra mussel control (using chlorination) is practised but the intake structure is cleaned and the intake is backwashed each fall prior to camera inspection. Rooted aquatic plants are cleared from the area around the intake to a distance of approximately 3 m. Raw water is collected from a tap located behind the main pumps in the water plant building and prior to pre-chlorination and alum addition. Samples can be collected when the pumps are running.

Township of Severn - West Shore Water Treatment Plant (under construction)

The Westshore Water Treatment Plant, to be completed by 2005, will be operated by the Township of Severn to provide full treatment for a rated capacity of 2,780 m^3/d. The plant will have a 300 mm diameter polyethylene intake extending 950 m into the Lake. The intake structure will consist of an outer protective drum of polyethylene (915 mm diameter) with screens of 10 mm mesh outside a polyethylene intake head. The structure will be located approximately 7 m below the surface and 1 m above the lake bed. The intake will be fitted with a zebra mussel chlorination line extending into the intake structure. It is recommended that a

sampling intake line that extends beyond intake chlorination at the intake structure be installed with an independent pump that will allow sampling of raw water prior to any treatment.

City of Orillia

The City of Orillia WFP intake was constructed in 1994/95. The plant provides full treatment for a rated capacity of 27,276 m^3/d. The plant has the option of using both surface water and ground water as supplies. However, during 2003 only the surface water intake was used as a source of supply. The 1,000 mm diameter intake extends 374 m into the lake to a depth of 5.4 m. The inlet structure is constructed of stainless steel lid with a one-meter vertical bar-screen over a cone-shaped riser. The entire inlet structure is approximately 2 m off the lake bed. The intake has a raw water sampling line that extends beyond the inlet structure and has a separate sampling pump to a sampling faucet in the Plant laboratory. The inlet structure has a chlorine diffuser, chlorinating the water for the entire length of the intake for zebra mussel control. The inlet crib area is typically inspected using divers bi-annually.

The City of Orillia WFP provided an opportunity to compare the raw water samples with samples from the open water composite station at the intake, as the plant staff could run the sample line on any day of the week to coincide with open water sample runs. Raw water samples taken by plant staff at Orillia WFP, as part of the Ministry of the Environment Drinking Water Surveillance Program, were also compared with samples collected by SSEA staff during 2003. Chemistry and phytoplankton samples collected by SSEA during 2003 were also compared for an open Lake water column composite (station LC3) and the City of Orillia WFP raw water line (station LC0, Table 9). The basic chemistry (conductivity, ions) and nutrient concentrations were similar between the open Lake station composite (LC3) and the water intake sampling line (LC0). The single sample for the fall of 2003 from the DWSP basic chemistry was also very similar.

Phytoplankton samples were collected from the Orillia raw water sampling line on four occasions when composite samples (through the water column) were collected off the intake at Station LC3. Generally, the same species of algae were taken for both stations. The total biovolume in the water intake line was less than half of that found in the water column (Table 10). This is reasonable considering many of the common species of algae can at least partially regulate their vertical position in the water column in order to optimize their exposure to light.

Toxins, Taste and Odour

A family of toxins called microcystins has recently been identified and associated with the presence of some blue-green algae. The toxins may or may not accompany the presence of *Microcystis* and they may or may not be contribute to taste and odour. When present, however, microcystins do represent a human health concern (Health Canada 2002, MOE 2003). A Maximum Allowable Concentration (MAC) has been established by the Ministry of the Environment as a Ontario Drinking-Water Quality Standard (MOE 2003) (ODWQS). A comparison of the few measurements that could be made of microcystins in Lake Couchiching is shown in relation to seasonal *Microcystis* biovolume in 2003 (Table 11A & B). The rise in abundance of the blue-green algae *Microcystis* in the Lake coincided with an increase in the concentration of microcystin-LR. Fortunately, the microcystin-LR concentration in the raw water did not exceed the ODWQS of 1.5 ug/L as microcystin-LR.

Additional samples of microcystin-LR were collected in raw and treated water by City of Orillia WFP staff during 2004 and analyzed at MOE Laboratory Services Branch. These weekly samples of microcystin-LR show a clear peak in late summer that corresponds to the seasonal development of *Microcystis* in the Lake (Figure 7). Although microcystin-LR was measurable in the raw water, the finished water concentration was less than the detection limit for the test, indicating that the treatment process was successful in removing the substance.

As indicated above, many algae can impart an odour or a bad taste to water, especially when the algae are abundant in the raw water supply. Taste and odour may be enhanced by chlorination during the treatment process. Intense, earthy/musty taste and odour events in other lakes (such as Lake Ontario) have been linked to taste and odour compounds, geosmin and 2-methylisoborneol (MIB) which are produced in aquatic environments by cyanobacteria (blue-green algae) or mould-like, filamentous bacteria called actinomycetes (MOE 2003, Howell et al. 2001).

Minute concentrations (measured in parts per trillion) of these compounds create an earthy/musty taste and odour. Geosmin, the same substance that can be detected when rich soil is turned, is also found in some foods including beets. It can be detected at very low concentrations, with the average person noticing the odour of geosmin at as little as 4 nanograms per litre (ng/L). (A trillion nanograms equal one gram). MIB is usually noticeable at levels of approximately 9 ng/L. Samples of geosmin and MIB were taken by SSEA during the 2003 survey and are a regular part of the DWSP testing (Table 11C). MIB was found in low or non-detectable concentrations near or below the detection limit of the test with slightly elevated concentrations at Station LC3. Geosmin was found in higher concentrations in the spring samples and declined only slightly in summer and early fall. No specific linkage to blue-green algae abundance was evident for the few sample results available. It is recommended that a special sampling of the Orillia Intake be carried out in cooperation with the MOE to provide more frequent sampling (at least bi-weekly) of raw and finished water concentrations of MIB and geosmin and raw water biovolume of phytoplankton through an annual period. If possible, microcystin-LR should be sampled at the same time.

Conclusions

1. Lake Couchiching has good water quality. The trophic conditions have not generally changed since 1997. The only changes of note between 1997 and 2003 were an increasing predominance of blue-green alga *Microcystis* and a decrease in zebra mussel veliger biomass.

2. Subtle changes in the phytoplankton community were apparent in 2003 which have the potential to cause taste and odour problems to water supplies using the Lake. The biovolume of these algae are relatively low but the increasing predominance of the nuisance alga *Microcystis* is cause for concern and for vigilance over any factor that could lead to increased abundance of this alga.

3. The algae of concern appear to be pelagic, or living suspended in the open water. Very little attached filamentous algae were noted at intakes or at open water stations during 2003.

4. The increase in concentration of microcystin-LR biovolume appears to correspond to the increase in abundance of the blue-green alga *Microcystis*. Concentrations in raw water are less than 1.5 ug/L in raw water at intakes and in the open Lake. The Maximum Acceptable Concentration (MAC) as established in the ODWQS for microcystin-LR in drinking water is below detection (<0.05 ug/L) in the finished water at the City of Orillia WFP.

5. The concentration of other substances known to be associated with taste and odour, 2-methylisoborneol (MIB) and geosmin MIB was found in low or non-detectable concentrations with slightly elevated concentrations at Station LC3. Geosmin was found in higher concentrations in the spring samples and declined only slightly in summer and early fall. No specific linkage to blue-green algae abundance was evident for the few sample results available.

6. Water intakes can be used to monitor open water quality with the recognition that the inlet structures do not sample the entire water column. This means that chemistry monitored in the raw water from an intake may be very similar to the open water column but phytoplankton biovolume will be reduced in the intake sample as compared to open water sampling.

Recommendations

1. Should the municipalities around the lake or other agencies wish to use intakes to monitor lake water quality, raw water sampling could be initiated at the City of Orillia water intake during the ice-free period of the year for trophic status parameters such as low level total phosphorus, nitrogens and phytoplankton as a minimum.

2. A survey of the main intakes (Orillia, West Shore, Mnjikaning First Nation, Washago) should be carried out in cooperation with the OMOE and other agencies to provide a bi-weekly monitoring of raw and finished water concentrations of MIB and geosmin and raw water biovolume of phytoplankton as a minimum through the ice-free period of a year. If possible, microcystin-LR should also be sampled as part of the same survey. The results of this sampling would serve as a basis for operational decisions on treatment options for taste and odour as well as potential toxins from the raw water

3. Consideration should be given by the operating authorities to install raw water sampling lines that extend beyond the pre-treatment chlorination for zebra mussel control at West Shore and Mnjikaning First Nation water filtration plants. For those plants where chlorination for zebra mussel control is not part of the pre-treatment (Sandcastle Estates and Washago WFPs), raw water intake samples for trophic status should be collected only during periods when active pumping is taking place ahead of in-plant treatment processes.

4. The open water survey should be repeated approximately every five years. As a minimum, the survey should include five open water stations (LC3, LC5, LC17, LC22 and LC15) and station LC12 near Washago. These stations should be sampled for basic chemistry, nutrients (including low-level total phosphorus OMOE Dorset protocol or equivalent), water clarity, chlorophyll a , microcystin-LR, MIB and geosmin. Phytoplankton should be sampled and analysed as individual samples at least at five open water stations listed above.

5. Use of the regular video monitoring record of the inspections and cleaning of intakes in conjunction with intake sampling of zebra mussel veligers should be carried out as a monitoring tool to assess changes in the population of attached adult mussels.

6. The raw water temperature, especially in early spring, should be documented along with samples of algae as abrupt changes in temperature may also be a factor in the production of taste and odour causing chemicals.

References

Chapman, L.J. and Putnam, D.F. 1984. The physiography of southern Ontario. Third Edition, Ontario Geological Survey, Special Volume 2, 270p.

Dillon, P.J., K.H. Nicholls, W.A. Scheider, N.D. Yan and D.S. Jeffries. 1986. Lakeshore capacity study: Trophic status. Ontario Ministry of the Environment/Ministry of Municipal Affairs Report.

Gemza, A. 1995. Zooplankton seasonal dynamics and community structure in Severn Sound, Lake Huron. Water Qual. Res. J. Canada. 30(4):673-691.

Howell, T., Heintsch, L., Jenkins, S. And Winter, J. Abundance and distribution of cyanobacteria in Hamilton Harbour and adjoining area of Lake Ontario on September 6 and 20, 2001. Technical Memorandum, Ontario Ministry of the Environment.

Health Canada. 2002. Fact Sheet on Blue-Green algae (cyanobacteria) and their toxins.

Kilgour, B., Hawkins, B., Westwood, J., Kauss, P. And Gemza, A. 2000. Lake Couchiching Environmental Quality. Water Systems Analysts Inc. Report for the Ontario Ministry of the Environment. ISBN 0-7778-8497-6, ISBN 0-7778-8498-4.

KMP Engineering. 1999. Report on evaluation of taste and odour treatment alternatives for the City of Orillia Water Filtration Plant. Prepared for the City of Orillia.

Ministry of the Environment. 2003. Technical Support Document for Ontario ODWQSs, Objectives and Guidelines. Ontario Ministry of the Environment Report.

Sherman, R.K. 2002. Severn Sound Remedial Action Plan Stage 3 Report. Report prepared by Severn Sound Environmental Association for Environment Canada and the Ontario Ministry of the Environment.

Table 1 Lake Couchiching Survey Sample Locations 2003*
(refer to Canadian Hydrographic Services Chart 2028 Sheet 2 of 3 for marker buoy numbers)

Station ID	Lat	Long	Depth	Description
LC19	44 36 58.2	79 22 12.6	2.4	Approach to Atherley Between Buoys S304 and S306
LC1	44 36 43.8	79 24 20.3	2.9	Off Cedar Island
LC3	44 37 14.3	79 24 33.7	5.4	Off Orillia WFP Intake buoy
LC0			5.4	Orillia WFP intake raw sampling line
LC5	44 38 20.9	79 22 49.7	8.9	Open water immediately south of Chief's Island
LC17	44 39 19.1	79 21 54.3	7.0	Off Horseshoe Island
LC21	44 39 20.0	79 23 00.6	1.5	Off North side Chief's Island
LC22	44 39 13.4	79 23 48.0	6.7	west of Chief's Island off Buoy SC2
LC15	44 41 12.5	79 22 24.2	9.0	mid-lake W of Buoy SC
LC14	44 42 15.6	79 20 48.1	1.5	Bay east of Portage Island
LC12	44 44 26.0	79 20 24.7	2.0	Approach to channel at Washago off Buoy S262

* all stations with the exception of LC22 were similar to stations used in the 1997 survey

Table 2 **Water quality summary of five deep stations in Lake Couchiching 2003**

	LC3				LC5				LC17			
	SDV	Chl a	TP	N:P	SDV	Chl a	TP	N:P	SDV	Chl a	TP	N:P
04-Jun-03	3.8	1.5	9.4	43.1	4.1	0.8	7.9	50	3.5	1.2	9.0	50.6
24-Jun-03	6.3	0.5	8.5	48.8	5.6	0.5	9.1	50	3.6	0.6	9.1	48.7
22-Jul-03	4.2	1.2	8.9	48.5	6.3	1.3	9.1	52	6.2	1.2	10.8	41.6
06-Aug-03	4.6	2.8	10.7	38.8	4.3	2.3	10.5		4.3	2.3	9.5	44.9
26-Aug-03	5.0	2.3	8.2	50.7	5.1	1.7	12.4	38	4.8	1.7	12.3	38.8
01-Oct-03	5.1	1.3	9.1	44.6	6.2	1.5	10.3	43	4.7	1.4	9.1	50.2
mean	4.8	1.6	8.5	52.7	5.3	1.4	9.9	47	4.5	1.4	10.0	45.8

	LC22				LC15			
	SDV	Chl a	TP	N:P	SDV	Chl a	TP	N:P
04-Jun-03	3.8	1.1	8.7	49.1	3.5	0.8	7.1	53
24-Jun-03	7.5	0.2	8.4	50.4	6.9	0.3	7.1	57
22-Jul-03	5.4	1.2	13.1	34.4	4.8	1.4	9.2	48
06-Aug-03	3.3	3.0	11.1	37.4	3.8	2.9	12.0	35
26-Aug-03	4.6	2.4	9.5	46.8	3.7	2.4	6.4	69
01-Oct-03	6.7	1.4	9.9	42.0	5.2	1.8	9.1	47
mean	5.2	1.6	10.1	43.4	4.7	1.6	8.5	52

Table 3 Comparison of mean basic chemistry at station LC 5 in Lake Couchiching between 1997 and 2003
(results in mg/L unless otherwise noted)

	1997		2003	
	mean	sd	mean	sd
Calcium	40.7	1.1	36.3	3.0
Magnesium	7.16	0.14	7.50	0.19
Sodium	16.0	0.4	19.3	0.5
Potassium	1.88	0.06	1.86	0.12
Chloride	27.4	0.5	33.9	0.66
Sulphate	18.8	0.4	19.5	0.5
Conductivity(uS/cm)	335	7	332	10
pH	8.3	0.07	8.6	0.05
Dissolved inorg. C	25.5	0.8	22.8	1.6
Dissolved org. C	4.1	0.2	4.5	0.4

Table 4 Chlorophyll a concentration (ug/L) at stations in Lake Couchiching during 2003

	LC19	LC1	LC3	LC5	LC17	LC21	LC22	LC15	LC14	LC12	Lake- wide avg	Lake- wide Min	Lake- wide Max
04-Jun-03	0.9	1.4	1.5	0.8	1.2	1.0	1.1	0.8	0.8	0.8	1.0	0.8	1.5
24-Jun-03		0.4	0.5	0.5	0.6	0.2	0.2	0.3	0.3	0.3	0.4	0.2	0.6
22-Jul-03	6.6	1.5	1.2	1.3	1.2	1.2	1.2	1.4	1.7	1.8	1.9	1.2	6.6
06-Aug-03	1.6	2.6	2.8	2.3	2.3	2.7	3.0	2.9	2.6	3.5	2.6	1.6	3.5
26-Aug-03	0.5	1.7	2.3	1.7	1.7	2.5	2.4	2.4	2.4	1.9	2.0	0.5	2.5
01-Oct-03	1.7	1.2	1.3	1.5	1.4	1.8	1.4	1.8	1.9	1.7	1.6	1.2	1.9
Mean	2.3	1.5	1.6	1.4	1.4	1.6	1.6	1.6	1.6	1.7			

Table 5 **Total Biovolume (mm^3/m^3) of phytoplankton at stations from upstream to downstream in Lake Couchiching during 2003 * (A) and 1997 (B)**

	LC19 (2)	LC1(1)	LC3(2)	LC5(2)	LC17(2)	LC21(1)	LC22(2)	LC15(2)	LC14(1)	LC12(1)
A 2003										
Cyano	14	31	73	69	68	49	79	75	66	103
Dino	7	18	42	13	33	47	56	34	68	16
Crypto	25	26	21	17	14	20	22	16	22	12
Eugleno	0	2	0	0	0	1	1	1	0	0
Chryso	10	89	106	78	104	82	121	86	51	82
Chloro	223	14	17	14	20	12	17	18	27	23
Bacill	21	66	107	87	75	28	30	47	33	21
Total	299	246	366	277	313	239	325	275	268	257
Chlorophyll	2.5	1.5	1.6	1.4	1.4	1.6	1.6	1.6	1.6	1.7

* samples aliquots were recombined into a single samples for counting(1) or a mean of individual analyses(2) for the ice-free period of 2003

B 1997										
Cyano				5		2		16		3
Dino				6		8		20		5
Crypto				13		11		8		3
Eugleno				0		0		0		0
Chryso				153		74		142		51
Chloro				5		2		2		5
Bacill				92		43		142		25
Total				272		140		330		92

Table 6 **Density (A (#/m3) and biomass (B (mg/m^3) of the zebra mussel (Dreissena polymorpha) veligers at selected stations in Lake Couchiching during 2003**

A	LC3	LC5	LC17	LC22	LC15	LC12
04-Jun-03	0	130	3,986	0	0	0
24-Jun-03	8,752	3,510	4,680	7,131	16,118	1,884
22-Jul-03	488	953	1,894	5,720	7,863	21,053
06-Aug-03	117	219	1,746	238	0	650
26-Aug-03	260	0	0	0	0	217
01-Oct-03	0	0	0	0	0	0

B	LC3	LC5	LC17	LC22	LC15	LC12
04-Jun-03	0.00	0.03	0.91	0.00	0.00	0.00
24-Jun-03	1.57	0.74	0.98	1.35	2.08	0.35
22-Jul-03	0.10	0.23	0.28	0.97	1.88	4.43
06-Aug-03	0.05	0.09	0.49	0.08	0.00	0.21
26-Aug-03	0.11	0.00	0.00	0.00	0.00	0.05
01-Oct-03	0.00	0.00	0.00	0.00	0.00	0.00

Table 7 Comparison of mean trophic variables at stations LC5 and LC15 in Lake Couchiching between 1997 and 2003

(results in µg/L unless otherwise noted)

	LC5				LC15			
	1997		2003		1997		2003	
	mean	sd	mean	sd	mean	sd	mean	sd
Secchi disk visibility (m)	5.1		5.3	0.9			4.7	1.3
Chlorophyll a	1.1	0.7	1.4	0.6	1.3	0.6	1.6	1.0
Phytoplankton biovolume (mm3/m3)	272		277		330		275	
Total phosphorus (1)	9	1	9.9	1.6	8	3	8.5	2.1
ammonium	28	12	10	4	23	13	15	10
nitrate	16	9	7	2	16	10	7	2
total Kjeldahl nitrogen	420	40	440	30	420	30	420	30
TN:TP ratio	50.6	11.0	46.9	5.9	54.6	14.5	51.8	11.3
Silicates	1.30	0.30	1.24	0.42	1.15	0.56	1.08	0.44
zooplankton biomass (mg/m3)	24.1		46.0				48.9	
mussel veliger biomass (mg/m3)	4.2		0.2				0.7	

(1) low level total phosphorus for 2003

Table 8 Communal water treatment facilities using Lake Couchiching as a source of supply

