A survey of Otsego Lake's zooplankton community, summer 2003

Ryan E Burns[1]

INTRODUCTION

This study's objective was to evaluate the status of zooplankton in Otsego Lake. It is a component of research by Warner (1999) and Cornwell (in prep.) which relates to an evaluation of impacts by the invasive, planktivorous alewife (*Alosa pseudoharengus).* Zooplankton are an integral component of aquatic communities in the movement of energy and nutrients from the lower trophic levels, the primary producers (phytoplankton) to the higher trophic levels, namely Otsego's game fish (Warner 1999). Alewives were introduced into Otsego in 1986 (Foster 1990). Foster and Wigen (1990) hypothesized that monitoring the zooplankton community could be an indication of changes in the fish community, as alewife predation is size-selective, feeding primarily upon the largest of the zooplankton (Warner 1999). It was noted shortly thereafter that the dominant zooplankton were shifting from cladocerans and copepods to rotifers (Foster and Wigens 1990). Rotifers are generally poor quality food items for fish, sequester less nutrients and have substantially lower algal grazing rates than do crustacean plankton (Warner 1999). Trends in declining water clarity and increasing rates of hypolimnetic oxygen consumption through the 1990s (e.g. Albright 2003) were in part attributed to planktivory by alewives (Harman et al. 2002). Recent zooplankton surveys are intended to document any changes that may be related to changing alewife populations, which could be an affect of recent attempts to re-establish walleye (*Sander vitreus*) in the lake.

METHODS

Samples were collected bi-weekly, from 16 May to 8 October, at TR4C at the deepest part of Otsego Lake (Figure 1). At this site a 0.5m diameter conical plankton net with a 147um mesh was hauled from the top of the hypolimnion through the thermocline to the surface, a distance of 12m. A G.O. Environmental™ flow meter attached to the net was utilized to determine the volume of lake water filtered in each sample. Samples were initially persevered with 100% ethanol solution, diluted to a concentration of 50% ethanol, 50% lake water. However, later a preservation method which first deprives the zooplankton of oxygen prior to the addition of ethanol was used to aid in proper identification. This pertains particularly to the Rotifer community which when traumatized by the lethal effects of ethanol suddenly retract exterior appendages and other extremities in response, which are essential in making identification precise. Alka-Seltzer™, with active ingredient sodium bicarbonate, was used for removing oxygen from samples. After preservation, samples were shaken to suspend the zooplankton.

