Hydroacoustic surveys of Otsego Lake, 2006

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INTRODUCTION

In 2006, 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, while a cold-water fishery is maintained by stocking. 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 1980s (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 2006, 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 6 June and 26 October 06. Transects ran from shore to shore along a zig-zag pattern, distributed from the northern to southern ends of the lake. Ten transects were done in the spring survey, and 7 transects were completed in the fall survey due to computer malfunction. In the spring survey, data were collected with the same echo sounder that has been used in the past surveys (Simrad EY500, 70 kHz, 11.4 ^{o} beam width). In the fall, data were collected with a new echo sounder with a higher frequency and narrower beam width (Biosonics DtX 123 kHz, 7.8^{o} beam width) due to breakdown of the 70 kHz unit. Comparison between these different units will be discussed later. The transducers were towed at a depth of approximately 0.5 m, and data was stored directly on the hard drive of a laptop computer. The units were

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calibrated in spring and summer of 2006 and the performance checked against a standard copper sphere.

Acoustics data were analyzed with Sonardata Echoview v.4.0 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 (Cornell University, unpublished data). 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 6 June and 14 June 06 for 7 h each, and in the fall three nets were set on 27 October 06 for 16 h. Species, length, and weight were recorded for all fish caught.

RESULTS AND DISCUSSION

Acoustic fish abundance in June was estimated to be 2522 fish/ha, with a 95% confidence interval of +/- 907 fish/ha based on 10 transects (Table 1). This is significantly higher than the density was in June 2005 (236 fish/ha) probably due to a strong year class in 2006 (fall density 9,526 fish/ha) and high over-winter survival during the warm winter in 2005-06. Targets corresponding in size with alewife were strongly concentrated in the upper 5 m of the water column. In the spring netting survey, 126 alewife were caught in 42 net-h (avg. 3.0 alewife/net-h). Of the alewife catch, 26% were age-1 averaging 80 mm and 3.5 g. Older fish (74% of the catch) averaged 152 mm and 24.8 g. Biomass of alewife in June 2006, estimated from the acoustic abundance and average weight in gillnets, was estimated to be 2.3 kg/ha for yearlings, and 46.3 kg/ha for older fish (total alewife biomass 48.6 kg/ha). Larger fish targets (-35 dB and larger) were estimated to be approximately 7.6 fish/ha (95% CI +/-4.3 fish/ha, Table 2). These were most likely salmonids, thgouh 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.

Pelagic fish abundance in October was estimated to be 1,631 fish/ha, with a 95% confidence interval of +/- 2,010 fish/ha based on 7 transects (Table 3). Targets corresponding in size with alewife were concentrated in the upper 5 m of the water column. The distribution of targets throughout the lake was highly skewed; the first 3 transects in the north end of the lake averaged 4,586 fish/ha, while the remaining 4 transects averaged only 394 fish/ha. The area just south of the Sunken Island Shoal (42º 47.32' N, 74º 53.41' W) had target densities of 45,596 fish/ha; these targets appear to be fish, rather than noise or other suspicious-looking echoes. Alewife aggregations in the spring might be related to spawning activities, but aggregations of this magnitude in the fall are perplexing, and make the survey results difficult to interpret (the confidence limits encompass zero fish/ha). Further complicating matters is the use of a different acoustic setup and frequency in 2006.

The fall gillnet survey caught 401 alewife (8.4 fish/net-h), of which only 18% were young of the year (<95 mm). YOY alewife averaged 79 mm and 4.0 g in the nets, and older alewife averaged 122 mm and 14.7 g. Abundance of alewife was estimated to be 294 YOY/ha and 1,337 adults/ha. The biomass of YOY and adult alewife in fall of 2006 was estimated to be 1.2 kg/ha and 19.7 kg/ha, respectively, for a total biomass of 20.9 kg/ha. YOY were much less abundant in 2006, compared to last year when there were 8,032 yoy/ha in October. Larger fish targets (-35 dB and larger) occurred in the 15-40 m depths at a density of approximately 19.4 fish/ha (95% CI +/-19 fish/ha, Table 2).

Abundance of alewife in the fall (Figure 1) has varied in a cyclical pattern, 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, cyclical fluctuations in alewife abundance 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).

