Chlorophyll *a* concentrations in Otsego Lake, summer 2004

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INTRODUCTION

Otsego Lake is monitored annually for a variety of biotic and chemical limnological variables (i.e. Harman et al. 1997). The purpose of these ongoing studies is to realize trends and identify shifts in the lake's trophic state that may recommend modification in the management and use of the water body and its tributaries. Population dynamics of phytoplankton are a major indicator of water quality; the yearly documentation of algae distribution and number in the water column is an integral component of Lake Otsego's water quality monitoring regimen.

As this monitoring has indicated, Otsego's trophic status has shifted toward eutrophy through the 1990s, raising concerns about the affects of large algal blooms on recreational and municipal water use (Harman et al. 1997). The result of nutrient loading, these algal blooms first decrease water clarity as the phytoplankton population builds up in the photic zone, and ultimately reduce the dissolved oxygen supply at the bottom of the lake as bacteria decompose dead algae that fall through the hypolimnion. Large algal populations threaten the aesthetic and recreational appeal of the lake, its cold water fishery, and the potability of its water (Cooke et al. 1993). As phytoplankton are the main producers of the aquatic ecosystem, the biological impacts of algal blooms resonate through the food chain. More significantly, phytoplankton population spikes are a link in a chain of events that could ultimately lead to the release of internal, sediment-bound phosphorus (due to anoxic conditions at the lake's bottom), rendering phosphorus mitigation and management techniques ineffective (Harman et al. 1997).

Chlorophyll *a* is a photosynthetic pigment present in all algae (Wetzel 1975), and its concentration in the water column is commonly used to define a lake's quality and its trophic state (Cooke et al. 1993). Phytoplankton population succession is influenced by variations in light and temperature, as well as the organisms' ability to remain in the photic zone for a complete life cycle. Other contributing variables to their population dynamics include not only organic and inorganic nutrients, but also parasitism and predation (Wetzel 1975).

The purpose of this research is to document the vertical distribution of chlorophyll *a* in order to estimate the phytoplankton biomass in Otsego Lake. Concurrent with this study, temperature, pH, dissolved oxygen, and conductivity profiles were documented using a Hydrolab Scout II®. Additional analyses of nitrate+nitrite nitrogen, alkalinity, total phosphorus, chlorides, and calcium were conducted in profile from the surface to the bottom (Albright 2005).

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METHODS AND MATERIALS

Between 15 July and 12 August 2004, biweekly water samples were taken in profile from the deepest part of Otsego Lake, TR4-C (Figure 1). Using a Van Dorn sampler, water was collected starting at the lake's surface and at one meter intervals to 20 meters. Samples were transferred to 500mL Nalgene® bottles and transported back to the Biological Field Station, stored in a cooler on ice to prevent chlorophyll degradation due to heat and light. All sample processing was done in subdued light.

