Hydroacoustic surveys of Otsego Lake, 2007

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INTRODUCTION

In 2007, we sampled Otsego Lake (Otsego County, NY) with acoustics to estimate abundance of pelagic fishes in June and October. This was a cooperative project between Cornell University Biological Field Station, SUNY Cobleskill Department of Fisheries and Wildlife, and SUNY Oneonta Biological Field Station. Otsego Lake has a warm-water fishery dominated by bass, esocids, and sunfishes. A cold-water fishery includes wild lake trout (*Salvelinus namaycush*) (Tibbits, 2008), augmented by stocking, and stocked populations of Atlantic salmon (*Salmo salar*) and brown trout (*S. trutta*). In recent years, a walleye population has been established through stocking as well. Nearly all of these fisheries are probably strongly affected by a dense alewife population that became established in the late 1980's (Harman et al. 2002). Schooling characteristics and patchy distribution of offshore baitfish populations such as alewife often make conventional netting gear ineffective at providing reliable density estimates. However, hydroacoustics combined with netting often provides more reliable estimates (Wanzenbock et al. 2003). Our report summarizes the results of hydroacoustic surveys of Otsego Lake in the spring and fall of 2007, and comparison to surveys as far back as 1996.

METHODS

Cornell University researchers surveyed the offshore pelagic fish communities using hydroacoustics. Small-mesh netting for alewife was done in conjunction with these surveys by SUNY Oneonta and SUNY Cobleskill staff. Density of fish targets in the acoustics was estimated along transects in the lake, and the catch in gillnets was used to identify targets and to sample length, weight, and depth distribution of alewife.

Hydroacoustic surveys were conducted on the nights of 7 June and 17 October 07. Transects ran from shore to shore along a zig-zag pattern, distributed from the northern to southern ends of the lake. Nine transects were done in the spring survey, and 11 transects were completed in the fall survey. In both surveys, data were collected using a Biosonics DtX 123 kHz, 7.8^{o} beam width transducer. The transducer was towed at a depth of approximately 0.5 m, and data were stored directly on the hard drive of a laptop computer. The units were calibrated in spring and fall of 2007 and the performance checked against a standard copper sphere.

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Acoustics data were analyzed with Sonardata Echoview v.4.30 software. On the echograms for each of the transects, the surface (0-2 m) and the bottom (~0.2 m from the actual bottom) were removed to leave just the open water area for analysis of fish density. Fish density (#/m^2) was calculated using the area backscattering coefficient and average in-situ target strength. Only targets with a target strength of –61 dB and larger were considered to be fish targets, based on target strength distributions of alewife in cages (Brooking and Rudstam 2008, submitted). Target strength distributions were checked so that echoes which were too small to be fish could be removed, along with the surface, the bottom, and other noise. Noise level at 30 m was estimated to be –80 dB (in the TS domain) thus satisfying a 10 dB signal to noise ratio even for the smallest targets included in the analysis, at the depths where most fish were found. The density of fish per square meter was then multiplied by 10,000 to get the density of fish/ha. Average and standard deviation were calculated based on the actual number of transects done.

Small mesh gillnets were set in conjunction with the spring and fall surveys. Each net was multi-mesh with seven 3 m wide panels of different mesh sizes (6.2, 8, 10, 12.5, 15, 18.7 and 25 mm bar mesh). Nets were 21 m long by 6 m deep and set from the surface downward or from the bottom upward. Three nets were set on the nights of 7 June 07, and in the fall three nets were set on 17 October 07 for 4 h each. Species, length, and weight were recorded for all fish caught. A sample of alewife from the fall were frozen for thiaminase testing by Cornell University (results not yet available).

RESULTS AND DISCUSSION

Acoustic fish abundance in June was estimated to be 1,330 fish/ha, with a 95% confidence interval of +/- 399 fish/ha based on 9 transects (Table 1, Figure 1). This is lower than the density was in June 2006 (2522 fish/ha) but higher than 2004-2005 (907 and 236 fish/ha, respectively). Targets corresponding in size with alewife were strongly concentrated in the upper 10 m of the water column. In the spring netting survey, 784 alewife were caught in 3 nets (avg. 65.3 alewife/net-h). Of the alewife catch, only 6 (0.8%) were age-1 averaging 80 mm and 3.7 g. Older fish (99.2% of the catch) averaged 122 mm and 13.2 g. Biomass of alewife in June 2007, estimated from the acoustic abundance and average weight in gillnets, was estimated to be 0.04 kg/ha for yearlings, and 17.4 kg/ha for older fish (total alewife biomass 17.5 kg/ha).

Pelagic fish abundance in October was estimated to be 3,921 fish/ha, with a 95% confidence interval of +/- 1,492 fish/ha based on 11 transects (Table 2, Figure 2). Targets corresponding in size with alewife were concentrated in the upper 10 m of the water column. The distribution of targets throughout the lake was highly skewed; the first transect in the north end of the lake averaged 8,240fish/ha, the next 8 transects averaged only 2,591 fish/ha, while the last two transects at the south end of the lake averaged 7,084 fish/ha. Such large differences in density make the survey results difficult to interpret. More accurate estimates of abundance could be obtained by re-analyzing past surveys using geospatial techniques. This may also provide insight into whether alewife spatial distribution patterns are consistent between years.

