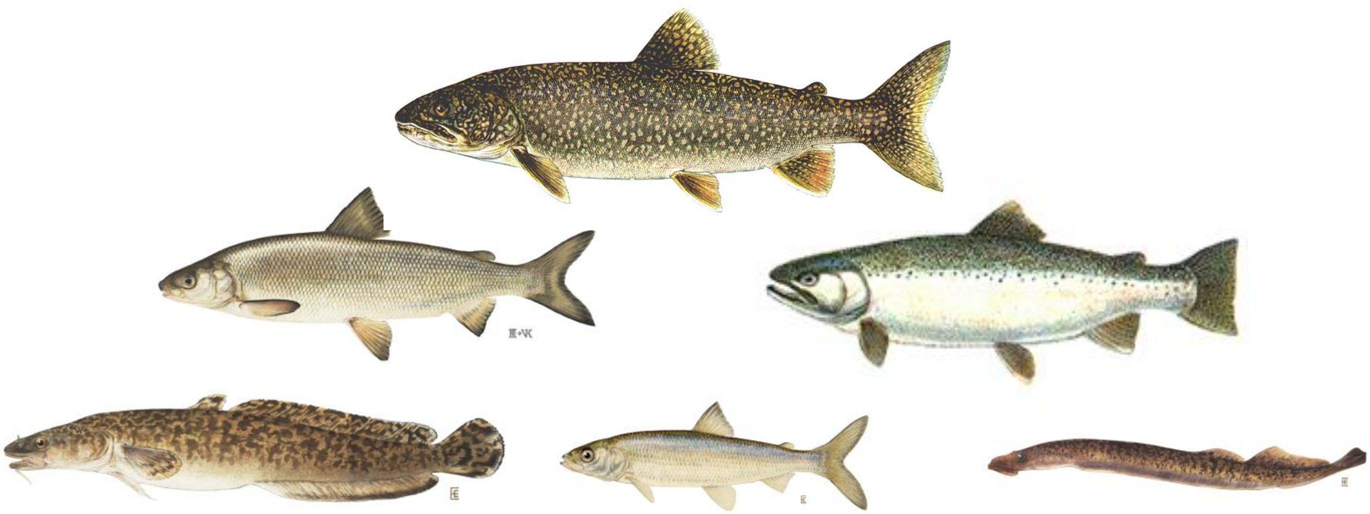
2023 REPORT OF THE LAKE ERIE COLDWATER TASK GROUP

March 2024

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



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COLDWATER TASK GROUP EXECUTIVE SUMMARY REPORT MARCH 2024

Lake Erie Committee

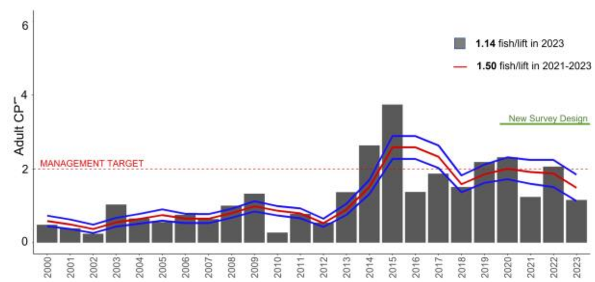
REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

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 2023-2024: (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.

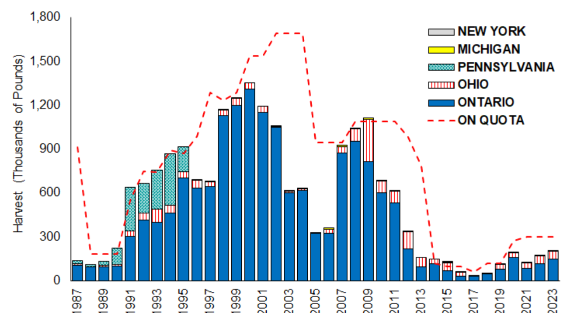
Lake Trout

A total of 274 lake trout were collected in the Coldwater Assessment Survey in 2023. Adult (age 5+) relative abundance in standard nets decreased to 1.1 fish per lift, below the target of 2.0 described in the 2021 Lake Trout Management Plan. There were 22 age classes and four strains captured in 2022. Lake trout ages 3, and 13 were the dominate cohorts. Ages 8, 11, 14, 15, 16 also contributed notably. Lake trout older than age-10 continue to increase in abundance and comprised 60% of the total catch. Finger Lakes and Lake Champlain strains comprised the majority of the population. The Partnership Survey caught 48 lake trout in 2023. The Partnership abundance in the east basin, 0.78 fish/lift increased from 2022 (0.37 fish/lift) and is above the time series mean (0.45 fish/lift).



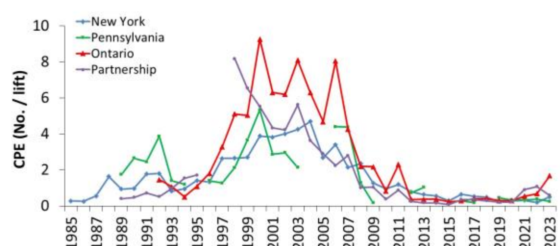
Lake Whitefish

Lake whitefish harvest in 2023 was 204,233 pounds, distributed between Ontario (73%), Ohio (27%), and Pennsylvania (<1%). Harvest increased 20% from 2022 and remains low compared to previous decades. Gill net fishery age composition ranged from ages 3 to 20 with ages 4, 5, and 8 representing the majority of the harvest. Relative to recent decades, lake whitefish survey and fishery status indicators in 2023 were moderate or better. Assessment surveys caught lake whitefish from ages 2 to 30, with age compositions that partially overlapped the 2023 gill net fishery. Bottom trawl and gill net survey indices forecast modest recruitment of age 3 lake whitefish in 2024 and 2025 with better recruitment expected in 2026.



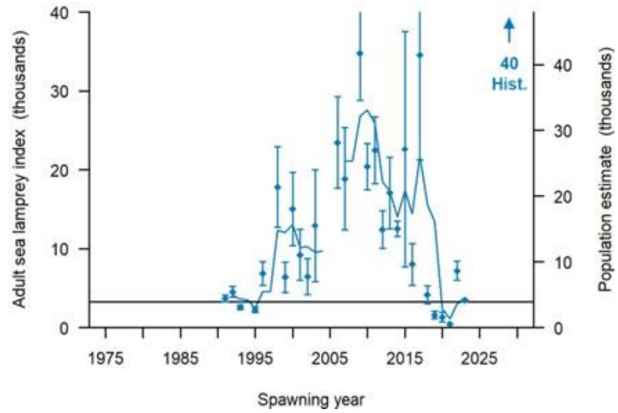
Burbot

Total commercial harvest of burbot in Lake Erie in 2023 was 3,416 pounds. All was incidental. Burbot abundance and biomass indices from annual assessment surveys remained at low levels, relative to the time series, however 2023 catch rates were elevated in some surveys. The burbot catch rate in the Interagency Coldwater Assessment Survey averaged 0.99 fish/lift, a decadal high while those in the Ontario Partnership Assessment Survey averaged 0.59 fish/lift. Burbot in the Coldwater Assessment Survey and Partnership ranged in age from 2 to 19 and the largest age class present was 4 year olds. Round goby was the dominant prey item in burbot diets.



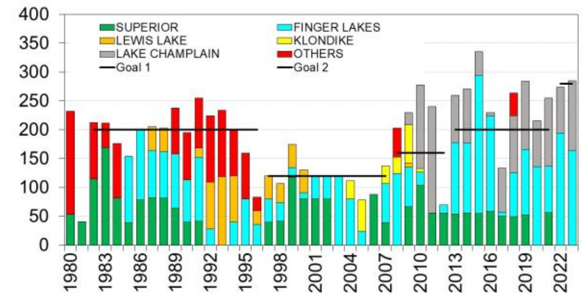
Sea Lamprey

The A1-A3 wounding rate on lake trout over 532 mm was 8.3 wounds per 100 fish in 2023. 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 (3,500) represents a decrease from last year however the three year average-index is above the target of 3,300. No lampricide treatments were completed in 2023 because larval assessments the previous season did not identify populations requiring immediate treatment. A new sea lamprey infestation was detected in the River Raisin.



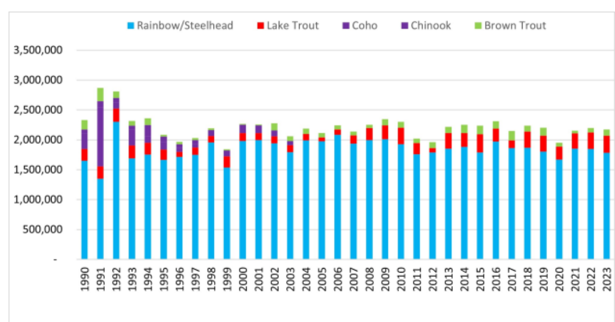
Lake Erie Salmonid Stocking

A total of 2,172,324 yearling salmonids were stocked in Lake Erie in 2023, which was slightly below the long-term average (1990-2022). Lake trout stocking finally met the 280,000 goal, and two different strains were stocked in 2023. By species, there were 284,985 yearling lake trout stocked in the east basin of Lake Erie, 103,394 brown trout stocked in Pennsylvania waters, and 1,783,945 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 2023 is: Pennsylvania (1,028,892; 57.7%), Ohio (464,898; 26%), New York (173,827; 9.7%), Ontario (60,533; 3.4%), and Michigan (55,795; 3%). Total steelhead stocking in 2023 (1.78 million) was below the long-term average. Annual stocking numbers have been consistently in the 1.7-2.0 million fish range since 1993. The summer open lake steelhead harvest was estimated at 13,512 steelhead across New York, Pennsylvania and Ohio and below the long-term average harvest of 23,503. Tributary angler surveys, representing 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. The Partnership index gill net catch rate for steelhead (0.03 fish/lift) was low relative to the 25-year time series (4th percentile).



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 MacDougal (OMNRF) Mark Haffley (PAFBC), Joe Schmitt (USGS), Andy Cook (OMNRF)

East Basin Coldwater Assessment Programs

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 gill nets 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 gill net 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 10ºC 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 2023 (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 during the fishing period.

To date, for the purposes of comparing relative abundance (CPE) of lake trout, burbot, and lake whitefish, over the complete Coldwater Assessment survey time series, only data from standard assessment nets (nets #1 and #3) are used. Catches since 2020 in offshore nets suggest that, for some species, incorporation of this additional data into abundance estimates may be prudent (see 1.2 adult lake trout abundance; below). As additional years off offshore data become available, the task group continues to explore its incorporation into status estimates. Currently, unless indicated, all metrics other than relative abundance use data from all collected fish 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 gill net 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 gill nets. 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.

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.

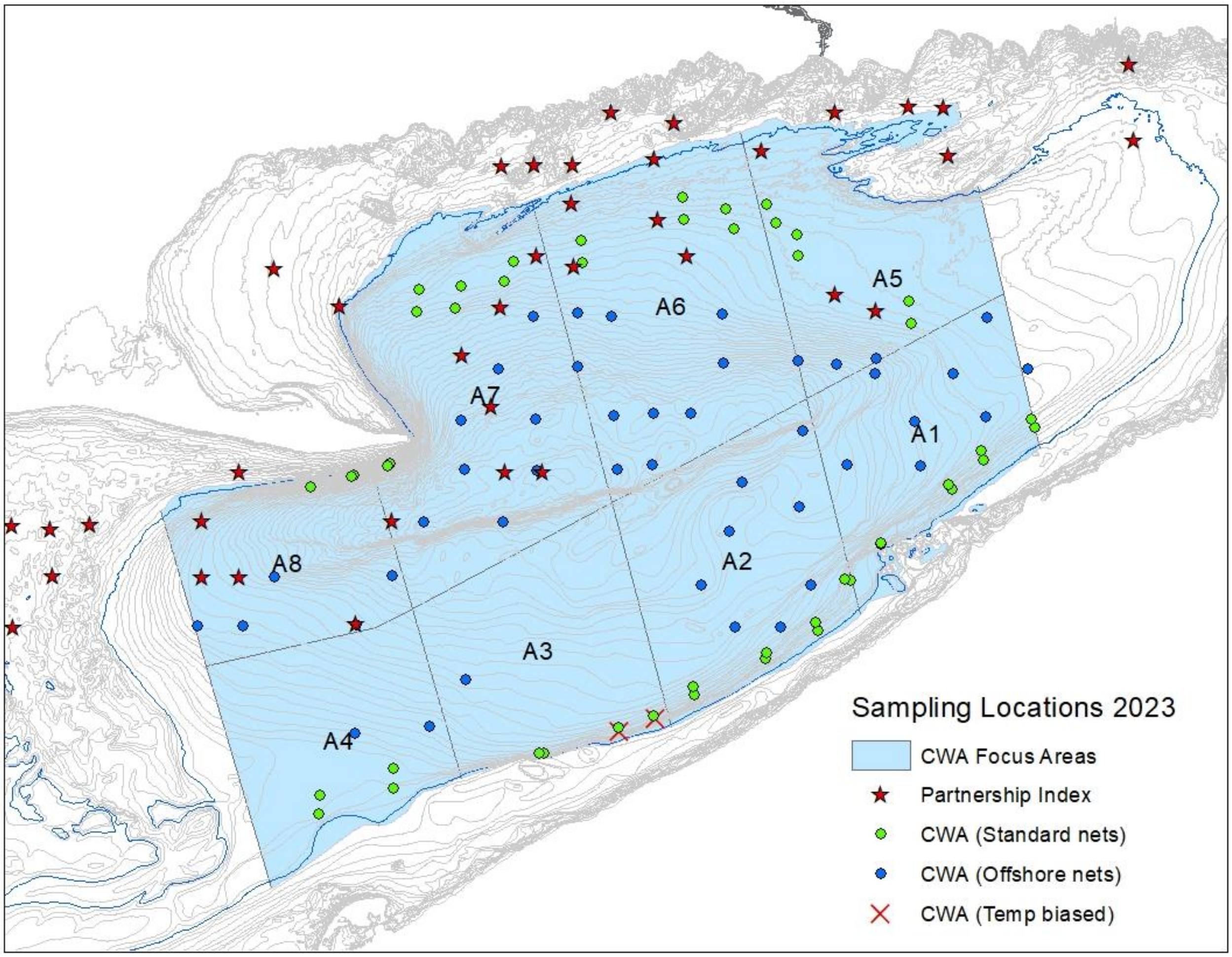


FIGURE 1. Locations of gillnets set for assessment of cold-water species during thermal stratification in the eastern basin of Lake Erie, 2023. Coldwater Assessment Survey sites are indicated with circles (green – standard sets; blue – offshore sets) within survey areas A1 -A8 (blue polygons bounded 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 (OMNRF), Brian Schmidt, Carey Knight (ODNR), Joe Schmidt (USGS), and Justin Chiotti (USFWS), Mark Haffley (PFBC), Tom MacDougall (OMNRF), Pascal Wilkins (DEC)

Commercial Harvest

The total harvest of lake whitefish in Lake Erie during 2023 was 204,233 pounds (Figure 1.1.1). Ontario accounted for 73% of the lake-wide total, harvesting 148,616 pounds, followed by Ohio (27%; 54,735 pounds) and Pennsylvania (882 lbs). New York and Michigan did not harvest Lake Whitefish in 2023 (Figure 1.1.2). Total lake whitefish harvest in 2023 increased 20% from 2022. Lake whitefish harvest in Ontario increased 27% from 2022 whereas Ohio's harvest increased by 3%. Lake whitefish harvest in Pennsylvania increased by 858 pounds from 2022.

Ontario's commercial fishers harvested 50% of quota (300,000 pounds) in 2023. Most (91%) of Ontario's 2023 Lake Whitefish harvest was from gill nets with 9% from commercial smelt trawls. The largest fraction of Ontario's whitefish harvest (71%) was caught in the west basin (Ontario-Erie statistical district OE-1) followed by OE-2 (16%) and OE-4 (10%), with the remaining harvest distributed eastward among statistical districts OE-3 (4%), and OE-5 (<1%; Figure 1.1.2). Maximum harvest in Ontario waters during 2023 was distributed west of Point Pelee and west of Pelee Island (Figure 1.1.2). Harvest in OE-1 from October to December represented 67% of Ontario's lake whitefish harvest. Peak harvests occurred in OE-1 during December (69,545 pounds), November (25,554 pounds) and in OE-2 during December (7,531 pounds) with 5% of OE-1 harvest occurring from January to May. Central basin lake whitefish harvest (OE2, OE3) was comparable during the first (13,977 lbs) and second (14,956 lbs) halves of the year. In eastern Lake Erie, 14,894 pounds of lake whitefish were landed in 2023 with 94% of harvest from commercial trawls and the remaining 6% from gill nets. There was no reported effort targeting lake whitefish during 2023 in Ontario waters of Lake Erie. Lake-wide, Ontario's lake whitefish harvest came from fisheries targeting walleye (86%), rainbow smelt (9%), white bass (3%), white perch (1%) and yellow perch (<1%). An additional 43 pounds were surrendered to MNRF that included tagged whitefish and whitefish used for genetic samples.

As there was no reported targeted gill net harvest or effort in 2023, 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) lacking 2014-2023 data, catch rates are presented based on all large mesh (>=76 mm or 3") gill net effort (kg/km) and large mesh gill net effort with lake whitefish in the catch (kg/km; the latter excludes zero catches). Catch rates based on all large mesh effort (3.7 kg/km) and effort with lake whitefish in the catch (8.44 kg/km) during 2023 increased by 41% and 1% from 2022, respectively. Harvest rate metrics in 2023 remained well below the time series averages (9.5 kg/km, 24.7 kg/km respectively) (1998-2023).

