

Chlorophyll *a* concentrations in Otsego Lake, summer 2003

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INTRODUCTION

Limnological studies of biotic and abiotic factors are performed on Otsego Lake each year (i.e. Harman et al. 1997). These studies are done in order to recognize trends and problems before they become a threat. This early detection allows for better decisions regarding the management of the potential problems. One problem that jeopardizes the lake's health is excessive phosphorous loading (Harman et al. 1997), the consequences of which relate to increased algal productivity. Light, temperature, inorganic nutrients (such as phosphorus), competition of available resources, staying in the photic zone of the lake, and the avoidance of destruction by other organisms are some of the interrelating factors that contribute to the growth of phytoplankton (Wetzel 1975).

The studied factors involve the abundance and density of phytoplankton in the lake. Since phytoplankton is at the base of the food chain its abundance dictates the success of other organisms, such as zooplankton, which are fed upon by fish. Conversely, the phytoplankton affects the dissolved oxygen content and transparency of the lake. The dissolved oxygen content is lowered when the phytoplankton dies and sinks to the bottom where it decomposes, a process which uses up available dissolved oxygen. The lack of oxygen jeopardizes cold water fish and could ultimately lead to internal phosphorus release, rendering conventional management approaches ineffective (Harman et al. 1997).

The purpose of the work conducted on chlorophyll *a*, a light sensitive pigment present in all plants used for photosynthesis, was to record and evaluate its vertical distribution in the lake throughout the summer. Concurrent with this work, profiles of chemical and physical parameters were recorded (Albright 2004).

METHODS AND MATERIALS

Chlorophyll *a* samples were collected at TR4-C (Figure 1), the deepest part of the lake, weekly from June 26 to August 12. The samples were taken in profile every meter from the surface down to 20 meters. A Van Dorn sampler was used to collect the water samples. The samples were then transferred to 500ml Nalgene® bottles and were transported back to the Biological Field Station in a cooler on ice. This was to prevent the chlorophyll, which is sensitive to heat and light, from degrading. All samples were processed in the dark for the

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same reason. The surface, 10 meter, and 20 meter samples were processed in duplicate as a quality assurance measure.

Laboratory processing began upon returning to the Field Station. Processing involved passing 100ml of each sample through a GF/A Whatman® 47-mm glass microfiber filter using a low-pressure vacuum pump. Filters were then folded in half and blotted to remove excess water. The edges were then trimmed off the filter where no chlorophyll had encountered the filter. The trimmed filters were then placed in Petri dishes labeled with the sample's depth. These Petri dishes were then placed in a large beaker and then the beaker was wrapped in aluminum foil and labeled with the date and location. The beaker was placed in a freezer at -20°C until further processing.

The next day, processing continued in subdued light. Each filter was cut into small pieces, to increase surface area, and placed into a 10ml glass grinding tube with approximately 4ml of buffered acetone (90% acetone and 10% saturated MgCO₃) and ground, with a Teflon pestle connected via chuck to an electric drill, into a homogenous slurry. The slurry along with the pestle and grinding tube were rinsed into a 15ml centrifuge tube. The samples were topped up to 10ml and the tube was capped and shaken. The centrifuge tubes were placed in a refrigerator, wrapped in aluminum foil to prevent exposure to light, to steep for a minimum of 2 hours and no longer than 24 hours to complete the extraction process.

The slurry was then centrifuged at 1000g for five minutes to remove particulate matter that may affect the chlorophyll *a* reading. The substance was then transferred to a 1-cm cuvette. Chlorophyll *a* concentrations were then determined using a Turner Designs TD-700 Fluorometer® following the methodologies outlined by Arar and Collins (1997).

