2020 REPORT OF THE LAKE ERIE COLDWATER TASK GROUP

March 2021

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

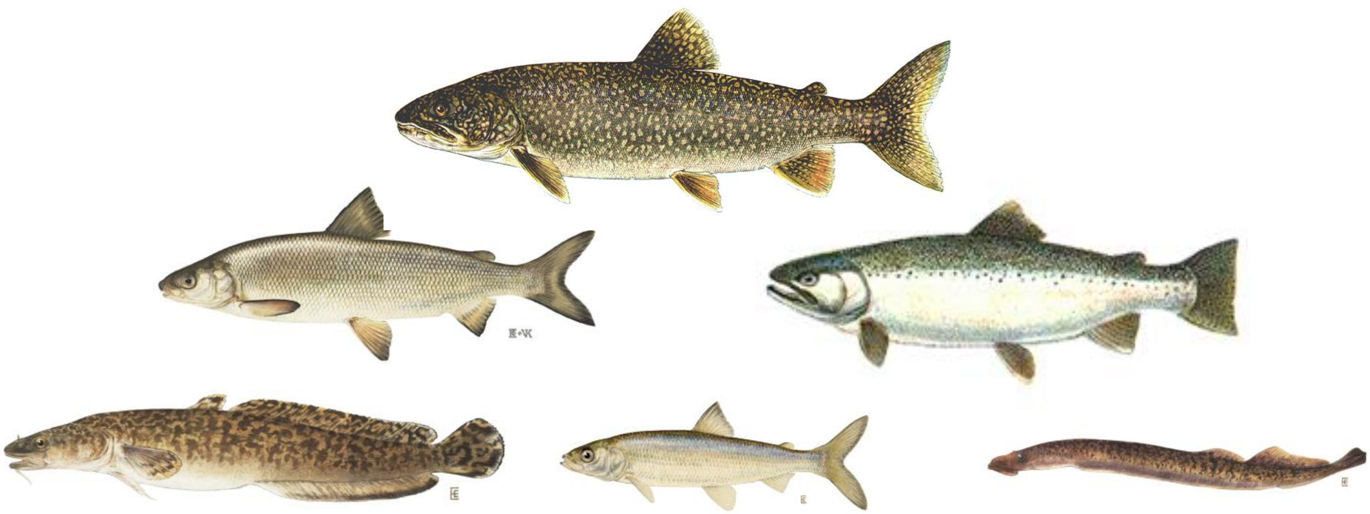

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TABLE OF CONTENTS

Reporting of 2020 – 2021 Coldwater Task Group Charges

Coldwater Task Group Executive Summary Report March 2021

Lake Erie Committee

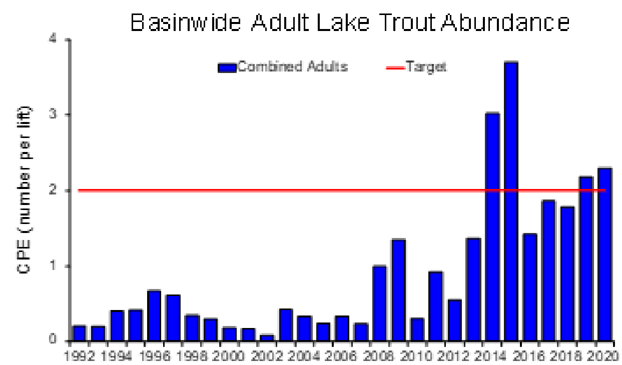
REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

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. Four charges were addressed by the CWTG during 2020-2021: (1) Report on the status of the cold water fish community, (2) Participation in Sea Lamprey assessment and control in the Lake Erie watershed, (3) Maintenance of an electronic database of Lake Erie salmonid stocking information, (4) Provide recommendations on Lake Trout Plan revision, and draft a new plan, within the scope of the FCGO for Lake Erie, for LEC review. The complete report is available from the Great Lakes Fishery Commission's Lake Erie Committee Coldwater Task Group website at http://www.glfc.org/lakecom/lec/CWTG.htm or upon request from an LEC or CWTG representative.

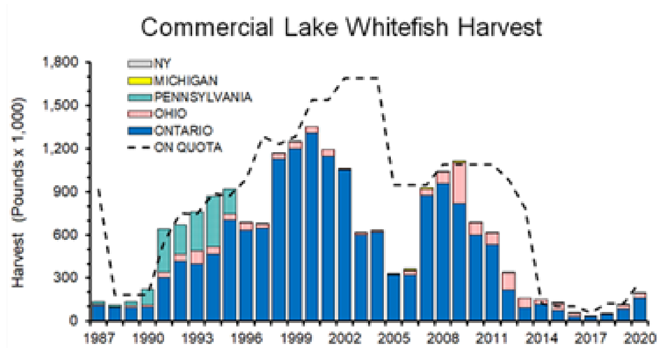
Lake Trout

A total of 239 Lake Trout were collected in 52 standard assessment gill net lifts across the eastern basin of Lake Erie in 2020. Basinwide Lake Trout abundance was 3.8 fish/lift, which is above average for the time series but well below the rehabilitation target of 8.0 fish/lift. However, adult abundance (ages 5+) was at its third highest measure in the time series and slightly above the target of 2.0 fish/lift. Lake Trout ages 4, 5, and 10 were the dominate cohorts; Lake Trout older than age-10 continue to increase in abundance and comprised 36% of the total catch. Finger Lakes and Lake Champlain strains comprise most of the population. The Lake Erie Lake Trout population continues to be supported by binational stocking efforts; naturally reproduced Lake Trout remain below detectable levels in the Coldwater Assessment Survey (CWA) despite nearly 40 years of restoration efforts.



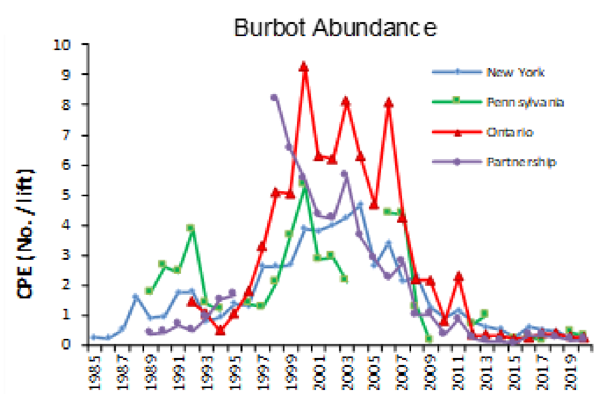
Lake Whitefish

Lake Whitefish harvest in 2020 was 191,556 pounds, distributed between Ontario (84%), Ohio (16%) and Pennsylvania (<1%). Harvest increased 67% from 2019 but was low compared to previous decades. Gill net fishery age composition ranged from ages 5 to 23. The 2015-year class (age 5) represented the majority of Lake Whitefish harvested in 2020. Gill net surveys caught Lake Whitefish from ages 0 to 17. Bottom trawl and gill net surveys forecast additional recruitment of age 3 Lake Whitefish from the 2018 cohort in 2021. Future contributions to fisheries from the 2019 and 2020 cohorts are expected to be less. Lake Whitefish status is showing some improvement with variable recruitment in recent years.



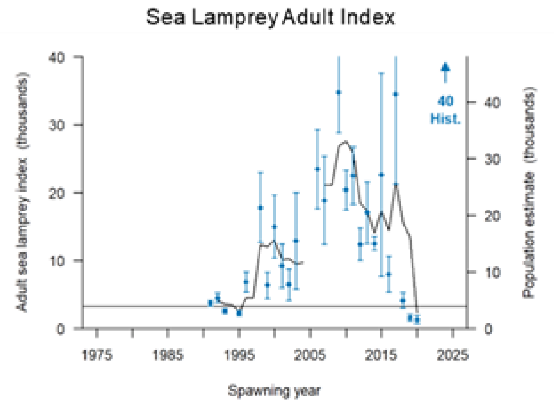
Burbot

Total commercial harvest of Burbot in 2020 was 1,814 pounds, all was incidental. Burbot abundance and biomass indices from annual CWA and Ontario Partnership Gillnet Assessment Surveys remained at very low levels. The catch rate in the CWA averaged 0.25 Burbot per lift and in the Ontario Partnership Assessment Survey averaged 0.21 Burbot per lift. Burbot in the CWA ranged in age from 3 to 21 and the mean age declined for a second consecutive year to 8.4 years. Burbot diets in 2020 were composed wholly of fish with Gizzard Shad and Rainbow Smelt the dominant prey items.



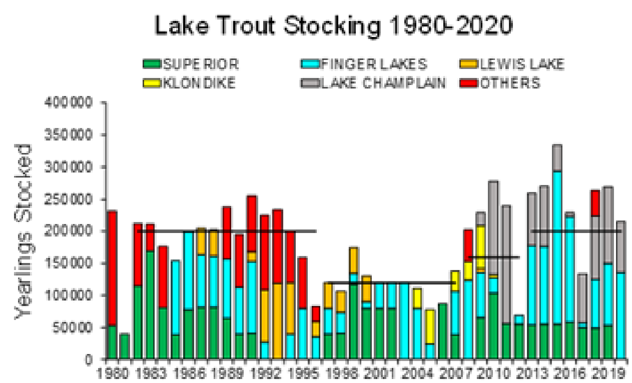
Sea Lamprey

The A1-A3 wounding rate on Lake Trout over 532 mm was 11.0 wounds per 100 fish in 2020. This was well above the target rate of 5.0 wounds per 100 fish. Wounding rates have been above target for 24 of the past 25 years. Large Lake Trout over 635 mm continue to be the preferred targets for Sea Lamprey in Lake Erie. The Index of Adult Sea Lamprey Abundance (1,300) represents a substantial decrease compared to recent years and was below the target population of 3,300 for the second consecutive year. Lampricide treatments were not completed in 2020 due to Covid-19 restrictions; five tributaries are scheduled for treatment in 2021. Comprehensive stream evaluations were not conducted in 2020 but are scheduled to resume in 2021, including extensive detection surveys around the basin to inventory all sources contributing to the Lake Erie population.



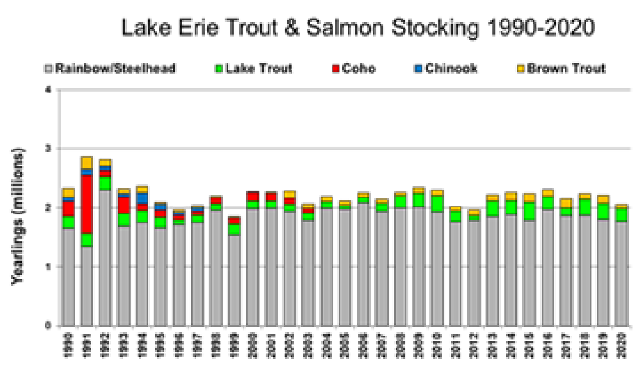
Lake Erie Salmonid Stocking

A total of 2,054,739 yearling salmonids were stocked in Lake Erie in 2020, which was about 8% below the long-term average (1990-2019). Lake Trout stocking was above targets for the seventh time in the past eight years. Due to COVID-19, Lake Trout stocking was limited to New York waters (119,175 yearling which was a mix of Finger Lakes (Seneca) and Lake Champlain strains and Pennsylvania waters (79,450 yearling Finger Lakes strain). An additional 41,030 fall fingerlings (Finger Lakes strain) were stocked into Cattaraugus Creek, NY by the USFWS in mid-October 2020. By species, there were 215,447 yearling Lake Trout stocked in all three basins of Lake Erie, 69,373 Brown Trout stocked in Pennsylvania waters, and 1,769,919 Rainbow/Steelhead Trout stocked across all four US jurisdictional waters.



Steelhead

All US agencies stocked yearling Rainbow Trout /steelhead in 2020; there were no Rainbow Trout stocked in Ontario waters. The summary of Rainbow Trout/ steelhead stocking in Lake Erie by jurisdictional waters for 2020 is: Pennsylvania (1,049,000 steelhead ; 59%), Ohio (469,265 steelhead; 27%), New York (138,530 steelhead; 48,750 domestic Rainbow Trout; 11%), and Michigan (64,374 steelhead; 4%). Total steelhead stocking in 2020 (1.770 million) was 4% below the long-term average. Annual stocking numbers have been consistently in the 1.7-2.0 million fish range since 1993. The 2020 estimated Rainbow/Steelhead Trout harvest from the summer open-water boat angler fishery totaled 3,910 fish by agencies reporting open lake boat angler creel data in 2020. Pennsylvania boat anglers harvested 3,575 Steelhead Trout, which is near the long-term average of 3,134 fish, but notably, the highest harvest estimate since 2010. New York boat anglers harvested an estimated 316 Steelhead Trout in 2020 about half the long-term average of 625 fish. Michigan open lake steelhead harvest remained negligible, with anglers harvesting an estimated 19 Steelhead Trout in 2020.



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 Matt Heerschap (OMNRF)

East Basin Coldwater Assessment Program

Two cold water assessments are conducted each year: 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 the entire east basin cold water habitat, decrease the number of required samples, and maintain comparable metrics between survey methodologies. The previous survey conducted since 1986 was a stratified, random transect approach using bottom set gill nets during the month of August. Specific details of this design and net configurations can be found in earlier versions of this report. This design divided the eastern basin of Lake Erie into eight sampling areas (A1-A8) with 13 transects per area (Figure 1). On any given transect, the first net gang (net #1) was fished parallel to shore (on contour) at a depth of 8-10 feet below the 10ºC isotherm. Each of the three successive nets gangs (nets #2-4) were set on contours along the transect in a deeper direction at increments of 5.0 feet greater depth or 0.5 miles distance from the previous gang, whichever occurred first. The placement of the fifth gang (net #5) was 50 feet deeper than the shallowest gang (net #1) or 1.0 mile distant from net #4, whichever occurred first. Typical effort was 130 standard assessment net gangs per year. This survey design resulted in over sampling of the area directly adjacent to the 10ºC isotherm and a complete lack of sampling in offshore waters (Figure 1. A).

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 (Figure 1.B). A 2.5 minute grid system is used for random selection of netting locations as opposed to the transect approach, and the previous areas A1-A8 are combined into four jurisdictional areas (NY: A1, A2; PA: A3, A4; ON East: A5, A6; ON West: A7, A8). Netting sites are divided into two groups – standard assessment nets and offshore assessment nets. The standard assessment nets 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 following the standard procedures for net #1 (i.e. 8-10 ft. deeper than the 10ºC isotherm) and net #3 (10 ft deeper than net #1). 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 protocols. These nets are set parallel to the shoreline but otherwise can be placed anywhere within the grid following the traditional protocol for temperature and depth. Additional net gangs are set in randomly selected offshore grids (offshore assessment nets). Nets in these areas are set in any location within the selected grid but in a direction consistent with the bottom contour. Targeted effort varies for each jurisdiction (NY: 16 assessment, 16 offshore; PA: 12 assessment, 12 offshore; ON East and ON West: 12 assessment, 13 offshore each). Altogether, a total of 52 standard assessment nets and 54 offshore assessment nets are targeted for a complete survey each year.

Prior to the re-design of the survey, an analysis comparing catch-per-effort (CPE) trends for lake trout, burbot, and lake whitefish from all standard assessment nets versus just nets #1 and #3 between 1985 and 2018 was performed (Figure 2). The goal of this analysis was to determine the feasibility of using these two nets for comparison to the long-term data series. The results of the analysis indicated a strong relationship for both Lake Trout and Burbot, and a comparable but slightly weaker relationship for Lake Whitefish. The weaker relationship for lake whitefish was not unexpected given the patchy distribution and high variability in catches for this species in this survey, and higher catches of lake whitefish occurring in nets closer to the thermocline. As a result of this analysis, abundance indices (i.e. catch per unit effort (CPE)) for all three species will only use data from standard assessment nets (nets #1 and #3) for comparison to the long-term data series; a new abundance index will be developed utilizing all netting locations (i.e. both standard and offshore assessment netting). Unless indicated, all other data 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 the 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.

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 adipose fin-clipped or does not contain a CWT. Stomach content data, if examined, are usually collected as on-site enumeration or from preserved samples. Sampling was conducted in all jurisdictions in 2020 (Figure 1.B). Total sampling effort was 52 standard assessment nets and 42 offshore assessment nets (94 sets total). Offshore assessment nets were not set in Pennsylvania waters due to boat issues.

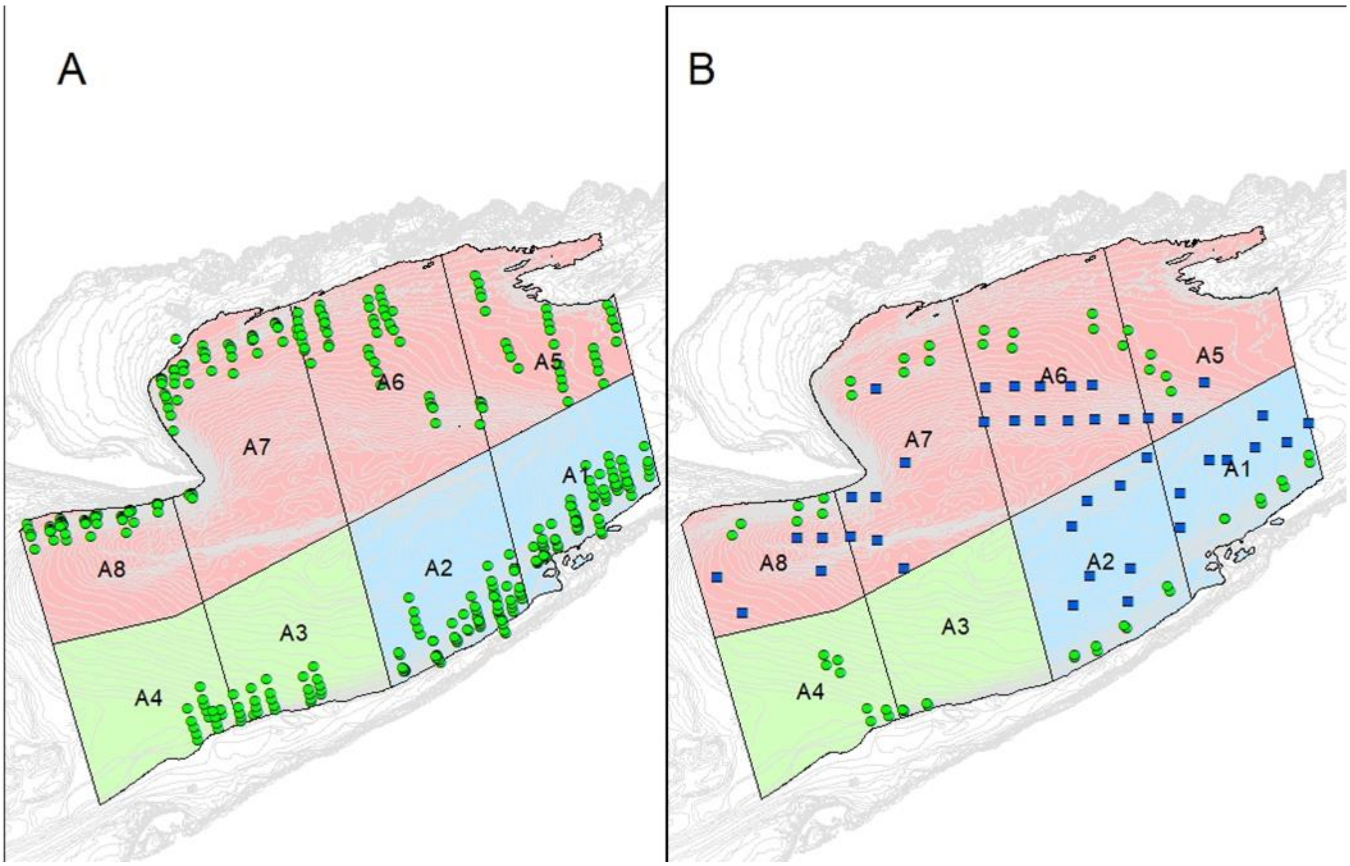


FIGURE 1. Standard sampling areas (A1-A8) used for assessment of assessment of cold water species in the eastern basin of Lake Erie in 2017-2019 (A) and 2020 (B). Green circles (A and B) represent the location of all standard assessment nets set in each sampling area; blue squares (B only) represent new offshore assessment netting locations randomly selected from a 2.5-minute grid system.