Lake whitefish harvest in Ohio waters during 2023 was exclusively from commercial trap nets. Ohio lake whitefish harvest in 2023 (54,735 pounds) was distributed among the west (O-1 97%) and central basin (O-2 2%; O-3 1 %). The majority (91%) of lake whitefish harvest in Ohio during 2023 was taken from grids 902, and 904 (red grids) with 5% from grid 802 (blue grid) (Figure 1.1.2). Lake whitefish were harvested from 1,511 trap net lifts (zero catches excluded) in 2023, with lifts distributed among District 1 (O-1) (73%), District 2 (O-2) (12%) and District 3 (O-3) (15%), respectively. Trap net harvest was greatest in November (82% or 44,735 lbs) followed by December (7,560 lbs or 14%) in O-1 and in O-2 during May (784 lbs or 1%). The trap net catch rate (36 lbs / lift) in 2023 was 3% above the 2022 level and exceeded the mean (30 lbs/lift 1996-2023) (Figure 1.1.4). Ohio trap net harvest was from gear targeting yellow perch and lake whitefish. Whitefish harvest in Pennsylvania waters was also from trap nets targeting yellow perch and lake whitefish (882 pounds). In Pennsylvania, lake whitefish were targeted in the deep channel south of Pennsylvania Ridge (Figure 1.1.2). Lake whitefish catch rates doubled in Pennsylvania waters during 2023 (52 lbs / lift) in comparison to 2022 (Figure 1.1.4).

Ontario's west basin fall whitefish harvest in 2023 was comprised of ages 3 to 20 with age 4 (2019 cohort), 5 (2018 cohort) and 8 (2015 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 2023. The landed value of whitefish in Ontario during 2023 was $279,380 or $1.88 / lb CDN. The landed weight of roe from Ontario's 2023 lake whitefish fishery was 730 pounds, collected from the west basin in November (85%) ,October (6%) and December (6%). The remaining 3% of roe came from OE-2 during November and December. The approximate landed value of the roe was $ 3,714 or $ 5.09 / lb CDN.

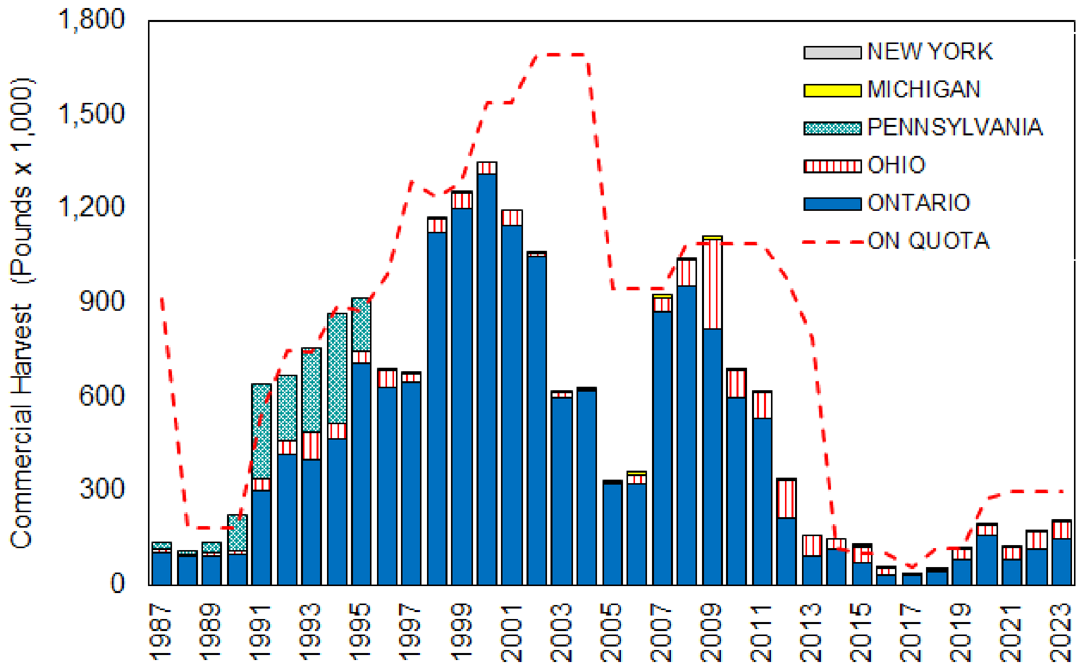


FIGURE 1.1.1. Lake whitefish total harvest from 1987-2023 by jurisdiction in Lake Erie. Pennsylvania ceased gill netting in 1996. Ontario quota is presented as a dashed line.

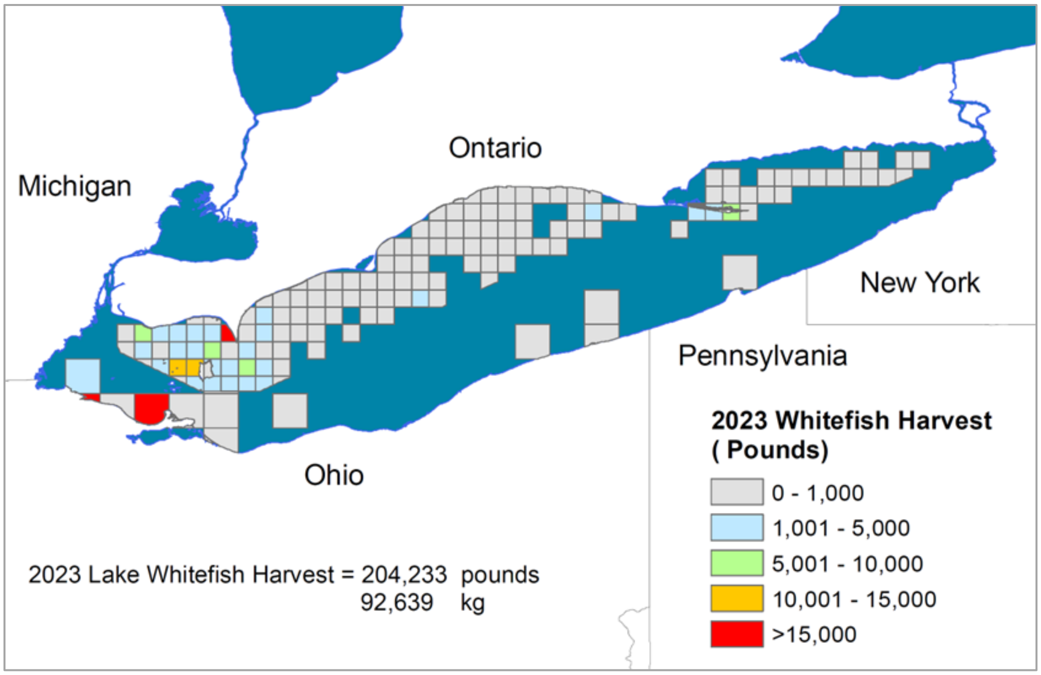


FIGURE 1.1.2. Commercial harvest of lake whitefish in Lake Erie during 2023 by 5-minute (Ontario) and 10-minute (U.S.) grids.

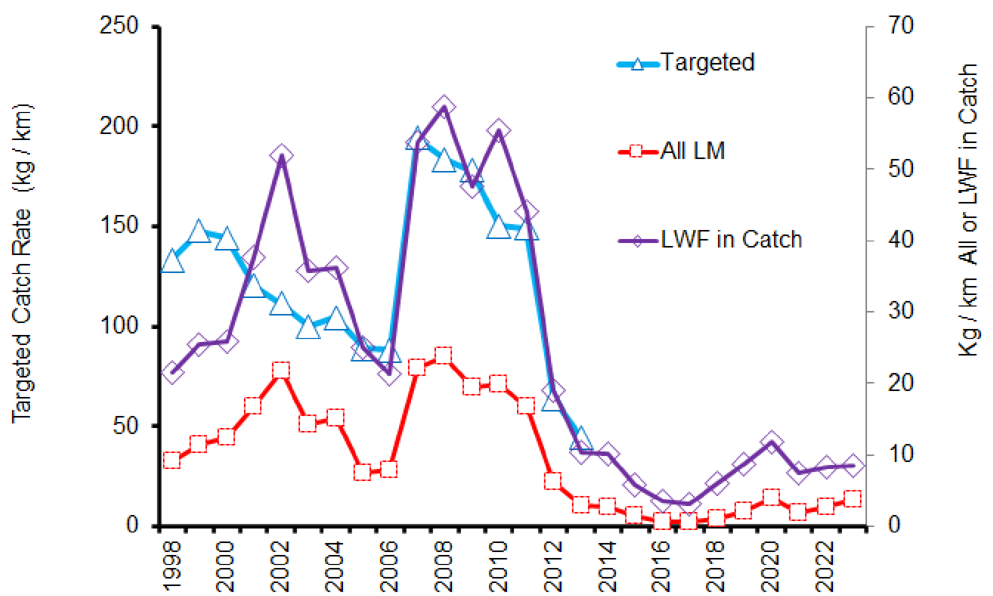


FIGURE 1.1.3. Lake-wide Ontario annual commercial large mesh gill net catch rates (1998-2023). Targeted Lake Whitefish catch rate (kg/km; left axis), catch rate relative to all large mesh gillnet fished (kg/km; right axis), and catch rates from large mesh effort with Lake Whitefish in the catch (kg/km; right axis). No targeted Lake Whitefish effort or harvest in 2014 - 2023

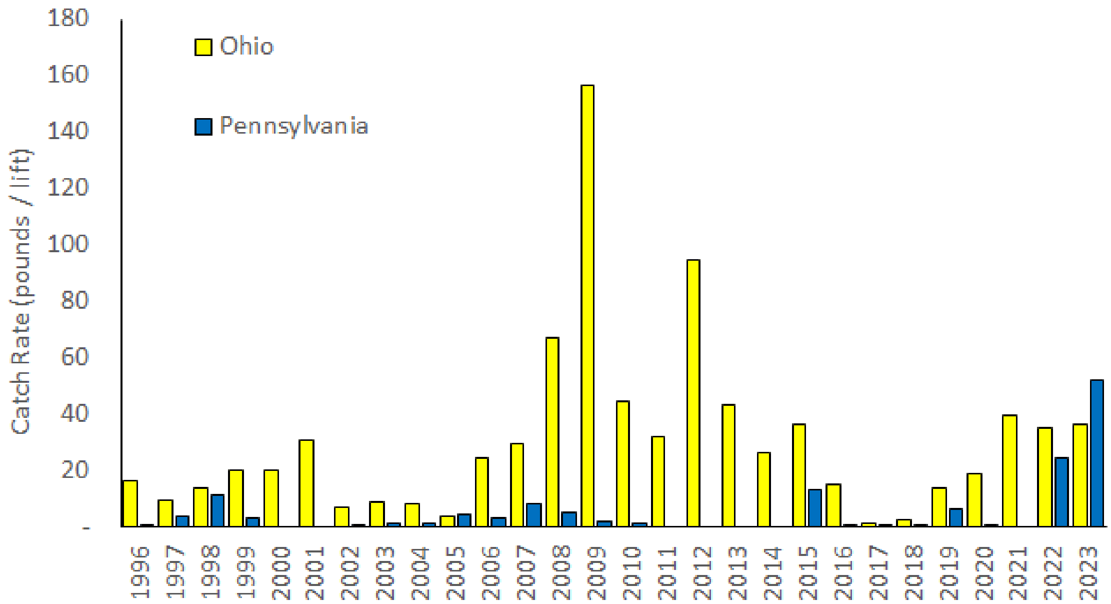


FIGURE 1.1.4. Lake whitefish commercial trap net catch rates in Ohio and Pennsylvania (pounds per lift), 1996-2023. Zero harvest for PA in 2011-2014, 2021. Trap nets are prohibited in eastern PA waters (YP MU4). Effort includes lifts with lake whitefish in the catch.

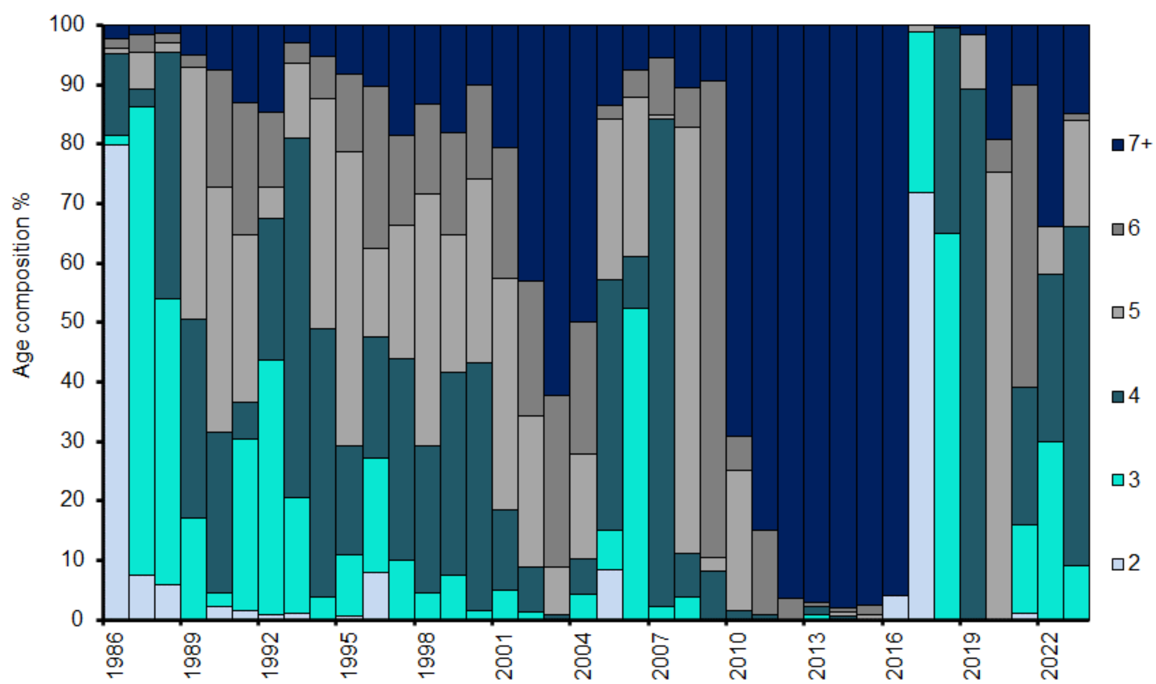


FIGURE 1.1.5. Ontario fall commercial lake whitefish harvest age composition in statistical district 1, 1986-2023, from effort with gill nets ≥3 inches, October to December. N=100 in 2023. Ages 7+ includes whitefish ages 7 and older.

Assessment Surveys

Gill net 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 basin, Pennsylvania Ridge and central basin. Partnership Survey catch rates were pooled despite differences in thermal stratification, and migratory behavior when east and central basin surveys occur. The necessity of combining the Partnership Surveys arises from variable, low catches observed among all basin-specific surveys. Partnership survey catch rates in 2023 were based on 111 sites with 222 gangs fished on bottom and at standard canned depths.

Lake whitefish catch rates in CWA nets fished on bottom at standard (thermocline interface) stations (48 lifts) during 2023 (1.44 fish/lift) decreased from 2022 (4.15 fish/lift) and was 58th percentile in the 39-year time series 1985-2023 (Figure 1.1.6). CWA catch rates by jurisdiction in 2023 were highest in New York (2.56 fish/lift), followed by Pennsylvania (1.00 fish/lift) and Ontario (0.86 fish/lift). Lake whitefish aged in CWA surveys ranged in age from 2 to 30 with ages 4 (18%) and 8 (18%) most abundant (Figure 1.1.7). Lake whitefish mean age in CWA was 9.4 in 2023.

Partnership Survey catch rates of lake whitefish ages 0 to 2 was 0.01 fish/lift in 2023, a decline from 2022 (0.03 fish/lift) (Figure 1.1.6). The catch rate for age-3 and older lake whitefish caught in 2023 Partnership Surveys was 0.35 fish/lift, up from 0.09 fish/lift in 2022 (Figure 1.1.6). A total of 79 lake whitefish were caught lake-wide with catches distributed among the east (70), Pennsylvania Ridge (2), east-central (3) and west-central (4) surveys. The age composition in Partnership surveys ranged from ages 2 to 20, dominated by age-4 (39%; 2019-year class), and age-8 (28%; 2015-year class) (Figure 1.1.7). Mean age in Partnership surveys in 2023 was 6.1.

Trawl surveys in Ohio waters of the central basin of Lake Erie (Ohio Districts 2 and 3 combined) encounter juvenile Lake Whitefish. June and October catch rates are presented in Figures 1.1.8 and 1.1.9 as indicators of year class strength. In 2023, the age 0 catch rate in the central basin was slightly above average in June (0.31/ ha) whereas age 0 whitefish were absent from October trawls (0 /ha) (Figure 1.1.8). New York's east basin age 0 lake whitefish trawl index (2.38/ha) in 2023 was 2nd highest in the 32 year time series (Figure 1.1.8).

Age 1 lake whitefish were caught at low densities (0.07 / ha,) during June whereas none were caught during October in Ohio bottom trawls (Figure 1.1.9). Pennsylvania's bottom trawl survey also caught age 1 lake whitefish in similar, low densities (0.08 / ha). During some years, lake whitefish were encountered in Ontario's deep, offshore fall bottom trawl assessment in Outer Long Point Bay, however, in 2023, juvenile lake whitefish were not caught in the Long Point Bay survey.