Name of system	Certificate of Approval	Rated Capacity (m^3/d)	Intake diameter (mm)	Intake distance from shore (m)	Depth of intake (m)	Zebra Mussel Control ?	Comments
City of Orillia	9451-5RFLA3	27,276	1000	374	5.4	Y	good potential for raw w monitor, separate sampling line and pump for raw w.
West Shore	under construction	2,780	300	950	7	Y	raw w monitor, if line installed, will monitor bottom water conditions
Sandcastle Estates	1013-5EBL35	388.8	200	400	2	N	good potential for raw w monitor when pumps running
Washago	1161-5HKRK7	544	200	18	2.1	N	good potential for raw w monitor when pumps running
Camp Wahanowin	6826-5G8T8Q	214	50 (twin)	60	2	N	seasonal potential for raw w monitor
YMCA Geneva Park	8208-5BGRBS	1280	200	40	2	N	good potential for raw w monitor when pumps running
Mnjikaning First Nation	NA	3800	250	100	3.7	Y	needs raw water line to head of intake with separate pump

Table 9 Comparison of mean trophic variables and basic chemistry at the raw water sampling line and Station LC3 off the Orillia Water Filtration Plant, 2003

(results in ug/L unless otherwise noted)

	DWSP(3)	LC0		LC3	
	15-Sep-03	mean	sd	mean	sd
Secchi disk visibility (m)				4.8	0.9
Chlorophyll a		1.3	0.5	1.6	0.8
Phytoplankton biovolume (mm^3/m^3)(1)		153		299	
Total phosphorus (2)	8	9.2	0.8	9.1	0.9
ammonium	14	20	9	18	7
nitrate	5	6	2	7	3
total Kjeldahl nitrogen	410	440	20	410	10
TN:TP ratio	51.9	48.2	2.9	45.8	4.4
Silicates	1.64	1.41	0.32	1.24	0.37
Dissolved Inorganic Carbon	21.7	22.1	1.4	22.5	1.8
Dissolved Organic Carbon	4.7	4.3	0.3	4.3	0.3
Calcium	33.4	34.8	2.1	35.5	2.8
Magnesium	7.45	7.48	0.15	7.98	1.48
Sodium	19.6	19.5	0.4	19.4	0.5
Potasium	1.75	1.80	0.11	1.82	0.10
Chloride	34.5	34.13	0.53	33.85	0.59
Sulphate	19.3	19.7	0.4	19.6	0.3
Hardness	114	117	5	121	7
fConductivity (uS/cm)	332			333	9

(1) mean of July to October biovolume results

(2) low level total phosphorus for 2003

(3) MOE Drinking Water Surveillance Program data

Table 10 Biovolume (mm3/m3) of phytoplankton at open water Station LC3 compared with Orillia WFP sample inlet (LC0) during 2003

LC3	Cyano	Dino	Crypto	Eugleno	Chyrso	Chloro	Bacill	Total
04-Jun-03	8.80	222.09	31.77	0.00	333.14	4.31	33.26	634.17
24-Jun-03	10.22	13.10	11.21	0.00	105.91	7.70	216.61	364.75
22-Jul-03	71.21	4.76	7.09	0.00	56.93	26.96	14.98	181.93
06-Aug-03	231.95	3.38	13.21	1.61	25.76	20.73	14.34	310.98
26-Aug-03	51.62	0.29	45.02	0.00	93.14	33.60	355.70	579.37
01-Oct-03	63.22	7.23	18.30	0.00	20.99	7.48	7.00	124.22
mean	72.84	41.81	21.10	0.27	105.98	16.80	106.98	365.90
Jul mean*	104.50	3.92	20.91	0.40	49.21	22.19	98.01	299.13

LC0	Cyano	Dino	Crypto	Eugleno	Chyrso	Chloro	Bacill	Total
04-Jun-03								
24-Jun-03								
22-Jul-03	42.97	0.79	12.77	0.00	18.92	12.89	16.16	104.50
06-Aug-03	65.78	0.00	58.82	0.00	16.21	9.05	25.05	174.91
26-Aug-03	42.07	10.78	19.45	0.00	22.00	19.73	153.56	267.59
26-Sep-03	76.05	10.67	12.92	1.13	5.04	9.27	16.21	131.29
01-Oct-03	54.97	1.62	12.77	0.00	12.33	10.70	5.76	98.15
mean	56.37	4.77	23.35	0.23	14.90	12.33	43.35	155.29

* same samples dates for LC0 used to calculate mean for LC3

Table 11A Biovolume (mm^3/m^3) of *Microcystis* at selectected stations in Lake Couchiching during 2003 (1)

	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
LC0			28.78	48.90	35.58	52.50
LC3	1.44	1.15	41.31	190.03	30.57	61.54
LC5	1.62	13.97	42.42	207.82	48.12	54.01
LC15	0.03	5.04	60.05	191.10	40.69	86.58
LC17	1.46	2.35	37.63	197.46	80.46	36.54
LC22	1.75	0.48	51.17	208.78	37.95	45.72
mean lake	1.14	4.60	46.52	199.04	47.56	56.88

(1) >90% of *Microcystis* was *M. aeruginosa* at LC3 and LC15

Table 11B Microcystin-LR and -LA results (ug/L) at selected stations in Lake Couchiching during 2003

	24-Jun-03		01-Oct-03	
	-LR	-LA	-LR	-LA
LC0	0.05	0.05	0.58	0.38
LC3	0.05	0.05	0.71	0.43
LC5				
LC15	0.05	0.05	0.69	0.42
LC17	0.05	0.05	0.80	0.39
LC22	0.05	0.05	0.81	0.45
mean lake	0.05	0.05	0.70	0.41

Table 11C 2-methylisoborneol (MIB) and geosmin results (ng/L) at selected stations in Lake Couchiching during 2003

	03-Mar-03		24-Jun-03		26-Aug-03		15-Sep-03		01-Oct-03	
	MIB	geosmin	MIB	geosmin	MIB	geosmin	MIB	geosmin	MIB	geosmin
LC0(1)	6.2	42	4.8	37.0	8.2	20.0	25	28	3.1	28.0
LC3			4.1	34.0	12.0	28.0			12.0	29.0
LC5			4.8	32.0						
LC15			4.5	32.0	5.4	18.0			1.0	24.0
LC17			3.0	33.0					1.0	32.0
LC22			4.6	27.0	7.0	24.0			1.0	22.0
mean lake			4.2	33.6	8.5	22.0			4.3	28.3

(1) Data from MOE Drinking Water Surveillance Program for City of Orillia raw water intake

Figure 1 Map of Lake Couchiching Survey Sample Locations, 2003

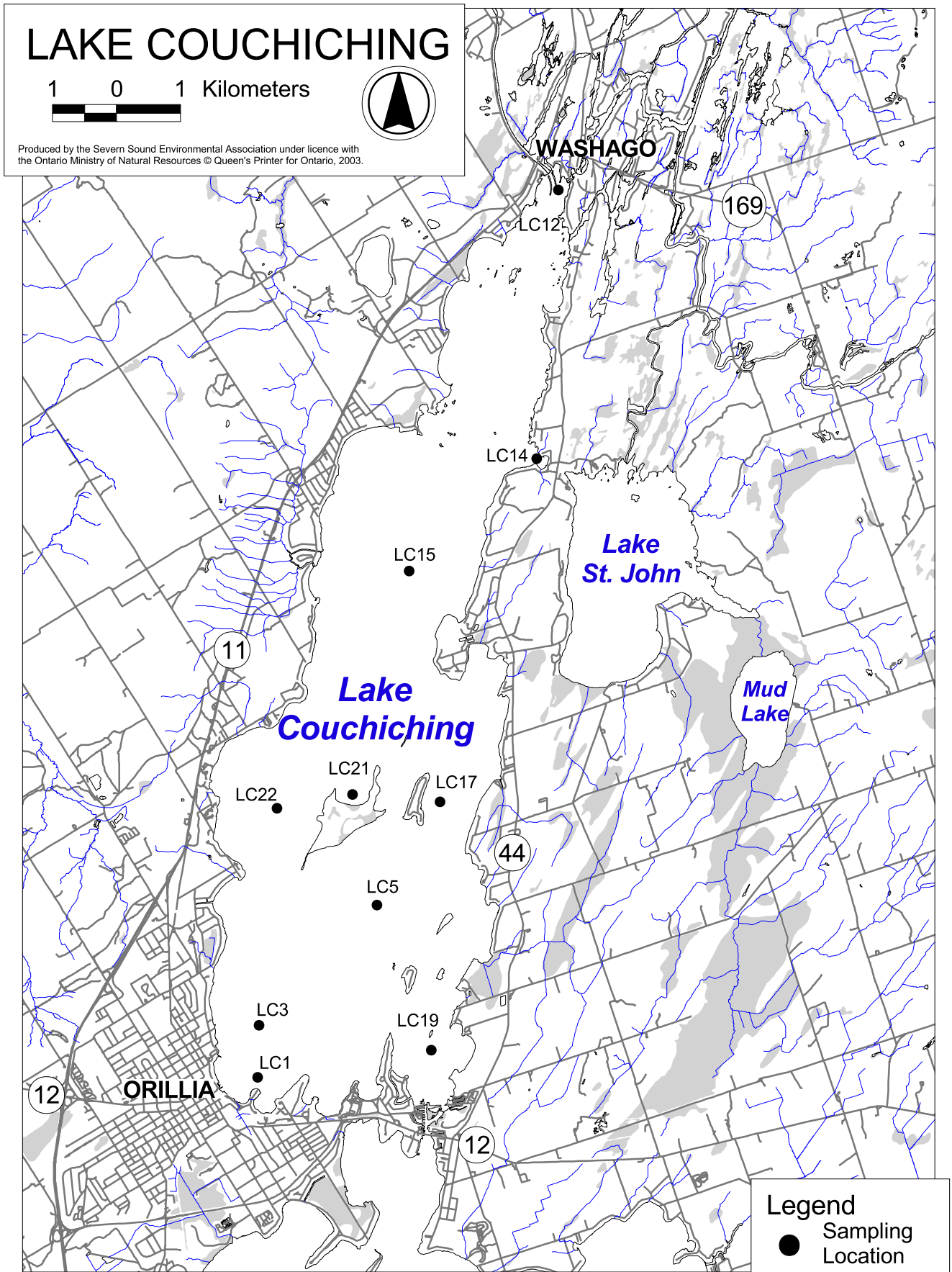


Figure 2 Comparison of phytoplankton community structure at Station LC5 in Lake Couchiching between 1997 and 2003 (biovolume in mm^3/m^3)

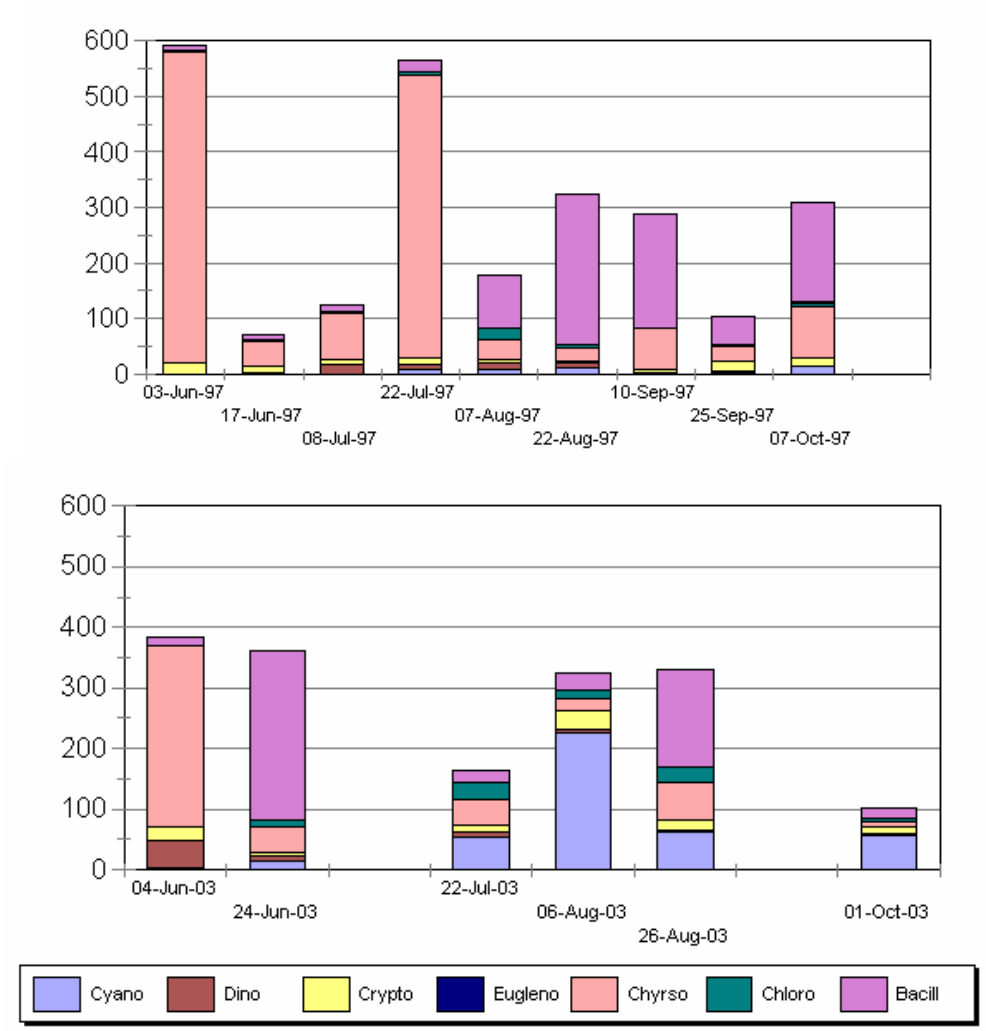
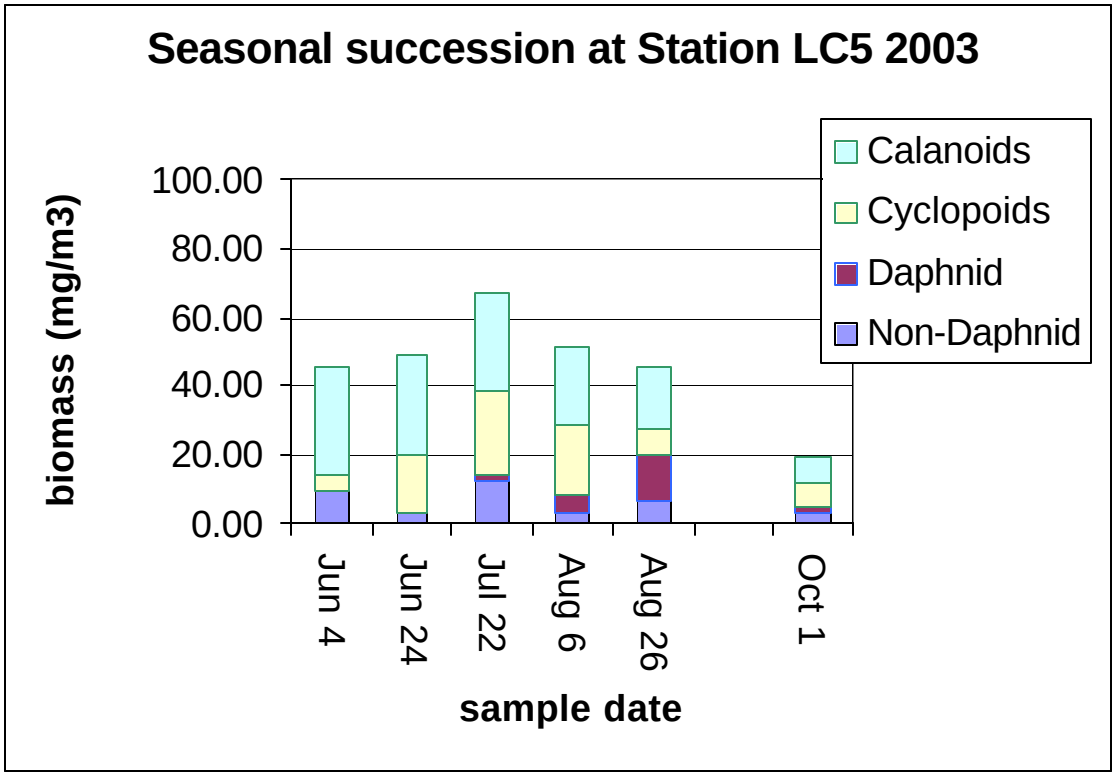


Figure 3 Comparison of seasonal succession of zooplankton in Lake Couchiching between 1997 and 2003 at Station LC5



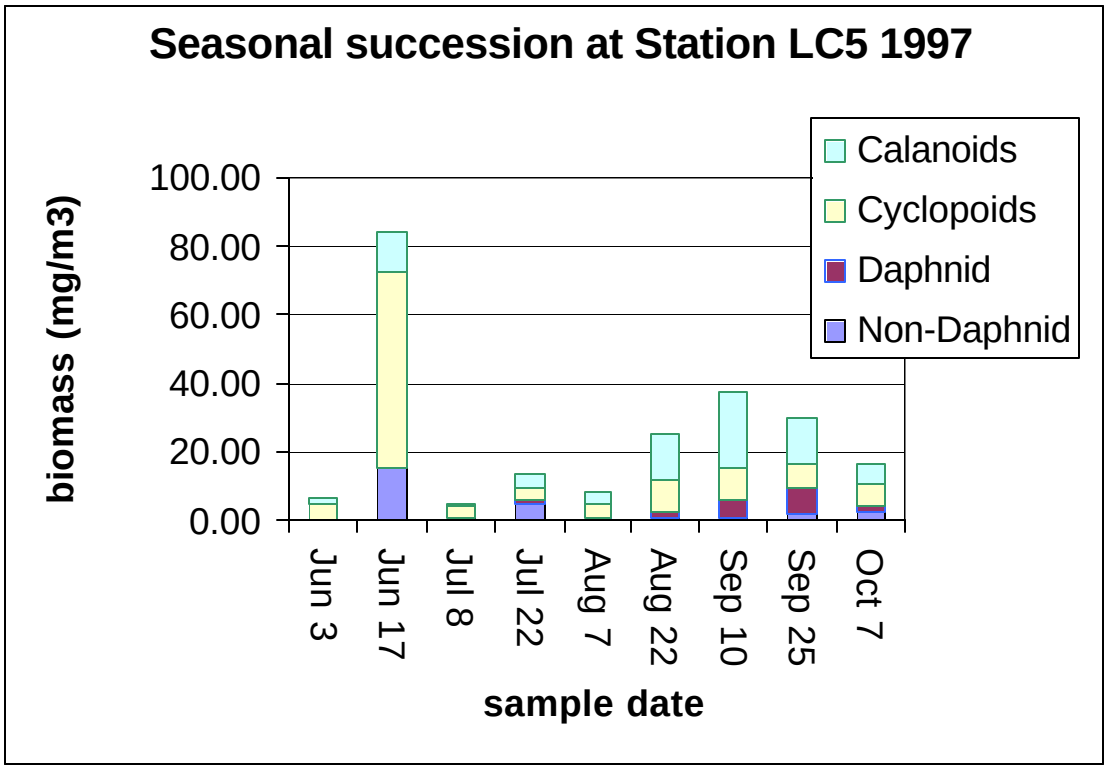


Figure 4A Seasonal biomass of common species of zooplankton from Lake Couchiching, 2003

