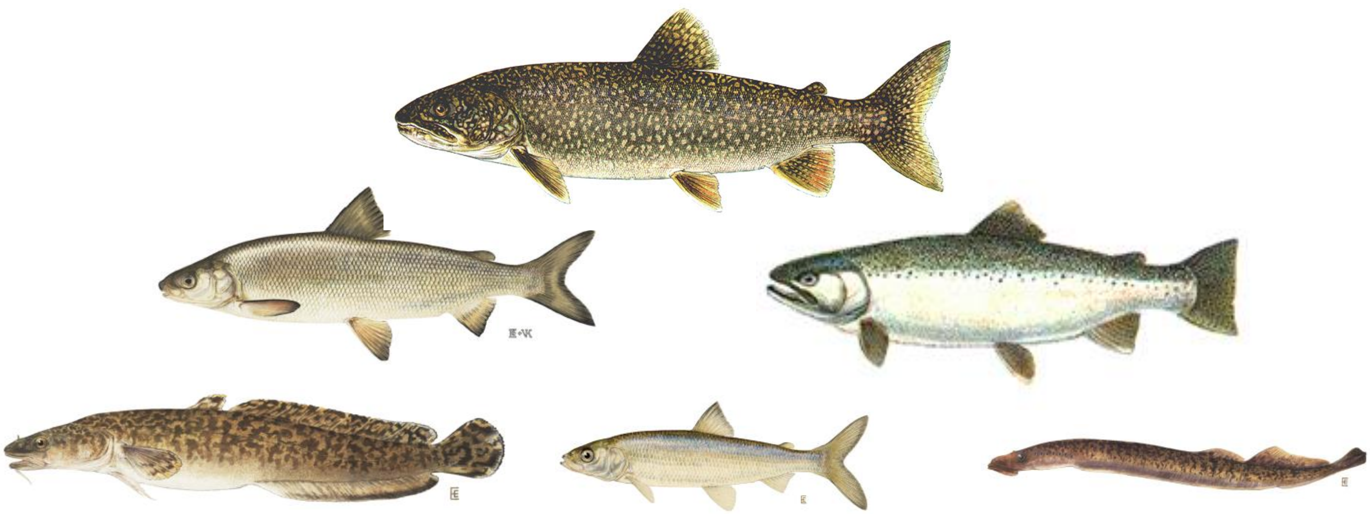
2022 REPORT OF THE
LAKE ERIE COLDWATER TASK GROUP

March 2023

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



CWTG Members:

Tom MacDougall	Ontario Ministry of Natural Resources and Forestry (Co-Chair)
Graham Montague	Ohio Division of Natural Resources
John Buskiewicz	Michigan Department of Natural Resources
Justin Chiotti	United States Fish and Wildlife Service
Andy Cook	Ontario Ministry of Natural Resources and Forestry
Chris Eilers	United States Fish and Wildlife Service
James Markham	New York Department of Environmental Conservation
Lexi Sumner	Department of Fisheries and Oceans, Canada
Joe Schmitt	United States Geological Survey
James Roberts	United States Geological Survey
Mark Haffley	Pennsylvania Fish and Boat Commission (Co-Chair)

Note: Data contained in this report is considered provisional. Use of data for external publication must be approved by the CWTG; please contact the CWTG Co-chairs for permission.

Citation:

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

Cover Art and Line Drawings from:

Raver, Duane. 1999. Duane Raver Art. U.S. Fish and Wildlife Service. Shepherdstown, West Virginia, USA.

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

TABLE OF CONTENTS

Reporting of 2022 – 2023 Coldwater Task Group Charges

Charge 1:	Coordinate annual standardized coldwater assessment among all eastern basin agencies and report upon the status of coldwater fish community	5
Charge 1.1	Report on the status of lake whitefish	7
Charge 1.2:	Report of the status of lake trout relative to rehabilitation plan targets	21
Charge 1.3	Report on the status of burbot	26
Charge 1.4	Report on rainbow trout / steelhead	31
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	34
Charge 3:	Maintain an annual interagency electronic database of Lake Erie salmonid Stocking for the STC, GLFC, and Lake Erie agency data depositories	41
Acknowledgments		47
References		48

Coldwater Task Group Executive Summary Report March 2023

Lake Erie Committee

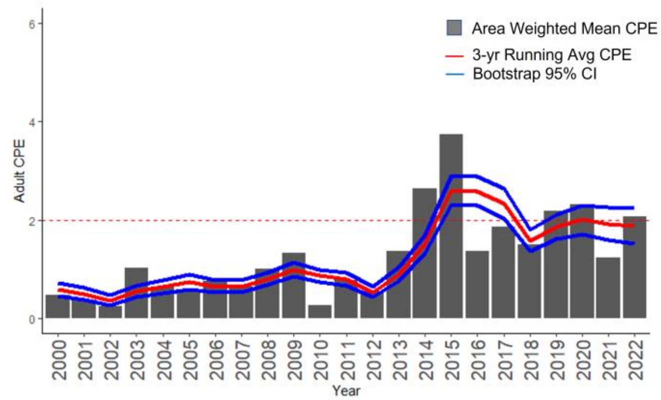
REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

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 2022-2023: (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.

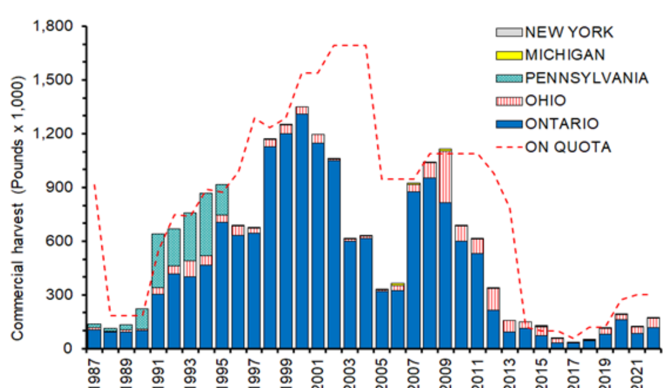
Lake Trout

A total of 344 lake trout were collected in the Coldwater Assessment Survey in 2022. Adult (age 5+) relative abundance increased to 2.1 fish per lift, above the target of 2.0 described in the 2021 Lake Trout Management Plan. There were 17 age classes and six strains captured in 2022. Lake trout ages 7, 12, and 13 were the dominate cohorts. Lake trout older than age-10 continue to increase in abundance and comprised 56% of the total catch. Finger Lakes and Lake Champlain strains comprised the majority of the population. The Partnership Survey caught 22 lake trout in 2022. The Partnership abundance of 0.37 fish/lift decreased from 2021 (0.92 fish/lift) and is below the time series mean (0.44 fish/lift).



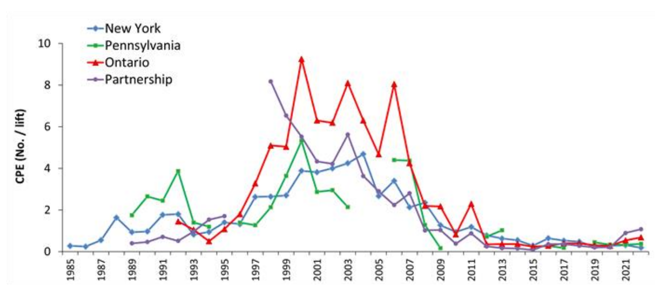
Lake Whitefish

Lake whitefish harvest in 2022 was 170,393 pounds, distributed between Ontario (69%), Ohio (31%), Pennsylvania and New York (<1%). Harvest increased 40% from 2021 and remains low compared to previous decades. Gill net fishery age composition ranged from ages 3 to 19 with ages 3, 4, and 7 representing the majority of the harvest. Lake whitefish status indicators were highly variable among surveys and fisheries in 2022 ranging from low to high. Assessment surveys caught lake whitefish from ages 1 to 29, with age compositions that partially overlapped the 2022 gill net fishery. Bottom trawl and gill net surveys forecast low to moderate recruitment of age 3 lake whitefish from the 2020 cohort in 2023. Continued conservative management and research is encouraged to support lake whitefish population growth and sustainability.



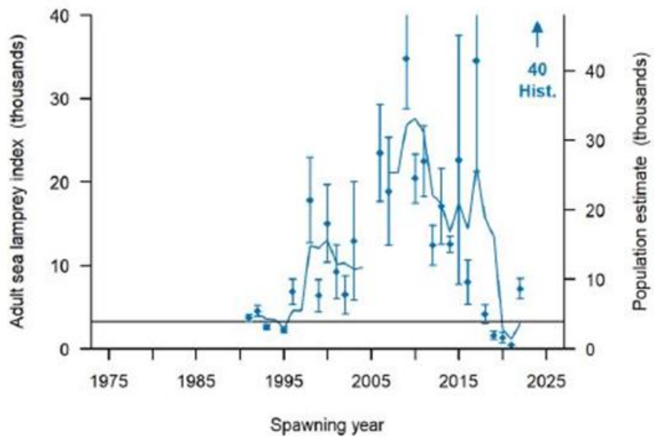
Burbot

Total commercial harvest of burbot in Lake Erie in 2022 was 1,911 pounds. All was incidental. Burbot abundance and biomass indices from annual assessment surveys remained at low levels, continuing a downward trend since the early-2000s. The burbot catch rate in the Interagency Coldwater Assessment Survey averaged 0.46 fish/lift and in the Ontario Partnership Assessment Survey averaged 1.08 fish/lift. Burbot in the Coldwater Assessment Survey and Partnership ranged in age from 2 to 21 and mean age was 7 years. Rainbow smelt was the dominant prey item in burbot diets.



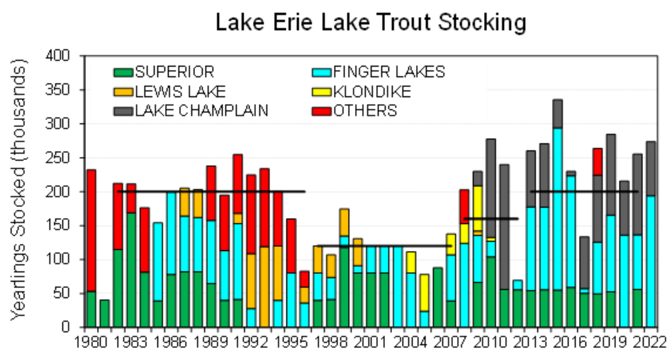
Sea Lamprey

The A1-A3 wounding rate on lake trout over 532 mm was 4.0 wounds per 100 fish in 2022. This was below the target rate of 5.0 wounds per 100 fish for the second year in a row and for only the third time in the previous 26 years. Large lake trout over 736 mm continue to be the preferred targets for sea lamprey in Lake Erie. The Index of Adult Sea Lamprey Abundance (7,200) represents an increase from last year however the three year average-index is below the target of 3,300 for the third year in a row. Lampricide treatments were not completed in 2020 due to Covid-19. Stream barrier assessments were conducted on seven tributaries in 2022. All barriers assessed were found to be effective in limiting sea lamprey infestations.



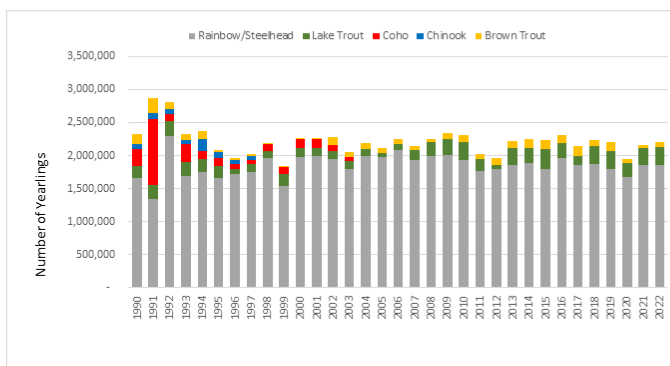
Lake Erie Salmonid Stocking

A total of 2,197,448 yearling salmonids were stocked in Lake Erie in 2022, which was slightly below the long-term average (1990-2021). Lake trout stocking was just shy of the 280,000 goal, and two different strains were stocked in 2022. By species, there were 273,766 yearling lake trout stocked in the east and central basins of Lake Erie, 75,082 brown trout stocked in Pennsylvania waters, and 1,848,600 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 2022 is: Pennsylvania (1,079,958; 58%), Ohio (470,912; 26%), New York (189,835; 10%), Ontario (43,225; 2%), and Michigan (64,670; 4%). Total steelhead stocking in 2022 (1.85 million) was slightly above 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 22,231 steelhead across New York, Pennsylvania and Ohio and near the long-term average harvest of 23,503. Tributary angler surveys, representing the majority (>90%) of the targeted fishery effort for steelhead, found average catch rates of 0.44 fish/hour in 2021-22 in New York tributaries, which are among the highest in the country. Steelhead catch rates in Partnership index gill net surveys (0.13 fish/lift) were low relative to the 23-year time series.



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

Jim Markham (NYSDEC) and Tom MacDougall (OMNRF)

East Basin Coldwater Assessment Program

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

The Coldwater Assessment Survey was redesigned in 2020 to provide better coverage of east basin cold-water habitat, decrease the number of required samples, and maintain comparable metrics between survey methodologies. The previous approach (1986 -2019) utilized a stratified, random transect design for locating bottom set 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. A 2.5-minute grid system is used for random selection of netting locations as opposed to the transect approach. 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 2022 (Figure 1). Sampling effort included 52 standard assessment nets and 48 offshore assessment nets (100 sets total).

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. Unless indicated, all other metrics use data from all collected fish regardless of sampling location. Biased sets due to temperature shifts or other issues were 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.

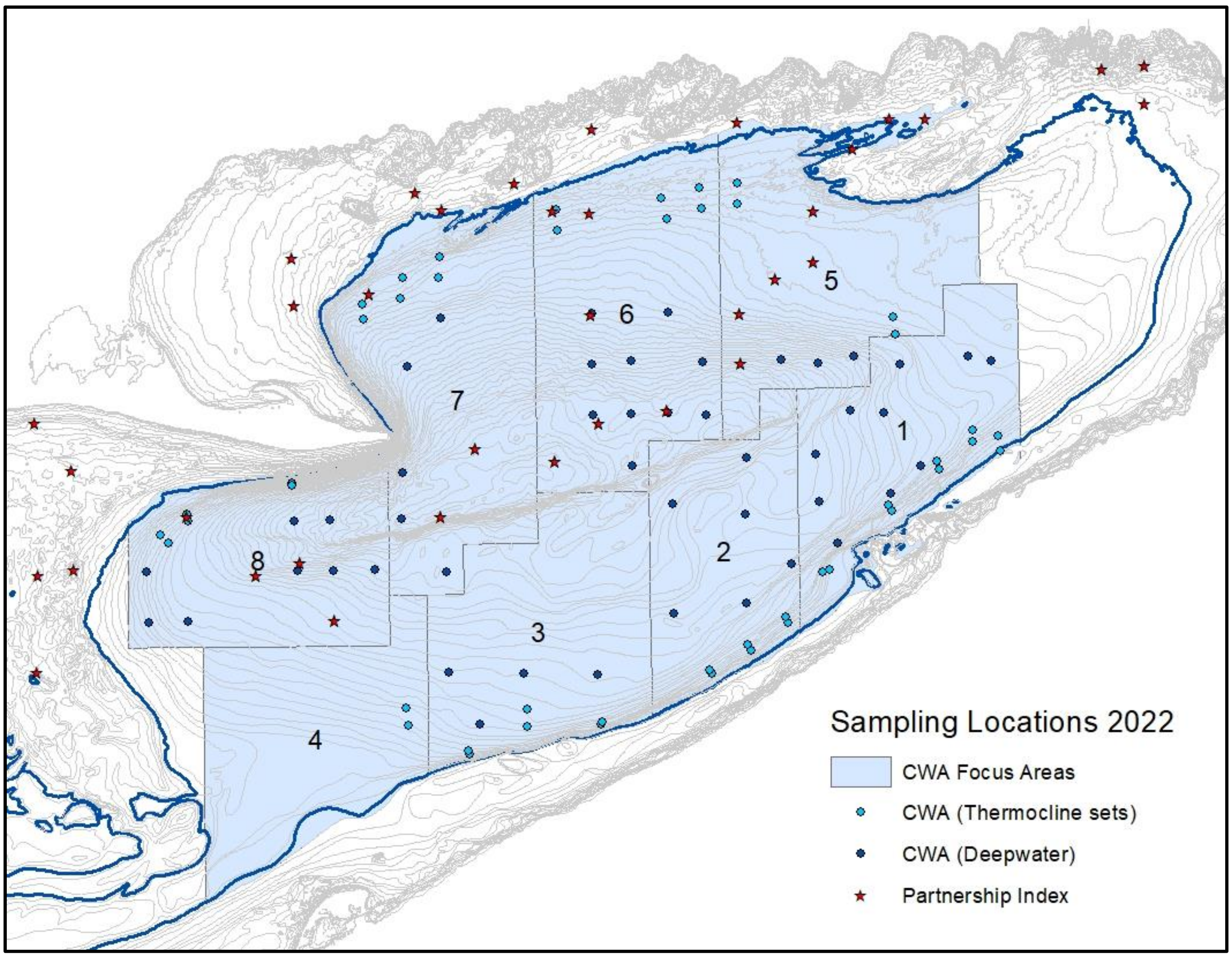


FIGURE 1. Locations of gillnets set for assessment of cold-water species during thermal stratification in the eastern basin of Lake Erie, 2022. Coldwater Assessment Survey sites are indicated with circles (green – standard sets; blue – offshore sets) within survey areas 1-8 (blue polygons bounded by 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, Graham Montague (ODNR), Joe Schmidt (USGS), and Justin Chiotti (USFWS)

Commercial Harvest

The total harvest of lake whitefish in Lake Erie during 2022 was 170,393 pounds (Figure 1.1.1). Ontario accounted for 69% of the lake-wide total, harvesting 117,287 pounds, followed by Ohio (31%; 53,068 pounds) with minimal harvest by Pennsylvania (24 lbs) and New York (14 lbs). Lake whitefish were not harvested in Michigan waters during 2022 (Figure 1.1.2). Total lake whitefish harvest in 2022 increased 40% from 2021. Lake whitefish harvest in Ontario increased 39% from 2021 whereas Ohio's harvest increased by 42%.

