Lake Ontario April prey fish survey results and Alewife assessment, 2024

Brian C. Weidel[1], Jessica A. Goretzke[2], Jeremy P. Holden[3], Scott D. Stahl[1], Olivia M. Mitchinson[1], Scott P. Minihkeim[1]

1 – U.S. Geological Survey (USGS), Great Lakes Science Center, Lake Ontario Biological Station, Oswego, NY 13126

2 – New York State Dept. of Environmental Conservation (NYSDEC), Lake Ontario Research Unit, Cape Vincent, NY 13618

3 – Ontario Ministry of Natural Resources (OMNR), Lake Ontario Management Unit, Picton, Ontario, Canada, K0K 2T0

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ABSTRACT

The Lake Ontario April bottom trawl survey assesses pelagic prey fish populations, in particular Alewife *Alosa pseudoharengus*, which are the primary prey supporting the lake's sport fish populations. The 2024 survey included 234 trawls in the main lake and embayments and sampled depths from 3.9 to 245 m (13 – 809 ft). The survey captured 441,942 fish from 28 species with a total weight of 10,519 kg (23,142 lbs.). Alewife were 89% of the total catch by number while Deepwater Sculpin *Myoxocephalus thompsonii,* Round Goby *Neogobius melanostomus*, and Rainbow Smelt *Osmerus mordax*, comprised 4%, 3%, and 2% of the catch respectively.

The estimated Alewife biomass increases slightly from 2023 to 2024 (83.9 to 84.2 $kg\cdot ha^{-1}$) and was the largest biomass value since whole lake sampling began in 2016. Adult Alewife abundance increased in 2024 as predicted in 2023, and most of the total Alewife biomass was comprised of adult fish (97%), predominantly from the 2020 and 2022 year classes. In contrast, Age-1 Alewife biomass (2.2 $kg\cdot ha^{-1}$) was the lowest estimated since whole lake sampling began in 2016 (previous range: 2.7 – 26.7 $kg\cdot ha^{-1}$), indicating reproductive success was poor in 2023. Adult Alewife biomass is predicted to remain relatively high but decline slightly in 2025 and 2026, due to the smaller year classes produced in 2021 and 2023. Alewife condition as measured by the weight of a standard length fish (165 mm; ~6.5 inches), was 32.8 g, which was within of the range of previously observed values (28.0 – 35.9 g, 1997 – 2023). Acoustic-based prey fish densities, in the water above the bottom trawl, were similar to observations from 2021 – 2023 and were orders of magnitude lower than bottom trawl densities. These acoustic results support the seasonal timing of the April survey, when the majority of Alewife and other pelagic prey fishes are near the lake bottom and susceptible to capture with bottom trawls.

The trawl survey also provides information on the status of other pelagic prey fishes and native fish restorations. In 2024, biomass indices for Rainbow Smelt, Emerald Shiner *Notropis atherinoides,* and Threespine Stickleback *Gasterosteus aculeatus*, were similar to 2023 values while the index for Cisco *Coregonus artedi* declined. The density index for naturally reproduced, juvenile Lake Trout *Salvelinus namaycush* declined relative to 2023. Density estimates of Lake Whitefish *Coregonus clupeaformis* continue to be orders of magnitude lower in U.S. waters relative to Canadian waters. A single purported Bloater *Coregonus hoyi* (total length = 148 mm, sampling depth = 105 m) was captured near Rochester, NY during the 2024 survey. This is the eighth Bloater recaptured during this survey since restoration stocking began in 2012.

INTRODUCTION

Why study Lake Ontario prey fish?

Lake Ontario supports economically valuable sport fisheries for trout and salmon[1], and Alewife *Alosa pseudoharengus* is the primary prey fish supporting those sport fish populations[2–5]. Alewife are native to the Atlantic Coast and are thought to have gained access to Lake Ontario through canals that were connected to the Hudson River in the 1860s[6]. By 1878, Alewife were described in "immense quantities" and by 1880 as "the dominant fish occurring in Lake Ontario"[7]. Prey fish surveys began approximately 100 years later (1978) and have shown Alewife continue to dominate the Lake Ontario fish community, however their abundance has declined since the 1980s and early 1990s, coincident with lake productivity declines[8] and natural reproduction from introduced salmonids[9]. Fishery managers use this report's information on the Alewife population status and trajectory, as well as information on other prey fish populations, to adjust predator stocking rates in Lake Ontario[10,11]. Prey fish surveys also inform the status of native fish populations of restoration or conservation interest such as Lake Trout *Salvelinus namaycush*[12,13] and Bloater *Coregonus hoyi*[13].

This report presents results from the multi-agency 2024 Lake Ontario April prey fish survey and Alewife assessment. Results are tailored to address the Fish Community Objectives: 2.3 "Increase prey fish diversity—maintain and restore a diverse prey fish community including Alewife, Cisco, Rainbow Smelt, Emerald Shiner, and Threespine Stickleback" and 2.4 "Maintain predator/prey balance—maintain abundance of top predators (stocked and wild) in balance with available prey fish" [14]. This research is also guided by the U.S. Geological Survey (USGS) Ecosystems Mission Area, Species Management Research Program to "provide science that is used by managers, policy makers, and others for decisions that protect, conserve, and enhance healthy fish and wildlife populations" (https://www.usgs.gov/programs/species-management-research-program).

Why are bottom trawl surveys used to study Alewife and other prey fish?

Bottom trawl surveys conducted in early spring (~April) have been the most consistent method for quantifying the relative abundance of Lake Ontario Alewife. For most of the year, Alewife inhabit the lake's open water habitat[15], but in late winter and early spring they are near the lake bottom[16,17]. This deep water habitat use is because winter surface temperatures are below Alewife's preferred temperature range (11 – 25°C, 52 – 77°F) and the warmest water (~ 4°C, 39°F) is on the lake bottom[16,18–20]. Historic data show bottom trawl surveys conducted in June, July, and October capture fewer Alewife compared to the April survey because the fish are off the lake bottom at those times of year[15]. Summer hydroacoustic surveys have also indexed Alewife abundance[2], but those estimates are also much lower than April bottom trawl estimates. Alewife in near-surface waters can be difficult to quantify with acoustics and appear to avoid acoustic survey vessels, which results in lower biomass estimates[15,21].