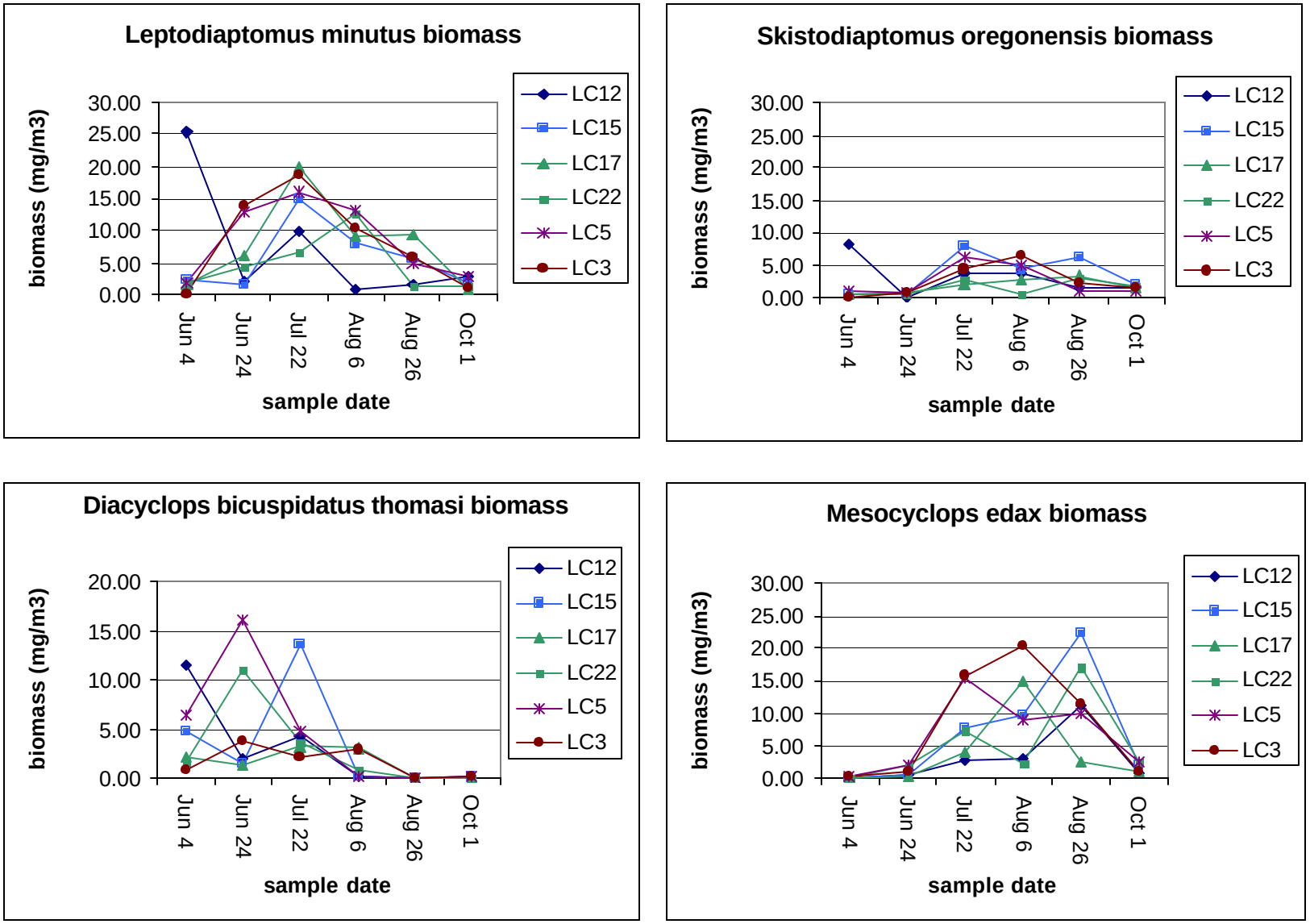
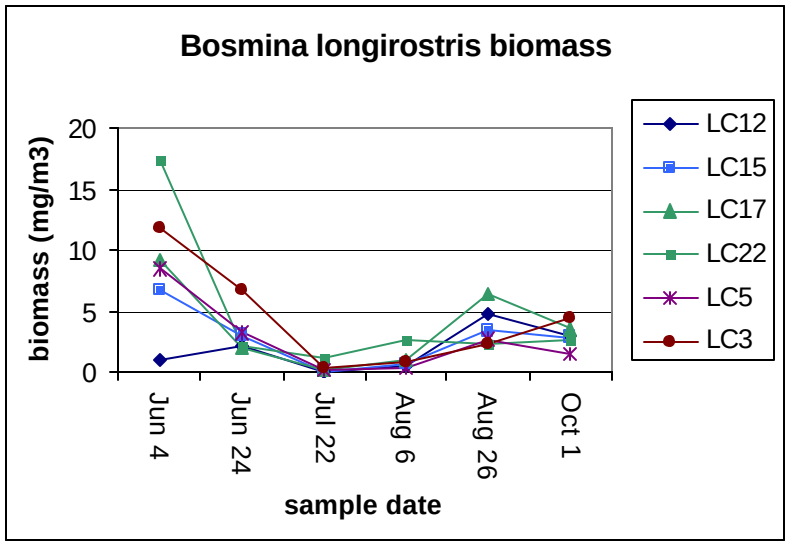
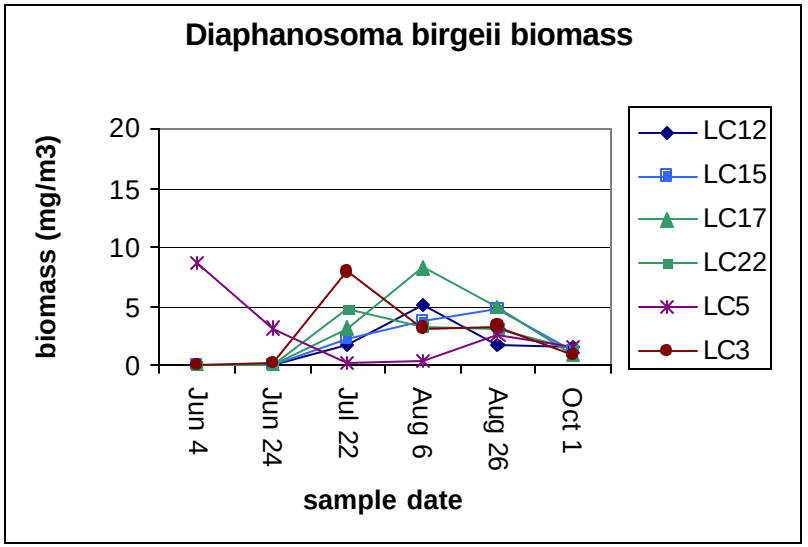
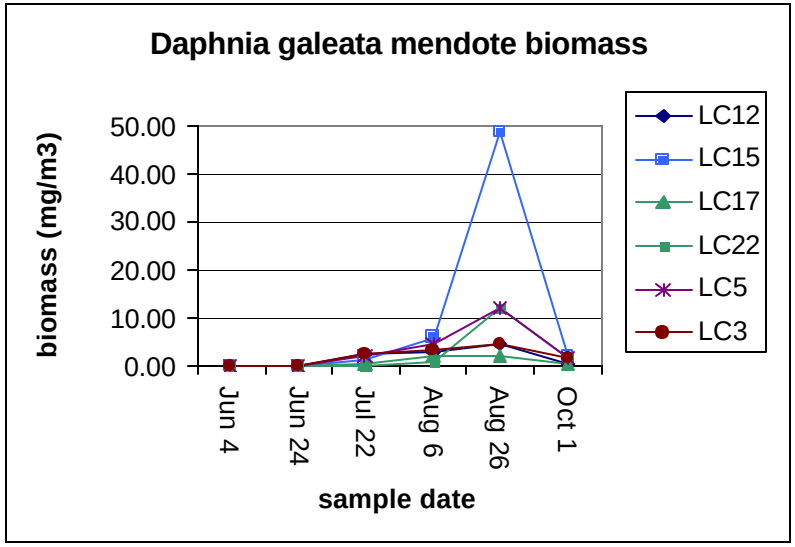


Figure 4B Seasonal biomass of common species of zooplankton from Lake Couchiching, 2003







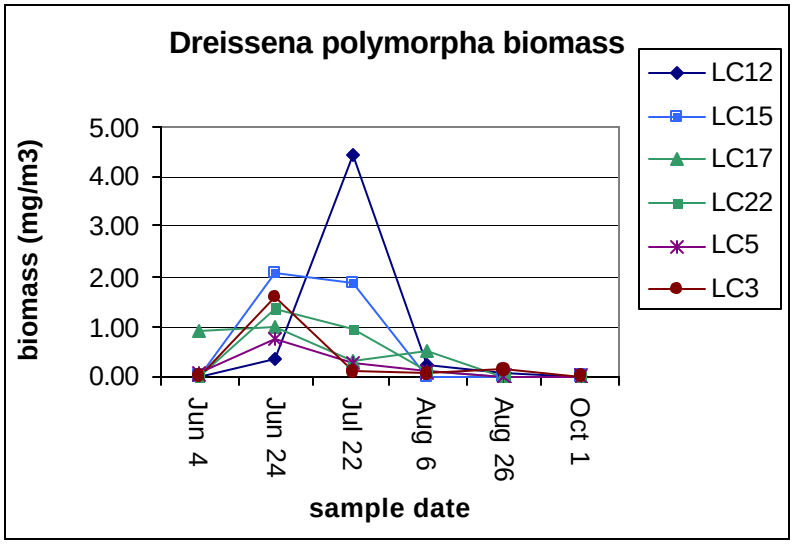
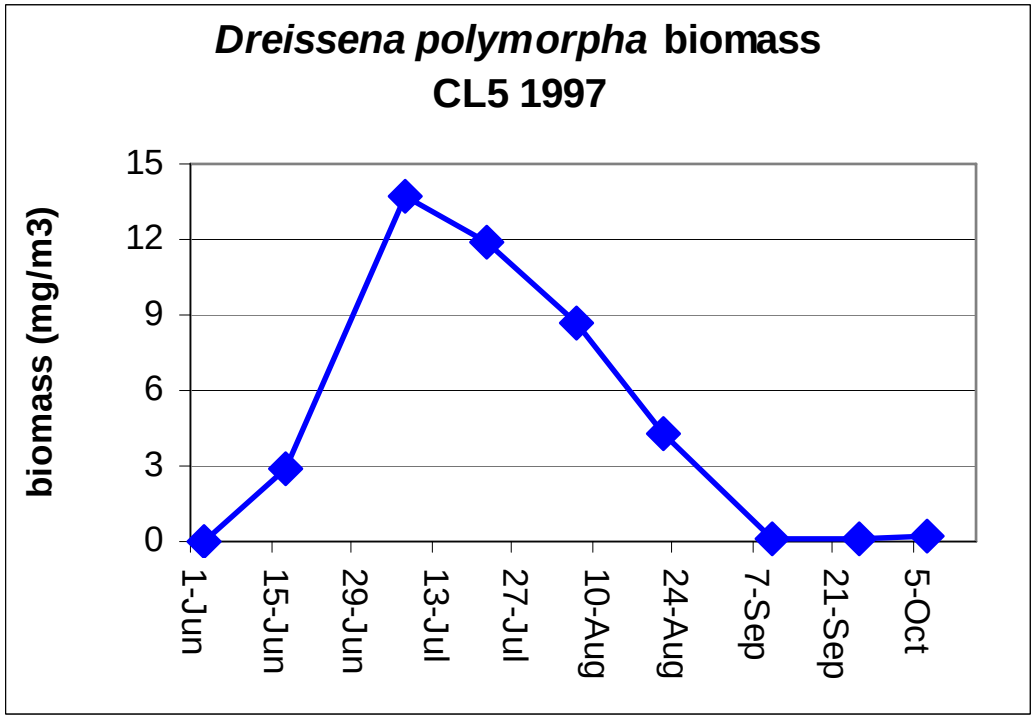


Figure 5 **Comparison of zebra mussel biomass (*Dreissena polymorpha*) biomass at Station LC5 between 1997 and 2003**



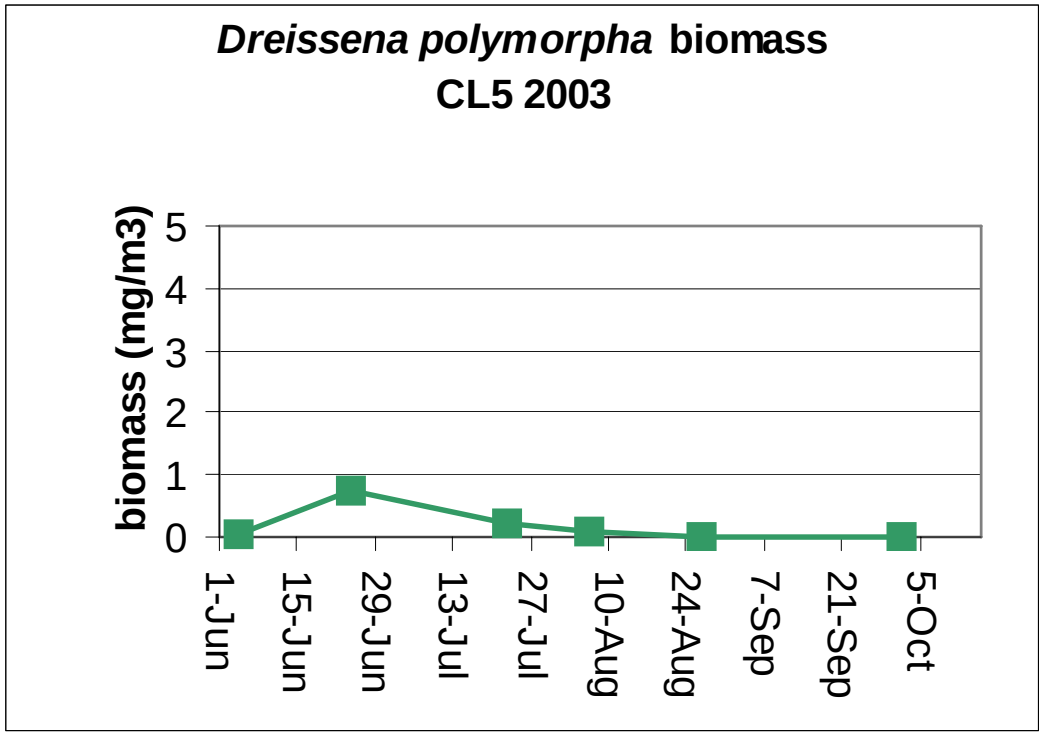


Figure 6 Location of communal water treatment plant intakes in Lake Couchiching, 2003

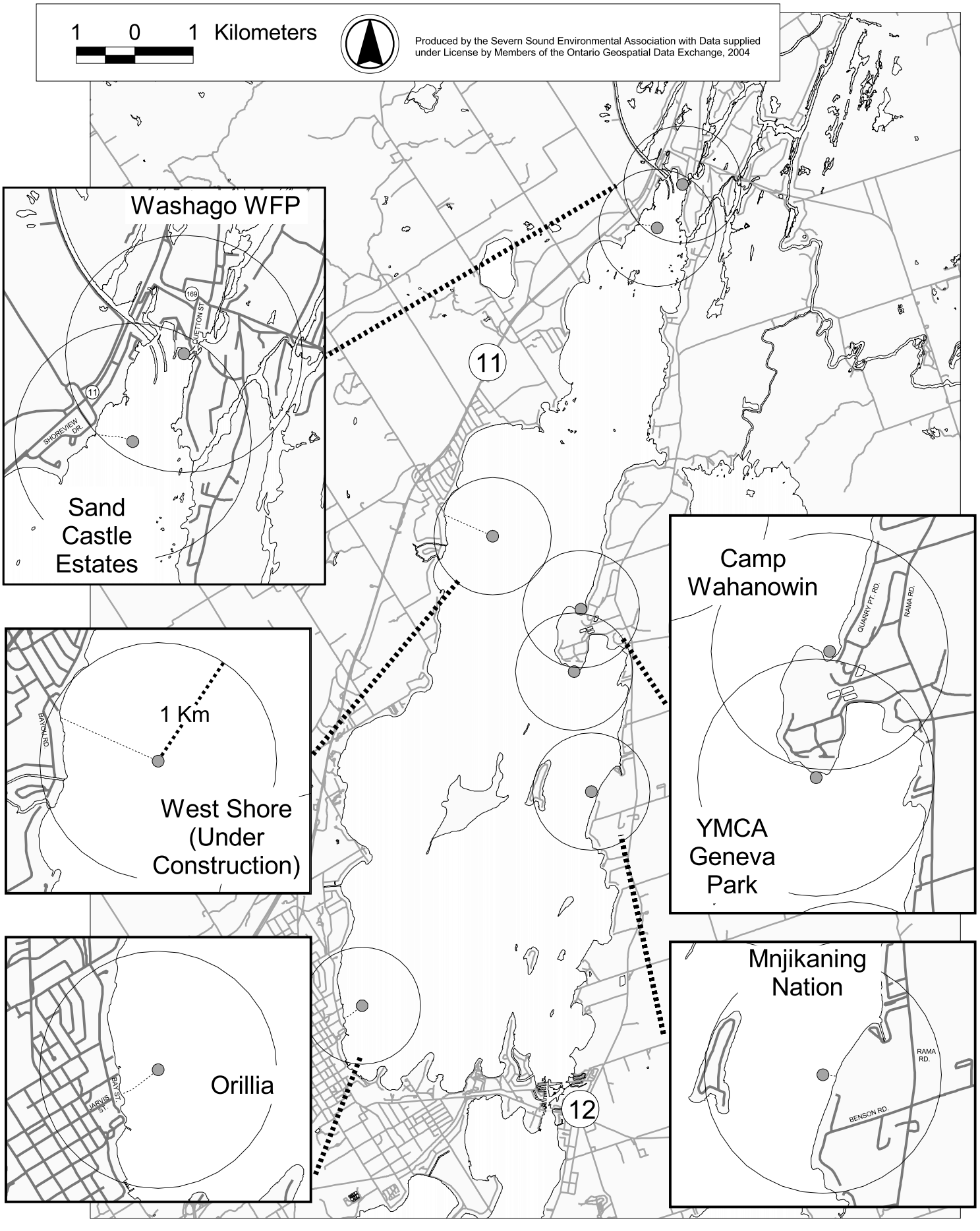
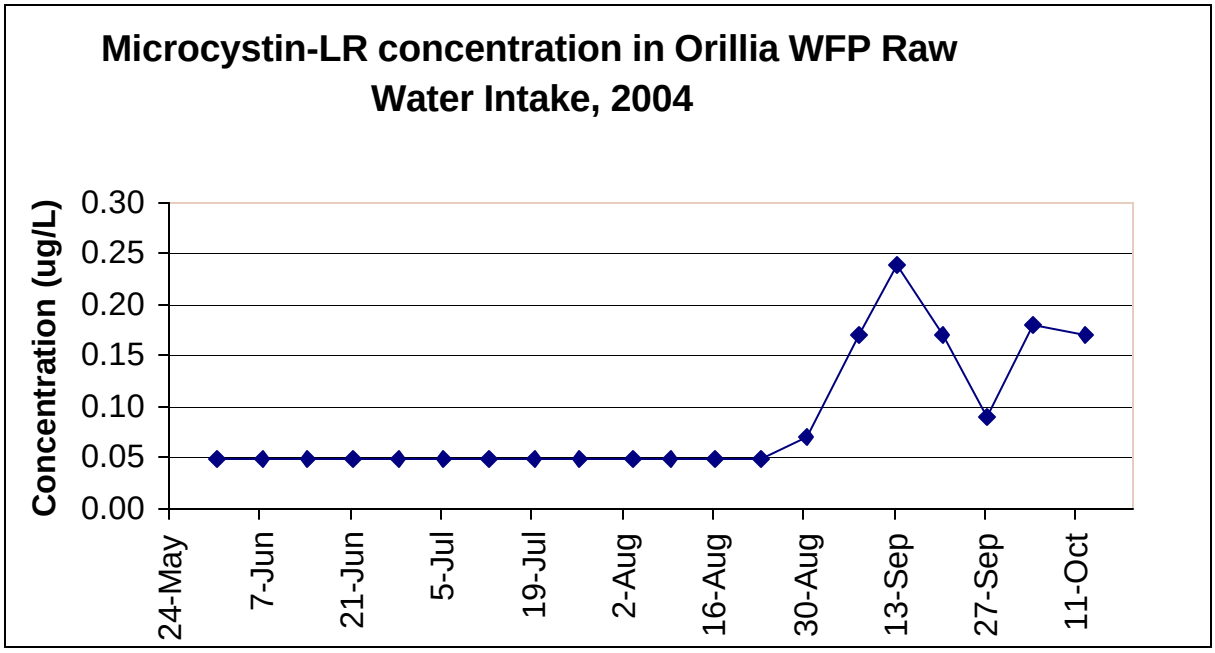