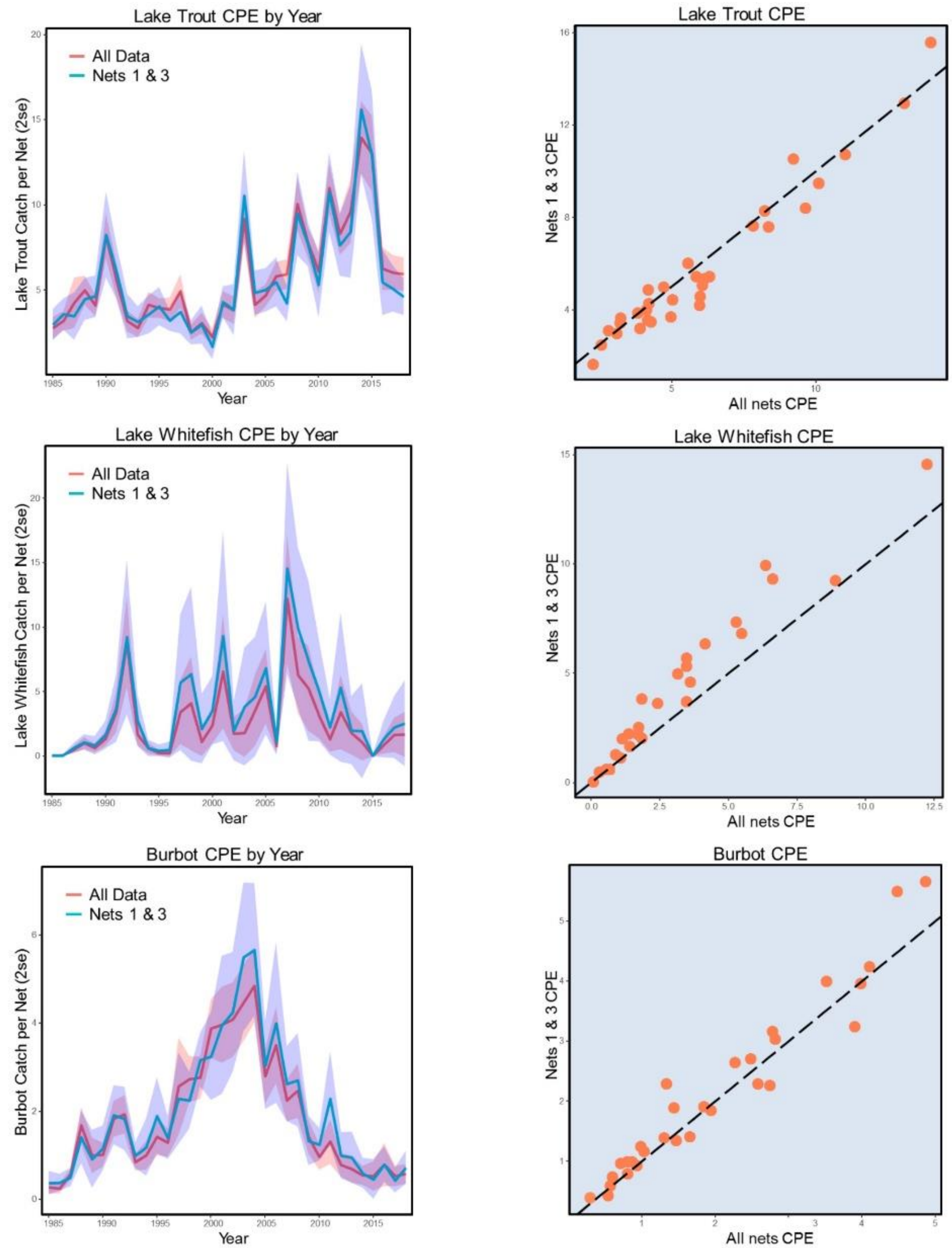


FIGURE 2. Comparison of Lake Trout, Lake Whitefish, and Burbot CPE using all standard assessment nets and only nets #1 and #3 including confidence limits (2 SE's), 1985-2018 (left side graphs), and plot of CPE for all nets versus nets #1 and #3 by year (right side).

1.1 Report on the status of the Lake Whitefish fishery.

Andy Cook (OMNRF), Brian Schmidt (ODW), John Deller (ODW), and Megan Belore (OMNRF)

Commercial Harvest

The total harvest of Lake Whitefish in Lake Erie during 2020 was 191,556 pounds (Figure 1.1.1). Ontario accounted for 84% of the lake-wide total, harvesting 160,580 pounds, followed by Ohio (16%; 30,973 pounds) and Pennsylvania (<1%; 3 lbs). Lake Whitefish were not harvested in New York or Michigan waters during 2020 (Figure 1.1.2). Total Lake Whitefish harvest in 2020 increased 67% from 2019. Lake Whitefish harvest in Ontario doubled in 2020 relative to 2019 whereas Ohio's harvest during 2020 and 2019 were approximately the same. Pennsylvania's negligible harvest in 2020 dropped from 2,286 lbs in 2019.

Ontario's harvest in 2020 represented 58% of the quota (275,000 pounds). Almost all (>99%) of Ontario's 2020 Lake Whitefish were harvested in gill nets. The remaining harvest of 390 pounds was caught in trawls targeting Rainbow Smelt. The largest fraction of Ontario's Whitefish harvest (87%) was caught in the west basin (Ontario-Erie statistical district OE-1) followed by OE-2 (11%), with the remaining harvest distributed eastward among statistical districts OE-3 (1%), OE-4 (<1%) and OE-5 (<1%; Figure 1.1.2). Maximum harvest in 2020 was distributed west of Pelee Island (Figure 1.1.2). Harvest in OE-1 from October to December represented 85% of Ontario's Lake Whitefish harvest. Peak harvests occurred in OE-1 during November (53,767 pounds) and December (60,929 pounds); only 2% of OE-1 harvest occurred from January to June. The largest fractions of Whitefish harvested in the central basin (OE2, OE3) were taken during fall months. Only 1,467 pounds of Lake Whitefish were landed in eastern Lake Erie (OE-4 and OE-5) in 2020 with 73% of harvest from gill nets and 27% of harvest from commercial trawls. There was no reported effort targeting Lake Whitefish during 2020 in Ontario waters of Lake Erie. Lake-wide, Ontario's Lake Whitefish harvest came from fisheries targeting Walleye (93%), White Bass (6%), White Perch (1%), Yellow Perch (<1%) and Rainbow Smelt (<1%). An additional 77 pounds of Lake Whitefish were surrendered to MNRF that included Whitefish with acoustic tags and fish of unmarketable size.

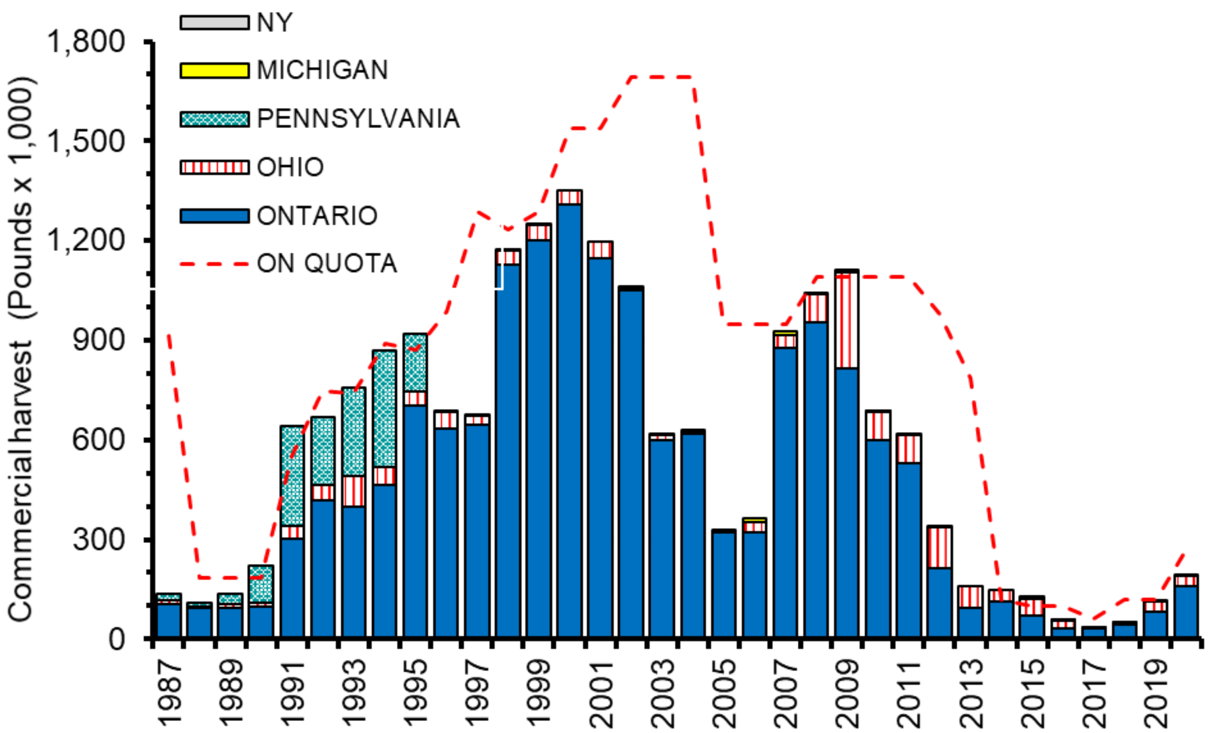


FIGURE 1.1.1. Lake Whitefish total harvest from 1987-2020 by jurisdiction in Lake Erie. Pennsylvania ceased gill netting in 1996. Ontario quota is presented as a dashed line.

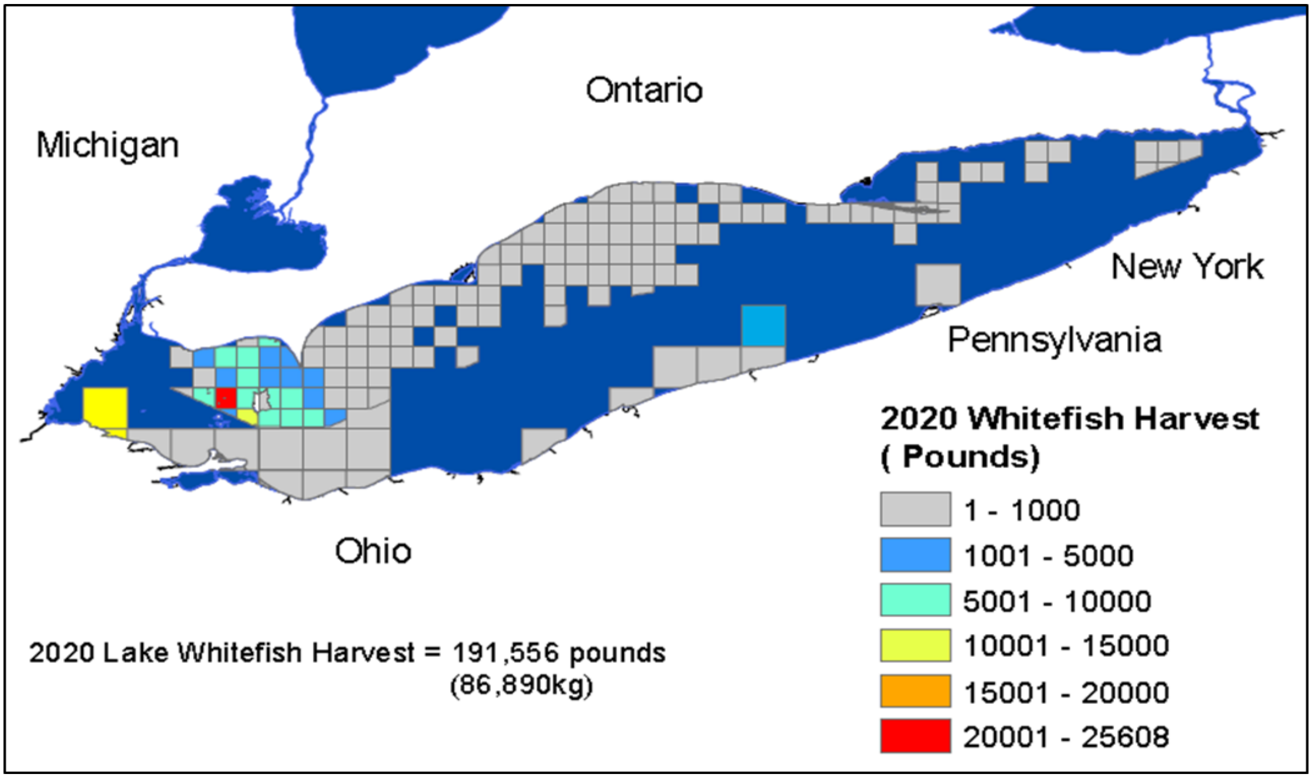


FIGURE 1.1.2. Commercial harvest of Lake Whitefish in Lake Erie during 2020 by 5-minute (Ontario) and 10-minute (U.S.) grids.

As there was no reported targeted gill net harvest or effort in 2020, 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 2014-2020 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 and effort with Lake Whitefish in the catch during 2020 increased by 89% and 35% from 2019, respectively. Although Whitefish harvest rates showed modest improvement in 2020, harvest rates were less than half of the time series averages (1998-2020) for both metrics.

All Lake Whitefish harvested in Ohio waters during 2019 came from commercial trap nets. Ohio Lake Whitefish harvest in 2020 (30,973 pounds) was distributed among the west (O-1 89%) and central basins (O-2 3%; O-3 8 %). Lake Whitefish were harvested from 1,643 trap net lifts (zero catches excluded) in 2020, with lifts distributed among District 1 (O-1) (52%), District 2 (O-2) (23%) and District 3 (O-3) (25%), respectively. Trap net harvest was greatest in November (87% or 26,878 lbs) in O-1 followed by June (1,344 lbs or 4%) and July (1,065 lbs or 3%) in O-3 and May in O-2 (3% or 918 lbs). Trap net catch rates (18.9 lbs / lift) in Ohio increased 36% in 2020 from 2019 but remained below the mean (29.6 lbs/lift 1996-2020) (Figure 1.1.4). The majority (83%) of Lake Whitefish harvest in Ohio during 2020 was taken east of Maumee Bay from grids 902 and 802 (Figure 1.1.2). Catch rates in grid 802 (143 lbs / lift) were the second highest observed in that grid from 2005-2020. Whitefish harvest in Pennsylvania during 2020 was negligible (3 lbs), with a corresponding low catch rate (Figure 1.1.4).

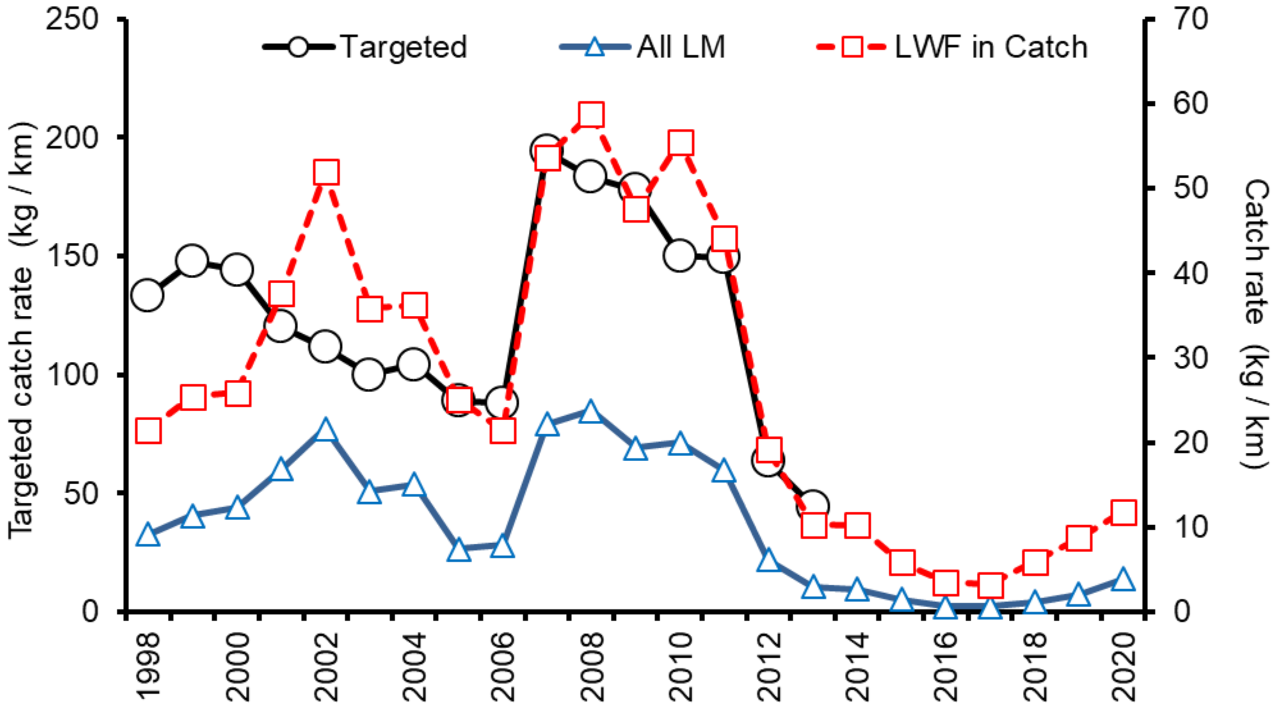


FIGURE 1.1.3. Lake-wide Ontario annual commercial large mesh gill net catch rates according to three forms of effort. Targeted Lake Whitefish catch rate (kg/km; left axis), catch rate relative to all large mesh gillnet fished (kg/km; right axis), and catch rates from large mesh effort with Lake Whitefish in the catch (kg/km; right axis). No targeted Lake Whitefish effort or harvest was reported in 2014 - 2020.