Why is it important to estimate the area swept by each vessel's bottom trawls?

While bottom trawl procedures and durations are standardized, the area of the lake bottom swept during a standard trawl varies substantially with sampling depth[22,23]. In general, the deeper the trawl, the more 'extra' time the trawl is in contact with the bottom and sampling prey fish. Sensors attached to the trawl estimate the trawl width, bottom contact time, and speed, which are multiplied to calculate the area swept. Accounting for the differences in area swept by different trawls provides more accurate indices of prey fish biomass (weight per area) and density (number per area)[22]. Since 2019, Lake Ontario prey fish abundance indices have been reported in units relative to area (e.g., kilograms per hectare or $kg \cdot ha^{-1}$). For reference, a hectare is 10,000 m^2 or ~2.5 acres and the ratio 'kilogram per hectare' is similar to the 'pound per acre' ratio. Reporting prey fish abundance in area-standardized units facilitates comparisons among prey fish populations in different lakes.

METHODS

How was the bottom trawl survey conducted?

The April bottom trawl survey began in 1978 and was collaboratively conducted by the USGS and New York State Department of Environmental Conservation (NYSDEC) in U.S. waters of Lake Ontario. Daytime bottom trawling was conducted at ~100 fixed sites, over depths from 8 – 150 m (26 – 495 ft.) and used an 11.8 m (39 ft.) headrope nylon trawl. That original trawl was replaced in 1997 with an 18.3 m (60 ft.) headrope polypropylene '3N1' trawl due to large catches of dreissenid mussels. In 2016, the survey was expanded to include Canadian waters, a broader depth range, embayment sites, and the Province of Ontario's research vessel (Fig. 1)[23]. In this report, abundance indices are reported from 1997 to present, when surveys used the consistent '3N1' trawl design, while condition indices are reported from 1978 to present. Since 1997, intended trawl times have varied from 2 – 10 minutes, bottom contact times varied from 1.7 – 17.6 minutes, and trawl speed varies from 3.7 – 6.7 kph (2.3 – 4.1 mph). If observations on trawl wing width and bottom contact time were not available for a given trawl, they were estimated with established relationships based on sampling depth (Fig. 2)[24].

How were abundance and individual fish indices calculated?

Bottom trawl catches are expressed as the mean stratified biomass ($kg \cdot ha^{-1}$) or density ($N \cdot ha^{-1}$) means in either U.S. or whole lake regions. Stratification is based on depth, where each stratum is a 20 m (66 ft) depth interval (i.e., 1 – 20 m, 21 – 40 m). Weighting is based on the proportional area of depth strata within U.S. and Canadian portions of the lake. Biomass and density values are considered indices because we lack estimates of trawl catchability (proportion of the true biomass or density captured by the trawl)[25]. Alewife condition illustrates annual variability in the weight of a standardized length Alewife (total length = 165 mm; ~ 6.5 inches)[26]. The average weight at 165 mm is predicted using a log linearized length – weight relationship based on 100 – 450 Alewife measurements each year from fish that are 150 – 180 mm (5.9 – 7.1 inches).

How were Alewife population age structure and year class abundance determined?

We annually interpret Alewife ages from sagittae otoliths (ear stones) to estimate the abundance of each Alewife year class (all the fish born in a particular year). Ages were interpreted for n = 500 to 1,300 Alewife each year using compound microscopes, reflected light, and multiple interpreters[27]. Year class abundances were estimated using an age-length key developed from annual age interpretations and length frequency distributions[28]. Tracking the abundance of each year class through time allows us to estimate a range of values for survival and growth at different ages which we use to predict how the Alewife biomass may change in the future.

How were future Alewife biomass values predicted?

We use a Monte Carlo simulation approach to predict adult Alewife biomass two years into the future (2025, 2026)[29]. Simulations begin with the most recent year's abundance and mean weight for each age of Alewife. For a given age, survival and growth into the next year are randomly selected from previously observed distributions for those parameters, and the next year's biomass was summed. The number and size of Age-1 Alewife is randomly sampled from the previous years of Age-1 observations. We conducted 1,000 simulations as described above to predict a range of possible biomass levels. We also illustrate how previous years' predicted biomasses compare to the observed mean biomass.

How were hydroacoustic data collected and analyzed?

The density of prey fish in open water habitats (3 m above lake bottom to surface), which are not sampled by bottom trawls, was estimated with hydroacoustics[21,30]. Hydroacoustic data were collected using 120 kHz-split beam echosounder and standard procedures[21,30]. Acoustic data were collected preceding and following a bottom trawl at depths from 5 to 236 m. Acoustic-based prey fish density estimates were computed with Echoview version 11.1, assuming a mean target strength of -43 decibels (dB).

RESULTS AND DISCUSSION

The 2024 April bottom trawl survey included 234 trawls in main lake and embayment sites (Fig.1), at depths from 3.9 to 245.2 m (13 – 809 ft). The survey captured 441,942 fish from 28 species with a total weight of 10,519 kg (23,142 lbs.) and 467 kg (1,028 lbs.) of dreissenid mussels (Table 1)[31]. Numerically, Alewife were 89% of the catch while Deepwater Sculpin *Myoxocephalus thompsonii,* Round Goby *Neogobius melanostomus,* and Rainbow Smelt *Osmerus mordax*, comprised 4, 3, and 2% of the catch, respectively (Table 1).

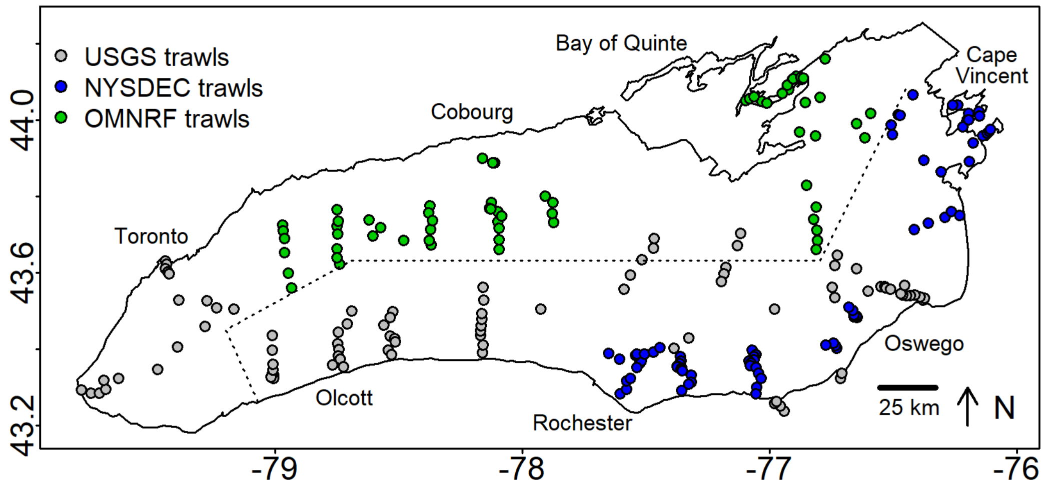

Figure 1. Lake Ontario bottom trawl sites from the 2024 multi-agency April prey fish survey[29]. The dotted line represents the U.S. – Canada border.