Figure 7 Microcystin-LR concentration in raw water from the Orillia Water Filtration Plant, 2004



Source: Ministry of the Environment analyses of samples taken by City of Orillia staff

Appendix 1 Open water quality data for stations in Lake Couchiching 2003

Measurements taken in the field 1 Meter Below Surface

Station	Date	Composite Depth (m)	Secchi Depth (m)	Temp. (oC)	D.O. (mg/L)	Conductivity (uS/cm)	pH	Chlorophyll a acidified (ug/L)	Chl. a (ug/L)	Chl. b (ug/L)	Dorset TP1 (ug/L)	Dorset TP2 (ug/L)	Dorset TP (ug/L)	Rexdale TP (mg/L)	Ammonia (mg/L)	TKN (mg/L)	Nitrate (mg/L)
LC0	06/04/03																
LC0	06/24/03							1	0.7	0.1	8.1	7.4	7.8	0.009	0.012	0.40	0.005
LC0	07/22/03							1	0.8	0.1	9.4	9.2	9.3	0.010	0.014	0.44	0.009
LC0	08/06/03							1	2.1	0.2	10.2	9.8	10.0	0.011	0.036	0.44	0.005
LC0	08/26/03							1	1.6	0.1	9.2	8.8	9.0	0.009	0.019	0.43	0.006
LC0	09/26/03							1	1.2	0.1	9.0	9.4	9.2	0.010	0.021	0.46	0.005
LC0	10/01/03							1	1.1	0.1	10.2	9.4	9.8	0.008	0.016	0.44	0.005
	mean							1.0	1.3	0.1			9.2	0.010	0.020	0.44	0.006
	sd							0.0	0.5	0.0			0.8	0.001	0.009	0.02	0.002
LC23	10/01/03							1	1.3	0.1	11.0	11.4	11.2	0.009	0.023	0.43	0.005
LC1	06/04/03	2.5	2.9	15.23	11.5	343		1	1.4	0.1	10.8	9.2	10.0	0.010	0.029	0.43	0.006
LC1	06/24/03	3	3.2	21.61	10.03	344	8.54	1	0.4	0.1	10.8	10.0	10.4	0.011	0.008	0.41	0.007
LC1	07/22/03	2	2.5	21.57	8.92	326	8.65	1	1.5	0.2	9.3	10.3	9.8	0.010	0.016	0.47	0.009
LC1	08/06/03	2.5	2.6	23.25	7.78	321	8.46	1	2.6	0.3	12.2	12.2	12.2	0.014	0.045	0.45	0.005
LC1	08/26/03	1.5	1.9	21.42	6.97	321	8.57	1	1.7	0.1	14.4	10.4	12.4	0.014	0.018	0.52	0.006
LC1	10/01/03	2	2.2	14.07	9.21	328	8.46	1	1.2	0.1	9.8	12.8	11.3	0.011	0.017	0.41	0.008
	mean	2.3	2.6	19.53	9.07	331	8.54	1.0	1.5	0.2			11.0	0.012	0.022	0.45	0.007
	sd	0.5	0.5	3.85	1.61	10	0.08	0.0	0.7	0.1			1.1	0.002	0.013	0.04	0.001
LC3	06/04/03	4	3.8	15.06	11.58	344		1	1.5	0.1	9.2	9.6	9.4	0.008	0.024	0.40	0.005
LC3	06/24/03	6	6.3	21.69	10.33	344	8.58	1	0.5	0.1	8.59	0.6	8.5	0.009	0.010	0.41	0.005
LC3	07/22/03	4	4.2	21.58	8.6	330	8.61	1	1.2	0.1	8.78	9.1	8.9	0.012	0.019	0.42	0.013
LC3	08/06/03	5	4.6	23.04	7.9	322	8.55	2	2.8	0.2	10.8	10.6	10.7	0.010	0.029	0.41	0.005
LC3	08/26/03	4.5	5.0	21.96	7	327	8.56	2	2.3	0.1	7.6	8.8	8.2	0.008	0.012	0.41	0.006
LC3	10/01/03	4.5	5.1	14.45	9.19	328	8.48	1	1.3	0.1	8.8	9.4	9.1	0.011	0.015	0.40	0.006
	mean	4.7	4.8	19.63	9.10	333	8.56	1.3	1.6	0.1			9.1	0.010	0.018	0.41	0.007
	sd	0.8	0.9	3.82	1.66	9	0.05	0.5	0.8	0.0			0.9	0.002	0.007	0.01	0.003
LC5	06/04/03	8	4.1	14.42	12.24	345		1	0.8	0.1	7.6	8.2	7.9	0.008	0.017	0.39	0.004
LC5	06/24/03	8	5.6	21.05	10.49	345	8.59	1	0.5	0.1	9.4	8.8	9.1	0.013	0.010	0.45	0.007
LC5	07/22/03	9	6.3	21.31	8.46	329	8.65	1	1.3	0.1	9.4	8.8	9.1	0.018	0.018	0.47	0.009
LC5	08/06/03	8	4.3	23.07	7.91	323	8.62	1	2.3	0.2	10.8	10.2	10.5				
LC5	08/26/03	8	5.1	22.65	7.11	325	8.54	1	1.7	0.1	11.2	13.6	12.4	0.011	0.010	0.47	0.007
LC5	10/01/03	7.5	6.2	14.17	9.5	327	8.52	1	1.5	0.1	10.0	10.6	10.3	0.007	0.016	0.44	0.006
	mean	8.1	5.3	19.45	9.29	332	8.58	1.0	1.4	0.1			9.9	0.011	0.014	0.44	0.007
	sd	0.5	0.9	4.06	1.87	10	0.05	0.0	0.6	0.0			1.6	0.004	0.004	0.03	0.002
LC12	06/04/03	1.5	1.8	15.84	11.05	347	8.4	1	0.8	0.1	9.0	9.0	9.0	0.007	0.024	0.40	0.005
LC12	06/24/03	1	1.3	23.16	11.18	336	8.62	1	0.3	0.1	9.1	8.3	8.7	0.020	0.017	0.42	0.005
LC12	07/22/03	1	1.6	22.48	10.23	317	8.85	1	1.8	0.1	10.1	10.5	10.3	0.049	0.014	0.68	0.009
LC12	08/06/03	1	1.4	23.67	8.25	318	8.55	2	3.5	0.3	9.8	10.6	10.2	0.012	0.028	0.46	0.005
LC12	08/26/03	1	1.5	22.53	7.67	314	8.74	1	1.9	0.1	8.0	10.0	9.0	0.009	0.017	0.46	0.005
LC12	10/01/03	1	1.3	11.95	10.29	321	8.59	1	1.7	0.1	10.4	10.4	10.4	0.007	0.018	0.44	0.005
	mean	1.1	1.5	19.94	9.78	326	8.63	1.2	1.7	0.1			9.6	0.017	0.020	0.48	0.006
	sd	0.2	0.2	4.86	1.47	13	0.16	0.4	1.1	0.1			0.8	0.016	0.005	0.10	0.002
LC14	06/04/03	3.5	4.1	15.5	10.75	350	8.4	1	0.8	0.1	7.6	7.4	7.5	0.006	0.025	0.39	0.006
LC14	06/24/03	3	3.7	22.49	9.65	346	8.46	1	0.3	0.1	7.8	7.8	7.8	0.010	0.014	0.39	0.005
LC14	07/22/03	3	3.6	22.12	8.46	329	8.65	1	1.7	0.1	10.3	10.3	10.3	0.012	0.014	0.45	0.074
LC14	08/06/03	3	3.5	23.36	8.07	323	8.59	2	2.6	0.2	10.6	10.2	10.4	0.010	0.026	0.41	0.005
LC14	08/26/03	3	3.3	22.84	7.47	320	8.68	2	2.4	0.1	8.2	9.6	8.9	0.009	0.022	0.46	0.008
LC14	10/01/03	3	3.6	14.51	9.15	323	8.52	2	1.9	0.1	10.2	10.4	10.3	0.009	0.011	0.41	0.007
	mean	3.1	3.6	20.14	8.93	332	8.55	1.5	1.6	0.1			9.2	0.009	0.019	0.42	0.018
	sd	0.2	0.3	4.01	1.18	13	0.11	0.5	0.9	0.0			1.3	0.002	0.006	0.03	0.028

Appendix 1 Open water quality data for stations in Lake Couchiching 2003

		Measurements taken in the field			1 Meter Below Surface												
Station	**Date**	**Composite Depth** (m)	**Secchi Depth**	**Temp.** (oC)	**D.O.** (mg/L) (m)	**Conductivity** (uS/cm)	**pH**	**Chlorophyll a acidified** (ug/L)	**Chl. a** (ug/L)	**Chl. b** (ug/L)	**Dorset TP1** (ug/L)	**Dorset TP2** (ug/L)	**Dorset TP** (ug/L)	**Rexdale TP** (mg/L)	**Ammonia** (mg/L)	**TKN** (mg/L)	**Nitrate** (mg/L)
LC15	06/04/03	7	3.5	15.39	10.92	349	8.44	1	0.8	0.1	7.6	6.6	7.1	0.008	0.018	0.37	0.007
LC15	06/24/03	8	6.9	21.89	10.34	345	8.56	1	0.3	0.1	6.9	7.4	7.1	0.010	0.011	0.40	0.007
LC15	07/22/03	9	4.8	21.9	8.39	331	8.62	1	1.4	0.1	9.1	9.2	9.2	0.011	0.011	0.43	0.011
LC15	08/06/03	8	3.8	23.19	7.88	323	8.58	2	2.9	0.2	12.8	11.2	12.0	0.013	0.034	0.42	0.005
LC15	08/26/03	7.4	3.7	22.82	7.2	320	8.62	2	2.4	0.1	10.6		10.6	0.010	0.009	0.44	0.005
LC15	10/01/03	9	5.2	15.05	9.66	323	8.52	1	1.8	0.1	9.4	8.8	9.1	0.010	0.010	0.43	0.005
	mean	8.1	4.7	20.04	9.07	332	8.56	1.3	1.6	0.1			9.2	0.010	0.015	0.42	0.007
	sd	0.8	1.3	3.77	1.47	12	0.07	0.5	1.0	0.0			1.9	0.002	0.010	0.03	0.002
LC17	06/04/03	6	3.5	14.69	10.91	346		1	1.2	0.1	9.0	9.0	9.0	0.011	0.022	0.43	0.025
LC17	06/24/03	3.5	3.6	21.24	10.48	344	8.6	1	0.6	0.1	9.5	8.8	9.1	0.021	0.019	0.43	0.015
LC17	07/22/03	7	6.2	21.42	8.49	327	8.71	1	1.2	0.1	10.9	10.8	10.8	0.011	0.017	0.44	0.009
LC17	08/06/03	7	4.3	23.29	7.67	321	8.62	1	2.3	0.2	9.2	9.8	9.5	0.009	0.021	0.42	0.007
LC17	08/26/03	5	4.8	22.95	7.04	324	8.57	1	1.7	0.1	13.8	10.8	12.3	0.013	0.011	0.47	0.007
LC17	10/01/03	6.5	4.7	13.26	9.06	326	8.51	1	1.4	0.1	8.6	9.6	9.1	0.007	0.020	0.45	0.007
	mean	5.8	4.5	19.48	8.94	331	8.60	1.0	1.4	0.1			10.0	0.012	0.018	0.44	0.012
	sd	1.4	1.0	4.36	1.53	11	0.07	0.0	0.6	0.0			1.3	0.005	0.004	0.02	0.007
LC19	06/04/03	2	2.4	10.08	12.86	357		1	0.9	0.1	7.0	6.8	6.9	0.006	0.019	0.36	0.025
LC19	06/24/03																
LC19	07/22/03	1	1.2	20.44	8.71	355	8.5	5	6.6	1.8	12.3	11.6	12.0	0.017	0.018	0.46	0.009
LC19	08/06/03	1	1.1	22.92	6.74	356	8.15	1	1.6	0.3	13.2	13.6	13.4	0.012	0.055	0.43	0.005
LC19	08/26/03	1.5	1.9	20.72	6.72	350	8.3	1	0.5	0.1	9.8	8.8	9.3	0.008	0.011	0.38	0.005
LC19	10/01/03	2	2.6	13.46	8.74	355	8.29		1.7	0.5	9.4	8.8	9.1	0.010	0.034	0.42	0.019
	mean	1.5	1.8	17.52	8.75	355	8.31	2.0	2.3	0.6			10.1	0.011	0.027	0.41	0.013
	sd	0.5	0.7	5.47	2.50	3	0.14	2.0	2.5	0.7			2.6	0.004	0.018	0.04	0.009
LC21	06/04/03	2	2.9	15.71	10.87	348		1	1.0	0.1	6.4	6.8	6.6	0.009	0.019	0.40	0.005
LC21	06/24/03	2	2.5	21.44	10.61	340	8.6	1	0.2	0.1	8.8	10.5	9.7	0.008	0.011	0.42	0.005
LC21	07/22/03	2	2.4	21.97	8.96	325	8.69	1	1.2	0.1	9.2	11.0	10.1	0.018	0.008	0.45	0.015
LC21	08/06/03	2	2	22.79	7.9	322	8.51	1	2.7	0.2	13.8	11.2	12.5	0.012	0.042	0.41	0.005
LC21	08/26/03	2	2.4	22	7.03	322	8.57	2	2.5	0.1	8.2	8.6	8.4	0.009	0.018	0.45	0.006
LC21	10/01/03	2	2.4	14.15	9.23	324	8.54	1	1.8	0.1	12.0	12.0	12.0	0.006	0.012	0.43	0.005
	mean	2.0	2.4	19.68	9.10	330	8.58	1.2	1.6	0.1			9.9	0.010	0.018	0.43	0.007
	sd	0.0	0.3	3.73	1.49	11	0.07	0.4	1.0	0.0			2.2	0.004	0.012	0.02	0.004
LC22	06/04/03	4	3.8	15.06	11.58	344		1	1.1	0.1	9.0	8.4	8.7	0.008	0.020	0.42	0.007
LC22	06/24/03	7	7.5	21.81	9.91	341	8.56	1	0.2	0.1	8.0	8.9	8.4	0.013	0.013	0.42	0.005
LC22	07/22/03	7	5.4	21.7	8.93	323	8.73	1	1.2	0.1	11.6	14.7	13.1	0.011	0.014	0.44	0.012
LC22	08/06/03	3	3.3	23.09	7.83	321	8.55	2	3.0	0.2	10.6	11.6	11.1	0.010	0.032	0.41	0.005
LC22	08/26/03	6	4.6	22.18	7.25	320	8.62	2	2.4	0.1	10.2	8.8	9.5	0.009	0.015	0.44	0.005
LC22	10/01/03	6	6.7	14.19	9.39	325	8.56	1	1.4	0.1	9.6	10.2	9.9	0.009	0.012	0.41	0.006
	mean	5.5	5.2	19.67	9.15	329	8.60	1.3	1.6	0.1			10.1	0.010	0.018	0.42	0.007
	sd	1.6	1.6	3.95	1.55	11	0.08	0.5	1.0	0.0			1.8	0.002	0.008	0.01	0.003

Appendix 1

Station	Date	Total N (mg/L)	Silicate (mg/L)	DIC (mg/L)	DOC (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potasium (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Hardness (mg/L)	N:P
LC0	06/04/03												
LC0	06/24/03	0.405	0.92	24.7	3.8	38.5	7.28	19.1	1.96	33.3	19.2	126	52.3
LC0	07/22/03	0.449	1.16	21.9	4.2	32.6	7.42	19.0	1.81	33.9	19.5	112	48.1
LC0	08/06/03	0.445	1.36	21.3	4.4	34.4	7.40	19.4	1.67	33.9	19.4	116	44.5
LC0	08/26/03	0.436	1.66	20.8	4.5	33.2	7.44	19.3	1.68	34.5	19.6	113	48.4
LC0	09/26/03	0.465	1.70	21.8	4.5	35.2	7.68	20.1	1.84	34.7	20.1	119	50.5
LC0	10/01/03	0.445	1.68	21.8	4.5	34.8	7.64	19.9	1.86	34.5	20.1	118	45.4
	mean	0.441	1.41	22.1	4.3	34.8	7.48	19.5	1.80	34.13	19.7	117	48.2
	sd	0.020	0.32	1.4	0.3	2.1	0.15	0.4	0.11	0.53	0.4	5	2.9
LC23	10/01/03	0.435	1.66	21.8	4.4	35.6	7.74	20.0	1.89	34.5	20.4	121	38.8
LC1	06/04/03	0.436	0.68	24.6	4.6	38.3	7.32	19.2	1.94	33.2	19.1	126	43.6
LC1	06/24/03	0.417	0.84	24.3	4.0	37.2	7.24	19.1	1.96	33.5	19.2	123	40.1
LC1	07/22/03	0.479	1.18	21.8	4.3	32.6	7.34	19.0	1.78	33.6	19.2	111	48.8
LC1	08/06/03	0.455	1.44	20.5	4.4	32.3	7.34	19.7	1.70	33.6	19.9	111	37.3
LC1	08/26/03	0.526	1.74	19.3	4.8	31.2	7.52	19.5	1.60	34.9	19.7	109	42.4
LC1	10/01/03	0.418	1.66	21.6	4.4	36.2	7.56	19.8	1.89	34.4	20.2	121	37.0
	mean	0.455	1.26	22.0	4.4	34.6	7.39	19.4	1.81	33.87	19.6	117	41.5
	sd	0.042	0.43	2.1	0.3	3.0	0.13	0.3	0.14	0.64	0.5	7	4.4
LC3	06/04/03	0.405	0.80	24.6	4.6	39.3	7.30	18.8	1.90	33.0	19.3	128	43.1
LC3	06/24/03	0.415	0.88	24.7	3.9	38.2	7.36	19.1	1.93	33.5	19.3	126	48.8
LC3	07/22/03	0.433	1.12	22.6	4.5	32.9	11.00	18.9	1.83	33.8	19.3	127	48.5
LC3	08/06/03	0.415	1.30	20.4	4.2	32.9	7.34	19.8	1.72	33.8	19.5	112	38.8
LC3	08/26/03	0.416	1.64	21.1	4.3	33.7	7.32	19.6	1.69	34.4	19.9	114	50.7
LC3	10/01/03	0.406	1.68	21.6	4.5	36.0	7.58	20.0	1.87	34.6	20.0	121	44.6
	mean	0.415	1.24	22.5	4.3	35.5	7.98	19.4	1.82	33.85	19.6	121	45.8
	sd	0.010	0.37	1.8	0.3	2.8	1.48	0.5	0.10	0.59	0.3	7	4.4
LC5	06/04/03	0.394	0.86	24.6	4.6	40.6	7.32	18.9	1.98	33.1	19.3	131	49.9
LC5	06/24/03	0.457	0.86	24.4	4.1	37.6	7.32	18.9	1.96	33.5	19.4	124	50.4
LC5	07/22/03	0.479	1.12	22.3	4.4	34.1	7.48	19.1	1.78	33.7	19.2	116	52.6
LC5	08/06/03												
LC5	08/26/03	0.477	1.70	21.4	5.1	33.1	7.70	19.4	1.70	34.4	19.4	114	38.5
LC5	10/01/03	0.446	1.66	21.5	4.5	36.1	7.68	20.2	1.86	34.7	20.4	122	43.3
	mean	0.451	1.24	22.8	4.5	36.3	7.50	19.3	1.86	33.88	19.5	121	46.9
	sd	0.035	0.42	1.6	0.4	3.0	0.19	0.5	0.12	0.66	0.5	7	5.9
LC12	06/04/03	0.405	0.56	24.1	4.6	38.9	7.12	20.1	1.94	35.1	18.6	126	45.0
LC12	06/24/03	0.425	0.60	23.1	4.0	35.5	7.20	19.8	1.94	34.5	18.6	118	49.0
LC12	07/22/03	0.689	0.94	19.9	4.5	30.6	7.38	19.7	1.77	34.2	18.9	107	66.8
LC12	08/06/03	0.465	1.28	19.7	4.6	31.4	7.36	19.9	1.73	34.1	18.9	109	45.6
LC12	08/26/03	0.465	1.40	19.2	4.6	28.5	7.52	20.0	1.70	35.0	18.9	102	51.7
LC12	10/01/03	0.445	1.58	20.4	4.8	35.2	7.62	20.7	1.78	34.7	19.5	119	42.8
	mean	0.482	1.06	21.1	4.5	33.4	7.37	20.0	1.81	34.60	18.9	114	50.1
	sd	0.104	0.43	2.0	0.3	3.8	0.19	0.4	0.10	0.41	0.3	9	8.8
LC14	06/04/03	0.396	0.60	24.7	4.5	39.7	7.20	19.9	1.88	34.8	18.8	129	52.8
LC14	06/24/03	0.395	0.58	24.3	3.6	38.3	7.24	19.1	1.92	34.3	18.8	125	50.5
LC14	07/22/03	0.524	0.90	22.1	4.6	33.5	7.38	19.6	1.83	34.1	19.2	114	50.9
LC14	08/06/03	0.415	1.20	20.3	4.3	32.5	7.50	20.1	1.83	34.1	19.1	112	39.9
LC14	08/26/03	0.468	1.34	19.0	4.5	31.5	7.40	19.6	1.69	35.0	19.2	109	52.6
LC14	10/01/03	0.417	1.66	20.9	4.6	35.7	7.68	20.2	1.80	34.8	19.9	121	40.5
	mean	0.436	1.05	21.9	4.4	35.2	7.40	19.8	1.83	34.52	19.2	118	47.9
	sd	0.051	0.43	2.3	0.4	3.3	0.18	0.4	0.08	0.40	0.4	8	6.0