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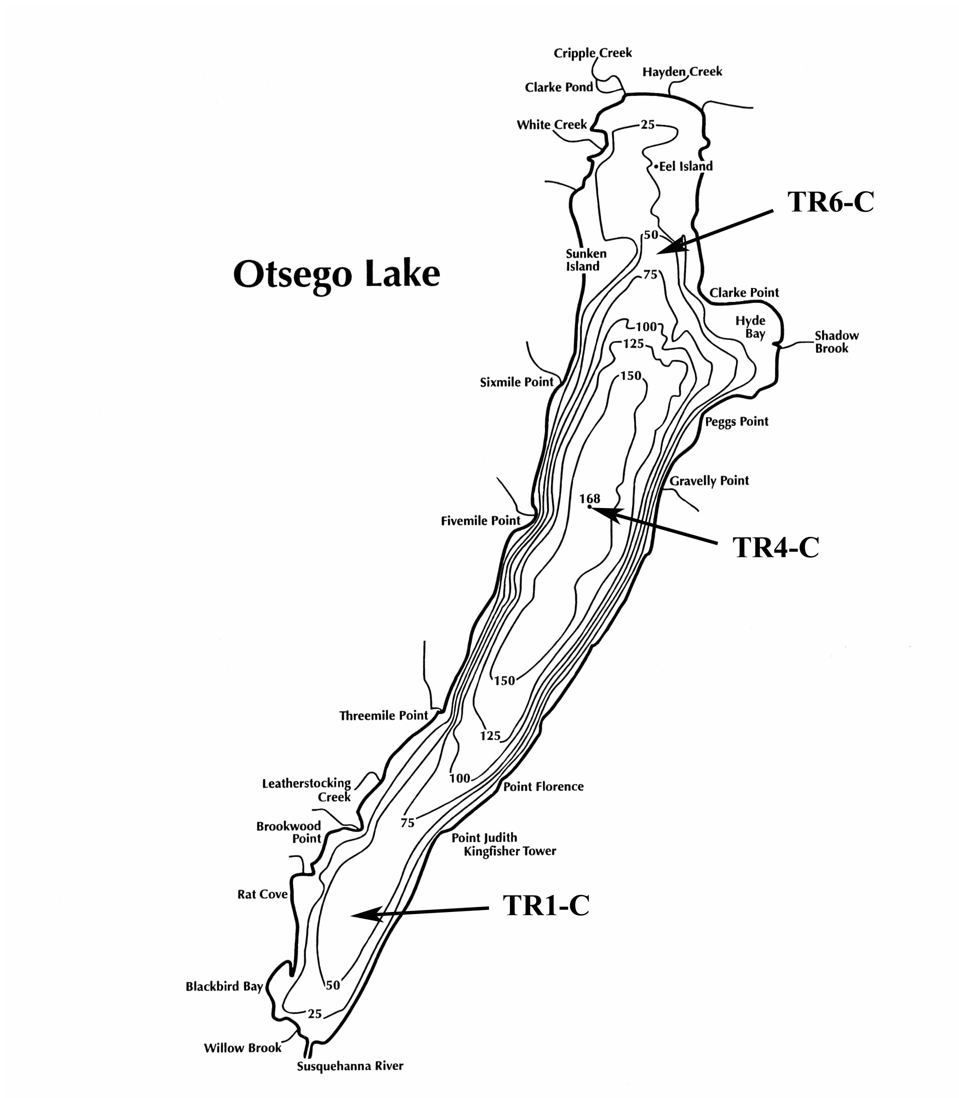

Figure 1. Otseego Lake, New York, showing location of sample site (TR4-C).

A Henson-Stiple pipette was then used to immediately extract 1ml of sample, which was then placed in a Sedgwick rafter cell. Cells were analyzed in at least triplicate.

Cladocerans were distinguished between species *Bosmina longirostris, Daphnia pulex* and *Ceriodaphnia reticulate*. Copepods were merely distinguished between Cyclopoid, Calanoid and their juvenile stage, Nauplius. Rotifers were more diverse. While identification to broad taxa levels were all that was required for estimating filtering rates and phosphorus regeneration, efforts were made to identify organisms to the genus or species level. All were identified using a compound scope at 100X magnification. Densities per cell and length (determined using an occular micrometer) were tabulated. By considering the volume of water filtered and the final volume of after preservation, zooplankton densities were converted to actual estimates, number per l in the lake. Methods were kept as consistent has possible with previous surveys for ease of comparison.

Mean densities and lengths were then used for cladocerans, copepods and rotifers to calculate dry weight (Peters and Downing 1984), daily filtering rate (Knoechel and Holtby 1986) and phosphorus regeneration (Esjmon-Karabin 1983) on each date sampled according to the equations given in Table 1.

Dry Weight:	D.W.=9.86*(length in mm)^2.1
Filtering Rate:	F.R.=11.695*(length in mm)^2.48
Phosphorous regeneration:	
Cladocerans:	P.R.=.519*(dry weight in ug)$^{-.023}$*e$^{0.039}$*(temp.in C)
Copepods:	P.R.=.229*(dry weight in ug)$^{-.645}$*e$^{0.039}$*(temp.in C)
Rotifers:	P.R.=.0514*(dry weight in ug)$^{-1.27}$*e$^{0.096}$*(temp.in C)

Table 1. Equations used to determine zooplankton dry weight, filtering rate, and phosphorus regeneration.

RESULTS AND DISCUSSION

Table 2 provides a summary of the data, including mean epilimnetic temperature, numbers of taxa per liter, average length, mean dry weight per individual and per liter, phosphorus regeneration rates per individual and per liter, filtering rates and the percent of the epilimnion per day.

