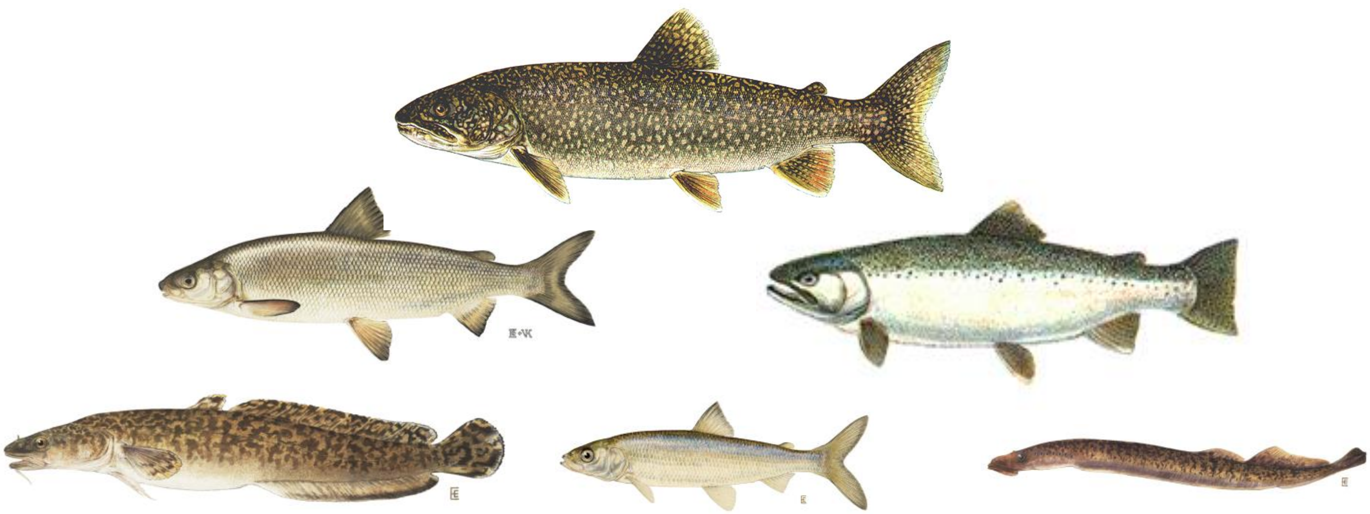
2024 REPORT OF THE LAKE ERIE COLDWATER TASK GROUP

March 2025

Presented to:
Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission



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Kraft, C.E., D.M. Carlson, and M. Carlson. 2006. *Inland Fishes of New York (Online)*, Version 4.0. Department of Natural Resources, Cornell University, and the New York State Department of Environmental Conservation.

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Lake Erie Committee

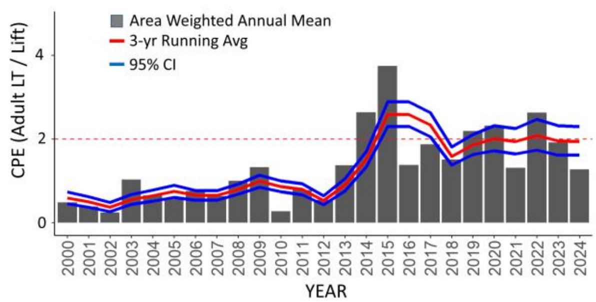
REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

Introduction

This year's Lake Erie Committee (LEC) Coldwater Task Group (CWTG) has produced an Executive Summary Report encapsulating information from the CWTG annual report. Three charges were addressed by the CWTG during 2024: (1) Report on the status of the cold-water fish community, (2) Participation in the Integrated Management of Sea Lamprey Process on Lake Erie, outline and prescribe the needs of the Lake Erie Sea Lamprey management program, and (3) Maintenance of an electronic database of Lake Erie salmonid stocking information. The complete report is available from the Great Lakes Fishery Commission's Lake Erie Committee Coldwater Task Group website at http://www.glfc.org/lake-erie-committee.php or upon request from an LEC or CWTG representative.

Lake Trout

A total of 250 lake trout were collected in the Coldwater Assessment Survey in 2024. Adult (age 5+) relative abundance decreased to 1.29 fish per lift, below the target of 2.0 described in the 2021 Lake Trout Management Plan. The 3-yr running average remained at target therefore no management actions related to adult abundance are being recommended for 2025. There were 21 age classes and four strains captured in 2024. Lake trout ages 4, and 14 were the dominate cohorts. Ages 5,9,12,15,16, and 17 also contributed notably. Lake trout older than age-10 continue to increase in abundance and comprised 50% of the total catch. Finger Lakes and Lake Champlain strains comprised the majority of the population. The Partnership Survey changed design in 2024 targeting waters less than 30m in depth and no longer fished the Pennsylvania Ridge.



Lake Whitefish

Lake whitefish harvest in 2024 was 81,222 pounds, distributed between Ontario (83%), Ohio (15%), and Pennsylvania (2%). Harvest decreased 60% from 2023 and remains low compared to previous decades. Gillnet fishery age composition ranged from ages 3 to 9 with ages 5, 4, and 3 representing the majority of the harvest. Relative to recent decades, lake whitefish survey and fishery status indicators in 2024 were moderate or better. Assessment surveys caught lake whitefish from ages 1 to 22, with age compositions that partially overlapped the 2024 gill net fishery. Bottom trawl and gillnet survey indices forecast modest recruitment of age 3 lake whitefish in 2025 and 2026.

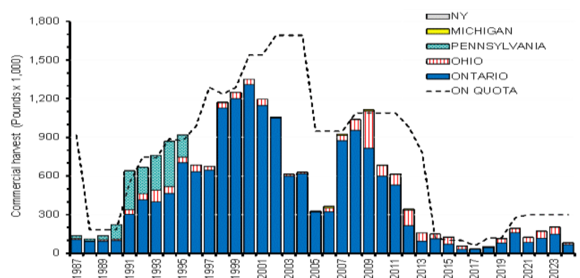
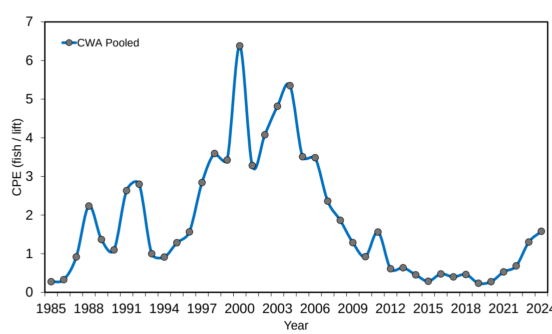


FIGURE 1.1.1. Lake whitefish total harvest from 1987-2024 by jurisdiction in Lake Erie. Pennsylvania ceased gill netting in 1996. Ontario quota is presented as a dashed line.

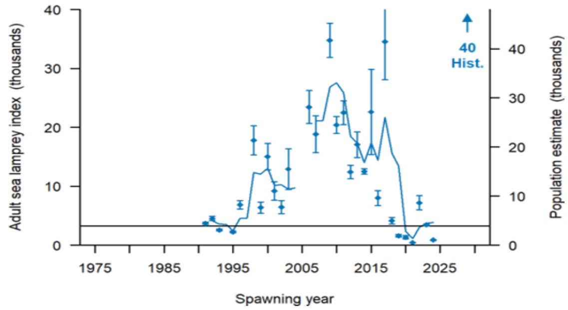
Burbot

Total commercial harvest of burbot in Lake Erie in 2024 was 1,100 pounds. All was incidental. Burbot abundance and biomass indices from annual assessment surveys remained at low levels, relative to the time series; however 2024 catch rates continued to be elevated in some surveys. The burbot catch rate in the Interagency Coldwater Assessment Survey averaged 1.59 fish/lift, a decadal high while those in the Ontario Partnership Assessment Survey averaged 0.62 fish/lift. Burbot in the Coldwater Assessment Survey and Partnership Survey ranged in age from 2 to 16 and the largest age class present were 5 year olds. Rainbow smelt was the dominant prey item in burbot diets followed closely by round goby.



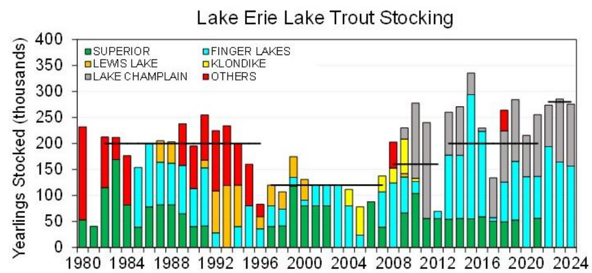
Sea Lamprey

The A1-A3 wounding rate on lake trout over 532 mm was 15.7 wounds per 100 fish in 2024. This is above the target rate of 5.0 wounds per 100 fish. Large lake trout continue to be the preferred targets for sea lamprey in Lake Erie. The Index of Adult Sea Lamprey Abundance (870) represents a significant decrease from last year however the three year average-index is slightly above the target of 3,300. Only one lampricide treatments was completed in 2024 in Conneaut Creek in PA and DFO completed 24 granular Bayluscide plots in both jurisdictions on the St. Clair River.



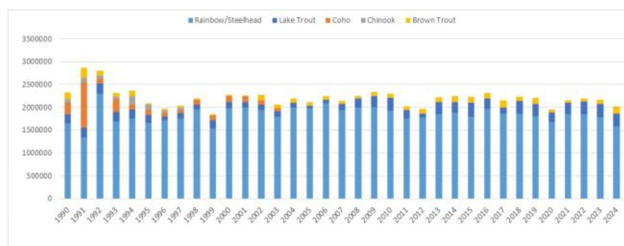
Lake Erie Salmonid Stocking

A total of 2,020,737 yearling salmonids were stocked in Lake Erie in 2024, which was below the long-term average (1990-2023). Lake trout stocking fell slightly below the 280,000 goal, and two different strains were stocked in 2024. By species, there were 275,191 yearling lake trout stocked in the east basin of Lake Erie, 163,394 brown trout stocked in Pennsylvania waters, and 1,582,152 rainbow/steelhead trout stocked across all five State and Provincial jurisdictional waters.



Steelhead

The summary of steelhead stocking in Lake Erie by jurisdictional waters for 2024 is: Pennsylvania (817,488; 51.6%), Ohio (466,520; 29.5%), New York (215,104; 13.6%), Michigan (50,048; 3.1%), and Ontario (32,992; 2%). Total steelhead stocking in 2024 (1.58 million) was below the long-term average. Annual stocking numbers have been consistently in the 1.5-2.0 million fish range since 1993. The summer open lake steelhead harvest was estimated at 26,637 steelhead across New York, Pennsylvania, Ohio, Ontario, and Michigan and above the long-term average harvest of 22,019. Tributary angler surveys, represented the majority (>90%) of the targeted fishery effort for steelhead. Catch rates remain high and there are planned creel surveys in the future in most jurisdictions.



CHARGE 1: Coordinate annual standardized cold-water assessment among all eastern basin agencies and report upon the status of the cold-water fish community

Pascal Wilkins (NYSDEC) and Tom MacDougall (OMNR) Mark Haffley (PAFBC), Joseph Schmitt (USGS), Andy Cook (OMNR)

East Basin Coldwater Assessment Program

Two fishery independent gillnet surveys are conducted each year in the eastern basin of the lake during thermal stratification: the inter-agency August Coldwater Assessment (hereafter referred to as the "Coldwater Assessment Survey") in New York, Ontario, and Pennsylvania waters of the eastern basin, and the Ontario Partnership Index Fishing Program (hereafter referred to as the "Partnership Survey") in Ontario waters.

The Coldwater Assessment Survey was redesigned in 2020 to provide better coverage of east basin cold-water habitat, decrease the number of required samples, and maintain comparable metrics between survey methodologies. The previous approach (1986 -2019) utilized a stratified, random transect design for locating bottom set gillnets during the month of August. Briefly, 5 gangs of gillnet were set, parallel to the depth contour, at successively deeper locations, starting at a location prescribed relative to the 10º C isotherm. Details of the design and net configurations can be found in earlier versions of this report. This survey design resulted in over-sampling of the area directly adjacent to the 10º C isotherm and a complete lack of sampling in offshore waters.

The new survey used an analysis of catch-per-effort (CPE) trends for lake trout, burbot, and lake whitefish to justify reducing the number of standard set gillnet gangs from five to two (details; CWTG 2020); CPE estimates generated using only catches from net #1 and net #3 were shown to be comparable to those generated from the complete set of 5, over the complete survey time series.

The new survey continues to occur during August each year following stratification, covers a similar sampling area, and employs the same gillnet configuration previously used. In addition to the transect approach (now using only two nets; #1 and #3 locations), a 2.5-minute grid system is used for choosing additional randomly selected netting locations, primarily in deeper waters. Netting sites are divided into two groups – standard assessment nets and offshore assessment nets.

<u>Standard assessment nets</u> are set in grids located in similar areas to the previous assessment survey. Two net gangs in each randomly chosen standard assessment grid are set as follows: net #1 is located 8-10 ft. deeper than the 10˚ C isotherm, and net #3 is located 10 ft deeper than this. If the depth and temperature criteria were to fall outside of the standard assessment grid (i.e., shallower, or deeper), then nets would be moved to the adjacent grid to the north or south following the previous protocols. The nets are set parallel to the shoreline but otherwise can be placed anywhere within the grid following the traditional protocol for temperature and depth.

<u>Offshore assessment nets</u> are set in randomly selected offshore grids. Nets in these areas are set within the selected grid in a direction consistent with the bottom contour. Targeted effort varies for each jurisdiction (NY: 16 standard, 16 offshore; PA: 12 standard, 12 offshore; ON East and ON West: 12 standard, 13 offshore each). Altogether, a total of 52 standard assessment nets and 54 offshore assessment nets are targeted for a complete survey each year. Sampling was conducted in all jurisdictions in 2024 (Figure 1). Sampling effort included 50 standard assessment nets and 45 offshore assessment nets (95 sets total). Abundance data from two standard nets in PA waters was excluded in 2023 due to temperatures exceeding 10˚C during the fishing period.

In 2020 through 2023, for the purposes of comparing relative abundance of lake trout, burbot, and lake whitefish, to earlier survey catch rates, only data from standard assessment nets (nets #1 and #3) was used. Subsequent examination of catch rates in offshore nets suggested that, for some species, incorporation of this additional data into abundance estimates would be prudent. Following consultation with LEC in March 2024, it was decided that going forward, data from all nets would be utilized for lake trout and burbot catch rate analysis. Catch rates for lake whitefish, which are caught in offshore nets less frequently, continues to be restricted to standard net catches. Unless otherwise stated, for all metrics other than relative abundance, data from all collected fish are used, regardless of sampling location Biased sets due to temperature shifts or other issues are deleted from abundance index calculations but are otherwise used for age, growth, diet, and wounding statistics.

The Partnership Survey is a lake wide gillnet survey of Canadian waters that has provided a spatially robust assessment of fish species abundance and distribution since 1989. The Partnership Survey uses suspended and bottom set gillnets. While most catches of cold-water species occur in eastern waters during thermal stratification in September (Figure 1), some, information also comes from the Central Basin of the lake following turnover. A change in study design, adopted in 2024, limited the ability of the survey to inform the complete set of metrics used previously for Coldwater Assessment. No partnership nets were set in waters deeper than 30 meters, limiting catches of lake trout and burbot, and to a lesser extent, lake whitefish. Lake whitefish metrics from the partnership survey will be reported with the caveat that additional uncertainty exists following the new survey design.

All sampled lake trout are examined for total length, weight, sex, maturity, fin clips, and wounds by sea lamprey. Snouts from each lake trout are retained, and coded-wire tags (CWT) are extracted in the laboratory to accurately determine age and genetic strain. Otoliths and genetic samples are also retained when the fish is not tagged (i.e., not fin clipped or CWT). Stomach content data, if examined, are usually collected as on-site enumeration or from preserved samples.

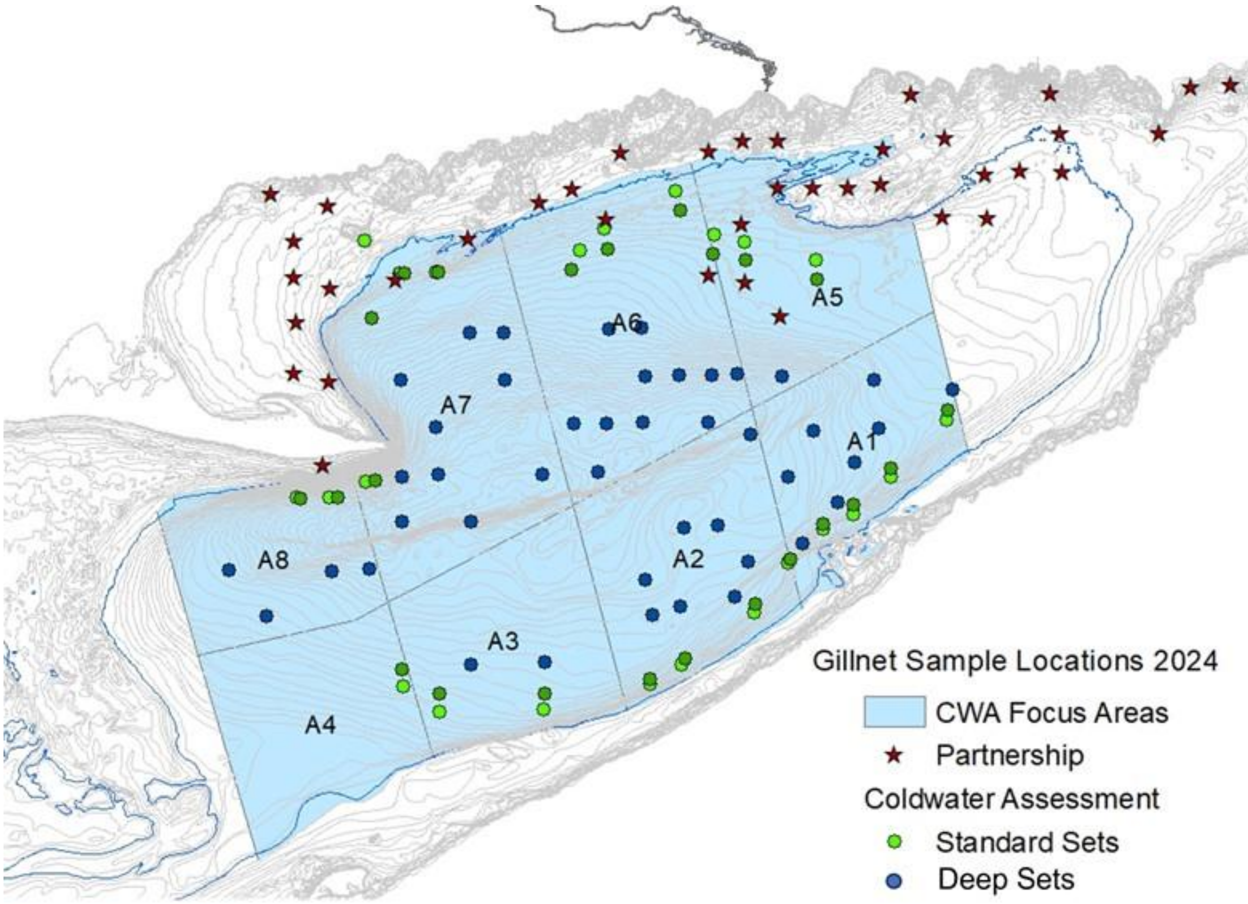


FIGURE 1. Locations of gillnets set for assessment of cold-water species during thermal stratification in the eastern basin of Lake Erie, 2024. Coldwater Assessment Survey sites are indicated with circles (green – standard sets; blue – offshore sets) within survey areas A1-A8 (blue polygons bounded by the blue 20m depth contour. Partnership Assessment Survey sites are indicated with red stars.

1.1 Report on the status of lake whitefish

Andy Cook, Megan Belore (OMNR), Brian Schmidt, Amanda Popovich (ODNR), Joseph Schmitt (USGS), and Justin Chiotti (USFWS), Mark Haffley (PFBC), Tom MacDougall (OMNR), Pascal Wilkins (DEC)

Commercial Harvest

The total harvest of lake whitefish in Lake Erie during 2024 was 81,222 pounds (Figure 1.1.1). Ontario accounted for 83% of the lake-wide total, harvesting 67,283 pounds, followed by Ohio (15%; 11,970 pounds) and Pennsylvania (2%, 1,969 lbs). New York and Michigan did not harvest Lake Whitefish in 2024 (Figure 1.1.2). Total lake whitefish harvest in 2024 decreased 60% from 2023. Lake whitefish harvest in Ontario decreased 55% from 2023 while Ohio's harvest decreased by 78%. Lake whitefish harvest in Pennsylvania increased by 123% from 2023.

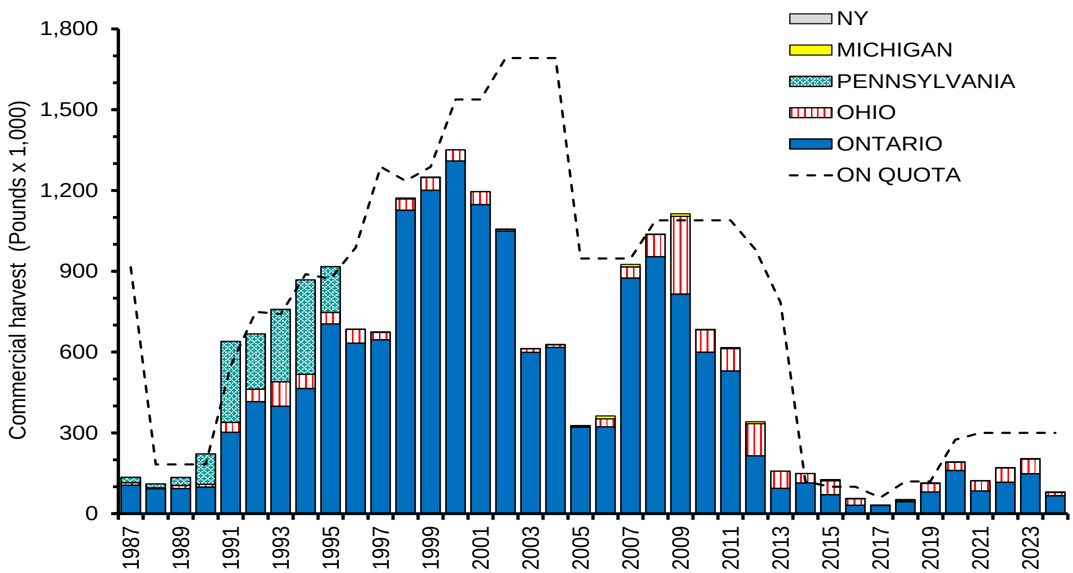


FIGURE 1.1.1. Lake whitefish total harvest from 1987-2024 by jurisdiction in Lake Erie. Pennsylvania ceased gillnetting in 1996. Ontario quota is presented as a dashed line.