Appendix 1

Station	Date	Total N (mg/L)	Silicate (mg/L)	DIC (mg/L)	DOC (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potasium (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Hardness (mg/L)	N:P
LC15	06/04/03	0.377	0.62	24.3	4.5	41.0	7.18	20.0	1.93	34.5	18.7	132	53.1
LC15	06/24/03	0.407	0.64	24.5	3.7	38.0	7.26	19.6	1.95	34.1	18.9	125	57.0
LC15	07/22/03	0.441	0.90	22.0	4.5	32.9	7.32	19.2	1.80	34.1	19.0	112	48.0
LC15	08/06/03	0.425	1.16	20.6	4.3	34.2	7.38	19.7	1.69	34.0	19.2	116	35.4
LC15	08/26/03	0.445	1.46	19.6	4.8	31.6	7.30	19.6	1.71	35.4	19.1	109	42.0
LC15	10/01/03	0.435	1.68	20.8	4.6	33.5	7.66	20.0	1.75	34.8	19.8	115	47.8
	mean	0.422	1.08	22.0	4.4	35.2	7.35	19.7	1.80	34.48	19.1	118	47.2
	sd	0.026	0.44	2.0	0.4	3.6	0.17	0.3	0.11	0.54	0.4	9	7.7
LC17	06/04/03	0.455	0.84	25.5	4.7	39.7	7.32	19.2	2.05	33.2	19.4	129	50.6
LC17	06/24/03	0.445	0.78	24.7	3.7	38.7	7.26	19.1	1.93	34.0	19.3	127	48.7
LC17	07/22/03	0.449	1.12	21.5	4.6	32.9	7.44	19.4	1.77	34.3	19.4	113	41.6
LC17	08/06/03	0.427	1.26	20.3	4.4	32.6	7.30	19.9	1.73	34.2	19.2	111	44.9
LC17	08/26/03	0.477	1.66	20.0	4.8	32.8	7.62	19.6	1.64	35.0	19.7	113	38.8
LC17	10/01/03	0.457	1.68	21.6	4.6	36.2	7.70	20.3	1.82	35.1	20.1	122	50.2
	mean	0.452	1.22	22.3	4.5	35.5	7.44	19.6	1.82	34.30	19.5	119	45.8
	sd	0.016	0.39	2.3	0.4	3.2	0.18	0.5	0.15	0.70	0.3	8	4.9
LC19	06/04/03	0.385	1.44	25.9	4.5	43.2	7.42	18.7	1.96	32.6	19.9	138	55.8
LC19	06/24/03												
LC19	07/22/03	0.469	1.38	25.5	4.0	38.9	7.32	19.1	1.87	33.5	19.8	127	39.1
LC19	08/06/03	0.435	1.54	25.4	4.0	40.5	7.34	19.5	1.95	33.3	20.0	131	32.5
LC19	08/26/03	0.385	1.56	24.5	4.4	40.5	7.54	19.3	1.97	34.9	20.0	132	41.4
LC19	10/01/03	0.439	1.76	25.3	4.1	41.7	7.62	19.6	2.08	33.9	20.4	136	48.2
	mean	0.423	1.54	25.3	4.2	41.0	7.45	19.2	1.97	33.64	20.0	133	43.4
	sd	0.037	0.15	0.5	0.2	1.6	0.13	0.4	0.08	0.85	0.2	4	8.9
LC21	06/04/03	0.405	0.56	24.7	4.4	39.5	7.32	19.8	1.96	34.5	18.8	129	61.4
LC21	06/24/03	0.425	0.58	23.8	4.0	36.8	7.18	19.5	1.93	34.1	18.7	121	43.9
LC21	07/22/03	0.465	0.96	21.4	4.6	32.4	7.30	18.9	1.77	34.0	19.2	111	46.1
LC21	08/06/03	0.415	1.26	20.1	4.5	33.4	7.36	19.6	1.72	34.0	19.0	114	33.2
LC21	08/26/03	0.456	1.58	20.0	4.7	31.4	7.38	19.7	1.72	35.0	19.2	109	54.3
LC21	10/01/03	0.435	1.70	21.2	4.5	34.5	7.68	19.9	1.78	34.7	19.8	118	36.3
	mean	0.434	1.11	21.9	4.5	34.7	7.37	19.6	1.81	34.38	19.1	117	45.8
	sd	0.023	0.49	2.0	0.2	3.0	0.17	0.4	0.11	0.42	0.4	7	10.7
LC22	06/04/03	0.427	0.52	24.5	4.8	39.6	7.26	20.0	1.96	35.1	18.7	129	49.1
LC22	06/24/03	0.425	0.58	23.8	3.9	36.9	7.20	19.6	1.95	34.2	19.0	122	50.4
LC22	07/22/03	0.452	1.06	21.4	4.3	31.3	7.24	19.3	1.79	33.9	19.2	108	34.4
LC22	08/06/03	0.415	1.32	20.2	4.3	32.5	7.44	19.9	1.77	33.8	19.5	112	37.4
LC22	08/26/03	0.445	1.66	20.1	4.7	32.0	7.50	19.5	1.69	33.9	19.1	111	46.8
LC22	10/01/03	0.416	1.70	21.1	4.5	34.8	7.70	20.0	1.81	34.6	19.7	119	42.0
	mean	0.430	1.14	21.9	4.4	34.5	7.39	19.7	1.83	34.25	19.2	117	43.4
	sd	0.015	0.51	1.9	0.3	3.2	0.19	0.3	0.11	0.51	0.4	8	6.5

Appendix 2.1 **Phytoplankton Encountered in Lake Couchiching**
Station LC0
(Biovolume mm3/m3)

Taxon	22-Jul-03	06-Aug-03	26-Aug-03	26-Sep-03	01-Oct-03
Cyanophytes					
Anabaena	2.56	present	2.84	0.7	0.27
Aphanizomenon					
Aphanocapsa					
Aphanothece	1.11	0.81	0.52	0.02	0.58
Chroococcus	9.99	8.94	1.86	0.59	0.18
Gloeotrichia					0.04
Gomphosphaeria	0.01	0.51	0.19	0.02	0.23
Lyngbya	present	0.19			
Merismopedia	0.46	0.03	0.21	0.01	
Microcystis aeruginosa					
M. novacekii					
M. viridis					
Microcystis	28.78	48.9	35.58	73.94	52.5
*Microcystis**					
Oscillatoria Agardhii					
O. limnetica					
O. Redeckei					
Oscillatoria	0.06	5.94	0.47	0.39	0.21
Phormidium mucicola		0.46	0.4	0.38	0.96
Radiocystis					
Romeria					
unid blue-green					
Sub-total	42.97	65.78	42.07	76.05	54.97
Dinophytes					
Ceratium			8.65		
Gymnodinium			0.63	3.61	1.45
Peridinium	0.79		1.5	7.06	0.17
Sub-total	0.79	0	10.78	10.67	1.62
Cryptophytes					
Chroomonas					
Cryptomonas	5.39	30.01	3.67	1.51	1.76
Cyathomonas					
Katablepharis	0.09	1.18		0.1	
Rhodomonas	7.29	27.63	15.78	11.31	11.01
Sub-total	12.77	58.82	19.45	12.92	12.77
EUGLENO					
Euglena				1.13	
Trachelomonas					
unid eugleno					
Sub-total	0	0	0	1.13	0

Appendix 2.1 **Phytoplankton Encountered in Lake Couchiching**
Station LC0
(Biovolume mm3/m3)

Taxon	22-Jul-03	06-Aug-03	26-Aug-03	26-Sep-03	01-Oct-03
Chrysophytes					
banana chrysophyte	1.22				
Bicosoeca		0.15	0.27		
Chromulina	10.73	4.92	6.09	2.65	10.85
Chrysochrom parva	0.17	0.52	3.86	0.09	0.11
Chrysolykos					
Codonocladium		3.73	1.99		0.09
Codonosiga					
Desmarella	0.07			0.03	
Dinobryon	0.06		0.77		present
Epipyxis	0.48		0.07		0.09
Kephyrion	0.06	0.03			0.06
Kephyrion/Pseudokephyrion					
Mallomonas	2.62	6.12	0.77		present
Ochromonas	0.13				
Pseudokephyrion					
Rhizochrysis					
Salpingoeca	0.07			0.07	
Spiniferomonas	2.12	0.48	0.44	1.38	0.07
Synura					
unid chryso cyst					0.41
unid chrysomonad	0.96	0.26	7.55	0.82	0.65
Uroglena	0.23		0.19		
Sub-total	18.92	16.21	22	5.04	12.33
Chlorophytes					
Ankistrodesmus	0.01	present			
Botryococcus				0.46	
Carteria					
Chlamydomonas	1.77		0.31	0.7	
Closterium					
Coccomyxa	1.36	0.41	0.12	0.66	0.41
Coelastrum	1.03	2.05	2.11	0.23	1.58
Cosmarium		1.88	4.15	0.03	
Dictyosphaerium	0.09	0.13	0.11	0.13	
Elakatothrix				0.13	
Euastrum					
Franceia					
Gloeocystis/Sphaerocystis			8.93	4.17	
Gloeocystis	3.96	2.32			5.19
Golenkinia	0.37	1.14		0.55	
Kirchneriella			0.03	0.17	
Monomastix					
Mougeotia					
Oedogonium					
Oocystis	0.94	0.13	0.73	0.83	1.99
Pediastrum	0.89		0.29		
Pedinomonas	0.02	0.41			
Polytoma					
Quadrigula					
Scenedesmus	1.86	0.42	0.28	1.34	0.75
Scourfieldia	0.14				
Spermatozopsis					
Sphaerocystis					
Sphaerozosma					
Spirogyra					
Staurastrum					
Tetraëdron	present	0.07			
Tetrastrum			2.67		
unid. green	0.45	0.09			0.78
Xanthidium					
Zygnema					
Sub-total	12.89	9.05	19.73	9.4	10.7

Appendix 2.1 **Phytoplankton Encountered in Lake Couchiching**
Station LC0
(Biovolume mm3/m3)

Taxon	22-Jul-03	06-Aug-03	26-Aug-03	26-Sep-03	01-Oct-03
Bacillariophytes					
Achnanthes	0.2	1.94	0.12	0.26	0.29
Amphipleura					
Amphora					
Anomoeoneis					
Asterionella		0.38	0.49	0.05	0.16
Campylodiscus					
Ceratoneis					
Cocconeis	2.32	2.17	0.2		0.36
Cyclotella	2.72	4.85	2.13	0.35	2.51
Cymbella	present				0.15
Denticula					
Diatoma					
Diatoma elongatum					
Epithemia		0.5	1.94		0.51
Eunotia					0.04
Fragilaria	6.73	12.72	147.78	12.62	0.1
Frustulia					
Gomphonema	0.3	0.1	0.24	0.24	1.31
Gyrosigma	0.81				
Mastogloia				0.54	
Melosira					
Navicula	0.26	0.54	0.37	0.22	present
Nitzschia			0.09		0.32
Pinnularia					
Rhizosolenia	2.3	1.69			
Rhopalodia		present		0.38	
Stenopterobia					
Stephanodiscus Binderanus					
Surirella					
Synedra	0.19	0.16	0.02	0.08	0.01
Synedra ulna				1.47	
unid. diatom	0.33		0.18		
Sub-total	16.16	25.05	153.56	16.21	5.76
Total biovolume	104.5	174.91	267.59	131.42	98.15
Ice-Free Average					155

Appendix 2.2

Phytoplankton Encountered in Lake Couchiching
Station LC3
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Cyanophytes						
Anabaena		8.27	6.59	31.6	11.48	
Aphanizomenon						
Aphanocapsa						
Aphanothece		present	3.17	4.3	0.26	0.2
Chroococcus	1.14	0.8	19.17	5.42	4.58	0.39
Gloeotrichia						0.24
Gomphosphaeria	0.03		0.22	0.17	0.61	0.19
Lyngbya	present					
Merismopedia	present		0.2	0.12	2.03	
Microcystis aeruginosa						
M. novacekii						
M. viridis						
Microcystis	1.44	1.15	41.31	190.03	30.57	61.54
*Microcystis**						
Oscillatoria Agardhii						
O. limnetica						
O. Redeckei						
Oscillatoria	6.19		0.55	0.09	1.48	0.27
Phormidium mucicola				0.22	0.26	0.35
Radiocystis					0.35	0.04
Romeria						
unid blue-green						
Sub-total	8.8	10.22	71.21	231.95	51.62	63.22
Dinophytes						
Ceratium					present	
Gymnodinium	16.85	2.33	3.53	3.38		4.83
Peridinium	206.04	10.77	1.23		0.29	2.4
Sub-total	222.89	13.1	4.76	3.38	0.29	7.23
Cryptophytes						
Chroomonas						
Cryptomonas	4.81	2.23	3.4	5.17	35.18	8.92
Cyathomonas						
Katablepharis	8.96	0.13	1.43	3.32	0.54	0.81
Rhodomonas	18	8.85	2.26	4.72	9.3	8.57
Sub-total	31.77	11.21	7.09	13.21	45.02	18.3
EUGLENO						
Euglena						
Trachelomonas						
unid eugleno				1.61		
Sub-total	0	0	0	1.61	0	0

Appendix 2.2

Phytoplankton Encountered in Lake Couchiching
Station LC3
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Chrysophytes						
banana chrysophyte			0.73			
Bicosoeca						
Chromulina	26.57	7.66	27.42	11.53	11.95	4.38
Chrysochrom parva	0.88	3.82	3.63	2.93	4.75	1.48
Chrysolykos						
Codonocladium	1.34			2.6		
Codonosiga						
Desmarella	0.17			0.23	0.18	
Dinobryon	85.06	16.71	1.25	present	5.79	
Epipyxis			0.35			
Kephyrion			0.09	0.12	0.12	0.09
Kephyrion/Pseudokephyrion	3.31	0.29				
Mallomonas		15.42	9.82	5.19	19.84	1.74
Ochromonas	1.17	0.67				0.01
Pseudokephyrion						
Rhizochrysis						
Salpingoeca				0.36	0.24	
Spiniferomonas	0.39	3.08	5.04	2.02		1.42
Synura	4.55	1.23				1.97
unid chryso cyst				0.14	0.41	
unid chrysomonad	2.59	2.89		0.64	2.99	9.9
Uroglena	207.11	54.14	3.33		45.22	
Sub-total	333.14	105.91	51.66	25.76	91.49	20.99
Chlorophytes						
Ankistrodesmus						
Botryococcus						
Carteria					2.28	0.14
Chlamydomonas	0.09	1	2.7	2.22	2.77	0.18
Closterium						
Coccomyxa	0.05	0.02	2.69	0.94	0.23	0.51
Coelastrum			3.91	3.71	1.09	0.69
Cosmarium					4.51	
Dictyosphaerium						0.04
Elakatothrix					0.1	
Euastrum						
Franceia						
Gloeocystis/Sphaerocystis			5.27		17.96	4.46
Gloeocystis	0.17	0.53	8.02	8.19		
Golenkinia			3.69	1.85		
Kirchneriella			0.02	1.33		
Monomastix						
Mougeotia	0.18					
Oedogonium	0.44					
Oocystis	0.78		3.71	0.88		
Pediastrum			0.57	present		0.51
Pedinomonas	1.06	1.15		0.2		
Polytoma				0.06		
Quadrigula				0.07		
Scenedesmus	1.54	4.37	0.35	0.89	3.65	0.21
Scourfieldia			0.27			
Spermatozopsis						
Sphaerocystis						
Sphaerozosma						
Spirogyra						
Staurastrum						
Tetraëdron		0.2				
Tetrastrum			0.43		1.01	
unid. green		0.43	0.6	0.39		0.71
Xanthidium						
Zygnema						
Sub-total	4.31	7.7	32.23	20.73	33.6	7.45

Appendix 2.2

Phytoplankton Encountered in Lake Couchiching
Station LC3
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Bacillariophytes						
Achnanthes	0.52		0.5	0.92	0.61	0.24
Amphipleura						
Amphora						
Anomoeoneis						
Asterionella	4.87	15.58		present	5.4	
Campylodiscus						
Ceratoneis				0.02		
Cocconeis	0.53		0.12	present	0.23	0.73
Cyclotella	5.69	192.31	4.3	4.8	2.59	4.69
Cymbella	present				0.2	
Denticula						
Diatoma						
Diatoma elongatum						
Epithemia	0.19		1.33			
Eunotia	2.29					
Fragilaria	2.76	7.42	4.89	5.98	346.21	
Frustulia						
Gomphonema			0.82	0.56	0.2	present
Gyrosigma						
Mastogloia						
Melosira						
Navicula	6.06	0.13		0.19	0.07	
Nitzschia	0.94					0.22
Pinnularia						
Rhizosolenia		1.09	1.98	1.03		1.09
Rhopalodia	5.49					
Stenopterobia						
Stephanodiscus Binderanus	0.41					
Surirella						
Synedra	3.51	0.08	0.52	0.84	0.19	0.03
Synedra ulna			0.52			
unid. diatom						
Sub-total	33.26	216.61	14.98	14.34	355.7	7
Total biovolume	634.17	364.75	181.93	310.98	577.72	124.19
Ice-Free Average						366