Rotifers, the lake's smaller zooplankton, continue to be the most abundant group (Table 3), particularly prior to mid-June. The dominant rotifers are the brachionids *Kerratella cochlearis* and *Kellicottia longispina* (Morgan 2001; Martin 2003), though in 2003 several other species were quite common. *Polyartha vulgaris* was more numerous than *Kerratella cochlearis* on some dates and more numerous than *Kellicottia longispina* on others. Though the most abundant group, rotifers do not provide the same forage base to planktivorous fish, nor do they effectively filter algae form the water column. Their mean size increased from an average of 0.118 mm in 2002 to 0.150 mm in 2003 for the months of May to August.

Copepods were second to rotifers in abundance and dominated the crustacean community from May through mid-June. Copepods were often noted carrying eggs, and nauplii (their larval stage) were by far the most numerous of their taxa recorded throughout the summer.

A	B	C	D	E	F	G	H	I	J
	Avg. Temp.	**#/L**	**Avg length**	**mean**	**Dry wt**	**Phos. Regen. Rate**	**Phos. Regen.**	**Filtering Rates**	**% Epilimnion**
5/16/2003	**(deg. C)**		**(mm)**	**Dry Wt (ug)**	**(ug/l)**	**$ugP*mgdrywt^{-1}*ind*h^{-1}$**	**Rate (ug/l/day)**	**ml/ind/day**	**filtered/day**
Cladocera	8	2	0.250	0.536	0.83	0.818	0.016	0.376	0.06
Copepods		39	0.302	0.798	31.11	0.362	0.270	0.600	2.34
Rotifers		829	0.110	0.096	79.29	0.654	1.244	0.049	4.06
total		869			**111.23**		**1.531**		**6.46**
5/29/2003									
Cladocera	10.3	10	0.390	1.365	13.92	0.722	0.241	1.132	1.15
Copepods		66	0.374	1.250	82.87	0.296	0.589	1.020	6.76
Rotifers		830	0.146	0.173	143.88	0.383	1.323	0.099	8.21
total		906			**240.67**		**2.154**		**16.13**
6/12/2003									
Cladocera	13	29	0.284	0.701	20.33	0.935	0.456	0.516	1.49
Copepods		48	0.331	0.967	46.23	0.388	0.431	0.754	3.60
Rotifers		767	0.132	0.140	107.62	0.650	1.678	0.077	5.91
total		844			**174.18**		**2.565**		**11.01**
6/26/2003									
Cladocera	15.2	108	0.271	0.635	68.32	1.042	1.709	0.459	4.93
Copepods		52	0.306	0.820	42.48	0.471	0.480	0.620	3.21
Rotifers		299	0.125	0.125	37.38	0.928	0.833	0.067	2.01
total		458			**148.18**		**3.021**		**10.16**
7/10/2003									
Cladocera	16.7	82	0.249	0.532	43.46	1.151	1.201	0.372	3.04
Copepods		52	0.226	0.434	22.70	0.752	0.410	0.293	1.53
Rotifers		358	0.107	0.090	32.34	1.623	1.259	0.046	1.64
total		492			**98.50**		**2.870**		**6.21**
Excel® formula format for:		Cladocera		9.86*D^2.1	C*E	(0.519*E^-0.23)*(EXP(0.039*B))	G*E*C*24/1000	11.695*D^2.48	C*I/10
		Copepods		"	"	(0.229*E^-0.645)*(EXP(0.039*B))	"	"	"
		Rotifers		"	"	(0.0154*E^-1.27)*(EXP(0.096*B))	"	"	"

Table 2: Summary of mean epilimnetic temperature, zooplankton densities and mean length per taxa, as well as derived values for mean weight per individual and per l, phosphorus regeneration per individual and per l, filtering rates per individual and the percent of the epilimnion filtered per day. The formulas used to derive these values in Excel® are also given in a format compatable with that software. The letters in the forulas refer to the column headers across the top of the sheet.