Alewife biomass, density, condition, and spatial distribution

From 2023 to 2024, Lake Ontario Alewife biomass increased slightly from 83.9 to 84.2 kg per hectare, however the density declined from 6795 to 3727 fish per hectare (Fig. 3). This density decline was due to a below average catch of Age-1 Alewife in 2024 (Fig. 4). The total Alewife biomass was primarily comprised of adult fish (97%), predominantly from the 2020 and 2022 year classes

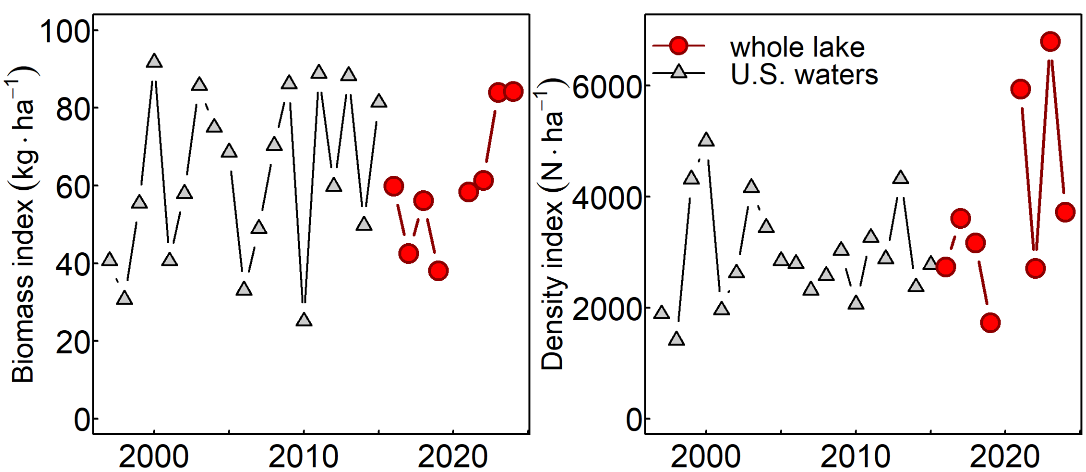

Figure 3. Total Alewife *Alosa pseudoharengus* biomass (left) and density (right) indices from the Lake Ontario April bottom trawl survey, 1997 – 2024[29]. No survey was conducted in 2020.

The total Alewife biomass estimate for 2024 is similar to previously observed high values in the modern time series (since 1997), however, it is important to recognize Lake Ontario Alewife biomass estimates were greater in the late 1970s through the early 1990s. In those years different studies reported Alewife biomass estimates as high as 182 kg·ha^{-1} in 1989[32] or 280 kg·ha^{-1} between 1987 – 1991[33]. Estimating past Lake Ontario Alewife biomass values is complicated because the 1978 – 1996 surveys used a bottom trawl that underestimated biomass relative to the current trawl and in those years the survey only sampled U.S. waters. Biomass estimates vary based on analytical assumptions about trawl to trawl conversion factors and how estimates of Alewife biomass in U.S. waters represents Canadian waters. While Lake Ontario Alewife biomass has declined since the early 1990s, survey data from other Great Lakes indicates Lake Ontario supports the greatest Alewife biomass. In Lake Michigan, fall bottom trawl and summer hydroacoustic surveys estimated Alewife biomass ranged from near zero to 14 kg per hectare, from 1997 – 2023[34]. During that same period similar surveys on Lake Huron estimated Alewife biomass from zero to 12 kg per hectare[35].

The biomass of adult Alewife, (Age-2 and older) increased from 2023 to 2024 as predicted in last year's report[22]. Interestingly, the 2024 estimate for Age-1 Alewife (2.2 kg·ha^{-1}) was the lowest value observed since whole lake sampling began in 2016 (Fig. 4, right panel, red points). Lower than average reproductive success is common in the Alewife time series. A recent analysis of Alewife populations in Lakes Ontario, Michigan, and Huron found the size of a year class was synchronized through time across the three lake populations suggesting climate is an important driver of Alewife reproductive success in the Great Lakes. That analysis found the annual differences in spring and summer water temperatures best explained annual variability in reproductive success across the three lakes (warmer spring water temperatures ~ better reproductive success)[36].