Appendix 2.3 **Phytoplankton Encountered in Lake Couchiching**
Station LC5
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Cyanophytes						
Anabaena			0.26	0.4	0.55	0.14
Aphanizomenon			0.22			
Aphanocapsa				0.64	2.46	
Aphanothece			1.23	3.58	1.02	0.08
Chroococcus		0.3	10.07	7.31	7.05	0.98
Gloeotrichia						
Gomphosphaeria				3.29	0.36	0.09
Lyngbya						
Merismopedia			present	1.75	0.32	present
Microcystis aeruginosa						
M. novacekii						
M. viridis						
Microcystis	1.62	13.97	42.42	207.82	48.12	54.01
*Microcystis**						
Oscillatoria Agardhii						
O. limnetica						
O. Redeckei						
Oscillatoria	0.13		0.54	0.29	0.03	0.86
Phormidium mucicola				0.83	0.58	0.11
Radiocystis						
Romeria						
unid blue-green					0.32	
Sub-total	1.75	14.27	54.74	225.91	60.81	56.27
Dinophytes						
Ceratium					1.77	
Gymnodinium	17.51		4.52	2.68		2.32
Peridinium	29.91	8.72	2.6	2.49	2.49	0.12
Sub-total	47.42	8.72	7.12	5.17	4.26	2.44
Cryptophytes						
Chroomonas						
Cryptomonas	1.75		7.16	16.99	8.87	2.22
Cyathomonas						
Katablepharis	3.55	3.25	1.29	0.75		0.4
Rhodomonas	16.96	2.41	2.64	13.84	8.47	9.49
Sub-total	22.26	5.66	11.09	31.58	17.34	12.11
EUGLENO						
Euglena						0.12
Trachelomonas						
unid eugleno						
Sub-total	0	0	0	0	0	0.12

Appendix 2.3 **Phytoplankton Encountered in Lake Couchiching**
Station LC5
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Chrysophytes						
banana chrysophyte		0.12	1.03			
Bicosoeca	present	0.27	0.95	0.14	0.14	0.14
Chromulina	7.64	4.47	20.84	1.82	11.05	6.14
Chrysochrom parva	2.94		1.87	5.06	4.79	0.47
Chrysolykos	0.26					
Codonocladium				1.58	3.67	0.14
Codonosiga				0.47		
Desmarella			0.06	0.36	0.17	
Dinobryon	97.57	10.76	0.33		7.82	0.02
Epipyxis			0.59			
Kephyrion				0.06		0.06
Kephyrion/Pseudokephyrion	1.36	1.63	0.06			
Mallomonas	0.62	12.51	6.51	7.24	2.1	
Ochromonas				0.04	0.05	
Pseudokephyrion			0.06			
Rhizochrysis	1.1					
Salpingoeca					0.2	
Spiniferomonas	0.56		2.81	0.74	0.47	
Synura						
unid chryso cyst	3.39		0.2			0.36
unid chrysomonad	4.74	5.57	7.17	0.72	9.23	0.9
Uroglena	177.28	5.94			21.5	
Sub-total	297.46	41.27	42.48	18.23	61.19	8.23
Chlorophytes						
Ankistrodesmus						
Botryococcus					2.14	2.36
Carteria						
Chlamydomonas		1.09	2.18	0.8	1.07	
Closterium					0.25	
Coccomyxa		0.18	1.15	1.07	0.02	0.09
Coelastrum			0.42	4.47	4.67	0.06
Cosmarium					2.05	
Dictyosphaerium					1.38	
Elakatothrix						
Euastrum						
Franceia						
Gloeocystis/Sphaerocystis						
Gloeocystis		0.37	11.54	7.95	1.2	0.91
Golenkinia			2.21	1.1		
Kirchneriella						
Monomastix						
Mougeotia						
Oedogonium						
Oocystis		present	3.64	0.28	8.78	0.44
Pediastrum			0.51			
Pedinomonas						
Polytoma			0.06			
Quadrigula				present		
Scenedesmus	present	8.21	1.56		0.04	0.26
Scourfieldia			0.09			
Spermatozopsis	0.03					0.01
Sphaerocystis						
Sphaerozosma						
Spirogyra						
Staurastrum						
Tetraëdron			0.1		0.4	
Tetrastrum			2.42		2.42	0.06
unid. green		0.43	1.34	0.08	0.73	0.06
Xanthidium						
Zygnema						
Sub-total	0.03	10.28	27.22	15.75	25.15	4.25

Appendix 2.3

Phytoplankton Encountered in Lake Couchiching
Station LC5
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Bacillariophytes						
Achnanthes	1.15		0.45			0.59
Amphipleura						
Amphora						
Anomoeoneis						
Asterionella	4.74	7.24		2.33	0.46	
Campylodiscus						
Ceratoneis						
Cocconeis	0.09	present	0.57		present	
Cyclotella	4.71	268.34	5.52	9.96	2.15	7.51
Cymbella		present				
Denticula						
Diatoma						
Diatoma elongatum	0.07					
Epithemia				present		0.5
Eunotia						
Fragilaria	1.56	1.59	8.01	10.92	157.91	2.51
Frustulia						
Gomphonema					0.32	3.2
Gyrosigma						0.34
Mastogloia					0.05	
Melosira						
Navicula						0.29
Nitzschia	0.57	0.06	0.17		0.21	0.22
Pinnularia						
Rhizosolenia			4.43	2.37		
Rhopalodia						present
Stenopterobia						
Stephanodiscus Binderanus		3.96				
Surirella						1.76
Synedra	1.29	0.4	0.96	0.4	0.01	0.35
Synedra ulna						
unid. diatom				0.49		
Sub-total	14.18	281.59	20.11	26.47	161.11	17.27
Total biovolume	383.1	361.79	162.76	323.11	329.86	100.69
Ice-Free Average						277

Appendix 2.4 **Phytoplankton Encountered in Lake Couchiching**
Station LC15
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Cyanophytes						
Anabaena			0.23	2.11	5.22	10.57
Aphanizomenon				3.76		
Aphanocapsa				1.13		
Aphanothece	present		6.16	5.05	2.12	1.84
Chroococcus		0.09	2.16	12.32	2.42	1.55
Gloeotrichia						
Gomphosphaeria	0.08	0.04	0.57	1.28	0.44	1.5
Lyngbya			1.31			
Merismopedia			0.14	2.56	0.21	0.01
Microcystis aeruginosa						
M. novacekii						
M. viridis						
Microcystis	0.03	5.04	60.05	191.1	40.69	86.58
*Microcystis**						
Oscillatoria Agardhii						0.13
O. limnetica						
O. Redeckei						
Oscillatoria		0.93				0.05
Phormidium mucicola			0.03	1.08	0.12	0.23
Radiocystis					0.1	
Romeria						
unid blue-green						
Sub-total	0.11	6.1	70.65	220.39	51.32	102.46
Dinophytes						
Ceratium				2.57	2.44	
Gymnodinium	58.72	4.48	1.85	3.88		
Peridinium	117.84	1.29	2.23	0.63	1.55	3.49
Sub-total	176.56	5.77	4.08	7.08	3.99	3.49
Cryptophytes						
Chroomonas						
Cryptomonas	3.56	0.4	11.81	5.48	24.74	0.61
Cyathomonas						
Katablepharis	5.08	0.4	1.02	0.28		0.21
Rhodomonas	10.03	3.85	6.74	12.67	4.62	2.83
Sub-total	18.67	4.65	19.57	18.43	29.36	3.65
EUGLENO						
Euglena					0.4	0.13
Trachelomonas					0.2	
unid eugleno				2.77		
Sub-total	0	0	0	2.77	0.6	0.13

Appendix 2.4 **Phytoplankton Encountered in Lake Couchiching**
Station LC15
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Chrysophytes						
banana chrysophyte		0.52	0.37	0.26		
Bicosoeca					1.14	0.54
Chromulina	20.62	12.85	16.53	7.46	8.9	1.84
Chrysochrom parva	1.81	0.95	7.52	5.81	1.13	0.66
Chrysolykos	0.05					
Codonocladium					0.93	
Codonosiga						
Desmarella	0.19				0.23	0.25
Dinobryon	36.94	9.12	0.44		0.78	1.05
Epipyxis	0.57				0.1	
Kephyrion	0.38					0.25
Kephyrion/Pseudokephyrion		1.98	0.28	0.34		
Mallomonas	3.15	3.33	4.61	17.83	2.84	4.32
Ochromonas		0.31	0.93			
Pseudokephyrion	8.34					
Rhizochrysis			0.49			
Salpingoeca						
Spiniferomonas	3.07	1.6	6.14	2.95		1.21
Synura						
unid chryso cyst	2.22	0.04			1.04	
unid chrysomonad	2.42	3.07	4.11	0.61	3.32	1.09
Uroglena	200.18	4.62	0.49		86.94	
Sub-total	279.94	38.39	41.91	35.26	107.35	11.21
Chlorophytes						
Ankistrodesmus						
Botryococcus					0.46	1.06
Carteria						
Chlamydomonas		1.51	1.28	1.7	2.36	0.06
Closterium						
Coccomyxa	0.16	0.04	3.84	0.83	0.3	0.15
Coelastrum			1.58	0.83	1.86	3.02
Cosmarium				4.15	3.35	
Dictyosphaerium		present		0.2	0.06	
Elakatothrix					0.43	
Euastrum						
Franceia						
Gloeocystis/Sphaerocystis					11.15	
Gloeocystis	0.19	0.09	4.37	7.66		2.27
Golenkinia		1.41	2.04			0.27
Kirchneriella						
Monomastix						
Mougeotia						
Oedogonium		0.04				
Oocystis		present	5.59	6.89	8.05	1.52
Pediastrum		1.11		5.64		0.39
Pedinomonas	0.02	0.93	0.13			
Polytoma			0.06			
Quadrigula			present	0.26		
Scenedesmus	1.79	0.84	0.32	1.98	2.84	1.15
Scourfieldia						
Spermatozopsis						
Sphaerocystis						
Sphaerozosma						
Spirogyra						
Staurastrum				0.53		
Tetraëdron			0.2			
Tetrastrum			1.05		0.65	
unid. green		0.08	0.26		0.7	1.66
Xanthidium						1.34
Zygnema						
Sub-total	2.16	6.05	20.72	30.67	32.21	12.89

Appendix 2.4 **Phytoplankton Encountered in Lake Couchiching**
Station LC15
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Bacillariophytes						
Achnanthes	0.15	0.24				
Amphipleura						
Amphora						
Anomoeoneis						
Asterionella	2.63	12.23	0.72	4.35	4.09	
Campylodiscus						
Ceratoneis					present	
Cocconeis		present	0.13			
Cyclotella	2.28	45.96	2.14	11.74	2.48	0.55
Cymbella	0.21		0.09		0.45	
Denticula		0.49				
Diatoma						
Diatoma elongatum	0.19					
Epithemia	0.46					
Eunotia		present				
Fragilaria		0.84	5.26	10.56	155.34	3.04
Frustulia						
Gomphonema	0.05		0.04	2.67	0.03	
Gyrosigma						
Mastogloia						
Melosira						
Navicula		0.96	0.3			0.04
Nitzschia	0.81	0.53	0.69		0.08	
Pinnularia						
Rhizosolenia			0.06	5.74		
Rhopalodia						
Stenopterobia						
Stephanodiscus Binderanus						
Surirella						0.45
Synedra	0.24	0.2	0.38	0.11	0.36	0.07
Synedra ulna	1.97					
unid. diatom						0.41
Sub-total	8.99	61.45	9.81	35.17	162.83	4.56
Total biovolume	486.43	122.41	166.74	349.77	387.66	138.39
Ice-Free Average						275

Appendix 2.5 **Phytoplankton Encountered in Lake Couchiching**
Station LC17
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Cyanophytes						
Anabaena			1.28	1.94	9.17	
Aphanizomenon						
Aphanocapsa						
Aphanothece			4.09	5.93	1.29	0.57
Chroococcus			5.08	8.23	5.94	0.56
Gloeotrichia						0.22
Gomphosphaeria			0.82	2.02	0.13	0.12
Lyngbya						
Merismopedia			1.07	1.28	2.14	
Microcystis aeruginosa						
M. novacekii						
M. viridis						
Microcystis	1.46	2.35	37.63	197.46	80.46	36.54
*Microcystis**						
Oscillatoria Agardhii						
O. limnetica						
O. Redeckei						
Oscillatoria		0.09	0.06	0.75	0.24	
Phormidium mucicola				0.32	1.09	0.13
Radiocystis					0.1	
Romeria						
unid blue-green						
Sub-total	1.46	2.44	50.03	217.93	100.56	38.14
Dinophytes						
Ceratium					2.06	
Gymnodinium	9.45	16.84	4.04	1.31	4.99	0.64
Peridinium	136.34	3.41	2.37	8.48	1.44	3.91
Sub-total	145.79	20.25	6.41	9.79	8.49	4.55
Cryptophytes						
Chroomonas						
Cryptomonas	7.27	0.16	3.89	6.87	10.09	5.09
Cyathomonas						
Katablepharis	1.52	1.55	0.85	0.9		
Rhodomonas	22.32	1.51	2.38	4.87	4.34	7.51
Sub-total	31.11	3.22	7.12	12.64	14.43	12.6
EUGLENO						
Euglena						
Trachelomonas						
unid eugleno						
Sub-total	0	0	0	0	0	0

Appendix 2.5 **Phytoplankton Encountered in Lake Couchiching**
Station LC17
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Chrysophytes						
banana chrysophyte			0.52	0.26		
Bicosoeca			0.09	0.14	0.54	
Chromulina	19.18	3.07	24.14	5.81	13.49	8.16
Chrysochrom parva	4.88	2.3	2.47	2.71	2.31	0.25
Chrysolykos	0.04					
Codonocladium					7.57	0.13
Codonosiga	0.4		0.37			
Desmarella			0.48	0.14		0.06
Dinobryon	74.57	6.76	0.34		1.39	
Epipyxis						0.45
Kephyrion			0.14	0.13		0.13
Kephyrion/Pseudokephyrion	5.51	1.23				
Mallomonas	1.03	9.26	11.43	4.02	1.97	7.79
Ochromonas	1.48				0.02	0.23
Pseudokephyrion				0.27		
Rhizochrysis						
Salpingoeca						
Spiniferomonas	2.82	1.72	1.86	1.99	1.48	0.6
Synura						
unid chryso cyst	0.65	2.69	0.23	0.14	0.26	0.09
unid chrysomonad	2.49	5.8	3.82	5.33	1.27	2.64
Uroglena	264.89	16.32	1.42		77.97	
Sub-total	377.94	49.15	47.31	20.94	108.27	20.53
Chlorophytes						
Ankistrodesmus						
Botryococcus						
Carteria						
Chlamydomonas	0.4	3.54	1.02	2.6	3.17	
Closterium						
Coccomyxa			1.2	0.74	0.6	0.04
Coelastrum			2.79	14.69	0.49	1.57
Cosmarium					4.57	
Dictyosphaerium					0.06	
Elakatothrix					0.04	
Euastrum						
Franceia						
Gloeocystis/Sphaerocystis					18.61	
Gloeocystis		0.19	1.75	7.95		5.08
Golenkinia			0.37	1.88	3.69	
Kirchneriella			0.004		0.99	
Monomastix	0.04					
Mougeotia						
Oedogonium						
Oocystis			0.75	5.88	9.14	5.42
Pediastrum		2.06	0.63	1.08	1.3	
Pedinomonas						
Polytoma			0.03			
Quadrigula						
Scenedesmus	1.08	4.21	0.86	0.35	4.39	0.8
Scourfieldia	0.12			0.06		
Spermatozopsis						
Sphaerocystis						
Sphaerozosma						
Spirogyra						
Staurastrum						
Tetraëdron			0.3			
Tetrastrum				0.53	1.44	
unid. green	0.2		0.43	0.18		0.05
Xanthidium						
Zygnema						
Sub-total	1.84	10	10.134	35.94	48.49	12.96

Appendix 2.5 **Phytoplankton Encountered in Lake Couchiching**
Station LC17
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Bacillariophytes						
Achnanthes	0.24	3.42	0.09	0.15	0.22	0.18
Amphipleura						
Amphora						
Anomoeoneis						
Asterionella	1.94	11.79		0.53	2.09	0.37
Campylodiscus						
Ceratoneis						
Cocconeis	0.54	5.06	present	0.38		0.09
Cyclotella	1.75	221.97	4.62	5.52	6.63	4.25
Cymbella	0.4	0.56	0.06			0.05
Denticula						
Diatoma						
Diatoma elongatum	0.25	0.68				
Epithemia		2.19			0.26	
Eunotia		3.52				
Fragilaria	11.87	29.55	0.23	10.34	86.11	2.79
Frustulia						
Gomphonema		1.18		0.27	1.85	1.87
Gyrosigma						
Mastogloia						0.11
Melosira						
Navicula	0.07	1.27	0.37	0.22	2.77	0.31
Nitzschia		0.3	0.04		0.04	0.09
Pinnularia						2.77
Rhizosolenia			1.89			
Rhopalodia			0.66			
Stenopterobia						0.21
Stephanodiscus Binderanus						
Surirella						
Synedra	2.2	3.22	1.09	0.34	0.23	0.08
Synedra ulna						
unid. diatom	1.61	1.16	0.54			0.26
Sub-total	20.87	285.87	9.59	17.75	100.2	13.43
Total biovolume	579.01	370.93	130.594	314.99	380.44	102.21
Ice-Free Average						313

Appendix 2.6 **Phytoplankton Encountered in Lake Couchiching**
Station LC22
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Cyanophytes						
Anabaena			0.6	0.8	28.91	1.44
Aphanizomenon		0.03				
Aphanocapsa						
Aphanothece		present	5.98	4.47	1.25	2.34
Chroococcus	0.09	2.49	30.77	23.82	4.8	0.94
Gloeotrichia	present					
Gomphosphaeria	0.03	present	0.3	0.55	0.46	0.02
Lyngbya						
Merismopedia		0.01	present	0.19	8.24	0.73
Microcystis aeruginosa						
M. novacekii						
M. viridis						
Microcystis	1.75	0.48	51.17	208.78	37.95	45.72
*Microcystis**						
Oscillatoria Agardhii						
O. limnetica						
O. Redeckei						
Oscillatoria	0.26	0.13	0.06	8.79	0.21	0.18
Phormidium mucicola			0.04	0.31	0.27	0.21
Radiocystis						
Romeria						
unid blue-green						
Sub-total	2.13	3.14	88.92	247.71	82.09	51.58
Dinophytes						
Ceratium			3.61			7.18
Gymnodinium	59.63	3.69	0.58	7.62	16.6	
Peridinium	217.88	6.56	5.05		4.71	0.36
Sub-total	277.51	10.25	9.24	7.62	21.31	7.54
Cryptophytes						
Chroomonas						
Cryptomonas	7.73	3.54	19.25	7.7	49.03	9.32
Cyathomonas			0.1			
Katablepharis	1.9	2.8	0.21	1.6	3.03	
Rhodomonas	10.46	3.92	2.64	2.47	2.74	5.68
Sub-total	20.09	10.26	22.2	11.77	54.8	15
EUGLENO						
Euglena					0.15	present
Trachelomonas						
unid eugleno			3.73			
Sub-total	0	0	3.73	0	0.15	present