Ontario's harvest in 2022 represented 39% of the quota (300,000 pounds). Most (89%) of Ontario's 2022 lake whitefish harvest was from gill nets with 11% from smelt trawls. The largest fraction of Ontario's whitefish harvest (76%) was caught in the west basin (Ontario-Erie statistical district OE-1) followed by OE-4 (10%), with the remaining harvest distributed eastward among statistical districts OE-2 (9%), OE-3 (4%) and OE-5 (1%; Figure 1.1.2). Maximum harvest in Ontario waters during 2022 was distributed west of Pelee Island (Figure 1.1.2). Harvest in OE-1 from October to December represented 69% of Ontario's lake whitefish harvest. Peak harvests occurred in OE-1 during December (49,462 pounds), November (17,463 pounds) and October (14,164 pounds) with 9% of OE-1 harvest occurring from January to May. Central basin lake whitefish harvest (OE2, OE3) was comparable during the first (7,622 lbs) and second (7,763 lbs) halves of the year. Only 12,915 pounds of lake whitefish were landed in eastern Lake Erie (OE-4 and OE-5) in 2022 with 95% of harvest from commercial trawls and the remaining 5% from gill nets. There was no reported effort targeting lake whitefish during 2022 in Ontario waters of Lake Erie. Lake-wide, Ontario's lake whitefish harvest came from

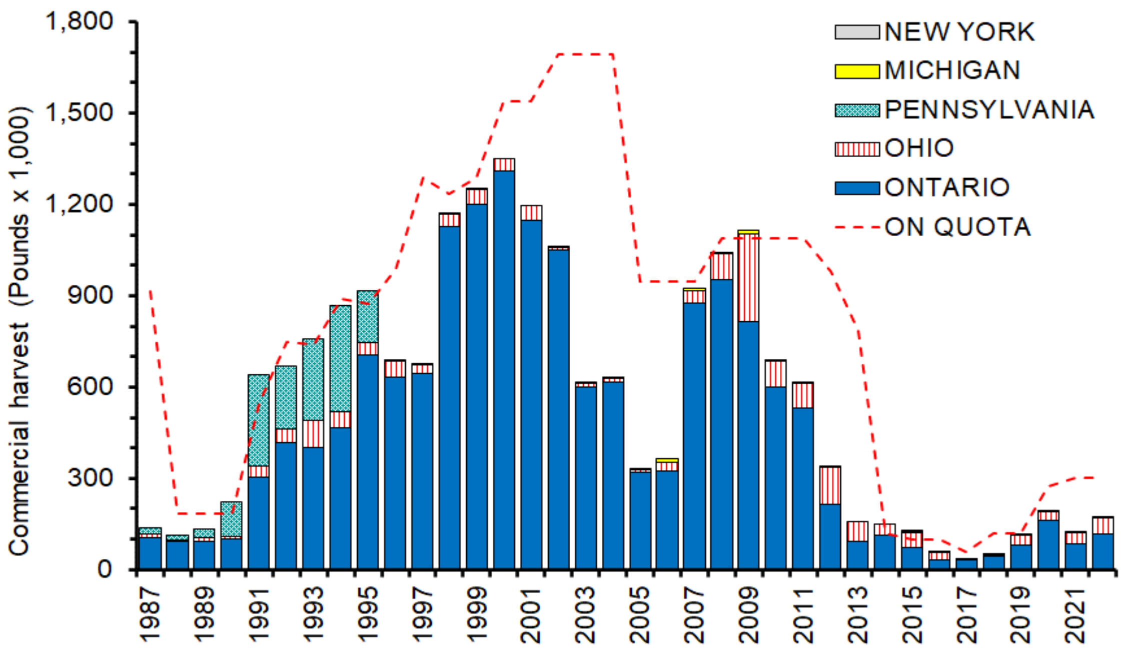


FIGURE 1.1.1. Lake whitefish total harvest from 1987-2022 by jurisdiction in Lake Erie. Pennsylvania ceased gill netting in 1996. Ontario quota is presented as a dashed line.

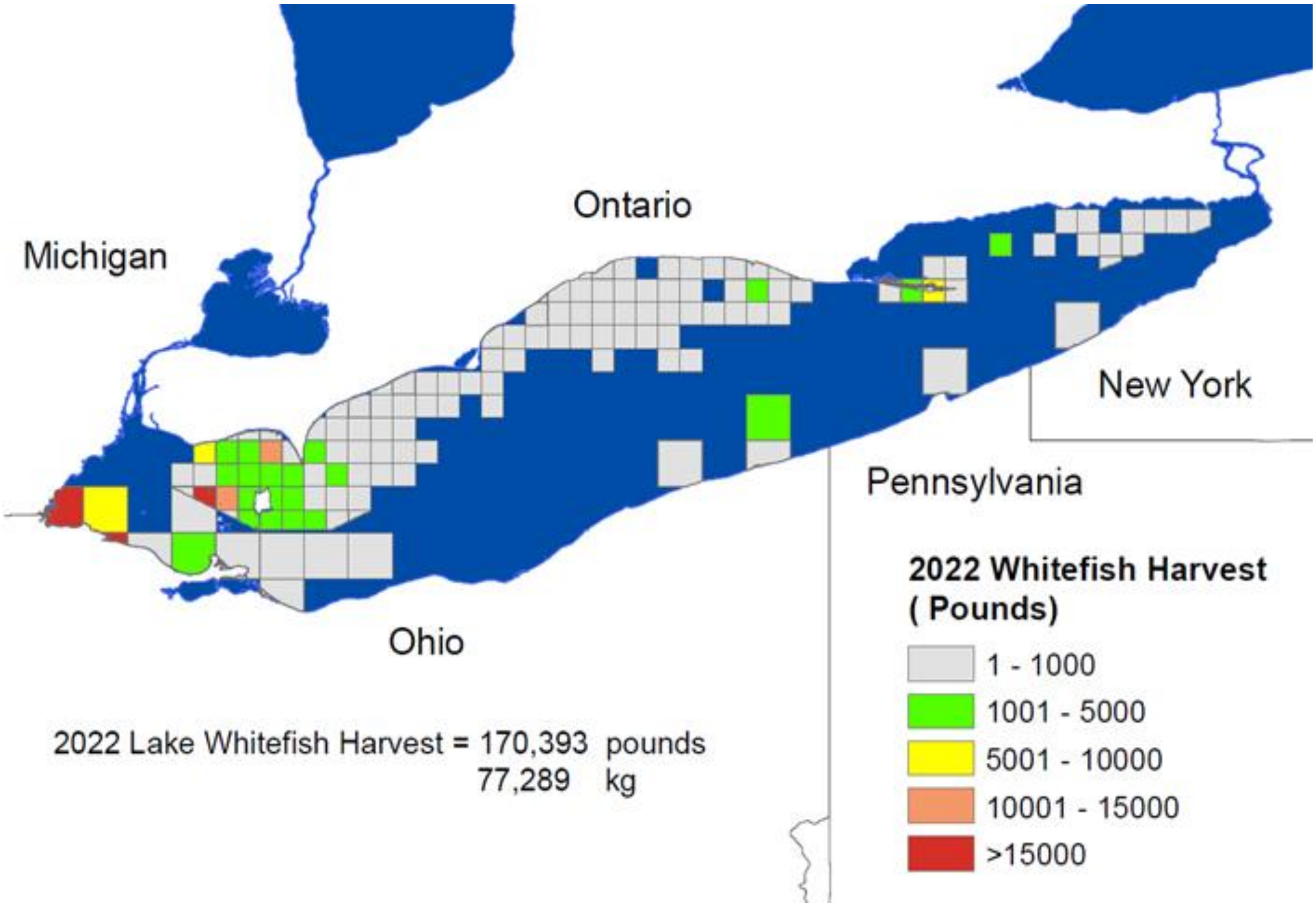


FIGURE 1.1.2. Commercial harvest of lake whitefish in Lake Erie during 2022 by 5-minute (Ontario) and 10-minute (U.S.) grids.

fisheries targeting walleye (85%), rainbow smelt (11%), white bass (3%), white perch (<1%) and yellow perch (<1%). An additional 44 pounds were surrendered to MNRF that included tagged whitefish.

As there was no reported targeted gill net harvest or effort in 2022, 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 2014-2022 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 (2.6 kg/km) and effort with lake whitefish in the catch (8.4 kg/km) during 2022 increased by 43% and 12% from 2021, respectively. Harvest rate metrics in 2022 remained well below the time series averages (9.8 kg/km, 25.4 kg/km respectively) (1998-2022).

Lake whitefish harvest in Ohio waters during 2022 was exclusively from commercial trap nets. Ohio lake whitefish harvest in 2022 (53,068 pounds) was distributed among the west (O-1 96%) and central basin (O-2 <1%; O-3 4 %). Lake whitefish were harvested from 1,516 trap net lifts (zero catches excluded) in 2022, with lifts distributed among District 1 (O-1) (70%), District 2 (O-2) (4%) and District 3 (O-3) (26%), respectively. Trap net harvest was greatest in November (86% or 45,471 lbs) followed by December (2,646 lbs or 5%) and October (2603 or 5%) in O-1 and June (1,637 lbs or 3%) and July (266 lbs or 1%) in O-3. The trap net catch rate (35 lbs / lift) in 2022 was 11% less than 2021 but exceeded the mean (30 lbs/lift 1996-2022) (Figure 1.1.4). The majority (90%) of lake whitefish harvest in Ohio during 2022 was taken near Maumee Bay from grids 902, 801 and 802 (Figure 1.1.2). The catch rate in grid 801 (223 lbs / lift) during 2022 was greater than 6 / 10 previous years. The catch rate in grid 802 (100 lbs/lift) exceeded 8 of 12 previous years. Whitefish harvest in Pennsylvania waters was nominal, from a single trap net lift during 2022 (24 pounds).

Ontario's west basin fall whitefish harvest in 2022 was comprised of ages 3 to 19 with age 3 (2019 cohort), 4 (2018 cohort) and 7 (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 2022.

The landed value of whitefish in Ontario during 2022 was $203,207 or $1.73 / lb CDN. The landed weight of roe from Ontario's 2022 lake whitefish fishery was 545 pounds, collected from the west basin in November (64%) and October (36%). The approximate landed value of the roe was $ 2,126 or $ 3.90 / lb CDN.

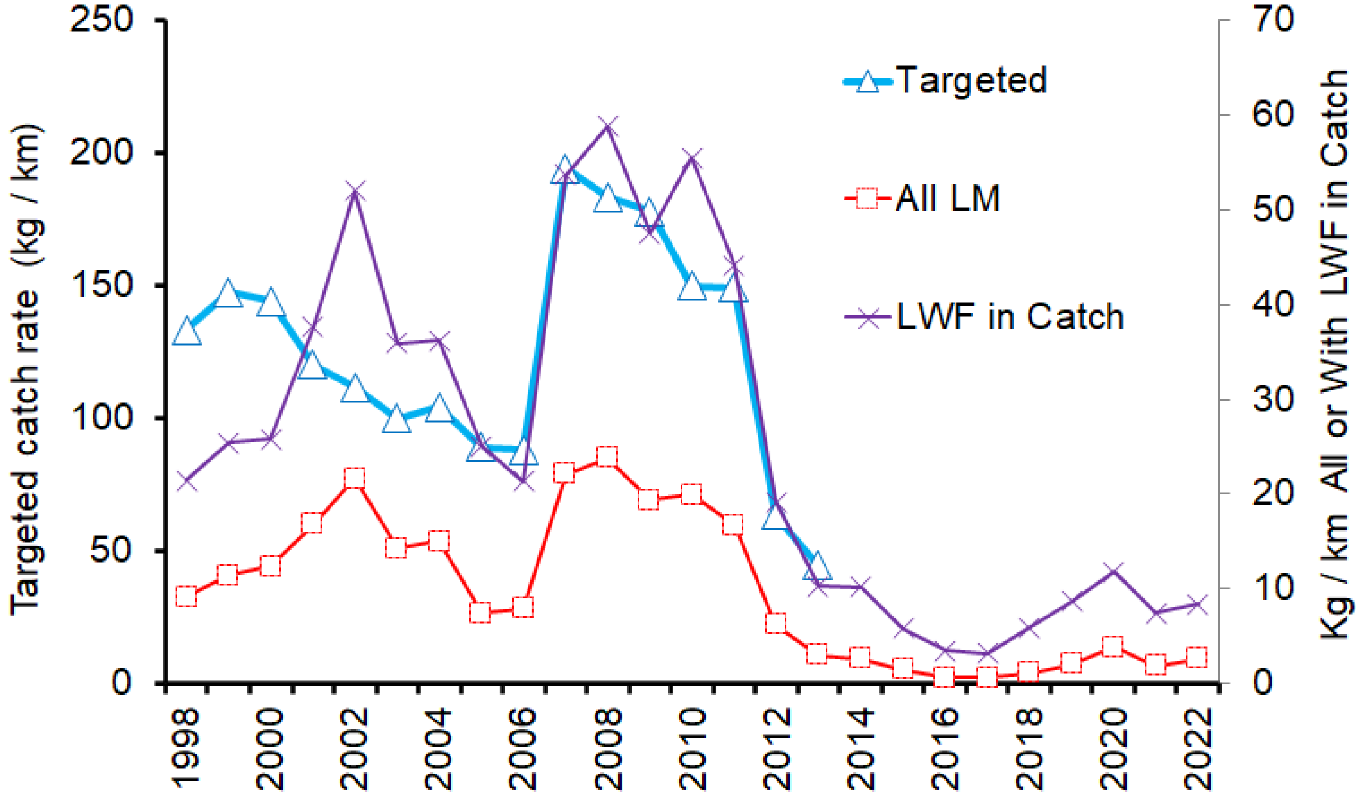


FIGURE 1.1.3. Lake-wide Ontario annual commercial large mesh gill net catch rates according to three forms of effort. Targeted lake whitefish catch rate (kg/km; left axis), catch rate relative to all large mesh gillnet fished (kg/km; right axis), and catch rates from large mesh effort with lake whitefish in the catch (kg/km; right axis). No targeted lake whitefish effort or harvest was reported in 2014 - 2022.

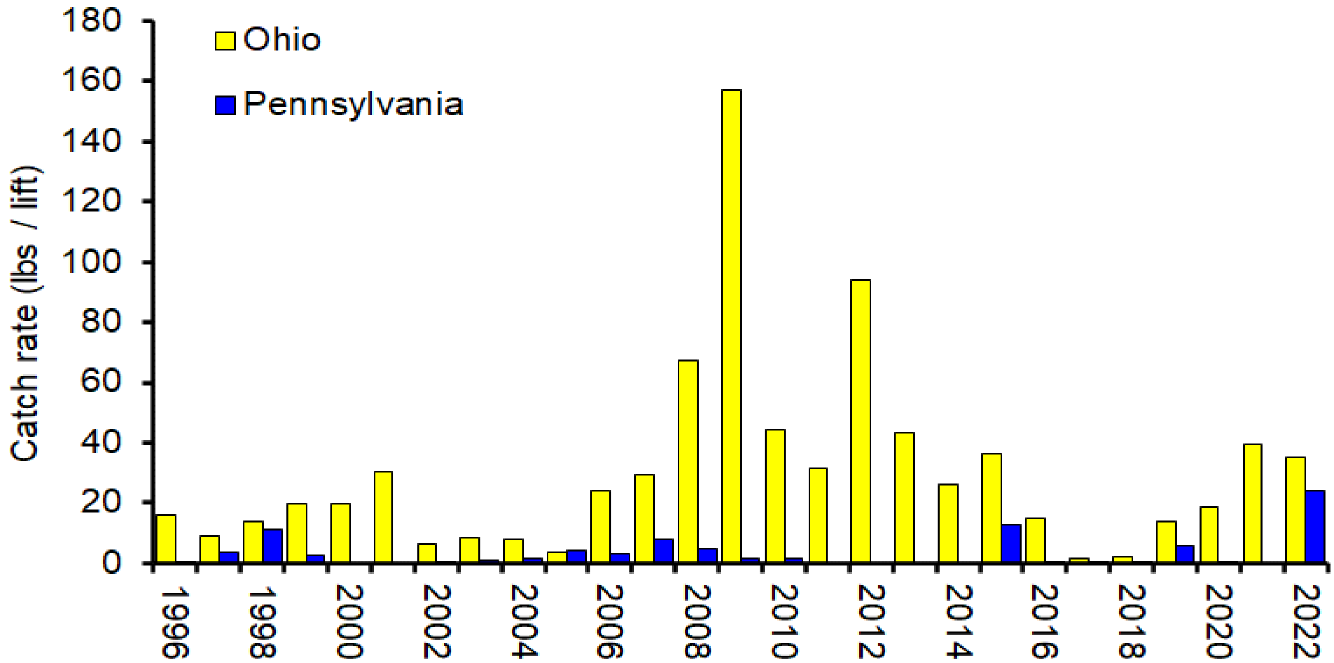


FIGURE 1.1.4. Lake whitefish commercial trap net catch rates in Ohio and Pennsylvania (pounds per lift), 1996-2022. Zero harvest for PA in 2000-2001, 2011-2014 and 2021.