Ontario's west basin fall harvest in 2020 was comprised of ages 5 to 23 with age 5 (2015 cohort) representing 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 2020.

The landed value of Whitefish in Ontario during 2020 was $224,961 or $ 1.40 / lb CDN. The landed weight of roe from Ontario's 2020 Lake Whitefish fishery was 1,857 pounds, most (74%) of which was collected from the west basin during November. The remainder of roe was collected from October and December in the west basin, and October to December in the west-central basin. The approximate landed value of the roe was $ 5,485 or $ 2.95 / lb CDN.

Assessment Surveys

Gill net assessment of Lake Whitefish in Lake Erie include Cold Water Assessment (CWA) netting in New York, Ontario and Pennsylvania waters of the east basin and Ontario's Partnership gill net 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 catch rates in 2020 were based on 110 sites with 220 gangs fished on bottom and at standard canned depths.

Lake Whitefish catch rates in CWA nets fished on bottom at standard stations (52 lifts) during 2020 (0.87 LWF/lift) decreased from 2019 (1.76 LWF/lift) and was ranked as the 43rd percentile over the 36-year time series 1985-2020 (Figure 1.1.6). The CWA catch rate in 2020 exceeded 2013-2017 indices (Figure 1.1.6). Among interagency CWA surveys in 2020, catch rates were highest in New York (2.25 LWF/lift), followed by Ontario (0.46 LWF/lift) and Pennsylvania (0 LWF/lift).). Lake Whitefish captured in the Ontario CWA survey ranged in age from 1 to 16 with age 2 (2018 year class) most abundant (N=11) (Figure 1.1.7). Adult Lake Whitefish caught during the 2020 CWA survey exhibited the highest A1-3 and A4 wounding rates since 2001. All Whitefish with wounds were caught in U.S. waters.

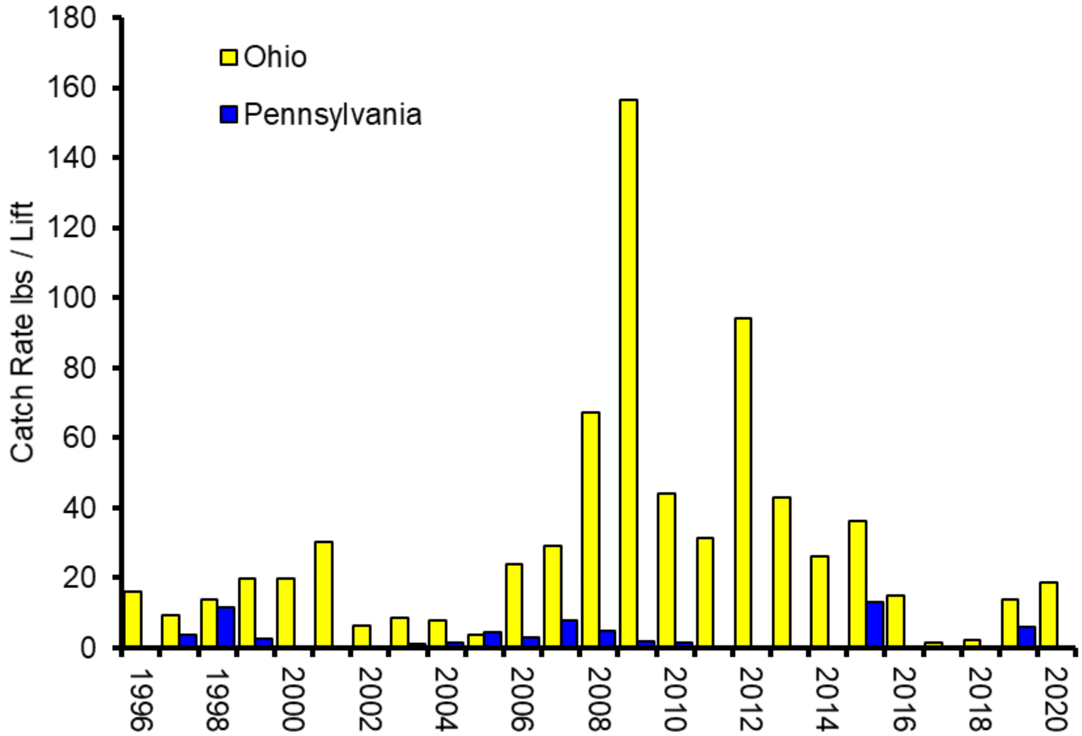


FIGURE 1.1.4. Lake Whitefish commercial trap net catch rates in Ohio and Pennsylvania (pounds per lift), 1996-2020. Zero harvest for PA in 2011-2014.

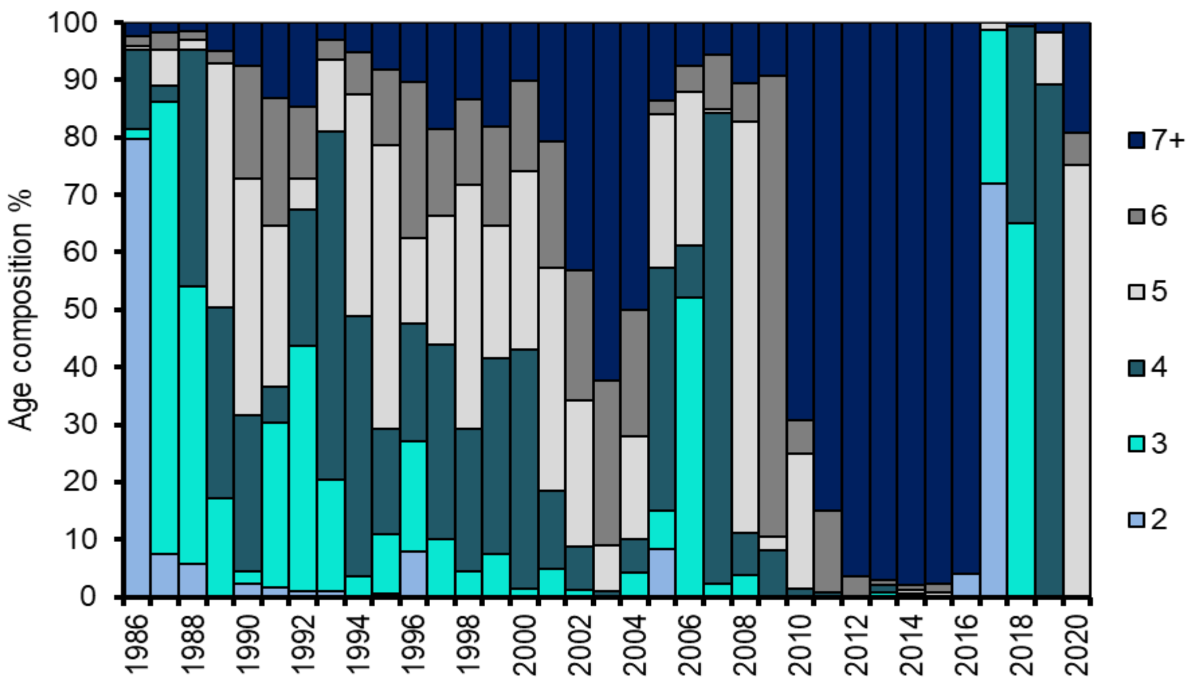


FIGURE 1.1.5. Ontario fall commercial Lake Whitefish harvest age composition in statistical district 1, 1986-2020, from effort with gill nets ≥3 inches, October to December. N=109 in 2020. Ages 7+ includes Whitefish ages 7 and older.

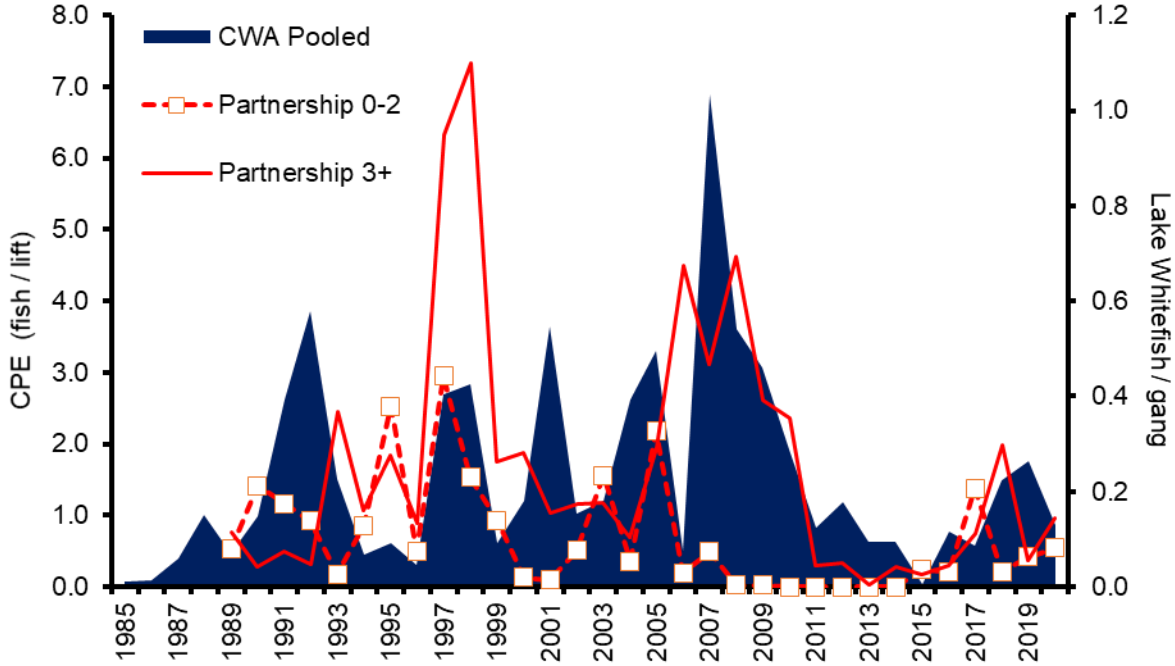


FIGURE 1.1.6. Catch per effort (number fish/lift) of Lake Whitefish caught in standard coldwater assessment gill nets (CWA) in New York, Ontario and Pennsylvania waters, weighted by number of lifts (blue area). Partnership index catch rates (WF/gang) for ages 0-2 (dots) and ages 3 and older (squares)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

Partnership catch rates of Lake Whitefish ages 0 to 2 was 0.08 LWF/gang in 2020, a slight increase from 2019 (Figure 1.1.6). Catch rates for age-3 and older Lake Whitefish caught in 2020 Partnership surveys climbed to 0.15 LWF/gang from 0.05 LWF/gang in 2019 (Figure 1.1.6). Lake Whitefish were caught in index nets (48) and auxiliary gear (1) throughout Lake Erie in 2020, excluding the west basin survey. The age composition observed in Partnership index gear ranged from ages 0 to 17, with age-5 (42%; 2015 year class), age-1 (23%; 2019 year class), age-3 (10%; 2017 year class) and age-2 (8%; 2018 year class; Figure 1.1.7) most abundant. Of 49 Lake Whitefish examined, none exhibited Sea Lamprey scars or wounds in 2020.

Although a summary is not presented here, the Pennsylvania nearshore gill net index in 2020 caught 9 Lake Whitefish consisting of ages-5 (67%), 6 (11%) and-7 (22%) (Figure 1.1.7).

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 2020, trawls were not completed during June. Ages 0 and 1 Lake Whitefish were present at low densities (0.04 /ha, 0.02 / ha respectively) during the October central basin survey (Figures 1.1.8 and 1.1.9).

Pennsylvania bottom trawl surveys from May to November also describe year class strength Lake Whitefish as juveniles. Juvenile Lake Whitefish trawl indices experienced record highs during the 1980s and 1990s that have not been observed since (Figures 1.1.8 and 1.1.9). YOY and yearling Lake Whitefish were not caught in 2020 trawls.

New York's east basin trawl survey in 2020 did not catch any YOY Lake Whitefish (Figure 1.1.8). During some years, Lake Whitefish were encountered in Ontario's deep, offshore fall bottom trawl assessment in Outer Long Point Bay, however, in 2020, juvenile Lake Whitefish were not caught in the Long Point Bay survey.

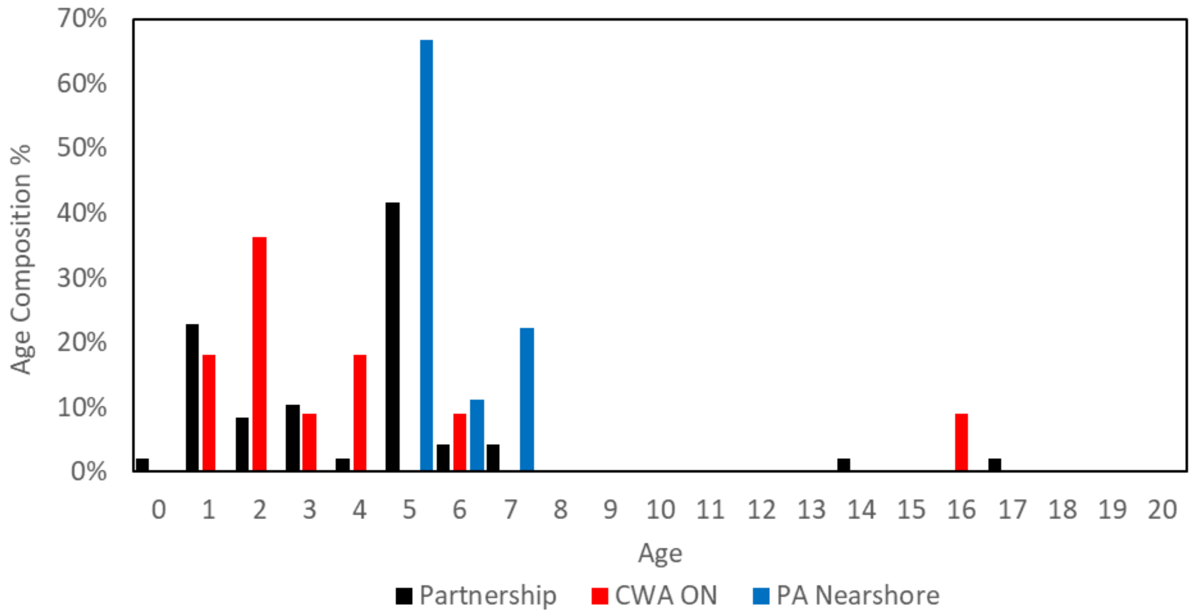


FIGURE 1.1.7. Age-frequency of Lake Whitefish collected from Cold Water Assessment (CWA) gill net surveys and Ontario Partnership index, and Pennsylvania Nearshore assessment in 2020 (N=11, 48 and 9 respectively). CWA ages are incomplete due to COVID restrictions.

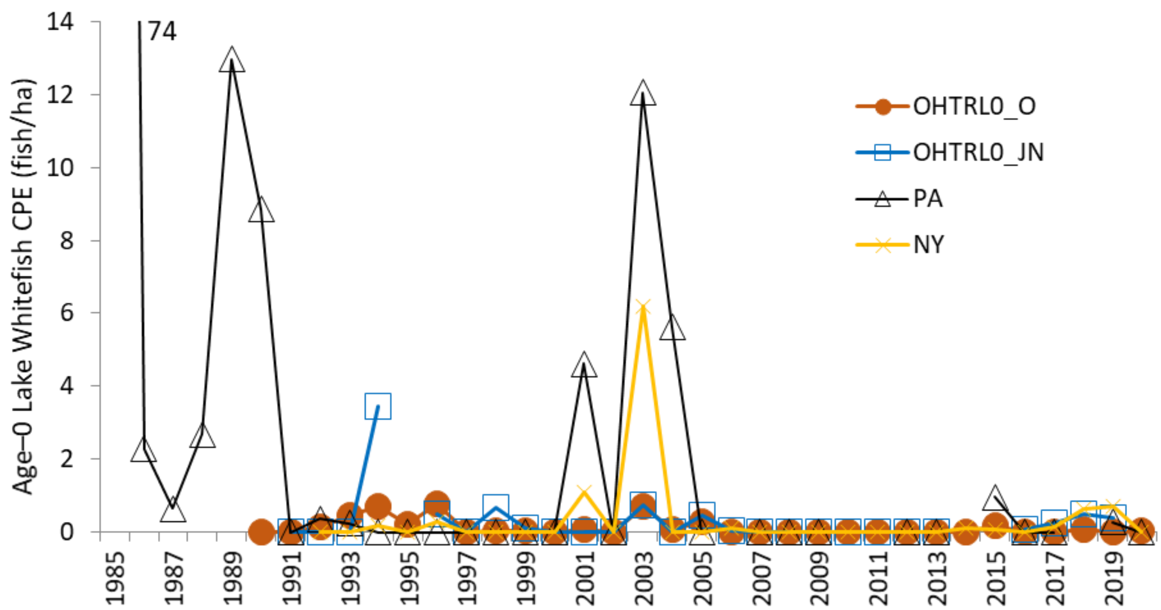


FIGURE 1.1.8. Age 0 Lake Whitefish catch per hectare in Ohio (central basin during June – OHTRL0_JN, October – OHTRL0_O), Pennsylvania (PA) and New York (NY) fall assessment trawls. Ohio data are means for October trawls in District 2 and 3. Pennsylvania did not conduct trawls during 2018. Ohio did not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

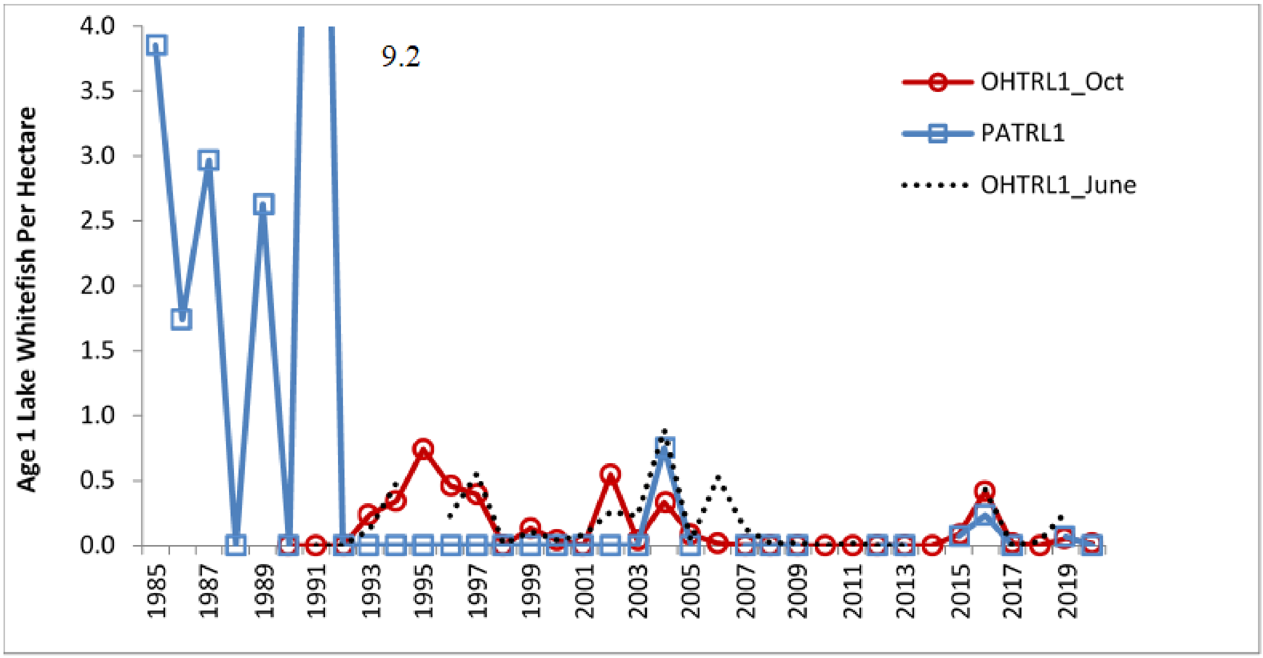


FIGURE 1.1.9. Age 1 Lake Whitefish trawl catch rates (number per ha) in Ohio waters during June (dotted line) and October (circles) and in Pennsylvania (PATRL1) waters (squares). Pennsylvania 1991 value (9.2) exceeds maximum axis value. Pennsylvania did not trawl in 2018. Ohio did not trawl in June 2020.