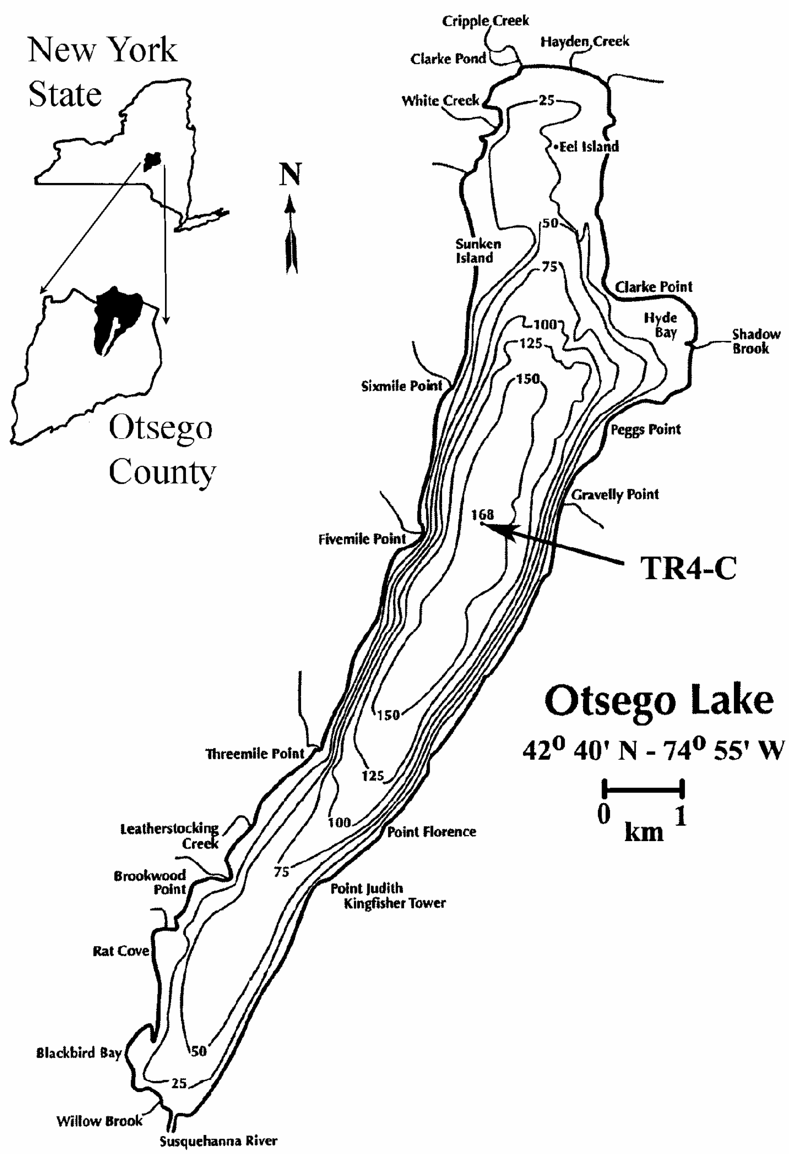

Figure 1. Bathymetric Map of Lake Otsego showing sampling site TR4-C. Depth in feet.

Upon returning to the Field Station, laboratory processing began by passing 100mL sub-samples through a GF/A Whatman® 47-mm glass mircofiber filter using a low pressure vacuum pump. Forceps were used to remove the filters from the filter funnels and to fold them in half. After the folded filters were blotted dry with paper towel, excess filter that did not contact the sample was cut away and discarded. Each trimmed filter was then placed in its own Petri dish labeled with the site, date, depth, and sub-sample volume. All the Petri dishes were placed in a large beaker covered in aluminum foil, which was stored in a freezer at -20ºC until further processing. The surface, 10 meter and 20 meter samples were processed in duplicate for quality assurance purposes.

Sample processing continued as small pieces of each filter were cut into a 10mL glass grinding tube, along with approximately 4mL buffered acetone (90% acetone and 10% saturated $MgCO_3$). This was ground into a homogenous slurry with a Teflon pestle connected to an electric drill via chuck. The slurry, grinding tube and pestle were rinsed with buffered acetone into a 15mL centrifuge tube, and this sample was topped up with buffered acetone to 10mL. After steeping in the dark, the slurry was centrifuged at 1000g for ten minutes to eliminate particulate matter that could interfere with a sample's chlorophyll *a* reading. The sample was poured into a 1cm cuvette, and the chlorophyll *a* concentration was read by a Turner Desigen TD-700 Fluorometer® following the methodologies of Arar and Collins (1997).

RESULTS AND DISCUSSION

The chlorophyll *a* concentration profiles for the summer of 2004 are shown in Figure 2, with the sample duplicates at 0, 10 and 20 meters averaged. Profiles were similar on each sampling date, with concentrations of about 4µg/L through the epilimnion to approximately 8 meters. Below 9 meters, the concentrations were about 2µg/L. On 12 August, water samples at 1 meter and 2 meters had the highest concentrations of chlorophyll *a* recorded during this summer's study period, 4.98µg/L. The lowest concentration, 0.07µg/L, was documented at 20 meters on 15 July, and 16 meters on 12 August.