Appendix 2.6 **Phytoplankton Encountered in Lake Couchiching**
Station LC22
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Chrysophytes						
banana chrysophyte		0.16	0.5	0.33		
Bicosoeca			0.09		0.4	
Chromulina	24.11	8.55	22.79	21.72	13.59	7.77
Chrysochrom parva	0.99	2.07	2.63	3.49	4.18	0.62
Chrysolykos	0.44					
Codonocladium		0.09	1	1.94	0.4	0.33
Codonosiga						
Desmarella			0.35			0.06
Dinobryon	33.73	7.86	5.27	2.41	1.21	0.11
Epipyxis					0.21	
Kephyrion			0.3		0.49	
Kephyrion/Pseudokephyrion	5.07	1.03		0.88		
Mallomonas	21.3	13.37	19.16		15.47	4.06
Ochromonas			0.27			
Pseudokephyrion						
Rhizochrysis						0.74
Salpingoeca						
Spiniferomonas	0.54	0.13	15.09	1.77		0.27
Synura		0.74				
unid chryso cyst		0.06		0.14	0.08	0.21
unid chrysomonad	3.53	2.84	7.37	1.56	19.52	2.84
Uroglena	197.32	3.38	4.64		207.64	1.86
Sub-total	287.03	40.28	79.46	34.24	263.19	18.87
Chlorophytes						
Ankistrodesmus						
Botryococcus						
Carteria						
Chlamydomonas		1.23	3.71	0.85	1.63	0.73
Closterium						
Coccomyxa		0.09	0.74	1.17	0.43	0.6
Coelastrum			6.27	7.24	1.86	0.61
Cosmarium			3.2		0.68	
Dictyosphaerium			0.69			
Elakatothrix					0.13	
Euastrum						
Franceia						
Gloeocystis/Sphaerocystis						
Gloeocystis		0.24	3.97	7.73	11.01	4.18
Golenkinia		0.49	1.48			
Kirchneriella	0.12					
Monomastix						
Mougeotia						
Oedogonium						
Oocystis		0.12	7.87	5.23	2.11	4.36
Pediastrum			0.28		0.39	
Pedinomonas		1.7	0.27	0.33		
Polytoma			0.29			
Quadrigula					0.03	
Scenedesmus	0.55	1.58	0.87		7.16	0.34
Scourfieldia			0.77			
Spermatozopsis						0.01
Sphaerocystis						
Sphaerozosma						
Spirogyra						
Staurastrum						
Tetraëdron		0.89				
Tetrastrum			0.16	1.67	0.35	
unid. green	0.4	0.43	1.4			0.06
Xanthidium						
Zygnema						
Sub-total	1.07	6.77	31.97	24.22	25.78	10.89

Appendix 2.6

Phytoplankton Encountered in Lake Couchiching
Station LC22
(Biovolume mm3/m3)

Taxon	04-Jun-03	24-Jun-03	22-Jul-03	06-Aug-03	26-Aug-03	01-Oct-03
Bacillariophytes						
Achnanthes	0.8	0.32				
Amphipleura						
Amphora						
Anomoeoneis						
Asterionella	2.11	2.43			3.5	
Campylodiscus						
Ceratoneis						
Cocconeis	0.42	present	0.49	0.09	0.04	0.26
Cyclotella	5.61	39.21	1.58	2.16	3.03	0.46
Cymbella	present	0.57				
Denticula		present				
Diatoma						
Diatoma elongatum						
Epithemia				0.39		
Eunotia				1.11	0.47	9.57
Fragilaria	1.8		2.97	14.99	78.11	
Frustulia						
Gomphonema	present		0.52	0.3	0.1	0.02
Gyrosigma					0.44	
Mastogloia						1.81
Melosira						
Navicula	0.09	0.3		0.45	0.42	0.02
Nitzschia	1.14		0.14		0.34	
Pinnularia						
Rhizosolenia				0.63		
Rhopalodia						
Stenopterobia						
Stephanodiscus Binderanus						
Surirella						
Synedra	0.49	0.15	0.37	0.23	0.09	0.04
Synedra ulna						
unid. diatom						
Sub-total	12.46	42.98	6.07	20.35	86.54	12.18
Total biovolume	600.29	113.68	241.59	345.91	533.86	116.06
Ice-Free Average						325

Appendix 3.1
Lake Couchiching Zooplankton LC3 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae	16.3						16.3
Alona guttata							
Alona sp.		10.8					10.8
Bosmina longirostris	8725.4	6152.5	325	675.9	2022	3109.5	3501.7
Ceriodaphnia lacustris					115.5	216.6	166.1
Ceriodaphnia sp.							
Chydorus sphaericus	195.3	65	16.3		57.8		83.6
Diaphanosoma birgeii		65	2599.9	1143.9	1079.7	267.6	1031.2
Diaphanosoma brachyurum							
Eubosmina coregoni			16.3			12.7	14.5
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			292.5	195	28.9	89.2	151.4
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus		10.8					10.8
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae		10.8	1072.5	1143.9	2079.7	599	981.2
Daphnia longiremis						12.7	12.7
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				91	375.5	12.7	159.7
Calanoid Copepods							
Calanoid copepodid	976.7	3552.9	13.975	468	2079.7	1019.5	1351.8
Calanoid nauplii	195.3	1386.5	2469.9	442	202.2	114.7	801.8
Epischura lacustris		54.2	32.5	26	14.4	12.7	28.0
Epischura lacustris copepod	97.7	32.5					65.1
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	32.6	4419.4	6109.8	3327.7	1906.4	356.8	2692.1
Limnocalanus macrurus							
Skistodiaptomus oregonensis	16.3	119.2	585	883.9	332.2	267.6	367.4
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	16669.4	10571.9	7929.8	12062.9	6816.9	4179.9	9705.1
Cyclopoid nauplii	22399.5	10398.6	18719.5	27037.6	17099.9	11622.3	17879.6
Cyclops scutifer							
Cyclops vernalis	16.3	2.7					9.5
Diacyclops bicuspidatus thomasi	260.5	909.9	536.2	753.9	14.4	38.2	418.9
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	32.6	270.8	3899.9	4263.6	3235.1	293.1	1999.2
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	146.5	260	3769.9	4887.6	2137.5	1784.1	2164.3
Tropocyclops extensus							
Total Density	49780.4	38293.5	48389.0	57402.9	39597.8	24008.9	42912.1
Non-daphnid	8937.0	6304.1	3250.0	2014.8	3303.9	3695.6	4584.2
Daphnid	0.0	10.8	1072.5	1234.9	2455.2	624.4	899.6
Calanoid	1318.6	9564.7	9211.2	5147.6	4534.9	1771.3	5258.0
Cyclopoid	39524.8	22413.9	34855.3	49005.6	29303.8	17917.6	32170.2
Dreissena polymorpha veliger	0.0	8752.2	487.5	117.0	260.0	0.0	1602.8

Appendix 3.2
Lake Couchiching Zooplankton LC5 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae		8.1			15.7		11.9
Alona guttata							
Alona sp.							
Bosmina longirostris	6954.3	2664.7	173.3	349.3	2631.2	1363.2	2356.0
Ceriodaphnia lacustris					39.2	63.4	51.3
Ceriodaphnia sp.							
Chydorus sphaericus	251.8	170.6		24.4	54.8	23.8	105.1
Diaphanosoma birgeii				812.4	1033.7	269.5	705.2
Diaphanosoma brachyurum		8.1	3582				1795.1
Eubosmina coregoni	8.1		7.2	16.2	15.7		11.8
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			166.1	24.4	62.6	118.9	93.0
Ilyocryptus spinifer							
Leptodora kindtii			7.2				7.2
Pleuroxus hamulatus	32.5						32.5
Pleuroxus sp.				24.4			24.4
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			390	1787.3	2693.8	554.8	1356.5
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva		8.1	21.7	186.9	274.1	31.7	128.6
Calanoid Copepods							
Calanoid copepodid		1527.3	953.3	974.9	1096.3	1775.4	1265.4
Calanoid nauplii	81.2	633.7	166.1	584.9	101.8	55.5	270.5
Epischura lacustris	24.4	24.4	86.7	8.1	7.8	31.7	30.5
Epischura lacustris copepod	130		7.2	8.1	15.7	71.3	46.5
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	584.9	4094.6	4968.6	4289.5	1660.1	951.1	2758.1
Limnocalanus macrurus							
Skistodiaptomus oregonensis	146.2	113.7	837.7	747.4	156.6	190.2	365.3
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	26517.2	10398.9	5199.7	7279.2	6390	4501.9	10047.8
Cyclopoid nauplii	19238	8319.1	9359.4	15078.4	8144.1	6847.9	11164.5
Cyclops scutifer							
Cyclops vernalis	8.1	16.2					12.2
Diacyclops bicuspidatus thomasi	1657.3	3964.6	1126.6	65		31.7	1369.0
Eucyclops agilis		8.1					8.1
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	32.5	422.5	2946.5	2144.8	2443.2	760.9	1458.4
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	227.5	251.8	1444.4	6759.3	2098.7	2092.4	2145.7
Tropocyclops extensus							
Total Density	55894.0	32634.5	31443.7	41164.9	28935.1	19735.3	34967.9
Non-daphnid	7246.7	2851.5	3935.8	1251.1	3852.9	1838.8	3496.1
Daphnid	0.0	8.1	411.7	1974.2	2967.9	586.5	991.4
Calanoid	966.7	6393.7	7019.6	6612.9	3038.3	3075.2	4517.7
Cyclopoid	47680.6	23381.2	20076.6	31326.7	19076.0	14234.8	25962.6
Dreissena polymorpha veliger	130.0	3509.6	953.3	219.4	0.0	0.0	802.0

Appendix 3.3
Lake Couchiching Zooplankton LC12 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae	86.7						86.7
Alona guttata							
Alona sp.							
Bosmina longirostris	909.9	1819.4	259.9	715.2	4159.4	2750	1769.0
Ceriodaphnia lacustris					43.3	100	71.7
Ceriodaphnia sp.							
Chydorus sphaericus	86.7	130		65		50	82.9
Diaphanosoma birgeii			584.8	1755.5	476.6	550	841.7
Diaphanosoma brachyurum							
Eubosmina coregoni					43.3		43.3
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			130	520.2		150	266.7
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus							
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			714.8	1365.4	1169.8	200	862.5
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				65	216.6		140.8
Calanoid Copepods							
Calanoid copepodid	3726.2	2339.2	1884.3	1950.6	606.6	4200	2451.2
Calanoid nauplii		2274.2	2079.3	1495.4	519.9	850	1443.8
Epischura lacustris							
Epischura lacustris copepod	86.7						86.7
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	7972.3	649.8	3248.9	7542.3	476.6	1000	3481.7
Limnocalanus macrurus							
Skistodiaptomus oregonensis	1386.5		649.8	585.2	216.6	250	617.6
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	31195.8	8317.1	10656.3	4031.2	7279	2250	10621.6
Cyclopoid nauplii	78336.2	11955.8	27550.4	10143	44714	8400	30183.2
Cyclops scutifer							
Cyclops vernalis							
Diacyclops bicuspidatus thomasi	3032.9	584.8	1104.6	65			1196.8
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax		130	714.8	520.2	3466.2	350	1036.2
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	433.3	844.7	1754.4	3641.1	1126.5	2350	1691.7
Tropocyclops extensus							
Total Density	127253.2	29045.0	51332.3	34460.3	64514.4	23450.0	55009.2
Non-daphnid	1083.3	1949.4	974.7	3055.9	4722.6	3600.0	2564.3
Daphnid	0.0	0.0	714.8	1430.4	1386.4	200.0	621.9
Calanoid	13171.7	5263.2	7862.3	11573.5	1819.7	6300.0	7665.1
Cyclopoid	112998.2	21832.4	41780.5	18400.5	56585.7	13350.0	44157.9
Dreissena polymorpha veliger	0.0	1884.3	21052.6	650.2	216.6	0.0	3967.3

Appendix 3.4
Lake Couchiching Zooplankton LC15 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae							
Alona guttata							
Alona sp.				8.100			8.1
Bosmina longirostris	5084.100	2989.700	57.800	584.900	3524.200	2462.900	2450.6
Ceriodaphnia lacustris					36.100	102.600	69.4
Ceriodaphnia sp.							
Chydorus sphaericus	130.000	40.600		40.600	36.100	41.000	57.7
Diaphanosoma birgeii			780.500	1169.900	1386.600	342.100	919.8
Diaphanosoma brachyurum							
Eubosmina coregoni	7.200						7.2
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum	7.200		159.000	113.700	151.700	362.600	158.8
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus		8.100					8.1
Pleuroxus sp.							
Polyphemus pediculus		16.200					16.2
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			477.000	2404.700	10052.700	506.300	3360.2
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva			14.500	178.700	866.600		353.3
Calanoid Copepods							
Calanoid copepodid	664.400	1137.400	549.300	1104.900	982.200	1395.600	972.3
Calanoid nauplii	86.700	1299.900	925.100	471.200	1039.900	47.900	645.1
Epischura lacustris	7.200		180.700			6.800	64.9
Epischura lacustris copepod	57.800		57.800	32.500			49.4
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus						6.800	6.8
Leptodiaptomus minutus	736.600	503.700	4972.200	2664.700	1791.000	629.400	1882.9
Limnocalanus macrurus							
Skistodiaptomus oregonensis	72.200	65.000	1127.400	601.200	895.500	314.700	512.7
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	24496.300	5589.400	4509.600	8059.100	14328.000	3448.000	10071.7
Cyclopoid nauplii	16407.900	8969.000	11678.800	2014.800	31891.400	6896.100	12976.3
Cyclops scutifer							
Cyclops vernalis					7.200		7.2
Diacyclops bicuspidatus thomasi	138.800	390.000	3469.000	32.500	7.200	27.400	677.5
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	28.900	130.000	1789.400	2599.700	6355.200	643.100	1924.4
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	108.316	601.200	1214.100		3004.300	3885.900	1762.8
Tropocyclops extensus							
Total Density	48033.6	21740.2	31962.2	22081.2	76355.9	21119.2	36882.1
Non-daphnid	5228.5	3054.6	997.3	1917.2	5134.7	3311.2	3273.9
Daphnid	0.0	0.0	491.5	2583.4	10919.3	506.3	2416.8
Calanoid	1624.9	3006.0	7812.5	4874.5	4708.6	2401.2	4071.3
Cyclopoid	41180.2	15679.6	22660.9	12706.1	55593.3	14900.5	27120.1
Dreissena polymorpha veliger	0.0	16118.3	7863.0	0.0	0.0	0.0	3996.9

Appendix 3.5
Lake Couchiching Zooplankton LC17 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris						9.4	9.4
Acroperus harpae				9.3	11.6		10.5
Alona guttata							
Alona sp.							
Bosmina longirostris	8232.2	1671.3	130	761.4	6406.7	2675.2	3312.8
Ceriodaphnia lacustris			18.6		34.8	160.1	97.5
Ceriodaphnia sp.							
Chydorus sphaericus	303.3	18.6	37.1	37.1	58	65.9	86.7
Diaphanosoma birgeii			1039.9	2748.4	1532	273.2	1398.4
Diaphanosoma brachyurum							
Eubosmina coregoni				9.3	359.8		184.6
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			120.7	9.3	58	47.1	58.8
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus	10.8			9.3			10.1
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina				9.3			9.3
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			111.4	631.4	1021.4	141.3	476.4
Daphnia longiremis			18.6			9.4	14.0
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva			9.3	18.6	127.7		51.9
Calanoid Copepods							
Calanoid copepodid	1213.2	315.7	928.5	668.5	2785.5	1017.3	1154.8
Calanoid nauplii	119.2	334.3	362.1	724.2	1299.9	75.4	485.9
Epischura lacustris	10.8		18.6		11.6		13.7
Epischura lacustris copepod	75.8		18.6				47.2
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	519.9	1968.4	6239.6	2896.9	2878.4	263.8	2461.2
Limnocalanus macrurus							
Skistodiaptomus oregonensis	75.8	111.4	306.4	390	487.5	226.1	266.2
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	12131.7	6165.3	3788.3	6982.4	7428	3466.5	6660.4
Cyclopoid nauplii	3986.1	9507.9	9062.2	14261.8	21169.9	7234.4	10870.4
Cyclops scutifer	32.5						32.5
Cyclops vernalis							
Diacyclops bicuspidatus thomasi	584.9	371.4	891.4	817.1	11.6		535.3
Eucyclops agilis	14211.4						14211.4
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax		92.9	1002.8	3416.9	650	367.4	1106.0
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus		501.4	1411.3	2302.7	2692.7	1544.8	1690.6
Tropocyclops extensus							
Total Density	41507.6	21058.6	25515.4	36703.9	49025.1	17567.9	31896.4
Non-daphnid	8546.3	1689.9	1346.3	3593.4	8460.9	3230.9	4478.0
Daphnid	0.0	0.0	139.3	650.0	1149.1	150.7	348.2
Calanoid	2014.7	2729.8	7873.8	4679.6	7462.9	1582.6	4390.6
Cyclopoid	30946.6	16638.9	16156.0	27780.9	39415.1	12613.1	23925.1
Dreissena polymorpha veliger	3986.1	4679.7	1894.2	1745.6	0.0	0.0	2050.9

Appendix 3.6
Lake Couchiching Zooplankton LC21 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03
Non-Daphnid Cladocera						
Acatholeberis curvirostris						
Acroperus harpae						
Alona guttata						
Alona sp.						
Bosmina longirostris			422.5			
Ceriodaphnia lacustris						
Ceriodaphnia sp.						
Chydorus sphaericus						
Diaphanosoma birgeii			292.5			
Diaphanosoma brachyurum						
Eubosmina coregoni						
Eubosmina longispina						
Eurycercus lamellatus						
Graptoleberis testudinaria						
Holopedium gibberum			195			
Ilyocryptus spinifer						
Leptodora kindtii						
Pleuroxus hamulatus						
Pleuroxus sp.						
Polyphemus pediculus						
Sida crystallina						
Simocephalus serrulatus						
Simocephalus vetulus						
Streblocerus serricaudatus						
Daphnid Cladocera						
Daphnia ambigua						
Daphnia galeata mendotae			195			
Daphnia longiremis						
Daphnia pulicaria						
Daphnia parvula						
Daphnia retrocurva						
Calanoid Copepods						
Calanoid copepodid			1020			
Calanoid nauplii			5199.9			
Epischura lacustris						
Epischura lacustris copepod						
Eurytemora affinis						
Leptodiaptomus ashlandii						
Leptodiaptomus sicilus						
Leptodiaptomus minutus			3899.9			
Limnocalanus macrurus						
Skistodiaptomus oregonensis			97.5			
Skistodiaptomus reighardi						
Cyclopoid Copepods						
Cyclopoid copepodid			4289.9			
Cyclopoid nauplii			14559.6			
Cyclops scutifer						
Cyclops vernalis						
Diacyclops bicuspidatus thomasi			650			
Eucyclops agilis						
Eucyclops serrulus						
Macrocyclops albidus						
Mesocyclops edax			162.5			
Orthocyclops modestus						
Paracyclops fimbriatus poppei						
Tropocyclops p. mexicanus			1690			
Tropocyclops extensus						
Total Density			32674.3			
Non-daphnid			910.0			
Daphnid			195.0			
Calanoid			10217.3			
Cyclopoid			21352.0			
Dreissena polymorpha veliger			2015.0			

Appendix 3.7
Lake Couchiching Zooplankton LC22 Density 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae					10.8		10.800
Alona guttata							
Alona sp.							
Bosmina longirostris	13518.2	1708.4	965.6	2339.7	1906.4	2560.9	3833.2
Ceriodaphnia lacustris			9.3		130	67.9	69.1
Ceriodaphnia sp.							
Chydorus sphaericus	32.5	37.1	9.3		21.7	29.1	25.9
Diaphanosoma birgeii		18.6	1634.2	1169.8	974.9	446.2	848.7
Diaphanosoma brachyurum							
Eubosmina coregoni							
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum		27.9	83.6	173.3	43.3	48.5	75.3
Ilyocryptus spinifer							
Leptodora kindtii			9.3	21.7	10.8		13.9
Pleuroxus hamulatus	10.8	9.3				9.7	9.9
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina					10.8		10.8
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			92.9	411.6	2426.3	543.2	868.5
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				86.7	86.7		86.7
Calanoid Copepods							
Calanoid copepodid	1213.2	1411.3	1411.3	2859.6	227.5	1125.2	1374.7
Calanoid nauplii	32.5	176.4	2896.9	1516.5	65	145.5	805.5
Epischura lacustris		9.3				19.4	14.4
Epischura lacustris copepod	21.7	9.3					15.5
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	563.3	1411.3	2079.9	4332.8	379.1	426.8	1532.2
Limnocalanus macrurus							
Skistodiaptomus oregonensis	97.5	65	352.8	65	433.3	281.3	215.8
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	11438.5	9656.5	6239.6	4159.4	10571.9	4423.3	7748.2
Cyclopoid nauplii	14038.1	10993.5	17084.5	17677.6	22530.3	7682.6	15001.1
Cyclops scutifer							
Cyclops vernalis							
Diacyclops bicuspidatus thomasi	476.6	2896.9	1002.8	216.6		9.7	920.5
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	10.8	520	2154.1	498.3	5026	776	1497.5
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	184.1	213.6	2377	2946.3	1278.2	2987.7	1664.5
Tropocyclops extensus							
Total Density	41637.8	29164.4	38403.1	38474.9	46133.0	21583.0	35899.4
Non-daphnid	13561.5	1801.3	2711.3	3704.5	3108.7	3162.3	4674.9
Daphnid			92.9	498.3	2513.0	543.2	911.9
Calanoid	1928.2	3082.6	6740.9	8773.9	1104.9	1998.2	3938.1
Cyclopoid	26148.1	24280.5	28858.0	25498.2	39406.4	15879.3	26678.4
Dreissena polymorpha veliger	0.0	7130.9	5719.6	238.3	0.0	0.0	2181.5