The fall gillnet survey caught 195 alewife (16.3 fish/net-h), of which 58.4% were young of the year (<100 mm). YOY alewife averaged 82 mm and 5.3 g in the nets, and older alewife averaged 135 mm and 18.2 g. Abundance of alewife was estimated to be 2,290 YOY/ha and 1,631 adults/ha. The biomass of YOY and adult alewife in fall of 2007 was estimated to be 12.1 kg/ha and 29.7 kg/ha, respectively, for a total biomass of 41.8 kg/ha. YOY were more abundant than last year when there were only 294 yoy/ha in October, but not as abundant as 2005 (8,032 yoy/ha).

Larger fish targets (-35 dB and larger) occurred in the 15-40 m depths at a density of approximately 6.5 fish/ha (95% CI +/-3.4 fish/ha, Table 3). This is within the range of values found in past years. These fish targets were most likely salmonids, though this estimate may include some other predators such as cisco, whitefish, walleye, or bass, which are typically bottom-oriented predators but will sometimes suspend in open water when open water forage is available. This is probably a minimal estimate of predator density since some overlap of target strengths occurred, and since other predators are likely too close to bottom to be detected. More investigation into counting predators with acoustics is planned in 2008.

Abundance of alewife in the fall (Figure 2) has varied from a low of 1,400 fish/ha in 2000 to almost 11,000 fish/ha in 2002. These alewife densities are mostly within the range of densities observed in the Finger Lakes (1500-4000/ha, Cornell University, unpublished data) though higher in some years in Otsego Lake. Densities of alewife in Cayuta Lake (a small, highly productive shallow lake in Schuyler County) have shown a similar range in densities (2,000-12,000 fish/ha from 1995-2005, Cornell University, unpublished data) as Otsego Lake. Cause for these large fluctuations in alewife year class strength have often been attributed to cannibalism by adult alewife on their own larvae, predation by walleye and salmonid predators, winter kills and die-offs due to dramatic changes in thermal regimes from sudden wind events (Crowder 1980, Eck and Wells 1987, Jones et al. 1993).

The National Science Foundation has funded a collaborative research project between SUNY Oneonta, SUNY Cobleskill, and Cornell University. SUNY Oneonta Biological Field Station as well as SUNY Cobleskill have purchased acoustic gear, and additional surveys are planned for 2008. We plan to do more intensive seasonal surveys for alewife and predators, along with comparisons between different acoustic frequencies. Additionally, a mark/recapture population estimate for walleye will be done in Spring 2008, using trapnets to mark walleye in the spawning runs. This will provide researchers with additional insight into the effects that walleye and salmonid predators may have on the Otsego Lake alewife population and other trophic interactions in Otsego Lake.

Table 1. Otsego Lake spring alewife density from acoustic surveys.

Date	Alew (#/ha)	# transects	stdev	95% SE
6/2/2004	907	9	175	114
6/4/2005	236	9	214	137
6/6/2006	2522	10	1463	907
6/7/2007	1330	9	611	399

Table 2. Otsego Lake fall alewife density from acoustics surveys.

Date	Alewife (#/ha)	# transects	stdev	95% SE
9/16/1996	5170	7	1434	1063
10/12/1997	2053	9	798	521
10/1/2000	1382	8	925	774
10/13/2001	8562	9	3811	2490
10/1/2002	10901	16	4886	2394
10/10/2003	3851	16	2901	1421
10/9/2004	2418	9	1571	1026
10/5/2005	9562	9	3555	2322
10/26/2006	1631	7	2713	2010
10/17/2007	3921	11	2524	1492

Table 3. Estimated abundance of predator-size echoes from acoustics.

Date	Predators (#/ha)	N	stdev	95% SE
9/16/1996	7.5	7	4.2	3.1
10/12/1997	3.3	9	3.4	2.2
10/13/2001	35.2	9	13.9	9.1
10/1/2002	15.2	16	10.7	5.2
10/10/2003	1.2	16	1.5	0.7
10/9/2004	3.5	9	4.7	3.1
10/5/2005	8.6	9	8.8	5.7
10/26/2006	19.4	7	25.6	19.0
10/17/2007	6.5	11	5.7	3.4

Figure 1. Spring alewife density in Otsego Lake, 1996-2007, with 95% CI.