Ontario's commercial fishers harvested 22% of quota (300,000 pounds) in 2024. Most (88%) of Ontario's 2024 lake whitefish harvest was from gillnets with 12% from commercial trawls. The largest fraction of Ontario's lake whitefish harvest (57%) was caught in the west basin (Ontario-Erie statistical district OE-1) followed by OE-2 (22%), OE-4 (11%), with the remaining harvest distributed eastward among statistical districts OE-3 (8%), and OE-5 (2%; Figure 1.1.2). Maximum harvest in Ontario waters during 2024 was distributed northwest of Pelee Island and west of Point Pelee (Figure 1.1.2). Harvest in OE-1 from October to December represented 50% of Ontario's lake whitefish harvest. Peak harvests occurred in OE-1 during December (18,158 pounds) and November (13,057 pounds) with central basin harvest (OE2 and OE3) during March and April (11,584) accounting for 17% of Ontario's harvest. In eastern Lake Erie (OE4 and OE5), 8,292 pounds of lake whitefish were landed in 2024 with most (93%) of harvest from commercial trawls and the remaining 7% from gillnets. There was no reported effort targeting lake whitefish during 2024 in Ontario waters of Lake Erie. Lake-wide, Ontario's lake whitefish harvest came from fisheries targeting walleye (80%), rainbow smelt (12%), white bass (4%), white perch (4%) and yellow perch (1%). In addition, a tagged lake whitefish was surrendered to MNR from commercial fisheries in 2024.

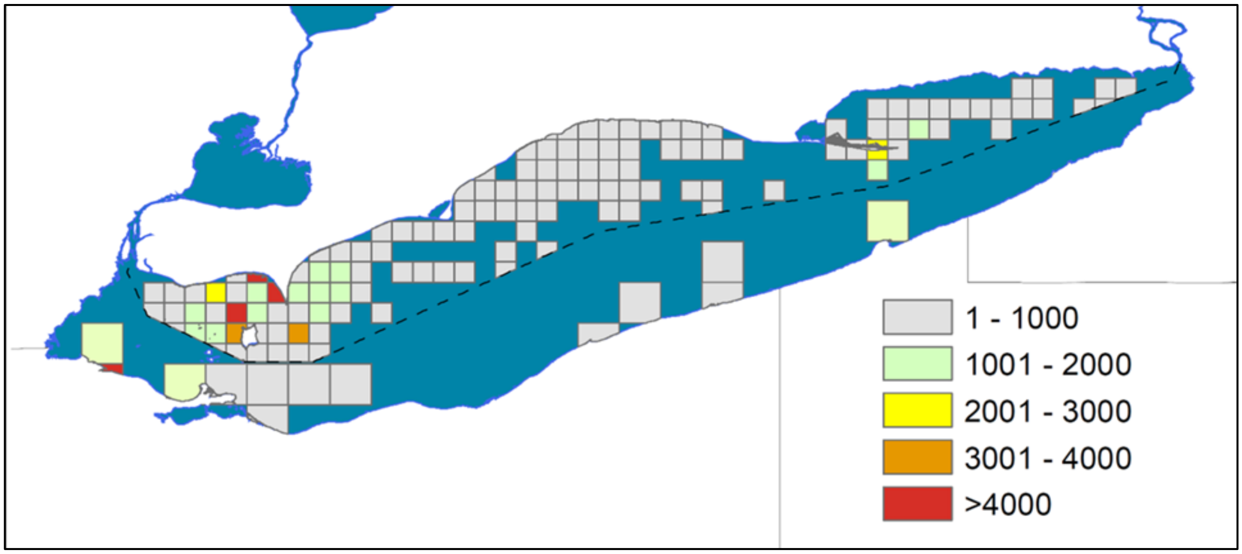


FIGURE 1.1.2. Commercial harvest of lake whitefish (pounds) in Lake Erie during 2024 by 5-minute (Ontario) and 10-minute (U.S.) grids.

As there was no reported targeted gillnet harvest and effort in 2024, Ontario annual lake-wide commercial catch rates are presented in three forms (Figure 1.1.3). Along with a time series of targeted catch rates (kg/km) up to 2013, catch rates are presented based on all large mesh (>=76 mm or 3”) gillnet effort (kg/km) and large mesh gillnet effort with lake whitefish in the catch (kg/km; the latter excludes effort with zero catches). Catch rates based on all large mesh effort (1.51 kg/km) and effort with lake whitefish in the catch (4.45 kg/km) during 2024 decreased by 59% and 47% from 2023, respectively. Harvest rate metrics in 2024 remained well below the time series averages (9.2 kg/km, 24.0 kg/km respectively) (1998-2024).

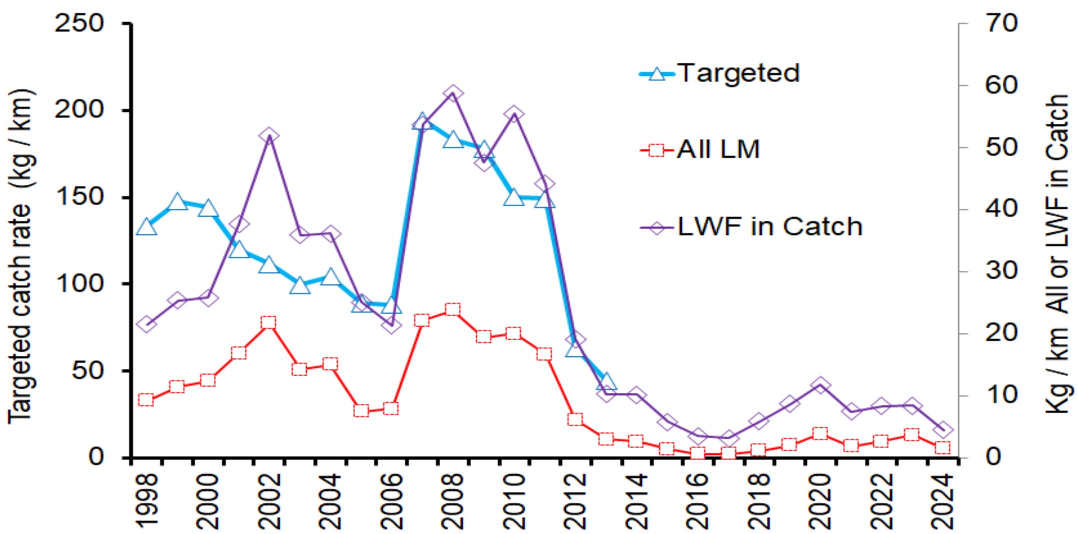


FIGURE 1.1.3. Lake-wide Ontario annual commercial large mesh gillnet catch rates (1998-2024). Targeted Lake Whitefish catch rate (kg/km; left axis), catch rate relative to all large mesh gillnet fished (kg/km; right axis), and catch rates from large mesh effort with Lake Whitefish in the catch (kg/km; right axis). No targeted Lake Whitefish effort or harvest in 2014 – 2024.

Lake whitefish harvest from commercial trap nets in Ohio waters during 2024 was 11,970 pounds, distributed among the west (O-1, 99%) and central basin (O-2, O-3 1 %). The majority (91%) of lake whitefish harvest in Ohio during 2024 was taken from grids 902, 904 and grid 802 (Figure 1.1.2). Lake whitefish were harvested from 830 trap net lifts (zero catches excluded) in 2024, with lifts distributed among District 1 (O-1) (83%), District 2 (O-2) (5%) and District 3 (O-3) (12%), respectively. Trap net harvest was greatest in November (62% or 7,362 lbs) followed by December (4,022 lbs or 34%) and October (2%) in O-1 during 2024. The trap net catch rate (14.4 lbs / lift) in 2024 was 60% below the 2023 level and the mean (29.8 lbs/lift 1996-2024) (Figure 1.1.4). Lake whitefish harvest in Pennsylvania waters totaled 1,969 pounds in 2024, with harvest confined to the deep channel north of Pennsylvania (Figure 1.1.2). Lake whitefish catch rates doubled in Pennsylvania waters during 2024 (104 lbs / lift) from 2023 (Figure 1.1.4).

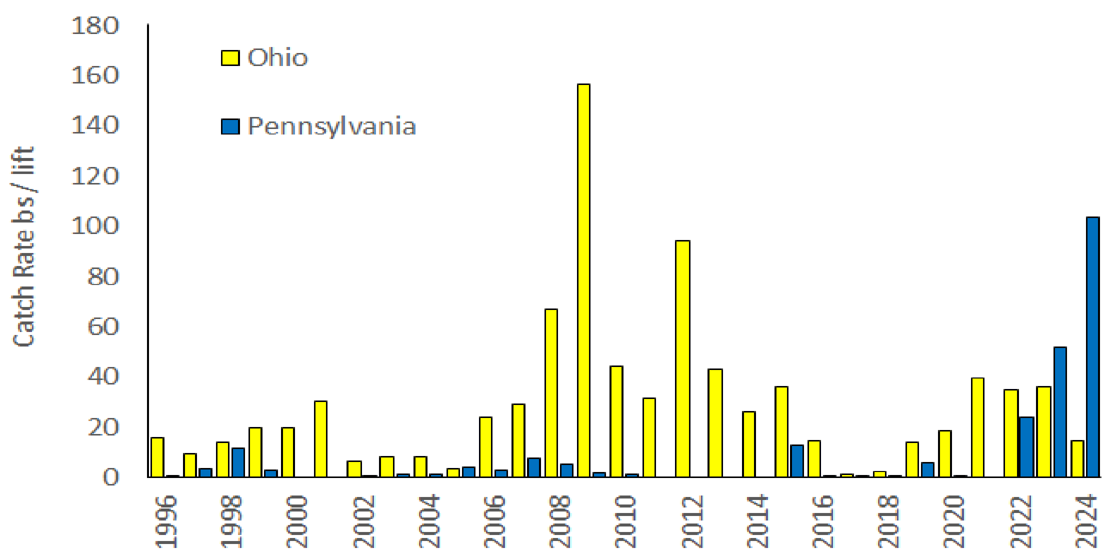


FIGURE 1.1.4. Lake whitefish commercial trap net catch rates in Ohio and Pennsylvania (pounds per lift), 1996-2024. Zero harvest for PA in 2011-2014, 2021. Trap nets are prohibited in eastern PA waters (YP MU4). Effort includes lifts with lake whitefish in the catch.

Ontario's west basin fall lake whitefish harvest in 2024 was comprised of ages 3 to 9 with age 5 (2019 cohort), 4 (2020 cohort) and 3 (2021 cohort) accounting for the majority of lake whitefish harvested (Figure 1.1.5). The age composition of lake whitefish harvested in U.S. waters was not assessed in 2024. The landed value of whitefish in Ontario during 2024 was $125,387 or $1.86 / lb CDN. The landed weight of roe from Ontario's 2024 lake whitefish fishery was 358 pounds, collected from the west basin in November (99%) and, October (1%). The approximate landed value of the roe was $ 1,967 or $ 5.49 / lb CDN.

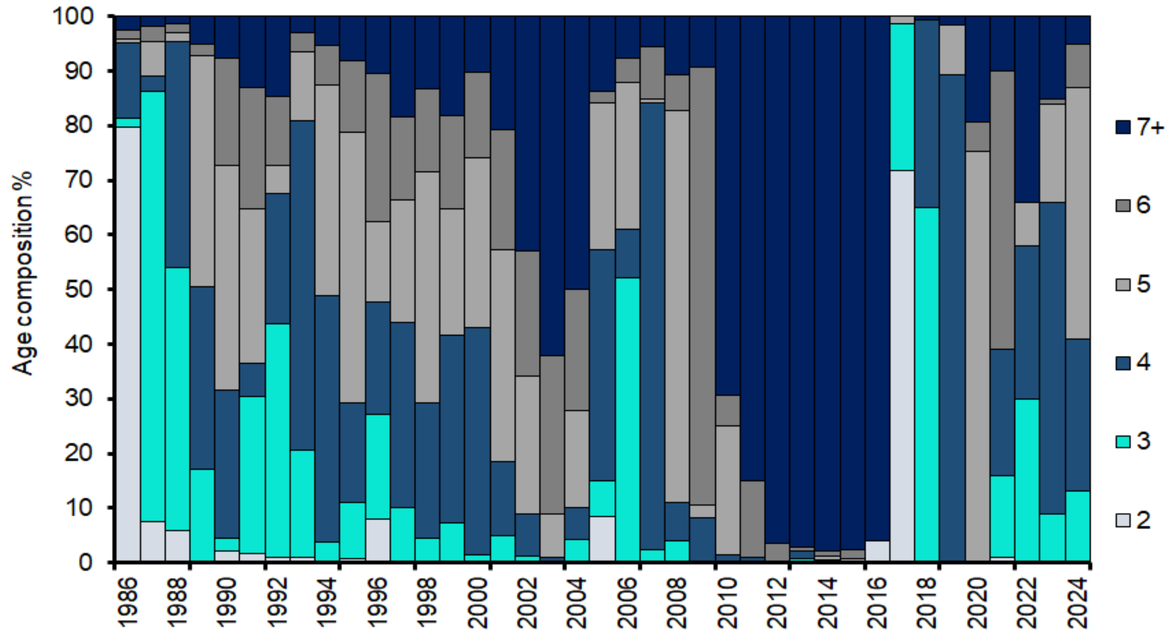


FIGURE 1.1.5. Ontario fall commercial lake whitefish harvest age composition in statistical district 1, 1986-2024, from effort with gillnets ≥3 inches, October to December. N=100 in 2024. Ages 7+ includes whitefish ages 7 and older.

Assessment Surveys

Gillnet assessment surveys of lake whitefish in Lake Erie include Coldwater Assessment (CWA) netting in New York, Ontario and Pennsylvania waters of the east basin and Ontario's Partnership Survey covering the east, and central basins. Partnership Survey catch rates were pooled despite differences in thermal stratification, and migratory behavior when east and central basin surveys occur. Partnership survey catch rates in 2024 were based on 111 sites with 222 gangs fished on bottom and at standard canned depths. A survey design change was implemented in 2024 with the objective to improve the precision of yellow perch assessment in the east basin. A redistribution of survey effort resulted in the elimination of the Pennsylvania Ridge survey and east basin survey effort at depths > 30 m while increasing effort in the east basin survey at depth strata ≤ 30 m.

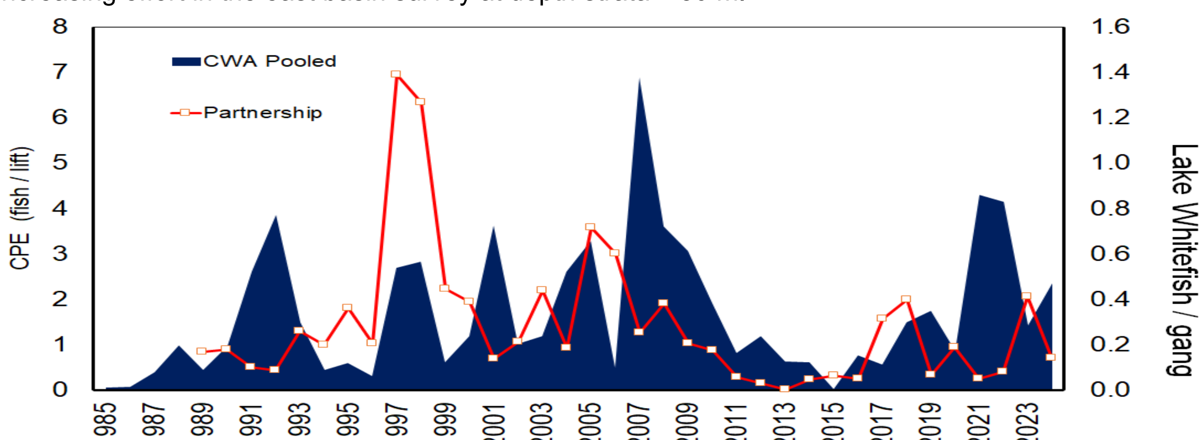


FIGURE 1.1.6. Catch per effort (number fish/lift) of lake whitefish caught in standard Coldwater Assessment Survey gillnets (CWA) in New York, Pennsylvania, and Ontario waters. Partnership index catch rates (LWF/gang) for all ages (line with squares) (second axis).

Lake whitefish catch rates in CWA nets fished on bottom at standard (thermocline interface) stations (44 lifts) during 2024 (2.36 fish/lift) increased from 2023 (1.44 fish/lift) and was 69th percentile in the 40-year time series 1985-2024 (Figure 1.1.6 Lake whitefish aged in CWA surveys ranged in age from 1 to 22 with ages 9 and 10 most abundant (Figure 1.1.7). Lake whitefish mean age in CWA was 8.5 in 2024.

Partnership survey catch rates of lake whitefish declined from 0.41 fish / gang to 0.14 fish / gang in 2024 (Figure 1.1.6). The age composition in Partnership surveys ranged from ages 1 to 21, with age-5 (22%; 2019-year class) most abundant (Figure 1.1.7). Age-1 catch rates were moderate (0.009 / gang) whereas age 2 fish were absent. Mean age of lake whitefish caught in Partnership surveys in 2024 was 6.3. A total of 33 lake whitefish were caught lake-wide with catches distributed among the east (23), east-central (5), west-central (4) and west basin (1) surveys.

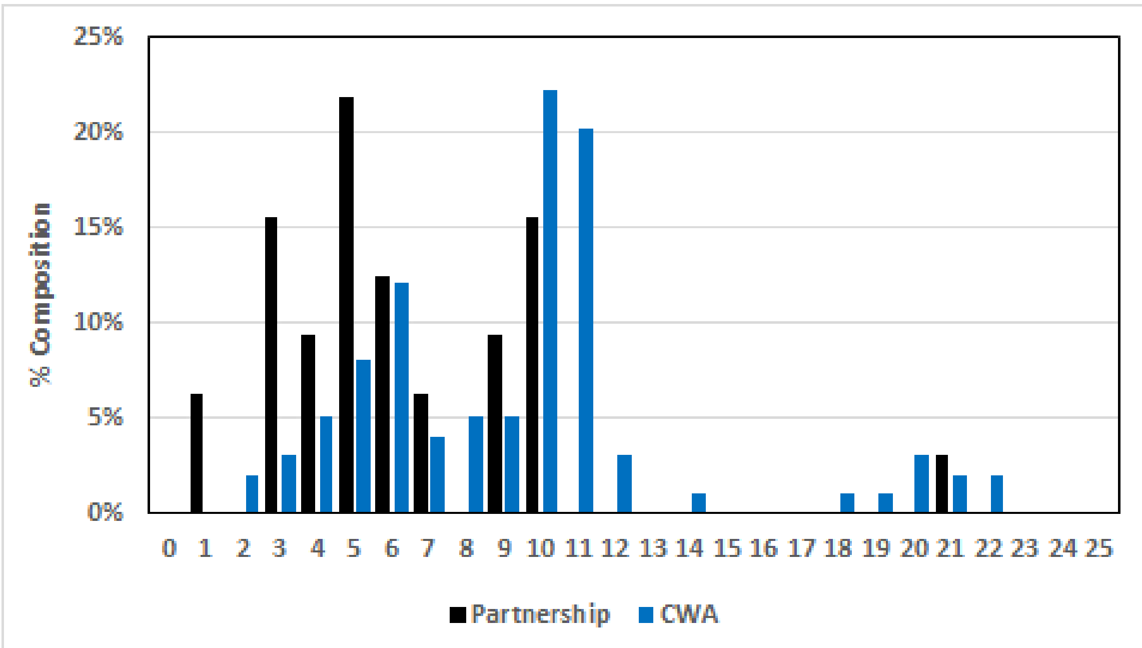


FIGURE 1.1.7. Lake whitefish age composition in the cold water assessment (CWA) and partnership gillnet surveys during 2024. Sample sizes were 99 and 32 respectively. Partnership surveys include west-central, east-central and east basins.

Trawl surveys in Ohio waters of the central basin of Lake Erie (Ohio Districts 2 and 3) encounter juvenile lake whitefish. Ages 0 and 1 June and October catch rates (O-2 and O-3 combined) are presented in Figures 1.1.8 and 1.1.9 as indicators of year class strength. In 2024, the age-0 catch rate in the central basin was slightly above average in June (0.32/ ha) whereas the age-0 whitefish catch rate (0.08/ha) was slightly below average in October trawls (Figure 1.1.8). New York's east basin age-0 lake whitefish trawl index (0.68/ha) in 2024 exceeded the 33-year time series mean (0.39/ha) (Figure 1.1.8).

Age-1 lake whitefish were caught at moderate densities (0.11 / ha,) during June whereas none were caught during October in Ohio bottom trawls (Figure 1.1.9). During some years, lake whitefish are encountered in Ontario's deep, offshore fall bottom trawl assessment in Outer Long Point Bay. In 2024, one yearling lake whitefish was caught in the Long Point Bay survey.

