

Otsego Lake limnological monitoring, 2006

Matthew F. Albright

ABSTRACT

Limnological analyses of several abiotic factors were performed during 2006 on Otsego Lake, Cooperstown, N.Y. The purpose was to monitor the chemical and physical parameters affecting water quality for comparison with past findings. This work is part of an ongoing study begun thirty years ago. Throughout the year, profiles of water temperature, dissolved oxygen, pH and conductivity were measured using a Hydrolab Scout 2[®], a Hyrdolab Surveyor 4[®] or a Eureka Amphibian/Manta[®] at the deepest spot in the Lake (TR4-C). Water samples were collected in profile for the analyses of total phosphorus, nitrite+nitrate, ammonia, total nitrogen, calcium, chloride, and alkalinity. Secchi disk transparency was measured. The data, after comparison with earlier information, indicate that water quality varies in relation to the volume of cold water fish habitat in late summer. These changes are attributed to fluctuations in nutrient loading, weather conditions, and food web alterations due to the proliferation of the alewife.

INTRODUCTION

Otsego Lake is a glacially formed, dimictic lake supporting a cold water fishery. The Lake is generally classified as being chemically mesotrophic, although flora and fauna characteristically associated with oligotrophic lakes are present (Iannuzzi, 1991).

This study is the continuation of year-round protocol that began in 1991. The data collected in this report run for the calendar year and are comparable with contributions by Homburger and Buttigieg (1992), Groff et. al.(1993), Harman (1994; 1995) Austin et al. (1996), and Albright (1997; 1998; 1999; 2000; 2001; 2002; 2003; 2004; 2005; 2006). Concurrent additional work included summer chlorophyll *a* profiles (Stevens 2007), descriptions of the zooplankton (Albright 2007) and neckton communities (Reinicke and Walters 2007; Golding, Reinicke and Foster 2007; Brooking and Cornwell 2007) and estimates of fluvial nutrient inputs (Snyder 2007).

MATERIALS AND METHODS

Readings were collected bi-weekly during open water conditions and monthly through the ice. However, because of unsafe ice conditions, data were only collected between 8 March and 17 November.

Data were collected near the deepest part of the Lake (TR4-C) (Figure 1), which is considered representative as past studies have shown the Lake to be spatially homogenous with respect to the factors under study (Iannuzz 1991). Physical measurements were recorded at 2 m

intervals between 0 and 20 m and 40 m to the bottom; 5 meter intervals were used between 20 and 40 m. Measurements of pH, temperature, dissolved oxygen and conductivity were recorded on site with the use of a Hydrolab Scout 2[®], a Hydrolab Surveyor 4[®] or a Eureka Amphibian/Manta[®] multiprobe digital microprocessor which had been calibrated according to manufacturer's instruction immediately prior to use (Hydrolab Corp. 1993; Eureka Environmental Engineering 2005). Samples were collected for chemical analyses at 4 m intervals between 0 and 20 m and 40 m and the bottom; 10 m intervals were used between 20 and 40 m. A summary of methodologies employed for chemical analyses are given in Table 1. Composite samples were collected from the surface to 20 m for Chlorophyll *a* measurements, which were determined using a Turner Designs TD-700[®] fluorometer following the methods of Welschmeyer (1994).