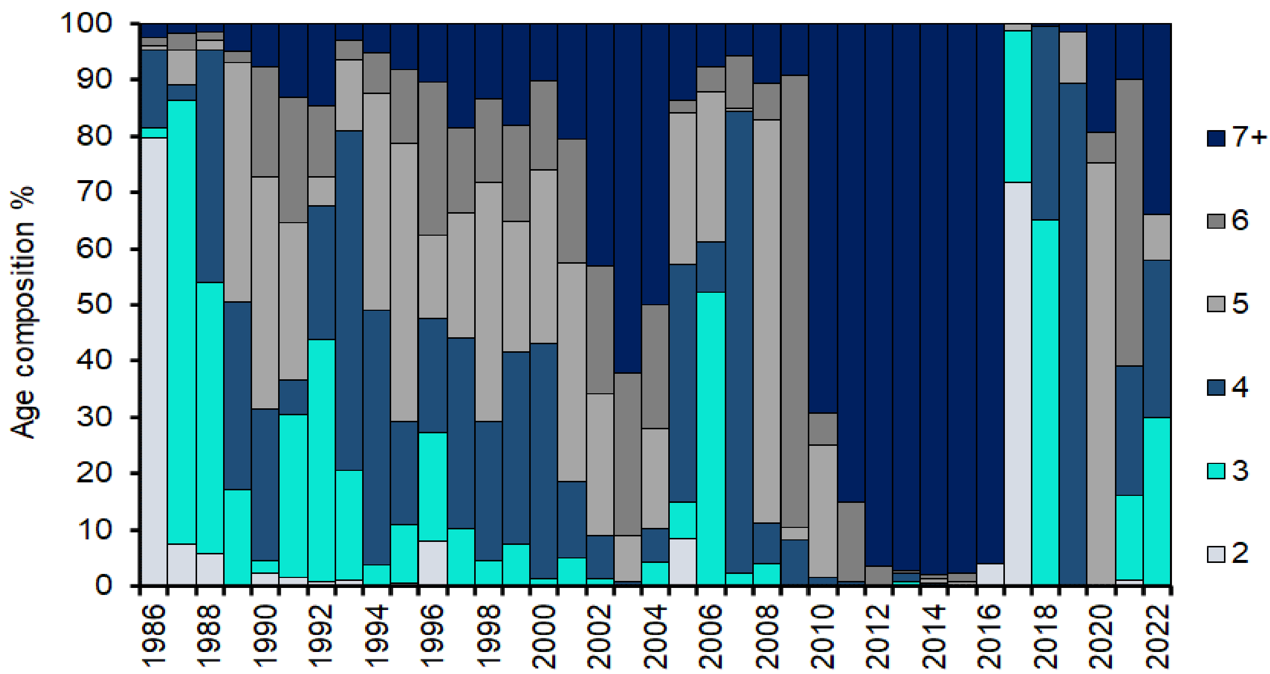


FIGURE 1.1.5. Ontario fall commercial lake whitefish harvest age composition in statistical district 1, 1986-2022, from effort with gill nets ≥3 inches, October to December. N=119 in 2022. Ages 7+ includes whitefish ages 7 and older.

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 2022 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 stations (46 lifts) during 2022 (4.15 fish/lift) decreased marginally from 2021 (4.30 fish/lift) and was third highest in the 38-year time series 1985-2022 (Figure 1.1.6). The high catch rate was influenced by record high catch rates in Ontario and Pennsylvania waters. Catch rates by jurisdiction in 2022 were highest in Ontario (5.09 fish/lift), followed by Pennsylvania (3.63 fish/lift) and New York (3.13 fish/lift). Lake whitefish aged in CWA surveys ranged in age from 1 to 29 with ages 7(25%) ,3 (19%) 8 (16%) and 4 (11%) most abundant (Figure 1.1.7).

Partnership Survey catch rates of lake whitefish ages 0 to 2 was 0.03 fish/lift in 2022, a decline from 2021 (0.07 fish/lift) (Figure 1.1.6). The catch rate for age-3 and older lake whitefish caught in 2022 Partnership Surveys was 0.05 fish/lift, down from 0.13 fish/lift in 2021 (Figure 1.1.6). A total of 20 lake whitefish were caught lake-wide with catches distributed among the east (17), Pennsylvania Ridge (1), east-central (1) and west-central (1) basin surveys. The age composition in Partnership surveys ranged from ages 1 to 7, consisting of age-3 (38%; 2019-year class), age-2 (29%; 2020-year class), age-7 (14%; 2015-year class), age-4 (10%; 2018-year class) and age-1 (5%; 2021 year class) fish (Figure 1.1.7).

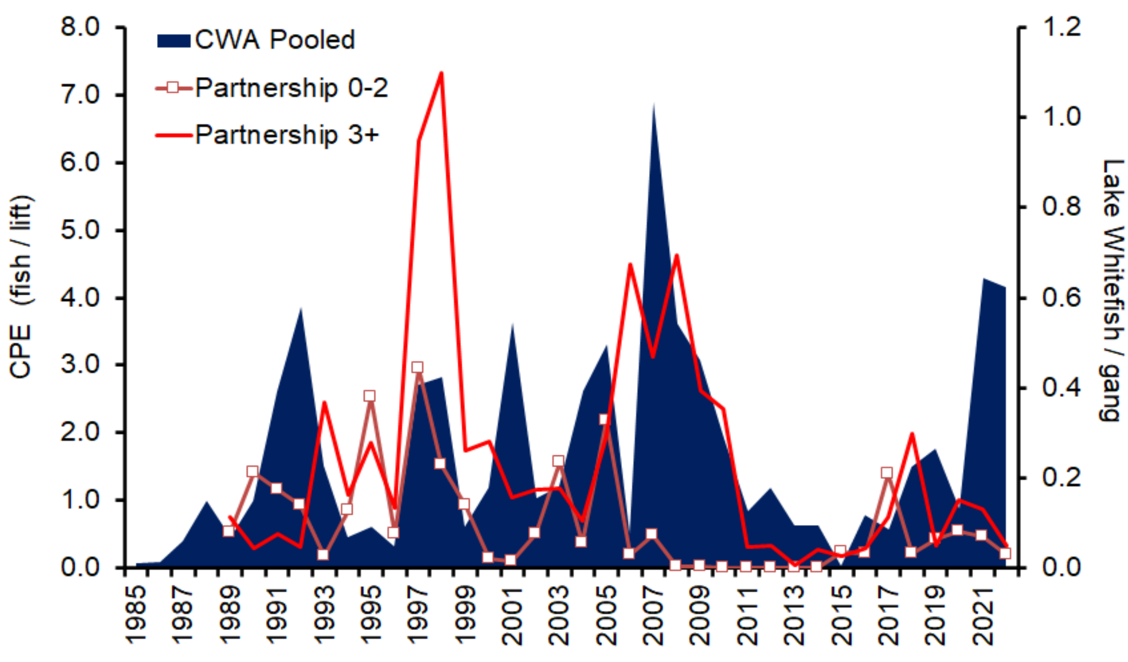


FIGURE 1.1.6. Catch per effort (number fish/lift) of lake whitefish caught in standard coldwater assessment gill nets (CWA) in New York, Pennsylvania, and Ontario waters, weighted by number of lifts (blue area). Partnership index catch rates (LWF/gang) for ages 0-2 (dots) and ages 3 and older (squares) (second axis).

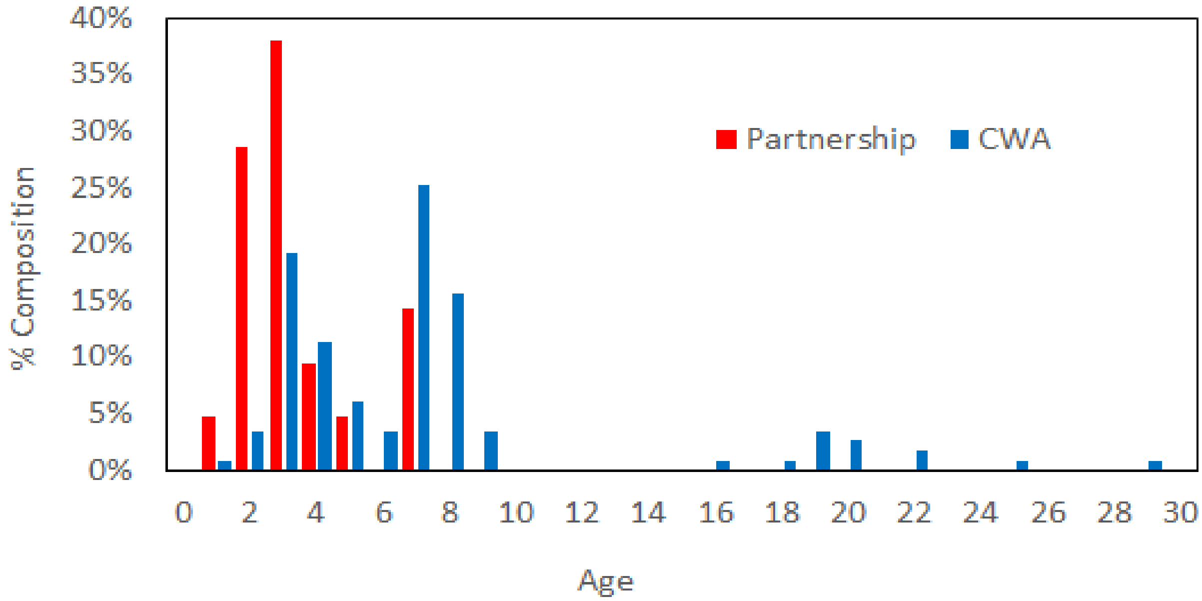


FIGURE 1.1.7. Lake whitefish age composition (%) of the 2022 coldwater assessment (CWA) and partnership surveys. Sample size was 115 and 20 for the CWA and partnership surveys respectively. Partnership age composition is standardized to equal effort.

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 2022, the age 0 catch rate in the central basin was low in June (0.10 / ha) whereas age 0 were absent from October trawls (0 /ha) (Figures 1.1.8). New York's east basin trawl survey in 2022 didn't catch any age 0 lake whitefish (Figure 1.1.8). Yearling lake whitefish were caught at low densities (0.08 /ha,) during June while none were caught in October (Figure 1.1.9). Pennsylvania did not complete any trawl surveys in 2022. During some years, lake whitefish were encountered in Ontario's deep, offshore fall bottom trawl assessment in Outer Long Point Bay, however, in 2022, juvenile lake whitefish were not caught in the Long Point Bay survey.

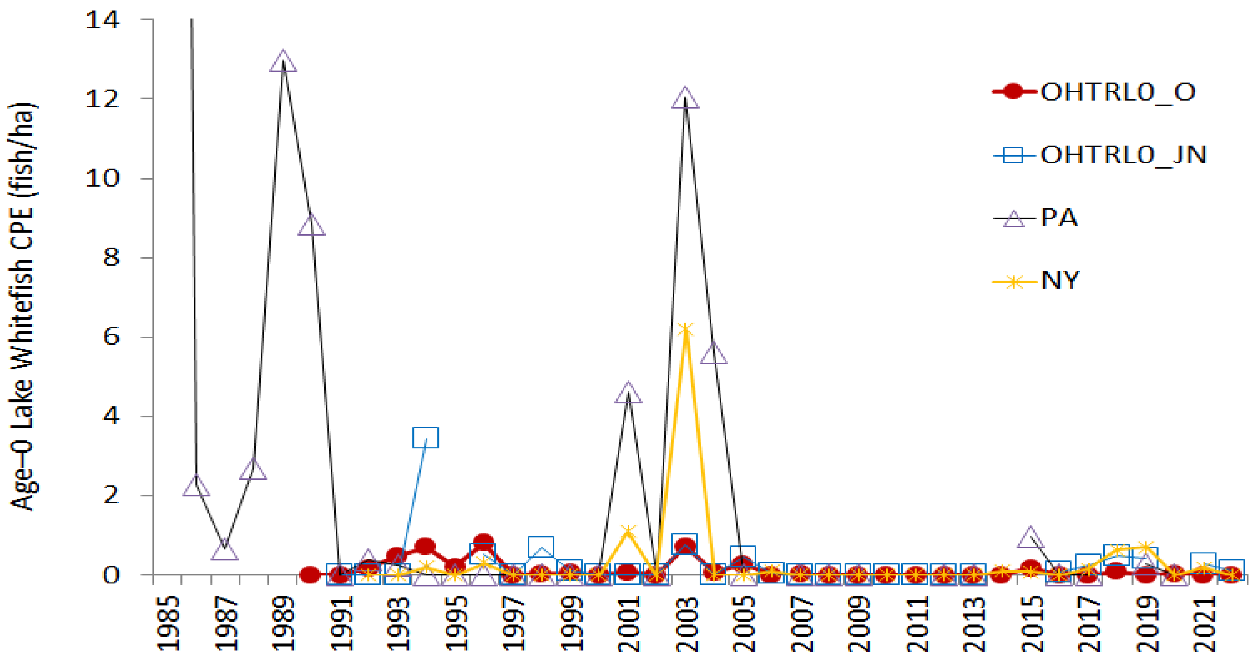


FIGURE 1.1.8. Age 0 Lake whitefish catch per hectare in Ohio (central basin during June – OHTRL0_JN, October – OHTRL0_O), Pennsylvania (PA) and New York (NY) fall assessment trawls. Ohio data are means for October trawls in District 2 and 3. Pennsylvania did not conduct trawls during 2018, 2021, 2022.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

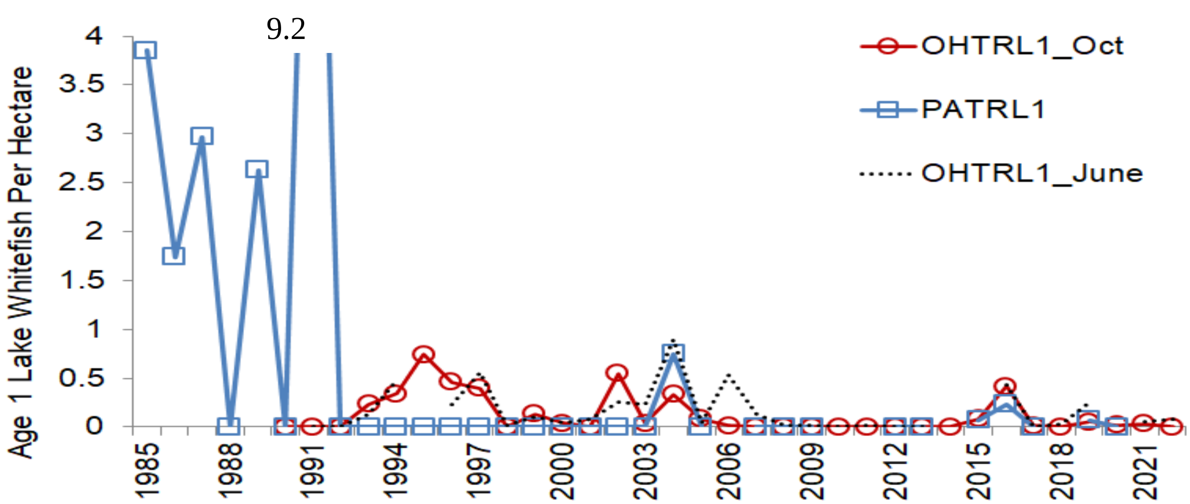


FIGURE 1.1.9. Age 1 Lake whitefish trawl catch rates (number per ha) in Ohio waters during June (dotted line) and October (circles) and in Pennsylvania (PATRL1) waters (squares). Pennsylvania 1991 value (9.2) exceeds maximum axis value. Pennsylvania did not trawl in 2018, 2021 and 2022. Ohio did not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

Stock Discrimination - Genetics

Lake whitefish tissue samples (N=88) collected from west, central, and eastern Lake Erie were sequenced using RAD-capture (Rapture) by Dr. Peter Euclide at Purdue University. Spawning lake whitefish samples from Niagara and Crib Reef (west basin) diverged from pre-spawn samples collected from the west basin (north side), central basin, and east basin of Lake Erie. This research has been published by the Journal of Great Lakes Research (Euclide et al. 2022). Peter Euclide and Joe Schmitt started a GLFWRA funded project looking at the genetic stock structure of lake whitefish across Lake Erie. Collections began in November and December of 2022 at the Detroit River, Maumee Bay, Pelee Island, West Sister Island, and Long Point Bay. Collections will continue in 2023 and will include additional central basin locations.