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Cladocera	17	72	0.347	1.068	76.90	0.992	1.831	0.847	6.10
Copepods		101	0.203	0.346	34.92	0.880	0.738	0.224	2.26
Rotifers		219	0.115	0.105	23.03	1.378	0.762	0.055	1.20
total		392			**134.85**		**3.330**		**9.56**
8/8/2003									
Cladocera	18	45	0.424	1.627	72.39	0.936	1.627	1.393	6.20
Copepods		132	0.233	0.463	61.17	0.760	1.115	0.316	4.17
Rotifers		387	0.121	0.117	45.22	1.324	1.437	0.062	2.40
total		564			**178.79**		**4.179**		**12.77**
8/22/2003	18.6								
Cladocera		69	0.515	2.447	167.63	0.422	1.700	2.256	15.45
Copepods		117	0.255	0.559	65.66	0.333	0.525	0.395	4.63
Rotifers		1086	0.099	0.077	83.25	0.402	0.803	0.038	4.10
total		1272			**316.54**		**3.027**		**24.19**
9/8/2003									
Cladocera	17.3	148	0.434	1.708	252.00	0.901	5.449	1.476	21.77
Copepods		136	0.283	0.696	94.59	0.568	1.289	0.511	6.94
Rotifers		632	0.108	0.092	58.19	1.677	2.342	0.047	2.96
total		916			**404.78**		**9.080**		**31.67**
9/18/2003									
Cladocera	17.3	27	0.344	1.049	28.00	1.008	0.677	0.829	2.21
Copepods		50	0.274	0.650	32.39	0.593	0.461	0.472	2.35
Rotifers		28	0.115	0.105	2.98	1.418	0.102	0.055	0.16
total					**63.37**		**1.240**		**4.72**
10/8/2003									
Cladocera	13.6	17	0.488	2.186	36.50	0.737	0.646	1.974	3.30
Copepods		50	0.314	0.866	43.03	0.427	0.441	0.661	3.29
Rotifers		17	0.102	0.082	1.42	1.369	0.047	0.041	0.07
total					**80.95**		**1.133**		**6.65**
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Cladocerans were the dominant crustacean from the latter half of June through mid -September and, because of their greater mean weight, they contributed substantially more to biomass than did copepods during this period. From mid-September through 8 October, biomass of all groups were substantially reduced.

Table 4 compares mean numbers of crustacean plankton, mean cladoceran size and mean dry weight, percent of the epilimnion filtered per day and phosphorus regeneration by crustacean zooplankton between 2000, 2002 and 2003. While their total densities are down, larger mean sizes have resulted in higher dry weights and filtering rates while phosphorus regeneration rates are down.

Asplanchna priodontus
Brachionus spp.
Cephalodella spp.
Filinia longiseta
Gastropus stylifer
Kellicotia longispina
Keratella cochlearis
Keratella quadrata
Polyartha vulgaris
Trichocera multicrinis
Conochilus
Synchaeta oblonga

Table 3. Complete list of all taxa of rotifers recorded. Unknowns were frequently recorded.

	2000	2002	2003
Mean crustacean density (#/l)	208	146	132
Mean cladoceran size (mm)	0.29	0.30	0.36
Mean crustacean dry weight (ug/l)	175	145	177
Mean % of epilimnion filtered /day)	11.9	9.9	12.7
Mean phosphorus regeneration (ug/l/day)	4.49	2.6	3.1

Table 4. Mean crustacean density, mean cladoceran size and mean dry weight, percent of the epilimnion filtered per day and phosphorus regeneration by crustaceans in 2000, 2002 and 2003.

CONCLUSION

Research suggests that relative abundance and size of cladoceran zooplankton correlates with transparency because of ability to effectively crop algae (Warner 1999).

Algal densities, estimated by chlorophyll *a* concentrations, were lower in 2003 than in 2000 and 2002 (Schmitt 2004) while Secchi transparencies were higher (Albright 2004), substantiating this. Continued monitoring of the zooplankton community, concurrent with monitoring of populations of alewife and walleye, will be necessary to recognize any causal relationship between interactions of these trophic levels.

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