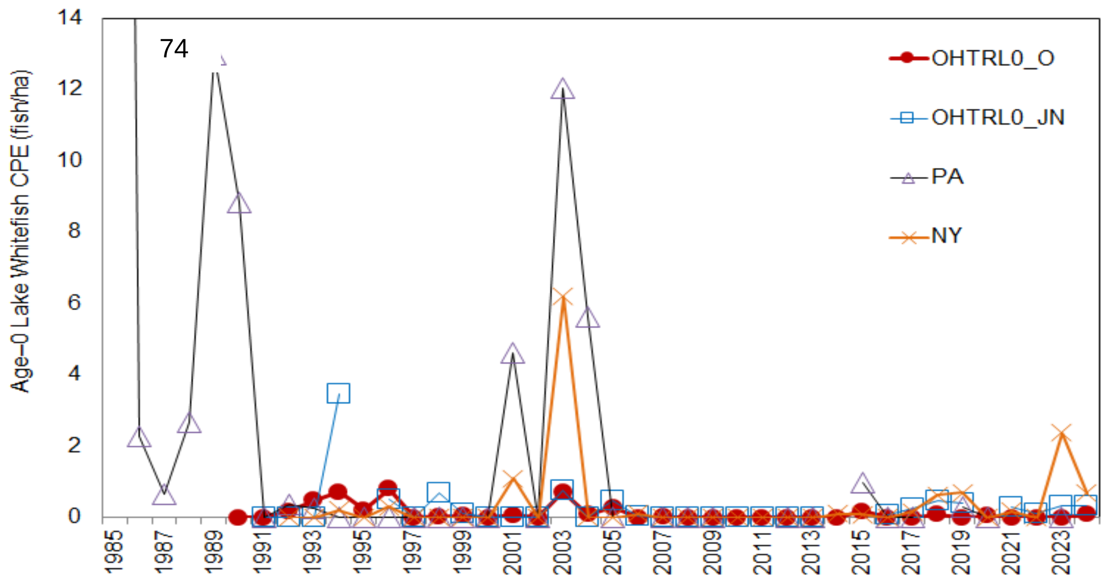


FIGURE 1.1.8. Age 0 lake whitefish catch per hectare in Ohio (central basin during June – OHTRL0_JN, October – OHTRL0_O), Pennsylvania (PA) and New York (NY) fall assessment trawls. Ohio data are means for October trawls in District 2 and 3. Pennsylvania did not conduct trawls during 2018, 2021, 2022. Ohio did not trawl in June 2020.

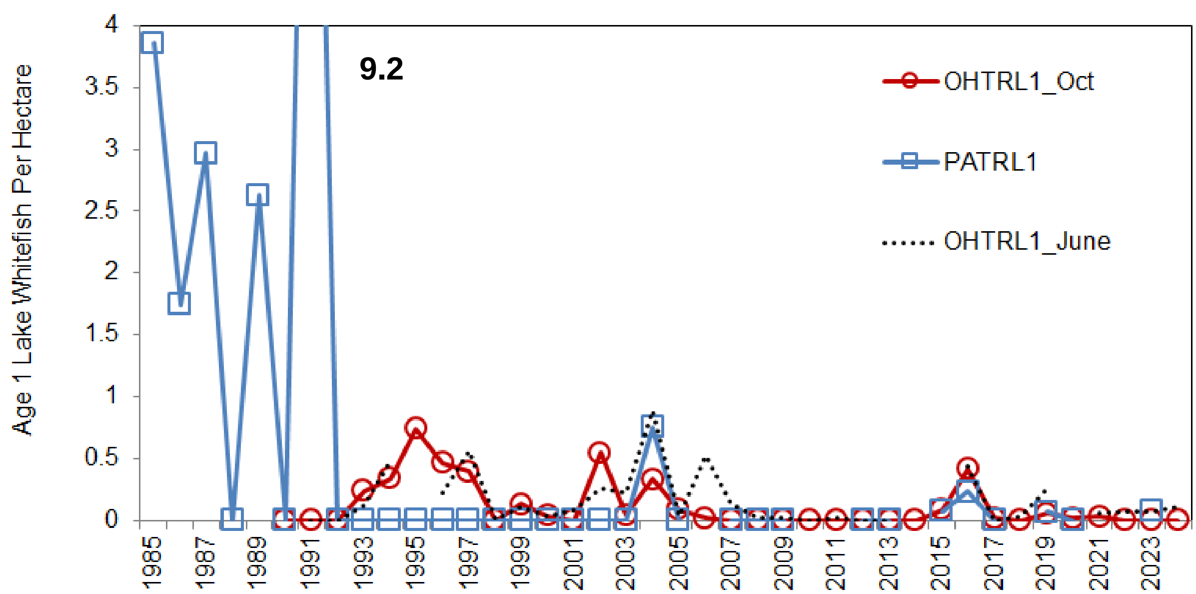


FIGURE 1.1.9. Age 1 lake whitefish trawl catch rates (number per ha) in Ohio waters during June (dotted line) and October (circles) and in Pennsylvania (PATRL1) waters (squares). Pennsylvania 1991 value (9.2) exceeds maximum axis value. Pennsylvania did not trawl in 2018, 2021, 2022, and 2024. Ohio did not trawl in June 2020.

Growth, Diet and Health

Trends in condition are presented for lake whitefish relative to historic lake whitefish condition reported by Van Oosten and Hile (1947). In 2024, samples were combined from commercial and survey data from Ontario according to the following selection criteria: ages 4 and older collected from Oct-Dec, excluding spawning and spent fish. In 2024, female mean condition factor (1.12) was near the historic mean condition (1.13) whereas male condition in 2024 (0.98) was below the historic mean (1.02) (Figure 1.1.10).

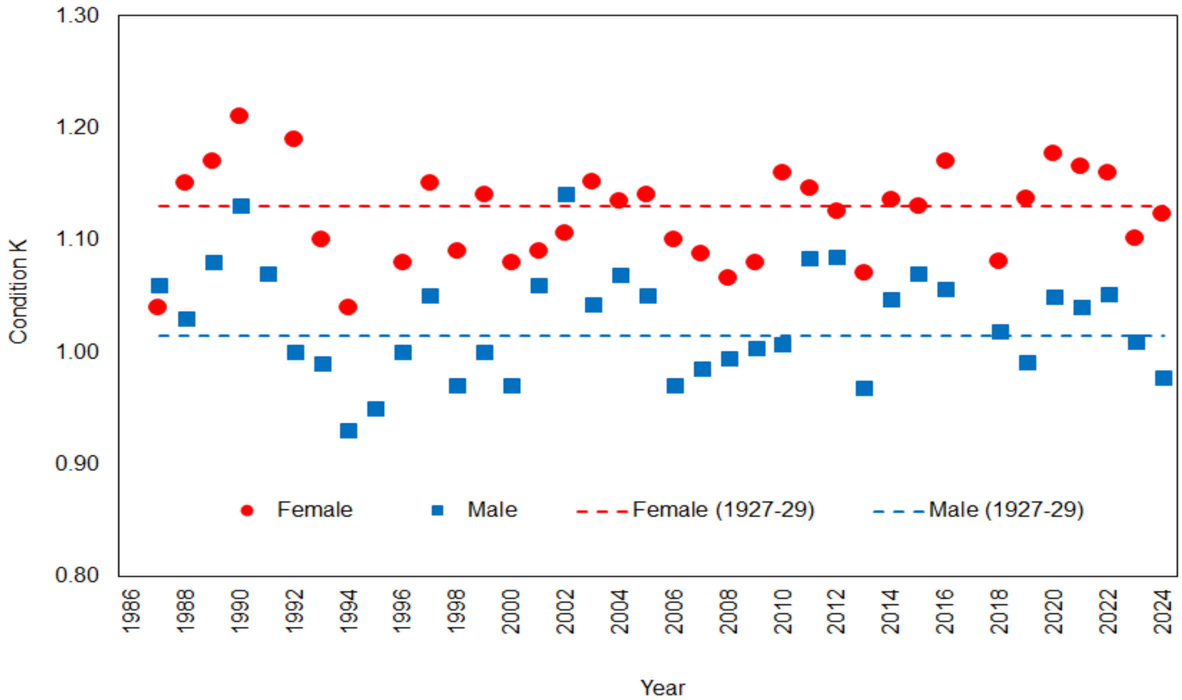


FIGURE 1.1.10. Mean condition factor (K) values of age 4 and older Lake Whitefish obtained from Ontario commercial and survey data (Oct-Dec) by sex from 1987-2024. Samples sizes in 2024 were: Males N=29 and Females N=35. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

Diet analyses were completed for lake whitefish ages 2 and older collected from Ohio waters of the central basin (D 2,3) from March to October 1995-2024. Over decades, lake whitefish diet composition (% dry weight) remained diverse with prey such as Isopods, Chironomids and clams prominent since 1995 (Figure 1.1.11). Dreissenid mussels and snails were better represented in lake whitefish diets during earlier years in contrast with recent years. Amphipods accounted for small fractions of lake whitefish diet periodically from 1995-2008 but were absent in samples since 2009. Zooplankton prey were variably present over time, with proportions occasionally amplified at low sample sizes (Figure 1.1.11). Other benthos appeared in diets during earlier years whereas fish prey occurred in lake whitefish diets sporadically over the entire time series. There is greater uncertainty describing lake whitefish diet composition for years with low sample sizes (Figure 1.1.11).

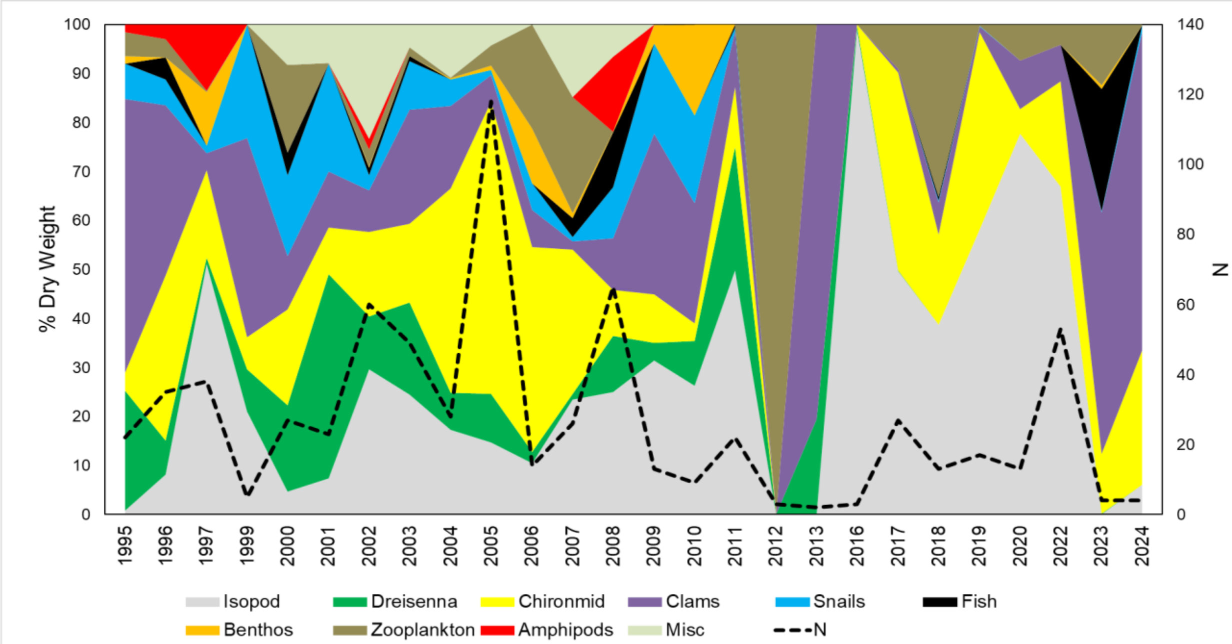


FIGURE 1.1.11. Lake whitefish (ages 2 and older) diet composition (% dry weight) by prey taxa collected from Ohio waters of central Lake Erie, 1995-2024. Number of lake whitefish stomachs with contents expressed as dotted line (second Y axis).

From 1995-2024, age-0 lake whitefish diet information was collected by ODNR during 19 years with annual samples ranging from 1 to 75. Age-0 lake whitefish diet samples from 1995-2024 were dominated by Isopods, Chironomids (larvae, pupae, adults) and zooplankton including *Daphnia* sp., *Bosmina* sp., Copepods, Ostracods, *Leptodora* sp., Chydoridae and other prey taxa. Fingernail clams and Dreissenid mussels were present earlier in the time series but have been absent in age-0 lake whitefish diet samples since 2017 and 2006 respectively. Invasive *Hemimysis* sp. were found in one age-0 lake whitefish diet in 2024.

Twenty-two years of age-1 lake whitefish diet composition was described by ODNR from 1994-2024, with annual samples ranging from 1 to 100. Age-1 lake whitefish diets were dominated by Chironomids (pupae and larvae) and Isopods from 1995-2024. Spiny water fleas and Dreissenid mussels also contributed significantly to yearling whitefish diets throughout the time series. Fingernail clams were relatively abundant in age-1 whitefish diets early in the time series but contributed less since 2016. Daphnia sp. were less important in the yearling diet during the 1990s but became more significant in samples collected since 2000. Amphipods occurred in age-1 whitefish samples from 1995-2002,reappeared during 2022, and did not appear in 2024. Mayflies occurred in yearling whitefish diets periodically during 1995, 1996 and in 2016.

Lake whitefish in Lake Erie exhibit a high prevalence of Digenean heart cysts from *Icthyocotylurus erraticus* (CWTG 2018). Heart cyst densities of lake whitefish were classified according to the proportion of the heart surface area covered by cysts; 0-none, 1-33%-light, 34-66%-moderate, 67-100%-heavy from Ontario's commercial sample program and partnership surveys. In 2024, 133 lake whitefish hearts were examined from the partnership survey and Ontario commercial fish sampling programs. Heart cysts were present in 68% of hearts examined. Among 133 whitefish, heart cyst densities were classified as none (32%), light (34%), moderate (24%), and heavy (11%). Annual heart cyst prevalence in lake whitefish monitored in Partnership surveys averaged 80% since 2016. This parasite is present in lake whitefish in the upper Great Lakes (Muzzal and Whelan, 2011). In Ireland, intermediate and final hosts of this parasite are snails and gulls respectively (Harrod and Griffiths 2005). Harrod and Griffiths (2005) reported that this parasite influenced gonad size of female pollan with different effects on liver size and condition of males and females. This parasite was also identified in rainbow smelt in Lake Erie (Dechtiar and Nepszy, 1988). The impact of this parasite on lake whitefish in Lake Erie remains unknown.

Acoustic Telemetry

Lake whitefish were implanted with 69 kHz acoustic transmitters and tagged with external Floy tags from 2015 to 2024 to monitor seasonal movements as described by detections in the GLATOS (Great Lakes Acoustic Telemetry Observation System) acoustic receiver network. This research is a collaboration of USGS, ODNR, USFWS, OMNR, GLFC, GLATOS, TNC and local partners to increase knowledge of lake whitefish behavior and support management of this data deficient species. To date, 390 lake whitefish were tagged in the GLATOS LEWHF project in areas including the Maumee Bay Ohio, west basin spawning reefs in Ohio and in Ontario waters, the Detroit River and the central basin of Lake Erie (Table 1.1.1). In 2019, The Nature Conservancy (TNC) and ODNR tagged an additional 15 lake whitefish near Turtle Island as part of a separate study (Table 1.1.1). Since 2015, 60 acoustic tags have been recovered by fisheries or found on shore (Table 1.1.1). Fishery tag recoveries totaled 56, distributed between Ontario's gillnet fishery (50), trawl fishery (1) and Ohio's trapnet fishery (5). An additional 4 buoyant transmitter tags were recovered on beaches in Ohio and New York from 2021-2022. In 2024, 3 lake whitefish were tagged in the Detroit River and 2 lake whitefish were tagged in the central basin off Pennsylvania.

Acoustic telemetry research described how seasonal habitat use by lake whitefish was influenced by hypoxic conditions in Lake Erie (Kraus et al. 2023). The manner in which seasonal hypoxic conditions influenced the vulnerability of lake whitefish to Lake Erie fisheries was examined by Kraus et al., 2024. Fishing and natural mortality were assessed based on years of detections and fishery captures (Cook et al. 2023). Mortality parameter estimates using acoustic telemetry data suggest that the current natural mortality estimate (0.35, Pauly 1984) may be inflated and that natural mortality estimates may be as low as M=0.15. Additional focus on lake whitefish mortality estimation is recommended. Recent efforts have focused on tagging other lake whitefish stocks in the Detroit River and Lake Erie's central basin (Table 1.1.1). In the future, lake whitefish tagging in eastern Lake Erie may contribute to Lake Erie lake whitefish stock assessment. Information about this project and other GLATOS projects is online: https://glatos.glos.us.

TABLE 1.1.1. Number of lake whitefish tagged with internal acoustic transmitters and Floy tags by location 2015 – 2024. Number of tagged whitefish recovered by fisheries or found from 2015 – 2024.

			Tags Recovered*										
Tag Year	Tag Location	# Tagged	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	All
2015	Maumee Bay	10	0	0	1	0	0	0	0	0	0	0	1
2016	Hen Island - Little Chicken	37		3	0	0	1	1	0	0	1	0	6
2017	Crib Reef	25			1	0	1	1	1	0	0	0	4
2017	Hen Island - Little Chicken	55			5	1	1	1	1	1	0	0	10
2017	Niagara Reef	25			0	0	0	2	0	0	1	0	3
2018	DR mouth	2				0	0	0	0	0	0	0	0
2019	Crib Reef	50					0	3	5	1	1	0	10
2019	SW Colchester	35					4	1	2	0	0	0	7
2019	Western Lake Erie, Turtle I	15					0	0	1	4	0	0	5
2020	Pelee Island	20						1	0	2	0	0	3
2020	SW Colchester	14						0	0	0	0	0	0
2021	Pelee Island	16							0	0	0	0	0
2022	Hen Island - Little Chicken	45								5	0	0	5
2022	Pelee Island	29								4	1	1	6
2023	Detroit River	7									0	0	0
2024	Detroit River	3										0	0
2024	Lake Erie Central Basin	2										0	0
All Years	All Locations	390	0	3	7	1	7	10	10	17	4	1	60

* Includes tags found on beaches; Crib Reef 2019 tag cohort: 4 floating tags were found; 2021 (3) and 2022 (1)

Statistical Catch at Age Analysis (SCAA) Population Model

A two-gear statistical catch-at-age (SCAA) model for lake whitefish (CWTG 2024) was updated with 2024 harvest and survey data. The model configuration consists of equal weighting (lambdas=1) among data sources, a catchability block to address a switch by Ontario's gillnet fishery to incidental harvest in 2014 and a selectivity block to account for a shift in fishery mesh size since 2017. The SCAA model consists of 2 gears (gillnet fishery catch and effort and Partnership Survey catch rates) but includes harvest from all jurisdictions with an adjustment to gillnet effort that accounts for the additional harvest. SCAA model results are presented in Figure 1.1.12. Principal components analysis (PCA) was used to consolidate 10 lake whitefish recruitment indices into 2 principal components (Y. Zhao, personal communication, 2015) for use in linear regression with SCAA age-3 abundance estimates to forecast future recruitment of age-3 whitefish and for comparisons to SCAA age-3 estimates (Table 1.1.2, Figure 1.1.12). SCAA and PCA recruitment estimates for cohorts 2014, 2015 are similar following years of accumulated data (Table 1.1.2). Abundance and spawner biomass levels were forecasted to 2027 assuming 2024 SCAA terminal survival estimates. Forecasted spawner biomass from 2025 – 2027 was compared to a State of the Lake (SOLE) limit reference point (LRP) that describes lake whitefish population status. The LRP was based on the range (1.8-2.9 million kg) of depressed spawning stock biomass (SSB) estimated from 2014-2017. Lake whitefish spawner biomass levels may remain above the 2014-2017 Limit Reference Point until 2027, provided fisheries' harvest remains conservative (Figure 1.1.13). Initiatives to further understand lake whitefish recruitment in Lake Erie are described below.

Age-0 Lake Whitefish Bottom Trawl Index a Using Bayesian Hierarchical Model

Zero catches are common among Age-0 lake whitefish bottom trawl surveys in Lake Erie. Amidon et al. (2025) analysed young-of-the-year lake whitefish bottom trawl data from New York, Ohio and Pennsylvania waters of Lake Erie to produce annual estimates of year class strength (1992-2021). By developing a Bayesian hierarchical Binomial-Poisson mixture model, estimation uncertainty was reduced, improving the reliability of the composite recruitment index. The model incorporates the data generating process, adapting to new information as it becomes available. This approach may support improved lake whitefish stock assessment in the future.

Recruitment Dynamics of Cisco and Lake Whitefish across the Great Lakes

Native cisco and lake whitefish populations are central to management and restoration initiatives across the Great Lakes, including through the Coregonine Restoration Framework endorsed by the Council of Lake Committees (Bunnell et al. 2023). Unfortunately, many populations have experienced declining recruitment in recent decades. A basin-wide collaboration led by PhD student Taylor Brown at Cornell University is investigating lake whitefish and cisco recruitment dynamics and drivers across the Great Lakes. Brown et al. (2024a) used long-term survey data to estimate cisco and lake whitefish year-class strength in each of the Great Lakes (except cisco in Lake Erie, where cisco are extirpated) and Lake Simcoe from 1956–2015. They found that lake whitefish year-class strength was synchronously above average in all six lakes during the 1980s-1990s, but that recruitment trajectories diverged thereafter. In contrast, cisco year class strength was sporadic, highly variable through time, and not synchronous among lakes. Year-class strength dynamics were dissimilar between the two species, despite having similar early life histories. Analyses to quantify which hypothesized drivers best explain observed lake whitefish and cisco year-class strength among lakes are ongoing. This study will evaluate key hypotheses regarding how important recruitment drivers differ among lakes and between species (Brown et al. 2024b). The results from this research will be used to relate important drivers of recruitment to ongoing ecosystem change and identify which recruitment bottlenecks are likely actionable by managers and stewards.