Figure 3 illustrates the mean summer time chlorophyll *a* concentrations in Lake Otsego recorded over the past five summers. During the summers of 2001, 2002 and 2003, peak concentrations were recorded just above the thermocline. This trend was not followed this year, when mean epilimnion chlorophyll *a* concentrations were generally higher and without considerable variation. Below 9 meters, every mean concentration documented during summer 2004 was lower than previously recorded, and the data were more consistent through the vertical column. It is possible that these differences do not only represent changes in the algal population distribution in Lake Otsego, but also the difference in the starting and ending dates of data collection between the years. In 2004, data collection began late, 15 July and continued for only six weeks and three sample collections. Studies that started earlier in the summer (i.e. Wayman 2003) may have sampled and documented seasonal algal blooms that were not present by mid July.

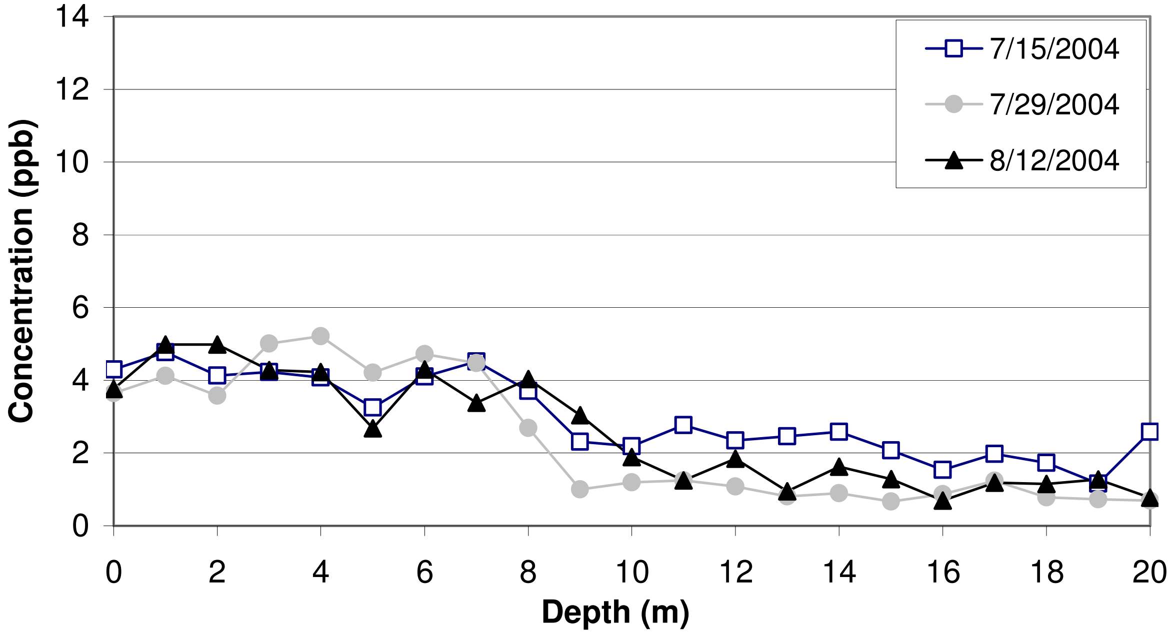

Figure 2. Summer 2004 profiles of chlorophyll *a*.