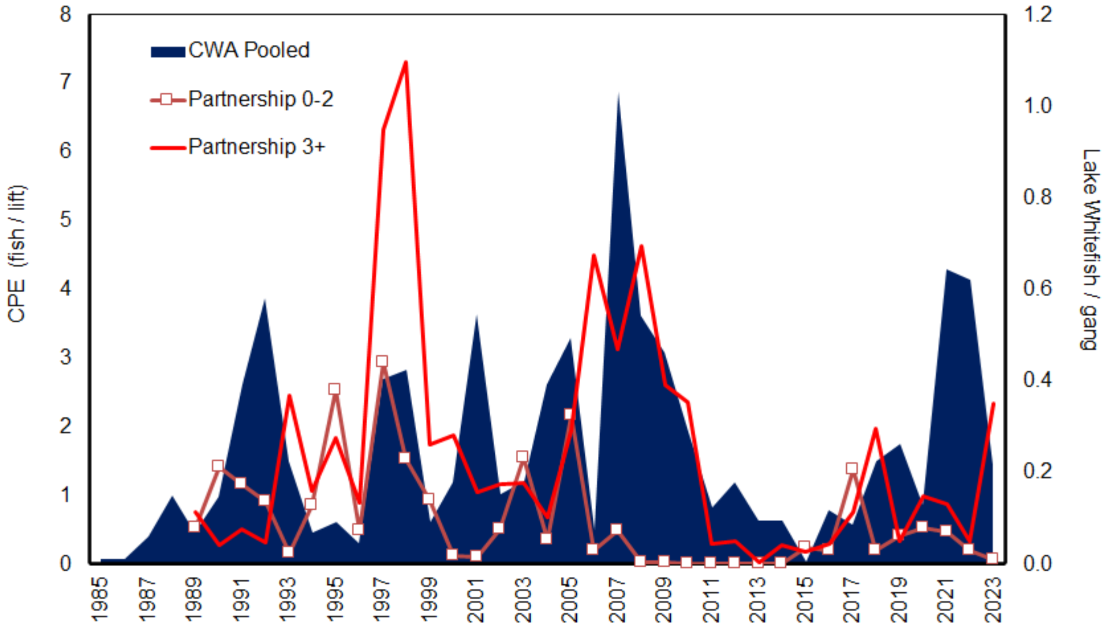


FIGURE 1.1.6. Catch per effort (number fish/lift) of lake whitefish caught in standard coldwater assessment gill nets (CWA) in New York, Pennsylvania, and Ontario waters, weighted by number of lifts (blue area). Partnership index catch rates (LWF/gang) for ages 0-2 (dots) and ages 3 and older (squares) (second axis).
FIGURE 1.1.7. Lake whitefish age composition in the cold water assessment (CWA) and partnership gill net surveys during 2023. Sample sizes were 85 and 79 respectively.

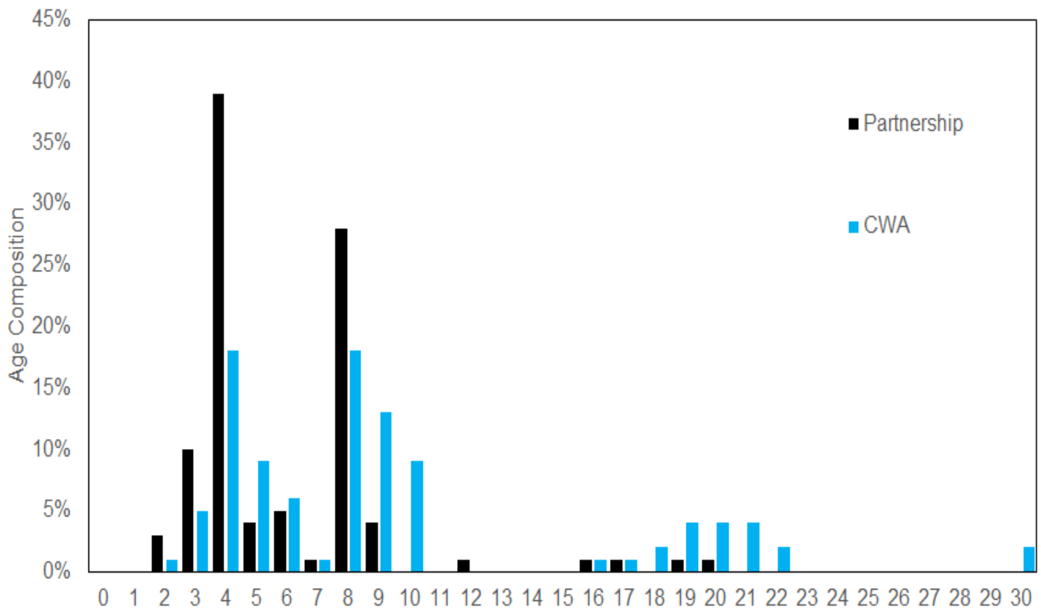


FIGURE 1.1.7. Lake whitefish age composition in the cold water assessment (CWA) and partnership gill net surveys during 2023. Sample sizes were 85 and 79 respectively.

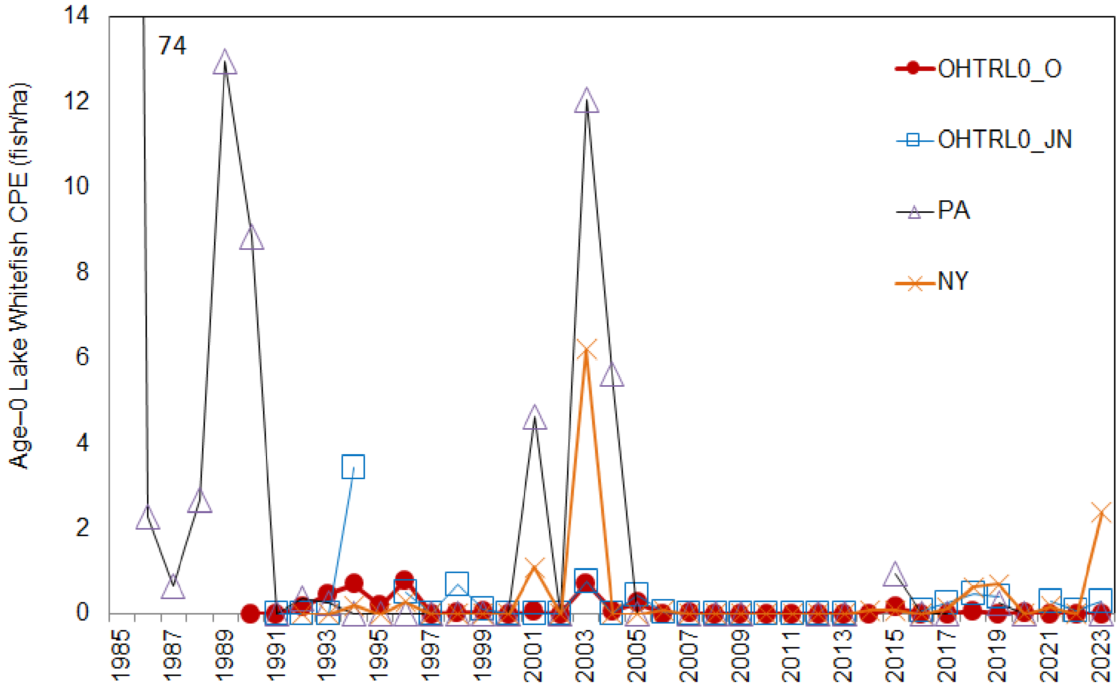


FIGURE 1.1.8. Age 0 Lake whitefish catch per hectare in Ohio (central basin during June – OHTRL0_JN, October – OHTRL0_O), Pennsylvania (PA) and New York (NY) fall assessment trawls. Ohio data are means for October trawls in District 2 and 3. Pennsylvania did not conduct trawls during 2018, 2021, 2022.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

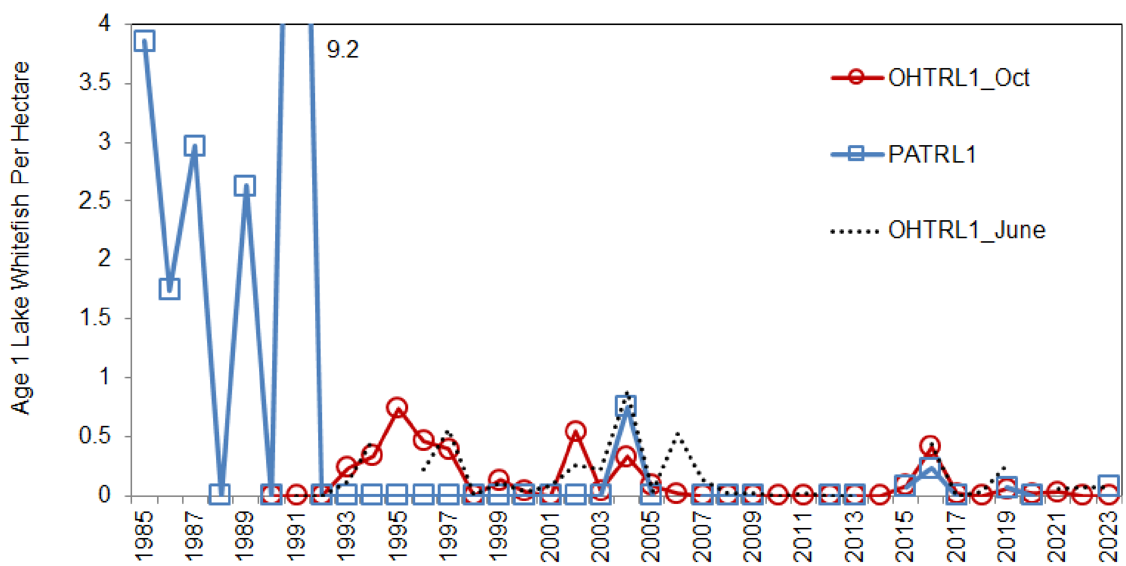


FIGURE 1.1.9. Age 1 Lake whitefish trawl catch rates (number per ha) in Ohio waters during June (dotted line) and October (circles) and in Pennsylvania (PATRL1) waters (squares). Pennsylvania 1991 value (9.2) exceeds maximum axis value. Pennsylvania did not trawl in 2018, 2021 and 2022. Ohio did not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

Stock Discrimination - Genetics

During 2022 and 2023, lake whitefish tissue samples (N=324) were collected during the spawning period (November and December) from the Detroit River and the west, central, and east basins of Lake Erie. These samples will be sequenced using RAD-capture (Rapture) by Dr. Peter Euclide at Purdue University and Dr. Jared Homola at University of Wisconsin Stevens Point. This GLFWRA-funded project is a follow up of Euclide et al. (2022), who found evidence that spawning lake whitefish samples from Niagara and Crib Reef (west basin) were genetically divergent from samples collected elsewhere in the lake. This new data should provide further insight into lake whitefish stock structure in Lake Erie.

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 2023, samples were combined from commercial and survey data from Ontario and Ohio according to the following selection criteria: ages 4 and older collected from Oct-Dec, excluding spawning and spent fish. In 2023, female and male mean condition factors were slightly below their respective historic means (Figure 1.1.10).

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 1995-2023. 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 whitefish diets during earlier years in contrast with recent years. Amphipods accounted for small fractions of 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 whitefish diet composition for years with low sample sizes (Figure 1.1.11).

From 1995-2023, age 0 lake whitefish diet information was collected by ODNR during 18 years with annual samples ranging from 1 to 75. Age 0 lake whitefish diet samples from 1995-2023 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.

Twenty-one years of age 1 lake whitefish diet composition was described by ODNR from 1994 to 2022 with annual samples ranging from 1 to 100. Age 1 lake whitefish diets were dominated by Chironomid pupae, larvae and Isopods from 1995-2022. 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 and reappeared during 2022. 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 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. In 2023, 178 lake whitefish hearts were examined from the partnership survey and Ontario commercial fish sampling programs. Heart cysts were present in 84% of hearts examined. Among 178 whitefish, heart cyst densities were classified as none (16%), light (65%), moderate (15%), and heavy (4%).

Annual heart cyst prevalence in lake whitefish monitored in Partnership surveys exceeded 70% 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.

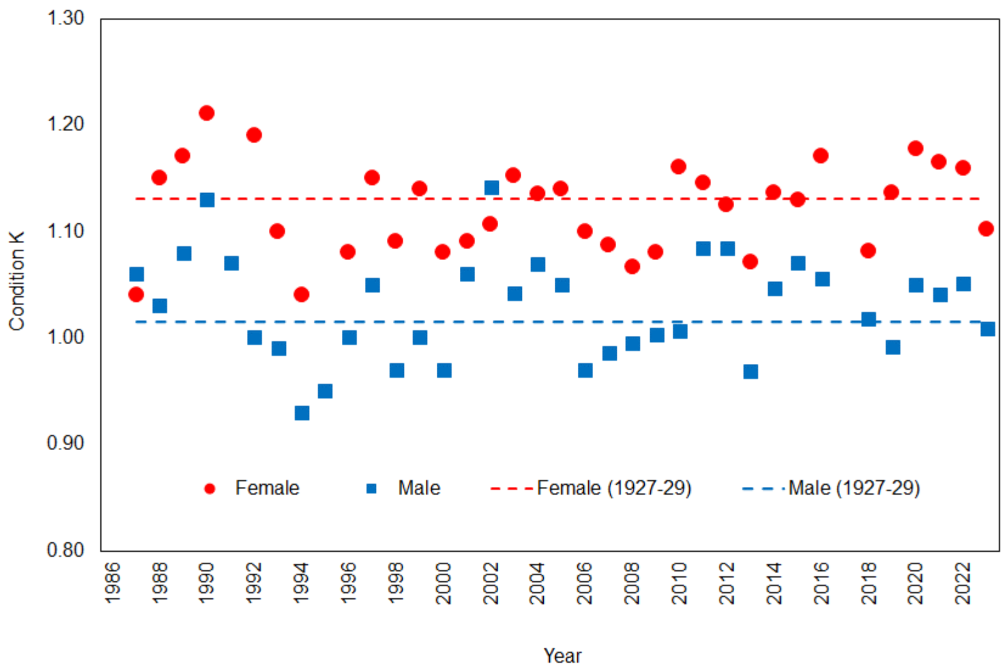


FIGURE 1.1.10. Mean condition factor (K) values of age 4 and older Lake Whitefish obtained from Ontario and Ohio commercial and survey data (Oct-Dec) by sex from 1987-2023. Samples sizes in 2023 were: Males N=19 and Females N=22. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

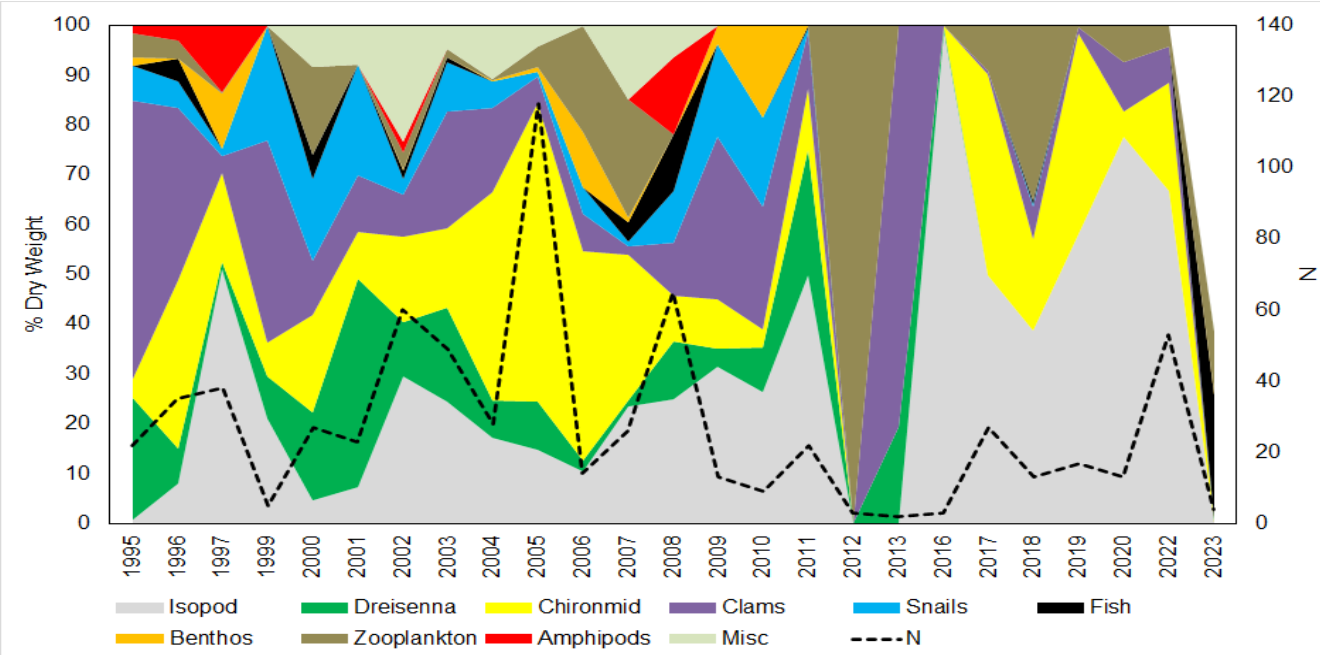


FIGURE 1.1.11. Lake whitefish (ages 2 and older) diet composition (% dry weight) by prey taxa collected from Ohio waters of central Lake Erie, 1995-2023. Number of lake whitefish stomachs with contents expressed as dotted line (second Y axis).