Stock Discrimination - Genetics

A pilot study investigating genetic differences in Lake Whitefish is ongoing for Lake Erie. In 2019 and 2020, scientists from USGS, OMNRF, and NYSDEC collected 127 whitefish genetic samples from all three basins of Lake Erie. Samples were shipped to University of Wisconsin – Milwaukee where DNA was extracted and genotyped using RAD Capture sequencing (Ali et al. 2016) and previously developed bait panel. Analysis is ongoing, however preliminary results indicate that there may be at least two genetically distinct spawning stocks of Whitefish in Lake Erie. Additional evaluation of genotype data has identified several outlier loci that appear to differentiate samples collected in the eastern and western basins of Lake Erie. The presence of highly differentiated markers mean that local adaptation could play a role in shaping Lake Whitefish population structure. Together, these results suggest that development of genetic resources, such as a larger scale population genetic assessment or a GT-seq panel, would provide additional insight into Lake Whitefish connectivity and recruitment in Lake Erie.

Growth, Diet and Health

Trends in condition are presented for Lake Whitefish sampled by agencies in relation to historic Lake Whitefish condition reported by Van Oosten and Hile's (1947). In 2020, 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 2020, female and male mean condition factors were above their respective historic means (Figure 1.1.10). Mean gonadosomatic index (GSI) of mature females with developing or fully developed ovaries in 2020 was 0.17 (Std=0.02 N=10).

Stomach contents from 13 Lake Whitefish caught in Ohio waters of Lake Erie during October 2020 were examined. Dry weights of Lake Whitefish diets contained isopods (77.7%), Sphaeriidae (9.8%), Daphnia (7.3%) and chironomids (5.0%).

Lake Whitefish in Lake Erie exhibit a high prevalence of Digenean heart cysts from *Icthyocotylurus erraticus* (CWTG 2018). In 2020, 97% of Lake Whitefish examined from Ontario commercial samples had heart cysts while 79 % of

Whitefish collected from the Partnership gill net survey had heart cysts. Yearling Whitefish caught in the Partnership survey had a lower incidence (27%) of this parasite in 2020. This parasite is present in Lake Whitefish in the upper Great Lakes (Muzzal and Whelan, 2011). In Ireland, intermediate and final hosts of this parasite are snails and gulls respectively (Harrod and Griffiths 2005). Harrod and Griffiths (2005) reported that this parasite influenced gonad size of female Pollan with different effects on liver size and condition of males and females. This parasite was also identified in Rainbow Smelt in Lake Erie (Dechtiar and Nepszy, 1988). The impact of this parasite on Lake Whitefish in Lake Erie remains unknown.

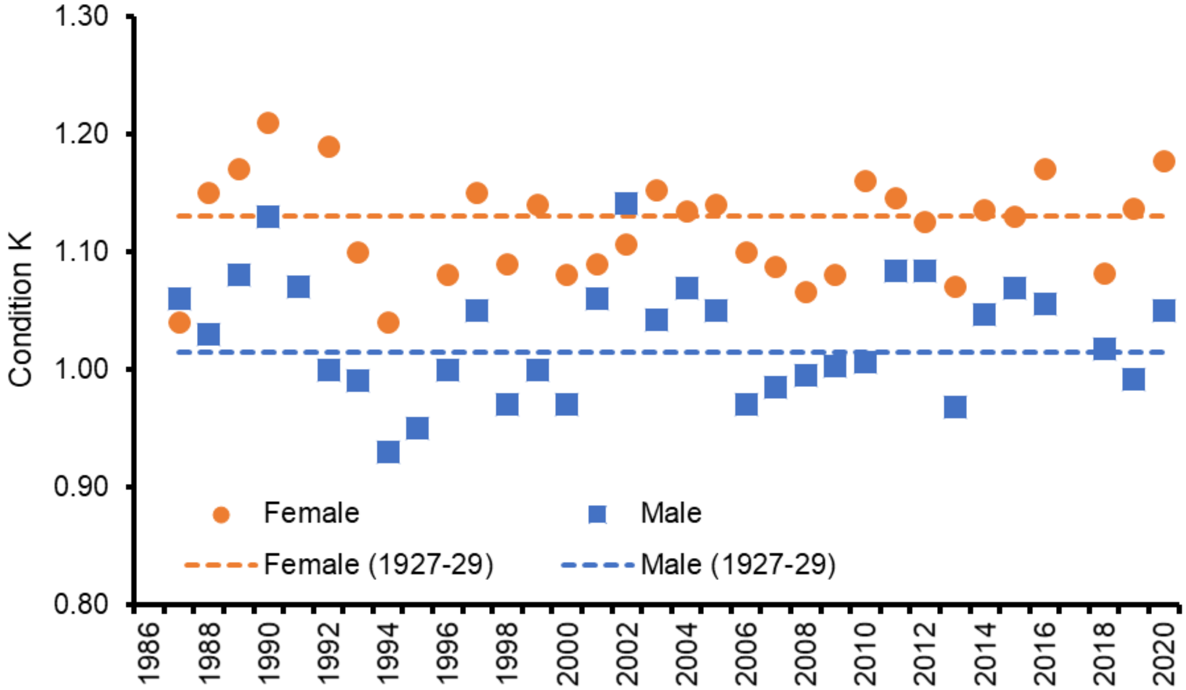


FIGURE 1.1.10. Mean condition factor (K) values of age 4 and older Lake Whitefish obtained from Ontario, Ohio, and Pennsylvania commercial and survey data (Oct-Dec) by sex from 1987-2020. Samples sizes in 2020 were: Males N=60 and Females N=13. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

Acoustic Telemetry

Lake Whitefish were implanted with acoustic transmitters and tagged with external Floy tags from 2015 to 2020 to monitor seasonal movements described by detections throughout the GLATOS (Great Lakes Acoustic Telemetry Observation System) 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, 273 Lake Whitefish were tagged in the GLATOS LEWHF project in areas including the Maumee River 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 Lake Whitefish acoustic study (Table 1.1.1). Since 2015, 28 tagged Lake Whitefish were caught by Ontario's commercial fishery (Table 1.1.1). Vulnerability to capture by fisheries varied among tagging locations. The number of Lake Whitefish detected annually in Lake Erie's GLATOS receiver network are presented in Figure 1.1.11. Detections were distributed lake-wide with the greatest number of Whitefish detected in the southern portion of the east-central basin and in western Lake Erie. Fall spawning migrations to the west basin and movement eastward during thermal stratification were observed annually. Lake Whitefish movement up the Detroit River was observed during 2018 and 2019. Detections plotted for 2020 represent a fraction of the year; a complete description of detections that occurred during 2020 will become available later in 2021 as more receiver data are downloaded. As data accumulates from this study, seasonal habitat use and population parameters will inform Lake Whitefish population models and support Lake Whitefish management. Information about this project and other GLATOS projects is online: https://glatos.glos.us/.

TABLE 1.1.1. Number of Lake Whitefish tagged with internal acoustic transmitters and Floy tags by location 2015 – 2020. Number of tagged Whitefish recaptured by fisheries from 2016 – 2020.

			Year of Recapture					
Tag Year	Release Location	# Tagged	2016	2017	2018	2019	2020	Total
2015	Maumee Bay	10	0	1	0	0	0	1
2016	Hen Island - Little Chicken	37	3	0	0	1	1	5
2017	Crib Reef	25		1	0	1	1	3
	Hen Island - Little Chicken	55		5	1	1	1	8
	Niagara Reef	25		0	0	0	2	2
2018	Detroit River mouth	2			0	0	0	0
2019	Crib Reef	50				0	3	3
	Detroit River mouth	35				4	1	5
	Maumee Bay [1]	15				0	0	0
2020	Detroit River mouth	14					0	0
	Pelee Island	20					1	1
All	Crib Reef	75	0	1	0	1	4	6
	Detroit River mouth	51	0	0	0	4	1	5
	Hen Island - Little Chicken	92	3	5	1	2	2	13
	Maumee Bay	25	0	1	0	0	0	1
	Niagara Reef	25	0	0	0	0	2	2
	Pelee Island	20	0	0	0	0	1	1
	All	288	3	7	1	7	10	28

1. Maumee Bay tagging in 2019 was a different project than LEWHF

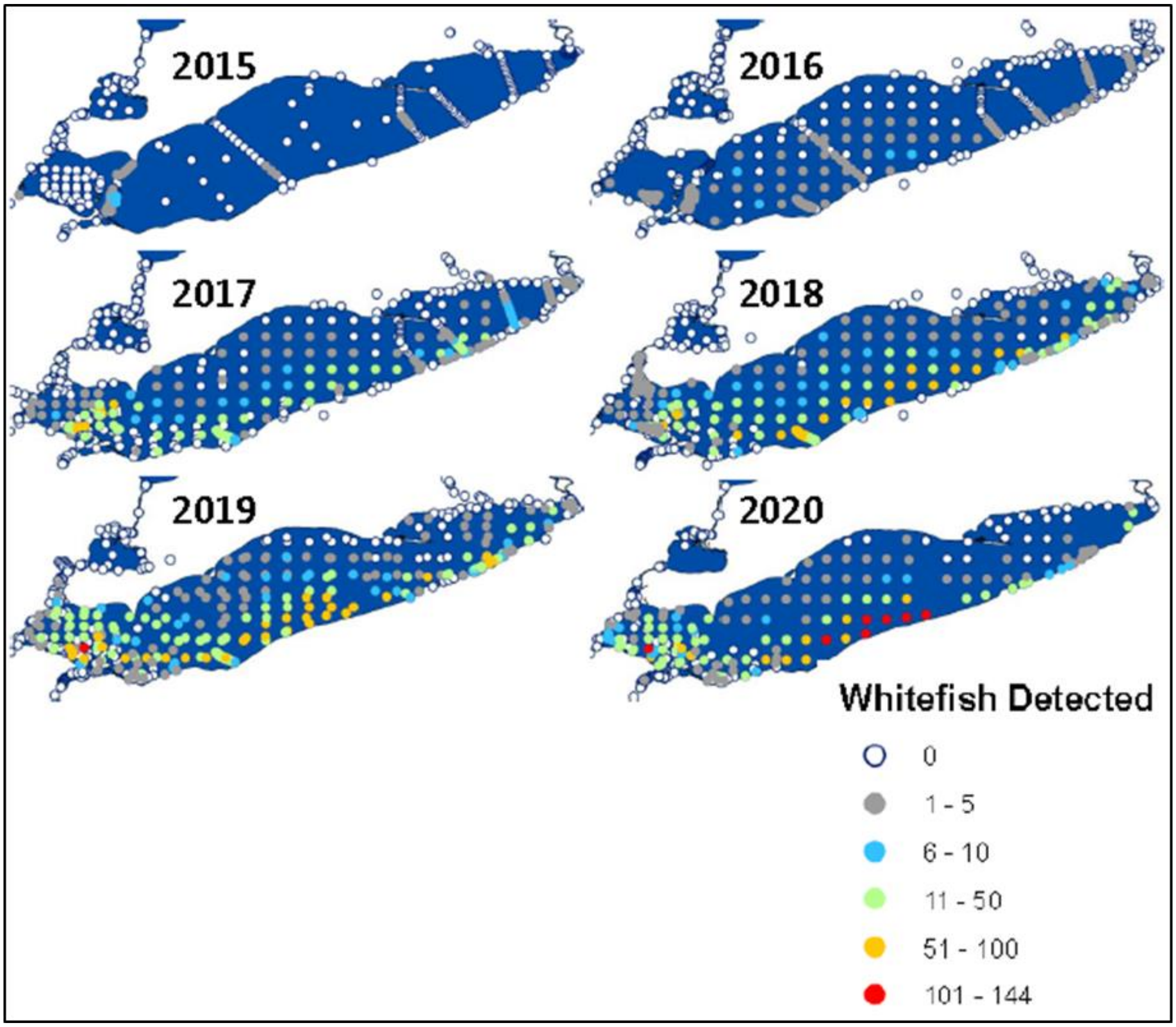


FIGURE 1.1.11. Number of individual Lake Whitefish detected by receivers annually during the LEWHF GLATOS study 2015 – 2020. Detections in 2020 are limited to the first part of the year. .

Statistical Catch at Age Analysis (SCAA) Population Model

A two-gear statistical catch-at-age (SCAA) model for Lake Whitefish (CWTG 2020) was updated with 2020 harvest and survey data. The model configuration consists of equal weighting (lambdas=1) among data sources and a catchability block to address a switch by Ontario's gill net fishery to incidental harvest 2014-2020. 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 analyses (PCA) were 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 three-year-old 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 that may have been influenced by changing fishery characteristics (Table 1.1.2, Figure 1.1.12). This alternate forecast (Figure 1.1.12 dotted line) was produced for comparison with SCAA estimates. Abundance and spawner biomass were forecasted to 2023 assuming 2020 SCAA survival estimates. Forecasted spawner biomass from 2021 – 2023 was compared to unfished spawner biomass estimates (SSB20%, SSB30%, SSB40%) (CWTG 2018) to assess Lake Whitefish population status. Lake Whitefish spawner biomass levels may remain above the mean SSB40% for the next several years to 2023, provided fisheries' harvest remains conservative (Figure 1.1.13).

TABLE 1.1.2. Age 3 abundance estimates from statistical catch at age analysis (SCAA). Principal components analysis (PCA) for juvenile Whitefish indices (ages 0,1,2) used in linear regression with SCAA age 3 abundance estimates to estimate age 3 abundance of 2014 – 2020 cohorts. Number of surveys, ages and cumulative variance of 1st and 2nd principal components (P1,P2) presented for each cohort. Regression statistics R^2 and probability of significance (P>F).

Year	Year Class	SCAA	PCA-REG	Lower	Upper	# Surveys	PCA Ages	Cumulative Variance P1, P2	Adj R^2	Pr > F
2017	2014	2,061,000	840,924	630,546	1,051,301	7	0,1,2	0.89	0.99	<.0001
2018	2015	7,836,400	3,576,069	3,229,479	3,922,660	9	0,1,2	0.87	0.98	<.0001
2019	2016	45,730	185,905	(111,336)	483,146	10	0,1,2	0.86	0.99	<.0001
2020	2017	17,624	659,165	355,864	962,465	9	0,1,2	0.83	0.98	<.0001
2021	2018		2,501,499	2,293,799	2,709,199	9	0,1,2	0.87	0.99	<.0001
2022	2019		654,998	323,437	986,559	8	0,1	0.86	0.98	<.0001
2023	2020		419,549	21,825	817,272	4	0	0.94	0.95	<.0001

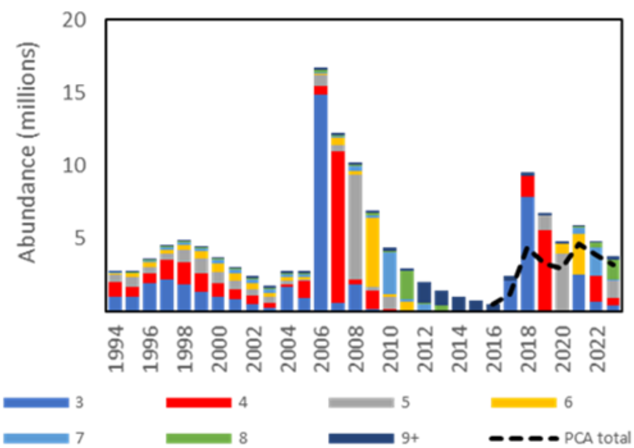


FIGURE 1.1.12. Lake Whitefish abundance estimates at age (3 to 9+) from SCAA and age 3 recruitment projections from PCA – regression estimates for cohorts 2014-2020. SCAA estimates of survival from 2020 assumed for 2021 – 2022. SCAA total abundance estimates since 2017 diverge due to higher SCAA estimates of 2014, 2015 cohorts compared to PCA-regression estimates (PCA total - dotted line). (see Table 1.1.2).

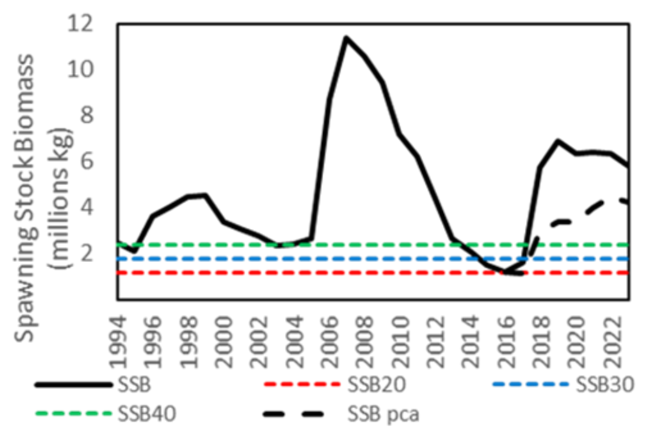


FIGURE 1.1.13. Lake Whitefish spawning stock biomass (SSB) estimates (kg - black line) projected to 2022 assuming constant survival from SCAA in 2020. Alternate SSB trajectory (dashed) based on PCA estimates of 2014, 2015 and more recent cohorts. Biological reference points SSB20%, SSB30%, SSB40% of unfished population (SSB0) presented for reference.

Summary

Lake Whitefish fishery and survey indicators showed mixed signals in 2020. Total Lake Whitefish harvest in 2020 (191,556 pounds) increased from 2019. Ontario's incidental harvest in 2020 attained 58% of Lake Whitefish final quota which increased to 275,000 pounds in 2020. Ohio's trap net fishery targeted Lake Whitefish in 2020, harvesting 30,973 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 2020, 15% 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. Lake Whitefish fisheries will be dominated by fish ages 6 and older in 2021. Surveys indicate that recruitment from the 2018 cohort may contribute to 2021 fisheries. The Coldwater Task Group recommends continued conservative management of Lake Whitefish.