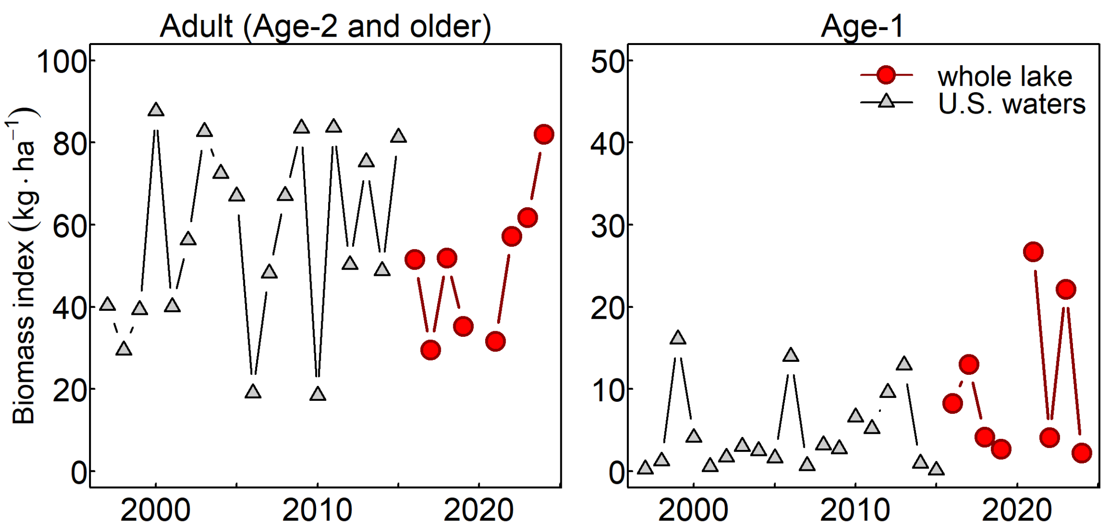

Figure 4. Alewife *Alosa pseudoharengus* biomass indices for adults Age-2 and older (left) and Age-1 (right) from the April bottom trawl survey in Lake Ontario, 1997 – 2024[29]. The Age-1 biomass value indexes the reproductive success of the Alewife population one year prior (i.e., high Age-1 biomass in 2021 represents a large year class produced in 2020). No survey was conducted in 2020.

Adult Alewife condition increased slightly in 2024 relative to 2023 and was near the middle of the range of values previously observed (Fig. 5). The condition of individual Alewife can be influenced by a suite of interacting factors including the previous year's condition, Alewife density, water temperature, and food availability. In general condition increases when Alewife densities are lower, and condition decreases when Alewife density is higher. For instance, the abrupt decline in the index value at the beginning of the time series (1978 to the early 1980s) occurred while the population abundance increased

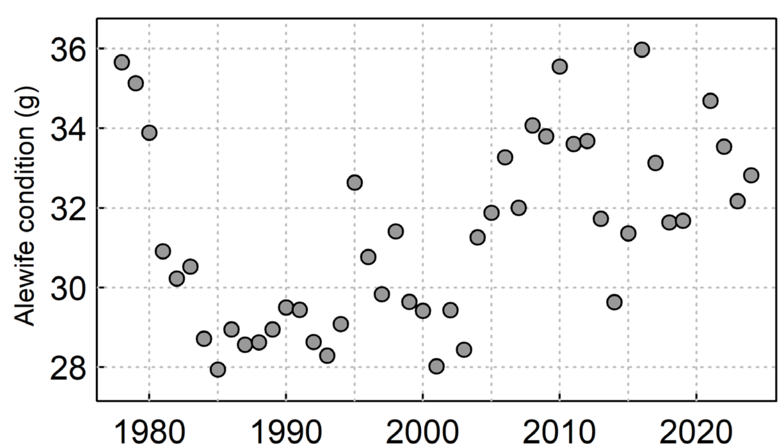

Figure 5. Alewife condition values as indexed by the predicted weight of a standard length (165 mm; ~6.5 inches) Alewife *Alosa pseudoharengus* in Lake Ontario from the April bottom trawl, 1978 – 2024[29]. No survey was conducted in 2020.

dramatically following a mass mortality event in 1976 – 1977[37].

In 2024, mean Alewife biomass in Canadian and U.S. waters of Lake Ontario was similar: 86.5, and 81.7 kg·ha^{-1}, respectively (Fig. 6). Since 2016, when sampling was expanded to the whole lake, results have shown that Alewife biomass can be considerably different in Canadian and U.S. portions of Lake Ontario (Figure 6; years: 2016 – 2018, 2022). These annual changes in Alewife spatial distribution highlight the importance of surveying the whole lake for understanding Lake Ontario Alewife population dynamics.

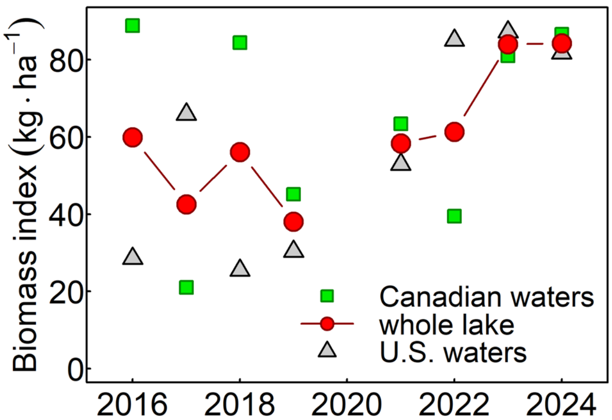

Figure 6. Mean biomass index of Alewife *Alosa pseudoharengus* (all ages) from the April bottom trawl survey, 2016 – 2019 and 2021 – 2024 based on different lake regions[29]. No survey was conducted in 2020.

Alewife age structure, survival, growth

A total of 1,209 Alewife ages were interpreted from whole sagittae otoliths collected from fish that had a total length range from 65 to 230 mm (2.5 – 9.0 inches). The oldest interpretation was Age-9 and was from the 2015 year class. In 2024 the Alewife population was primarily comprised of the 2020 and 2022 year classes (Fig. 7, bottom panels).