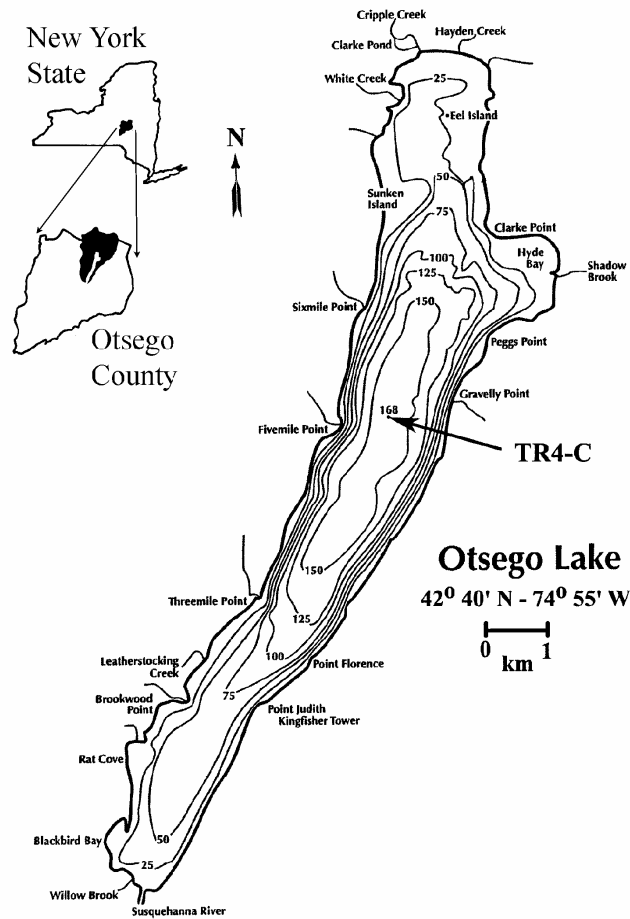


Figure 1. Bathymetric map of Otsego Lake showing sampling site (TR4-C).

Parameter	Sample volume	Preservation	Method	Reference
Total Phosphorus-P	10 ml	H ₂ SO ₄ to pH<2	Persulfate digestion followed by single reagent ascorbic acid	Liao and Marten 2001
Total Nitrogen-N	5 ml	H ₂ SO ₄ to pH<2	Cadmium reduction method following peroxodisulfate digestion	Pritzlaff 2003; Ebina et. al 1983
Nitrite+Nitrate-N	10 ml	H ₂ SO ₄ to pH<2	Cadmium reduction	Pritzlaff 2003
Ammonia-N	10 ml	H ₂ SO ₄ to pH<2	Phenolate	Liao 2001
Calcium	50 ml	None	EDTA titrimetric	EPA 1983
Chloride	100 ml	None	Mercuric nitrate titration	APHA 1989
Alkalinity	100 ml	Cool to <4°C, measure ASAP	Titration to pH=4.6	APHA 1989
Chlorophyll <i>a</i>	100 ml	Ice sample, filter ASAP, process in reduced light	Fluorometric	Welshmeyer 1994

Table 1. Summary of laboratory methodologies.

RESULTS AND DISCUSSION

Temperature

Surface temperature reached a high of 25.60 C° on 3 August. The coldest temperature recorded was 1.69 C° near the bottom on 8 March. The lake was completely covered by ice on 9 February. The lake was completely ice-free on 17 February; it re-froze on 28 February. The lake was ice-free on 1 April. Stratification was evident by 4 May.

Dissolved Oxygen

Dissolved oxygen concentrations ranged from surface readings of 14.10 mg/l at the surface on 8 March to 2.28 mg/l at the bottom on 17 November. Year long profiles are given in Figure 2. Areal hypolimnetic oxygen depletion rates, at 0.084 mg/cm²/day, were the lowest since before 1992 (Table 2), but are still over the lower limit of eutrophy (0.05 mg/cm²/day) suggested by Hutchinson (1957).