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

James Markham (NYSDEC), Andy Cook, Matt Heerschap, Tom MacDougall (OMNRF), Chuck Murray (PFBC), Joe Schmitt, Ed Roseman (USGS), Justin Chiotti (USFWS)

In the 2020 CWA 376 Lake Trout were caught in the Coldwater Assessment Survey netting in 2020; 239 of these were caught in standard assessment nets. New York and Ontario East produced the highest CPE (standard assessment nets only) values in 2020 with slightly lesser catches in Pennsylvania. Ontario West produced the lowest catches. The highest CPE's are typically recorded in New York, coinciding with higher yearling Lake Trout stocking over time. Lake Trout catches were typically much lower in Ontario waters, where annual stocking is less and did not commence until 2006. However, CPE's in Ontario East have increased in recent years

Lake Trout captured in standard assessment netting in 2020 represented thirteen age-classes among four different strains (Figure 1.2.1). Ages 4, 5, and 10 were the most abundant and represented 60% of the total catch. The abundance of Lake Trout older than age-10 continues to increase and now comprises 36% of the overall catch. Lake Champlain (LC) and Finger Lakes (FL) were the most numerous Lake Trout strains caught in 2020, followed by the Slate Island (SI) strain. These three strains have been the most commonly stocked Lake Trout strains in Lake Erie over the past twelve years. Catches of the Klondike (KL) ecotype have declined to the point that they were scarcely detected.

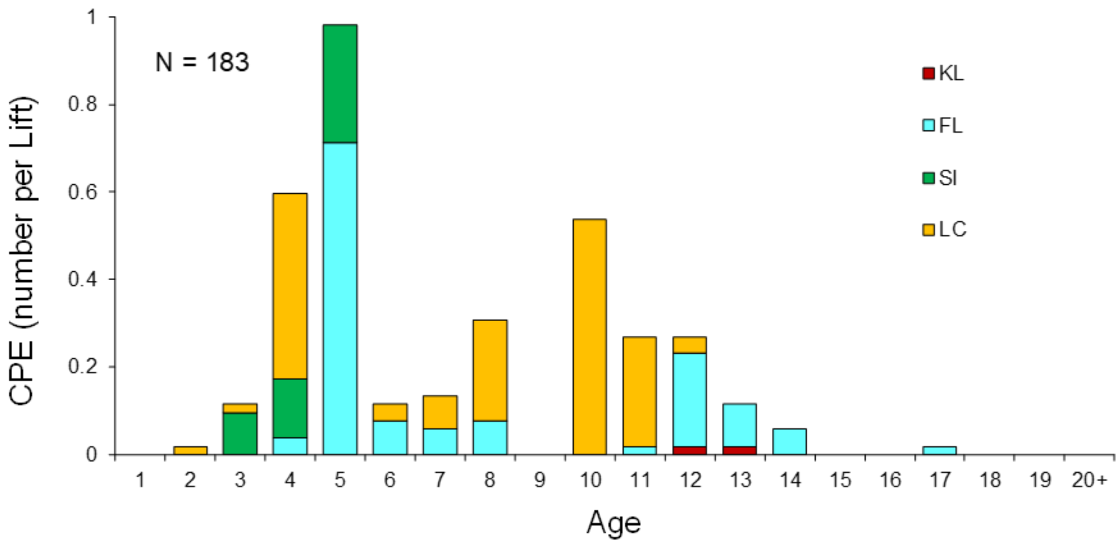


FIGURE 1.2.1. Relative abundance (number per lift) at age of Lake Trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, August 2020.

Area-weighted mean CPE of Lake Trout (all ages) caught in the eastern basin in 2020 was 3.8 fish per lift (Figure 1.2.2). This was above average (2.4 fish/lift) for the time series but well below the rehabilitation target of 8.0 fish/lift (Markham et al*.* 2008).

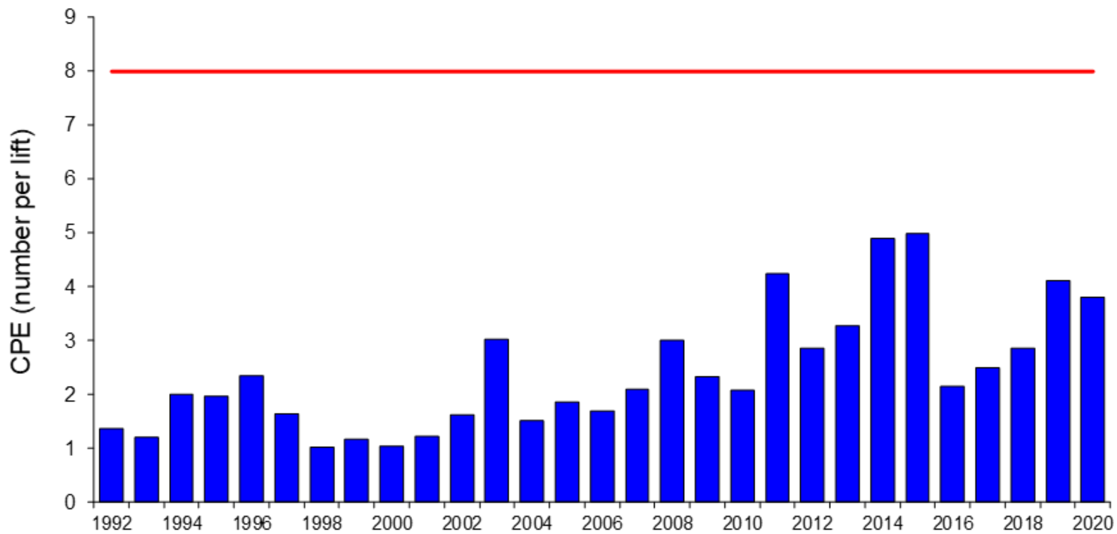


FIGURE 1.2.2. Mean combined CPE (number per lift, weighted by area) for Lake Trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1992-2020. The red solid line represents the rehabilitation target of 8.0 fish per lift for all ages.

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. Adult abundance increased in 2020 to 2.3 fish per lift, ranking as the third highest in the time series and slightly above the target of 2.0 fish/lift (Figure 1.2.3).

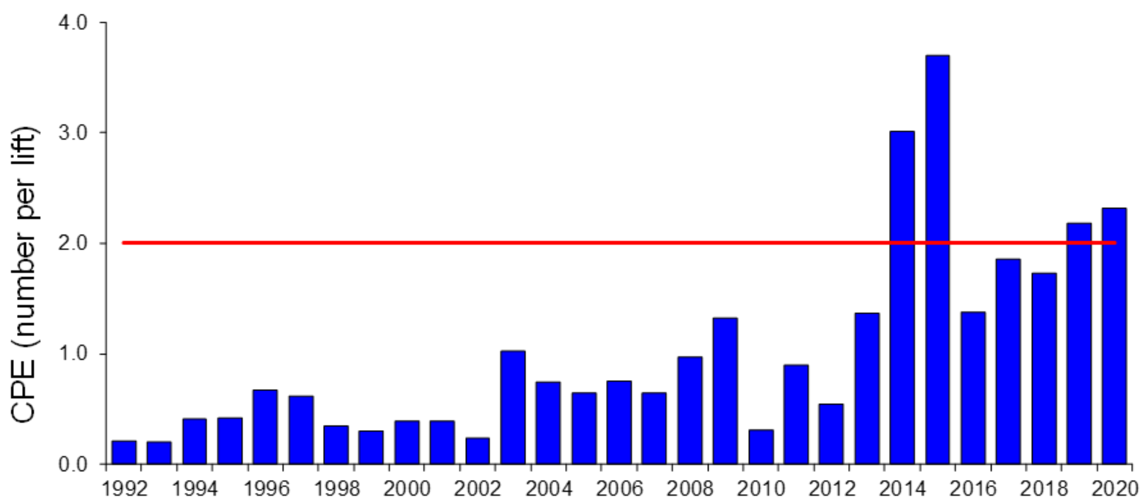


FIGURE 1.2.3. Relative abundance (number per lift, weighted by area) of age-5-and-older Lean strain and Klondike ecotype Lake Trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1992-2020. The red solid line represents the adult rehabilitation target of 2.0 fish per lift.

Forty (40) Lake Trout were caught in Partnership Survey index gear in the Pennsylvania Ridge (7) and east basin (33) surveys in 2020. All Lake Trout were captured in nets fished on bottom (40). The 2020 Lake Trout index in the east basin (0.55 fish/lift) declined from 2019 but was above the time series mean (0.43 fish/lift). Catch rates in the Pennsylvania Ridge survey (0.44 fish/lift) increased from 2019 and was also above average (0.19 fish/lift) (Figure 1.2.4). Lake Trout with coded wire tags (22 or 55%) were assigned to the following strains: Slate Island (17 or 43%), Lake Champlain (3 or 8%), Finger Lakes (2 or 5%) and unknown (without coded wire tag: 18 or 45%). Four Lake Trout lacked fin clips (10%). Ages derived from coded wire tags ranged from 3 to 14 with ages-4 (43%) and 5 (35%) most abundant.

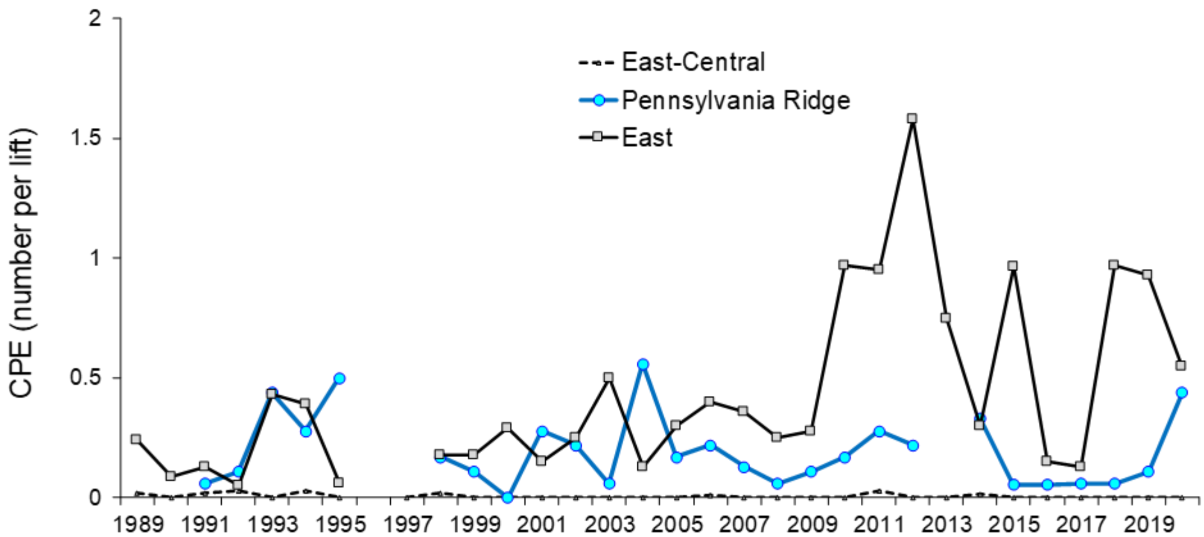


FIGURE 1.2.4. Lake Trout CPE (number per lift) by basin from the OMNRF Partnership Index Fishing Program, 1989-2020. Includes canned (suspended) and bottom gill net sets, excluding thermocline sets.

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. An estimated 447 Lake Trout were harvested in New York waters out of an estimated catch of 1,556 fish in 2020. Pennsylvania anglers harvested an estimated 67 fish from a total catch of 273 Lake Trout. (Figure 1.2.5). 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.

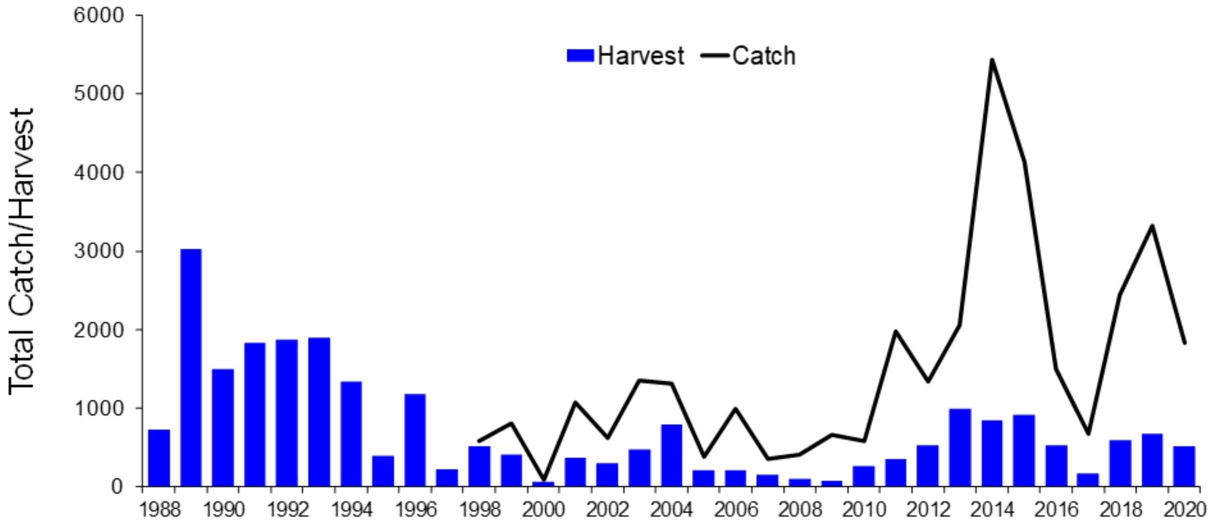


FIGURE 1.2.5. Estimated Lake Trout catch and harvest by recreational anglers in the New York and Pennsylvania waters of Lake Erie, May-October, 1988-2020

Natural Reproduction

Naturally reproduced Lake Trout remain below detectable levels in the Coldwater Assessment Survey. In 2020, only one potentially wild fish (no fin clips; no CWT's) out of a total of 376 Lake Trout (all nets) was caught during the survey, representing less than 1% of the fish captured. Three additional non-clipped/non-tagged Lake Trout (8% of survey catch) were caught in the Partnership Survey. Altogether, a total of 86 potentially wild Lake Trout have been recorded since 2000 in the Coldwater Assessment Survey. Rates of unmarked fish remain similar to measures of unmarked fish in the hatchery. Otoliths are collected from Lake Trout found without CWTs or fin-clips and will be used in future stock discrimination studies. In 2020 a revised management plan was drafted in order to guide rehabilitation in 2021 and beyond.

Diet

Seasonal diet information for Lake Trout is not available based on current sampling protocols. Diet information was limited to fish caught during August 2020 in the coldwater gill net assessment surveys in the eastern basin of Lake Erie. Rainbow Smelt have traditionally been the main prey item for Lake Trout, usually comprising over 90% of Lake Trout diet items. However, Round Goby have become a common prey item since they invaded the east basin of Lake Erie in the early 2000s (Figure 1.2.6). In years of lower adult Rainbow Smelt abundance, Lake Trout prey more on Round Goby.

In 2020, Rainbow Smelt were the dominant prey fish, occurring in 94% of the non-empty Lake Trout stomachs (Figure 1.2.6). Similar to the previous pattern over the past 15 years, the occurrence of Round Goby declined with high occurrence of Rainbow Smelt, representing less than 4% in stomachs. This was the lowest occurrence of Round Goby in Lake Trout diets in the time series. The occurrence of fish species other than Rainbow Smelt and Round Goby in Lake Trout diets has increased in recent years. Other fish species comprised 7% of the diets in 2020, which was the third highest occurrence in the time series. Yellow perch comprised the majority of this group (4%); other species included *Morone spp*. (White Perch, White Bass) (1%) and Gizzard Shad (2%).

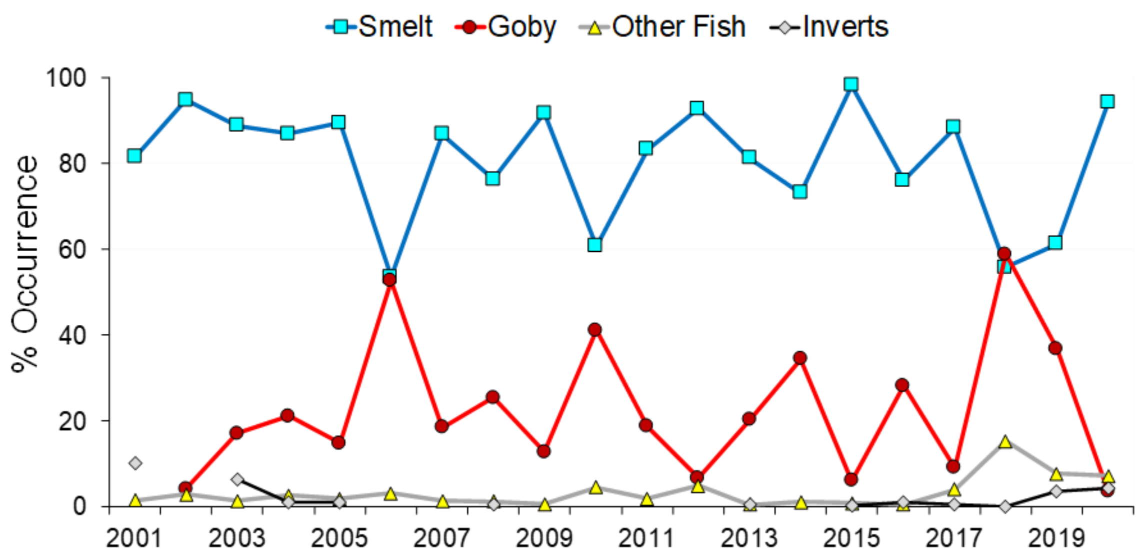


FIGURE 1.2.6. Percent occurrence in diet of Rainbow Smelt, Round Goby, all other fish species, and invertebrates from non-empty stomachs of Lake Trout caught in eastern basin assessment gill nets, August, 2001-2020.

1.3 Report on the Status of Burbot

Matthew Heerschap (OMNRF)

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. 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. Since 2012, catches have been consistently low. Burbot catch rates in Partnership Survey nets fished on bottom during thermal stratification (0.21 fish/lift) are presented for comparison with Coldwater Assessment survey Burbot catch rates (0.25 fish/lift, Figure 1.3.1). Coldwater Assessment (CWA) and east basin Partnership Survey indices share similar trends and magnitudes with some annual variation.