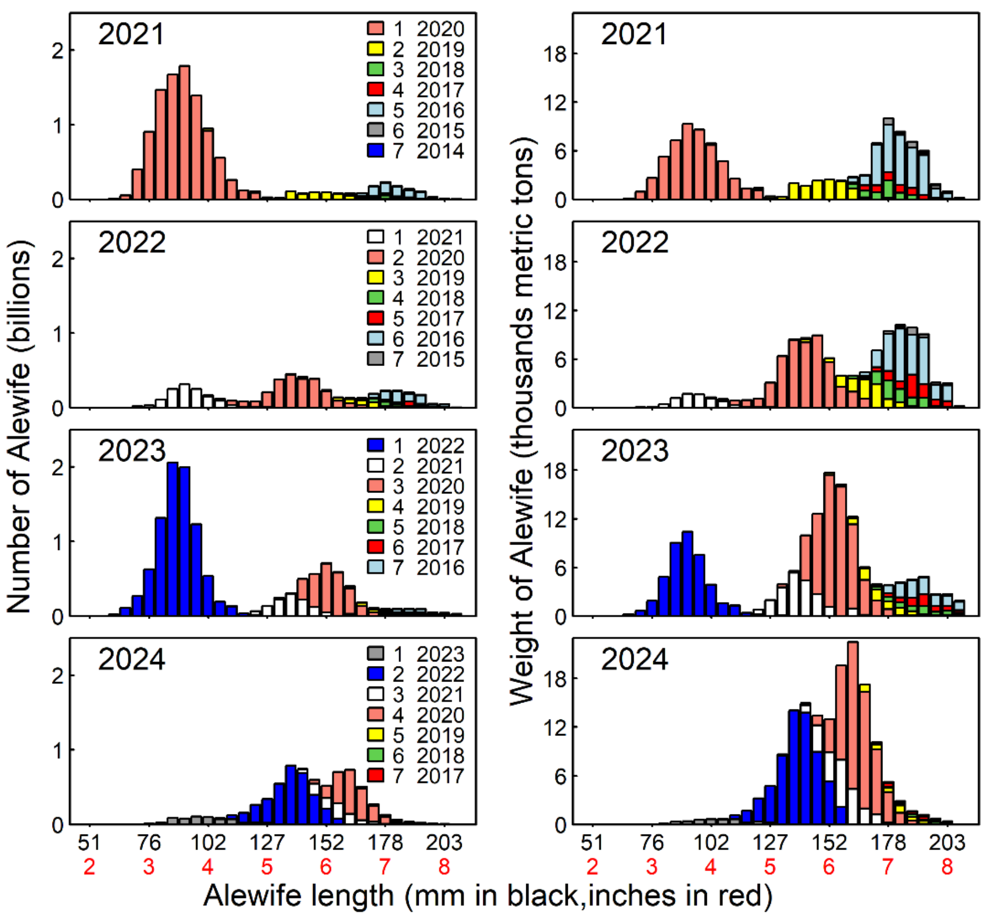

Figure 7. Alewife *Alosa pseudoharengus* size and age distribution in Lake Ontario from the April bottom trawl surveys, 2021 – 2024[29]. Bar height represents the number of Alewife (left panels) or weight (right panels) for each size bin (~1/5th inch or 5 mm). Bar colors represent distinct year class and are consistent across the panels.

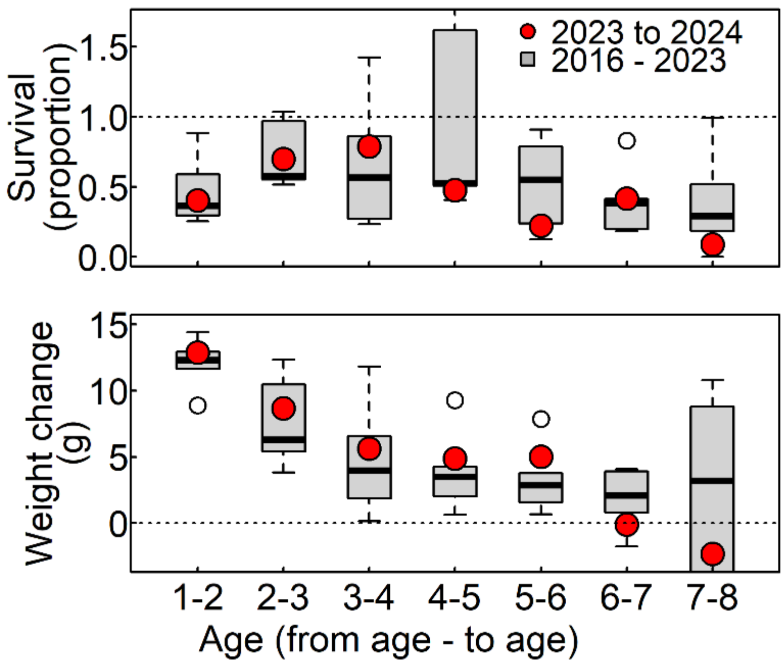

Figure 8. Estimates of Lake Ontario Alewife *Alosa pseudoharengus* survival (top) and weight change (bottom) since 2016[29]. The gray boxes represent the 25th and 75th quartiles of the estimates, black bars represent the median, and the whiskers represent the remaining range. Values considered outliers are represented as open circles outside the whiskers.

Alewife survival and growth estimates allow us to predict future adult biomass and aberrant values help identify potential survey biases (Table 2). In 2024, Alewife survival estimates were within the range of previously observed values (Fig. 8, top panel). A proportional survival value near or greater than one is not possible and likely reflects an underestimated abundance in a previous year's survey. Age specific growth estimates (weight change) observed in 2024 were also similar to or above the median of previously observed values through Age-6 (Fig. 8, bottom panel). Negative growth estimates, such as those observed for Age-6 and greater, can occur when the largest individuals of a cohort do not survive to the next year leaving only the smaller individuals resulting in negative growth estimates. This negative change in weight is most frequently observed in Alewife older than Age-6.

Predicted adult Alewife biomass

Population models predict future adult Alewife biomass based on the current year observations for abundance and mean size, and distributions of survival and growth (weight change) estimates from previous years. Figure 9 illustrates how the predicted biomass values (gray boxplots) were similar to the observed (red points) survey values from 2017 – 2024. The spread of predicted biomass has increased in recent years due to simulations that randomly select Age-1 abundance from the 2020 or 2022 year classes that were substantially more abundant than other year classes (Fig. 3).

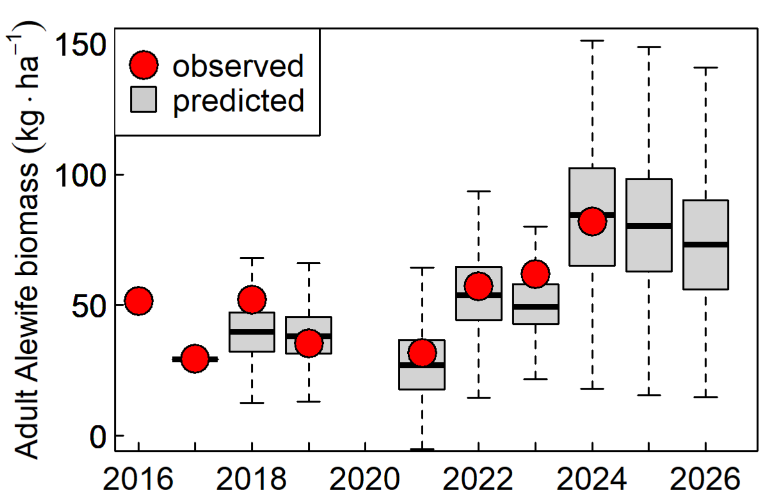

Figure 9. Simulated adult Alewife *Alosa pseudoharengus* (Age-2 and older) biomass (boxplots) and observed values (red circle) in Lake Ontario, 2016 – 2026[29]. In the gray boxplots the thick black bars represent the median, the boxes represent the 25th and 75th quartiles, and the whiskers represent the remaining range. No survey was conducted in 2020 therefore 2021 predictions were based on two years of predictions from the 2019 observations.