Summary

In 2024, lake whitefish fishery harvest (81,222 pounds) decreased 60% from 2023. Fishery performance varied across jurisdictions. Commercial fishery catch rates declined in Ontario (47%) and Ohio (60%) waters while increasing dramatically in Pennsylvania waters (100%). Trends in status conflicted between surveys whereby catch rates increased in the CWA (64%) and decreased in the Partnership (65%). A broad range of ages were represented in surveys and the gillnet fishery during 2024. In 2025, lake whitefish fisheries will benefit from whitefish ages 10 and older with contributions from fish ages 6 and younger. Statistical catch at age population and biomass estimates informed by agency recruitment indices forecast relatively constant abundance and biomass to 2027. The task group recommends efforts to integrate the CWA survey into the SCAA model in the future. To reduce whitefish bycatch in Ontario’s walleye gillnet fishery, walleye quota transfers from the west basin (Quota Zone 1) to the central basin (Quota Zones 2 and 3) are permitted by Ontario. In 2024, 26% of walleye quota in the west basin was transferred to central basin walleye fisheries, relieving fishing pressure on whitefish spawning and aggregating in the west basin. Ontario’s quota management accommodates bycatch of lake whitefish while discouraging targeted lake whitefish fisheries. The Coldwater Task Group recommends continued conservative management of lake whitefish. Ongoing studies of habitat use by all life stages and stock discrimination efforts continue to benefit our understanding of population dynamics, supporting sustainability of lake whitefish in Lake Erie.

TABLE 1.1.2. Age-3 abundance estimates from statistical catch at age analysis (SCAA). Principal components analysis (PCA) for juvenile lake whitefish indices (ages 0,1,2) used in linear regression with SCAA age-3 abundance estimates to estimate age-3 abundance of 2014 – 2024 cohorts. Number of surveys, ages and cumulative variance of 1st and 2nd principal components (P1, P2) presented.

Fishery Recruit Year	Year Class	SCAA Est. Age 3	PCA REG Est. Age 3	Lower	Upper	# Surveys	PCA Survey Ages	Cumulative Variance P1, P2	Adj R^2	Pr > F
2017	2014	1,731,230	908,471	614,442	1,202,500	7	0,1,2	0.89	0.98	<.0001
2018	2015	5,574,450	4,856,373	4,412,579	5,300,166	9	0,1,2	0.86	0.98	<.0001
2019	2016	51,298	210,604	(223,527)	644,735	10	0,1,2	0.86	0.99	<.0001
2020	2017	179,982	505,153	81,841	928,465	9	0,1,2	0.83	0.98	<.0001
2021	2018	802,056	3,197,988	2,973,888	3,422,088	9	0,1,2	0.86	0.99	<.0001
2022	2019	2,639,670	725,548	282,919	1,168,177	9	0,1,2	0.87	0.98	<.0001
2023	2020	954254	678,575	228,179	1,128,970	8	0,1,2	0.84	0.97	<.0001
2024	2021	828310	954,655	625,157	1,284,153	8	0,1,2	0.83	0.97	<.0001
2025	2022		908,390	676,581	1,140,199	9	0,1,2	0.86	0.98	<.0001
2026	2023		2,616,632	2,188,523	3,044,740	8	0,1	0.80	0.97	<.0001
2027	2024		1,317,560	1,037,598	1,597,521	4	0	0.89	0.97	<.0001

Regressions exclude age 3 SCAA estimates for the year class being assessed
Regressions also exclude age 3 SCAA estimates for year classes with 3 SCAA estimates or less (3 grabs)
Note # of surveys used differs depending on the cohort estimated. Surveys with a missing value for the year class assessed are excluded from PCA analysis for that year class.

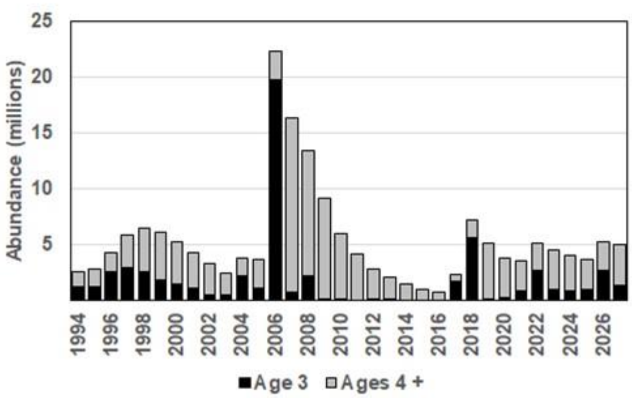


FIGURE 1.1.12. Lake whitefish abundance estimates at age 3 (black) and ages 4 and older (grey) from SCAA (1994-2024) with projections to 2027 from recruit indices in PCA and assumed terminal survival.

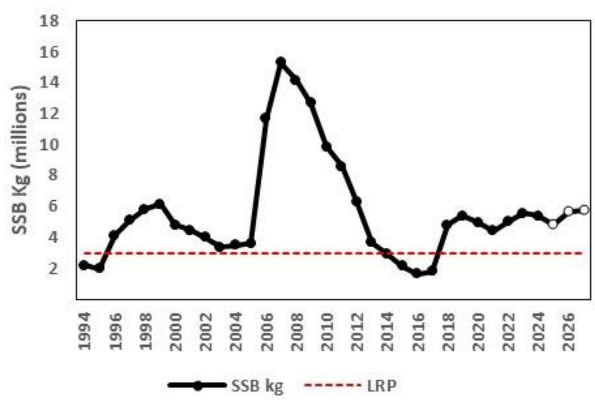


FIGURE 1.1.13. Lake whitefish spawning stock biomass estimates (millions of Kg, black line) projected to 2027 (white dots), assuming constant SCAA survival estimates from 2024. Limit reference point (red dashed line) was based on low SSB 2014-2017.

Cisco *Coregonus artedi*

In Lake Erie, cisco once supported the largest freshwater fishery on earth, but overfishing, habitat degradation, and invasive species led to their extirpation by 1960 (Eshenroder et al. 2016). Cisco are recognized within Lake Erie's Fish Community Objectives (Francis et al. 2020) as an important cold-water ecosystem component with historically important linkages between lower trophic levels (e.g., invertebrates and plankton) and apex predators (e.g., lake trout, walleye, etc.).

Recent cisco-like captures in Lake Erie

Despite being listed as extirpated, contemporary observations of cisco-like fishes in Lake Erie continue. From 2018–2023, three cisco were collected by USGS at Niagara Reef, while one cisco was collected by Jeff Herr, a commercial fishermen, just offshore of Crane Creek in the west basin. During this same period, six cisco-like fish, captured in association with the west basin islands and Erieau, in the central basin (Figure 1.1.14), were surrendered to OMNR for subsequent genetic analysis. Amanda Ackiss (USGS, Great Lakes Science Center, Ann Arbor), provided genetic analyses for all specimens. The fish captured by USGS and Jeff Herr were all true cisco *Coregonus artedi*, which are genetically most similar to Lake Huron cisco from Saugeen-Bruce Peninsula region. Several of the cisco-like specimens surrendered to OMNR from the west basin islands region were also true cisco most similar to Saugeen-Bruce Peninsula Lake Huron cisco. A few of the fish surrendered to OMNR were identified as bloater *Coregonus hoyi*. It appears that most contemporary cisco in Lake Erie have emigrated from Lake Huron, but more research is needed.

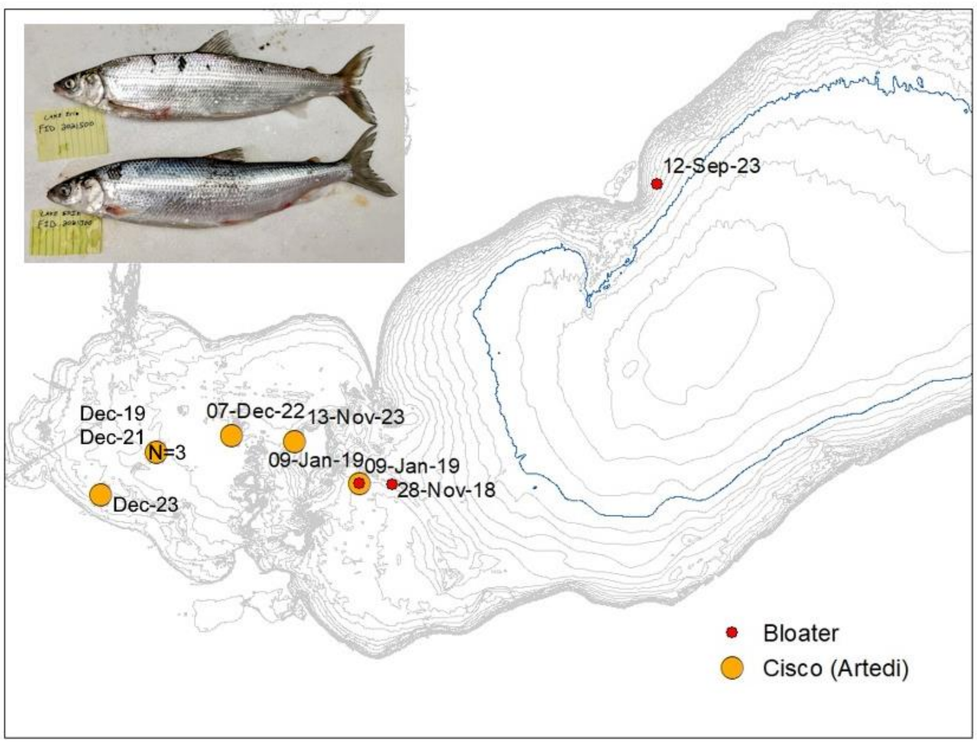


Figure 1.1.14. Locations and identities of N=10 cisco captured in western and west central Lake Erie between 2018 and 2023. Genetically identified *Coregonus hoyi* are shown with a red dot and *Coregonus artedi* are shown with an orange circle. Inset image: a flowing male and female cisco were captured by USGS at Niagara Reef, December 2021.

Recent projects and other ongoing work

Recently published studies relevant to Cisco in Lake Erie include:

1) An examination of survival, predation, and movement of acoustically tagged cisco (Kraus et al. 2024)

2) The exploration of a cisco population in an inland, historically stocked, Pennsylvania lake which provides evidence for a remnant population of the original Lake Erie cisco form (“*albus*”; Schmitt et al. 2024)

3) An analysis of potential synchrony of lake whitefish and cisco reproduction across and between the Great Lakes region, described in more detail in the lake whitefish section above (Brown et al. 2025)

Relevant ongoing work includes a pilot study investigating if eDNA can be used to detect spawning cisco in western Lake Erie during November and December (J. Schmitt, USGS), as well as several forthcoming products from GLFC-facilitated Lake Erie Threats Assessment and Spatial Unit Delineation workshops which occurred in 2024 under the umbrella of the Coregonine Restoration Framework (Bunnell et al. 2023).

Of additional note is the planned spring 2025 stocking of ~ 73K yearling cisco near Dunkirk, New York. These fish are being raised at the Allegheny National Fish Hatchery, Pennsylvania. This experimental introduction is planned to continue for 10 years. Additional research to assess survival and movement of stocked cisco are in preparation.

1.2 Report of the status of lake trout relative to rehabilitation plan targets

Pascal Wilkins (NYSDEC), Andy Cook, Tom MacDougall (OMNR), Mark Haffley (PFBC), Joseph Schmitt (USGS)

In 2024, 120 lake trout (all ages) were caught in the Coldwater Assessment Survey standard assessment nets, yielding an area-weighted catch rate (CPE; catch per effort) of 2.25 fish/lift. The highest catches occurred in New York waters (Areas 1 & 2; 4.5 fish/lift). Catch rates varied somewhat in the remaining areas (1.3 – 2.1 fish/lift) but were, generally, less than those observed in New York ((Figure 1.2.1).

With some exceptions, the highest CPEs have typically been recorded in New York, coinciding with higher cumulative lake trout stocking over time, followed by stocking in Pennsylvania and finally in Ontario waters, where annual stocking has been less and did not commence until 2006. This pattern may change in coming years as, under an updated management plan (LEC, 2021), numbers of yearling Lake Trout and locations stocked rotate between Ontario, New York, Pennsylvania and Ohio (with 3 of 5 locations stocked each year).

Catches of lake trout in offshore nets (N=130) exceeded catches in the standard assessment nets in 2024 (Figure 1.2.1). Similar to 2021–2023 the highest catches in offshore nets occurred in the most eastern portion of the assessment area (Areas 1,2,5,6). The area-weighted catch rate for all offshore assessment nets equaled 2.03 fish/lift.

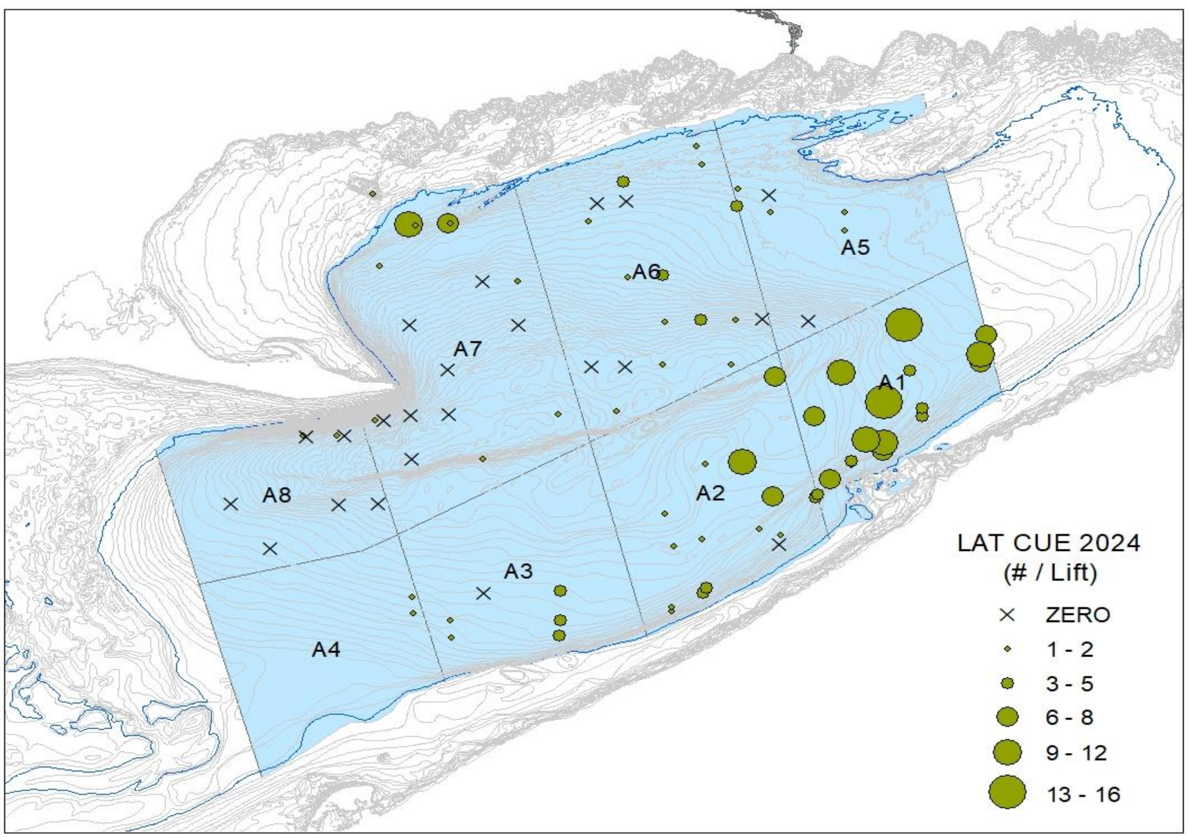


FIGURE 1.2.1. Catch rates (CPE; fish/lift) of lake trout (all ages) caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, August 2024. Relative CPE is indicated by scaled circle size. An "X" is used to represent net sets where no lake trout were caught

All assessment nets (standard and offshore) were used to provide the most complete representation of the age structure of the Lake Erie lake trout population. A total of twenty-one age-classes among four different strains were represented in 2024 with the oldest fish being age-25 (1999 year-class; FL strain) (Figure 1.2.2). Age 4 was the most abundant year class, representing 15% of the 216 fish whose ages could be determined. There was also strong representation from age-14 (14%) and age-3 (12%). Ages 5, 9, 12, 15, 16, and 17 contributed similarly, representing between 6–7 % of the ageable catch. The abundance of lake trout older than age-10 has increased in recent years and comprised 50% of the overall catch in 2024. Thirty-four of the 250 lake trout caught were not aged although total lengths of these fish suggest most were older adult fish. The strains of lake trout that contributed most to the total catch in 2024 were Finger Lakes (FL; 47%) and Lake Champlain (LC; 39%), followed by Slate Island (SI; 13%). These three strains have been the most commonly stocked lake trout strains in Lake Erie over the past fourteen years. The stocking of Slate Island strain was discontinued following the latest review and revision of Lake Erie's Lake Trout Rehabilitation Plan (LEC, 2021) due in large part to low survival to older ages; Slate Island strain lake trout were last stocked in 2021 and were still well represented as age 4 fish in 2024.

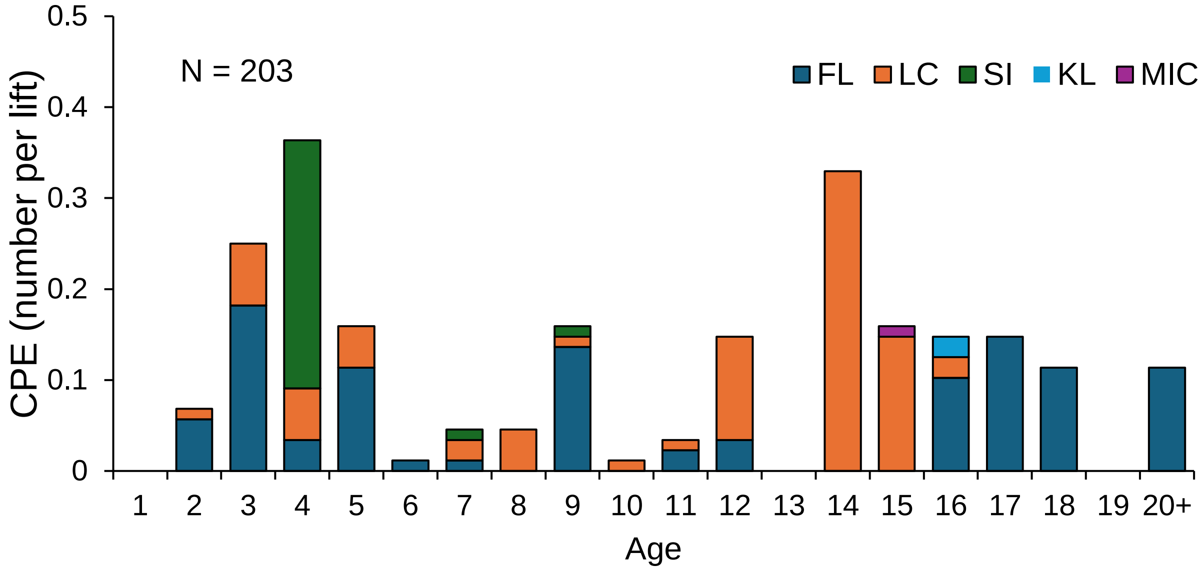


FIGURE 1.2.2. Relative abundance (number per lift) by strain at age, of lake trout sampled in all assessment gillnets in the eastern basin of Lake Erie, August 2024. Abbreviations for strains include: FL (Finger Lakes); SI (Slate Island); KL (Klondike); LC (Lake Champlain) and MIC (Michipicoten Island).

The relative abundance of adult (age-5+) lake trout caught in all assessment gillnets (weighted by area) in the Coldwater Assessment Survey serves as an indicator of the size of the lake trout spawning stock in Lake Erie. The targeted catch rate described in the 2021 Rehabilitation Plan (LEC, 2021) is 2.0 fish/lift. Adult abundance in all nets decreased in 2024 to 1.29 fish/lift from 1.63 fish/lift in 2023 (Figure 1.2.3). Adult abundance has been below target for three of the past four years. The 3-year running average of adult abundance was 1.75 fish/lift (2022–2024). Different from previous CWTG reporting on relative abundance, this report incorporates all assessment nets used since the redesign of the survey. No management actions related to adult abundance are being recommended for 2025.

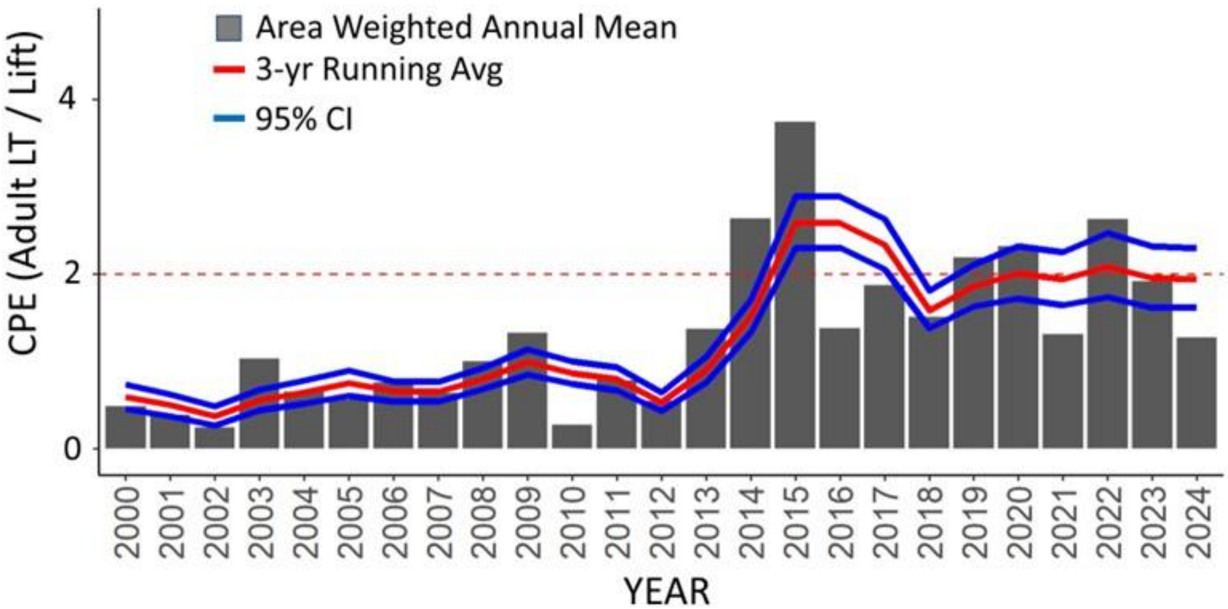


FIGURE 1.2.3. Mean combined CPE (number per lift, weighted by area) for lake trout sampled in all assessment gillnets in the eastern basin of Lake Erie, 2000-2024. Grey bars: annual mean adult (age 5+) lake trout CPE. Red dotted line: targeted adult lake trout CPE (2.0 fish/lift). Red solid line: 3-year running average of adult lake trout CPE. Blue solid lines: bootstrap estimates of the 95% confidence intervals.