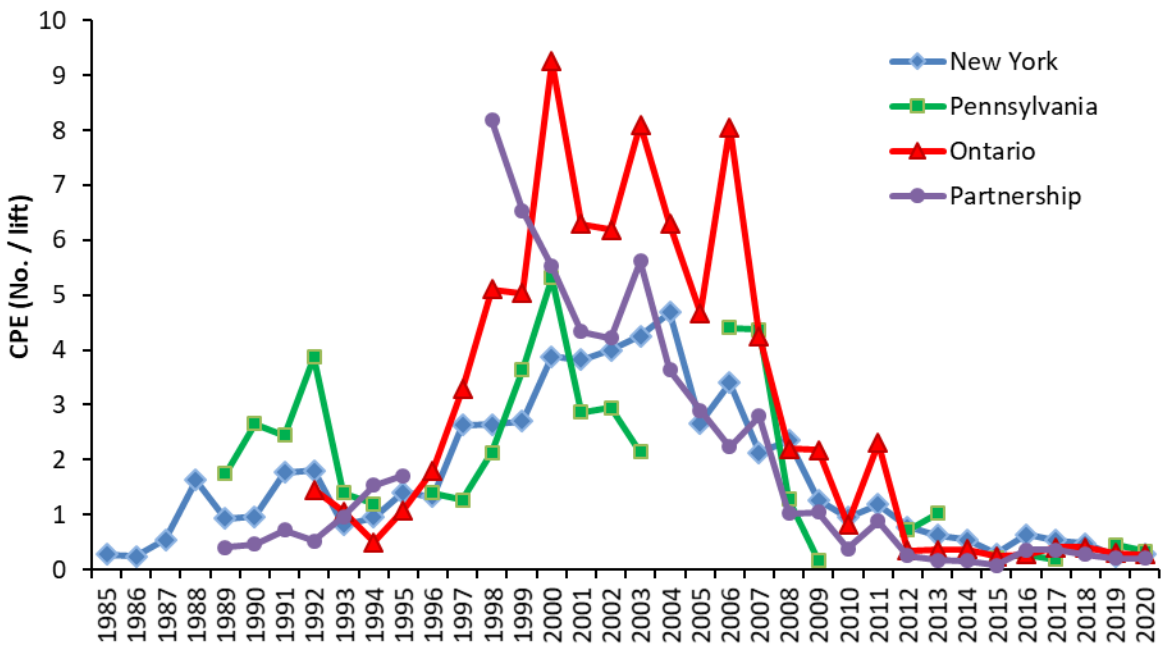


FIGURE 1.3.1. Burbot CPE (number per lift) by basin from the Interagency Coldwater Assessment and Ontario Partnership Surveys bottom set nets, 1985-2020.

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 2020 was 1,814 lbs, down from 2,128 lbs in 2019. Catches were 773 lbs in Ontario, 754 lbs in New York, 173 lbs in Pennsylvania and 114 lbs in Ohio.

Larval Burbot collections were conducted in 2019 in the Detroit River, St. Clair River, Lake St. Clair, and Lake Erie. Preliminary results indicate that 1,697 early life stage Burbot were captured using a combination of paired bongo nets, depth-stratified conical nets and bottom D-frame nets. Larval tows were not conducted in these systems in 2020. However, larval Burbot have been consistently collected in the St. Clair and Detroit river systems since the larval sampling program began (McCullough et al. 2015; Tucker et al. 2018).

Acoustic tagging of Lake Erie Burbot from Pennsylvania waters began in December 2018; two Burbot were implanted with acoustic telemetry transmitters and released. Preliminary movement data indicates that one of these fish survived and remained close to the release site over winter then began to move east towards Dunkirk, NY in the spring of 2019. In November 2019, 31 adult Burbot were collected from commercial trap nets near Erie, PA and 22 were successfully implanted with acoustic transmitters then released. The Ontario Ministry of Natural Resources and Forestry plans on tagging an additional 20 adult Burbot with acoustic transmitters in the eastern basin of Lake Erie in 2021. Information gathered from these tagged fish will help identify priority Burbot habitat and provide information regarding Lake Erie Burbot behaviour and spatial ecology. For more information visit: https://glatos.glos.us/home

Age and Recruitment

Burbot ages are estimated using otoliths for fish caught in the Interagency CWA Survey and the annual Partnership Gillnet Survey. The use of otolith thin sections is recommended as the best approach for accurate age determination of Burbot (Edwards et al. 2011). Burbot ranged in age from 3 to 21 years in 2020 (N = 26, Figure 1.3.2). The mean age in 2020 was 8.4 years, down from 12.0 years in the 2019 CWA survey (Figure 1.3.3). Age four fish, which are used as an indicator of recruitment, show a decline in Burbot recruitment beginning in the early 2000’s. Aside from a single recruitment event, signalled in 2017, Burbot recruitment has remained low. No age 4 Burbot were captured in the CWA in either 2019 or 2020 (Figure 1.3.3).

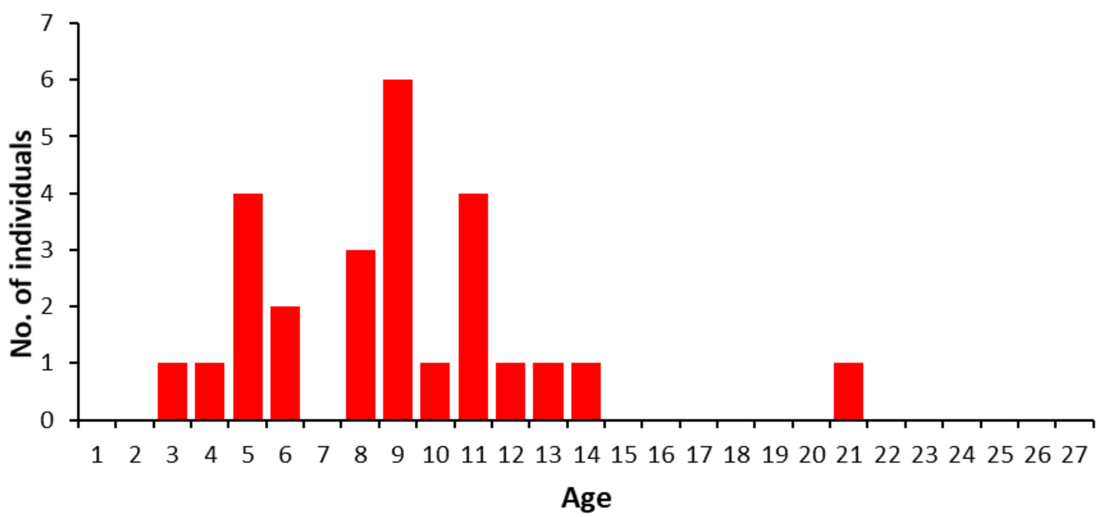


FIGURE 1.3.2. Age distribution of Burbot caught in the Interagency Coldwater Assessment Survey and the Partnership Gillnet Survey in eastern Lake Erie, 2020 (N=26).

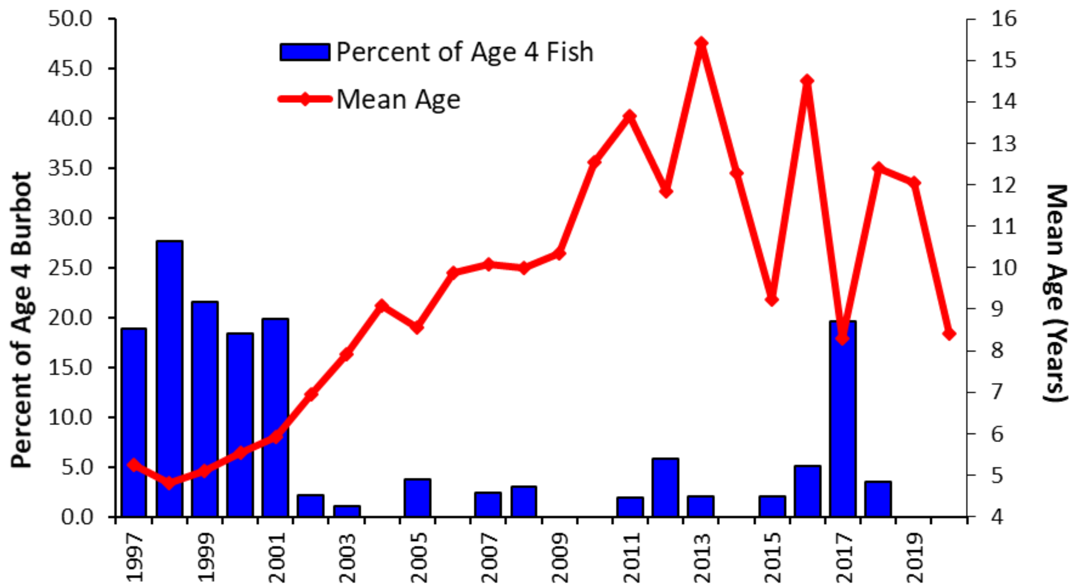


FIGURE 1.3.3. Mean age and percent of age-4 Burbot caught in the Interagency Coldwater Assessment Survey in eastern Lake Erie from 1997-2020.

Diet

Diet information was collected for Burbot caught in the 2020 Interagency CWA Survey. Analysis of stomach contents revealed a diet made up entirely of fish (N=9, Figure 1.3.4). Burbot diets continue to be diverse, with four different identifiable fish species found in stomach samples. Fish other than Rainbow Smelt or Round Goby comprised the most prevalent prey category, representing 48% of the identifiable prey items. Smelt represented the second most abundant category (42%). Round Goby, which has been a dominant prey item in Burbot diets since 2003, only represented 10% of the Burbot diet in 2020.

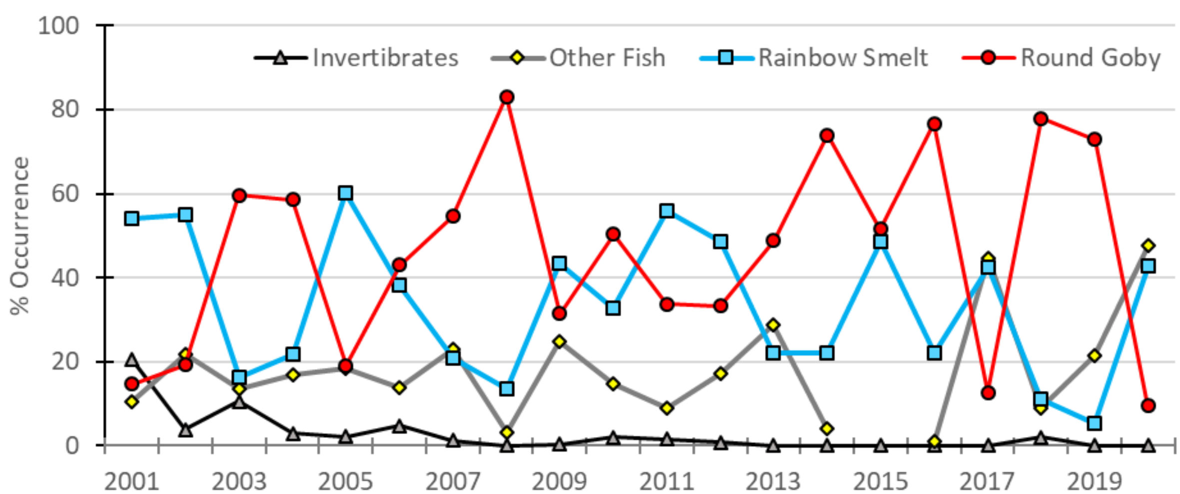


FIGURE 1.3.4: Frequency of occurrence of Rainbow Smelt, Round Goby, Other Fish, and Invertebrates in the diet of Burbot caught the Coldwater Assessment Survey in the eastern basin of Lake Erie, 2001-2020.

1.4 Report on Rainbow Trout / Steelhead

Chuck Murray (PFBC)

Exploitation

While Rainbow/Steelhead Trout harvest by boat anglers represents only a fraction of the total open lake estimated harvest, it remains the only annual estimate of steelhead harvest tabulated by most Lake Erie agencies. These estimates can provide some measure of the relative abundance of adult steelhead in Lake Erie. The 2020 estimated Rainbow/Steelhead Trout harvest from the summer open-water boat angler fishery totaled 3,910 fish by agencies reporting open lake boat angler creel data in 2020 (Table 1.4.1). The Ontario Ministry of Natural Resources and Forestry (OMNRF) have intermittently conducted open lake boat angler creel surveys, but no data was collected in 2020. Open lake boat harvest estimates for Steelhead Trout in Ohio were not available for this report. Pennsylvania boat anglers harvested 3,575 Steelhead Trout, which is near the long-term average of 3,134 fish, but notably, the highest harvest estimate since 2010. New York boat anglers harvested an estimated 316 Steelhead Trout in 2020 about half the long-term average of 625 fish. Michigan open lake steelhead harvest remained negligible, with anglers harvesting an estimated 19 Steelhead Trout in 2020.

TABLE 1.4.1. Estimated Rainbow Trout harvest by open lake boat anglers in Lake Erie, 1999-2020.

Year	Ohio	Pennsylvania	New York	Ontario	Michigan	Total
1999	20,396	7,401	1,000	13,000	100	41,897
2000	33,524	11,011	1,000	28,200	100	73,835
2001	29,243	7,053	940	15,900	3	53,139
2002	41,357	5,229	1,600	75,000	70	123,256
2003	21,571	1,717	400	N/A*	15	23,703
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*	68	25,685
2008	3,656	1,089	647	N/A*	39	5,431
2009	7,662	857	96	N/A*	150	8,765
2010	3,911	5,155	109	N/A*	3	9,178
2011	2,996	1,389	92	N/A*	3	4,480
2012	6,865	2,917	374	N/A*	9	10,165
2013	3,337	1,375	482	N/A*	53	5,247
2014	3,516	2,552	419	4,165	0	10,652
2015	4,622	1,165	673	N/A*	0	6,460
2016	3,577	806	452	N/A*	0	4,835
2017	6,804	1,727	516	N/A*	0	9,047
2018	5,330	837	783	N/A*	0	6,950
2019	2,887	1,719	224	N/A*	59	4,889
2020	N/A**	3,575	316	N/A*	19	3,910
mean	11,727	3,134	625	25,736	33	22,872

* no creel data collected by OMNRF in 2003, 2005-2013, 2015-2020. ** No creel data available due to COVID-19.

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 40 A1-A3 wounds were found on 364 Lake Trout greater than 532 mm (21 inches) total length in 2020 during coldwater assessment gill netting, equaling a wounding rate of 11.0 wounds per 100 fish (Table 2.1; Figure 2.1). This was below than the average wounding rate from the previous 10 years (12.0 wounds/100 fish) but above the target rate of 5.0 wounds per 100 fish (Markham et al. 2008). Wounding rates have remained above target for 24 of the past 25 years. Large Lake Trout continue to be the preferred targets for Sea Lamprey; Lake Trout greater than 736 mm (29 inches) had the highest A1-A3 wounding rates (15.4 wounds/100 fish) (Table 2.1). Small Lake Trout less than 532 mm (21 inches) are rarely attacked when larger Lake Trout are available.

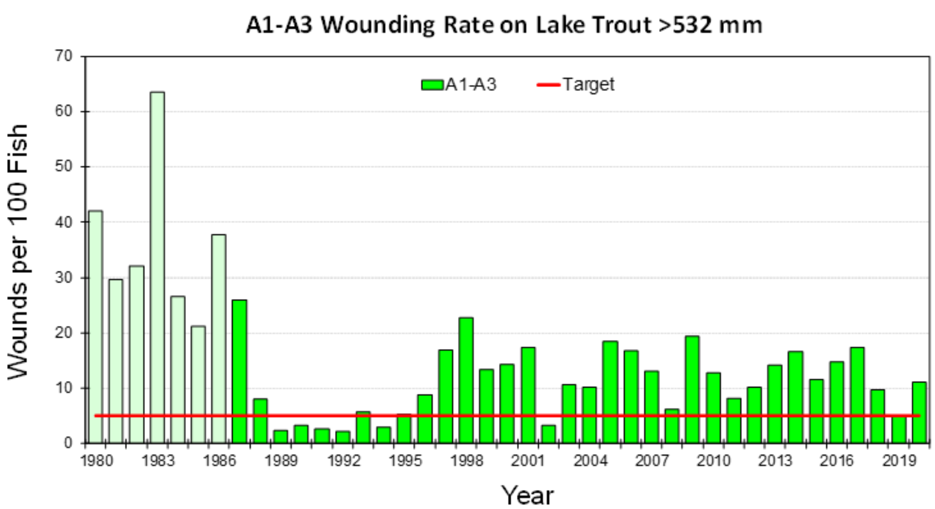


FIGURE 2.1. Number of fresh (A1-A3) Sea Lamprey wounds per 100 Lake Trout greater than 532 mm (21 inches) sampled in assessment gillnets in the eastern basin of Lake Erie, August-September, 1980-2020. The target rate (red solid line) is 5.0 wounds per 100 fish. Lighter shading indicates pre-treatment years.

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TABLE 2.1. Frequency of Sea Lamprey wounds observed on several standard-length groups of Lake Trout collected from assessment gill nets in the eastern basin of Lake Erie, August 2020.

Size Class Total Length (mm)	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
432-532	8	0	0	0	---	0	0
533-634	58	0	1	2	5	5.2	8.6
635-736	118	0	0	8	37	6.8	31.4
>736	188	1	8	20	145	15.4	77.1
>532	364	1	9	30	187	11.0	51.4

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, 2020. SI=Slate Island, FL=Finger Lakes, KL=Klondike, LC=Lake Champlain.

Lake Trout Strain	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
SI	31	0	0	0	0	0.0	0.0
FL	129	1	3	13	74	13.2	57.4
KL	3	0	0	2	1	66.7	33.3
LC	132	0	4	12	86	12.1	65.2

Finger Lakes (FL) and Lake Champlain (LC) strain Lake Trout were the most sampled strains in 2020, and they accounted for the majority of the fresh (A1-A3) and healed (A4) Sea Lamprey wounds (Table 2.2). Wounding rates have typically been similar between these two strains in recent years. Sample sizes on Klondike strain (KL) Lake Trout were too low (N=3) to provide meaningful measures of wounding. However, the KL strain has historically had higher wounding rates than FL and LC strain Lake Trout, indicative of higher susceptibility of this strain to Sea Lamprey attacks. There were no signs of fresh or healed Sea Lamprey wounds on the Slate Island (SI) strain in 2020, which could indicate either a high avoidance behavior of Sea Lampreys or a low survival rate from a Sea Lamprey attack.

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 have increased since 2004 in eastern basin waters of Lake Erie (Figure 2.2). In 2020, there was no fresh (A1-A3) or healed (A4) wounds on the 17 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.