These models test our understanding of Alewife population dynamics, identify potential survey biases, and inform future fish management decisions. As subsequent surveys increase the number of survival and growth estimates based on whole lake sampling, those estimates should help to adjust potentially biased abundance estimates from when the survey was only conducted in U.S. waters.

How many prey fish were above the bottom trawls?

Acoustic estimates of prey fish densities in open water were hundreds to thousands of times lower than bottom trawl estimates (Table 3, Fig. 10). The low acoustic densities, relative to trawl densities, indicate prey fishes in waters above the bottom trawl would have a minimal effect on whole lake biomass or density estimates. Incorporating acoustic sampling with bottom trawling helps characterize how prey fish habitat use varies and corroborates that most prey fishes are susceptible to the bottom trawl during the survey.

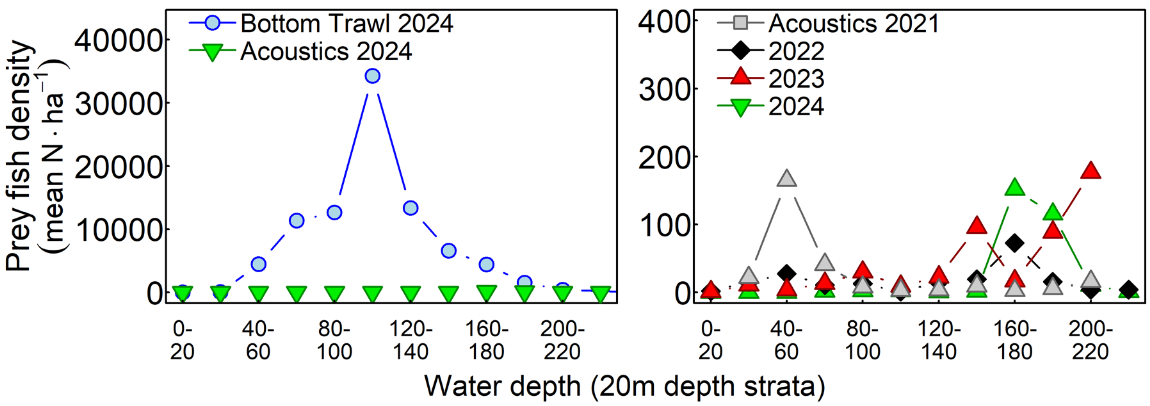

Figure 10. Mean prey fish density from bottom trawl and acoustics by depth in Lake Ontario, April 2024 (left panel) and acoustic densities relative to depth over differing years (right panel)[29]. Trawl densities represent the sum of Alewife *Alosa pseudoharengus* and Rainbow Smelt *Osmerus mordax*. Note the vertical scales differ between the plots.

Pelagic fish biomass indices (non-Alewife)

The 2024 Rainbow Smelt, Emerald Shiner *Notropis atherinoides* and Threespine Stickleback *Gasterosteus aculeatus*, biomass indices were similar to 2023, while the 2024 Cisco biomass index was lower than 2023 (Fig. 11).

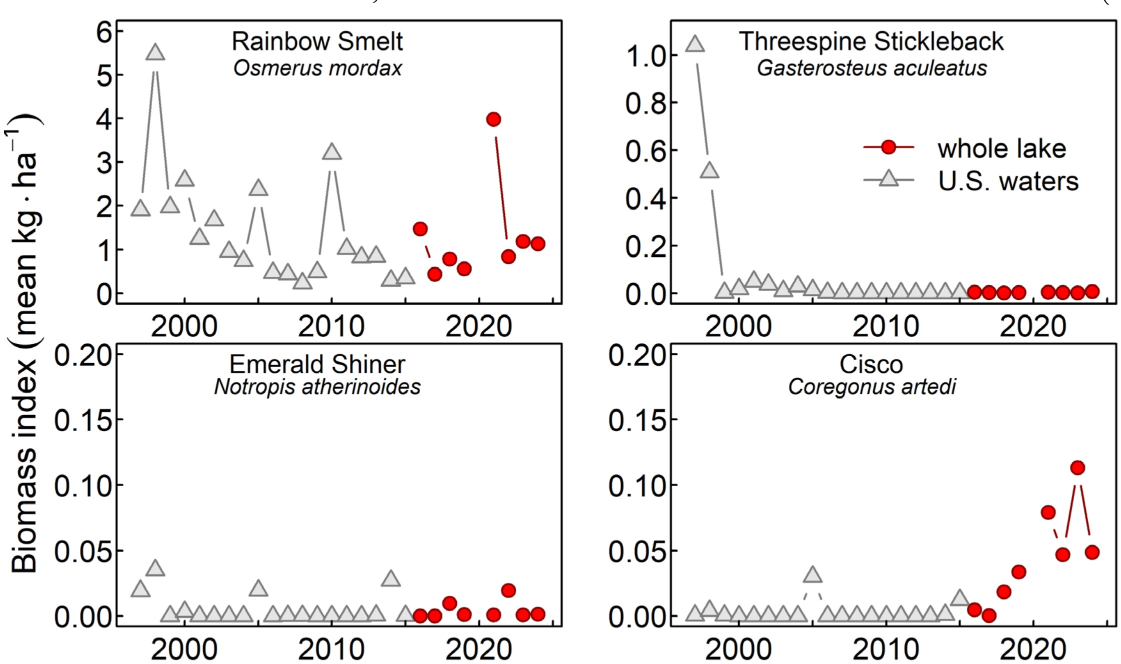

Figure 11. Biomass indices for Lake Ontario pelagic prey fishes from the April bottom trawl survey, 1997 – 2024[29]. No survey was conducted in 2020. Note differing vertical scales on each of the panels.