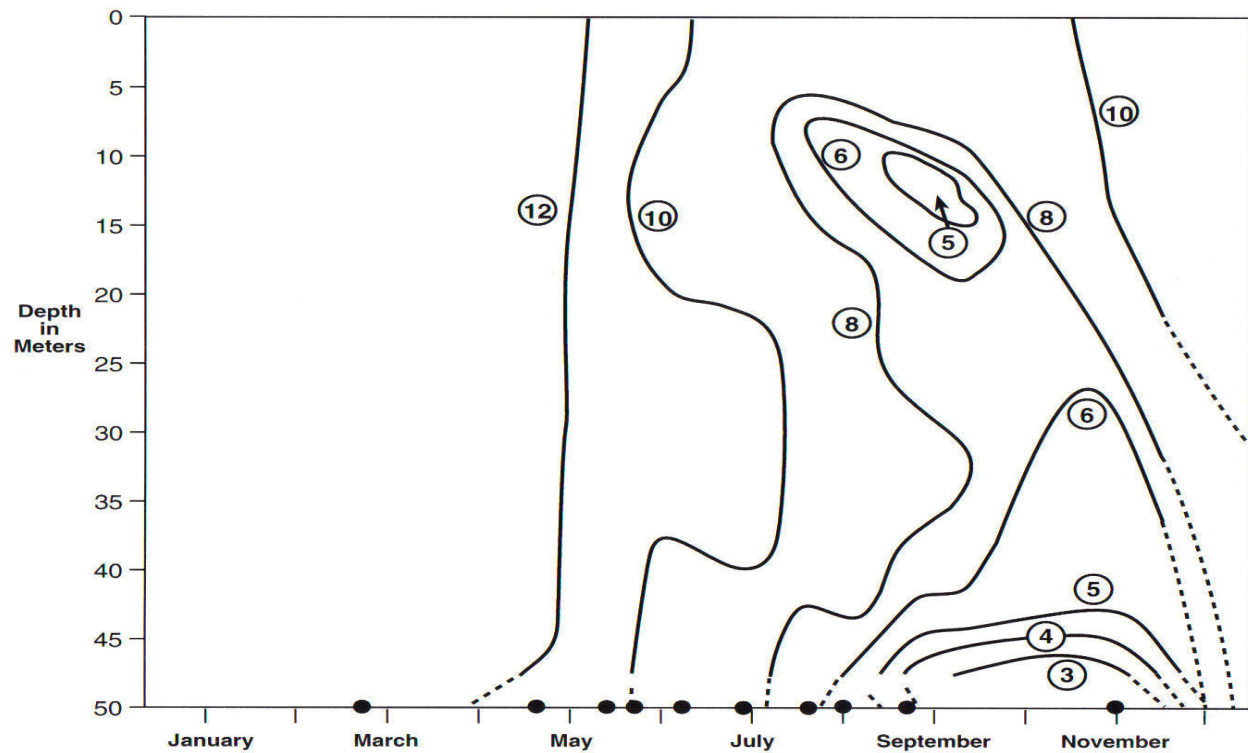


Figure 2. Otsego Lake oxygen profiles, 2006. Isopleths in mg/l.

Interval	AHOD (mg/cm ² /day)
05/16/69 – 09/27/69	0.080
05-30-72 – 10/14/72	0.076
05/12/88 – 10/06/88	0.042
05/18/92 – 09/29/92	0.091
05/10/93 – 09/27/93	0.096
05/17/94 – 09/20/94	0.096
05/19/95 – 10/10/95	0.102
05/14/96 – 09/17/96	0.090
05/08/97 – 09/25/97	0.101
05/15/98 – 09/17/98	0.095
05/20/99 – 09/27/99	0.095
05/11/00 – 09/14/00	0.109
05/17/01 – 09/13/01	0.092
05/15/02 – 09-26/02	0.087
05/16/03 – 09/18/03	0.087
05/20/05 – 09/24/05	0.102
05/27/05 – 10/05/05	0.085
05/05/06 – 09/26/06	0.084

Table 2. Areal hypolimnetic oxygen deficits (AHOD), Otsego Lake computed over summer stratification in 1969, 1972 (Sohacki, unpubl.), 1988 (Iannuzzi, 1991) and 1992-2006.

Conductivity

Conductivity (an indirect measure of ions in solution) values ranged from 279 $\mu\text{mhos/cm}$ in surface waters on 17 August and 7 September to 330 $\mu\text{mhos/cm}$ at 48 m on 22 June.

Alkalinity

Alkalinity averaged 115 mg/l (as CaCO_3) throughout the year. The minimum value of 98 mg/l was observed at 4 m on 22 June; the maximum value (129 mg/l) occurred at the 4 m on 8 March. These data are consistent with earlier findings (Harman et al., 1997).

Calcium

Calcium dynamics paralleled those of alkalinity. The year-long average was 50.2 mg/l. A low of 34.5 mg/l was encountered at 16 m on 3 August; a high of 61.7 was observed from 16 to 40 m on 8 March.

Chlorides

Chloride concentrations averaged 15.4 mg/l, exhibiting very little variation either temporally or spatially. Since the mid 1980s chlorides concentrations have been increasing by 0.5 to 1.0 mg/l/year, presumably attributable to road salting, continues However, the mean concentration in 2006 was actually 1.0 mg/l lower than that of 2006 (Figure 3).