During 2022, Lake Erie lake whitefish tissue samples were provided to Dr. Louis Bernatchez (University of Laval) to support collaborative research with OMNRF and DFO studying genomics of lake whitefish across the species range.

Growth, Diet and Health

Trends in condition are presented for lake whitefish in relation to historic lake whitefish condition reported by Van Oosten and Hile (1947). In 2022, 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 2022, female and male mean condition factors were above their respective historic means (Figure 1.1.10).

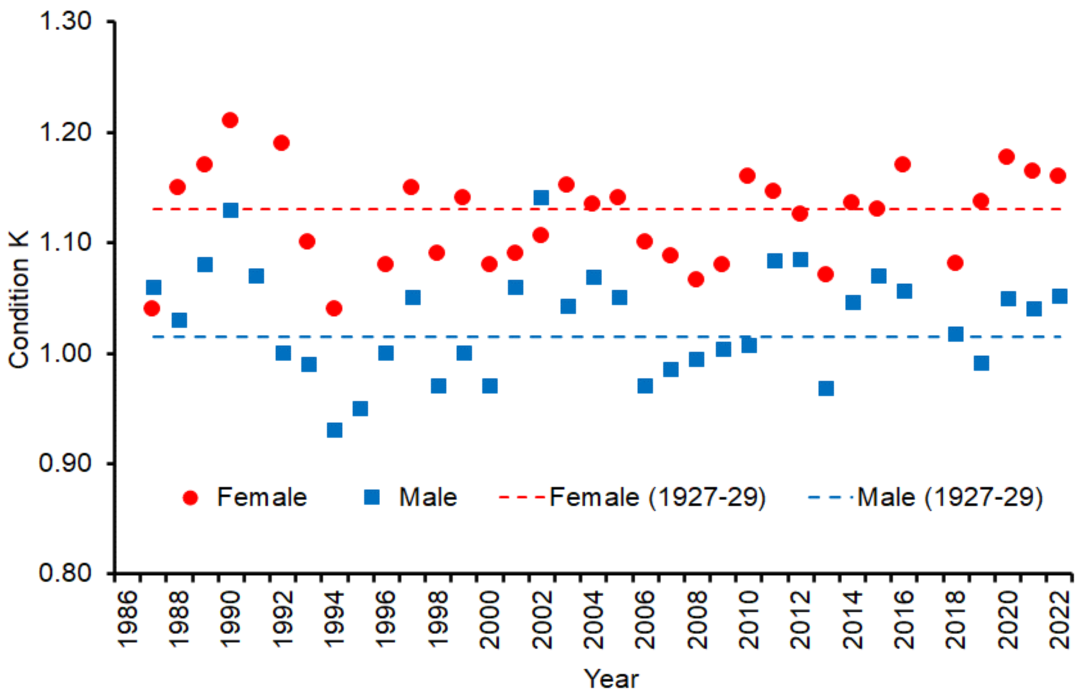


FIGURE 1.1.10. Mean condition factor (K) values of age 4 and older Lake Whitefish obtained from Ontario and Ohio commercial and survey data (Oct-Dec) by sex from 1987-2022. Samples sizes in 2022 were: Males N=41 and Females N=18. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

Diet analyses were completed for lake whitefish collected from Ohio waters of the central basin (D 2,3) from June to October 2022. Dry weight compositions were described for lake whitefish with stomach contents for ages 0 (10 fish), 1 (7 fish) and 2 (66 fish). Age 0 diet in June consisted mostly of zooplankton including Chydoridae (94%) and Copepods (2%) with 4% represented by Chironomid pupae. In August, age 0 diet consisted of Chydoridae and Chironomid pupae in equal proportions. Age 1 whitefish diets in June also included Chydoridae and Chironomid pupae in districts 2 and 3. In September (D3) the diet of age 1 whitefish was more diverse, consisting of Bythotrephes, Sphaerid clams, Chironomids and Isopods. Age 2 whitefish diets included Isopods, Chironomids, Chydoridae and Sphaerid clams.

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 2022, 209 lake whitefish hearts were examined from the CWA, partnership and Ontario commercial fish sampling programs. Heart cysts were present in 90% of hearts examined. Among 209 whitefish, heart cyst densities were classified as none (10%), light (60%), moderate (22%), and heavy (9%). 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.

Acoustic Telemetry

Lake whitefish were implanted with 69 kHz acoustic transmitters and tagged with external Floy tags from 2015 to 2022 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, 378 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 near the Detroit River mouth (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, 47 tagged lake whitefish were harvested by Ontario's commercial fishery (Table 1.1.1 An additional 4 buoyant transmitter tags were recovered on beaches in Ohio and New York from 2021-2022). Spatiotemporal patterns of lake whitefish refect their seaonal habitat and describe their vulnerability to capture by surveys and fisheries. Seasonal migrations through Lake Erie basins (west, central, and east) were described for each lake whitefish tagged in the west basin. The mean proportion of daily detections in each basin by month were calculated for tagged lake whitefish at large from 2016-2021. Annual movement trends (2016-2021) were consistent among years, allowing years to be pooled (2017-2021) to describe seasonal movement (Figure 1.1.11). Migratory whitefish mainly occupied the central basin for 5 months of the year (Jan-May) before migrating eastward as the lake stratified thermally. Whitefish detections were shared between the central and east basins during August transitioning to more detections in the east basin during September. As whitefish migrated westward during October, detections were divided among the three basins. Most whitefish were present in the west basin in November during peak spawning. Dispersal to the central basin during December was evident as the proportion of west basin detections declined. In addition to describing west-east movements, telemetry revealed that whitefish detections were more numerous in southern portions of central and eastern Lake Erie during thermal stratification (Krause et al. 2023). Telemetry also described lake whitefish oxythermal habitat use during summer months over a range of available water temperature and oxygen levels (Krause 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.

Statistical Catch at Age Analysis (SCAA) Population Model

A two-gear statistical catch-at-age (SCAA) model for lake whitefish (CWTG 2022) was updated with 2022 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 (Table 1.1.2, Figure 1.1.12). Age 3 abundance and subsequent trajectories were also estimated using PCA-regression to ground-truth SCAA age 3 abundance estimates from a model that may have been impacted by invalid assumptions related to the transition from targeted to non-targeted fisheries (Table 1.1.2, Figure 1.1.12). This alternate forecast (Figure 1.1.12 dotted line) was produced for comparison with SCAA estimates. As model data accumulates, SCAA and PCA recruitment estimates for cohorts (2014,2015) are converging. Abundance and spawner biomass were forecasted to 2025 assuming 2022 SCAA survival estimates. Forecasted spawner biomass from 2022 – 2025 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 (1.2-2.1 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 2025, provided fisheries' harvest remains conservative (Figure 1.1.13).

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 (2017-2018 & 2021) and zooplankton (2021) were collected weekly at 31 locations across the southern portion of Lake Erie. We found larval lake whitefish prefer to eat cyclopoid copepods, but all copepods and Cladocera are important edible zooplankton. In addition, both larvae and edible zooplankton were more concentrated at nearshore locations than offshore locations. Although we would expect nearshore larvae with access to more edible zooplankton to have more edible zooplankton in their stomachs, the biomass of edible zooplankton consumed was consistent between the nearshore and offshore locations, suggesting that offshore areas with relatively low edible zooplankton biomass harbor enough food to satiate larval lake whitefish. Since Lake Erie is more productive than the other Great Lakes, a mismatch between pelagic larvae and edible zooplankton may be unlikely regardless of location. Therefore, it is unlikely that prey availability limits survival through means of starvation. However, differences in seasonal edible zooplankton abundance could lead to increased larval growth, promoting survival. We're currently working to understand how edible prey abundance during the larval stage translates into fish growth and recruitment.

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. Fall of 2022 marked the second field season of the project, with egg mats and egg pumping deployed by crews in nearshore areas of the central and eastern basins. 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. Crews recollected lake whitefish eggs at many of the same locations they were observed in the central basin in 2021 (Figure 1.1.14), however, no lake whitefish eggs were collected in the eastern basin. The eggs were brought to the USGS Great Lakes Science Center where they are being reared to the larval stage to confirm species identification and undergo genetic analysis to hopefully identify the spawning stock. Lake trout (Salvelinus namaycush) eggs were also observed at sites in both basins. For more information on habitat evaluation at each site, please see the 2023 Lake Erie Habitat Task Group Report.

Summary

In 2022, lake whitefish fishery, survey and model indicators were variable with status signals ranging from low to high. Total lake whitefish harvest in 2022 (170,393 pounds) increased 40% from 2021. Ontario's incidental harvest in 2022 attained 39% of lake whitefish quota of 300,000 pounds. Ohio's trap net fishery targeted lake whitefish in 2022, harvesting 53,068 pounds. 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 2022, 12% of walleye quota in the west basin (MU1) 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 8 and older with contributions from fish ages 3, 4 and 5. The Coldwater Task Group recommends continued conservative management of lake whitefish. Research focused on lake whitefish habitat and survival during early life stages supports our understanding of population dynamics and future management of lake whitefish in Lake Erie. The Coldwater Task Group has been developing a single lake whitefish status index that integrates lake whitefish fishery and survey performance metrics. Upon completion, this status index may support lake whitefish management initiatives among jurisdictions.

TABLE 1.1.1. Number of lake whitefish tagged with internal acoustic transmitters and Floy tags by location 2015 – 2022. Number of tagged whitefish recaptured by fisheries from 2015 – 2023. Recaptures in 2023 are incomplete.

			Recaptures									
Tag Year	**Tag Location**	**# Tagged**	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
2015	Maumee Bay	10			1							1
2016	Hen Island - Little Chicken	37		3			1	1				5
2017	Crib Reef	25			1		1	1	1			4
2017	Hen Island - Little Chicken	55			5	1	1	1	1	1		10
2017	Niagara Reef	25						2			1	3
2018	DR mouth	2										0
2019	Crib Reef	50						3	2			5
2019	SW Colchester [1]	35					4	1	2			7
2019	Maumee Bay	15										0
2020	Pelee Island	20						1		2		3
2020	SW Colchester [1]	14										0
2021	Pelee Island	16										0
2022	Hen Island - Little Chicken	45								5		5
2022	Pelee Island	29								4		4
	Grand Total	378	0	3	7	1	7	10	6	12	1	47

1 . Staging Whitefish east of the Detroit River Mouth southwest of Colchester

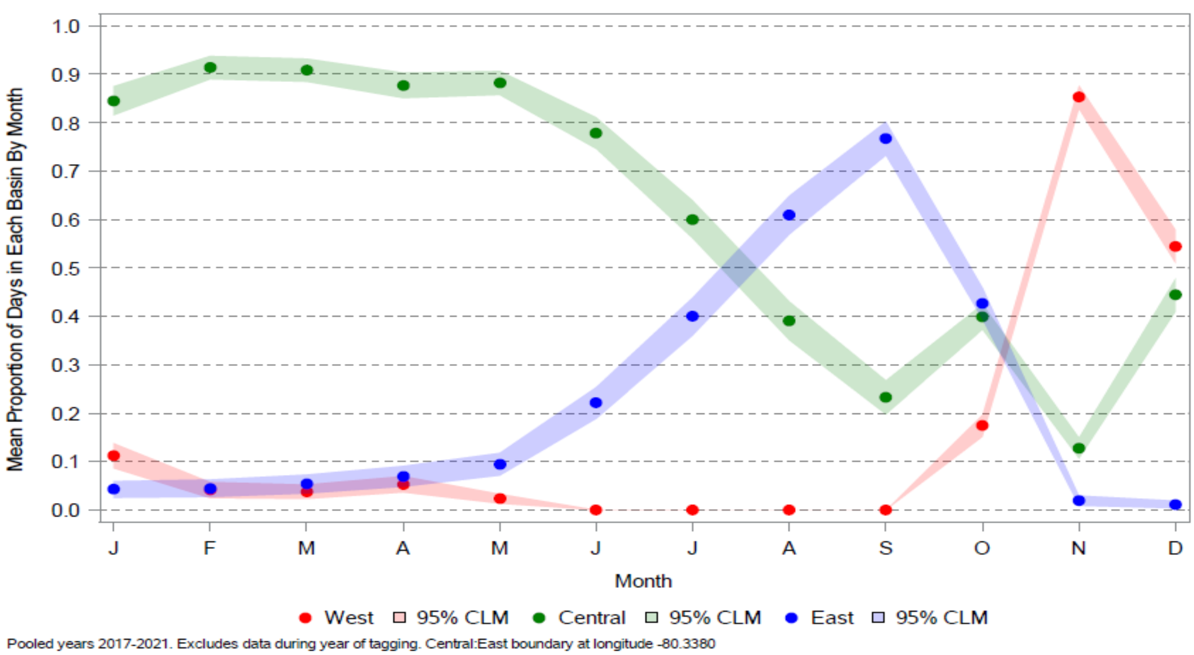


FIGURE 1.1.11. Mean proportion of days whitefish were detected monthly in the west, central and eastern basins from 2017-2021. Includes whitefish that were tagged in western Lake Erie 2015-2020. Analysis excluded detections during the year in which fish were tagged. Stationary fish detected but considered deceased were excluded from analyses.

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 – 2022 cohorts. Number of surveys, ages and cumulative variance of 1st and 2nd principal components (P1, P2) presented

Year	Year Class	SCAA	PCA REG	Lower	Upper	# Surveys	PCA Ages	Cumulative Variance P1, P2	Adj R^2	Pr > F
2017	2014	1,152,500	853,139	642,689	1,063,588	7	0,1,2	0.88	0.99	<.0001
2018	2015	5,033,190	3,648,858	3,294,796	4,002,920	9	0,1,2	0.87	0.98	<.0001
2019	2016	12,014	177,748	(125,409)	480,905	10	0,1,2	0.86	0.99	<.0001
2020	2017	174,907	662,992	350,835	975,149	9	0,1,2	0.83	0.98	<.0001
2021	2018	472,740	2,557,864	2,348,844	2,766,885	9	0,1,2	0.87	0.99	<.0001
2022	2019	764,483	789,667	454,591	1,124,742	9	0,1,2	0.85	0.98	<.0001
2023	2020		402,705	35,612	769,798	8	0,1,2	0.85	0.97	<.0001
2024	2021		1,027,956	806,125	1,249,787	7	0,1	0.83	0.99	<.0001
2025	2022		268,481	42,456	494,506	4	0	0.91	0.98	<.0001

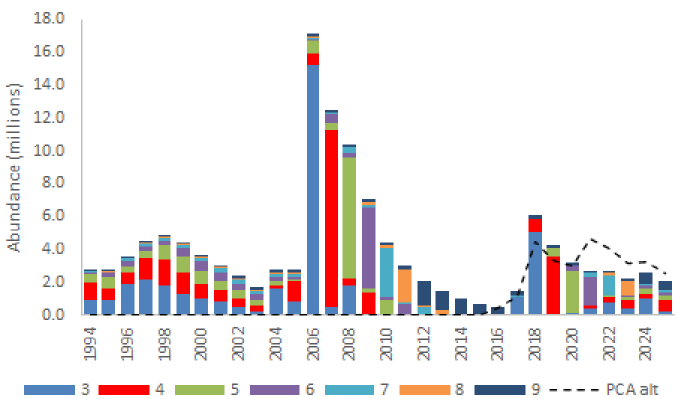


FIGURE 1.1.12. Lake Whitefish abundance estimates at age (3 to 9+) from SCAA (1994-2022) with projections to 2025 from recruit indices in PCA (stacked bar). Age 3 recruitment estimates from PCA – regression for cohorts 2014-2022 projected forward with SCAA terminal survival estimates as an alternate population assessment (dotted line).

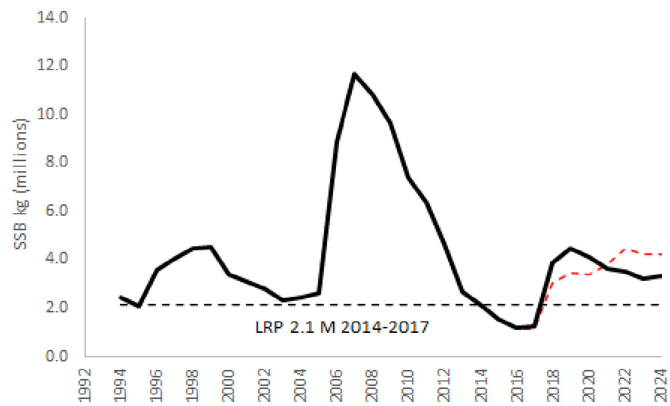


FIGURE 1.1.13. Lake Whitefish spawning stock biomass estimates (kg – black line) projected to 2025, assuming constant SCAA survival estimates from 2022. Alternate SSB trajectory (PCA alternate) based on recruit indices in PCA-regression for cohorts 2014-2022. SSB Limit reference point was based on low SSB 2014-2017 as a dotted line.