Native species of interest – Bloater, Lake Whitefish, Lake Trout

Bloater – Bloater *Coregonus hoyi* are a native pelagic prey fish that was historically abundant in Lake Ontario, was thought to be extirpated by the mid-1900s, and is currently being reintroduced[13]. This species closely resembles Cisco, therefore identification is confirmed using genetic analyses of fin tissue[38]. From 2015 – 2023 eight Bloater were captured during the April trawl survey[13]. In 2024, a single purported Bloater (total length = 148 mm; ~6 inches) was captured in a trawl near Rochester NY in approximately 105 m of water. Subsequent genetic analyses will confirm this identification.

Lake Whitefish – Lake Whitefish *Coregonus clupeaformis* are native to Lake Ontario and once supported important commercial fisheries, however, those catches have declined substantially since the late 1800s[39,40]. The whole lake spatial coverage of the April survey provides a unique perspective for understanding Lake Whitefish distribution and population status. Lake Whitefish are more regularly captured in Canadian waters near the Bay of Quinte, which accounts for the greater density estimates in the whole lake index relative to the index for the U.S. waters (Fig. 12).

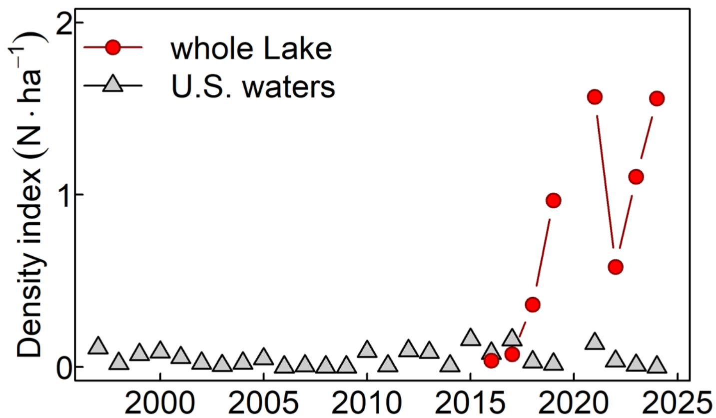

Figure 12. Density estimates for Lake Whitefish *Coregonus clupeaformis* in Lake Ontario from the April bottom trawl survey, 1997 – 2024[31]. No survey was conducted in 2020.

Lake Trout – Lake Ontario Lake Trout restoration began in the 1970s[41] and the lake-wide sampling of the April trawl survey can help inform the restoration status, especially of juvenile Lake Trout. Catches of naturally reproduced or wild, juvenile Lake Trout (total length < 500 mm) were generally rare, but over the past 10 years these naturally reproduced fish have been encountered more frequently in trawls, especially in the Niagara River area (Fig. 13, Fig. 14). The April survey results suggest wild juvenile Lake Trout are more frequently captured in U.S. waters relative to Canadian waters. Since 2016, 1.7% of trawls in Canadian waters (n = 578) captured wild juvenile Lake Trout while in 6.4% of trawls in U.S. waters (n = 1214) captured wild juvenile Lake Trout (Fig. 14). One possible explanation is that in Canadian waters, rocky substrate in depths from 30 – 80 m prevent bottom trawling in some regions of the north shore, which may limit the trawl survey's ability to capture naturally reproduced Lake Trout in that region of Canada (Fig. 14). Analyses on Lake Trout are included to support the Lake Ontario Lake Trout Working Group's research priorities related to naturally reproduced and stocked juvenile lake trout[42].

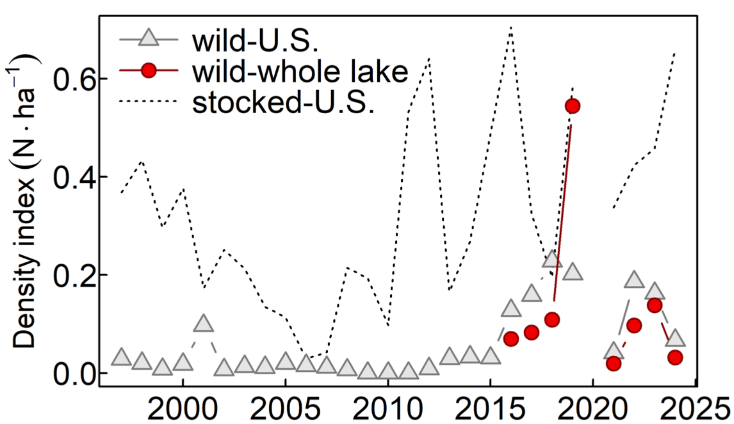

Figure 13. Density estimates for naturally reproduced (wild) and stocked juvenile Lake Trout *Salvelinus namaycush* (total length < 500 mm) in Lake Ontario from the April bottom trawl survey 1997 – 2023[31]. No survey was conducted in 2020.