We should note that the two years we used the different acoustics setup had the two lowest alewife densities in the data set, which raises concerns about their comparability. We sampled simultaneously with both units in Fall 2005 on Otsego Lake and on Oneida Lake. The densities in Otsego Lake compared very well (within 5% of each other). However, in the Oneida Lake survey, the density from the Biosonics unit was about 1.9 times higher. It's possible the higher frequency (with narrower beam angle) is not as comparable in a shallow lake like Oneida, plus there were different size fish targets present in Oneida. We have obtained similar fish densities with 70 and 120 kHz in Lake Erie in past studies (Rudstam et al. 1999). There have been some discrepancies between different acoustics units used, however the 95% confidence intervals generally overlap in surveys done with both units at the same time (Mason and Schaner, 2001). A collaborative proposal between SUNY Oneonta, SUNY Cobleskill, and Cornell University has been submitted to the National Science Foundation to obtain funding for additional acoustic gear to be located at SUNY Oneonta Biological Field Station. If approved, this project would provide further monitoring of the alewife population and more intensive analysis of spring and fall hydroacoustic data for alewife and predators, along with comparisons between different acoustic frequencies. 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
2004	907	9	175	114
2005	236	9	214	137
2006 (Biosonics)	2522	10	1463	907

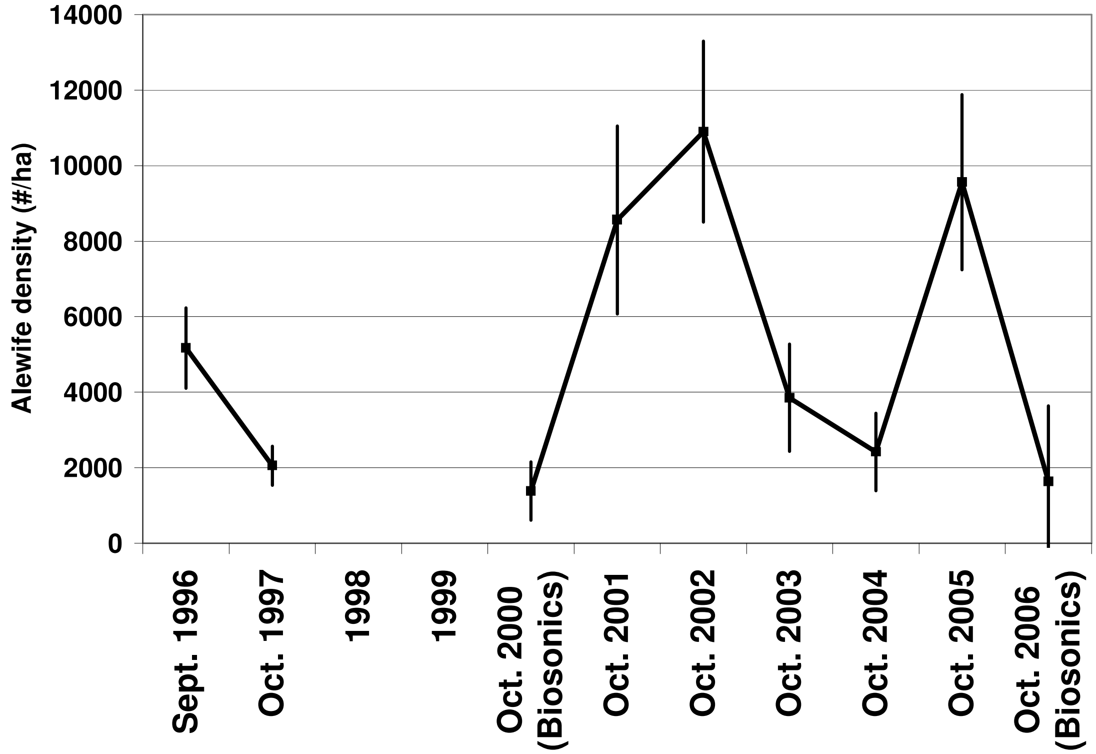
Table 2. Otsego Lake fall alewife density from acoustics surveys.

Date	Alew (#/ha)	# transects	stdev	95% SE
9/16/1996	5170	7	1434	1063
10/12/1997	2053	9	798	521
10/1/2000 (Biosonics)	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 (Biosonics)	1631	7	2713	2010

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

Figure 1. Fall alewife density in Otsego Lake, 1996-2006, with 95% CI.



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