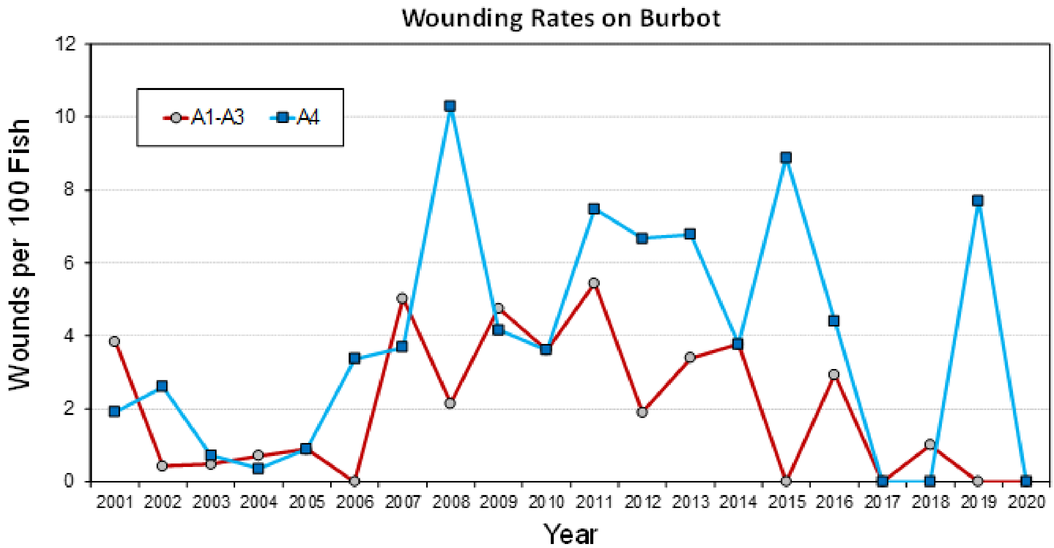

FIGURE 2.2. Number of A1-A3 and A4 Sea Lamprey wounds per 100 Burbot greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August, 2001-2020.

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). A total of 21 Lake Whitefish greater than 532 mm (21 inches) were checked for evidence of Sea Lamprey attacks in 2020 assessment netting; three of these fish had A1-A3 wounds (14.3 wounds/100 fish) while 2 had A4 wounds (9.5 wounds/100 fish) (Figure 2.3). These were the highest wounding rates observed on Lake Whitefish in this time series. Wounding rates on Lake Whitefish have generally remained consistent over the previous eight years with the exception of 2015 when only two fish were caught.

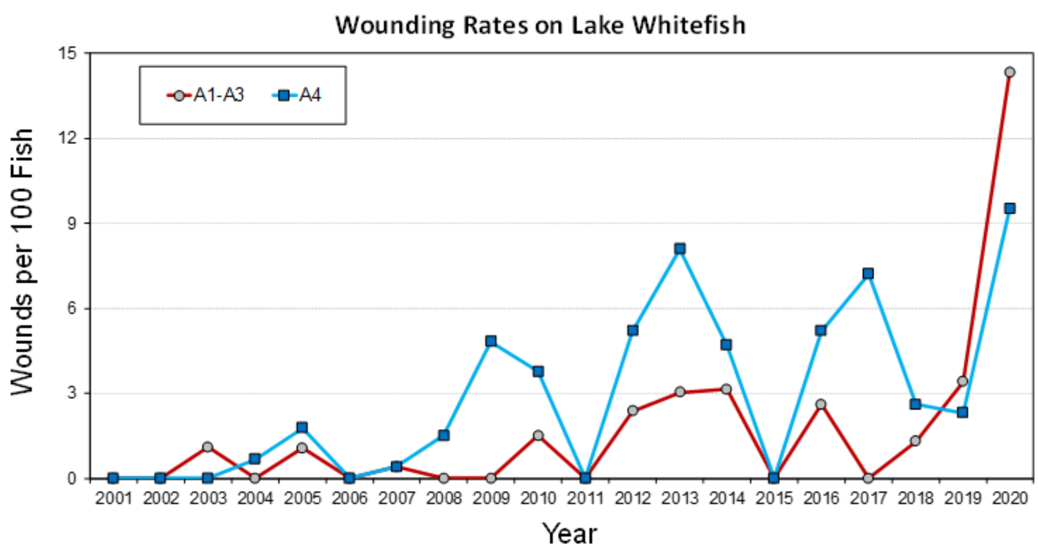

FIGURE 2.3. Number of A1-A3 and A4 Sea Lamprey wounds per 100 Lake Whitefish greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August, 2001-2020.

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 132 sites in 2020. Auxiliary gill nets (121 mm 50 meshes deep) were also fished suspended adjacent to index gear. 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 2020, sea Lamprey wounds and scars were not observed on any coldwater species such as Lake Trout (40), Lake Whitefish (49) and Burbot (10). Wounds (A1-A4) were observed on Walleye (0.02/100 fish), Yellow Perch (0.09 wounds / 100 fish), Smallmouth Bass (10/100 fish) and 1 Channel Catfish. Scars (B wounds) were observed on Yellow Perch (4/3281 examined), Smallmouth Bass (2/60 examined) and 1 Channel Catfish. The spatial distribution of fish with Sea Lamprey wounds and scars in 2020 is shown in Figure 2.4

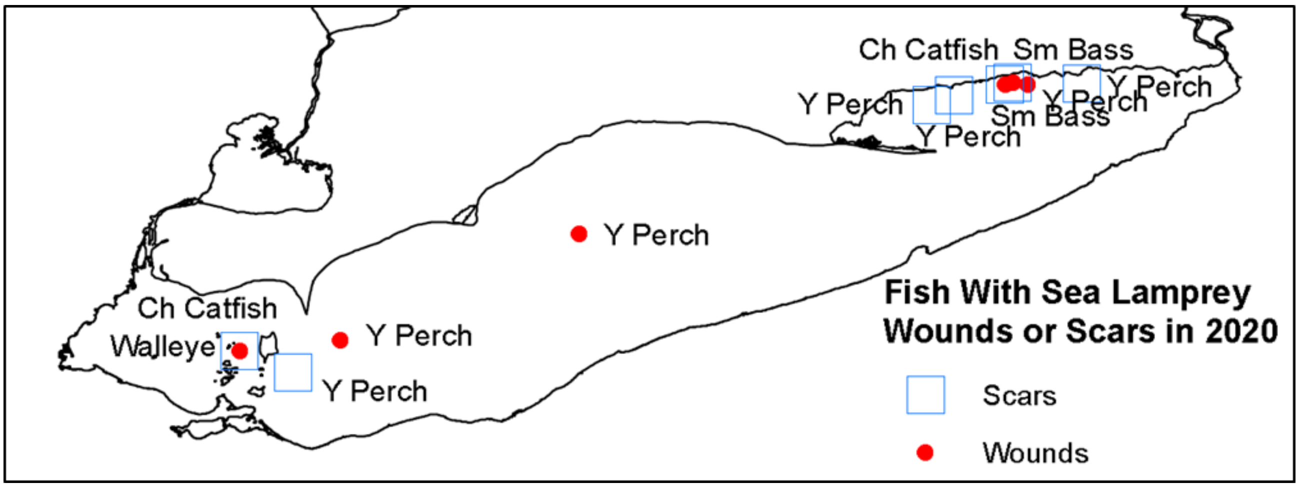

FIGURE 2.4. Individual fish with A1-A4 wounds (red circles) and B-type scars (blue squares) observed during Lake Erie Partnership surveys in 2020. Includes index and auxiliary gear.

Summary of 2020 Actions for the Integrated Management of Sea Lampreys in Lake Erie

Adult Assessment

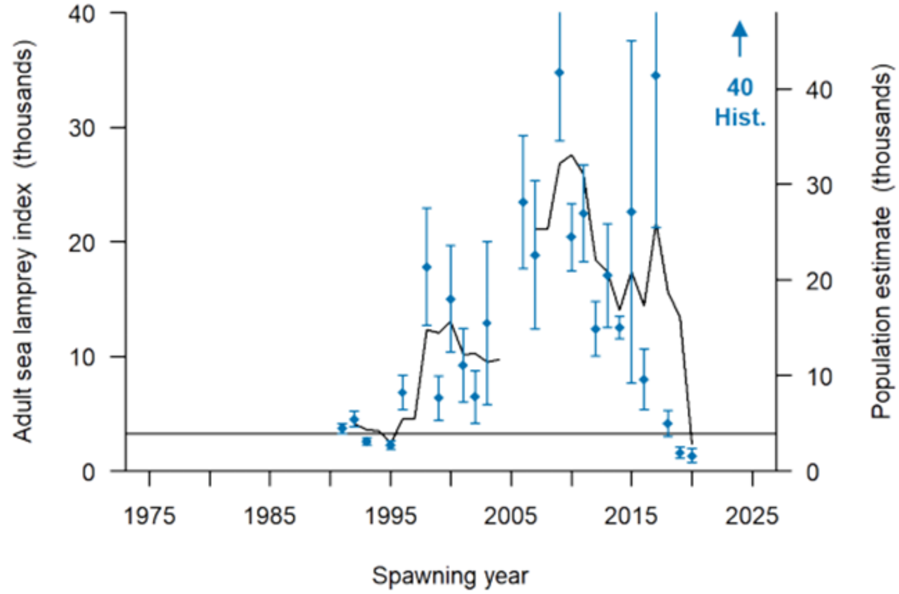

FIGURE 2.5. Index estimates with 95% confidence intervals (vertical bars) of adult sea lampreys, including historic pre-control abundance (as a population estimate) and the three-year moving average (line). The population estimate scale (right vertical axis) is based on the index-to-PE conversion factor of 1.2. The adult index in 2020 was 1,300 with 95% confidence interval (730-1,900). The three-year average of 2,400 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).

Lampricide Control

- Big Creek and Big Otter Creek (Canada), Grand River and Raccoon Creek (U.S.) were scheduled to be treated in 2020, but were cancelled due to the COVID-19 restrictions. These treatments are rescheduled for 2021.
- Conneaut Creek (U.S.) is scheduled for treatment in May 2021.

Larval Assessment

- All Canadian and U.S. larval assessments that were scheduled for 2020 are rescheduled for 2021.
- Distribution surveys are planned for Conneaut Creek and Raccoon Creek prior to treatment.
- Twenty-four plots in the upper section of the St. Clair River were scheduled to be surveyed with Granular Bayluscide (gB) in 2020 by the Department of Fisheries and Oceans. These surveys are rescheduled for 2021.
- Twelve plots in the Detroit River around Belle Isle are scheduled to be surveyed with Granular Bayluscide (gB) in 2021 by the U.S. Fish and Wildlife Service (USFWS).

Barriers

- Black River – The Michigan Department of Natural Resources (MIDNR) and USFWS-Alpena FWCO funded a feasibility study for the removal of Wingford dam. Project partners are currently working to find a mutually beneficial solution to allow fish passage while preventing sea lamprey escapement.

- Clinton River – The City of Rochester Hills, Clinton River Watershed Council, and MIDNR collaborated with USFWS staff to block a natural bypass around the Yates Mill dam. The bypass developed in a low-lying area during periods of high flow and has allowed sea lamprey escapement in the past. Steel sheet pile was installed at the upstream mouth of the bypass channel to divert flow back through the main channel. Construction began in August and the project was finished by September 2020.
- Cattaraugus Creek **–** The United States Army Corps Engineers (USACE), along with project partners from Erie County and New York Department of Environmental Conservation (NYDEC) have approved the selected plan for the Springville Dam Ecosystem Restoration Project. A Denil fishway with a seasonal trap and sort operation is included in the design. The Service has worked closely with the NYDEC and USACE to design a sea lamprey trap at the entrance of the fishway. The USACE resources for this project have shifted and the project is currently on hold.
- Grand River – The USACE is the lead agency administering a project to construct a sea lamprey barrier to replace the deteriorated structure in the Grand River. Construction of the dam began in summer 2019 and was complete by mid-summer 2020. Construction of trap inserts is currently underway.
- Conneaut Creek **–** The states of Pennsylvania and Ohio discussed with the Great Lakes Fishery Commission and the USFWS the potential for constructing a new barrier on Conneaut Creek in Ohio or Pennsylvania. The goal of the project is to reduce the amount of stream miles exposed to lampricide application and protect sensitive, native species (Mudpuppies, Hellbenders, and Northern Brook Lampreys). Seven potential barrier sites have been identified within Pennsylvania as the USACE works to finalize the Federal Interest Determination report. Monthly discussions continue working to identify the best type of barrier for the system.
- An estimated 109 barriers on Lake Erie tributaries will be inspected to ground truth the current barrier inventory data within the Barrier Inventory and Project Selection System (BIPSS) database.
- Consultations to ensure blockage at barriers were conducted with partner agencies on two sites in one river (Table 2.3).
- Seven purpose-built barriers in Canada were maintained as planned and the inflatable barrier at Big Creek was fully operational. All traps on related barriers were also operated as planned.

TABLE 2.3. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Erie streams during 2020.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Huron R.	-	HRWC[1]	Flat Rock Hydro Dam	Do Not Concur	Lowermost barrier
Huron R.	-	HRWC[1]	Peninsular Paper Dam	Concur	Upstream of blocking barrier

[1]Huron River Watershed Council

Research

Supplemental Sea Lamprey Control

Topic: Supplemental controls are tactics that supplement the two primary sea lamprey control tactics – lampricides and sea lamprey barriers. Supplemental controls primarily focus on the adult and juvenile life stages with the goal of reducing the reproductive potential of spawning populations within a tributary; these tactics include trapping adults or out-migrating juveniles, release of sterile males, and pheromone communication disruption, for example. History provides key lessons concerning the use of supplemental controls (1) they may only be useful when integrated with other control methods and (2) assessing their impact is not trivial, and therefore, requires experimental planning prior to deployment and sustained effort for multiple years. Building on recent success supplementing control in the Cheboygan and Black Mallard rivers (Lake Huron tributaries), our overall goals are to (1) develop, implement, and evaluate an integrated array of sea lamprey control tools focused on reducing reproduction that supplement on-going lampricide and barrier programs and (2) define stream characteristics where supplemental controls provide the greatest benefit.

Objective: Determine how effects of supplementing lampricide treatments with control tools that reduce reproduction vary among streams and why.

Method: Our objective will be accomplished by implementing an adaptive assessment plan on 12 experimental streams for 12 years to answer two guiding questions: (1) What is the relationship between reductions in reproduction via supplemental controls and recruitment of age-1 sea lamprey and (2) what ecological factors influence survival and growth from age 1 to the juvenile life stage? Hypotheses stemming from these questions will be investigated by collecting physical (temperature, discharge, larval habitat, spawning habitat), biological (adult abundance, juvenile abundance, larval abundance, larval pedigree analysis, close-kin capture-recapture), and lampricide treatment data. Within this adaptive assessment plan, suites of supplemental controls will be prescribed to complement the physical, biological, and social attributes of experimental streams for 6-8 years (treatment) with the remaining years serving as control. Lampricide treatment will occur when larval density exceeds thresholds set by the study team. Hence, supplemental controls (SupCon) and lampricide serve as management levers to vary spawning stock biomass (guiding question 1) and larval density (question 2) among several diverse streams.

Project Coordinators: Nicholas Johnson, USGS, Hammond Bay Biological Station; DFO: Gale Bravener, Fraser Neave, Bruce Morrison; USFWS: Sean Lewandoski, Lori Criger, Peter Hrodey, Aaron Jubar, Tim Sullivan, Matt Symbal, Jenna Tews; Michigan State University: Travis Brenden, Mike Jones, John Robinson, Kim Scribner; GLFC: Michael Siefkes.

Expected Products: (1) Improved sea lamprey control by reducing recruitment in streams where lampricide treatment is challenging. (2) Improved understanding of factors influencing sea lamprey recruitment, growth, and survival. (3) Science and technology transfer between field agents and researchers to address control program priorities. (4) Public engagement by conducting outreach in communities where supplemental controls will be tested. (5) Science products including peer reviewed publications and graduate student mentorship.

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

Chuck Murray (PFBC) and James Markham (NYSDEC)

Lake Trout Stocking

A total of 198,625 yearling Lake Trout were stocked in Lake Erie in 2020 (Figure 3.1). The USFWS Allegheny National Fish Hatchery stocked 119,175 yearlings in the eastern basin waters of New York and 79,450 yearlings in Pennsylvania at East Ave. boat launch in Northeast, PA. No Lake Trout were stocked in Ohio or Ontario waters in 2020 due to Covid-19 issues. The Lake Trout stocked in New York waters were a mix of Finger Lakes (Seneca) and Lake Champlain strains; only Finger Lakes strain was stocked in Pennsylvania. In addition to the yearlings, a total of 41,030 fall fingerlings (Finger Lakes strain) were stocked into Cattaraugus Creek, NY by the USFWS in mid-October 2020. The combined yearling and fall fingerling yearling equivalents totaled 215,447 yearlings, which exceeded the current annual Lake Trout stocking goal of 200,000 yearlings by 8%.

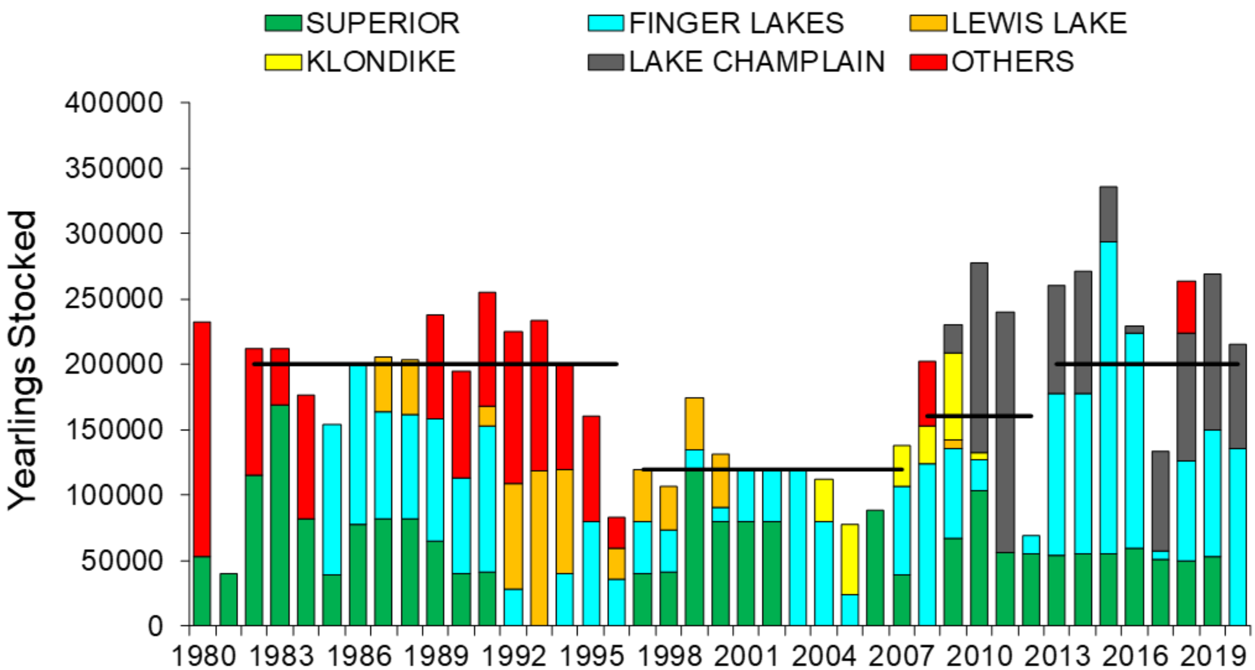

FIGURE 3.1. Lake Trout (in yearling equivalents) stocked by all jurisdictions in Lake Erie,1980-2020, by strain. Stocking goals through time are shown by black lines dark lines; the current stocking goal is 200,000 yearlings per year. Superior includes Superior, Apostle Island, Traverse Island, Slate Island, and Michipicoten strains; Others include Clearwater Lake, Lake Ontario, Lake Erie, and Lake Manitou strains. The conversion factor for yearling equivalents is 1 fall fingerling Lake Trout = 0.41 yearling Lake Trout.