RESULTS AND DISCUSSION

Figure 2 shows the average chlorophyll *a* concentrations in profile (the duplicates averaged together) for the summer of 2003. The error bars represent plus or minus one standard error. This graph shows that mean chlorophyll *a* concentration was generally lower than previous years. Like 2002 (Wayman 2003), levels were slightly elevated between 6 and 10 meters, the area slightly above the thermocline. The mean concentrations in profile were fairly consistent, varying from a low 1.5 µg/L at 20 meters to a high of 4.0 µg/L at 9 meters. The mean concentrations by date are similarly consistent, a low of 2.0 µg/L on August 12, and a high of 4.3 µg/L on June 26.

Figure 3 plots the summer mean chlorophyll *a* concentrations for 2000 (Durie 2001), 2001 (Wayman 2002), 2002 (Wayman 2003), and 2003. In 2003, the chlorophyll *a* concentrations from the surface down to 8 meters, above the thermocline, are the lowest of the four summers represented in the graph. From 9 meters to 20 meters the graph follows the general trend of the previous years and the concentrations are very similar. The graph of 2003 is most similar to the graph of 2002 (Wayman 2003); the peak is between 6 and 10 meters, just above the thermocline in both and vertical variation was slight. The concentrations for the summer of 2002 were about 30% higher from 0 to 7 meters.