Thiamine Concentrations in Lake Whitefish Eggs

Great Lakes colonization by Dreissenid Mussels altered the diets of Lake Whitefish. Mussels contain the enzyme thiaminase which breaks down thiamine. When mussels are consumed by female lake whitefish, thiaminase present in the diet may result in thiamine deficient eggs, potentially impairing recruitment. Jacques Rinchard and Jarrod Ludwig (SUNY Brockport) measured thiamine concentrations in lake whitefish eggs collected from Great Lakes agencies during 2023. Results presented at New York AFS 2024 revealed that Lake Erie lake whitefish egg thiamine concentrations were higher than most other Great Lakes populations. Thiamine concentrations in eggs collected from eastern Lake Erie were highest (18.1 ± 5.7 nmol/g, n = 6), exceeding thiamine concentrations in eggs from western Lake Erie (14.2 ± 5.5 nmol/g, n = 26). Implications of these results are not fully understood as there are no egg thiamine concentration thresholds determined at this time.

Acoustic Telemetry

Lake whitefish were implanted with 69 kHz acoustic transmitters and tagged with external Floy tags from 2015 to 2023 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, OMNRF, GLFC, GLATOS, TNC and local partners to increase knowledge of lake whitefish behavior and support management of this data deficient species. To date, 385 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 and in the Detroit River (Table 1.1.1). In 2019, The Nature Conservancy (TNC) and ODNR tagged an additional 15 lake whitefish near the mouth of the Maumee River as part of a separate study (Table 1.1.1). Since 2015, 59 acoustic tags have been recovered by fisheries or found on shore (Table 1.1.1). Fishery tag recoveries totalled 55, distributed between Ontario's gill net fishery (50) 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 2023, 7 lake whitefish were tagged in the Detroit River to describe contemporary habitat use in connecting waters that historically supported large migrations and related fisheries. Telemetry data were used to describe the fates of tagged lake whitefish over years of detections and fishery captures. Mortality parameter estimates using acoustic telemetry data suggest that the current natural mortality estimate (0.35, Pauly 1984) may be high, impacting catch at age analysis abundance estimates. Additional work will focus on this parameter. Whitefish detections were more numerous in southern portions of central and eastern Lake Erie during thermal stratification (Kraus et al. 2023). Lake whitefish oxythermal habitat use was also described during summer months over a range of available water temperature and oxygen levels (Kraus et al. 2023). Whitefish habitat selection is part of ongoing research benefiting from acoustic telemetry, archival acoustic tags, in situ dissolved oxygen and temperature sensors and environmental forecasting models. 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 – 2023. Number of tagged whitefish recovered by fisheries or found from 2015 – 2023.

			Tags Recovered*									
Tag Year	Tag Location	# Tagged	2015	2016	2017	2018	2019	2020	2021	2022	2023	All
2015	Maumee Bay	10	0	0	1	0	0	0	0	0	0	1
2016	Hen Island - Little Chicken	37		3	0	0	1	1	0	0	1	6
2017	Crib Reef	25			1	0	1	1	1	0	0	4
2017	Hen Island - Little Chicken	55			5	1	1	1	1	1	0	10
2017	Niagara Reef	25			0	0	0	2	0	0	1	3
2018	DR mouth	2				0	0	0	0	0	0	0
2019	Crib Reef	50					0	3	5	1	1	10
2019	SW Colchester	35					4	1	2	0	0	7
2019	Western Lake Erie, Turtle I	15					0	0	1	4	0	5
2020	Pelee Island	20						1	0	2	0	3
2020	SW Colchester	14						0	0	0	0	0
2021	Pelee Island	16							0	0	0	0
2022	Hen Island - Little Chicken	45								5	0	5
2022	Pelee Island	29								4	1	5
2023	Detroit River	7									0	0
All Years	All Locations	385	0	3	7	1	7	10	10	17	4	59

* Crib Reef 2019 tag cohort: includes 3 floating tags found in 2021 and 1 floating tag found in 2022 on shore

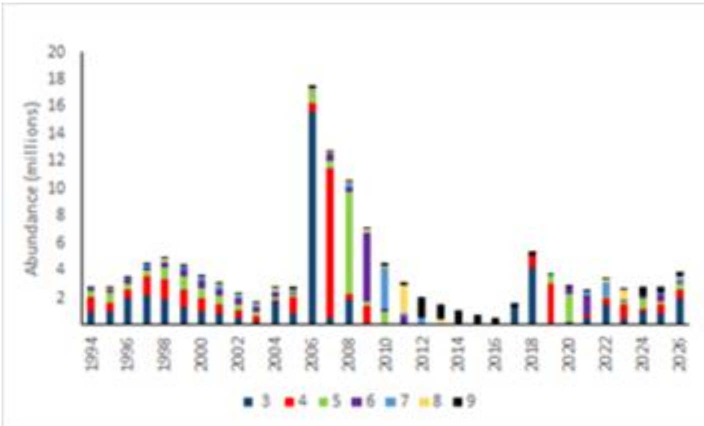
Statistical Catch at Age Analysis (SCAA) Population Model

A two-gear statistical catch-at-age (SCAA) model for lake whitefish (CWTG 2023) was updated with 2023 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 gill net 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 gill net 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 ground truthing SCAA age 3 estimates (Table 1.1.2, Figure 1.1.12). As model data accumulates, SCAA and PCA recruitment estimates for cohorts (2014, 2015) appear to be converging (Table 1.1.2). Abundance and spawner biomass levels were forecasted to 2026 assuming 2023 SCAA terminal survival estimates. Forecasted spawner biomass from 2024 – 2026 was compared to a State of the Lake (SOLE) limit reference point (LRP) to describe lake whitefish population status. The LRP was based on the range (1.2-2.2 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 2026, provided fisheries' harvest remains conservative (Figure 1.1.13).

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 – 2023 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	1,268,910	848,458	655,751	1,041,164	7	0,1,2	0.88	0.99	<.0001
2018	2015	4,234,020	3,723,732	3,379,638	4,067,826	9	0,1,2	0.87	0.98	<.0001
2019	2016	28,558	172,383	(137,075)	481,842	10	0,1,2	0.86	0.99	<.0001
2020	2017	210,048	667,918	373,712	962,125	9	0,1,2	0.83	0.98	<.0001
2021	2018	582,388	2,603,296	2,403,984	2,802,608	9	0,1,2	0.87	0.99	<.0001
2022	2019	1,553,640	786,380	473,118	1,099,641	9	0,1,2	0.85	0.98	<.0001
2023	2020	396048	410,425	72,954	747,897	8	0,1,2	0.85	0.97	<.0001
2024	2021		921,423	712,042	1,130,804	8	0,1,2	0.84	0.99	<.0001
2025	2022		908,390	676,581	1,140,199	8	0,1	0.87	0.99	<.0001
2026	2023		1,944,266	1,586,727	2,301,805	5	0	0.88	0.96	<.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.



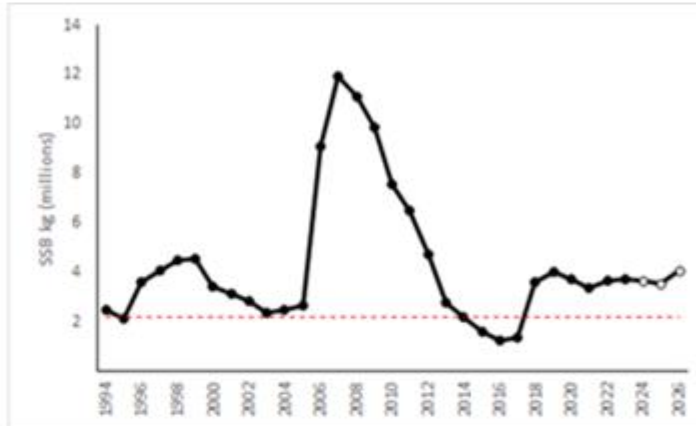


FIGURE 1.1.12. Lake Whitefish abundance estimates at age (3 to 9+) from SCAA (1994-2023) with projections to 2026 from recruit indices in PCA.

FIGURE 1.1.13. Lake Whitefish spawning stock biomass estimates (kg – black line) projected from 2024 to 2026 (white dots), assuming constant SCAA survival estimates from 2023. SSB Limit reference point (red dashed line) was based on low SSB 2014-2017.

Continued efforts to understand mechanisms influencing lake whitefish recruitment in Lake Erie

Zachary Amidon

Lake Erie's lake whitefish population has declined in recent years due to poor survival during the first growing season. The University of Toledo has been working with the USGS Great Lakes Science Center, The Nature Conservancy, and Ohio Department of Natural Resources to understand possible mechanisms responsible for the poor survival by investigating spatial and temporal food web relationships. Larval lake whitefish (1994-1998, 2017-2019 & 2021) and zooplankton (1994-1998, 2018-2019 & 2021) were collected weekly across the southern portion of Lake Erie. We found larval lake whitefish select for cyclopoid copepods that make up the majority of their diet. Within a given year we would expect nearshore larvae with access to more cyclopoid copepods to have more food in their stomachs, but larvae consumed similar amounts of food regardless of food access, suggesting that offshore areas with relatively low levels available food harbor enough food to satiate larval lake whitefish. However, interannual differences in spring cyclopoid copepods strongly and positively corelate to recruitment outcome (Figure 1.1.14). The confounding within and between year relationship makes it difficult to assign a mechanism to explain our results and the pathway may include direct or indirect interactions between cyclopoid copepods and recruitment. For example, an indirect explanation may be attributed to predation. Larval lake whitefish predators are currently unknown, however it's possible that when cyclopoid copepod biomass is high, omnivorous larval lake whitefish predators increase zooplankton consumption and decrease larval consumption, increasing lake whitefish survival. Regardless of mechanism, spring cyclopoid copepod biomass in the western basin is positively correlated with recruitment in Lake Erie, indicating that cyclopoid copepods or environmental conditions that promote spring cyclopoid copepod production result in higher lake whitefish recruitment. While most lake whitefish larvae are found in the western basin, the western basin has a lower spring cyclopoid copepod biomass than both the eastern and central basins (Barbiero et al. 2019; O'Donnell et al. 2023). In addition, western basin waters become too warm for larval Lake Whitefish in early June and the larvae must travel East to the cooler waters of the eastern and central basins to survive. Therefore, spring cyclopoid copepod biomass and water temperatures in the central and eastern basins may be more suitable for larval lake whitefish and result in measurable recruitment if larvae occupied those regions.

Therefore, restoration of historical spawning areas outside of the western basin may buffer against cohort loss through portfolio effects.

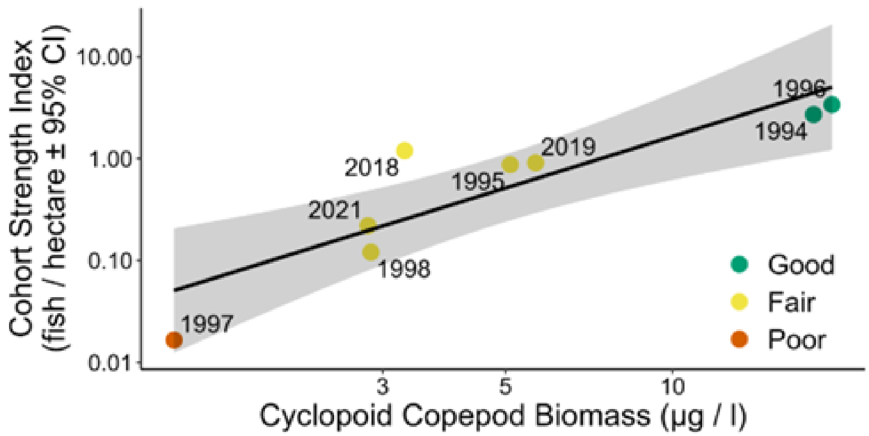


FIGURE 1.1.14. Relationship between lake whitefish cohort strength in Lake Erie and Cyclopoid Copepod biomass. Cohort strength is the median estimate from a Binomial-Poisson N-mixture model that incorporates fall (Sep 15 - Nov 30) bottom trawl data from New York DEC, Pennsylvania Fish and Boat Commission, and Ohio DNR (Central O2 & O3)

Identifying and characterizing lake whitefish spawning habitat

Justin Chiotti, Ed Roseman, Philippa Kohn, and Dimitry Gorsky

In 2021 the USFWS, USGS, TNC, ODNR, OMNRF, Univ. of Toledo, and NYSDEC began a joint project to assess Lake Whitefish spawning activity and spawning habitat in Lake Erie. The project seeks to 1) describe the contemporary spawning habitat used by Lake Whitefish at known spawning locations in the western basin of Lake Erie 2) verify and describe suspected spawning sites used by Lake Whitefish in the central and eastern basins of Lake Erie 3) describe the factors (e.g., substrate composition, bottom slope, water temperature) influencing spawning of Lake Whitefish in the central and eastern basins and 4) evaluate restoration opportunities by describing habitat where future stocking could be successful. Sampling was conducted following an occupancy modeling framework, with sampling sites revisited multiple times over the fall and winter, to determine the onset of spawning and account for imperfect detection of lake whitefish eggs. Egg collections occurred in the fall of 2021 and 2022, with Lake Whitefish eggs collected at sites near Lorain and Fairport, Ohio (CWTG 2023). Lake Whitefish eggs were taken to the USGS Great Lakes Science Center where they were reared to larval stage to confirm species identification and undergo genetic analysis. Lake Trout eggs were also collected in both years at the Fairport site and at locations in the eastern basin.

Work in 2023 focused on habitat evaluation at sampling sites. GoPro camera drops and sidescan sonar data was collected at each site. Substrate at each site was classified using the Coastal and Marine Ecological Classification Standard (CMECS). Lake Whitefish eggs were collected at depths ranging from 3.7 – 8.0 meters and at water temperatures < 5.5°C. At locations where eggs were collected the dominant substrate type was classified as bedrock, gravel mix or sand (Figure 1.1.15).

In 2024, MNRF is starting a broad scale larval fish survey in Ontario waters of west and central Lake Erie. Although focused on multiple species, this study should add to the existing knowledge of larval lake whitefish distribution, supporting identification of lake whitefish spawning and nursery habitats in Lake Erie.

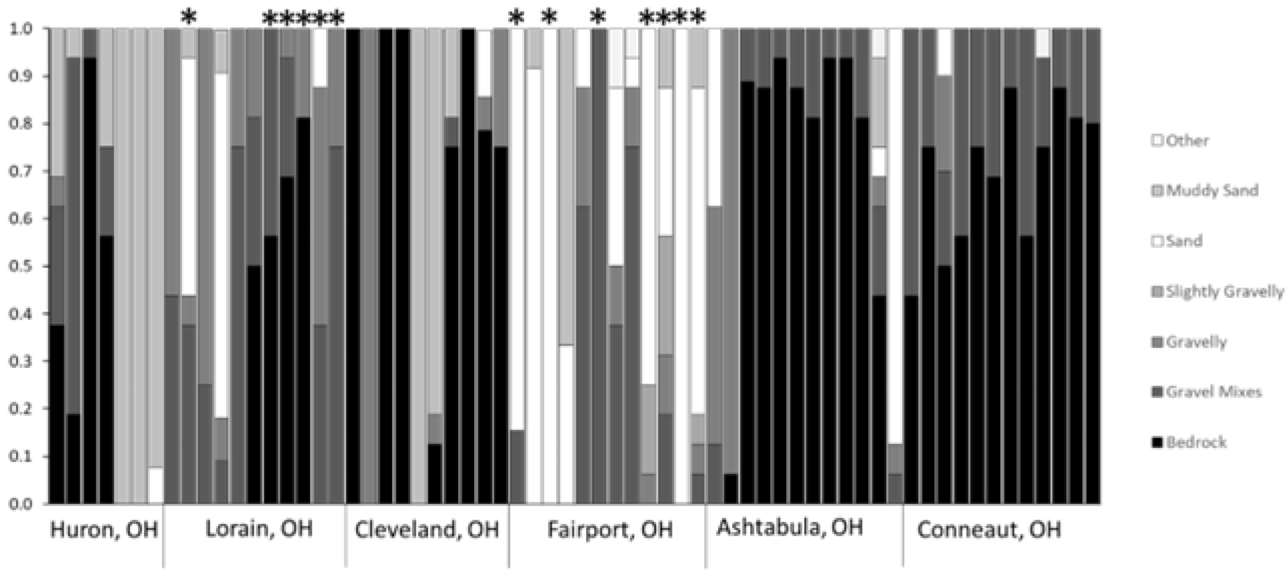


FIGURE 1.1.15. Proportion of substrate types according to the CMECS at each sampling location. Asterisk denotes locations where Lake Whitefish eggs were detected.

LWF Status Summary

In 2023, lake whitefish fishery, survey and model status indicators were moderate or better relative to recent decades. Total lake whitefish harvest in 2023 (204,233 pounds) increased 20% from 2022. Ontario's incidental harvest in 2023 attained 50% of lake whitefish quota of 300,000 pounds. Trap net fisheries harvested 55,617 pounds from trap nets targeting yellow perch and lake whitefish in Ohio and Pennsylvania waters. To reduce whitefish bycatch in the walleye gill net 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 2023, 8% of walleye quota in the west basin was transferred to central basin walleye fisheries, relieving fishing pressure on whitefish spawning or aggregating in the west basin. In 2023, lake whitefish fisheries will benefit from whitefish ages 9 and older with contributions from fish ages 4, 5 and 6. The Coldwater Task Group recommends continued conservative management of lake whitefish. Ongoing research focused on lake whitefish habitat and survival during early life stages supports our understanding of population dynamics and management of lake whitefish in Lake Erie.