The eastern Lake Erie Partnership survey design was modified in 2024 to confine sampling to depths ≤30 m which excluded deep water habitat of lake trout. Despite reduced sampling in the hypolimnetic habitat, 30 lake trout were caught in the east basin survey. All lake trout caught were adipose clipped; strains included Slate Island (24), Finger Lakes (2), Unknown –coded wire tag not found (2) and Unknown – not examined for CWT (2).

Recreational Catch and Harvest

Annual angler surveys in NY and PA provide a good record of change in the fishery over time. Recreational angler catch of lake trout in these waters has increased over the past decade, coinciding with increases in adult abundance. However, angler harvest of lake trout in Lake Erie remains very low with total (NY + PA) harvest in 2024 estimated at 373 fish (Figure 1.2.4). An estimated 250 lake trout were harvested in New York waters out of an estimated catch of 1,626 fish in 2024. Pennsylvania anglers harvested an estimated 123 fish from a total catch of 269 lake trout. It should be noted that these estimates do not include the fall nearshore fishery near spawning time (November, December), which has become more popular in recent years, especially in Pennsylvania waters. In Ontario waters, during the most recent recreational fishery survey

Anglers are surveyed much less frequently in Ontario waters. In 2014, an estimated 669 rod hours was directed at lake trout, derived from the report of one angler; zero lake trout were reported caught, targeted or otherwise. In 2024, seven anglers reported targeting lake trout. Total targeted effort in 2024 was estimated at 1,601 rod-hours with a total targeted catch of 104 lake trout (0.065 fish/rod-hour). In total 593 lake trout were caught in Ontario waters, and 275 of these were harvested. While targeted effort has increased in Ontario since 2014, it still represents <1% of overall east basin targeted fishery effort (all species).

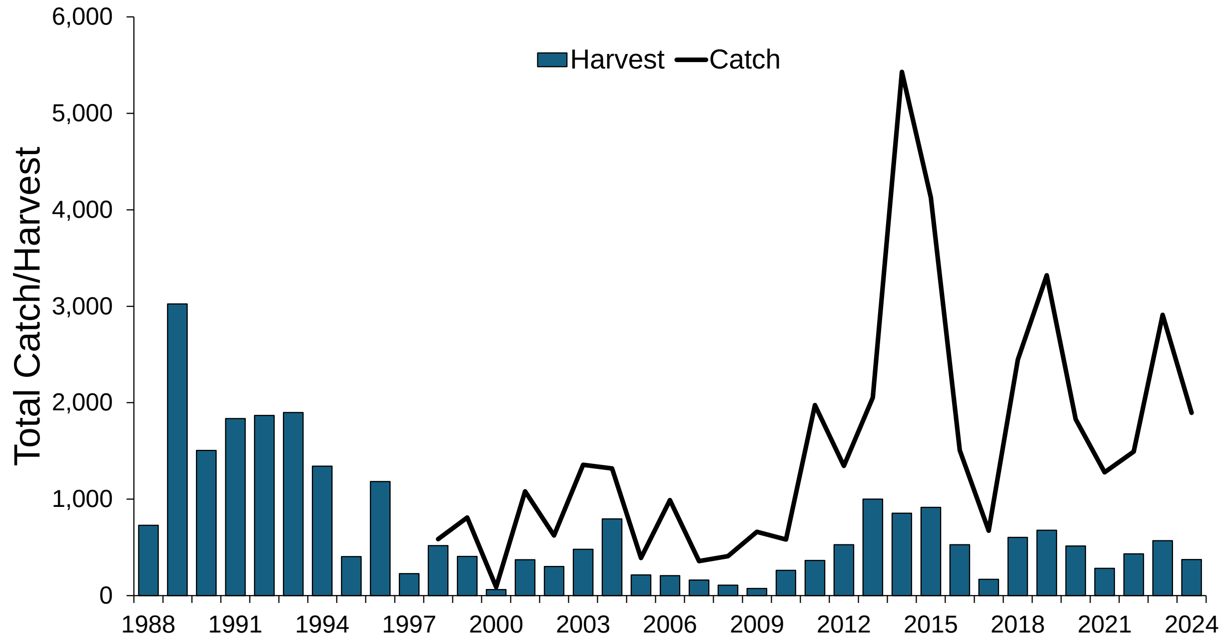


FIGURE 1.2.4. Estimated lake trout catch and harvest by recreational anglers in the New York and Pennsylvania waters of Lake Erie, May-October, 1988–2024.

Natural Reproduction

In Fall 2020, the results of an acoustic telemetry VPS array coupled with visual confirmation documented two lake trout spawning locations in the vicinity of Shorehaven Reef, NY. Fry trapping in April and May 2021–2023 at these two locations confirmed the presence of naturally reproduced post-embryo lake trout, the first documentation of successful reproduction since rehabilitation efforts began (Markham et al. 2022). In April and May 2024, Fry traps captured 5 lake trout eggs, 2 pre-embryo, and 31 post-embryo lake trout were collected across four additional spawning locations in the vicinity of Shorehaven Reef, NY. Sex and strain analysis results for the post-embryo lake trout collected in 2021–2024 should be available for the 2026 report.

All lake trout stocked into Lake Erie are marked by fin clip and/or coded wire tag, and observations of unmarked juvenile or adult lake trout remain low. Fish missing one and/or the other mark were used to calculate the rate of marking error. However, after marking errors are taken into account, a small but growing contribution from probable wild-produced fish is evident and has been increasing in recent years (Figure 1.2.5). In 2024, none of the 250 total lake trout caught during the survey were potentially wild (no fin clips; no CWT's). Altogether, a total of 89 potentially wild lake trout have been recorded since 2000 in the Coldwater Assessment Survey.

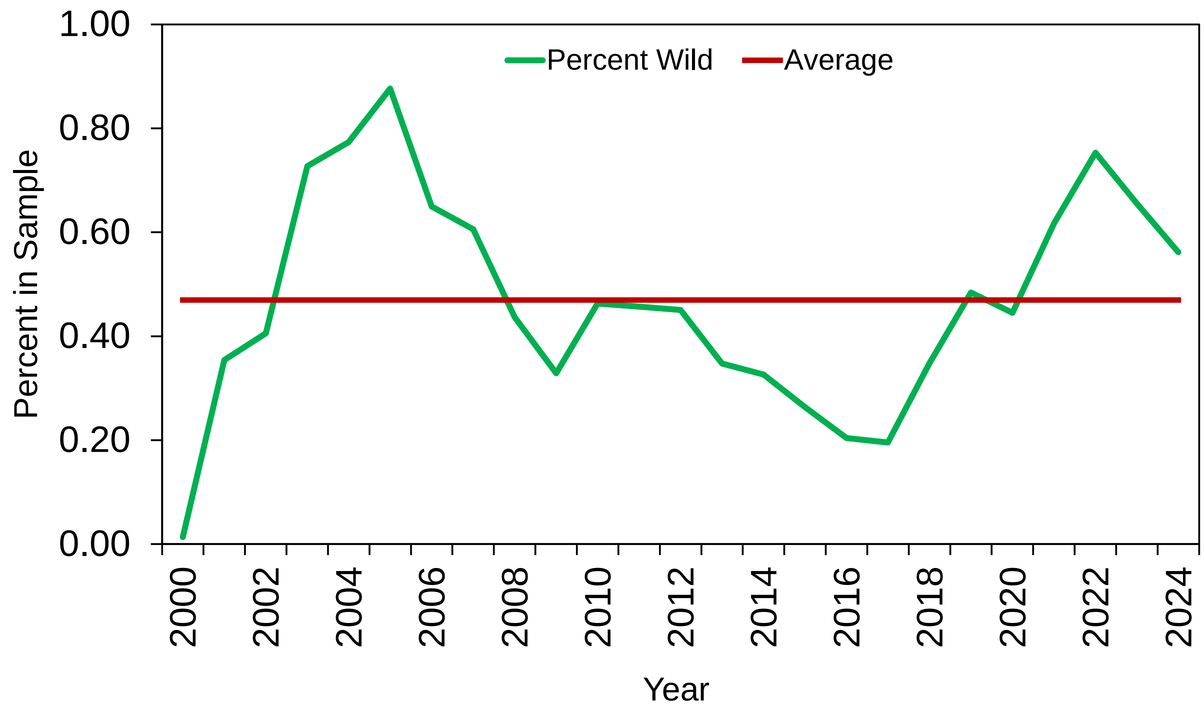


FIGURE 1.2.5. Percentage of potentially wild lake trout caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie for 5-year running average time blocks, 2000–2024 (green line), compared to the time series average (red line). A potentially wild fish has no fin clips and no coded-wire tag (CWT). Percentages are calculated after accounting for known marking error.

1.3 Report on the Status of Burbot

Tom MacDougall, Andy Cook, (OMNR), Pascal Wilkins (NYSDEC), Mark Haffley (PFBC), Joseph Schmitt (USGS)

Abundance and Distribution

Burbot are seasonally found in all the major basins of Lake Erie; however, the summer distribution of adult fish is restricted primarily to the 20-m and deeper, thermally stratified regions of the eastern basin. Coldwater Assessment and east basin Partnership Survey (bottom set nets) indices have historically displayed similar trends and magnitudes with some annual variation. Due to a recently modified survey design that excludes nets set deeper than 30m, Partnership Survey catch rates were deemed less suitable for 2024 reporting. During the early 1990s, burbot relative abundance was low throughout the lake. It increased between 1993 and 1998, peaked in the early 2000s, and then declined (Figure 1.3.1). For much of the past decade, catch rates have been consistently low with some regional differences. A time series low (0.24 fish/lift) occurred in 2019. Since then, catch rates in the CWA have increased each year, culminating in a 2024 overall CPE of 1.58 fish/lift. This was the highest catch rate since 2008 and represents the 65th percentile of the time series. In 2024, burbot were caught across a range of depths, but with slightly higher catch rates in standard nets set in shallower waters (Figure 1.3.1). They were caught in all jurisdictions and in each survey area with the exception of A4.

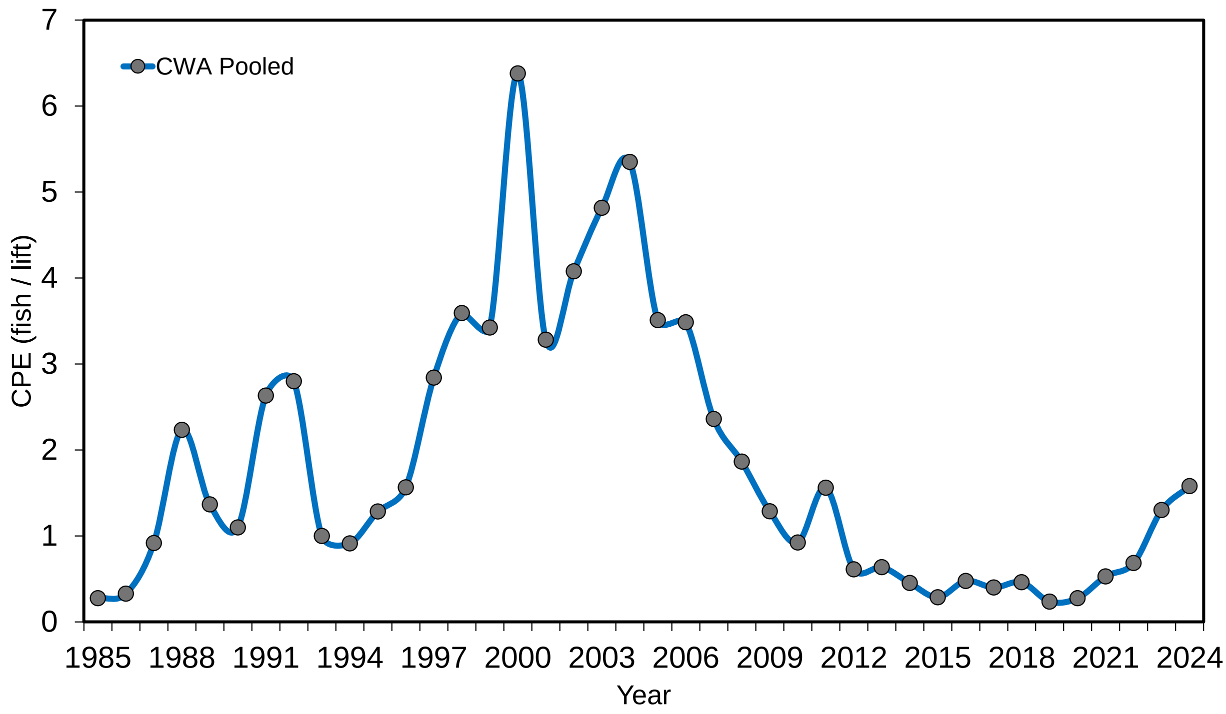


FIGURE 1.3.1. Burbot CPE (mean number per lift) from the Interagency Coldwater Assessment Survey (all nets), 1985-2024.

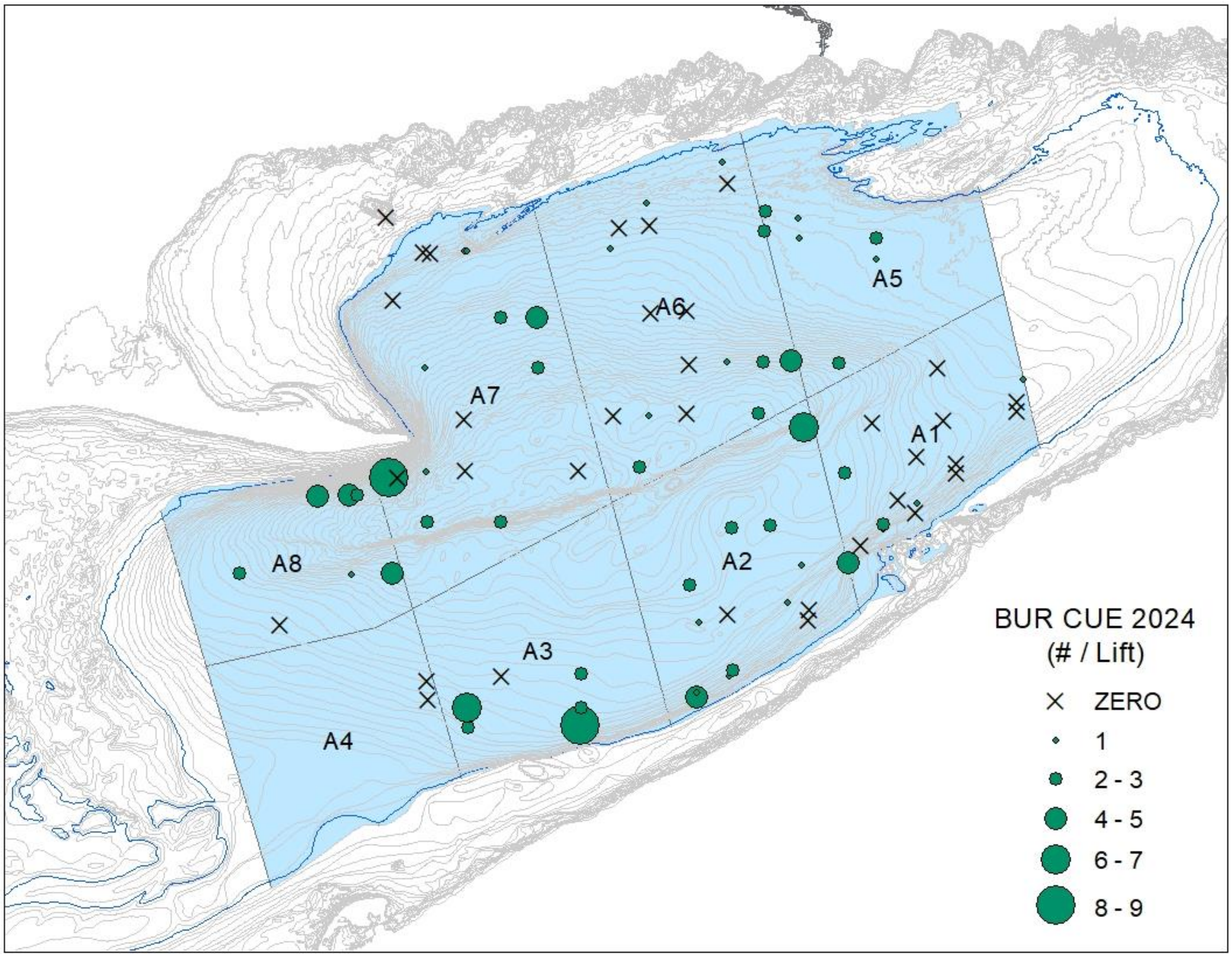


FIGURE 1.3.2. Catch rates (CPE; fish/lift) of burbot (all ages) caught in the Interagency Coldwater Assessment Survey (all nets), in the eastern basin of Lake Erie, August 2024. Relative CPE is indicated by scaled circle size. An “X” represents a net set where no burbot were caught.

Larval surveys can provide a picture of early life history habitat, distribution, and of centres of production. Surveys conducted in recent years by the USGS continue to document production of burbot associated with the Huron Erie Corridor (St. Clair River, Lake St. Clair, Detroit River) as well as the western basin of Lake Erie and at points eastward along the south shore. Larval burbot were captured in all three basins during a 2019 CSMI survey (DeBruyne et al., 2024) with the highest seasonal densities in the eastern basin near Dunkirk, NY, and the Niagara River. Larval burbot were captured in the western basin beginning in April and continued through August in low numbers, likely from larval burbot drifting from Lake Huron and St. Clair River. No burbot larvae were observed at offshore stations. The larval fish community was sampled in 2021 in the lower Detroit River and river mouth from late-March through May that also captured larval burbot (Robin L. DeBruyne, USGS, pers comm).

Commercial Fishery

Historically, fishery harvest of burbot occurred mainly in eastern Lake Erie with peak harvests in Pennsylvania waters. However, harvest decreased in Pennsylvania waters after 1995 following a shift from a gillnet to a trap net commercial fishery, resulting in a substantial decrease of commercial effort (CWTG 1997). In 1999, a market was developed for burbot in Ontario, leading the industry to actively target this species in 1999 and a concomitant increase was observed. However, this opportunistic market did not persist. Burbot catch is now incidental in nets targeting other species. The total commercial catch for Lake Erie in 2024 was 1,100 lbs, a decline of 68% from 2023 (3,416 lbs). The 2024 total catch included contributions from Ontario (58%, 637 lbs), Pennsylvania (26%, 286 lbs), New York (11%, 116 lbs), and Ohio (6%, 61 lbs), with the same proportional decrease from 2023 harvest apparent in each area. Ontario commercial catch in 2024 included reported landed harvest, discard and released burbot with nominal catch from Inner Long Point Bay. In 2024, the majority of burbot caught incidentally in Ontario waters was from central Lake Erie (81%).

Age and Recruitment

Ages of burbot caught in the CWA Survey are determined using otoliths. Otoliths were examined using either thin-sectioning or “crack-and-burn” techniques. To date, 114 burbot from the 2024 CWA survey have been aged using these methods. Burbot ranged in age from 2 to 16 years in 2024 (Figure 1.3.3). The catch had strong contributions from younger age classes; notably from 2019 (5-yr old; 34%) followed by 2020 (4-yr old; 26%) and 2018 (6-yr old; 11%). Strong contributions from younger year classes is a positive signal given concerns in the mid-2010s that the population was aging with no notable recruitment.