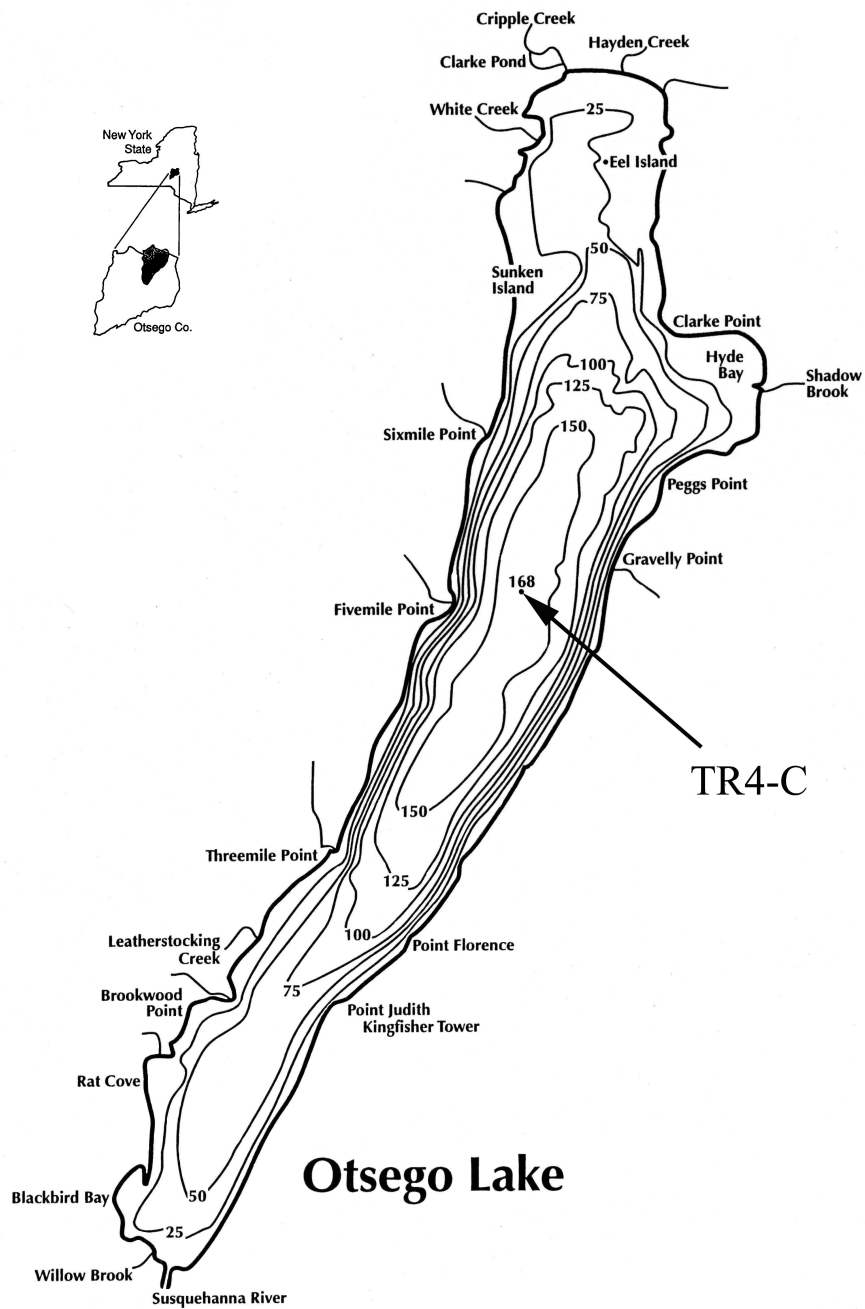


Figure 1. Bathymetric map of Otsego Lake showing sampling site (TR4-C). Depth in feet.

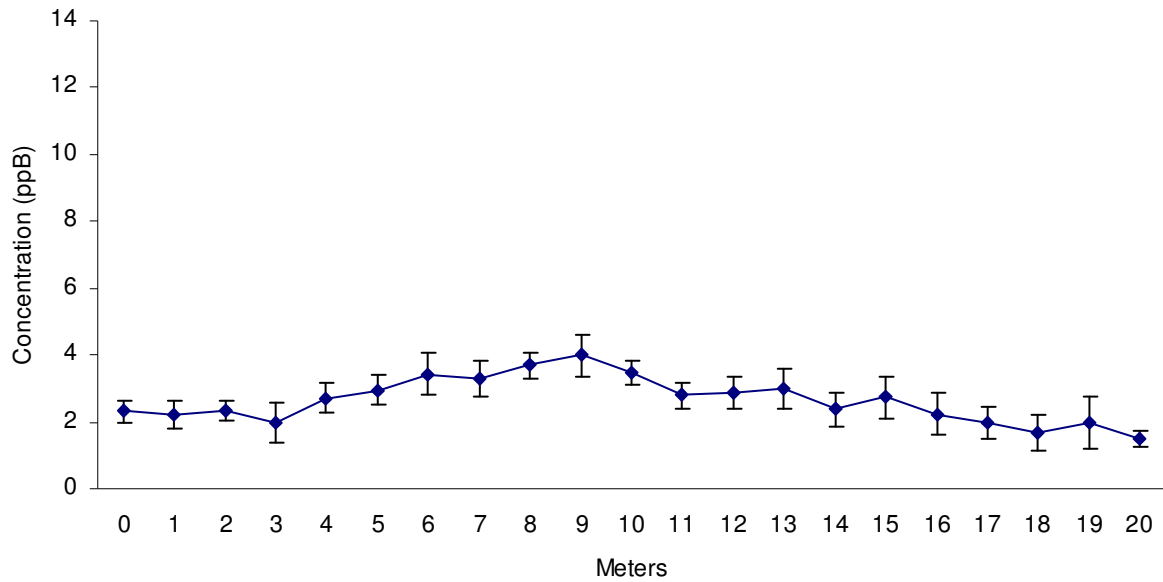


Figure 2. Mean chlorophyll *a* concentration in profile, summer 2003. Error bars represent +/- 1 standard error.