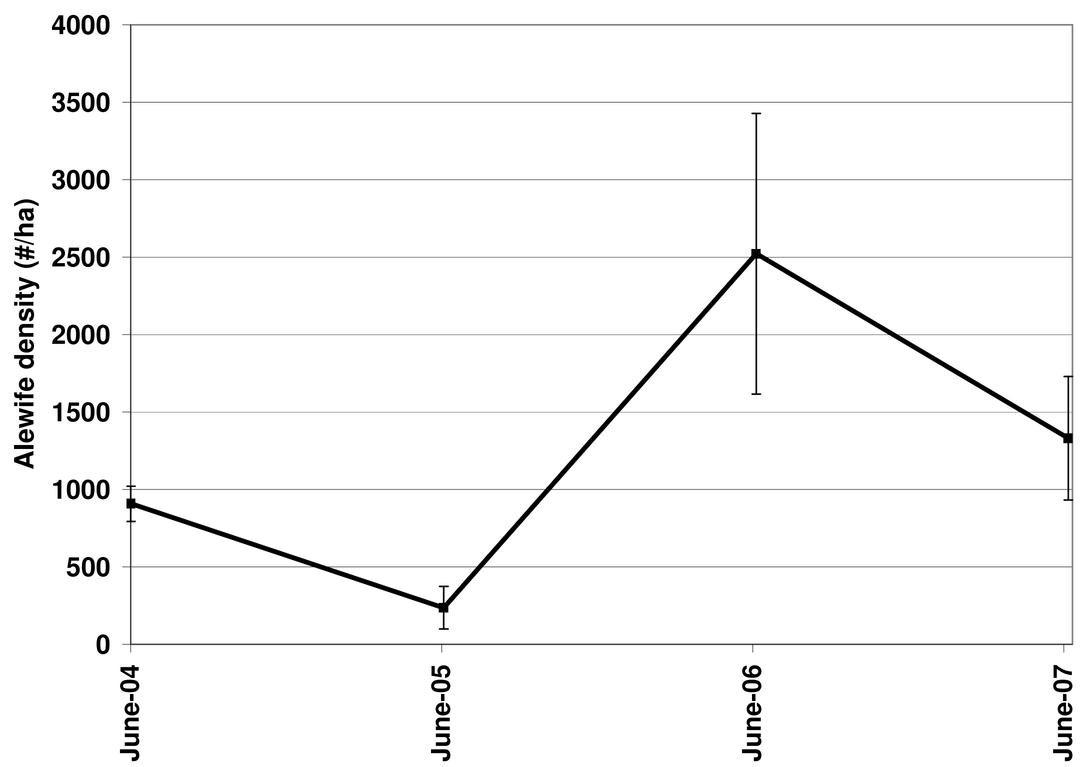
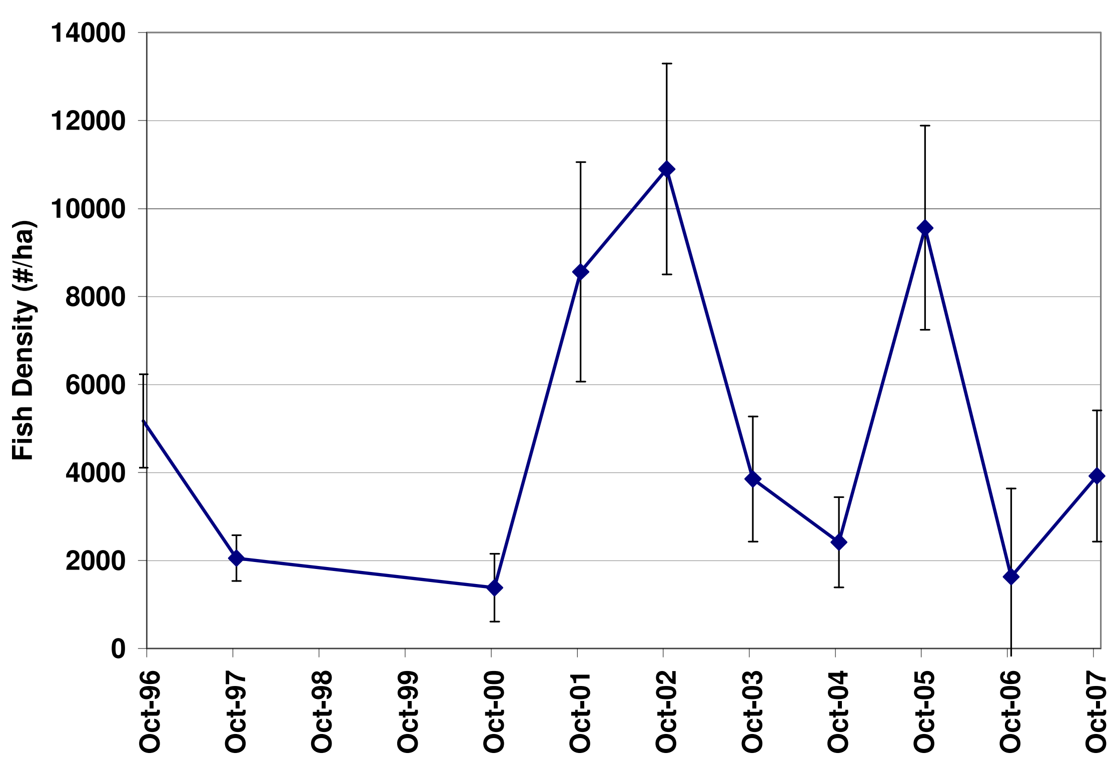


Figure 2. Fall alewife density in Otsego Lake, 1996-2007, with 95% CI.



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