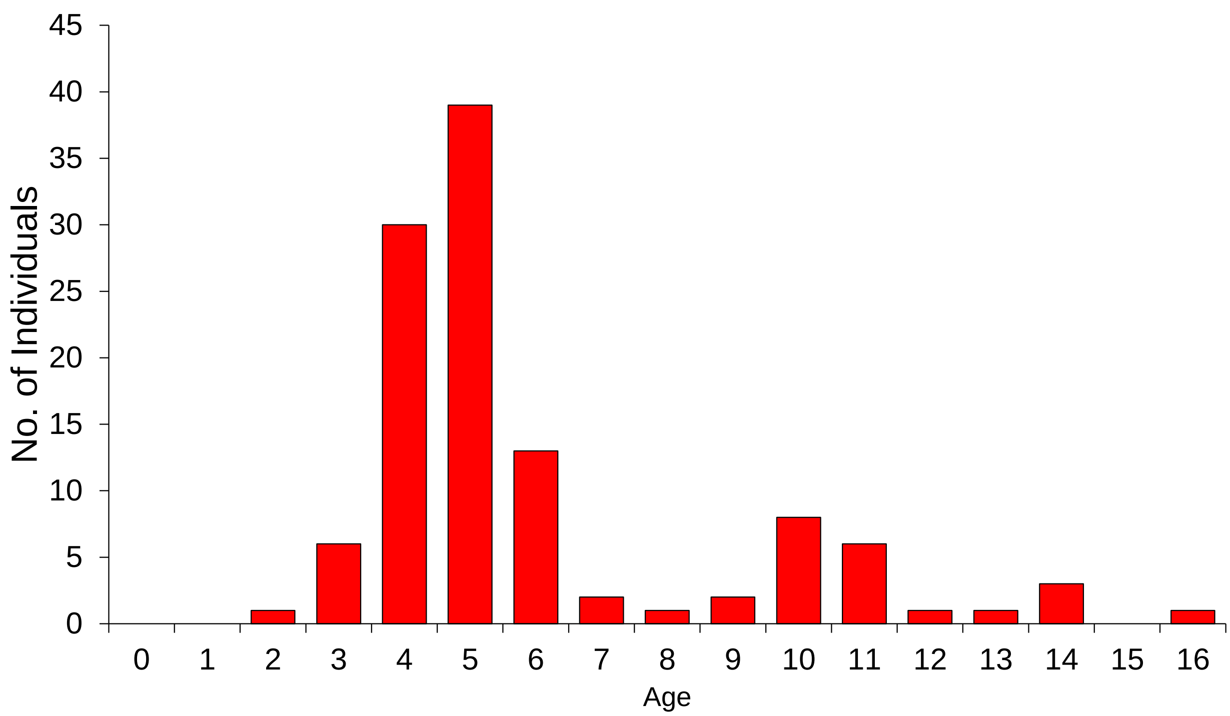


FIGURE 1.3.3. Age distribution of burbot caught in the Coldwater Assessment Survey in eastern Lake Erie, 2024 (N=114).

The annual mean age of burbot in the Coldwater Assessment has been erratic but has generally been decreasing, from a high of 14.3 in 2013. In 2024 mean age was 6.0 years, up slightly from 5.7 years in 2023 and down notably from 2020 (9.2 years) and 2019 (12.1 years) (Figure 1.3.4). The 2024 mean age was similar to that observed during the early 2000s, when overall CWA burbot catch rates were at a high point in the survey time series (Figure 1.3.4).

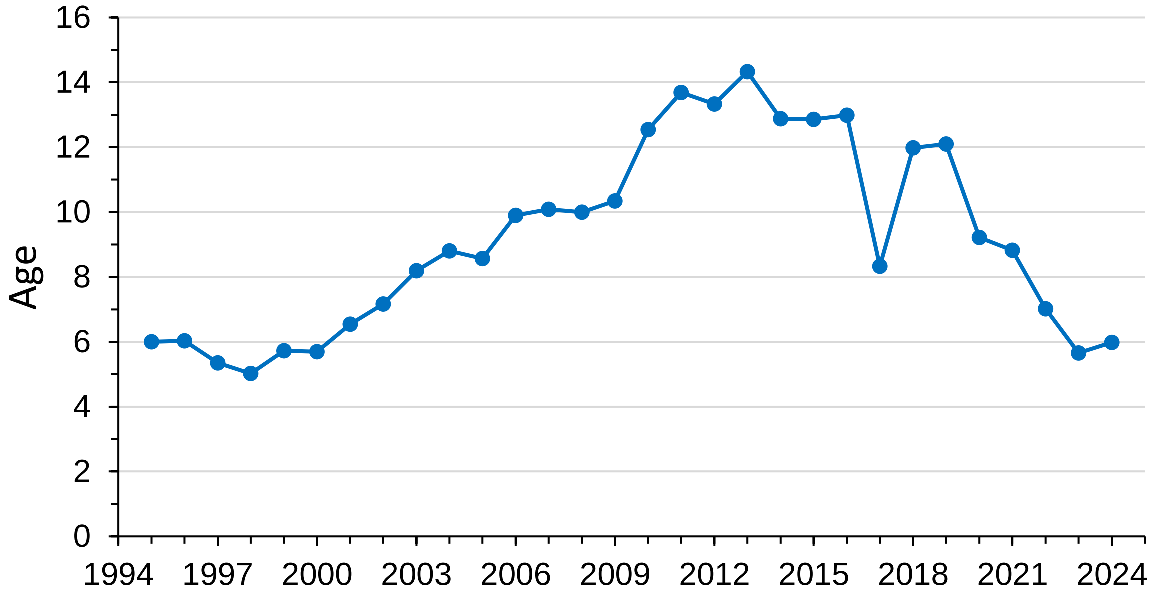


FIGURE 1.3.4. Mean age of burbot caught in the interagency Coldwater Assessment Survey in eastern Lake Erie from 1997–2024.

Diet

Diet information was collected for burbot caught in the 2024 CWA Survey. Analysis of the contents of non-empty stomachs (N=94, Figure 1.3.5) revealed a diet made up mainly of fish, but with some contribution from invertebrates. Burbot diets were dominated by rainbow smelt, (observed in 38% of non-empty stomachs), followed by round goby (in 36% of non-empty stomachs). This indication of similar use of both species in 2024 is rare. Relative contributions from round goby and rainbow smelt tend to fluctuate, relative to each other, from year to year. Nineteen percent of stomachs had fish that were not identifiable. The diet category of “Other” has variously included such species as gizzard shad and alewife. No gizzard shad, observed frequently in past years, were identified in 2024, however alewife were present in 9% of the non-empty stomachs, coincident with uncommonly frequent observations of alewife in several forage fish surveys conducted in 2024. Invertebrate prey included: Dreissenid mussels (2% of non-empty stomachs) and Cladocerans (1% of non-empty stomachs).

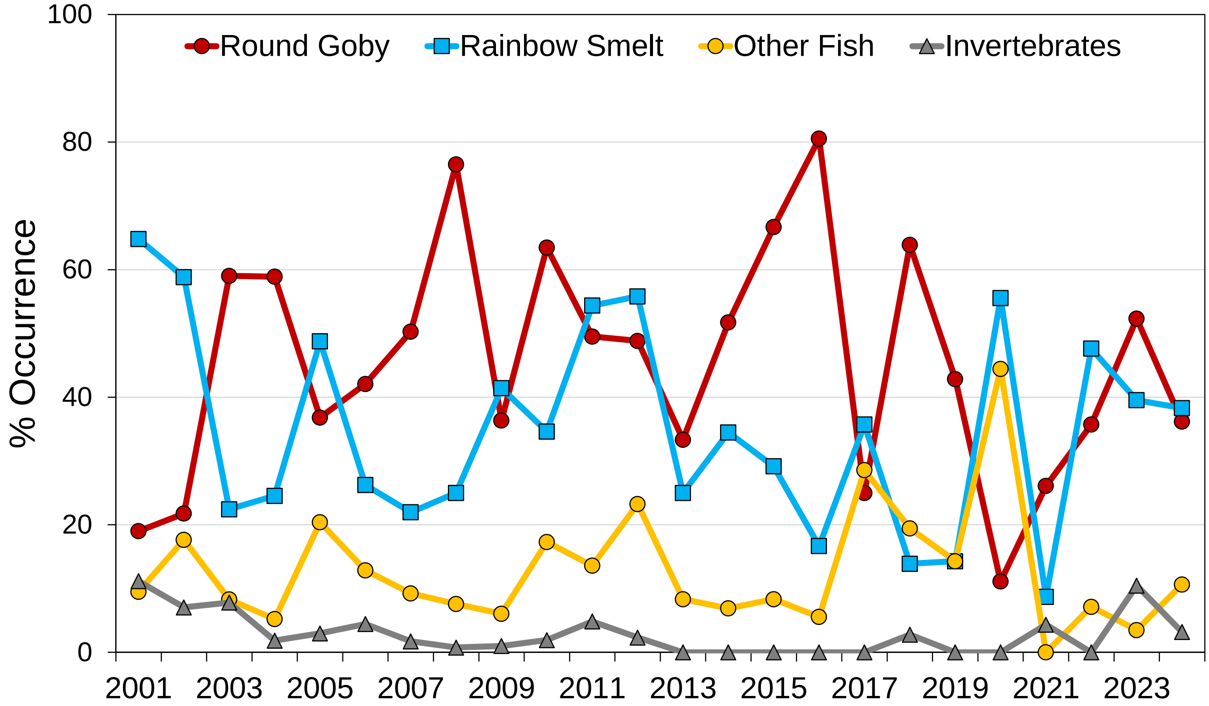


FIGURE 1.3.5: Frequency of occurrence of rainbow smelt, round goby, other fish, and invertebrates in the diet of burbot caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, 2001-2024.

1.4 Report on Rainbow Trout / Steelhead

Pascal Wilkins (NYSDEC), Carey Knight, Amanda Popovich (ODNR), Andy Cook (OMNR), Mark Haffley (PFBC)

Tributary Angler Surveys

The best available measures of the status of the Lake Erie steelhead population are provided through comprehensive tributary angler surveys that obtain measures of fishery performance (i.e., catch rates) and angler use. As such, the Lake Erie Fish Community Objectives (Francis et al. 2020) established a catch rate goal of 0.25 fish/angler hour in suitable tributaries to assess status and fishery performance of steelhead.

Initial measures of the tributary fishery were conducted in the 1980's and showed average steelhead catch rates of 0.10 fish per angler hour (Figure 1.4.1). In 2003-04, the NYSDEC began conducting tributary angler surveys to monitor catch, effort, and harvest of the New York steelhead fishery. These surveys were initially conducted in consecutive years, and at regular intervals (3-4 years) since then. Coincidentally, the PFBC conducted a similar survey on their steelhead fishery in 2003-04, and ODNR on theirs in 2008-09, 2009-10, and 2023-24. Results of these surveys have varied over time, with high tributary catch rates that averaged 0.60 fish/angler hour in the mid-2000's, moderate catch rates (0.35 fish/hour) from 2009–2015, and high catch rates again from 2018–2022 (0.5 fish/hour). The most recent ODNR angler survey was the first year in a 2-season survey (2023-24 and 2024-25). Survey methods were refined from previous tributary surveys conducted by ODNR in 2008-09 and 2009-10. These adjustments allowed the 2023-24 survey results to be more comparable with angler surveys conducted on Ohio inland waters and with the NYSDEC tributary angler survey. Updates to survey methods include a reduction from 89 to 66 sample sites across the seven tributaries actively managed by ODNR for steelhead trout. These updated surveys are planned every 10 years. Results from the 2023-24 survey showed an average steelhead catch rate of 0.23 fish/hour that was near, but slightly below, the catch rate goal of 0.25 fish/hour.

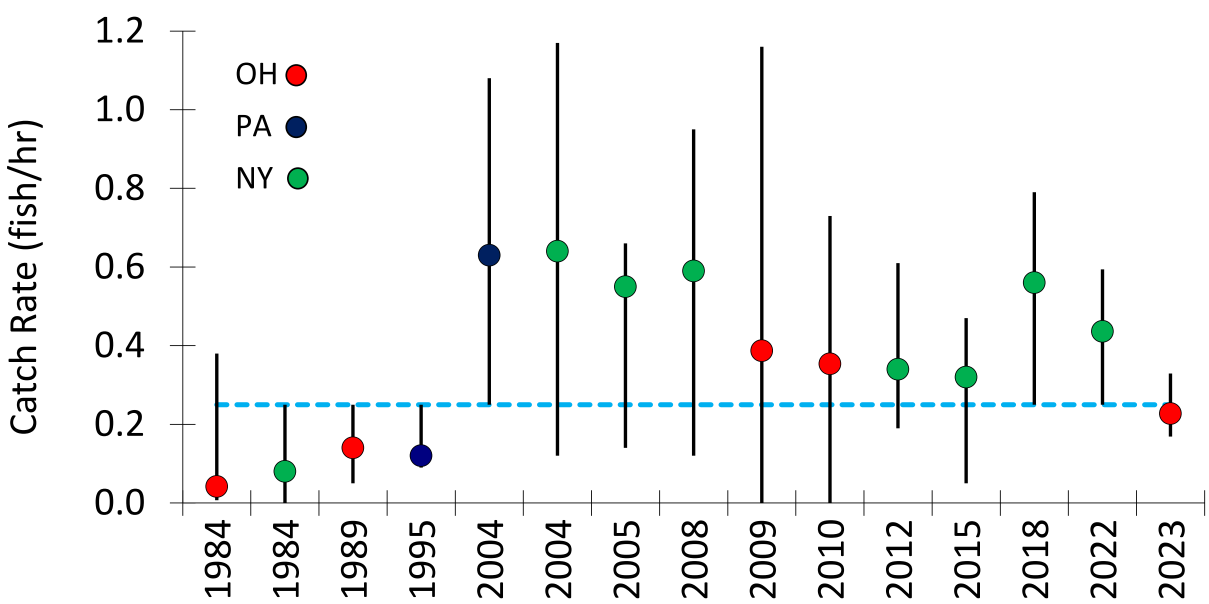


FIGURE 1.4.1. Targeted average steelhead catch rates (fish/angler hour) in Lake Erie tributary angler surveys by year and jurisdiction, 1984-2023. Vertical whiskers represent the range of individual tributary catch rates in the survey year. Dotted blue line is the fishery goal (0.25 fish/hr).

Exploitation

While steelhead harvest by boat anglers represents only a fraction of the total estimated harvest, it remains the only annual estimate of steelhead harvest tabulated by most Lake Erie agencies. These can provide some measure of the relative abundance of adult steelhead in Lake Erie. The 2024 estimated steelhead harvest from the summer open-water boat angler fishery totaled 26,637 fish across all US agencies as well as Ontario, a slight increase compared to 2023. The largest fraction of the harvest occurred in Ohio waters (14,839 fish ,56%), followed by Ontario (9,378 fish, 35%) with the remainder in Pennsylvania (2,039 fish,8%) and New York (378 fish ,1%). Open lake boat angler creel surveys have intermittently occurred in Ontario waters, and in 2024 their creel survey showed 9,378 steelhead harvested in the open lake with a catch rate of 0.11 fish/rod hour.

TABLE 1.4.1. Estimated harvest by open lake boat anglers in Lake Erie, 1999-2024.

Year	Ohio	Pennsylvania	New York	Ontario	Michigan	Total
1999	20,396	7,401	1,000	13,000	76	41,873
2000	33,524	11,011	1,000	28,200	532	74,267
2001	29,243	7,053	940	15,900	0	53,136
2002	41,357	5,229	1,600	75,000	39	123,225
2003	21,571	1,717	400	N/A*	18	23,706
2004	10,092	2,869	896	18,148	0	32,005
2005	10,364	2,333	594	N/A*	19	13,310
2006	5,343	1,876	354	N/A*	0	7,573
2007	19,216	5,075	1,465	N/A*	63	25,819
2008	3,656	1,156	647	N/A*	39	5,498
2009	7,662	758	96	N/A*	149	8,665
2010	3,911	4,865	109	N/A*	0	8,885
2011	2,996	1,718	92	N/A*	16	4,822
2012	6,865	2,809	374	N/A*	8	10,056
2013	3,337	1,510	482	N/A*	52	5,381
2014	3,516	2,627	419	4,165	6	10,733
2015	4,622	1,596	673	N/A*	6	6,897
2016	3,577	1,380	452	N/A*	0	5,409
2017	6,804	1,682	516	N/A*	60	9,062
2018	5,330	830	783	N/A*	49	6,992
2019	2,887	1,719	224	N/A*	59	4,889
2020	N/A**	3,584	316	N/A*	19	3,919
2021	20,991	1,893	104	N/A*	37	23,025
2022	22,042	905	251	N/A*	3	23,201
2023	11,763	1,204	545	N/A*	0	13,512
2024	14,839	2,039	378	9,378	3	26,637
mean	12,636	2,955	566	23,399	48	22,019

*no creel data collected by OMNRF in 2003, 2005-2013, 2015-2023. **No creel data available due to COVID 19

Abundance Indices

A change in the eastern Lake Erie Partnership Survey design was implemented in 2024. Index gillnet effort was reallocated to depths ≤30 m with the third gangs of index nets no longer fished in the thermocline. With only standard canned and bottom nets fished in the east basin survey, steelhead catch rates no longer provide a reliable measure of abundance. In 2024, three steelhead were caught in the east basin survey. In the future, steelhead results from this survey will no longer be presented in the report.

CHARGE 2: Continue to participate in the IMSL process on Lake Erie to outline and prescribe the needs of the Lake Erie sea lamprey management program

Chris Eilers (USFWS), Lexi Sumner (DFO), Pascal Wilkins (NYSDEC), and Andy Cook (OMNR)

The Great Lakes Fishery Commission and its control agents (U.S. Fish and Wildlife Service and Fisheries and Oceans, Canada) continue to apply the Integrated Management of Sea Lamprey (IMSL) program in Lake Erie including selection of streams for lampricide treatment and implementation of alternative control methods. The Lake Erie Coldwater Task Group has provided the forum for the assemblage of sea lamprey wounding data used to evaluate and guide actions related to managing sea lamprey and for the discussion of ongoing sea lamprey and fishery management actions that impact the Lake Erie fish community.

Lake Trout Wounding Rates

A total of 37 A1-A3 wounds were found on 235 lake trout greater than 532 mm (21 inches) total length in 2024 during Coldwater Assessment Survey gillnetting, equaling a wounding rate of 15.7 wounds per 100 fish (Table 2.1; Figure 2.1). This was above the target rate of 5.0 wounds per 100 fish. Large lake trout continue to be the preferred targets for sea lamprey; lake trout greater than 736 mm (29 inches) accounted for all but one of the fresh A1-A3 wounds (24.7 wounds/100 fish) in 2024 (Table 2.1). Small lake trout less than 532 mm (21 inches) are rarely attacked when larger lake trout are available.

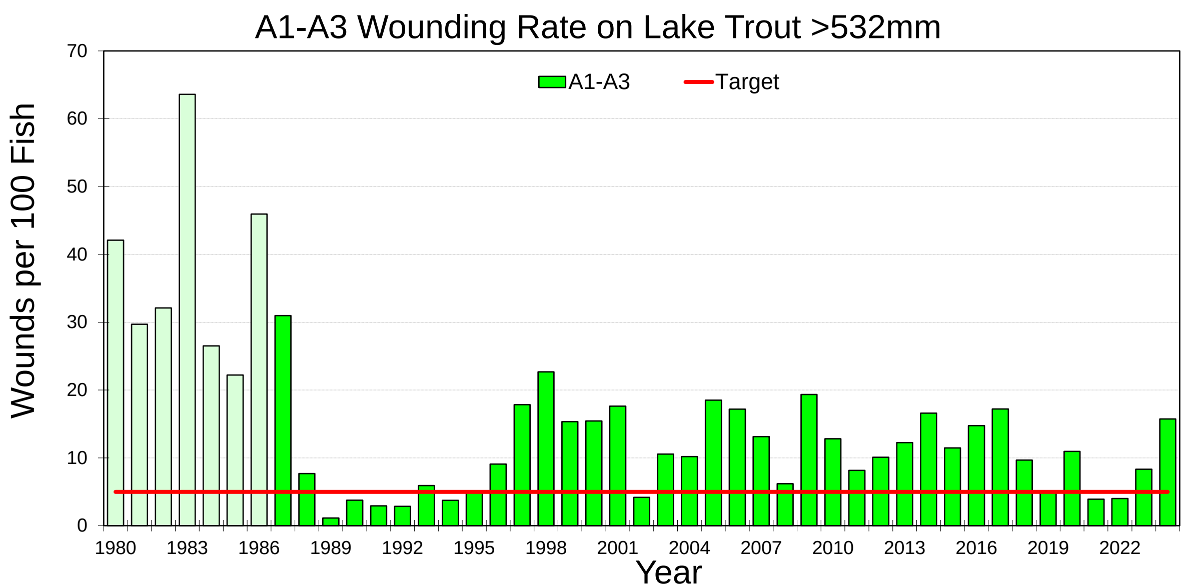


FIGURE 2.1. Number of fresh (A1-A3) sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gillnets in the eastern basin of Lake Erie, August-September, 1980-2024. The target rate (red solid line) is 5.0 wounds per 100 fish. Lighter shading indicates pre-treatment years.

TABLE 2.1. Frequency of sea lamprey wounds observed on standard length groups of lake trout collected from assessment gillnets in the eastern basin of Lake Erie, August, 2024.

Size Class Total Length (mm)	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
432–532	14	0	0	0	0	0.0	0.0
533–634	53	0	0	0	1	0.0	1.9
635–736	36	0	0	1	2	2.8	5.6
>736	146	2	5	29	106	24.7	72.6
>532	235	2	5	30	109	15.7	46.4

Finger Lakes (FL) and Lake Champlain (LC) were the most sampled lake trout strains in 2024, and they accounted for thirty-two of the 37 (86%) fresh (A1-A3) and the majority of the healed (A4) sea lamprey wounds (Table 2.2). Wounding rates have typically been similar between these two strains in recent years. The Slate Island strain accounted for one fresh and three healed wound on a low sample size of only thirty fish. This strain typically has higher wounding rates compared to the FL and LC strains. Sample sizes on all other known strains Michipicoten (MIC), and Klondike (KL)) were too low (N≤4) to provide meaningful measures of wounding. Lake trout that could not be assigned a strain (i.e., no tag or clip present) accounted for a substantial portion (11% fresh; 9% healed) of the wounding for the fourth consecutive year.

TABLE 2.2. Frequency of sea lamprey wounds observed on lake trout greater than 532 mm (21 inches), by strain, collected from assessment gillnets in the eastern basin of Lake Erie, August, 2024. SI=Slate Island, FL=Finger Lakes, LC=Lake Champlain, MIC= Michipicoten, KL=Klondike.