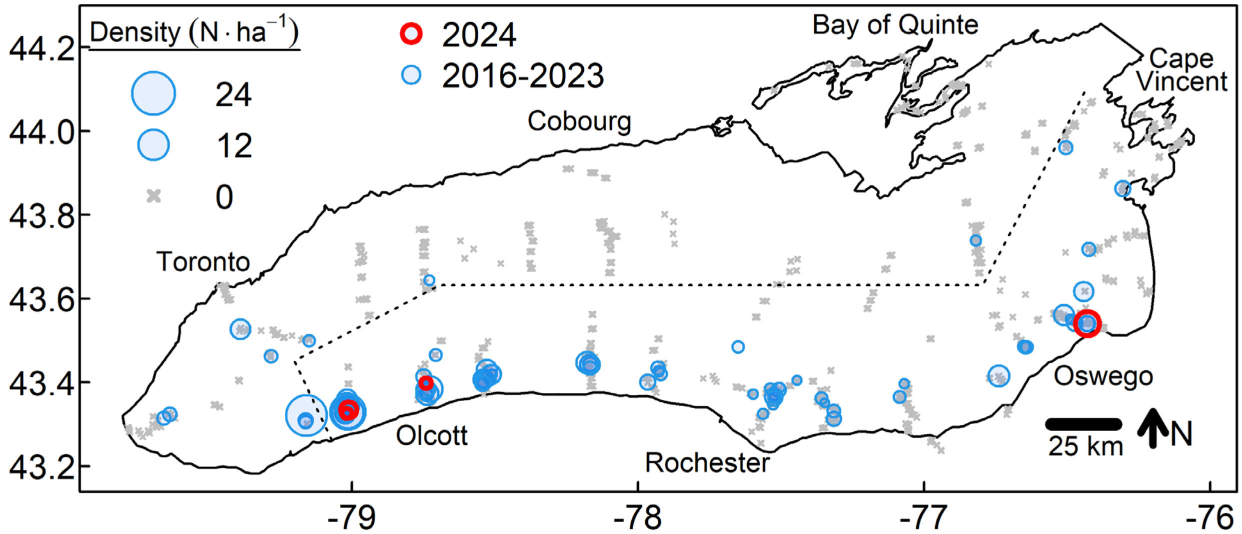

Figure 14. Spatial distribution of naturally reproduced juvenile (total length <500 mm) Lake Trout *Salvelinus namaycush* during the April bottom trawl survey in Lake Ontario from 2016 – 2024[31]. No survey was conducted in 2020. The size of the circles is proportional to the natural reproduced Lake Trout density (n·ha^{-1}). The dotted line represents the U.S. – Canada border.

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Table 1. Number of fish captured in Lake Ontario during the 2024 April bottom trawl survey. The density and biomass columns represent the lake wide, area-stratified mean value. The “NA” represents not available.

Species	Genus Species	Number	Proportion (number)	Density ($n \cdot ha^{-1}$)	Biomass ($kg \cdot ha^{-1}$)
Alewife	*Alosa pseudoharengus*	391552	0.89	3727.870	84.200
Deepwater Sculpin	*Myoxocephalus thompsonii*	17621	0.04	179.550	4.902
Round Goby	*Neogobius melanostomus*	13365	0.03	94.748	0.962
Rainbow Smelt	*Osmerus mordax*	10679	0.02	131.640	1.126
Yellow Perch	*Perca flavescens*	4220	0.01	119.612	1.087
Trout-perch	*Percopsis omiscomaycus*	1695	< 0.01	18.166	0.227
Spottail Shiner	*Notropis hudsonius*	1130	< 0.01	10.479	0.117
White Perch	*Morone americana*	793	< 0.01	9.451	0.387
Threespine Stickleback	*Gasterosteus aculeatus*	306	< 0.01	3.221	0.006
Pumpkinseed	*Lepomis gibbosus*	248	< 0.01	2.346	0.189
Lake Trout	*Salvelinus namaycush*	77	< 0.01	0.662	1.251
Lake Whitefish	*Coregonus clupeaformis*	62	< 0.01	1.559	0.184
Quillback	*Carpiodes cyprinus*	55	< 0.01	0.566	0.416
White Sucker	*Catostomus commersonii*	44	< 0.01	0.406	0.083
Emerald Shiner	*Notropis atherinoides*	20	< 0.01	0.181	0.001
Slimy Sculpin	*Cottus cognatus*	15	< 0.01	0.531	0.003
Walleye	*Sander vitreus*	14	< 0.01	0.304	0.167
Brown Bullhead	*Ameiurus nebulosus*	13	< 0.01	0.186	0.059
Cisco	*Coregonus artedi*	10	< 0.01	0.396	0.049
Freshwater Drum	*Aplodinotus grunniens*	6	< 0.01	0.155	0.236
Channel Catfish	*Ictalurus punctatus*	5	< 0.01	0.045	0.181
Lake Sturgeon	*Acipenser fulvescens*	3	< 0.01	0.030	0.010
Rock Bass	*Ambloplites rupestris*	3	< 0.01	0.030	0.000
American Eel	*Anguilla rostrata*	2	< 0.01	0.052	0.069
Bloater	*Coregonus hoyi*	1	< 0.01	0.009	0. 000
Common Carp	*Cyprinus carpio*	1	< 0.01	0.010	0.064
Chinook Salmon	*Oncorhynchus tshawytscha*	1	< 0.01	NA	NA
Longnose Gar	*Lepisosteus osseus*	1	< 0.01	NA	NA

Table 2. Mean and standard deviations (s.d.) for Alewife *Alosa pseudoharengus* weight change (grams) and survival (proportion) by age used for Lake Ontario population simulations. These values represent observations from 2016 – 2019 and from 2021 – 2024. Insufficient numbers of Age-9 through Age-11 Alewife were captured in successive years to estimate growth or survival therefore simulation values for ages were conservatively assumed to be zero.

Age	Weight change			Survival		
(from – to)	mean	s.d.	N	mean	s.d.	n
1 – 2	12.18	1.86	6	0.47	0.24	6
2 – 3	7.84	3.23	6	0.73	0.23	6
3 – 4	5.00	4.10	6	0.69	0.44	6
4 – 5	4.10	2.97	6	0.89	0.64	6
5 – 6	4.05	3.04	6	0.48	0.32	6
6 – 7	1.19	2.65	6	0.40	0.23	6
7 – 8	1.02	8.04	5	0.35	0.36	6
8 – 9	12.59	14.76	2	0.14	0.33	5
9 – 10	0.00	0.00	0	0.00	0.00	2
10 – 11	0.00	0.00	0	0.00	0.00	1

Table 3. Hydroacoustic density estimates and standard deviations (s.d.) sampling regions during the 2024 Lake Ontario April prey fish survey. Densities were estimated for depths from 3 m from the surface to 3 m above the lake bottom. Geographic coordinates are in decimal degrees and represent the approximate center of that region of hydroacoustic observations.

Region	Latitude	Longitude	Mean density ($N \cdot ha^{-1}$)	s.d.	Sample size
Hamilton	43.340	-79.574	0.30	0.92	21
Hamlin	43.505	-77.925	2.89	0.02	2
Oak Orchard	43.475	-78.165	126.92	407.26	24
Olcott	43.420	-78.730	0.84	2.37	16
Oswego	43.556	-76.609	1.89	3.04	22
Point Petre	43.633	-77.158	3.43	9.50	15
Scotch Bonnet	43.631	-77.513	0.91	1.44	20
Smoky Pt.	43.414	-77.359	11.61	12.75	6
Sodus Bay	43.506	-76.973	1.34	1.54	4
Southwicks	43.626	-76.701	1.41	1.63	8
Thirty Mile Pt.	43.447	-78.534	2.17	5.41	22
Toronto	43.571	-79.364	0.27	0.62	19
Youngstown	43.356	-79.011	0.19	0.38	21