FIGURE 1.1.14. Number of lake whitefish eggs detected at the Loraine and Fairport, Ohio sites in 2021 and 2022.

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

James Markham (NYSDEC), Andy Cook, Tom MacDougall (OMNRF), Mark Haffley (PFBC), Joe Schmitt (USGS)

In 2022, 148 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 2.73 fish/lift (Figure 1.2.1). The highest catches occurred in New York (Areas 1 & 2; 5.9 fish/lift) and Pennsylvania (Areas 3 & 4; 3.0 fish/lift) waters with lesser catches in Ontario waters (Ontario-east - Areas 5 & 6; 1.6 fish/lift; Ontario-west - Areas 7 & 8; 0.9 fish/lift). With some exceptions, the highest CPEs have typically been recorded in New York, coinciding with higher yearling lake trout stocking over time, and lower in Ontario waters, where annual stocking was less and did not commence until 2006.

Catches of lake trout in offshore nets (N=196) exceeded catches in the standard assessment nets in 2022 (Figure 1.2.1). Similar to 2021, 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 3.36 fish/lift, marking the second consecutive year that higher catch rates occurred in offshore nets compared to the standard assessment nets.

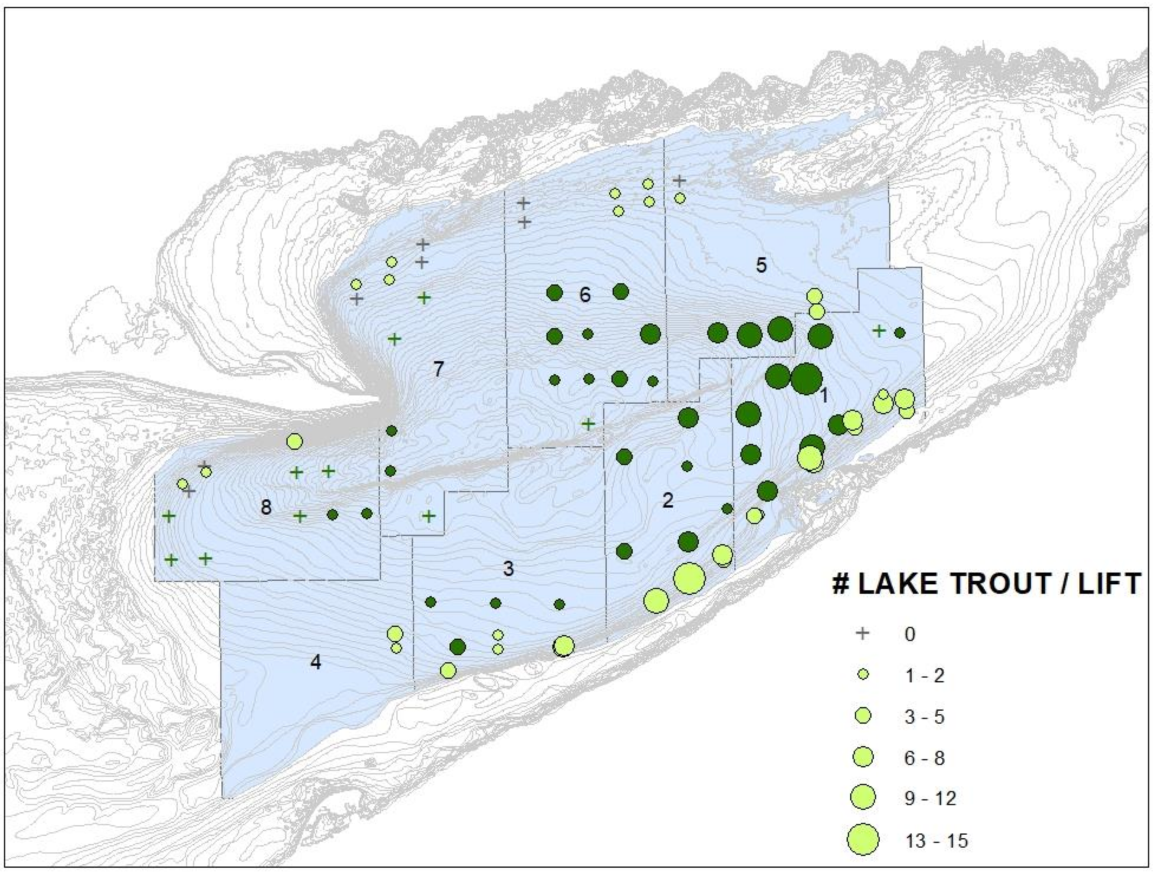


FIGURE 1.2.1. Catch rates (CPE; fish/lift) of lake trout (all ages) caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, August 2022. Relative CPE is indicated by scaled circle size. Light green circles represent standard net set locations; dark green circles indicate offshore 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 age-classes among six different strains were represented in 2022 with the oldest lake trout age-32 (1990 year class; FL strain) (Figure 1.2.2). Ages 7, 12, and 13 were the most abundant and represented 38% of the total catch. The abundance of lake trout older than age-10 has increased in recent years and comprised 56% of the overall catch in 2022. The strains of lake trout that contributed most to the total catch in 2022 were Lake Champlain (LC; 47%) and Finger Lakes (FL; 46%) followed by Slate Island (SI; 6%). These three strains have been the most commonly stocked lake trout strains in Lake Erie over the past thirteen years.

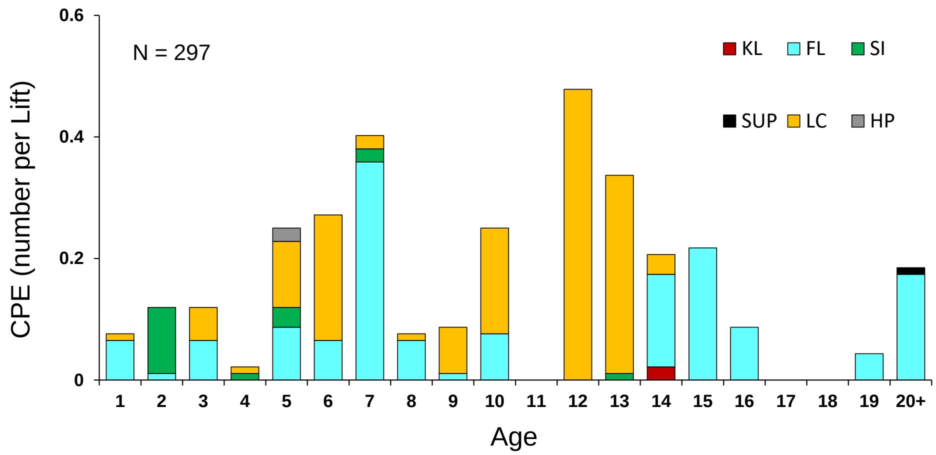


FIGURE 1.2.2. Relative abundance (number per lift) by strain at age, of lake trout sampled in all assessment gill nets in the eastern basin of Lake Erie, August 2022. Abbreviations for strains include HP (Huron-Parry Sound); FL (Finger Lakes); SI (Slate Island); SUP (Superior); KL (Klondike); and LC (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 (hereafter: the Plan) is 2.0 fish/lift. Adult abundance increased in 2022 to 2.1 fish/lift from 1.2 fish/lift in 2021 (Figure 1.2.3). Adult abundance has been above target for three of the past four years. The 3-year running average of adult abundance was 1.9 fish/lift. No Plan management actions were triggered as the 95% confidence limits of the 3-year running average of the CPE continue to bound the target. (Figure 1.2.3).

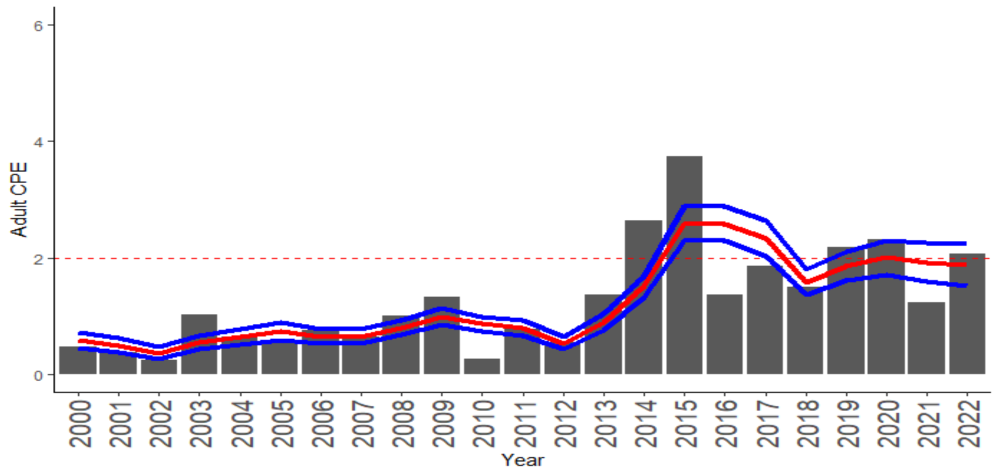


FIGURE 1.2.3. Mean combined CPE (number per lift, weighted by area) for lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 2000-2022. Grey bars: annual mean adult (age 5+) lake trout CPE. Red dotted line: targeted adult lake trout CPE (2.0 fish/lift). Red solid line: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

Twenty-two (22) lake trout were caught in Partnership Survey index gear in the east basin survey during 2022. No lake trout were caught in all other areas of the lake assessed. All lake trout were captured in nets fished on bottom. The 2022 lake trout index in the east basin (0.37 fish/lift) decreased from 2021 (0.92 fish/lift) and dropped below the time series mean (0.44 fish/lift). The catch rate in the Pennsylvania Ridge survey was 0 fish/lift in 2022; the time series mean is 0.18 fish/lift (Figure 1.2.4). Total catch was composed of Slate Island (12 or 55%), Finger Lakes (3 or 14%) and unknown (7 or 32%) strains. All lake trout had adipose fin clips. Ages derived from coded wire tags ranged from 1 to 14, consisting of age-2 (60%), age-1 (13%), age-5 (13%), age-7 (7%) and age-14 (7%).

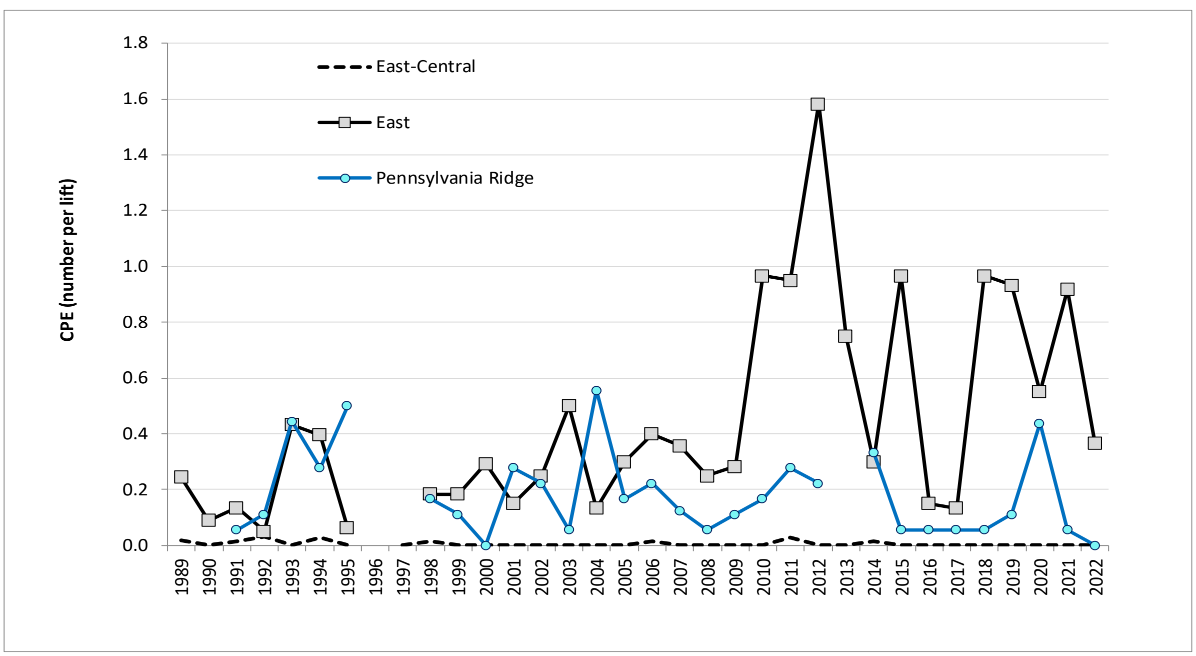


FIGURE 1.2.4. Lake trout CPE (number per lift) by basin from the OMNRF Partnership Index Fishing Program, 1989-2022. Includes canned (suspended) and bottom gill net sets, excluding thermocline sets.

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 2022 estimated at 433 fish (Figure 1.2.5). An estimated 216 lake trout were harvested in New York waters out of an estimated catch of 1,151 fish in 2022. Pennsylvania anglers harvested an estimated 217 fish from a total catch of 341 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 or in Ontario waters where no recent creel surveys have been conducted.

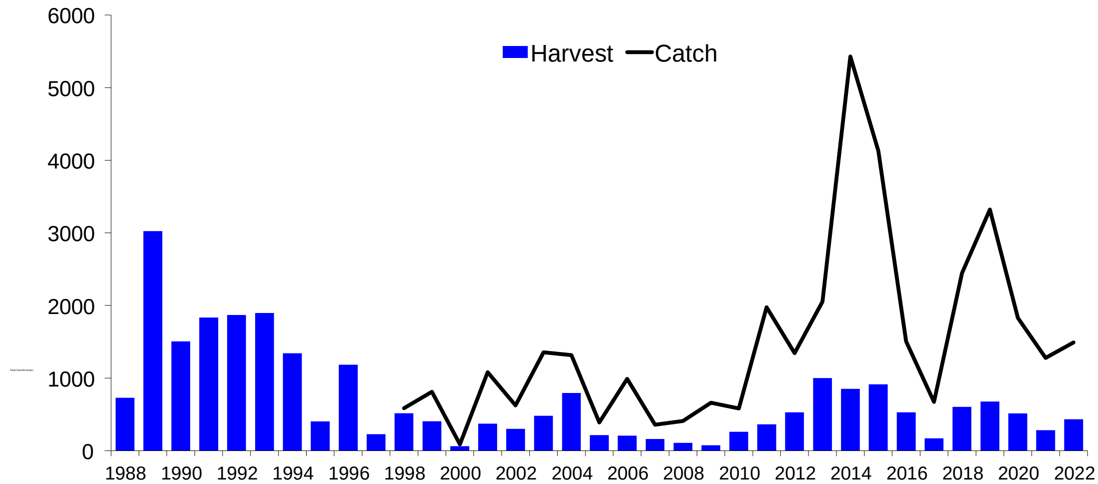


FIGURE 1.2.5. Estimated lake trout catch and harvest by recreational anglers in the New York and Pennsylvania waters of Lake Erie, May-October, 1988-2022.

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 May 2021 and 2022 at these locations confirmed the presence of naturally reproduced lake trout fry, 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. However, when 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 2022, five potentially wild fish (no fin clips; no CWT's) out of a total of 344 lake trout (all nets) were caught during the survey, representing 1.5% of the fish captured. Altogether, a total of 86 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.

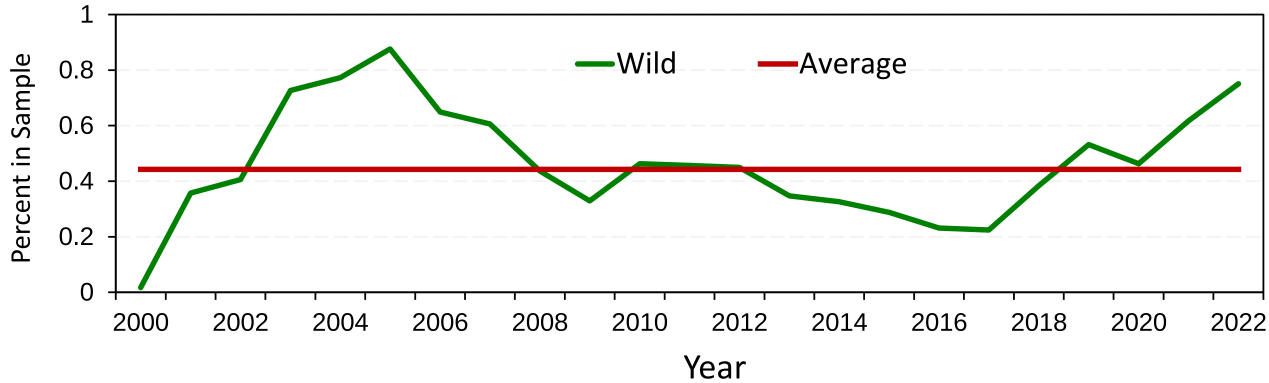


FIGURE 1.2.6. Percentage of potentially wild lake trout caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie for 5-year running average time blocks, 2000–2022. A potentially wild fish has no fin clips and no coded-wire tag (CWT).