Lake Trout Strain	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
FL	83	1	3	12	45	19.3	54.2
KL	2	0	0	0	6	0.0	300.0
SI	30	0	0	1	3	3.3	10.0
LC	75	1	2	13	45	21.3	60.0
MIC	1	0	0	0	0	0.0	0.0
Unknown	44	0	0	4	10	9.1	22.7

Burbot Wounding Rates

The burbot population, once the most prevalent cold-water predator in the eastern basin of Lake Erie, has declined over 95% (in relative abundance) since 2004 (see Charge 1). Coincidentally, both A1-A3 and A4 wounding rates on burbot had increased since 2004 in eastern basin waters of Lake Erie but have declined in recent years coinciding with low adult burbot abundance (Figure 2.2). In 2024, there was no fresh (A1-A3) or healed (A4) wounds on the 105 burbot sampled greater than 532 mm (21 inches) during Coldwater Assessment Survey gillnetting. The low sample sizes on burbot in recent years most likely provide a poor metric for actual wounding.

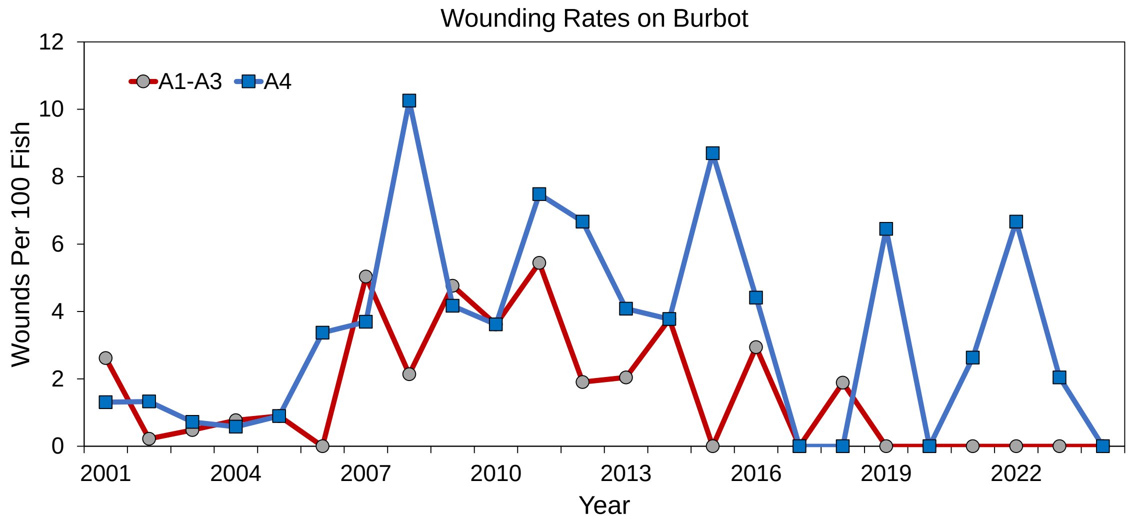


FIGURE 2.2. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot greater than 532 mm (21 inches) sampled in assessment gillnets in the eastern basin of Lake Erie, August, 2001–2024.

Lake Whitefish Wounding Rates

Reliable counts of sea lamprey wounds on lake whitefish have only been recorded since 2001. Wounds on lake whitefish were first observed in 2003, coincident with depressed adult lake trout abundance (see Charge 1) and have exhibited a general increasing trend until recently. A total of 72 lake whitefish greater than 532 mm (21 inches) were checked for evidence of sea lamprey attacks in 2024 assessment netting with no fresh A1-A3 or A4 wounds recorded (Figure 2.3). The low wounding rate on lake whitefish for the third consecutive year coincided with similar observations on burbot.

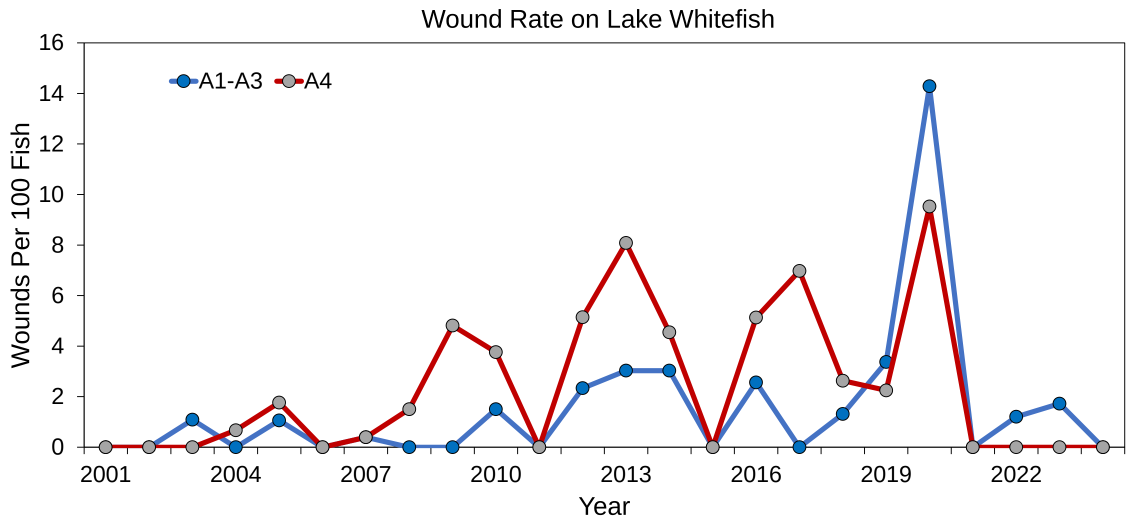


FIGURE 2.3. Number of A1-A3 and A4 sea lamprey wounds per 100 lake whitefish greater than 532 mm (21 inches) sampled in Coldwater Assessment gillnets in the eastern basin of Lake Erie, August, 2001–2024.

Ontario Partnership Program

The Ontario Partnership Index Fishing Program is an annual lake-wide gillnet survey of the Canadian waters of Lake Erie. Index gillnets were fished on bottom and suspended in the water column at 133 sites in 2024. Although sea lamprey wounds have been recorded on fish species since the survey began in 1989, detailed information on type and category of wound were not recorded until 2011.

In 2024, sea lamprey wounds and scars were not observed on any cold-water species such as lake trout, lake whitefish and burbot. All cold-water species caught were examined for lamprey wounds and scars in 2024. Lake-wide catches of lake trout, lake whitefish and burbot were 30, 33 and 26 respectively. One shorthead redhorse was observed with an A-1 wound in 2024. Only two shorthead redhorse were reportedly checked for wounds, although 120 fish were sampled in the lab. Two smallmouth bass exhibited one wound (A-1) and 3 B type scars. Although 100 smallmouth bass were reportedly checked for wounds, 126 fish were sampled in the lab. The spatial distribution of fish with sea lamprey wounds and scars in 2024 is shown in Figure 2.4. In 2024, 13,159 fish were examined for sea lamprey wounds and scars during Partnership Surveys.

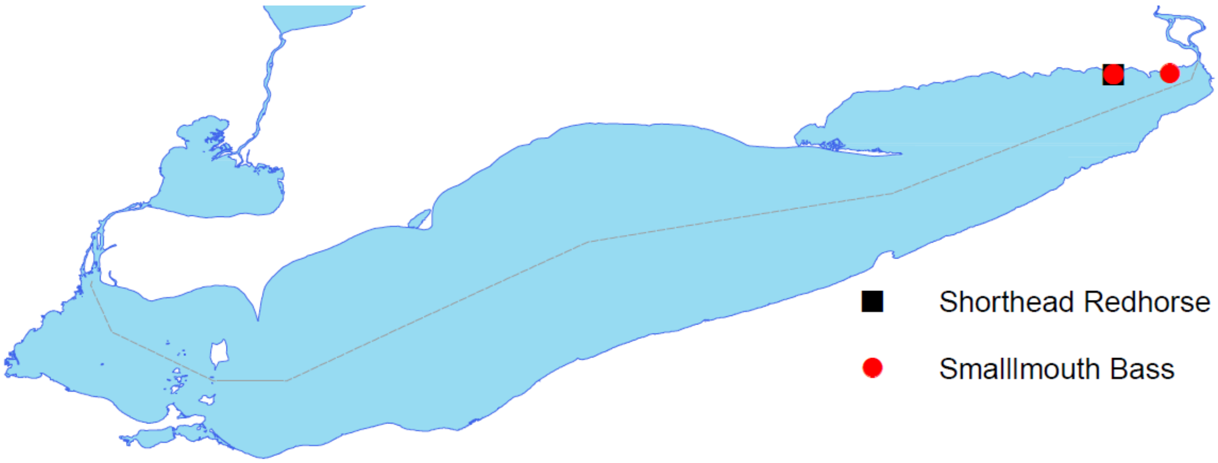


FIGURE 2.4. Individual fish with A1 and B-type scars observed during Lake Erie Partnership surveys in 2024. Two smallmouth bass exhibited one A1 wound and three B type scars. One shorthead redhorse had a single A1 wound in 2024.

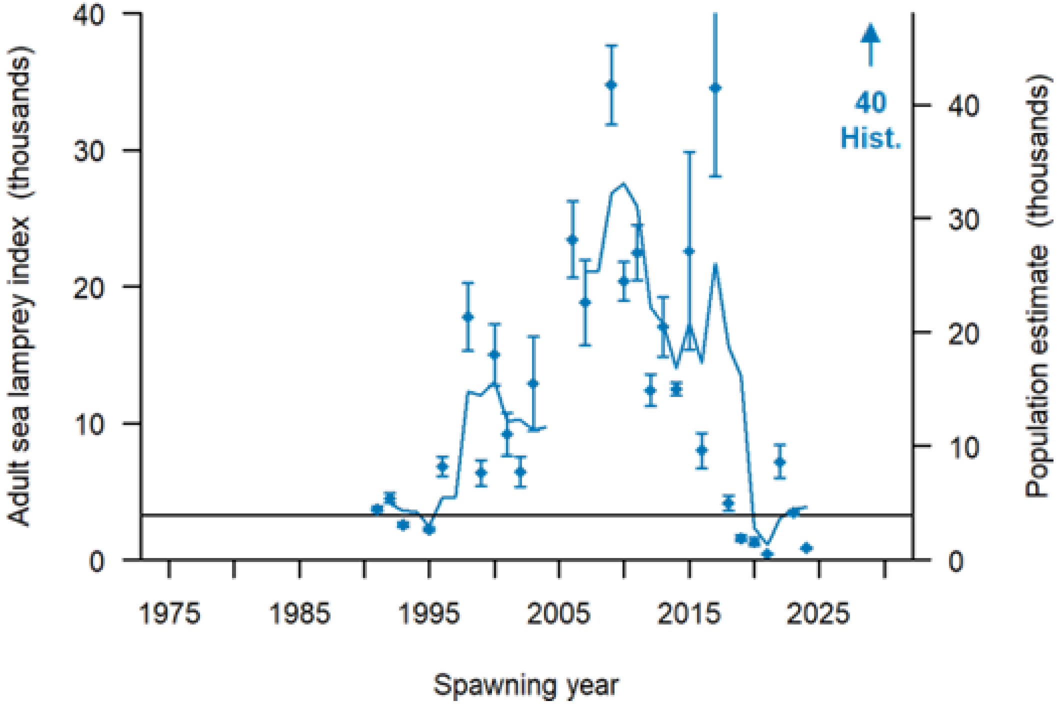


FIGURE 2.5. Index estimates with 95% confidence intervals (vertical bars) of adult sea lampreys, including historic pre-control abundance (as a population estimate) and the three-year moving average (line). The population estimate scale (right vertical axis) is based on the index-to-PE conversion factor of 1.2. The adult index in 2024 was 870 with 95% confidence interval (800-940). The three-year (2022-2024) average of 3,800 was above the target of 3,300. The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

Summary of 2024 actions for the integrated management of sea lampreys in Lake Erie

Adult Assessment

- Mark-recapture estimates were generated for 4 of the 5 index streams with population estimates modeled for Cattaraugus Creek. The 3-year average adult index exceeds the target (Figure 2.5).
- The 3-year average marking rate on lake trout (5.5 A1-A3 wounds/100 fish), which is the metric used by the GLFC to assess wounding trends, is just above target.

Lampricide Control

- Lampricide treatments were conducted in 1 tributary (0 Canada, 1 U.S.).

Larval Assessment

- Larval assessments were conducted in 55 tributaries (7 Canada, 48 U.S.).
- Detection surveys were conducted in 38 tributaries (1 Canada, 37 U.S.). No new infestations were detected.
- Post-treatment evaluation surveys were conducted in Conneaut Cr.; sea lamprey larvae were collected in the lowermost (deferred) reach.

- DFO completed 24 granular Bayluscide plots in Canadian and U.S. waters of the St. Clair R., sea lamprey were captured in 4 of the plots.

Barriers

- Clinton R. – Project partners completed a geomorphology study above Yates Mill Dam to guide stream channel modifications for resolving the formation of a bypass channel around this sea lamprey barrier. Stream channel realignment is the proposed solution for blocking the bypass channel and directing the river back over the barrier. Partners are working to acquire land adjacent to the barrier for construction and mitigation purposes.

- Grand R. – Harpersfield Dam was retrofitted with a second steel lip on the upper barrier step to remediate a nappe vibration that occurred under certain discharges. The Service is working with Stantec Engineering to identify a long-term solution to prevent any further deterioration of the structure.

- Huron R. – The engineering firm GEI has completed a feasibility study for the Flat Rock & Huroc dams fish passage project. The study has developed alternatives from repair to full removal of the dams. The Service and Commission are involved in design discussions to ensure effective sea lamprey blockage for each alternative.

- Conneaut Cr. – A feasibility study is approaching completion for a sea lamprey barrier construction project on the stream. Key landowners impacted by upstream inundation have rejected the barrier project. The focus may shift to repairing Bessemer Dam and using portable electrical barriers to prevent escapement into sensitive species areas.

- Field crews contacted owners of 52 sea lamprey barriers in the Lake Erie watershed during 2024. This outreach focused on confirming ownership and future intentions for each structure rather than structural deficiencies of the barriers themselves.

- The inflatable barrier at Big Cr. and the stop log barrier at Normandale Cr. went into operation in mid-March. All other barriers were maintained.

  The Big Otter Cr. barrier in Tillsonburg is under review for possible replacement. Feasibility and design studies were completed in 2018.

Risk Assessment

- The Upper Midwest Environmental Sciences Center (USGS) conducted tests to determine the toxicity of TFM to larval (glochidia) and juvenile life stages of the salamander mussel (*Simpsonaias ambigua*). Results are forthcoming.

- The Service's Genoa National Fish Hatchery is rearing salamander mussels to the adult life stage (~age 2). UMESC will test the adults during 2026 to determine sensitivity to TFM.

- The Risk Management Team participated with the Pennsylvania Department of Environmental Protection (PADEP) to conduct non-target mortality surveys in Pennsylvania waters before, during, and after the TFM treatment (April 24 - 28) of Conneaut Creek.

CHARGE 3: Maintain an annual interagency electronic database of Lake Erie salmonid stocking for the STC, GLFC, and Lake Erie agency data depositories

Pascal Wilkins (NYSDEC), Carey Knight, Amanda Popovich (ODNR), John Buszkiewicz (MDNR), Tom MacDougall (OMNR), Mark Haffley (PFBC)

Stocking Data Management

In addition to maintaining internal stocking data for Lake Erie, task group members upload all stocking events to the Great Lakes Fish Stocking Database (http://fsis.glfc.org/) to aid in the tracking of recoveries and returned tags and to support stocking coordination and outreach, throughout the Great Lakes.

Lake Trout Stocking

A total of 275,191 yearling lake trout were stocked into the eastern basin waters of Lake Erie in 2024, falling just short of the stocking goal of 280,000 yearlings (Figure 3.1). In US waters, the USFWS Allegheny National Fish Hatchery stocked a total of 195,686 yearlings split between Ohio (117,022 yearlings) and Pennsylvania (78,664 yearlings). These were a mix of Finger Lakes (Seneca; 57%) and Lake Champlain (43%) strains. No lake trout were stocked in New York waters in 2024 due to the new rotational stocking plan outlined in the revised Lake Trout Rehabilitation Plan (LEC 2021). In Ontario waters, a total of 79,505 yearlings were produced by OMNR Chatsworth Fish Culture Station and stocked at Tecumseh Reef. Ontario exclusively stocked a Lake Superior strain (Slate Island) through 2021. In keeping with the stocking strategy in the new lake trout rehabilitation plan (LEC, 2021), all Ontario fish stocked since 2021 have been a Finger Lakes strain (Seneca). (Figure 3.1).

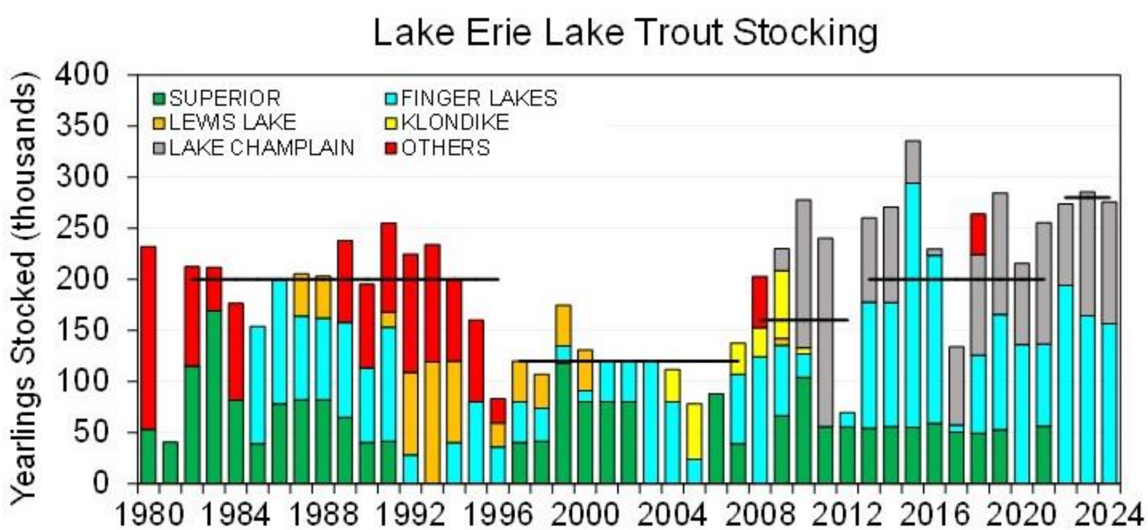


FIGURE 3.1. Lake trout (in yearling equivalents) stocked by all jurisdictions in Lake Erie, 1980-2024, by strain. Stocking goals through time are shown by black lines dark lines; the current stocking goal is 280,000 yearlings per year. Superior includes Superior, Apostle Island, Traverse Island, Slate Island, and Michipicoten strains; Others include Clearwater Lake, Lake Ontario, Lake Erie, and Lake Manitou strains.

Stocking of Other Salmonids

In 2024, over 2 million yearling trout were stocked in Lake Erie, including rainbow/steelhead trout (steelhead), brown trout and lake trout (Figure 3.2). Total 2024 salmonid stocking decreased 6.9% from 2023 and was 8.5% below the long-term average (1990-2023) of 2,209,664. Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 3.1 and are standardized to yearling equivalents.

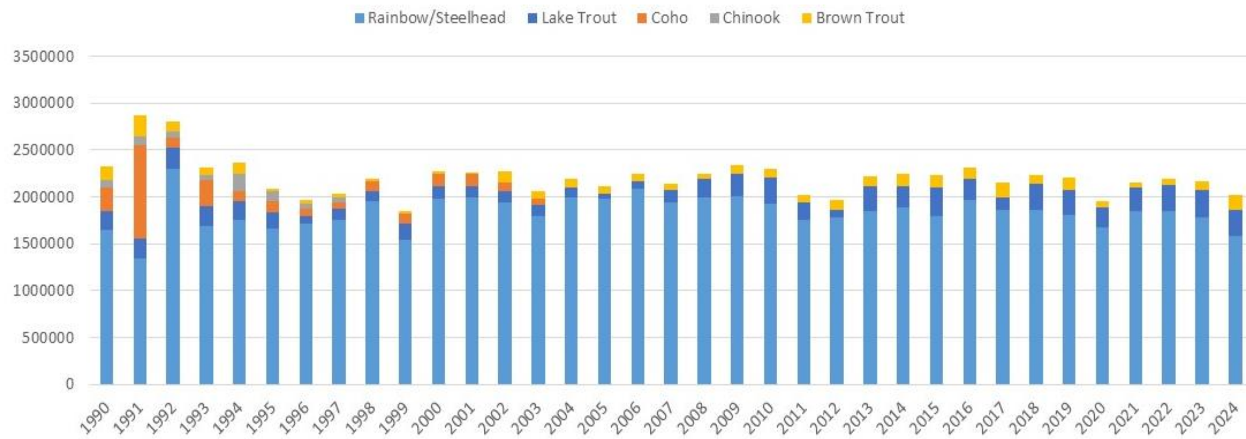


FIGURE 3.2. Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1990-2024.

All the US fisheries resource agencies and a few non-governmental organizations (NGO's) in Pennsylvania and Ontario currently stock steelhead in the Lake Erie watershed. A total of 1,582,152 yearling steelhead were stocked in 2024, accounting for 78% of all salmonids stocked. This was a 11% decrease from 2023 and slightly below the long-term (1990-2023) average annual stocking of 1,837,578 steelhead. This year Pennsylvania clipped roughly 100,000 Shasta strain rainbow trout to assess their contribution and to the fishery but looking at their return rates. Roughly half of all steelhead stocking occurred in Pennsylvania waters 51.6%, followed by 29.5% in Ohio waters, 13.6% in New York waters, 3.1% in Michigan waters, and 2% in Ontario waters. The NYSDEC stocked 165,104 yearling steelhead and 50,000 domestic rainbow trout in 2024, which in combination was above their stocking target of 192,500 yearlings. Steelhead stocking in Ohio was 16% above a target objective of 400,000 yearling steelhead while Pennsylvania steelhead stocking was down from a stocking objective of 1 million yearlings due to changes in hatchery rearing and facilities available to steelhead production. Stocking of rainbow trout in Ontario occurs in the central basin of the lake and is conducted by a local conservation club utilizing fertilized eggs provided by the OMNR fish culture section. The Ontario stocking in 2024 (32,992) was a significant decrease from the previous year (60,533). Details of stocking locations and numbers of fish per stream can be found in agency reports.