1.2 Report of the status of Lake Trout relative to rehabilitation plan targets

Pascal Wilkins (NYSDEC), Andy Cook, Tom MacDougall (OMNRF), Mark Haffley (PFBC), Joe Schmitt (USGS)

In 2023, 108 lake trout (all ages) were caught in the Coldwater Assessment Survey standard assessment nets, yielding an area-weighted catch rate (CPE; catch per lift) of 1.93 fish/lift (Figure 1.2.1). The highest catches occurred in New York (Areas 1 & 2; 5.5 fish/lift). Catch rates varied somewhat in the remaining areas (1.4 – 2.5 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=165) exceeded catches in the standard assessment nets in 2023 (Figure 1.2.1). Similar to 2021 and 2022, the highest catches in the 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 3.18 fish/lift, marking the second consecutive year that higher catch rates occurred in offshore nets compared to the standard assessment nets.

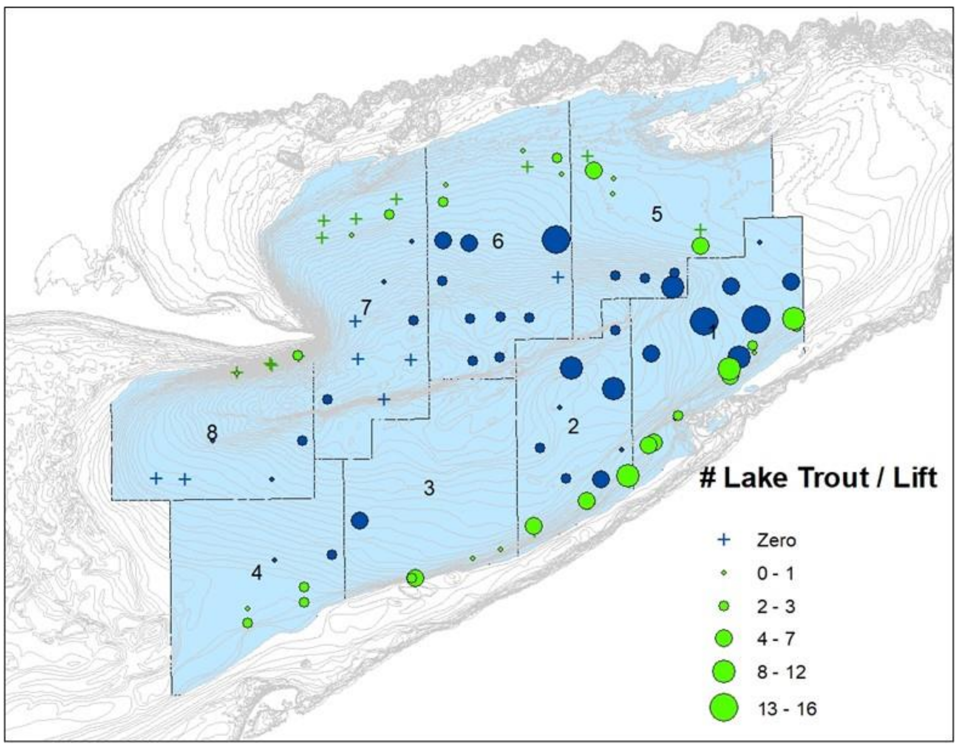


FIGURE 1.2.1. Catch rates (CPE; fish/lift) of lake trout (all ages) caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, August 2023. Relative CPE is indicated by scaled circle size. Light green circles represent standard net set locations; dark green circles indicate offshore net set locations; green crosses 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-two age-classes among four different strains were represented in 2023 with the oldest lake trout age-35 (1988 year class; FL strain) (Figure 1.2.2). Ages 13 was the most abundant and represented 15% of the 240 fish whose ages could be determined. There was also strong representation from ages 3 (11%). Ages 8, 11, 14, 15, and 16 contributed similarly, representing between 8-9 % of the ageable catch. The abundance of lake trout older than age-10 has increased in recent years and increased again in 2023, comprising 60% of the overall catch in 2023. Twenty-eight of the 268 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 2023 were Finger Lakes (FL; 45%) and Lake Champlain (LC; 43%), followed by Slate Island (SI; 11%). These three strains have been the most commonly stocked lake trout strains in Lake Erie over the past thirteen 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.

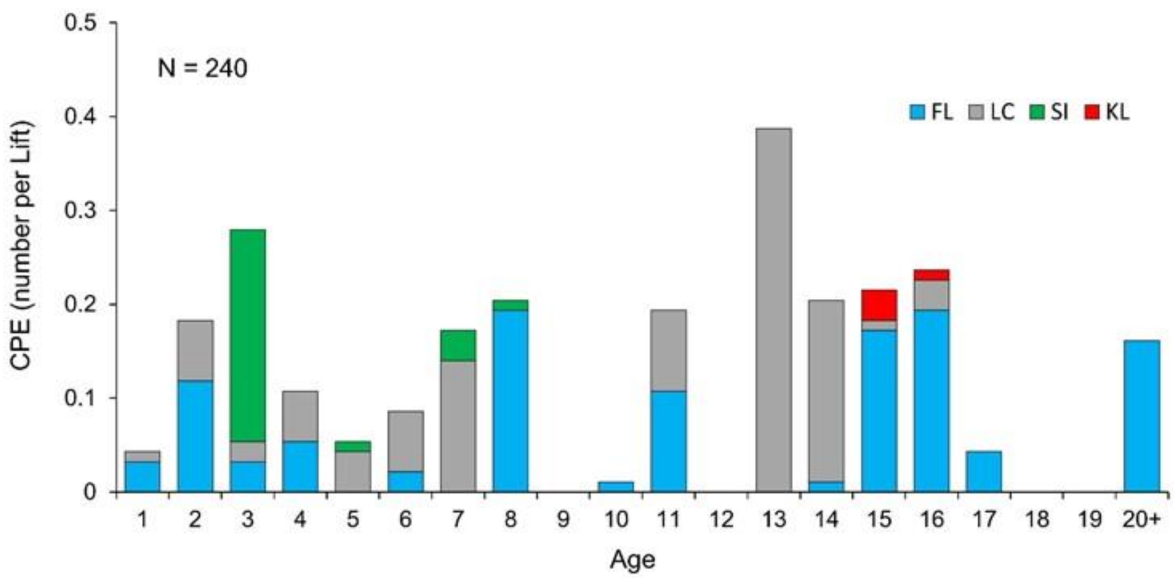


FIGURE 1.2.2. Relative abundance (number per lift) by strain at age, of lake trout sampled in all assessment gill nets in the eastern basin of Lake Erie, August 2022. Abbreviations for strains include HP (Huron-Parry Sound); FL (Finger Lakes); SI (Slate Island); SUP (Superior); KL (Klondike); and LC (Lake Champlain).

The relative abundance of adult (age 5+) lake trout caught in standard assessment gill nets (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 standard nets decreased in 2023 to 1.14 fish/lift from 2.1 fish/lift in 2022 (Figure 1.2.3). Adult abundance has been below target for two of the past four years. The 3-year running average of adult abundance was 1.50 fish/lift (20212023). The suitability of using only standard gillnet sets to index the size of the spawning stock has recently come into question based on the observation that adult catch rates have been highest in offshore net-sets in three of the last four years. The task group is considering how incorporation of catch data from the newly (2020) instituted offshore nets might be used to better index adult abundance, similar to how total catch is currently used to describe population age structure. By way of contrast, the 2023 adult catch rate in all nets was 1.9 fish/lift and the three year running average was 1.95 fish/lift. The task group will continue to present catch rates from standard nets (Figure 1.2.3) but will explore the addition of deepwater catch rates from this relatively young survey design into future assessments of adult abundance.   In light of this uncertainty, no management actions related to adult abundance are being recommended for 2024.

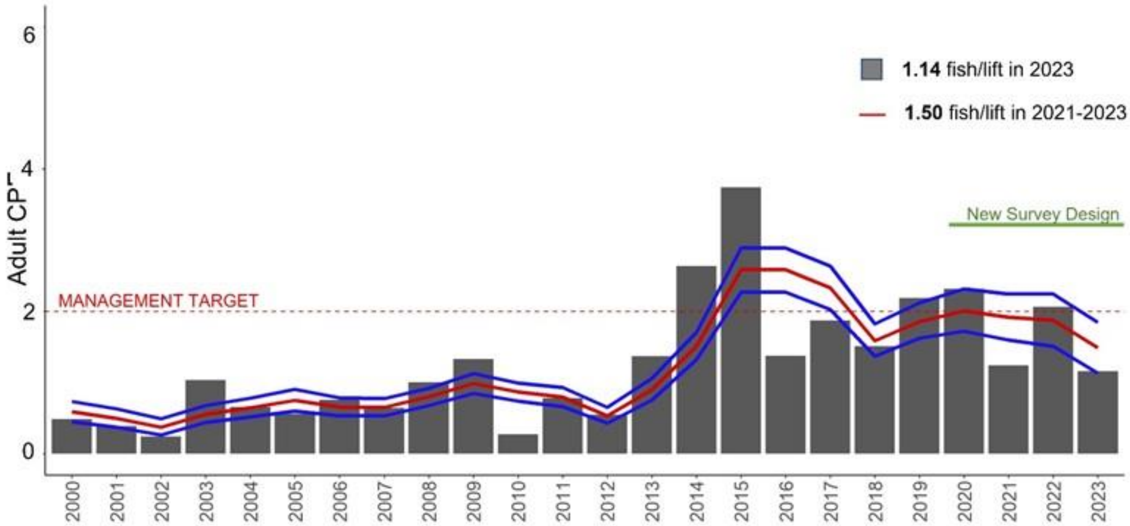


FIGURE 1.2.3. Mean combined CPE (number per lift, weighted by area) for lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 2000-2022. Grey bars: annual mean adult (age 5+) lake trout CPE. Red dotted line: targeted adult lake trout CPE (2.0 fish/lift). Red solid line: 3-year running average of adult lake trout CPE. Blue solid lines: bootstrap estimates of the 95% confidence intervals.

Forty-eight (48) lake trout were caught in 2023 Partnership surveys with most fish caught in the east basin (47) and 1 caught in the Pennsylvania Ridge. Most (44/48) lake trout were captured in nets fished on bottom with 4 caught in canned (suspended) gill nets. The 2023 lake trout index in the east basin (0.78 fish/lift) increased from 2022 (0.37 fish/lift) and exceeded the time series mean (0.45 fish/lift). The catch rate in the Pennsylvania Ridge survey was 0.06 fish/lift in 2023; the time series mean is 0.18 fish/lift (Figure 1.2.4). Total catch was composed of Slate Island (31 or 65%), Finger Lakes (10 or 21%), Lake Champlain (1 or 2%) and unknown (6 or 13%) strains. All lake trout had adipose fin clips. Ages derived from coded wire tags ranged from 1 to 8, consisting of age-1 (10%), age-2 (14%), age-3 (71%), age-7 (2%) and age-8 (2%).

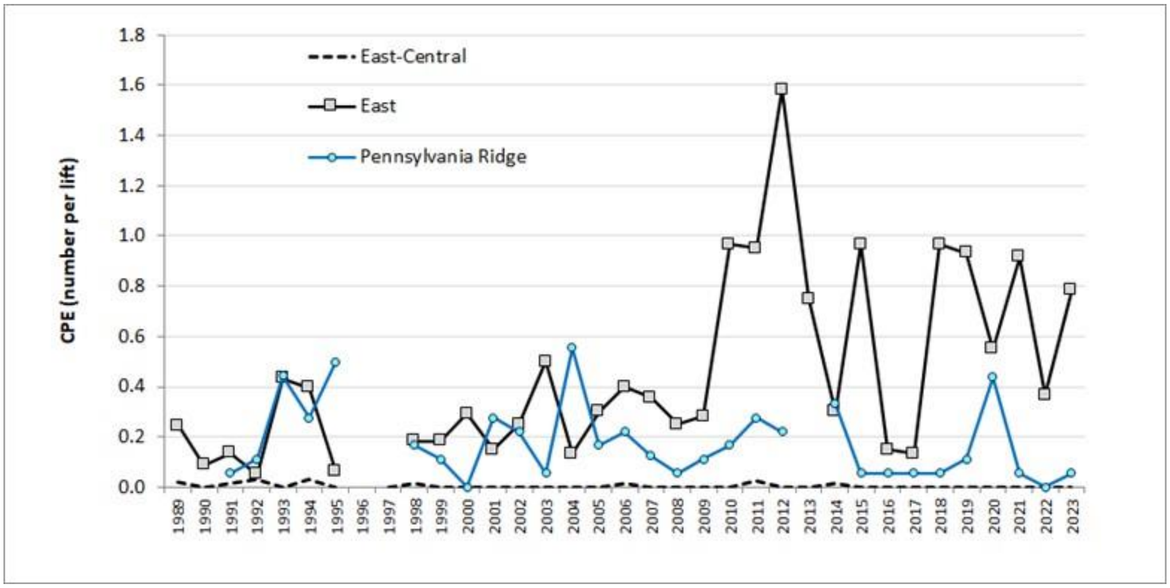


FIGURE 1.2.4. Lake trout CPE (number per lift) by basin from the OMNRF Partnership Index Fishing Program, 1989-2023. Includes canned (suspended) and bottom gill net sets, excluding thermocline sets.

Recreational Catch and Harvest

Recreational angler catch of lake trout 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 harvest in 2023 estimated at 569 fish (Figure 1.2.5). An estimated 290 lake trout were harvested in New York waters out of an estimated catch of 860 fish in 2023. Pennsylvania anglers harvested an estimated 279 fish from a total catch of 2,051 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 (2014) 669 rod-hours of effort were directed at lake trout, representing <1% of eastern basin angler effort in that year. No lake trout were reported harvested in the survey, targeted or otherwise.

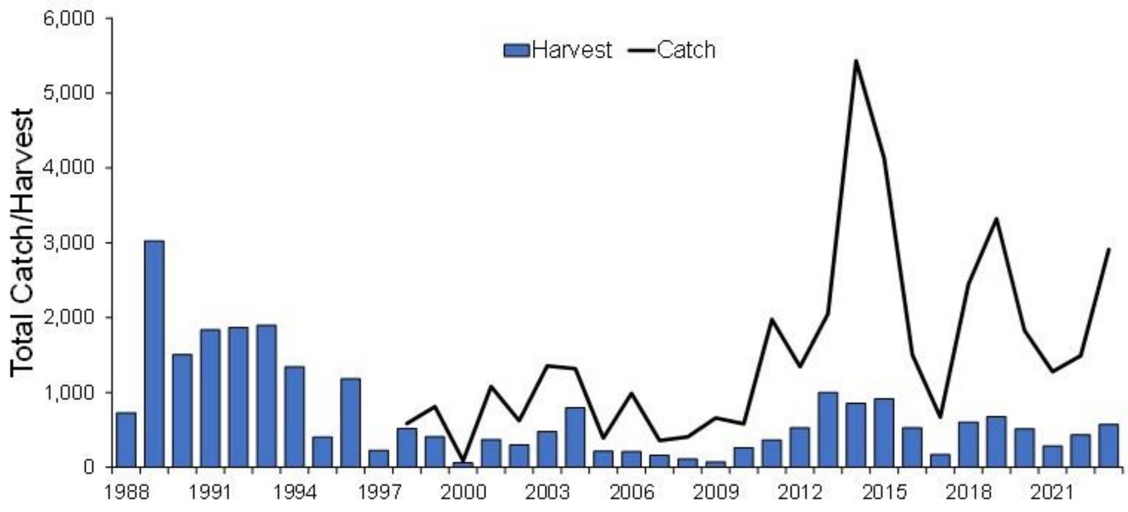


FIGURE 1.2.5. Estimated lake trout catch and harvest by recreational anglers in the New York and Pennsylvania waters of Lake Erie, May-October, 1988-2023.

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 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). 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 1.2.6). In 2023, three potentially wild fish (no fin clips; no CWT's) out of a total of 274 lake trout (all nets) were caught during the survey, representing 1.1% of the fish captured. Altogether, a total of 89 potentially wild lake trout have been recorded since 2000 in the Coldwater Assessment Survey. Otoliths are collected from lake trout found without CWTs or fin-clips and will be used in future stock discrimination studies.