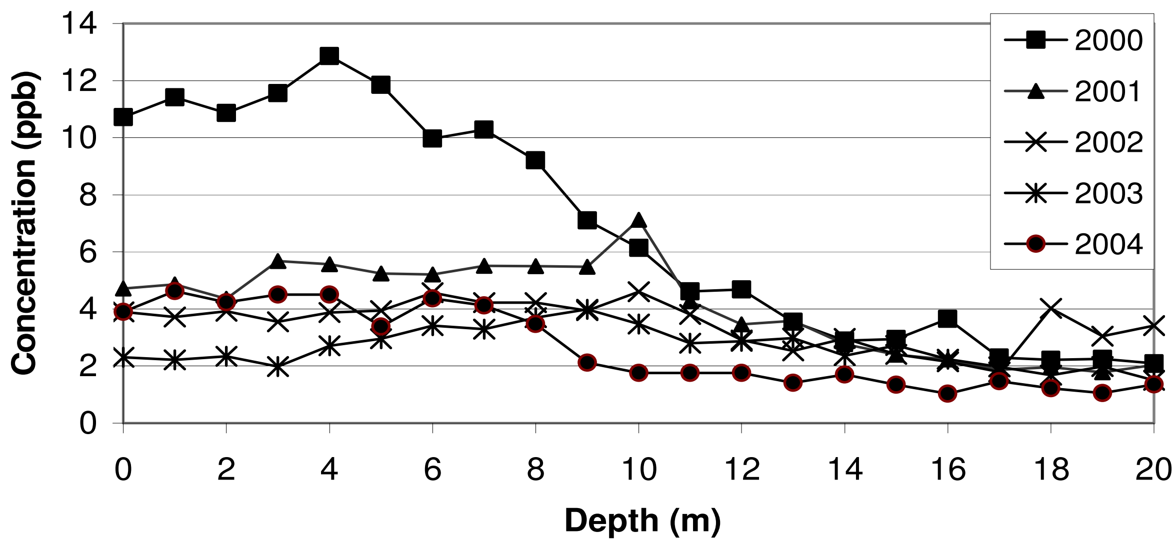

Figure 3. Summer mean chlorophyll *a* concentrations for 2000 (Durie 2001), 2001 (Waymane 2002), 2002 (Wayman 2003), 2003 (Schmidt 2004) and 2004.

The mean surface to 20 meter chlorophyll *a* concentrations during July 2004 were slightly higher than those of the same time in 2003, though previously from year to year there was a marked reduction in the pigment's presence. The general trend toward decreasing chlorophyll *a* concentrations over the past five years (Figure 4) has been concurrent with the apparent reduction of Otsego Lake's population of alewives (*Alosa psuedoharengus*), as documented by annual BFS trap netting (Leonard and Cheever 2005). That shift in the alewife population was concurrent with an increase in crustacean zooplankton abundance and mean size (Albright et al. 2005). Zooplankton graze upon phytoplankton, and their growing presence appears to be responsible for decreasing chlorophyll *a* concentrations.

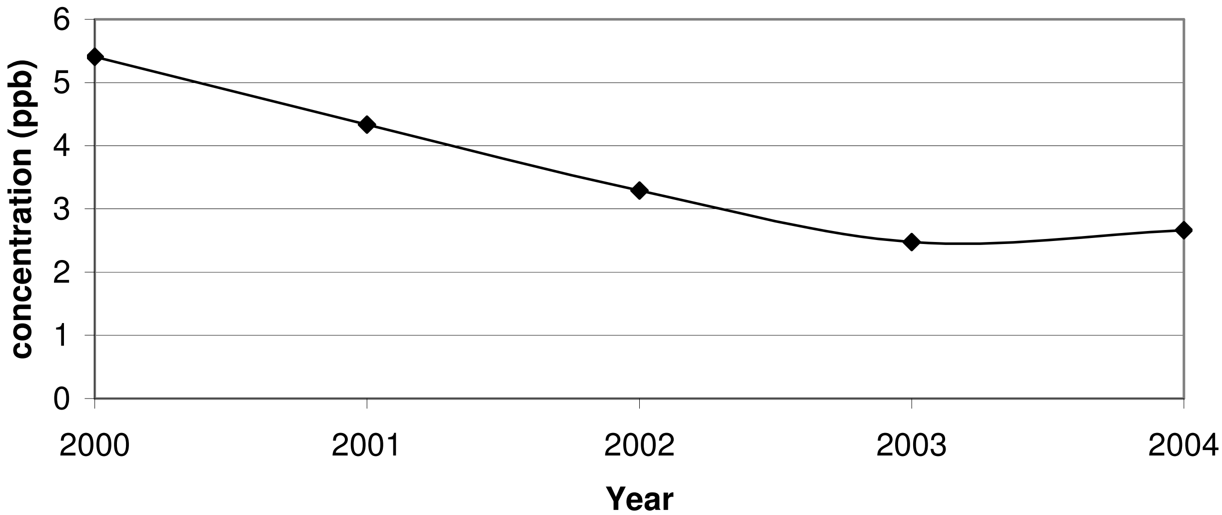

Figure 4. The mean, surface to 20 meters, chlorophyll a concentrations for the month of July, 2000 (Durie 2001), 2001 (Wayman 2002), 2002 (Wayman 2003), 2003 (Schmidt 2004) and 2004.

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