Brown trout stocking in Lake Erie totaled 163,394 yearling and adults in 2024, all in Pennsylvania waters to provide catchable trout for the opening of the 2024 Pennsylvania trout season as well as put, grow, and take fish for later stream returns which began in 2009. This was a significant increase from 2023 and a large increase in the long-term (1990-2021) average annual stocking of 87,519 brown trout. Brown trout stocking levels for catchable trout are expected to continue at the current rates in Pennsylvania.

TABLE 3.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2024

YEAR	Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
1990	ONT					31,530	31,530
	NYS DEC	113,730	5,730	65,170	48,320	160,500	393,450
	PFBC	82,000	249,810	5,670	55,670	889,470	1,282,620
	ODNR					485,310	485,310
	MDNR				51,090	85,290	136,380
	1990 Total	**195,730**	**255,540**	**70,840**	**155,080**	**1,652,100**	**2,329,290**
1991	ONT					98,200	98,200
	NYS DEC	125,930	5,690	59,590	43,500	181,800	416,510
	PFBC	84,000	984,000	40,970	124,500	641,390	1,874,860
	ODNR					367,910	367,910
	MDNR				52,500	58,980	111,480
	1991 Total	**209,930**	**989,690**	**100,560**	**220,500**	**1,348,280**	**2,868,960**
1992	ONT					89,160	89,160
	NYS DEC	108,900	4,670	56,750	46,600	149,050	365,970
	PFBC	115,700	98,950	15,890	61,560	1,485,760	1,777,860
	ODNR					561,600	561,600
	MDNR					14,500	14,500
	1992 Total	**224,600**	**103,620**	**72,640**	**108,160**	**2,300,070**	**2,809,090**
1993	ONT				650	16,680	17,330
	NYS DEC	142,700		56,390	47,000	256,440	502,530
	PFBC	74,200	271,700		36,010	973,300	1,355,210
	ODNR					421,570	421,570
	MDNR					22,200	22,200
	1993 Total	**216,900**	**271,700**	**56,390**	**83,660**	**1,690,190**	**2,318,840**
1994	ONT					69,200	69,200
	NYS DEC	120,000		56,750		251,660	428,410
	PFBC	80,000	112,900	128,000	112,460	1,240,200	1,673,560
	ODNR					165,520	165,520
	MDNR					25,300	25,300
	1994 Total	**200,000**	**112,900**	**184,750**	**112,460**	**1,751,880**	**2,361,990**
1995	ONT					56,000	56,000
	NYS DEC	96,290		56,750		220,940	373,980
	PFBC	80,000	119,000	40,000	30,350	1,223,450	1,492,800
	ODNR					112,950	112,950
	MDNR					50,460	50,460
	1995 Total	**176,290**	**119,000**	**96,750**	**30,350**	**1,663,800**	**2,086,190**
1996	ONT					38,900	38,900
	NYS DEC	46,900		56,750		318,900	422,550
	PFBC	37,000	72,000		38,850	1,091,750	1,239,600
	ODNR					205,350	205,350
	MDNR					59,200	59,200
	1996 Total	**83,900**	**72,000**	**56,750**	**38,850**	**1,714,100**	**1,965,600**
1997	ONT				1,763	51,000	52,763
	NYS DEC	80,000		56,750		277,042	413,792
	PFBC	40,000	68,061		31,845	1,153,606	1,293,512
	ODNR					197,897	197,897
	MDNR					71,317	71,317
	1997 Total	**120,000**	**68,061**	**56,750**	**33,608**	**1,750,862**	**2,029,281**
1998	ONT					61,000	61,000
	NYS DEC	106,900				299,610	406,510
	PFBC		100,000		28,030	1,271,651	1,399,681
	ODNR					266,383	266,383
	MDNR					60,030	60,030
	1998 Total	**106,900**	**100,000**	**0**	**28,030**	**1,958,674**	**2,193,604**
1999	ONT					85,235	85,235
	NYS DEC	143,320				310,300	453,620
	PFBC	40,000	100,000		20,780	835,931	996,711
	ODNR					238,467	238,467
	MDNR					69,234	69,234
	1999 Total	**183,320**	**100,000**	**0**	**20,780**	**1,539,167**	**1,843,267**

TABLE 3.1. (Continued) Summary of salmonid stockings in number of yearling equivalents, 1990-2024.

YEAR	Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
2000	ONT					10,787	10,787
	NYS DEC	92,200				298,330	390,530
	PFBC	40,000	137,204		17,163	1,237,870	1,432,237
	ODNR					375,022	375,022
	MDNR					60,000	60,000
	2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**
2001	ONT				100	40,860	40,960
	NYS DEC	80,000				276,300	356,300
	PFBC	40,000	127,641		17,000	1,185,239	1,369,880
	ODNR					424,530	424,530
	MDNR					67,789	67,789
	2001 Total	**120,000**	**127,641**	**0**	**17,100**	**1,994,718**	**2,259,459**
2002	ONT				4,000	66,275	70,275
	NYS DEC	80,000			72,300	257,200	409,500
	PFBC	40,000	100,289		40,675	1,145,131	1,326,095
	ODNR					411,601	411,601
	MDNR					60,000	60,000
	2002 Total	**120,000**	**100,289**	**0**	**116,975**	**1,940,207**	**2,277,471**
2003	ONT				7,000	48,672	55,672
	NYS DEC	120,000			44,813	253,750	418,563
	PFBC		69,912		22,921	866,789	959,622
	ODNR					544,280	544,280
	MDNR					79,592	79,592
	2003 Total	**120,000**	**69,912**	**0**	**74,734**	**1,793,083**	**2,057,729**
2004	ONT					34,600	34,600
	NYS DEC	111,600			36,000	257,400	405,000
	PFBC				50,350	1,211,551	1,261,901
	ODNR					422,291	422,291
	MDNR					64,200	64,200
	2004 Total	**111,600**	**0**	**0**	**86,350**	**1,990,042**	**2,187,992**
2005	ONT					55,000	55,000
	NYS DEC	62,545			37,440	275,000	374,985
	PFBC				35,483	1,183,246	1,218,729
	ODNR					402,827	402,827
	MDNR					60,900	60,900
	2005 Total	**62,545**	**0**	**0**	**72,923**	**1,976,973**	**2,112,441**
2006	ONT	88,000			175	44,350	132,525
	NYS DEC				37,540	275,000	312,540
	PFBC				35,170	1,205,203	1,240,373
	ODNR					491,943	491,943
	MDNR					66,514	66,514
	2006 Total	**88,000**	**0**	**0**	**72,885**	**2,083,010**	**2,243,895**
2007	ONT					27,700	27,700
	NYS DEC	137,637			37,900	272,630	448,167
	PFBC				27,715	1,122,996	1,150,711
	ODNR					453,413	453,413
	MDNR					60,500	60,500
	2007 Total	**137,637**	**0**	**0**	**65,615**	**1,937,239**	**2,140,491**
2008	ONT	50,000				36,500	86,500
	NYS DEC	152,751			36,000	269,800	458,551
	PFBC				17,930	1,157,968	1,175,898
	ODNR					465,347	465,347
	MDNR					65,959	65,959
	2008 Total	**202,751**	**0**	**0**	**53,930**	**1,995,574**	**2,252,255**
2009	ONT	50,000				18,610	68,610
	NYS DEC	173,342			38,452	276,720	488,514
	PFBC	6,500			64,249	1,186,825	1,257,574
	ODNR					458,823	458,823
	MDNR					70,376	70,376
	2009 Total	**229,842**	**0**	**0**	**102,701**	**2,011,354**	**2,343,897**

TABLE 3.1. (Continued) Summary of salmonid stockings in number of yearling equivalents, 1990-2024.

YEAR	Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
2010	ONT	126,864				33,447	160,311
	NYS DEC	144,772			38,898	310,194	493,864
	PFBC	1,303			63,229	1,085,406	1,149,938
	ODNR					433,446	433,446
	MDNR					66,536	66,536
	2010 Total	**272,939**	**0**	**0**	**102,127**	**1,929,029**	**2,304,095**
2011	ONT					36,730	36,730
	NYS DEC	184,259			38,363	305,780	528,402
	PFBC				36,045	1,091,793	1,127,838
	ODNR					265,469	265,469
	MDNR					61,445	61,445
	2011 Total	**184,259**	**0**	**0**	**74,408**	**1,761,217**	**2,019,884**
2012	ONT	55,330				21,050	76,380
	NYS DEC				35,480	260,000	295,480
	PFBC				65,724	1,018,101	1,083,825
	ODNR	17,143				425,188	442,331
	MDNR					64,500	64,500
	2012 Total	**72,473**	**0**	**0**	**101,204**	**1,788,839**	**1,962,516**
2013	ONT	54,240				2,000	56,240
	NYS DEC	41,200			32,630	260,000	333,830
	PFBC	82,400			71,486	1,072,410	1,226,296
	ODNR	82,200				455,678	537,878
	MDNR					62,400	62,400
	2013 Total	**260,040**	**0**	**0**	**104,116**	**1,852,488**	**2,216,644**
2014	ONT	55,632				56,700	112,332
	NYS DEC	40,691			38,707	258,950	338,348
	PFBC	53,370			97,772	1,070,554	1,221,696
	ODNR	83,885				428,610	512,495
	MDNR					67,800	67,800
	2014 Total	**233,578**	**0**	**0**	**136,479**	**1,882,614**	**2,252,671**
2015	ONT	55,370				70,250	125,620
	NYS DEC	81,867			37,840	153,923	273,630
	PFBC	82,149			103,173	1,079,019	1,264,341
	ODNR	85,433				421,740	507,173
	MDNR					64,735	64,735
	2015 Total	**304,819**	**0**	**0**	**141,013**	**1,789,667**	**2,235,499**
2016	ONT	60,005				4,324	64,329
	NYS DEC	51,461			38,110	407,111	496,682
	PFBC	32,500			83,249	1,074,849	1,190,598
	ODNR	75,650				416,593	492,243
	MDNR					66,000	66,000
	2016 Total	**219,616**	**0**	**0**	**121,359**	**1,968,877**	**2,309,852**
2017	ONT	50,982				59,750	110,732
	NYS DEC	76,456			36,480	267,166	380,102
	PFBC				123,186	1,032,421	1,155,607
	ODNR					442,228	442,228
	MDNR					60,706	60,706
	2017 Total	**127,438**	**0**	**0**	**159,666**	**1,862,271**	**2,149,375**
2018	ONT	55,940				35,500	91,440
	NYS DEC	95,445				311,843	407,288
	PFBC	39,660			98,966	979,851	1,118,477
	ODNR	79,230				478,408	557,638
	MDNR					62,000	62,000
	2018 Total	**270,275**	**0**	**0**	**98,966**	**1,867,602**	**2,236,843**
2019	ONT	53,285					53,285
	NYS DEC	95,672				153,944	249,616
	PFBC	39,677			132,496	1,072,012	1,244,185
	ODNR	80,026				512,548	592,574
	MDNR					64,374	64,374
	2019 Total	**268,660**	**0**	**0**	**132,496**	**1,802,878**	**2,204,034**

TABLE 3.1. (Continued) Summary of salmonid stockings in number of yearling equivalents, 1990-2024.

YEAR	Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
2020	ONT						0
	NYS DEC	135,997				187,280	323,277
	PFBC	79,450			66,883	949,000	1,095,333
	ODNR					469,265	469,265
	MDNR					64,374	64,374
	2020 Total	**215,447**	**0**	**0**	**66,883**	**1,669,919**	**1,952,249**
2021	ONT	56,197				67,062	123,259
	NYS DEC					194,569	194,569
	PFBC	80,618			46,607	1,091,197	1,218,422
	ODNR	118,523				498,972	617,495
	MDNR						0
	2021 Total	**255,338**	**0**	**0**	**46,607**	**1,851,800**	**2,153,745**
2022	ONT	74,866				43,225	118,091
	NYS DEC	119,100				189,835	308,935
	PFBC				75,082	1,079,958	1,155,040
	ODNR	79,800				470,912	550,712
	MDNR					64,670	64,670
	2022 Total	**273,766**	**0**	**0**	**75,082**	**1,848,600**	**2,197,448**
2023	ONT	83,670				60,533	144,203
	NYS DEC	80,515				173,827	254,342
	PFBC	120,800			103,394	1,028,892	1,253,086
	ODNR					464,898	464,898
	MDNR					55,795	55,795
	2023 Total	**284,985**	**0**	**0**	**103,394**	**1,783,945**	**2,172,324**
2024	ONT	79,505				32,992	112,497
	NYS DEC					215,104	215,104
	PFBC	78,664			163,394	817,488	1,059,546
	ODNR	117,022				466,520	583,542
	MDNR					50,048	50,048
	2024 Total	275,191	0	0	163,394	1,582,152	2,020,737

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REFERENCES

Amidon, Z.J., S.S. Qian, R.L. DeBruyne, M.R. Dufour, C.M. Mayer, E.F. Roseman and A. Sakas. 2025. A Bayesian hierarchical model framework to create a relative cohort strength index for sparse catch data from bottom trawls [unpublished manuscript]. University of Toledo Lake Erie Center, Department of Environmental Sciences, 6200, Bayshore Rd., Oregon, OH 43616, USA.

Barber, J., M. Steeves 2020. Sea Lamprey Control in The Great Lakes 2020. Annual Report to The Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Barbiero, R. P., L. G. Rudstam, J. M. Watkins, and B. M. Lesht. 2019. A cross-lake comparison of crustacean zooplankton communities in the Laurentian Great Lakes, 1997–2016. JOURNAL OF GREAT LAKES RESEARCH 45(3):672-690.

Brown, T.A., Rudstam, L.G., Sethi, S.A., Ripple, P., Smith, J.B., Treska, T.J., Hessell, C., Olsen, E., He, J.X., Jonas, J.L., Rook, B.J., Blankenheim, J.E., Beech, S.J.H., Brown, E., Berglund, E.K., Cook, H.A., Dunlop, E.S., James, S., Pothoven, S.A., Amidon, Z.J., Sweka, J.A., Carl, D.D., Hansen, S.P., Bunnell, D.B., Weidel, B.C., and Honsey, A.E. 2024a. Reconstructing half a century of coregonine recruitment reveals species-specific dynamics and synchrony across the Laurentian Great Lakes. ICES Journal of Marine Science 82(2): fsae160. doi:10.1093/icesjms/fsae160.

Brown, T.A., Rudstam, L.G., Sethi, S.A., Hessell, C., Olsen, E., Jonas, J.L., Rook, B.J., Pothoven, S.A., Beech, S.J.H., Dunlop, E.S., James, S., Smith, J.B., Amidon, Z.J., Carl, D.D., Bunnell, D.B., Tingley, III, R.W., Weidel, B.C., and Honsey, A.E. 2024b. Synthesizing professional opinion of lake whitefish and cisco recruitment drivers across the Great Lakes. Laurentian 2024(01). doi:10.70227/glfc-laur20240101.

Bunnell, D.B., Ackiss, A.S., Alofs, K.M., Brant, C.O., Bronte, C.R., Claramunt, R.M., Dettmers, J.M., Honsey, A.E., Mandrak, N.E., Muir, A.M., Jr, V.J.S., Smith, D.R., Strach, R.M., Sweka, J.A., Weidel, B.C., Mattes, W.P., and Newman, K.R. 2023. A science and management partnership to restore coregonine diversity to the Laurentian Great Lakes. Environmental Reviews 31(4): 716–738. doi:10.1139/er-2022-0109.

Coldwater Task Group. 2023. 2022 Report of the Lake Erie Coldwater Task Group, March 2023. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Coldwater Task Group. 2022. 2020 Report of the Lake Erie Coldwater Task Group, March 2022. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Coldwater Task Group. 2020. 2019 Report of the Lake Erie Coldwater Task Group, March 2020. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Coldwater Task Group. 2018. MacDougall, T., J. Markham, Z. Biesinger, J. Braunscheidel, A. Cook, C. Eilers, R. Kraus, S. Marklevitz, C. Murray, M. Rogers, G. Steinhart, K. Tallon, J. Trumpickas, C. Vandergoot, J. Boase, P. Penton, M. Belore, M. Faust, T. Hartman, K. Soper, A. Gorman and R. Drouin. Charge 8. The current state of knowledge of Lake Whitefish populations in Lake Erie, including knowledge gaps, impediments, uncertainties, and recommendations for strategies to advise management. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Coldwater Task Group. 1997. 1996 Report of the Coldwater Task Group, March 1997. Presented to the Standing Technical Committee' Lake Erie Committee of the Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Cook, A., R. Kraus, M. Faust, J.D. Schmitt, A.L. Sakas, Y. Zhao and C.S. Vandergoot. 2023. Lake Erie Whitefish Mortality Estimation Using Acoustic Telemetry. Conference presentation abstract. In proceedings of the 66th Annual Conference on Great Lakes Research, convened by the International Association for Great Lakes Research (IAGLR), Toronto, Ontario, Canada, May 8-12, 2023.

DeBruyne, R.L, Z.A. Amidon, M. Angelosanto, E. Eberly, D. Gorsky. 2024. Broad scale community-level larval fish survey of southern Lake Erie. Aquatic Ecosystem Health & Management, 27(1): 98–115,

Dechtiar, A.O. and S. Nepszy 1988. Survey of selected parasite fauna of selected fish species from Lake Erie 1970-75. In Parasites of Fishes in the Canadian Waters of the Great Lakes. Great Lakes Fishery Commission Technical Report No. 51.

Edwards, W.H., M.A. Stapanian, A.T. Stoneman. 2011. Precision of Two Methods for Estimating Age from Burbot Otoliths. Journal of Applied Ichthyology 27 (Supplement 1): 43-48.

Eshenroder, R.L., Vecsei, P., Gorman, O.T., Yule, D., Pratt, T.C., Mandrak, N.E., Bunnell, D.B. and A.M. Muir. 2016. Ciscoes (*Coregonus*, subgenus *Leucichthys*) of the Laurentian Great Lakes and Lake Nipigon. Great Lakes Fisheries Commission Misc. Pub. 16-01.

Euclide,P.T., R. T. Kraus, A. Cook, J. L. Markham, J. D. Schmitt. 2022. Genome-wide genetic diversity may help identify fine-scale genetic structure among lake whitefish spawning groups in Lake Erie. Journal of Great Lakes Research,Volume 48, Issue 5. P 1298-1305, ISSN 0380-1330.

Francis, J., Hartman, T., Kuhn, K., Locke, B., and Robinson, J. 2020 [online]. Fish community objectives for the Lake Erie basin [online]. Available from www.glfc.org/pubs/FisheryMgmtDocs/Fmd20-01.pdf [accessed 26 March 2023.

Harrod, C. and D. Griffiths. 2005. *Ichthyocotylurus erraticus* (Digenea:Strigeidae): factors affecting infection intensity and the effects of infection on pollan (*Coregonus autumnalis*), a glacial relict fish. Parasitology. 131 511-519.

Kraus, R.T., H. Andrew Cook, M.D. Faust, J. D. Schmitt, M. D. Rowe, C.S. Vandergoot. 2023. Habitat selection of a migratory freshwater fish in response to seasonal hypoxia as revealed by acoustic telemetry, Journal of Great Lakes Research, https://doi.org/10.1016/j.jglr.2023.01.004.

Kraus, R.T., H.A. Cook, A. Sakas, T.M. MacDougall, M.D. Faust, J.D. Schmitt and C.S. Vandergoot. 2024. Risk of capture is modified by hypoxia and interjurisdictional migration of Lake Whitefish (Coregonus clupeaformis). Sci Rep 14, 18061. https://doi.org/10.1038/s41598-024-65147-5.

Kraus, R.T., Markham, J., Robinson, J., MacDougall, T., Faust, M.D., Schmitt, J.D., Vandergoot, C.S., McKenna Jr, J.E. and D. Gorsky. 2024. On the survival and habitat use of hatchery-reared cisco (*Coregonus artedi*) in Lake Erie. Journal of Great Lakes Research 50(3) p.102343.

Markham, J.L., J.M. Robinson, C.C. Wilson, C.S. Vandergoot, P.D. Wilkins, R.C. Zimar, and M.N. Cochrane. 2022. Evidence of lake trout (*Salvelinus namaycush*) natural reproduction in Lake Erie. Journal of Great Lakes Research, https://doi.org/10.1016/j.jglr.2022.09.013 OR 48:6, 1728-1734.

Muzzall, P.M. and Whelan, G. 2011. Parasites of Fish from the Great Lakes: A Synopsis and Review of the Literature, 1871-2010. Great Lakes Fish. Comm. Misc. Publ. 2011-01.

O'Donnell, D. R., R. Briland, R. R. Budnik, S. A. Ludsin, and J. M. Hood. 2023. Trends in Lake Erie zooplankton biomass and community structure during a 25-year period of rapid environmental change. JOURNAL OF GREAT LAKES RESEARCH 49(3):685-697.

Pauly, D. 1984. Fish population dynamics in tropical waters.: a manual for use with programmable calculators. ICLARM Studies and Reviews 8, 325 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Schmitt, J.D., Fischer, D.P., Kao, Y.C., Frey, A., Chalupniki, M., McKenna Jr, J.E., Phillips, K., DuFour, M.R., Kraus, R.T. and R.L. Eshenroder. 2024. Historical and morphological evidence for a remnant population of Lake Erie cisco *Coregonus artedi (albus)* in Crystal Lake, Pennsylvania. Journal of Great Lakes Research 50(5) p.102407.

Van Oosten, J. and R. Hile. 1947. Age and growth of the Lake Whitefish, *Coregonus clupeaformis* (Mitchill), in Lake Erie. Transactions of the American Fisheries Society 77: 178-249.