Nutrients

Total phosphorus-P averaged 9.26 $\mu\text{g/l}$. There was no evidence of phosphorus release from the sediments prior to fall turnover, as had been suggested following 1995 monitoring (Harman et al. 1997). Nitrite+nitrate-N averaged 0.36 mg/l over the course of the year. Ammonia was consistently below detectable levels (< 0.02 mg/l). Total nitrogen averaged 0.59 mg/l. This implies that organic nitrogen averaged about 0.2 mg/l over the year.

Secchi disk transparency and chlorophyll *a*

Summertime (May-October) water transparency averaged 2.5 m and ranged from 1.8 m on 22 June to a high of 3.8 m on 8 March. Figure 4 summarizes Ann. mean summer (May-October) Secchi transparencies at TR4-C in 1935, 1968-73, 1975-82, 1984-87, 1988, and 1992-06. Composite chlorophyll *a* samples averaged 3.8 mg/l.



Figure 3. Mean chloride concentrations at TR4-C, 1925-2006. Points later than 1990 represent yearly averages (modified from Peters 1974).

CONCLUSIONS

Over the summer of 2006, mean chlorophyll *a* concentrations were comparable to those of recent years while mean numbers and sizes of cladoceran zooplankton continue to exceed those encountered between 1993 and 2003 (Albright 2007). Routine trap net collections indicate that littoral alewife (*Alosa pseudoharengus*) abundances are lower than measured since their establishment (Reinicke and Waters 2007), indicating that management strategies to control that species (Cornwell 2005) might be effective. Interestingly, mean summertime aerial hypolimnetic oxygen depletion was among the lowest ever recorded, despite the fact that mean Secchi transparency was also among the lowest ever recorded. The 15 year trend of markedly rising chloride concentrations did not continue in 2006; instead, chlorides declined by approximately 1 mg/l.

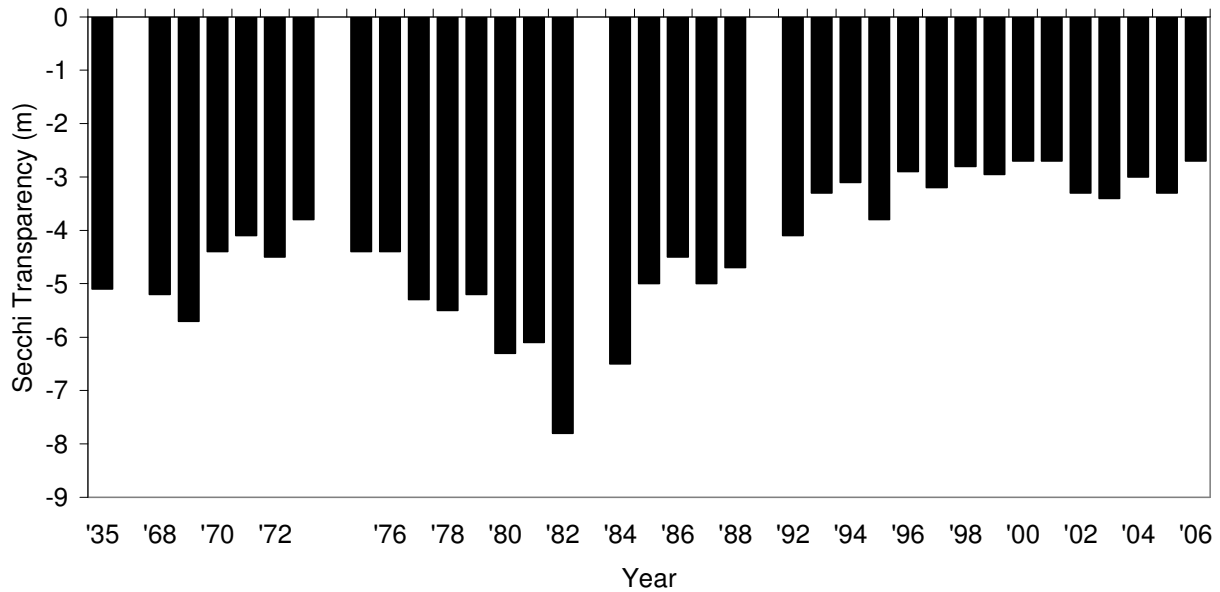


Figure 4. May-October mean Secchi transparencies collected at TR4-C, 1935-04 (modified from Harman et al., 1997).

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