1.3 Report on the Status of Burbot

Tom MacDougall, Andy Cook, (OMNRF), James Markham (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 2022, the mean burbot catch rate (0.46 fish/lift) in the east basin CWA was similar to that of 2021 (0.44 fish/lift) and therefore remained consistent with low annual means since 2012 (range 0.39-0.67 fish/lift). Catch rates in Ontario waters in 2022 (in both the CWA and Partnership Surveys) were notably higher, increasing to decadal highs of 0.68 and 1.08 fish per lift, respectively. Mean catch rate in Pennsylvania in 2022 increased slightly to 0.38 fish/lift. The mean catch rate in New York waters (0.19 fish/lift) was a time series low. While catches were distributed across the basin in 2022, locations with the highest catch rates tended to be in deeper waters of the basin, not well sampled prior to 2020 by the CWA (Figure 1.3.2). The CWA mean catch rate at non-standard, deepwater sites was 0.91 fish/lift nearly double that at the shallower sites. In 2022, six additional burbot were caught in canned gillnets in the east basin Partnership survey as well as eight burbot caught in the central basin portion of the survey which is assessed after fall turnover.

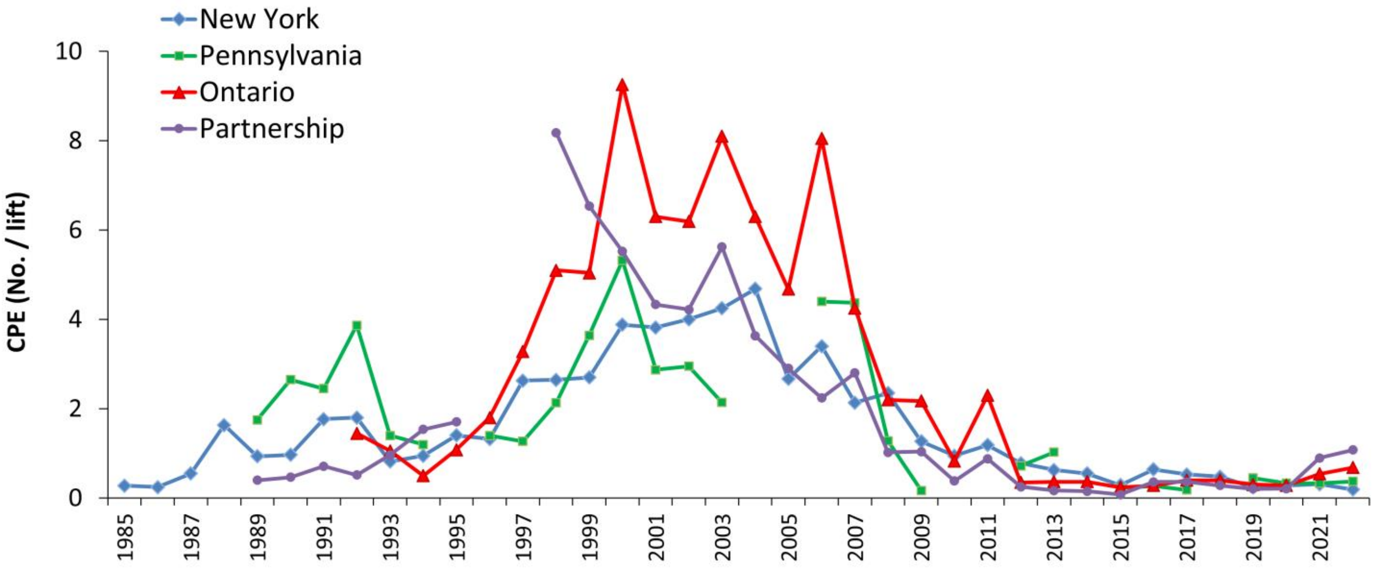


FIGURE 1.3.1. Burbot CPE (mean number per lift) by basin from the Interagency Coldwater Assessment (by jurisdiction; New York, Pennsylvania, Ontario) and the Ontario Partnership Survey (east basin bottom set nets), 1985-2022.

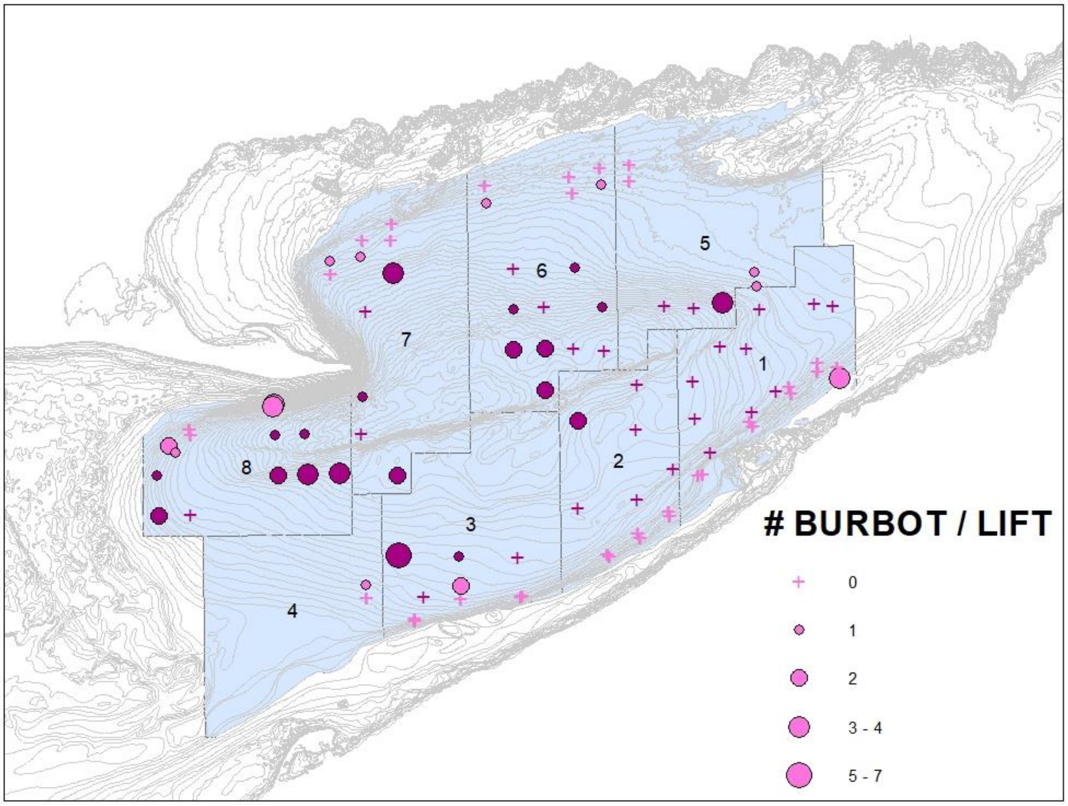


FIGURE 1.3.2. Catch rates (CPE; fish/lift) of burbot (all ages) caught in the Coldwater Assessment Survey in the eastern basin of Lake Erie, August 2022. Relative CPE is indicated by scaled circle size. Pink circles represent standard net set locations; purple circles indicate offshore net set locations; crosses represent net sets where no burbot were caught.

Most burbot commercial harvest occurs in the eastern end of the lake, with minimal harvest occurring in Ohio waters and the western and central basins of Ontario waters. Historically, burbot harvest was highest in Pennsylvania waters of Lake Erie. 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 harvest for Lake Erie in 2022 was 1,911 lbs, with most of this (1,785 lbs) coming from the Ontario gillnet fishery and with minimal reported trap net harvest in Ohio (93 lbs) and Pennsylvania (33 lbs). New York's trap net fishery reported catching and releasing 600 lbs of burbot.

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, 105 burbot from the 2022 Partnership (n=55) and CWA (n=50) surveys have been aged using these methods. Burbot ranged in age from 2 to 21 years in 2022 (Figure 1.3.3). The catch in both surveys had strong contributions from younger age classes; notably from 2019 (3-yr old; 37%) followed by 2018 (4-yr old; 20%). 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.

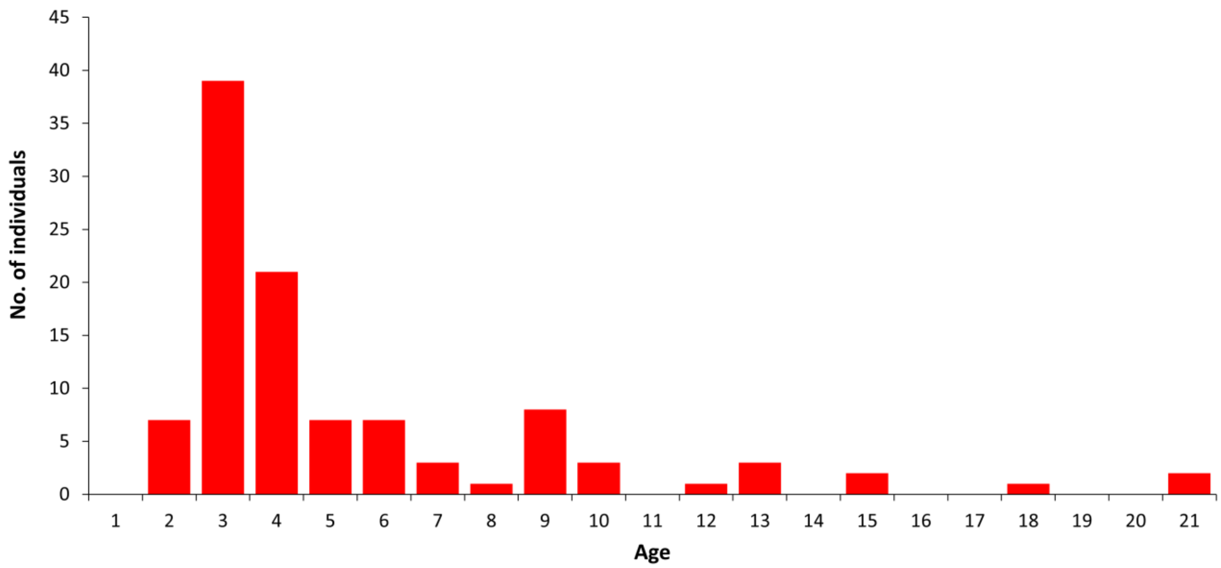


FIGURE 1.3.3. Age distribution of burbot caught in the Coldwater Assessment Survey and the Partnership Survey in eastern Lake Erie, 2022 (N=105).

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 2022 mean age was 7.0 years, down slightly from 7.3 years in 2021 and down notably from 2020 (8.4 years) and 2019 (12.1 years) (Figure 1.3.4). The 2022 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).

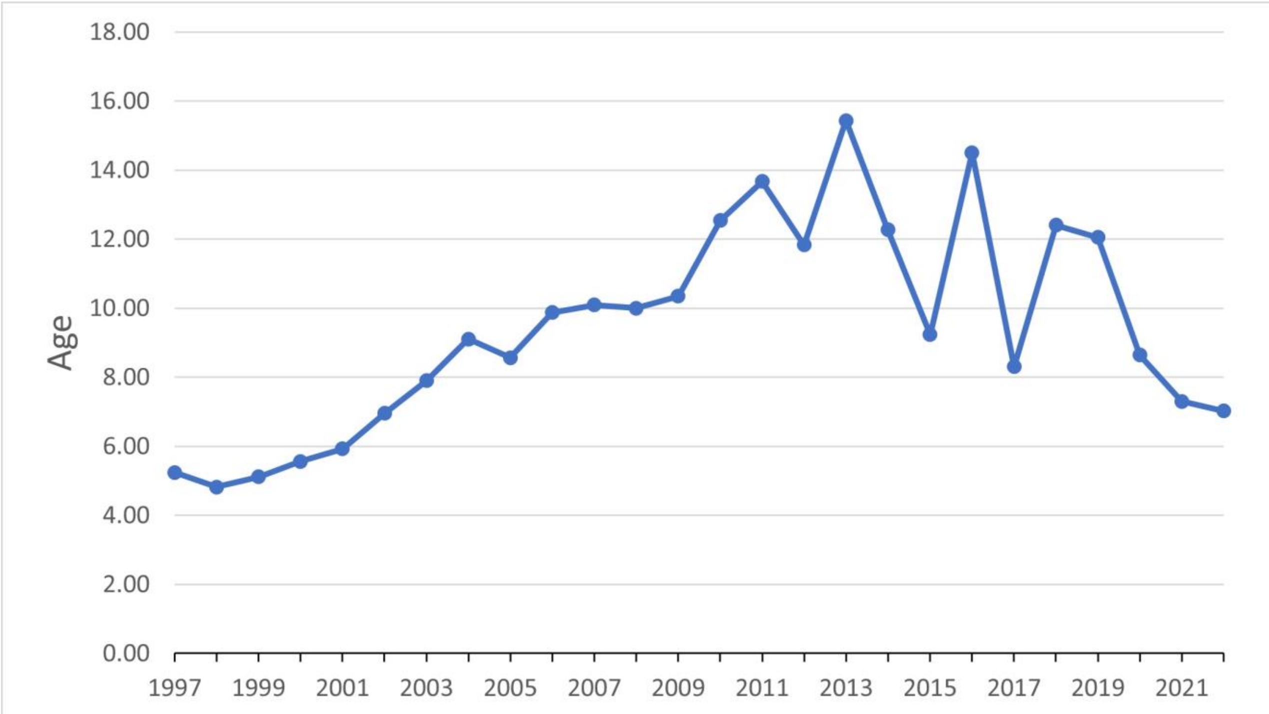


FIGURE 1.3.4. Mean age of burbot caught in the Interagency Coldwater Assessment Survey in eastern Lake Erie from 1997-2022.

Diet

Diet information was collected for burbot caught in the 2022 CWA Survey. Analysis of the contents of non-empty stomachs (N=38, Figure 1.3.5) revealed a diet made up exclusively of fish. Burbot diets were less diverse than in recent years and were dominated by rainbow smelt (55%) followed by round goby (39%). Relative contributions from round goby and rainbow smelt continue to fluctuate, relative to each other, from year to year. Two stomachs contained yellow perch while one additional stomach contained white perch in 2022. Five percent of the stomachs had fish that were not identifiable. No gizzard shad, observed frequently in past years, were identified in 2022. No Burbot were observed with invertebrate prey in 2022.

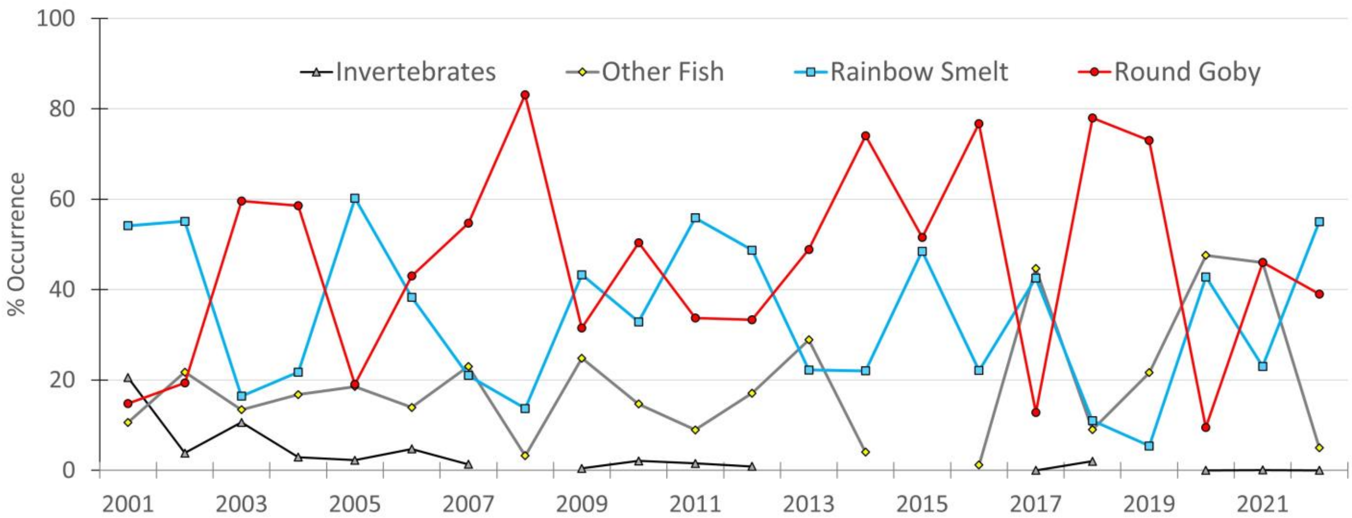


FIGURE 1.3.5: Frequency of occurrence of rainbow smelt, round goby, other fish, and invertebrates in the diet of burbot caught the Coldwater Assessment Survey in the eastern basin of Lake Erie, 2001-2022.

1.4 Report on Rainbow Trout / Steelhead

James Markham (NYSDEC), Graham Montague (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.