Appendix 4.1

Lake Couchiching Zooplankton LC3 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae	0.106						0.106
Alona guttata							
Alona sp.		0.081					0.081
Bosmina longirostris	11.79	6.782	0.367	0.899	2.358	4.37	4.428
Bythotrephes cederstoemii							
Ceriodaphnia lacustris					0.074	0.142	0.108
Ceriodaphnia sp.							
Chydorus sphaericus	0.178	0.058	0.015		0.056		0.077
Diaphanosoma birgeii		0.255	7.958	3.122	3.337	0.918	3.118
Diaphanosoma brachyurum							
Eubosmina coregoni			0.062			0.054	0.058
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			1.906	0.669	0.064	0.14	0.695
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus		0.017					0.017
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae		0.059	2.775	3.652	4.668	1.919	2.615
Daphnia longiremis						0.044	0.044
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				0.511	0.946	0.012	0.490
Calanoid Copepods							
Calanoid copepodid	1.104	4.94	1.709	0.7	2.848	1.489	2.132
Calanoid nauplii	0.072	0.473	0.632	0.119	0.044	0.03	0.228
Epischura lacustris		0.553	0.444	0.369	0.138	0.08	0.317
Epischura lacustris copepod	0.41	0.139					0.275
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	0.093	13.849	18.744	10.238	5.885	1.107	8.319
Limnocalanus macrurus							
Skistodiaptomus oregonensis	0.12	0.733	4.294	6.364	2.232	1.588	2.555
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	12.759	8.561	6.668	7.811	5.097	2.58	7.246
Cyclopoid nauplii	3.97	2.253	3.171	5.087	2.665	1.747	3.149
Cyclops scutifer		0.082					0.082
Cyclops vernalis	0.041						0.041
Diacyclops bicuspidatus thomasi	0.886	3.778	2.208	2.901	0.041	0.131	1.658
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	0.224	1.061	15.78	20.296	11.407	1.042	8.302
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	0.169	0.28	3.775	4.38	1.551	1.358	1.919
Tropocyclops extensus							
Total Biomass	31.922	43.954	70.508	67.118	43.411	18.751	45.944
Non-daphnid	12.074	7.193	10.308	4.690	5.889	5.624	7.630
Daphnid		0.059	2.775	4.163	5.614	1.975	2.917
Calanoid	1.799	20.687	25.823	17.790	11.147	4.294	13.590
Cyclopoid	18.049	16.015	31.602	40.475	20.761	6.858	22.293
Dreissena polymorpha veliger	0.00	1.57	0.10	0.05	0.11	0.00	0.305
Species Richness	14	18	16	15	17	18	16.333

Appendix 4.2

Lake Couchiching Zooplankton LC5 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae		0.065			0.091		0.078
Alona guttata							
Alona sp.							
Bosmina longirostris	8.542	3.199	0.185	0.42	2.705	1.55	2.767
Bythotrephes cederstoemii							
Ceriodaphnia lacustris					0.026	0.053	0.040
Ceriodaphnia sp.							
Chydorus sphaericus	0.256	0.178		0.21	0.048	0.017	0.142
Diaphanosoma birgeii			11.162	2.513	3.33	0.916	4.480
Diaphanosoma brachyurum		0.038					0.038
Eubosmina coregoni	0.066		0.019	0.056	0.045		0.0465
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			0.912	0.138	0.538	0.427	0.504
Ilyocryptus spinifer							
Leptodora kindtii			0.03	0.096			0.063
Pleuroxus hamulatus	0.009						0.009
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			1.98	4.749	12.165	1.533	5.107
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva		0.008	0.077	0.603	1.13	0.137	0.391
Calanoid Copepods							
Calanoid copepodid	2.075	2.207	1.174	1.273	1.381	2.678	1.798
Calanoid nauplii	0.025	0.203	0.044	0.16	0.029	0.015	0.079
Epischura lacustris	0.227	0.253	1.005	0.048	0.058	0.28	0.312
Epischura lacustris copepod	0.356		0.038	0.042	0.047	0.266	0.150
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	1.784	12.954	15.917	13.161	4.954	2.859	8.605
Limnocalanus macrurus							
Skistodiaptomus oregonensis	0.948	0.713	6.132	4.782	1.122	1.082	2.463
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	21.004	8.342	4.91	4.882	4.374	2.392	7.651
Cyclopoid nauplii	2.937	1.608	1.754	3.124	1.374	1.017	1.969
Cyclops scutifer							
Cyclops vernalis	0.035	0.063					0.049
Diacyclops bicuspidatus thomasi	6.378	16.123	4.776	0.24		0.116	5.527
Eucyclops agilis		0.07					0.070
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	0.168	2.047	15.413	8.897	9.911	2.654	6.515
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	0.242	0.291	1.353	5.557	1.685	1.687	1.803
Tropocyclops extensus							
Total Biomass	45.052	48.362	66.881	50.951	45.013	19.679	45.990
Non-daphnid	8.873	3.48	12.308	3.433	6.783	2.963	6.307
Daphnid		0.008	2.057	5.352	13.295	1.67	4.476
Calanoid	5.415	16.33	24.310	19.466	7.591	7.18	13.382
Cyclopoid	30.764	28.544	28.206	22.700	17.344	7.866	22.571
Dreissena polymorpha veliger	0.03	0.74	0.23	0.09	0.00	0.00	0.182
Species Richness	16	17	18	19	19	18	17.833

Appendix 4.3

Lake Couchiching Zooplankton LC12 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae	0.459						0.459
Alona guttata							
Alona sp.							
Bosmina longirostris	0.997	2.141		0.579	4.678	3.072	2.293
Bythotrephes cederstoemii			0.281				0.281
Ceriodaphnia lacustris					0.014	0.067	0.041
Ceriodaphnia sp.							
Chydorus sphaericus	0.097	0.068		0.1		0.046	0.078
Diaphanosoma birgeii			1.708	5.06	1.796	1.597	2.540
Diaphanosoma brachyurum							
Eubosmina coregoni					0.185		0.185
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			0.806	0.728		0.431	0.655
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus							
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			2.751	2.967	4.626	0.538	2.721
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				0.046	0.562		0.304
Calanoid Copepods							
Calanoid copepodid	6.237	2.387	1.964	2.071	0.657	6.444	3.293
Calanoid nauplii		0.496	0.566	0.406	0.138	0.254	0.372
Epischura lacustris							
Epischura lacustris copepod	0.438						0.438
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	25.333	1.98	9.881	0.728	1.436	2.959	7.053
Limnocalanus macrurus							
Skistodiaptomus oregonensis	8.323		3.793	3.96	1.485	1.51	3.814
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	24.797	5.538	7.436	2.941	3.933	1.172	7.636
Cyclopoid nauplii	13.199	1.898		1.891	7.696	1.31	5.199
Cyclops scutifer							
Cyclops vernalis							
Diacyclops bicuspidatus thomasi	11.57	2.03	4.29	0.241			4.533
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax		0.623	2.695	3.109	11.292	0.885	3.721
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	0.443	0.865		3.182	0.915	1.795	1.440
Tropocyclops extensus							
Total Biomass	91.893	18.026	36.171	28.009	39.413	22.08	39.265
Non-daphnid	1.553	2.209	2.795	6.467	6.673	5.213	4.152
Daphnid			2.751	3.013	5.188	0.538	2.873
Calanoid	40.331	4.863	16.204	7.165	3.716	11.167	13.908
Cyclopoid	50.009	10.954	14.421	11.364	23.836	5.162	19.291
Dreissena polymorpha veliger	0.00	0.35	4.43	0.21	0.05	0.00	0.839
Species Richness	11	10	11	15	14	14	12.500

Appendix 4.4

Lake Couchiching Zooplankton LC15 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae							
Alona guttata							
Alona sp.				0.017			0.017
Bosmina longirostris	6.761	3.01	0.082	0.706	3.473	2.876	2.818
Bythotrephes cederstoemii							
Ceriodaphnia lacustris					0.025	0.085	0.055
Ceriodaphnia sp.							
Chydorus sphaericus	0.14	0.048		0.053	0.034	0.036	0.062
Diaphanosoma birgeii			2.336	3.597	4.698	1.26	2.973
Diaphanosoma brachyurum							
Eubosmina coregoni	0.028						0.028
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum	0.006		0.533	0.287	0.787	1.262	0.575
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus		0.026					0.026
Pleuroxus sp.							
Polyphemus pediculus		0.233					0.233
Sida crystallina							
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			1.356	5.843	48.593	2.21	14.501
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva			0.046	0.555	3.936		1.512
Calanoid Copepods							
Calanoid copepodid	0.971	1.268	0.589	1.485	1.327	2.075	1.286
Calanoid nauplii	0.029	0.39	0.251	0.128	0.217	0.015	0.172
Epischura lacustris	0.069		2.402			0.043	0.838
Epischura lacustris copepod	0.207		0.249	0.096			0.184
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus						0.048	0.048
Leptodiaptomus minutus	2.283	1.591	14.979	8.085	5.57	1.896	5.734
Limnocalanus macrurus							
Skistodiaptomus oregonensis	0.491	0.488	8.046	4.237	6.211	1.985	3.576
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	19.356	4.319	3.78	5.857	10.684	1.8	7.633
Cyclopoid nauplii	2.9	1.676	2.09	1.64	5.862	1.152	2.553
Cyclops scutifer							
Cyclops vernalis					0.015		0.015
Diacyclops bicuspidatus thomasi	4.789	1.531	13.519	0.119	0.022	0.106	3.348
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	0.095	0.421	7.607	9.623	22.464	2.117	7.055
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	0.123	0.595	1.13		2.377	2.96	1.437
Tropocyclops extensus							
Total Biomass	38.248	15.596	58.995	42.311	116.295	21.926	48.895
Non-daphnid	6.935	3.317	2.951	4.660	9.017	5.519	5.400
Daphnid			1.402	6.398	52.529	2.21	15.635
Calanoid	4.050	3.737	26.516	14.031	13.325	6.062	11.287
Cyclopoid	27.263	8.542	28.126	17.239	41.424	8.135	21.788
Dreissena polymorpha veliger	0.00	2.08	1.88	0.00	0.00	0.00	0.659
Species Richness	15	13	16	16	17	17	15.667

Appendix 4.5

Lake Couchiching Zooplankton LC17 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris						0.0049	0.0049
Acroperus harpae				0.044	0.05		0.047
Alona guttata							
Alona sp.							
Bosmina longirostris	9.074	2.108	0.104	1.052	6.496	3.542	3.729
Bythotrephes cederstoemii							
Ceriodaphnia lacustris			0.024		0.027	0.132	0.061
Ceriodaphnia sp.							
Chydorus sphaericus	0.316	0.014	0.036	0.045	0.042	0.052	0.084
Diaphanosoma birgeii			3.182	8.293	4.882	0.865	4.3055
Diaphanosoma brachyurum							
Eubosmina coregoni				0.036	1.134		0.585
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum			0.691	0.009	0.159	0.157	0.254
Ilyocryptus spinifer							
Leptodora kindtii							
Pleuroxus hamulatus	0.039			0.012			0.0255
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina				0.04			0.040
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			0.388	2.09	2.039	0.408	1.512
Daphnia longiremis			0.054			0.066	0.06
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva			0.009	0.053	0.25		0.104
Calanoid Copepods							
Calanoid copepodid	1.718	0.376	1.107	0.806	3.196	1.627	
Calanoid nauplii	0.043	0.113	0.094	0.202	0.351	0.022	0.138
Epischura lacustris	0.104		0.259		0.196		0.186
Epischura lacustris copepod	0.337		0.06				0.199
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	1.582	6.124	19.935	9.077	9.257	0.797	7.795
Limnocalanus macrurus							
Skistodiaptomus oregonensis	0.393	0.655	2.061	2.767	3.347	1.439	1.777
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	12.17	4.949	3.17	3.509	4.223	1.92	4.990
Cyclopoid nauplii	2.359	1.602	1.486	2.523	3.909	1.132	2.169
Cyclops scutifer							
Cyclops vernalis	0.082						0.082
Diacyclops bicuspidatus thomasi	2.221	1.371	3.3	3.001	0.041		1.987
Eucyclops agilis	0.023						0.023
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax		0.294	4.01	15.083	2.436	1.053	4.575
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus		0.483	1.297	2.086	2.388	1.273	1.505
Tropocyclops extensus							
Total Biomass	30.461	18.089	41.267	50.684	44.373	14.485	33.227
Non-daphnid	9.429	2.122	4.037	9.531	12.790	4.7529	7.110
Daphnid			0.451	2.143	2.289	0.474	1.339
Calanoid	4.177	7.268	23.516	12.852	16.347	3.885	11.341
Cyclopoid	16.855	8.699	13.263	26.202	12.997	5.378	13.899
Dreissena polymorpha veliger	0.91	0.98	0.28	0.49	0.00	0.00	0.443
Species Richness	14	11	19	19	19	15	16.167

Appendix 4.6

Lake Couchiching Zooplankton LC21 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03
Non-Daphnid Cladocera						
Acatholeberis curvirostris						
Acroperus harpae						
Alona guttata						
Alona sp.						
Bosmina longirostris			0.55			
Bythotrephes cederstoemii						
Ceriodaphnia lacustris						
Ceriodaphnia sp.						
Chydorus sphaericus						
Diaphanosoma birgeii			0.853			
Diaphanosoma brachyurum						
Eubosmina coregoni						
Eubosmina longispina						
Eurycercus lamellatus						
Graptoleberis testudinaria						
Holopedium gibberum			0.797			
Ilyocryptus spinifer						
Leptodora kindtii						
Pleuroxus hamulatus						
Pleuroxus sp.						
Polyphemus pediculus						
Sida crystallina						
Simocephalus serrulatus						
Simocephalus vetulus						
Streblocerus serricaudatus						
Daphnid Cladocera						
Daphnia ambigua						
Daphnia galeata mendotae			0.654			
Daphnia longiremis						
Daphnia pulicaria						
Daphnia parvula						
Daphnia retrocurva						
Calanoid Copepods						
Calanoid copepodid			1.042			
Calanoid nauplii			1.214			
Epischura lacustris						
Epischura lacustris copepod						
Eurytemora affinis						
Leptodiaptomus ashlandii						
Leptodiaptomus sicilus						
Leptodiaptomus minutus			12.072			
Limnocalanus macrurus						
Skistodiaptomus oregonensis			0.519			
Skistodiaptomus reighardi						
Cyclopoid Copepods						
Cyclopoid copepodid			2.341			
Cyclopoid nauplii			2.459			
Cyclops scutifer						
Cyclops vernalis						
Diacyclops bicuspidatus thomasi			2.61			
Eucyclops agilis						
Eucyclops serrulus						
Macrocyclops albidus						
Mesocyclops edax			0.653			
Orthocyclops modestus						
Paracyclops fimbriatus poppei						
Tropocyclops p. mexicanus			1.622			
Tropocyclops extensus						
Total Biomass			27.386			
Non-daphnid			0.000			
Daphnid			0.654			
Calanoid			14.847			
Cyclopoid			9.685			
Dreissena polymorpha veliger	0.00	0.00	0.47	0.00	0.00	0.00
Species Richness	0	0	13	0	0	0

Appendix 4.7

Lake Couchiching Zooplankton LC22 Biomass 2003

Zooplankton Name	06/04/03	06/24/03	07/22/03	08/06/03	08/26/03	10/01/03	Average
Non-Daphnid Cladocera							
Acatholeberis curvirostris							
Acroperus harpae					0.028		0.028
Alona guttata							
Alona sp.							
Bosmina longirostris	17.386	2.12	1.183	2.781	2.352	2.762	4.764
Bythotrephes cederstoemii							
Ceriodaphnia lacustris			0.003		0.048	0.035	0.029
Ceriodaphnia sp.							
Chydorus sphaericus	0.023	0.043	0.012		0.016	0.035	0.026
Diaphanosoma birgeii		0.047	4.783	3.367	3.106	1.407	2.542
Diaphanosoma brachyurum							
Eubosmina coregoni							
Eubosmina longispina							
Eurycercus lamellatus							
Graptoleberis testudinaria							
Holopedium gibberum		0.038	0.253	0.883	0.116	0.096	0.277
Ilyocryptus spinifer							
Leptodora kindtii			0.048	0.111	0.055		0.071
Pleuroxus hamulatus	0.043	0.019				0.006	0.023
Pleuroxus sp.							
Polyphemus pediculus							
Sida crystallina					0.047		0.047
Simocephalus serrulatus							
Simocephalus vetulus							
Streblocerus serricaudatus							
Daphnid Cladocera							
Daphnia ambigua							
Daphnia galeata mendotae			0.2	0.944	12.078	1.585	3.702
Daphnia longiremis							
Daphnia pulicaria							
Daphnia parvula							
Daphnia retrocurva				0.224	0.262		0.243
Calanoid Copepods							
Calanoid copepodid	1.837	1.707	1.39	3.11	0.325	1.647	1.669
Calanoid nauplii	0.01	0.063	0.78	0.428	0.016	0.049	0.224
Epischura lacustris		0.103				0.191	0.147
Epischura lacustris copepod	0.101	0.025					0.063
Eurytemora affinis							
Leptodiaptomus ashlandii							
Leptodiaptomus sicilus							
Leptodiaptomus minutus	1.779	4.432	6.816	12.773	1.171	1.268	4.707
Limnocalanus macrurus							
Skistodiaptomus oregonensis	0.509	0.423	2.707	0.51	2.968	1.863	1.497
Skistodiaptomus reighardi							
Cyclopoid Copepods							
Cyclopoid copepodid	9.006	8.951	3.631	3.218	7.031	2.176	5.669
Cyclopoid nauplii	2.727	2.111	2.764	3.263	3.874	1.13	2.645
Cyclops scutifer							
Cyclops vernalis							
Diacyclops bicuspidatus thomasi	1.776	11.034	3.613	0.797		0.04	3.452
Eucyclops agilis							
Eucyclops serrulus							
Macrocyclops albidus							
Mesocyclops edax	0.037	2.143	7.448	2.177	17.127	2.562	5.249
Orthocyclops modestus							
Paracyclops fimbriatus poppei							
Tropocyclops p. mexicanus	0.202	0.22	2.113	2.695	0.927	2.168	1.388
Tropocyclops extensus							
Total Biomass	35.436	33.479	37.744	37.281	51.519	19.02	35.747
Non-daphnid	17.452	2.267	6.282	7.142	5.768	4.341	7.209
Daphnid			0.2	1.168	12.340	1.585	3.823
Calanoid	4.236	6.753	11.693	16.821	4.480	5.018	8.167
Cyclopoid	13.748	24.459	19.569	12.150	28.959	8.076	17.827
Dreissena polymorpha veliger	0.00	1.35	0.97	0.08	0.00	0.00	0.399
Species Richness	13	16	16	15	18	17	15.833