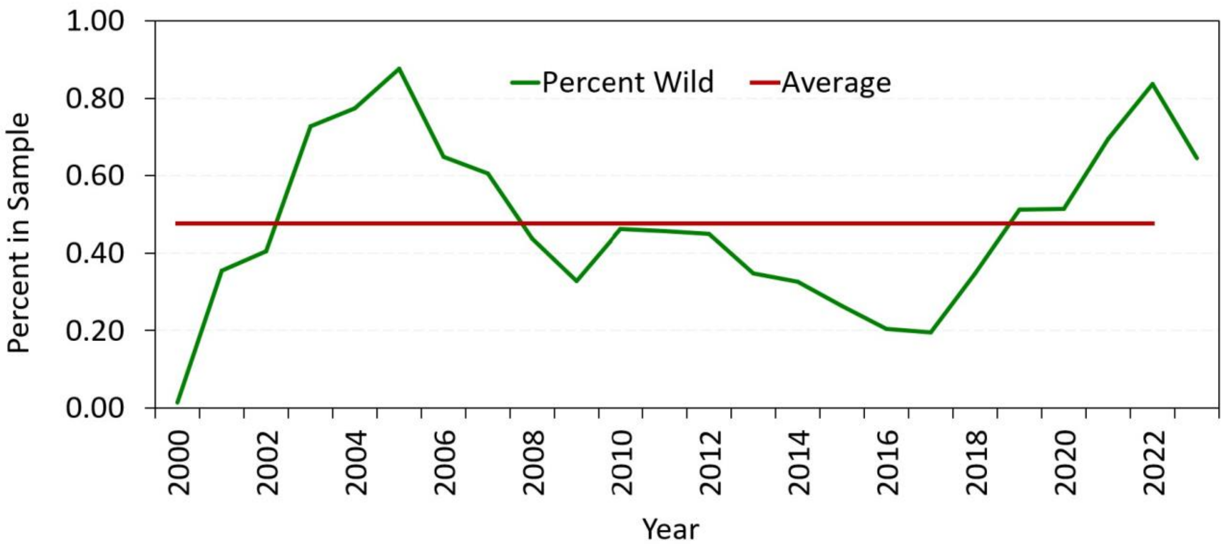


FIGURE 1.2.6. Percentage of potentially wild lake trout caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie for 5-year running average time blocks, 2000–2023 (green line), compared to the time series average (red line). A potentially wild fish has no fin clips and no coded-wire tag (CWT). Percentages are calculated after accounting for known marking error.

1.3 Report on the Status of Burbot

Tom MacDougall, Andy Cook, (OMNRF), Pascal Wilkins (NYSDEC), Mark Haffley (PFBC), Joe 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 display similar trends and magnitudes with some annual variation. During the early 1990s, burbot 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, catches have been consistently low with some regional differences. In 2023, the area weighted mean burbot catch rate in standard nets (0.99 fish/lift) in the CWA was more than double the mean catch rate in 2022 (0.42 fish/lift) and was the highest rate observed in the past decade, driven mainly by high catch rates in ON and NY waters. The CWA catch rate in Ontario waters during 2023 (1.67 fish/lift) increased from 2022 and was the highest observed since 2011. The mean catch rate in New York waters (0.50 fish/lift) also increased from 2022 (0.19 fish/lift). In contrast, the burbot catch rate during the 2023 Partnership Survey (0.59 fish/lift) declined from 2022 (1.08 fish/lift). Mean catch rate in Pennsylvania CWA in 2023 decreased slightly to 0.25 fish/lift. Burbot catches in the CWA were distributed across the basin in 2023; locations in U.S. waters with the highest catch rates were at deeper offshore sites, whereas high burbot catches occurred at both shallower thermocline locations and at deeper, offshore sites in Ontario waters (Figure 1.3.2). Deep offshore sites were not well sampled prior to 2020 by the CWA. The CWA area-weighted mean catch rate at offshore, deepwater sites was notably higher than at standard net locations (2.12 fish/lift). In 2023, one additional burbot was caught in 7.3 m canned gillnets in the east basin Partnership survey as well as five burbot caught in bottom nets in the east-central basin survey which is assessed after fall turnover.

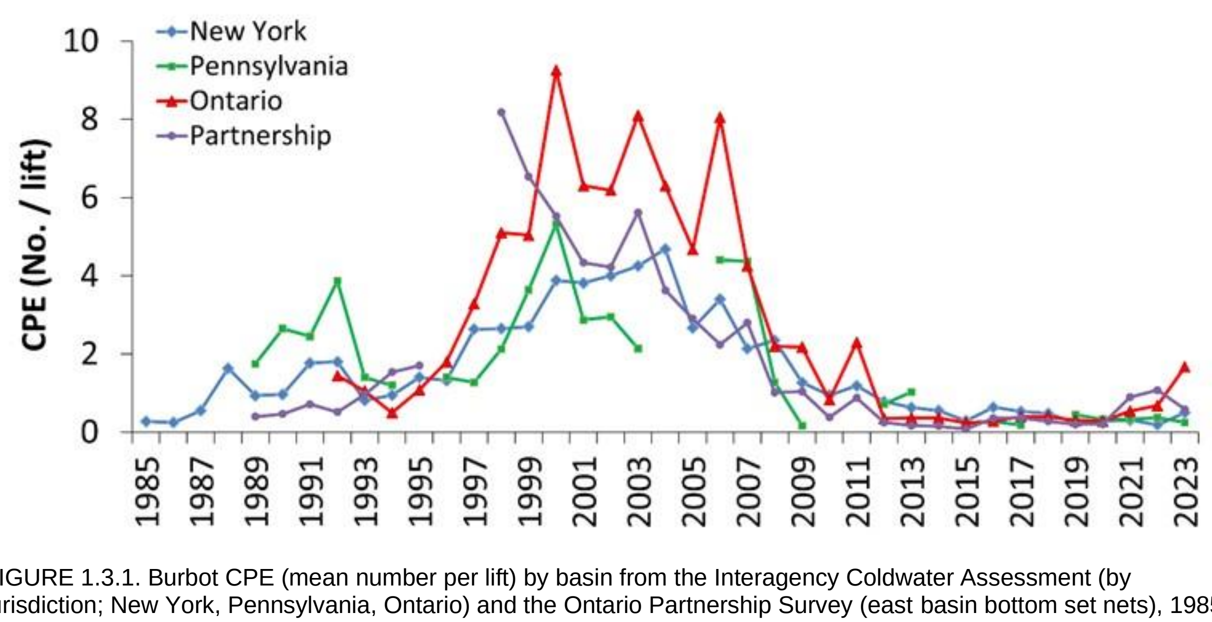


FIGURE 1.3.1. Burbot CPE (mean number per lift) by basin from the Interagency Coldwater Assessment (by jurisdiction; New York, Pennsylvania, Ontario) and the Ontario Partnership Survey (east basin bottom set nets), 1985-2023.

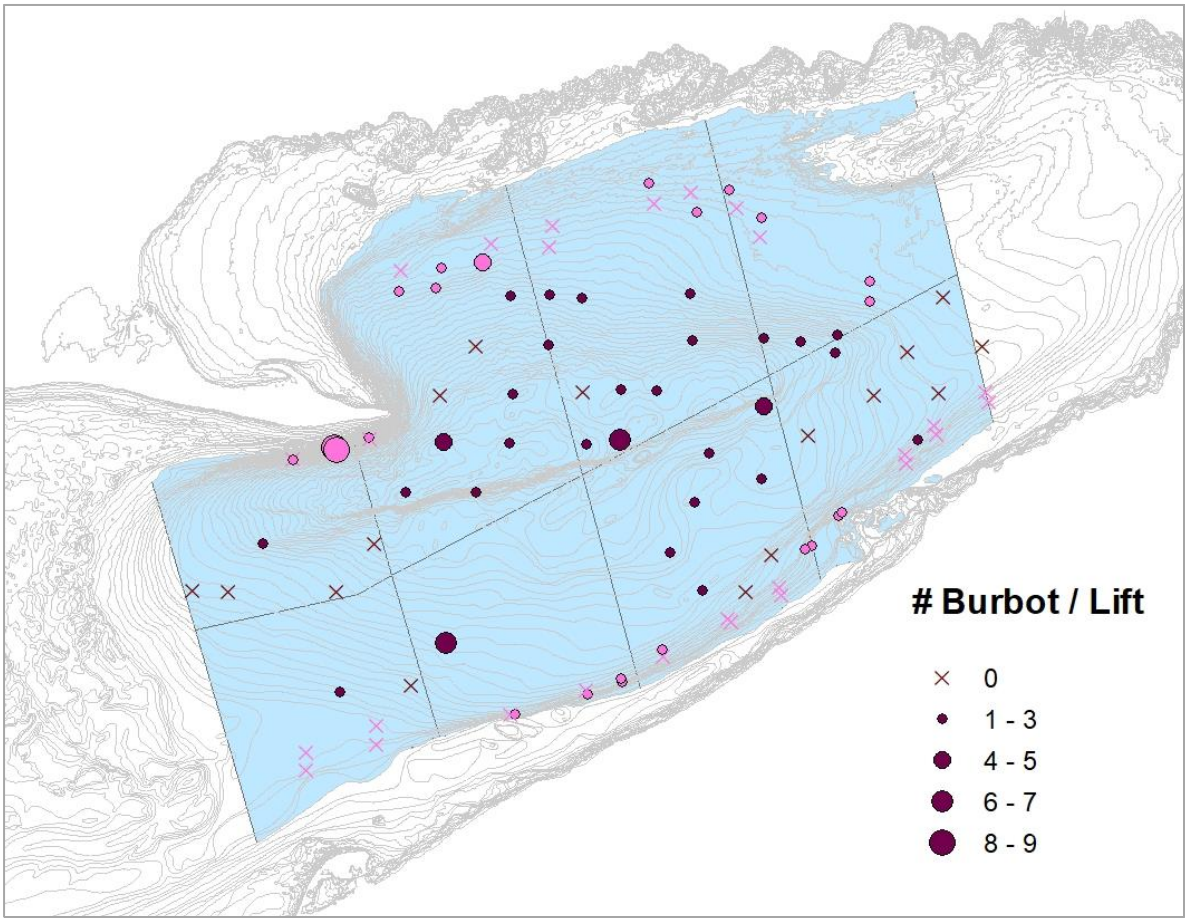


FIGURE 1.3.2. Catch rates (CPE; fish/lift) of burbot (all ages) caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, August 2023. Relative CPE is indicated by scaled circle size. Pink circles represent standard net set locations; purple circles indicate offshore net set locations; crosses represent net sets where no burbot were caught.

Historically, burbot harvest 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 gill net 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 2023 was 3,416 lbs, divided between Ontario (50%, 1,709 lbs), Pennsylvania (31%, 1,042 lbs), New York (11%, 382 lbs) and Ohio (8%, 283 lbs). Ontario commercial catch in 2023 included reported landed harvest, discard and released burbot with nominal catch from Inner Long Point Bay (16 pounds). In 2023, the majority of burbot caught incidentally in Ontario waters was from central Lake Erie (1,324 lbs, 78%). The largest monthly catch of burbot in central Lake Erie took place in March (480 lbs) in Ontario statistic district 2 (OE2). A sample of 8 burbot collected from the fishery on March 24, 2023, grid 51 (42.0417 - 82.3750) consisted of 4 fully developed males, 3 fully developed females and 1 female in spawning condition (running). Location, date and physiological state of these fish suggest that some burbot spawn in the west-central (OE2) portion of Lake Erie. Nominal burbot catch (19 lbs) in the west basin (OE1) occurred in 2023 during February-March, suggesting that some burbot may have been spawning in the west basin.

Recent efforts have been directed at understanding the behavioural ecology of burbot in Lake Erie using acoustic telemetry. Tagging of adult burbot from Pennsylvania waters occurred in 2018 (n=2) and 2019 (n=22). Preliminary analysis of movement data collected to date indicates that most of these fish remain close to the release site over winter before moving eastward to New York waters. Most detections occurred on receivers in waters <30 m deep and along the south shoreline. Some individuals were by receivers in both the Pennsylvania Ridge area and the adjacent deeper waters south of Long Point, ON. One individual made extensive use of the eastern portion of the central basin. At least four of these fish continued to be detected into the spring of 2021; One of these was detected as late as May 2022. For more information visit: https://glatos.glos.us/home

Age and Recruitment

Ages of Burbot caught in the CWA Survey and the Partnership Survey are determined using otoliths. Otoliths were examined using either thin-sectioning or "crack-and-burn" techniques. To date, 153 burbot from the 2023 Partnership (n=27) and CWA (n=126) surveys have been aged using these methods. Burbot ranged in age from 2 to 19 years in 2023 (Figure 1.3.3). The catch in both surveys had strong contributions from younger age classes; notably from 2019 (4-yr old; 27%) followed by 2020 (3-yr old; 24%) and 2018 (5-yr old; 14%). 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.

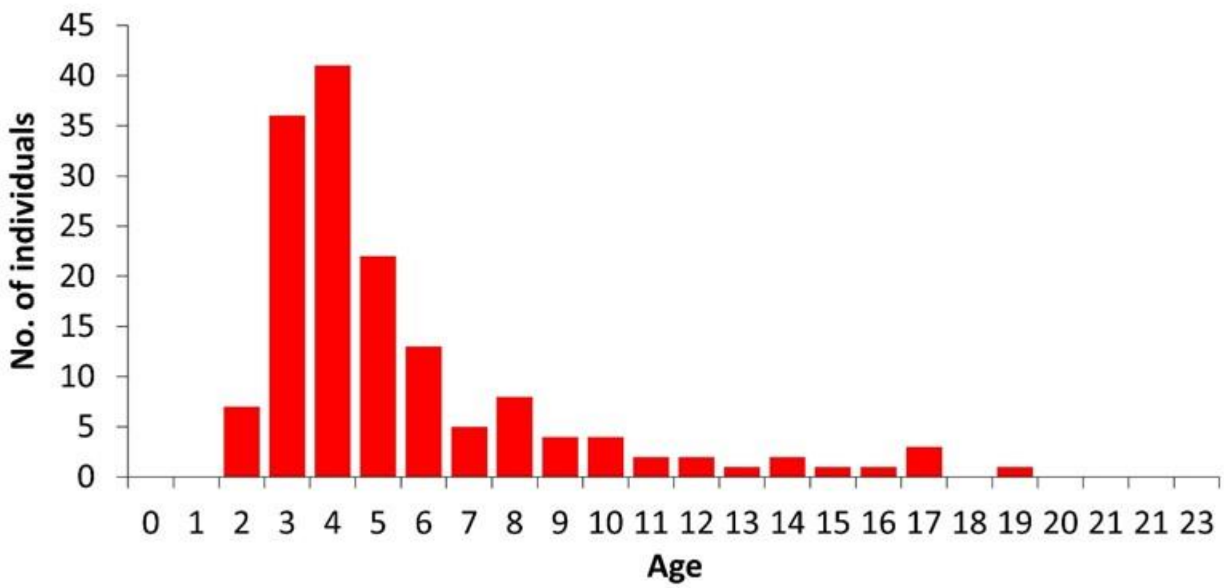


FIGURE 1.3.3. Age distribution of burbot caught in the Coldwater Assessment Survey and the Partnership Survey in eastern Lake Erie, 2023 (N=126).

The annual mean age of burbot in the Coldwater Assessment has been erratic but has generally been decreasing, from a high of 15.4 in 2013. In 2023 mean age was 5.7 years, down slightly from 7.0 years in 2022 and down notably from 2020 (8.4 years) and 2019 (12.1 years) (Figure 1.3.4). The 2023 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).

Larval 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 the 2019 CSMI survey, 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. 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).

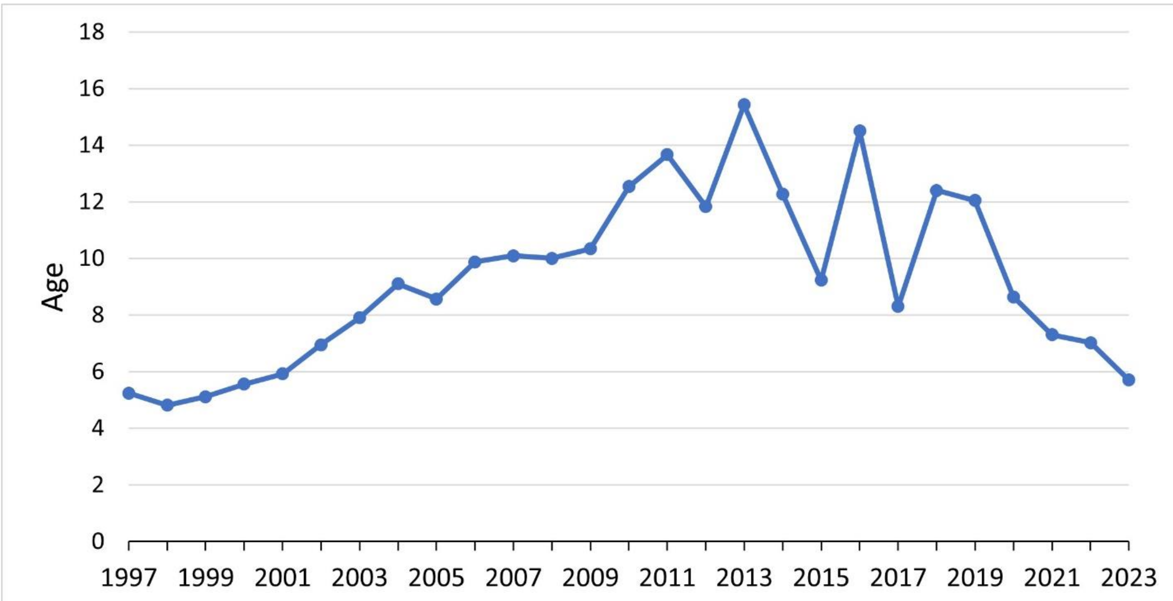


FIGURE 1.3.4. Mean age of burbot caught in the Interagency Coldwater Assessment Survey in eastern Lake Erie from 1997-2023.

Diet

Diet information was collected for burbot caught in the 2023 CWA Survey. Analysis of the contents of non-empty stomachs (N=86, Figure 1.3.5) revealed a diet made up mainly of fish, but with some contribution from invertebrates. Burbot diets were dominated by round goby, (observed in 54% of non-empty stomachs), followed by rainbow smelt (in 43% of non-empty stomachs). Relative contributions from round goby and rainbow smelt continue to fluctuate, relative to each other, from year to year. Ten percent of stomachs had fish that were not identifiable. No gizzard shad, observed frequently in past years, were identified in 2023, however alewife were present in 5% of the non-empty stomachs, coincident with uncommonly frequent observations of alewife in several forage fish surveys conducted in 2023. Invertebrate prey included: *Hemimysis* shrimp (7% of non-empty stomachs), Dreissenid mussels (2%), and Chironomid midges (1%).