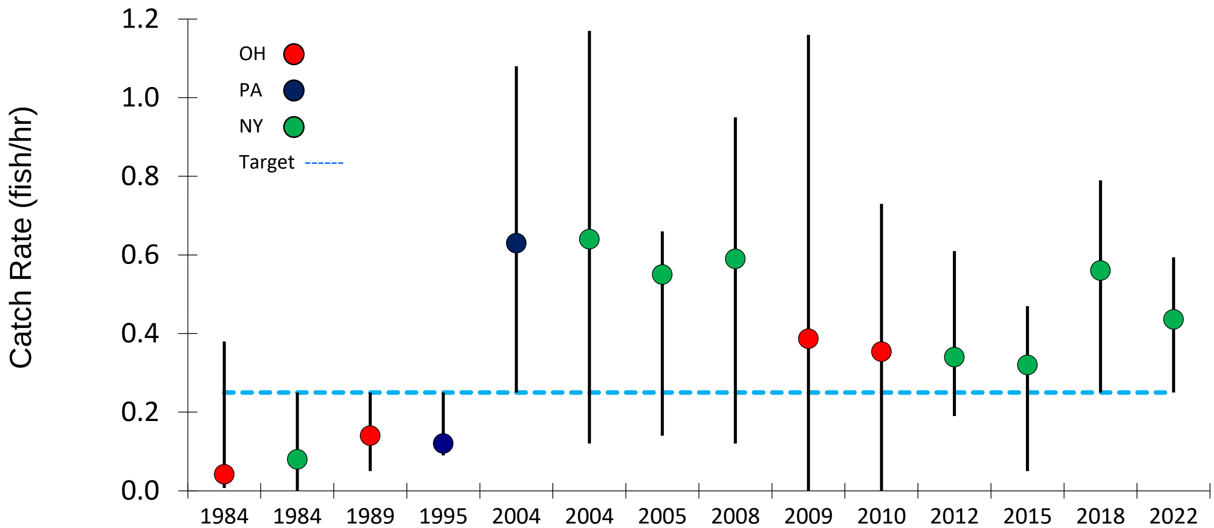


FIGURE 1.4.1. Targeted average steelhead catch rates (fish/angler hour) in Lake Erie tributary angler surveys by year and jurisdiction, 1984-2022. Vertical whiskers represent the range of individual tributary catch rates in the survey year. Dotted blue line is the fishery goal (0.25 fish/hr).

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 2022 estimated steelhead harvest from the summer open-water boat angler fishery totaled 23,503 fish across all US agencies, a slight increase compared to 2021 and the highest harvest of steelhead since 2007 (Table 1.4.1). The vast majority of the harvest occurred in Ohio waters (22,042 fish (93.8%) with the remainder in Pennsylvania (1,207 fish (5.1%)) and New York (251 fish (1.0%)). Open lake boat angler creel surveys have intermittently occurred in Ontario waters, but no data was collected in 2022.

TABLE 1.4.1. Estimated harvest by open lake boat anglers in Lake Erie, 1999-2022.

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	2,657	896	18,148	0	31,793
2005	10,364	2,183	594	N/A*	19	13,160
2006	5,343	2,044	354	N/A*	0	7,741
2007	19,216	4,936	1,465	N/A*	63	25,680
2008	3,656	1,089	647	N/A*	39	5,431
2009	7,662	857	96	N/A*	149	8,764
2010	3,911	5,155	109	N/A*	0	9,175
2011	2,996	1,389	92	N/A*	16	4,493
2012	6,865	2,917	374	N/A*	8	10,164
2013	3,337	1,375	482	N/A*	52	5,246
2014	3,516	2,552	419	4,165	6	10,658
2015	4,622	1,165	673	N/A*	6	6,466
2016	3,577	806	452	N/A*	0	4,835
2017	6,804	1,727	516	N/A*	60	9,107
2018	5,330	837	783	N/A*	49	6,999
2019	2,887	1,719	224	N/A*	59	4,889
2020	N/A**	3,575	316	N/A*	19	3,910
2021	20,991	1,136	104	N/A*	37	22,268
2022	22,042	1,207	251	N/A*	3	23,503
mean	12,578	2,989	574	25,736	52	22,043

*no creel data collected by OMNRF in 2003, 2005-2013, 2015-2022. **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 1999-2022 are presented in Figure 1.4.2.

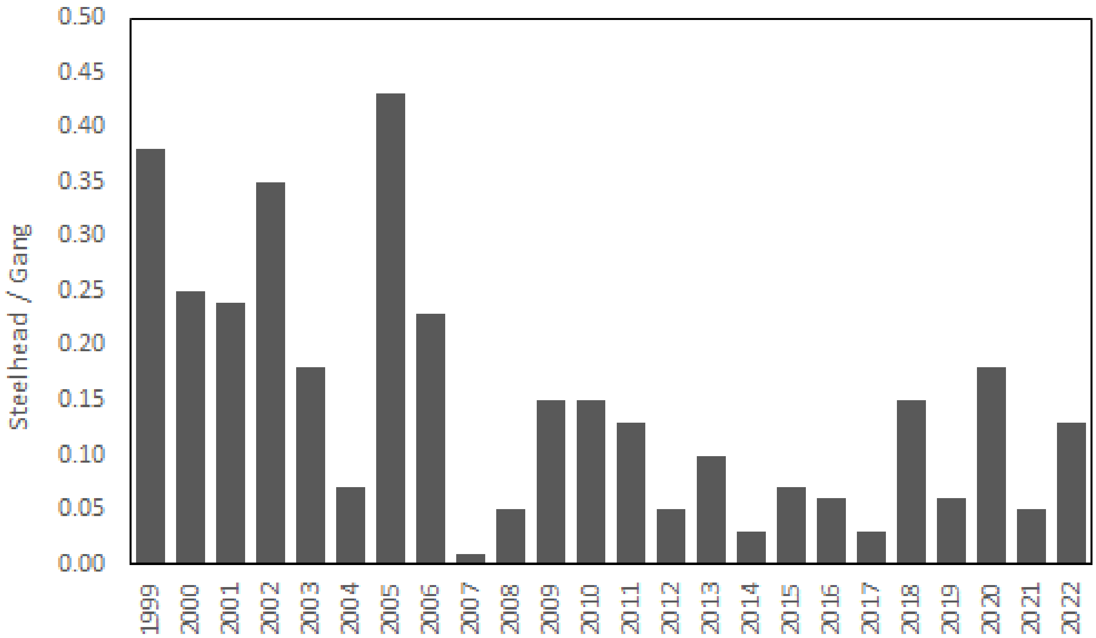


FIGURE 1.4.2. Steelhead catch per gang from the Partnership Survey, 1999-2022. West-central, east-central, Pennsylvania Ridge, east basin, and east cap area surveys were included. Index bottom, canned and thermocline canned nets were included. Catch rates were standardized to equal effort among mesh sizes. Thermocline nets were not fished in 2007.

Steelhead catch rates were generally high from 1999 to 2006 (average 0.27 fish/lift) but declined afterwards. Catch rates in 2022 (0.13 fish/lift, 48th percentile) were moderate relative to the 24-year time series. There were 28 steelhead caught in 2022 distributed between the east (14) and Pennsylvania Ridge (14) surveys. Catches were highest in thermocline nets (20), followed by canned (7) and bottom nets (1). None of the steelhead had fin clips or lamprey wounds or scars.

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), James Markham (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 13 A1-A3 wounds were found on 324 lake trout greater than 532 mm (21 inches) total length in 2022 during coldwater assessment gill netting, equaling a wounding rate of 4.0 wounds per 100 fish (Table 2.1; Figure 2.1). This was below the target rate of 5.0 wounds per 100 fish for the second consecutive year and only the third time in the past 27 years. Large lake trout continue to be the preferred targets for sea lamprey; lake trout greater than 736 mm (29 inches) accounted for all but one of the fresh A1-A3 wounds (5.1 wounds/100 fish) in 2022 (Table 2.1). Small lake trout less than 532 mm (21 inches) are rarely attacked when larger lake trout are available. However, one fresh A1 wound was observed on a lake trout less than 432 mm (17 inches) in 2022.

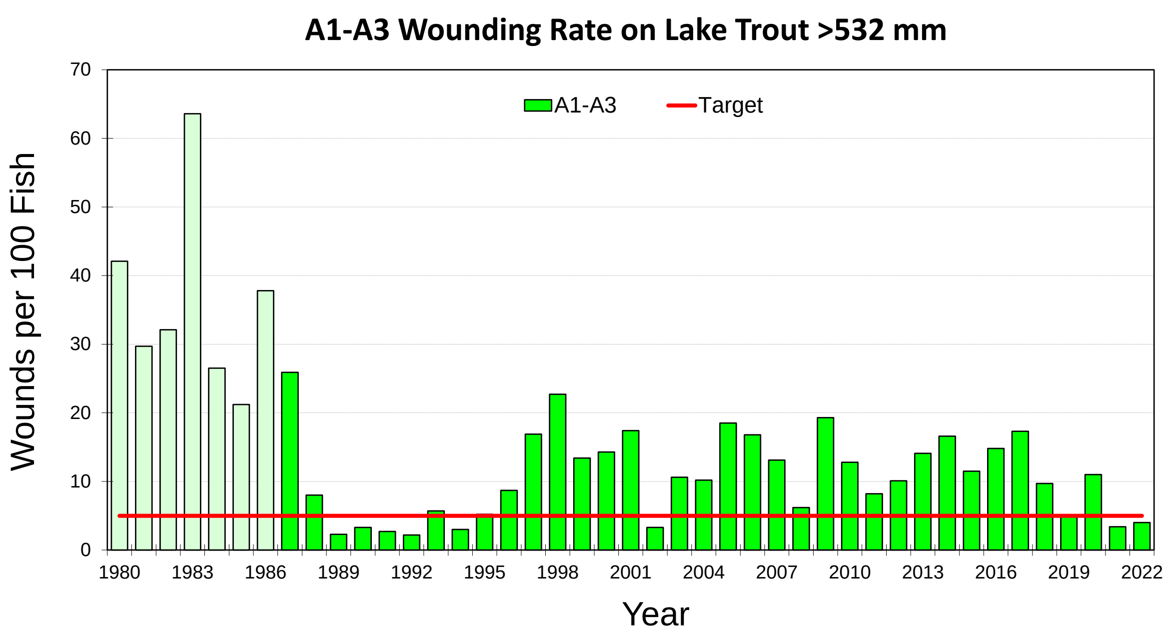


FIGURE 2.1. Number of fresh (A1-A3) sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1980-2022. The target rate (red solid line) is 5.0 wounds per 100 fish. Lighter shading indicates pre-treatment 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, 2022.

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	1	0	0	0	0	0.0	0.0
533-634	14	0	0	0	0	0.0	0.0
635-736	76	0	0	1	10	1.3	13.2
>736	234	1	3	8	126	5.1	53.8
>532	324	1	3	9	136	4.0	42.0

Finger Lakes (FL) and Lake Champlain (LC) were the most sampled lake trout strains in 2022, and they accounted for seven of the 13 (54%) 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 seven 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≤2) 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 (38% fresh;13% healed) of the wounding for the second 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, 2022. 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	7	0	0	1	1	14.3	14.3
FL	130	1	0	2	54	2.3	41.5
SUP	1	0	0	0	2	0.0	100.0
LC	137	0	2	2	58	2.9	42.3
HP	2	0	0	0	0	0.0	0.0
KL	2	0	0	0	5	0.0	250.0
Unknown	45	0	1	4	18	11.1	40.0

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 2022, there was no fresh (A1-A3) and two healed (A4) wounds on the 30 burbot sampled greater than 532 mm (21 inches) during coldwater assessment gill netting. The low sample sizes on burbot in recent years most likely provide a poor metric for actual wounding.

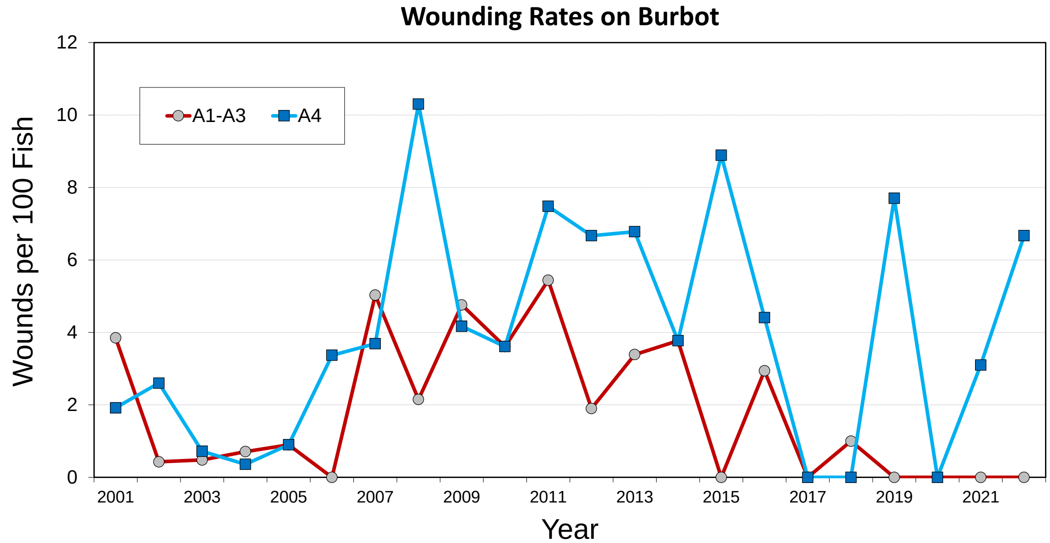


FIGURE 2.2. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August, 2001-2022.

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 83 lake whitefish greater than 532 mm (21 inches) were checked for evidence of sea lamprey attacks in 2022 assessment netting with one fresh A1-A3 (1.2 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.

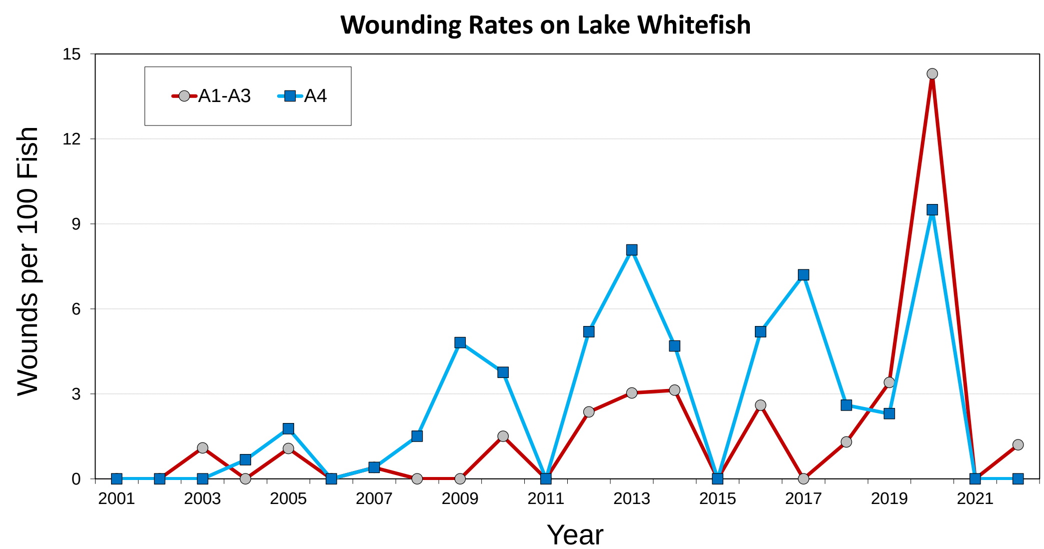


FIGURE 2.3. Number of A1-A3 and A4 sea lamprey wounds per 100 lake whitefish greater than 532 mm (21 inches) sampled in Coldwater Assessment gill nets in the eastern basin of Lake Erie, August, 2001-2022.

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 2022. 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 2022, sea lamprey wounds and scars were not observed on any coldwater species such as lake trout, lake whitefish and burbot; lake-wide catches of these species were 22, 20 and 55 respectively. Wounds (A1-A4; 0.03 wounds/100 fish) and scars (B type wounds; 0.03 scars/100 fish) were observed on Walleye. An A-1 wound was recorded for a freshwater drum, however the number of fish examined for wounds was uncertain. The spatial distribution of fish with sea lamprey wounds and scars in 2022 is shown in Figure 2.4.