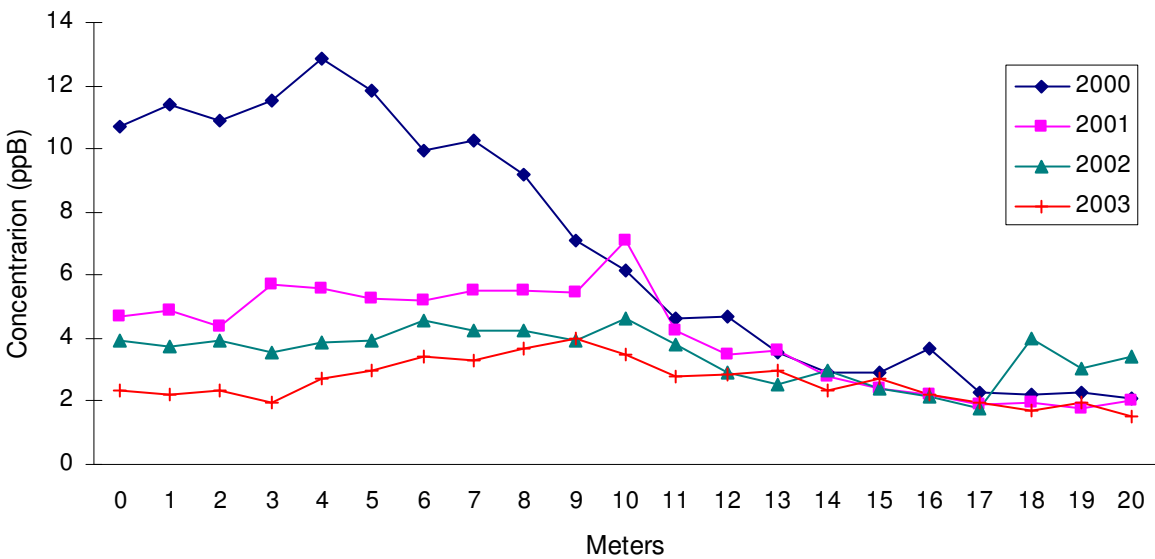


Figure 3. Summer mean chlorophyll *a* concentrations for 2000 (Durie 2001), 2001 (Wayman 2002), 2002 (Wayman 2003), and 2003.

Figure 4 plots the mean, surface to 20 meters, chlorophyll *a* concentration for 2000 (Durie 2001), 2001 (Wayman 2002), 2002 (Wayman 2003) and 2003. It shows a general trend of decreasing chlorophyll *a* concentrations over the past few years. This may be due to an apparent decrease in alewife (*Alosa pseudoharengus*) population in 2002, suggested by annual BFS trap netting (Gray and Foster 2003), which may have led to the rebound in larger-bodied zooplankton documented in 2002 (Martin 2003). The larger zooplankton allow for increased grazing, which helps to reduce the algal biomass in the lake.

Concurrent with this work, Secchi transparencies were higher during 2003 and rates of hypolimnetic oxygen depletion were lower (Albright 2004). There was an increase in mean zooplankton size between 2002 and 2003, suggesting that the percent of the epilimnion filtered per day has increased (Burns 2004). This increase may be responsible for the decrease in algal biomass for this year.

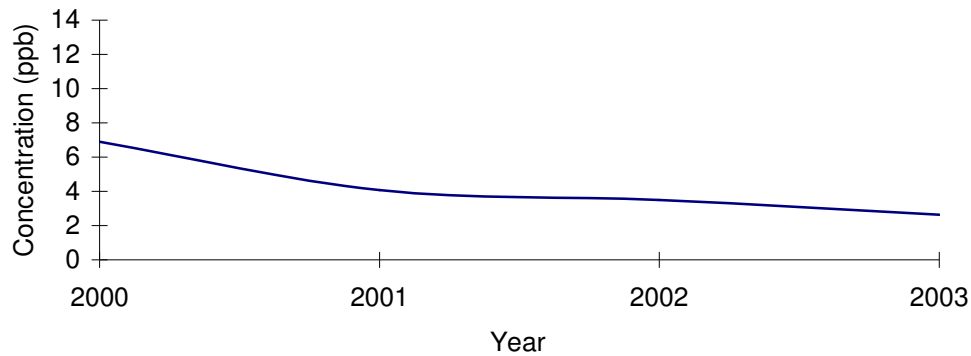


Figure 4. The mean, surface to 20 meters, chlorophyll *a* concentration for 2000 (Durie 2001), 2001 (Wayman 2002), 2002 (Wayman 2003), and 2003.

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