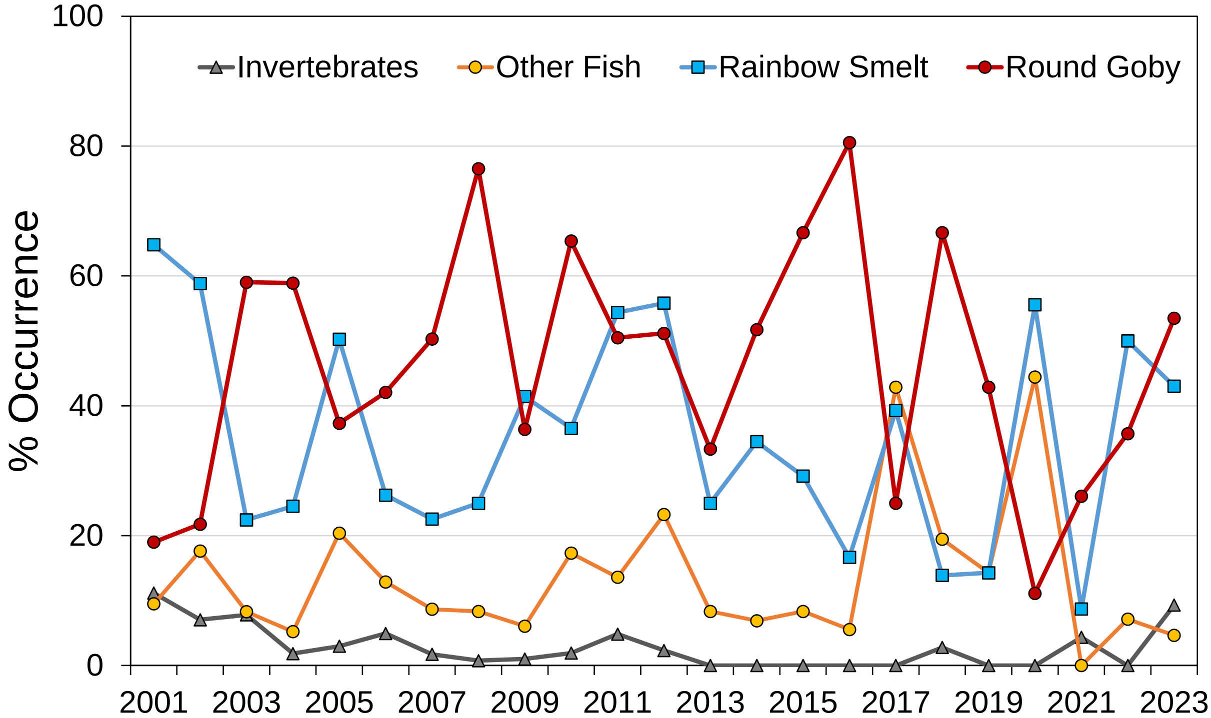


FIGURE 1.3.5: Frequency of occurrence of rainbow smelt, round goby, other fish, and invertebrates in the diet of burbot caught the Coldwater Assessment Survey in the eastern basin of Lake Erie, 2001-2023.

1.4 Report on Rainbow Trout / Steelhead

Pascal Wilkins (NYSDEC), Carey Knight (ODNR), Andy Cook (OMNRF), 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 and 2009-10. Results of these surveys showed high tributary catch rates that averaged 0.60 fish/angler hour in the mid-2000's, but then declined from 2009–2015 to 0.35 fish/hour. The most recent NYSDEC angler surveys conducted in 2017-18 and 2021-22 found tributary steelhead catch rates which were similar to the catch rates recorded in the mid-2000's (0.56, 0.44 fish/angler hour, respectively). Steelhead continue to meet the fishery goals established by the Lake Erie Committee and the Lake Erie tributaries remain one of the top destinations for steelhead anglers in the country.

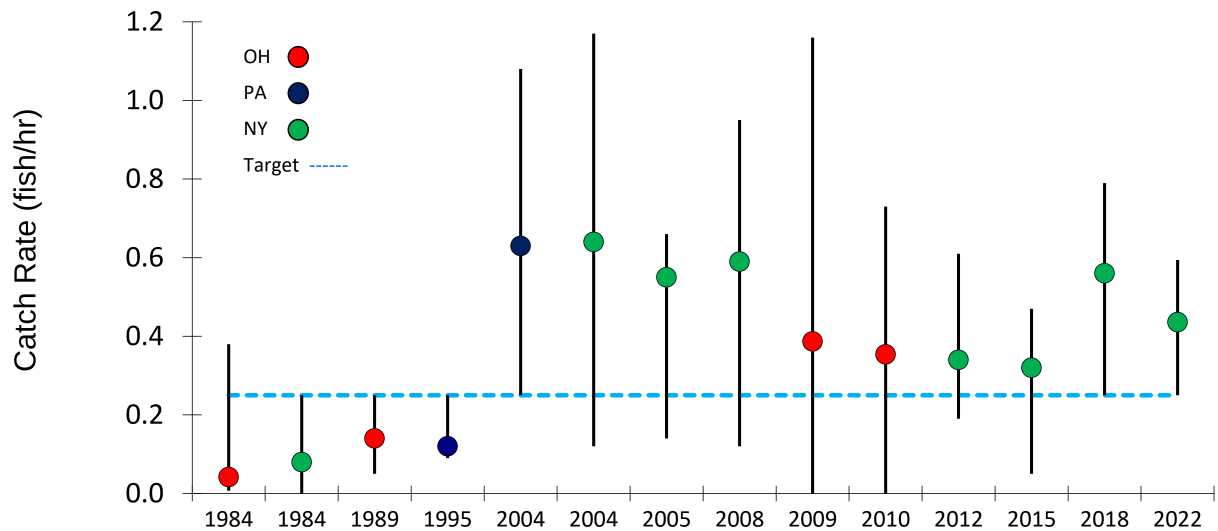


FIGURE 1.4.1. Targeted average steelhead catch rates (fish/angler hour) in Lake Erie tributary angler surveys by year and jurisdiction, 1984-2022. Vertical whiskers represent the range of individual tributary catch rates in the survey year. Dotted blue line is the fishery goal (0.25 fish/hr).

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 2023 estimated steelhead harvest from the summer open-water boat angler fishery totaled 13,512 fish across all US agencies, a significant decrease compared to 2022 but still the third highest harvest of steelhead since 2008 (Table 1.4.1). The vast majority of the harvest occurred in Ohio waters (11,763 fish (87%) with the remainder in Pennsylvania (1,204 fish (8.9%) and New York (545 fish (4%)). Open lake boat angler creel surveys have intermittently occurred in Ontario waters, but no data was collected in 2023.

TABLE 1.4.1. Estimated harvest by open lake boat anglers in Lake Erie, 1999-2023.

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
mean	12,544	2,992	573	25,736	50	22,137

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

Abundance Indices

Partnership Surveys have run since 1989 in Ontario waters of Lake Erie. Index nets were fished at random locations in the west, west-central, east-central, Pennsylvania Ridge and east basin annually. At each site, monofilament index gill nets ranging in mesh sizes from 1 ¼” to 6” were fished on bottom and suspended (canned) at standard depths that vary according to each basin surveyed. In the east basin and Pennsylvania Ridge surveys, additional index gangs were suspended in the thermocline where depths permitted. Thermocline gangs account for the highest catches of steelhead in Partnership Surveys. Unfortunately, thermocline gangs were not fished regularly until 1999. Steelhead were also caught in central basin surveys at lower densities in nets fished on bottom and suspended and fished after fall turnover. The west basin survey occurred when water temperatures were excessively high for salmonids, making this unsuitable for steelhead assessment. Standardized steelhead catch rates (fish/lift) for combined surveys in the east, and central basins and Pennsylvania Ridge from 1999-2023 are presented in Figure 1.4.2.

Steelhead catch rates were generally high from 1999 to 2006 (average 0.27 fish/lift) but declined afterwards. Catch rates in 2023 (0.03 fish/lift, 4th percentile) was low relative to the 25-year time series. There were 7 steelhead caught in 2023, exclusively in the east basin survey. Steelhead were caught in nets fished on bottom (2), in standard canned nets (3) and in nets fished in the thermocline (2). Few gangs of net (7) were fished in the thermocline in 2023. From 1999 to 2022, an average of 21 gangs were fished in the thermocline in the east basin and Pennsylvania Ridge surveys. This may have impacted catch rates in 2023. None of the steelhead had fin clips or lamprey wounds or scars in 2023.

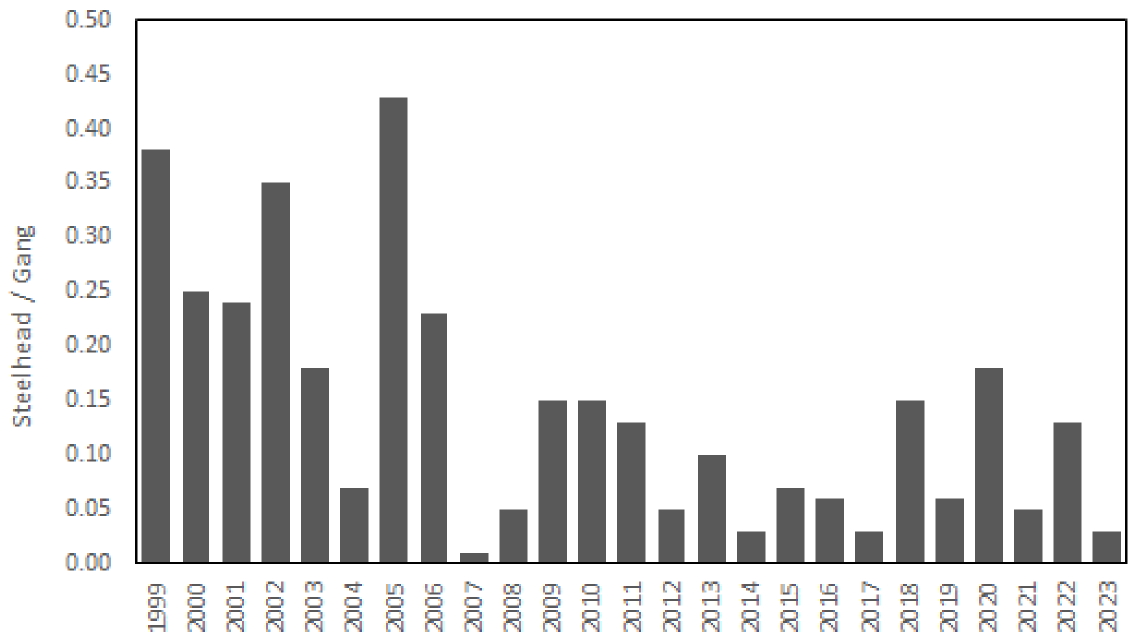


FIGURE 1.4.2. Steelhead catch per gang from the Partnership Survey, 1999-2023. West-central, east-central, Pennsylvania Ridge, east basin, and east cap area surveys were included. Index bottom, canned, and thermocline-canned nets were included. Catch rates were standardized to equal effort among mesh sizes. Thermocline nets were not fished in 2007. Only 7 gangs were fished in the thermocline in 2023 which may add uncertainty to catch rate estimates in 2023.

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 (OMNRF)

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 20 A1-A3 wounds were found on 240 lake trout greater than 532 mm (21 inches) total length in 2023 during coldwater assessment gill netting, equaling a wounding rate of 8.3 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 three of the fresh A1-A3 wounds (9.4 wounds/100 fish) in 2023 (Table 2.1). Small lake trout less than 532 mm (21 inches) are rarely attacked when larger lake trout are available.

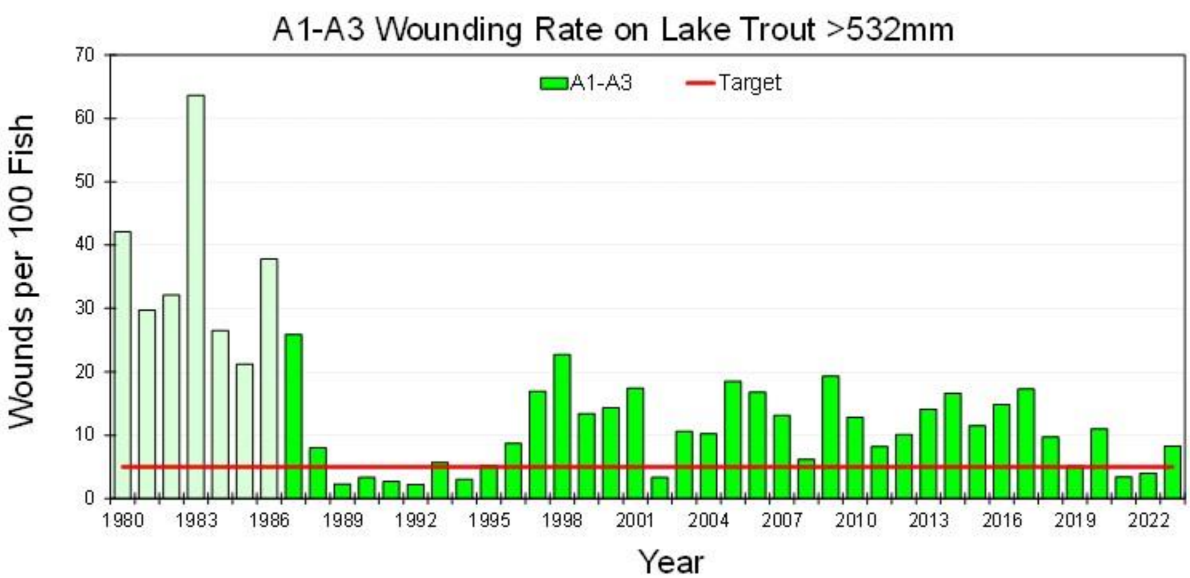


FIGURE 2.1. Number of fresh (A1-A3) sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1980-2023. The target rate (red solid line) is 5.0 wounds per 100 fish. Lighter shading indicates pre-treatment years.

TABLE 2.1. Frequency of sea lamprey wounds observed on standard length groups of lake trout collected from assessment gill nets in the eastern basin of Lake Erie, August, 2023.

Size Class Total Length (mm)	Sample Size	Wound Classification A1	A2	A3	A4	No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
432-532	11	0	0	0	0	0.0	0.0
533-634	22	0	0	0	0	0.0	0.0
635-736	38	1	1	1	7	7.9	18.4
>736	180	2	7	8	134	9.4	74.4
>532	240	3	8	9	141	8.3	58.8

Finger Lakes (FL) and Lake Champlain (LC) were the most sampled lake trout strains in 2023, and they accounted for thirteen of the 20 (65%) 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 one healed wound on a low sample size of only seventeen fish. This strain typically has higher wounding rates compared to the FL and LC strains. Sample sizes on all other known strains (Superior (SUP), Huron-Parry Sound (HP), 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 (15% fresh;12% healed) of the wounding for the third 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 gill nets in the eastern basin of Lake Erie, August, 2023. SI=Slate Island, FL=Finger Lakes, SUP=Superior, LC=Lake Champlain, HP=Huron-Parry Sound, KL=Klondike.

Lake Trout Strain	Sample Size	Wound Classification A1	A2	A3	A4	No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
SI	17	1	0	0	1	5.9	5.9
FL	91	1	3	4	66	8.8	72.5
LC	96	0	2	3	51	5.2	53.1
KL	4	0	1	2	6	75.0	150.0
Unknown	32	1	2	0	17	9.4	53.1

Burbot Wounding Rates

The burbot population, once the most prevalent coldwater 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 2023, there was no fresh (A1-A3) and two healed (A4) wounds on the 49 burbot sampled greater than 532 mm (21 inches) during coldwater assessment gill netting. Low sample sizes of burbot during some years increase uncertainty about wounding metrics.

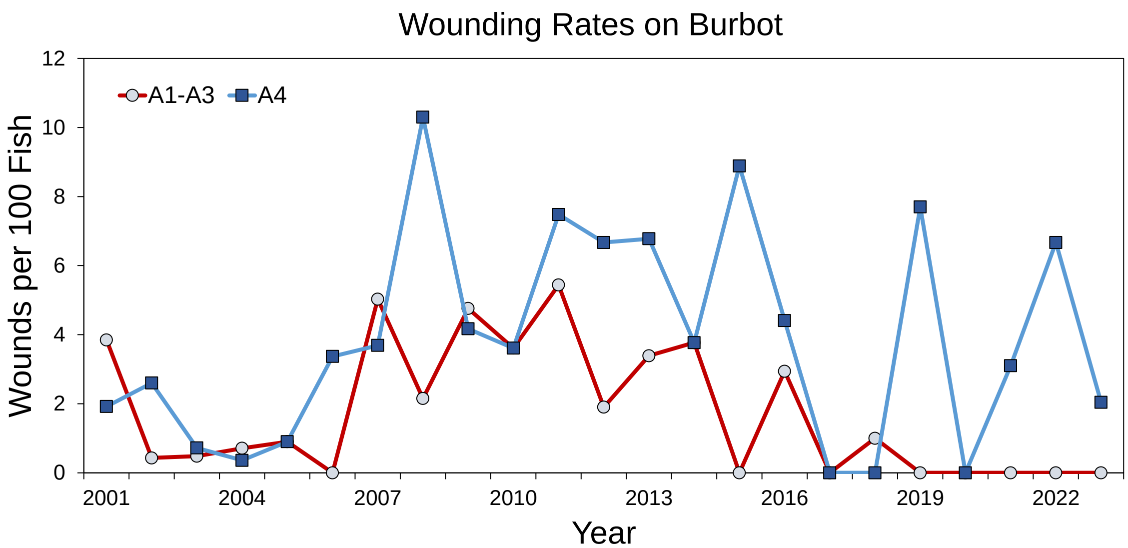


FIGURE 2.2. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August, 2001-2023.