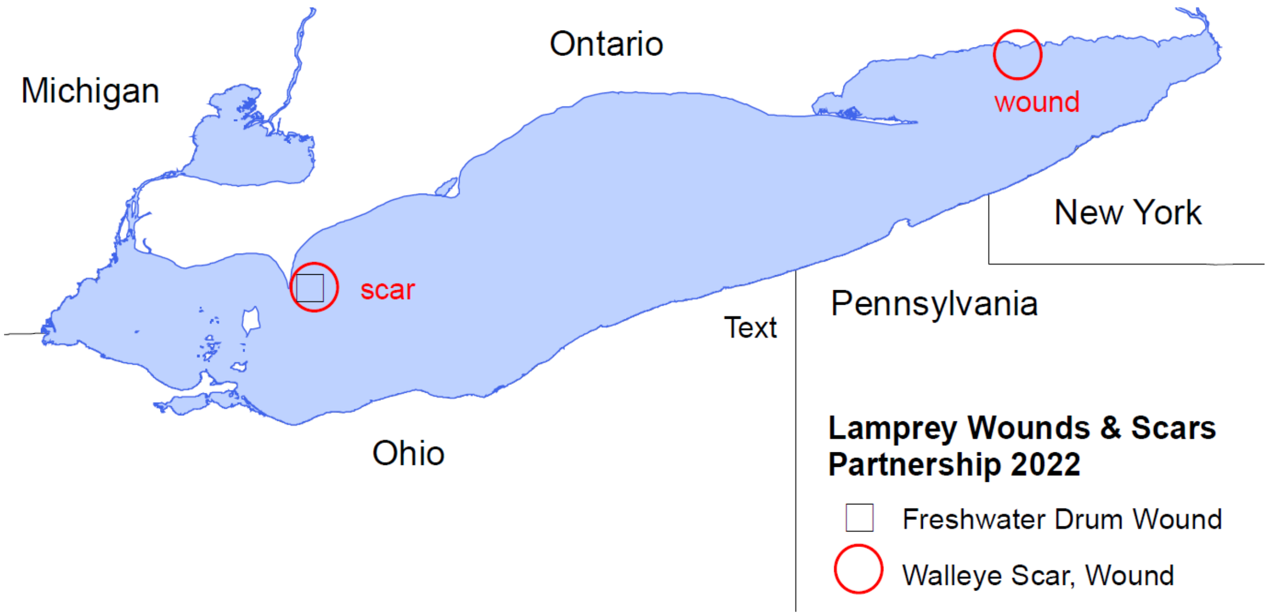


FIGURE 2.4. Individual fish with A1-A4 wounds (red circles) and B-type scars (blue squares) observed during Lake Erie Partnership surveys in 2022.

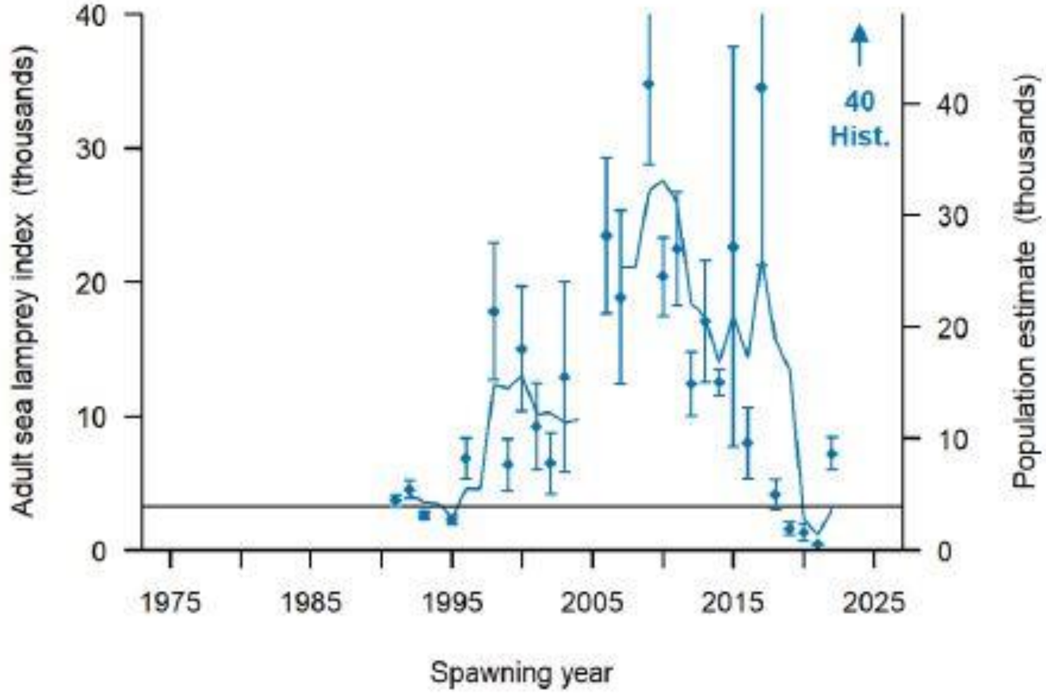


FIGURE 2.5. Index estimates with 95% confidence intervals (vertical bars) of adult sea lampreys, including historic pre-control abundance (as a population estimate) and the 3-year moving average (line). The population estimate (PE) scale (right vertical axis) is based on the index-to-PE conversion factor of 1.2. The adult index in 2022 was 7,200 with 95% confidence interval (6,000-8,400). The 3-year (2020-2022) average of 3,000 met the target of 3,300. The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

Summary of 2022 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 is meeting the target (Figure 2.5).

- The 3-year average marking rate on lake trout (6.2 A1-A3 wounds/100 fish), which is the metric used by the GLFC to assess wounding trends, is above target but has been decreasing over the past 5 years.

- Fyke nets and portable traps were set in Conneaut Creek in 2022 to assess adult sea lamprey migrations; 3 sea lampreys were captured during the spawning run. Adult assessment traps will be operated in Conneaut Creek again in 2023.

- With trapping efficiencies declining in Cattaraugus Creek over the past several years, FWS staff monitored water flows and trap placement to ensure traps were running efficiently.

Lampricide Control

- Lampricide treatments were completed in 3 tributaries (0 Canada, 3 U.S.); Cattaraugus Creek, Raccoon Creek, and the Grand River (OH).

Larval Assessment

- Larval assessments were conducted in 49 tributaries (20 Canada, 29 U.S.).
- Surveys to detect the presence of new larval populations were conducted in 27 tributaries (8 Canada, 19 U.S.); no new populations detected.
- Post-treatment assessments were conducted in Big Otter Creek, Big Creek, Grand River and Racoon Creek to determine the effectiveness of lampricide treatments conducted during 2021 and 2022.

- FWS completed 24 granular Bayluscide plots in U.S. waters of the St. Clair River; sea lamprey were captured in 6 of the plots. DFO completed 25 granular Bayluscide plots in Canadian waters of the St. Clair River; sea lamprey were captured in 5 of the plots.

Barriers

- Surveys to evaluate barrier effectiveness were conducted on 7 tributaries (3 Canada, 4 U.S.). All barriers assessed were found to be effective in limiting sea lamprey infestations.

- The City of Rochester Hills, Clinton River Watershed Council, and MIDNR collaborated with FWS staff to block a natural bypass around the Yates Mill Dam on the Clinton River. A geomorphic study conducted upstream of Yates Dam guided recommendations for river channel modifications to alleviate future bypass channel formation around the barrier.

- The Springville Dam fish passage project on Cattaraugus Creek continues to remain on hold until funding has been secured.

- 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. Additionally, the FWS has installed a pipe across the lower step of the barrier which will be used to effectively spread lampricide across the width of the river during lampricide treatments.

- Partners continue to pursue construction of a sea lamprey barrier in Conneaut Creek. A feasibility study is underway, a site has been tentatively selected, and 4 alternative barrier designs are being considered. Public outreach meetings were held in both May and November 2022 outlining project goals and objectives. Monthly virtual meetings continue with partners as the project moves forward.

- In 2022, 21 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.
- Routine maintenance, spring start-up, and safety inspections were performed on eight barriers (7 Canada, 1 U.S.).

- Field engineering, fabrication, and installation of a water intake deflector screen at Little Otter Creek. This work was undertaken to mitigate excessive sea lamprey trap water intake clogging caused by water-borne debris that is present at that location.

Risk Assessment

- The Risk Management Team (RMT) participated with partner agencies and local community volunteers to conduct non-target mortality surveys in the Grand River, Ohio during the spring lampricide treatment.

The RMT and USGS-Upper Midwest Environmental Science Center (UMESC) collected round hickorynut (*Obovaria subrotunda*) adults in Mill Creek (Grand River, OH) and three of the mussel's known host fish [blackside darter (*Percina maculata*), greenside darter (*Etheostoma blennioides*), fantail darter (*Etheostoma flabellare)]* in the mainstream of the Grand River between October 3–5. During November, UMESC propagated glochidia and juveniles and conducted tests to determine the toxicity of TFM to those life stages. The round hickorynut was proposed for federal listing as threatened during September 2020.

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

James Markham (NYSDEC), Graham Montague (ODNR), and 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 273,766 yearling Lake Trout were stocked into the eastern basin waters of Lake Erie in 2022, just shy of the stocking goal of 280,000 yearlings (Figure 3.1). In US waters, the USFWS Allegheny National Fish Hatchery stocked a total of 198,900 yearlings split between Dunkirk, New York (119,100 yearlings) and Fairport, Ohio (79,800 yearlings). These were a mix of Finger Lakes (Seneca; 60%) and Lake Champlain (40%) strains. No lake trout were stocked in Pennsylvania waters in 2022 due to the new rotational stocking plan outlined in the revised Lake Trout Rehabilitation Plan (LEC 2021). In Ontario waters, a total of 74,866 yearlings were stocked at Tecumseh Reef, which is a new stocking site in Ontario's rotation. The Ontario lake trout were all Finger Lakes (Seneca) strain in 2022, which represents a change from their previous Slate Island strain (Figure 3.1).

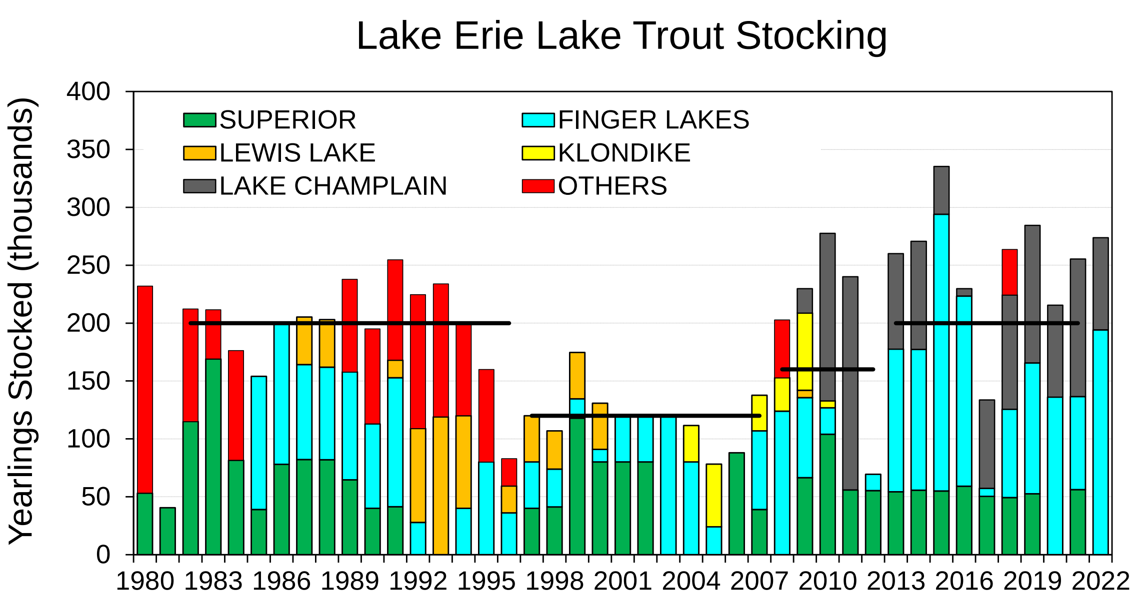


FIGURE 3.1. Lake trout (in yearling equivalents) stocked by all jurisdictions in Lake Erie, 1980-2022, by strain. Stocking goals through time are shown by black lines dark lines; the current stocking goal is 280,000 yearlings per year. Superior includes Superior, Apostle Island, Traverse Island, Slate Island, and Michipicoten strains; Others include Clearwater Lake, Lake Ontario, Lake Erie, and Lake Manitou strains.

Stocking of Other Salmonids

In 2022, over 2.19 million yearling trout were stocked in Lake Erie, including rainbow/steelhead trout (steelhead), brown trout and lake trout (Figure 3.2). Total 2022 salmonid stocking increased 2% from 2021 but was 0.8% below the long-term average (1990-2021). 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 1,848,600 yearling steelhead were stocked in 2022, accounting for 84% of all salmonids stocked. This was a 0.09% increase from 2021 and near the long-term (1990-2021) average annual stocking of 1,846,892 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 (58.4%), followed by 25.5% in Ohio waters, 10.3% in New York waters, 3.5% in Michigan waters, and 2.3% in Ontario waters. The NYSDEC stocked 139,835 yearling steelhead and 50,000 domestic rainbow trout in 2022, which in combination was near their stocking target of 192,500 yearlings. Steelhead stocking in Ohio was 17.7% above a target objective of 400,000 yearling steelhead while Pennsylvania steelhead stocking was roughly 8.0% 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 2022 (43,225) was 35% higher than the ten-year average (32,124). Details of stocking locations and numbers of fish per stream can be found in agency reports.

Brown Trout stocking in Lake Erie totaled 75,082 yearling and adults in 2022, all in Pennsylvania waters to provide catchable trout for the opening of the 2022 Pennsylvania trout season. This was almost a 38% increase from 2021 and 14% below the long-term (1990-2021) average annual stocking of 87,412 brown trout. These fish are in support of a put-grow-take brown trout program that was initiated in 2009. Brown trout stocking levels for catchable trout are expected to continue at the current rates in Pennsylvania.

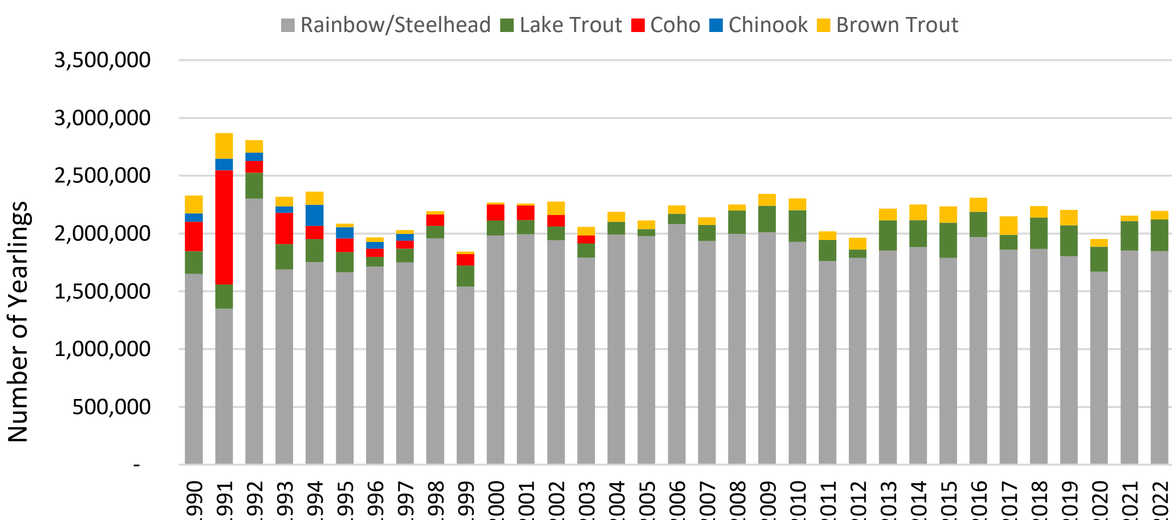


FIGURE 3.2. Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1990-2022.

TABLE 3.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2022

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, 1990-2022.

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, 1990-2022.

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, 1990-2022.

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**

ACKNOWLEDGMENTS

The Coldwater Task Group members wish to thank the following people for their support during the past year:

- Matt Faust and Jim McFee of the Ohio Department of Natural Resources, Division of Wildlife
- Megan Belore, Karen Soper and Yingming Zhao of the Ontario Ministry of Natural Resources and Forestry
- Richard Kraus of the United States Geological Survey
- Chris Vandergoot – GLATOS and Michigan State Unniversity
- Nicholas Boucher, Great Lakes Fishery Commission
- Zachary Amidon, University of Toledo
- Ed Roseman, Ph.D. Research Fishery Biologist, U.S. Geological Survey Great Lakes Science Center
- Philippa Kohn, Sustainable Fisheries Ecologist, The Nature Conservancy – Western & Central NY
- Dimitry Gorsky, U.S. Fish and Wildlife Service
- Charles Murray, Pennsylvania Fish and Boat Commission (retired)
- John Deller, Ohio Division of Natural Resources (retired)

The Coldwater Task Group report could not be completed without the contributions of all Lake Erie staff from the Michigan Department of Natural Resources, Ohio Division of Wildlife, Pennsylvania Fish and Boat Commission, New York Department of Environmental Conservation, United States Geological Survey – Biological Resources Division, and the Ontario Ministry of natural Resources and Forestry. In addition, the Coldwater Task Group expresses our thanks to the Great Lakes Fishery Commission and the Great Lakes Acoustic Telemetry Observation System for their continued support.

REFERENCES

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

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

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

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

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

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

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

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

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

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

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

REFERENCES (CONT)

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

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

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