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 since. A total of 58 lake whitefish greater than 532 mm (21 inches) were checked for evidence of sea lamprey attacks in 2023 assessment netting with one fresh A1-A3 (1.7 wounds/100 fish) and no healed A4 wounds recorded (Figure 2.3). The low wounding rate on lake whitefish for the second consecutive year coincided with observations on lake trout.

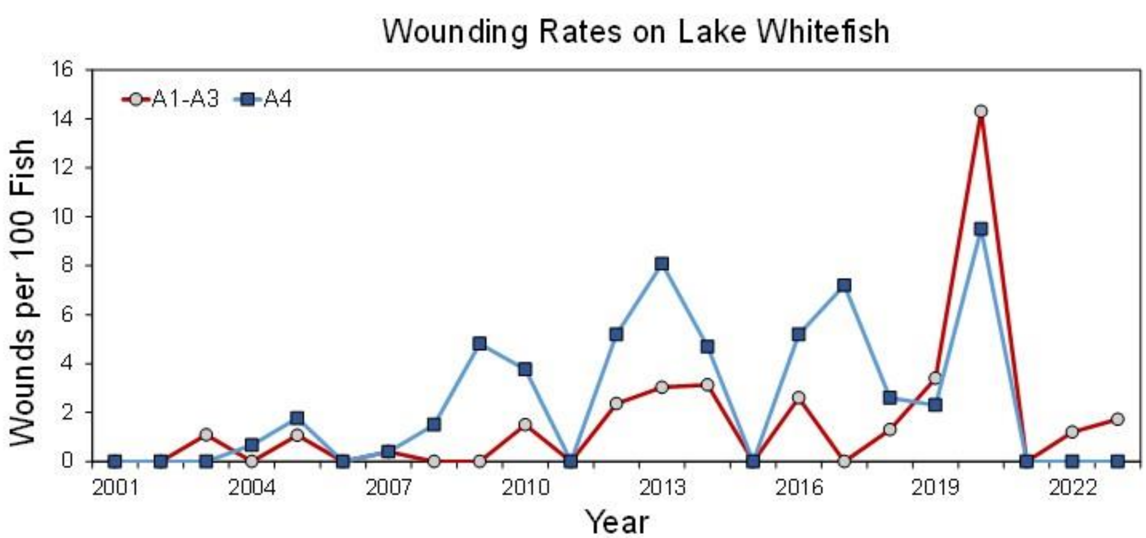


FIGURE 2.3. Number of A1-A3 and A4 sea lamprey wounds per 100 lake whitefish greater than 532 mm (21 inches) sampled in Coldwater Assessment gill nets in the eastern basin of Lake Erie, August, 2001-2023.

Ontario Partnership Program

The Ontario Partnership Index Fishing Program is an annual lake-wide gillnet survey of the Canadian waters of Lake Erie. Index gill nets were fished on bottom and suspended in the water column at 133 sites in 2023. 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 2023, sea lamprey wounds and scars were not observed on lake trout (N=28) or lake whitefish (N=79). A single burbot (1/28) caught in the east basin had 2 wounds (A3, A4). One smallmouth bass caught in the east basin had an A1 wound. In 2023, a total of 76 smallmouth bass were examined, distributed among east basin (60) and west basin (16) surveys.

Summary of 2023 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).

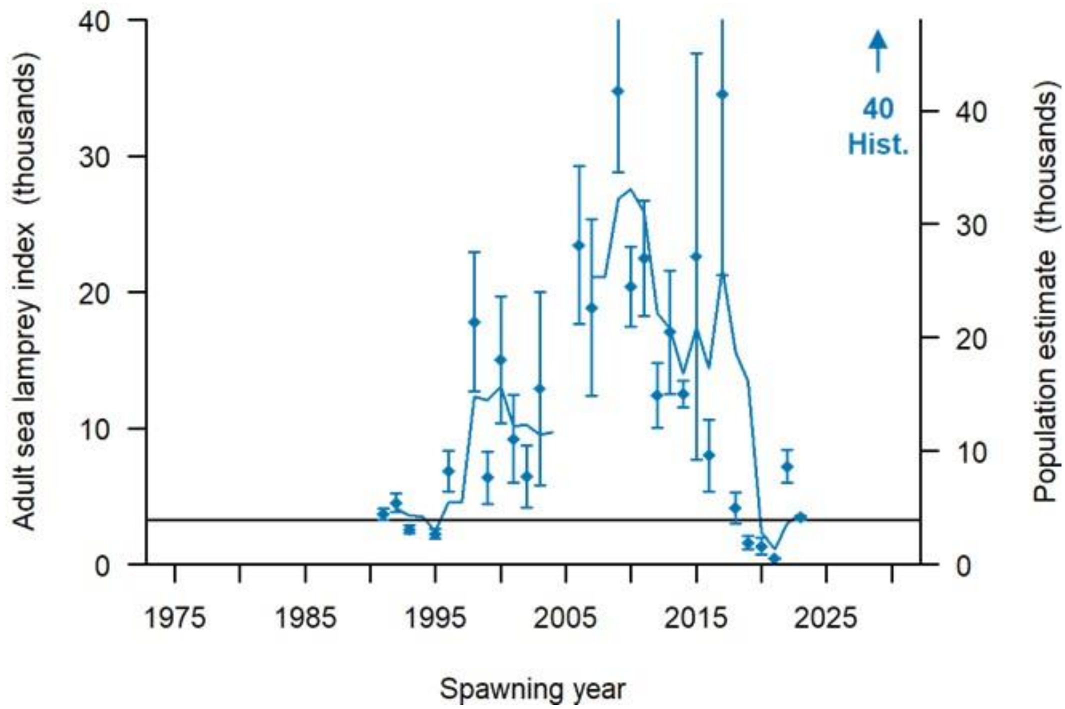


FIGURE 2.5. Index estimates with 95% confidence intervals (vertical bars) of adult sea lampreys, including historic pre-control abundance (as a population estimate) and the 3-year moving average (line). The population estimate (PE) scale (right vertical axis) is based on the index-to-PE conversion factor of 1.2. The adult index in 2023 was 3,500 with 95% confidence interval (3,300-3,600). The 3-year (2021–2023) average of 3,700 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).

Adult Assessment (cont'd)

- 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

- No lampricide treatments were conducted in Lake Erie tributaries in 2023

Larval Assessment

- Larval assessments were conducted in 68 tributaries (15 Canada, 53 U.S.).

- Surveys to detect the presence of new larval populations were conducted in 48 tributaries (9 Canada, 39 U.S.); A new sea lamprey infestation was detected in the River Raisin.

- No post-treatment assessments were conducted because no treatments occurred in 2023.

- FWS completed 24 granular Bayluscide plots in U.S. waters of the St. Clair River; sea lamprey were captured in 4 of the plots. DFO completed 18 granular Bayluscide plots in Canadian waters of the Detroit River, in which no sea lamprey were caught.

Barriers

- Project partners completed a stream geomorphology study above Yates Mill Dam on the Clinton River to provide guidance on stream channel modifications for resolving the formation of a bypass channel around this sea lamprey barrier. Project partners are working together to review the recommendations and plan a course of action.

- The Harpersfield Dam on the Grand River (OH) was retrofitted with a second steel lip on the upper barrier step remediating a nappe vibration which occurred under certain flow rates. The nappe break lip has pulled away from the structure in many sections and requires repair. The Service is working to identify a long-term solution to prevent any further deterioration of the structure.

- The engineering firm AECOM has been contracted to perform a feasibility study for the Flat Rock & Huron dams fish passage project on the Huron River. The study will focus on developing alternatives from repair to full removal of the dams. The Service and GLFC are involved in alternative design discussions ensuring sea lamprey infrastructure is considered to allow for a rapid response should the river become infested with sea lamprey.

- Consultations to ensure blockage at barriers were conducted with partner agencies on two sites within Willow Run Creek, Tributary to the Huron River.

- Partners continue to pursue construction of a sea lamprey barrier in Conneaut Creek. The feasibility study is approaching completion. The study identifies the preferred barrier design and location. During September 2023, an outreach meeting with landowners was held to provide updated project metrics and to inform them of potential impacts to their property. Additional meetings with impacted landowners and the public will continue in 2024.

- In 2023, 15 barriers on Lake Erie tributaries were inspected to ground truth the current barrier inventory data within the Barrier Inventory and Project Selection System (BIPSS) database.

Risk Assessment

- Streamside tests were conducted to determine the toxicity of TFM to logperch (*Percina caprodes*), the primary host fish for the federally endangered snuffbox mussel. Based on the results, logperch mortality during a TFM treatment could be about 5 and 23% at 1.0 and 1.5×MLC, respectively, during a 9-hour exposure. Mortality could then increase to about 50% at 2.0×MLC during a 9 exposure (Kirkeeng et al., in review).

- UMESC conducted tests to determine the toxicity of TFM to larval (glochidia) and juvenile life stages of hickorynut (*Obovaria olivaria*) and round hickorynut (*Obovaria subrotunda*) mussels. Tests demonstrated that TFM is not acutely toxic to the glochidial and juvenile life stage of either species at concentrations applied during stream treatments

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 (ODNR), John Buszkiewicz (MDNR), Tom MacDougall (OMNRF), Mark Haffley (PFBC)

Stocking Data Management

In addition to maintaining internal stocking data for Lake Erie, task group members additionally 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 284,985 yearling Lake Trout were stocked into the eastern basin waters of Lake Erie in 2023, exceeding the stocking goal of 280,000 yearlings (Figure 3.1). In US waters, the USFWS Allegheny National Fish Hatchery stocked a total of 201,315 yearlings split between Dunkirk, New York (80,514 yearlings) and Erie, PA (120,800 yearlings). These were a mix of Finger Lakes (Seneca; 60%) and Lake Champlain (40%) strains. No lake trout were stocked in Ohio waters in 2023 due to the new rotational stocking plan outlined in the revised Lake Trout Rehabilitation Plan (LEC 2021). In Ontario waters, a total of 83,670 yearlings were produced by OMNRF Chatsworth Fish Culture Station and stocked at Nanticoke Shoal. All Ontario fish stocked in 2023 were a Finger Lakes strain (Seneca), representing the first year where Slate Island strain were not represented (Figure 3.1).

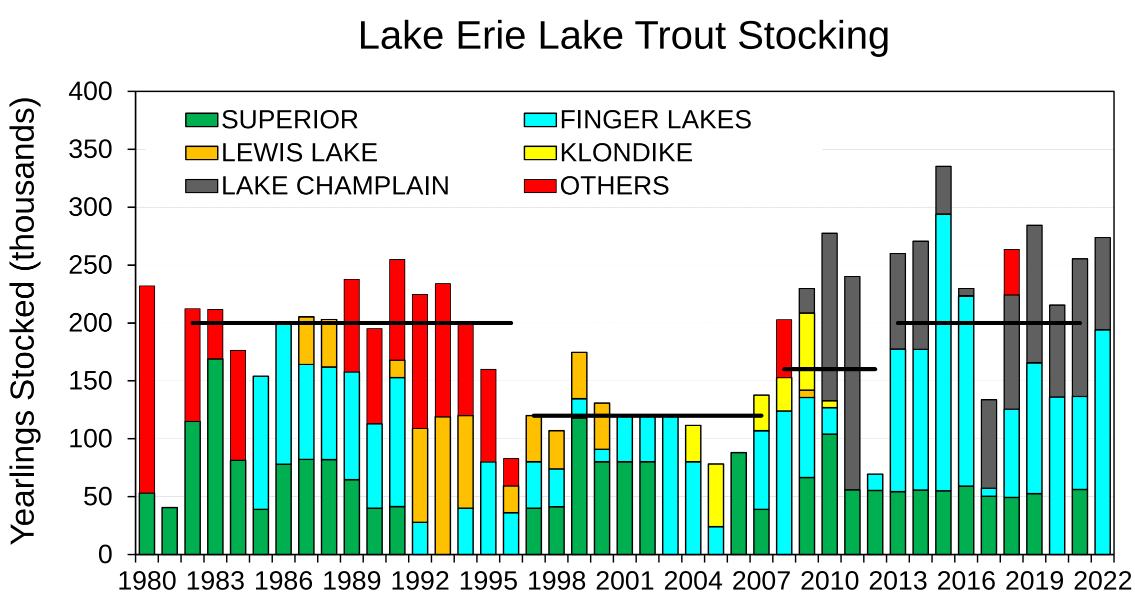


FIGURE 3.1. Lake trout (in yearling equivalents) stocked by all jurisdictions in Lake Erie, 1980-2023, by strain. Stocking goals through time are shown by black lines dark lines; the current stocking goal is 280,000 yearlings per year. Superior includes Superior, Apostle Island, Traverse Island, Slate Island, and Michipicoten strains; Others include Clearwater Lake, Lake Ontario, Lake Erie, and Lake Manitou strains.

Stocking of Other Salmonids

In 2023, over 2.17 million yearling trout were stocked in Lake Erie, including rainbow/steelhead trout (steelhead), brown trout and lake trout (Figure 3.2). Total 2023 salmonid stocking decreased 0.01% from 2022 and was 0.2% below the long-term average (1990-2022) of 2,215,221. Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 3.1 and are standardized to yearling equivalents.

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 1,783,945 yearling steelhead were stocked in 2023, accounting for 82% of all salmonids stocked. This was a 0.9% decrease from 2022 and slightly below the long-term (1990-2021) average annual stocking of 1,846,943 steelhead. None of the rainbow trout stocked into Lake Erie or its tributaries are clipped or otherwise marked. Over half of all steelhead stocking occurred in Pennsylvania waters 57.5%, followed by 26% in Ohio waters, 9.7% in New York waters, 3.1% in Michigan waters, and 3.4% in Ontario waters. The NYSDEC stocked 123,827 yearling steelhead and 50,000 domestic rainbow trout in 2023, which in combination was near their stocking target of 192,500 yearlings. Steelhead stocking in Ohio was 16.2% above a target objective of 400,000 yearling steelhead while Pennsylvania steelhead stocking was roughly .03% above a stocking objective of 1 million yearlings. 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 OMNRF fish culture section. The Ontario stocking in 2023 (60,533) was 40% increase from the previous year (43,225). Details of stocking locations and numbers of fish per stream can be found in agency reports.

Brown Trout stocking in Lake Erie totaled 103,394 yearling and adults in 2023, all in Pennsylvania waters to provide catchable trout for the opening of the 2023 Pennsylvania trout season as well as put, grow, and take fish for later stream returns which began in 2009. This was almost a 37% increase from 2022 and 18.8% increase in the long-term (1990-2021) average annual stocking of 87,038 brown trout. Brown trout stocking levels for catchable trout are expected to continue at the current rates in Pennsylvania.

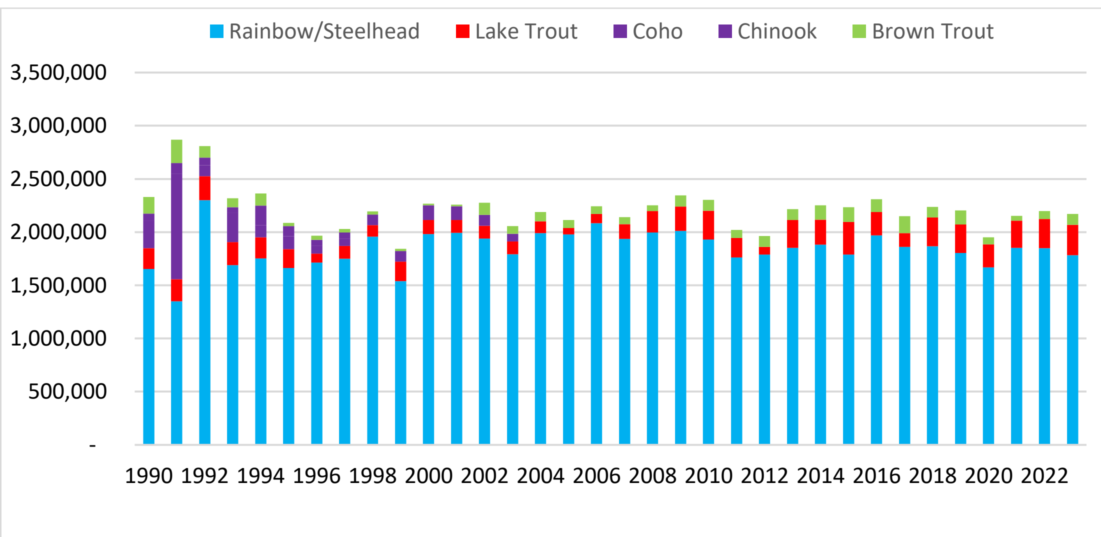


FIGURE 3.2. Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1990-2023.

TABLE 3.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2023

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, 1990-2023.

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, 1990-2023.

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, 1990-2023.

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**

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DISCLAIMER STATEMENT

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