Stocking of Other Salmonids

In 2020, almost 2.05 million yearling trout were stocked in Lake Erie, including Rainbow Trout/Steelhead, Brown Trout and Lake Trout (Figure 3.2). Total 2020 salmonid stocking decreased 6.8 % from 2019 and was 7.8% below the long-term average (1990-2019) of 2.28 million yearlings. Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 3.1 and are standardized to yearling equivalents.

Brown Trout stocking in Lake Erie totaled 69,323 yearling and adults in 2020, all in Pennsylvania waters. This was a 48% decrease from 2019 and 22% below the long-term (1990-2019) average annual stocking of 89,456 Brown Trout.

Between13 April and 28 April, about 19,000 adult Brown Trout were stocked by the PFBC to provide catchable trout for the opening of the 2020 Pennsylvania trout season. In a continued effort to provide a trophy Brown Trout program, the PFBC stocked about 42,000 yearling Brown Trout. These fish are in support of a put-grow-take Brown Trout program that was initiated in 2009. This program was implemented through the annual donation of 100,000 certified IPN-free eggs from the NYSDEC. Brown Trout stocking levels for catchable trout are expected to continue at the current rates in Pennsylvania.

All of the US fisheries resource agencies and a few non-governmental organizations (NGO's) in Pennsylvania currently stock Rainbow Trout/steelhead in the Lake Erie watershed. A total of 1,769,919 yearling Rainbow Trout/Steelhead were stocked in 2020, accounting for 86% of all salmonids stocked. This was a 2% decline from 2019 stocking numbers and 4% below the long-term (1990-2018) average of 1,852,627 yearling Rainbow Trout/Steelhead. About 59% of all Steelhead stocking occurred in Pennsylvania waters, followed by 27% in Ohio waters, 11% in New York waters, and 4% in Michigan waters. No Rainbow Trout were stocked in Ontario waters in 2020. The NYSDEC stocked 138,530 yearling Steelhead in 2020. New York also stocked 48,750 domestic Rainbow Trout in 2020. Steelhead stocking decreased 40% on New York, decreased 8% in Ohio, decreased 2% in Pennsylvania and was unchanged in Michigan. A full account of Rainbow Trout/Steelhead stocked in Lake Erie by jurisdiction for 2020 can be found under Charge 4 of this report, which also provides details about the locations and strains/sources of Rainbow Trout stocked across Lake Erie.

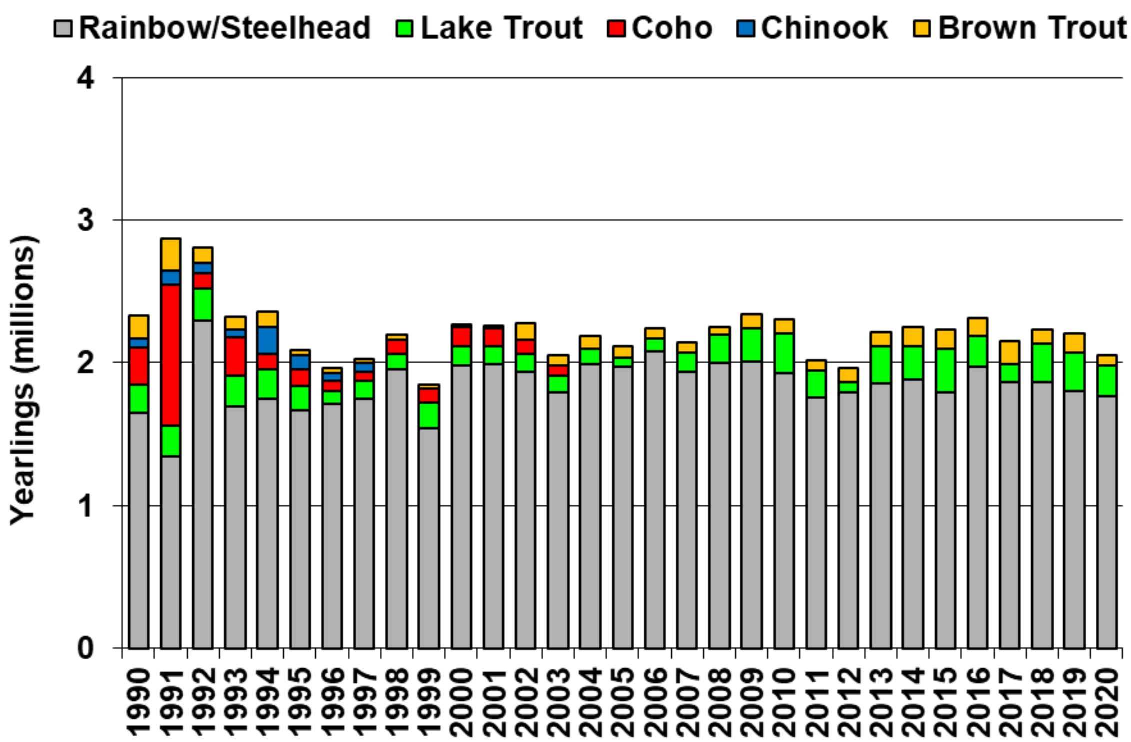

FIGURE 3.2. Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1990-2020.

TABLE 3.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2020.

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. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2020.

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. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2020.

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	528,401
	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**	**2,019,883**
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	0	0		59,750	110,732
	NYS DEC	76,456	0	0	36,480	267,166	380,102
	PFBC	0	0	0	123,186	1,032,421	1,155,607
	ODNR	0	0	0		442,228	442,228
	MDNR	0	0	0		60,706	60,706
	2017 Total	**127,438**	**0**	**0**	**159,666**	**1,862,271**	**2,149,375**
2018	ONT.	55,940	0			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				0	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**
2020	ONT.					0	0
	NYS DEC	135,997				187,280	323,277
	PFBC	79,450			69,373	1,049,000	1,197,823
	ODNR					469,265	469,265
	MDNR					64,374	64,374
	2020 Total	**215,447**	**0**	**0**	**69,373**	**1,769,919**	**2,054,739**

Pennsylvania stocked a naturalized Lake Erie strain Steelhead collected from Trout Run in Pennsylvania (Table 3.2). New York stocked a Washington strain Steelhead collected from Lake Ontario's Salmon River. Ohio stocked a combination of Manistee River strain (Lake Michigan), Ganaraska River strain (Lake Ontario) and Chambers Creek steelhead strain. Michigan stocked a Manistee River steelhead strain which is a naturalized strain from Lake Michigan. About 3% of the rainbow trout stocked in Lake Erie are a domestic strain stocked by the NYSDEC.

TABLE 3.2. Steelhead Trout stocking by jurisdiction and location for 2020.

Jurisdiction	Location	Strain	Number	Life Stage	Yearling Equivalents	
Michigan	Huron River	Manistee River, L. Michigan	64,374	Yearling	64,374	
					64,374	**Sub-Total**
Pennsylvania	Conneaut Creek	Trout Run, L. Erie	74,987	Yearling	74,987	
	Crooked Creek	Trout Run, L. Erie	73,934	Yearling	73,934	
	Elk Creek	Trout Run, L. Erie	197,795	Yearling	197,795	
	Fourmile Creek	Trout Run, L. Erie	36,436	Yearling	36,436	
	Godfrey Run	Trout Run, L. Erie	18,500	Yearling	18,500	
	Presque Isle Bay	Trout Run, L. Erie	83,250	Yearling	83,250	
	Raccoon Creek	Trout Run, L. Erie	30,600	Yearling	30,600	
	Sevenmile Creek	Trout Run, L. Erie	36,569	Yearling	36,569	
	Sixteenmile Creek	Trout Run, L. Erie	18,375	Yearling	18,375	
	Trout Run	Trout Run, L. Erie	46,416	Yearling	46,416	
	Twelvemile Creek	Trout Run, L. Erie	36,339	Yearling	36,339	
	Twentymile Creek	Trout Run, L. Erie	110,799	Yearling	110,799	
	Walnut Creek	Trout Run, L. Erie	185,000	Yearling	185,000	
					949,000	**Sub-Total**
Ohio	Ashtabula River	Manistee River/Chamber's Creek/Ganaraska River	50,294	Yearling	50,294	
	Chagrin River	Manistee River/Chamber's Creek/Ganaraska River	90,756	Yearling	90,756	
	Conneaut Creek	Manistee River/Chamber's Creek/Ganaraska River	75,116	Yearling	75,116	
	Grand River	Manistee River/Chamber's Creek/Ganaraska River	90,584	Yearling	90,584	
	Rocky River	Manistee River/Chamber's Creek/Ganaraska River	97,969	Yearling	97,969	
	Vermilion River	Manistee River/Chamber's Creek/Ganaraska River	64,546	Yearling	64,546	
					469,265	**Sub-Total**
New York	Buffalo Creek	Washington	10,000	Yearling	10,000	
	Canadaway Creek	Washington	10,000	Yearling	10,000	
	Cattaraugus Creek	Washington	56,030	Yearling	56,030	
	Cayuga Creek	Washington	7,500	Yearling	7,500	
	Chautauqua Creek	Washington	25,000	Yearling	25,000	
	Eighteen Mile Creek	Washington	20,000	Yearling	20,000	
	Silver Creek	Washington	5,000	Yearling	5,000	
	Walnut Creek	Washington	5,000	Yearling	5,000	
					138,530	**Sub-Total**
					1,621,169	**Grand Total**

Fisheries agency stocking of spring yearlings took place between 10 February and 17 April, with smolts averaging about 179 mm in length (Table 3.3). The Michigan Department of Natural Resources did an adipose (AD) fin clip on the steelhead they stocked in 2020. No other agencies tagged or clipped Rainbow Trout in 2020. Table 3.5 provides a list of all fin clips on steelhead from 2000 - 2020.

TABLE 3. Stocking summaries of yearling Steelhead Trout by fisheries agency for 2020.

Agency	Range of Dates Stocked	mean length (mm)	N of yearlings stocked
Michigan Dept. of Natural Resources	20 March - 24 March	197	64,374
New York Dept. of Environmental Conservation	18 March - 20 March	152	138,530
Ohio Division of Wildlife	13 April - 17 April	178	469,265
Pennsylvania Fish and Boat Commission	10 February - 13 March	182	949,000
		179	1,621,169

TABLE 3.5. Rainbow Trout (steelhead) fin-clip summary for Lake Erie, 2000-2020.

Year Stocked	Year Class	Michigan	New York	Ontario	Ohio	Pennsylvania
2000	1999	RP	RV	LP	-	-
2001	2000	RP	AD	-	-	-
2002	2001	RP	AD-LV	-	-	-
2003	2002	RP	RV	LP	-	-
2004	2003	RP	-	LP	-	-
2005	2004	RP	AD-LP	RP	-	-
2006	2005	-	-	LP	-	-
2007	2006	-	AD-LP	-	-	-
2008	2007	-	AD-LP	-	-	-
2009	2008	RP	-	-	-	-
2010	2009	-	-	-	-	-
2011	2010	-	AD-LP	-	-	-
2012	2011	-	-	-	-	-
2013	2012	-	-	-	-	-
2014	2013	-	-	-	-	-
2015	2014	-	AD; LV; CWT; AD+CWT	-	-	-
2016	2015	-	AD; LV; CWT; AD+CWT	-	-	-
2017	2016	-	-	-	-	-
2018	2017	-	-	-	-	-
2019	2018	AD	-	-	-	-
2020	2019	AD	-	-	-	-

Clip abbreviations: AD=adipose; RP= right pectoral; RV=right ventral; LP=left pectoral; LV=left ventral; CWT=Coded Wire Tag.

CHARGE 4: Report on the status of Lake Trout restoration by reviewing the Lake Erie Lake Trout Management Plan (2008-2020) by July 1, 2020. Draft new plan, within scope of new FCOs, for LEC review by March 1, 2021.

Matthew Heerschap (OMNRF), James Markham (NYSDEC)

Lake Trout Stocking Analysis

Introduction

Since 2008 Lake Trout management in Lake Erie has been guided by *A Strategic Plan for the Rehabilitation of Lake Trout in Lake Erie, 2008-2020* (Markham et al. 2008). The focus of this plan was to refine stocking numbers and strains to achieve targets associated with overall Lake Trout abundance and spawner biomass. This plan saw the achievement targets related to desired spawning stock abundance and demographics (ie. >10 age classes). However, the target for overall Lake Trout abundance was not achieved. In 2020, as part of the review and revision of this plan, Lake Trout stocking practices implemented over the plan period were assessed. Information generated in this section informed the development of a new Lake Trout management plan. This included analysis of strain and life history stage performance, stocking numbers and stocking locations. The new Lake Trout management plan, *A Plan to Support Lake Trout Rehabilitation in Lake Erie, 2021-2026,* is currently in draft form and will be available upon approval and acceptance by the Lake Erie Committee.

Strain Performance

Sea Lamprey Wounding

Sea Lamprey control began in Lake Erie in 1986. Prior to the first year of treatment greater than 25% of Lake Trout >533mm total length exhibited A1-A3 marks, 63% in 1983. At this time Lake Trout were attacked within two years of being stocked and age 5+ Lake Trout were absent from assessment surveys (Cornelius et al. 1995; Sullivan et al. 2003). Schneider et al. (1996) found that Sea Lamprey selectively preyed on the largest individual Lake Trout in Lake Ontario and that as the population of older and larger Lake Trout increased so to did age and length of fish with A1 marks. Over the past 24 years Sea Lamprey marking rates in Lake Erie have remained above the target rate in all but one year. However, in recent years (2018 and 2019) Sea Lamprey abundance has declined below target values (Coldwater Task Group 2020). In addition, the number of adult (age 5+) female Lake Trout has exceeded rehabilitation targets (0.5 fish/lift) in each of the past 6 years. Rogers et al. (2019), Schneider et al. (1996) and Madenjian et al. (2004) found that different strains of Lake Trout stocked in Lake Erie, Lake Ontario and Lake Huron experienced different Sea Lamprey wounding rates, theoretically due to behavioural differences resulting in different Sea Lamprey avoidance strategies. To test this in Lake Erie, A1-A3 wounding rates on adult Lake Trout were compiled for the most frequently stocked strains between 2008-2019. Wounding rates were lowest for the Slate Island (SI) strain (5.7 wounds/100 fish) and highest for the Klondike (KL) strain (15.5 wounds/100 fish) (Figure 4.1). As well, wounding rates on Finger Lakes (FL) strain (8.7 wounds/100 fish) were lower than the Lake Champlain (LC) strain (12.4 wounds/100 fish) despite them being genetically similar. This contrasts with findings from Lake Ontario and Lake Huron which found that Lake Trout strains from Lake Superior (Slate Island) were more likely to be attacked by Sea Lamprey than strains from the Seneca lakes region (Finger lakes). It should be noted, however, that the sample size of the Slate Island Lake Trout was very low compared to the other strains. Schneider et al. (1996) also found that Superior strain Lake Trout were more likely to be killed during an attack than Seneca strain Lake Trout. High mortality following a Sea Lamprey attack would therefore result in fewer A1-A3 marked individuals. Poor adult returns and low overall survival estimates of Slate Island strain Lake Trout in Lake Erie provide further support to this theory.

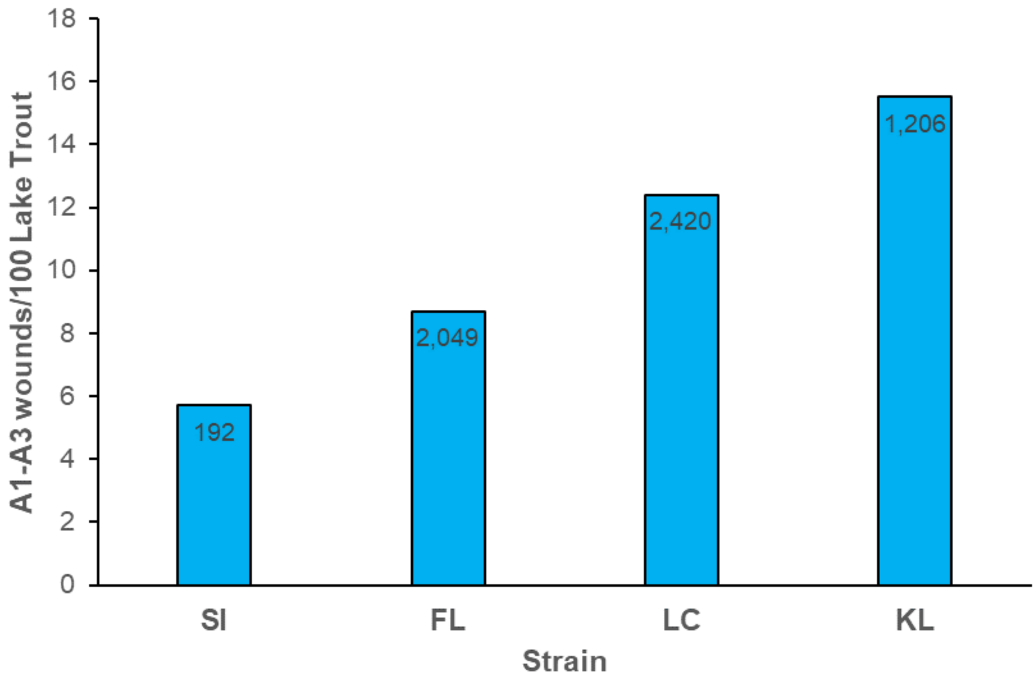

FIGURE 4.1. A1-A3 Lamprey wounds per 100 Lake Trout >532 mm for the four most frequently stocked strains in Lake Erie since 2008. FL-Finger Lakes, KL-Klondike, LC- Lake Champlain, SI-Slate Island. Data labels indicate the total number of fish assessed for wounds.
Update

Survival

Discrete strains of Lake Trout are the result of a high degree of reproductive segregation. These segregated populations developed adaptive traits which increase their likelihood of survival or reproduction. Several studies have demonstrated that the post stocking survival of native strains of Lake Trout is greater than the survival of non-native strains (Haskell et al. 1952; MacLean et al. 1981; Plosila 1977; Siesennop 1992). The mechanisms causing this disparity are unclear, however localized survival adaptations are a leading hypothesis. Unfortunately, no remnant of the historic Lake Erie population of Lake Trout exists in Lake Erie today. Therefore, new strains had to be introduced to rehabilitate the Lake Trout population. To assess the survival rates of the four most commonly stocked strains from 2003-2012, point estimates of annual survival (S) for individual cohorts were calculated for each year class using a catch curve analysis. This approach employed a 3-year running average of catch per unit effort at ages 4 through 11 (opposed to the individual values) due to the high year-to-year variability in catches, particularly of the Finger Lakes (FL) strain fish. The mean estimated survival for the 2003 – 2012-year classes combined was highest for the FL (0.78) and LC (0.88) strains (Table 4.1). Individual point estimates for both of these strains were above the Lake Trout Plan target survival of 0.60 (Markham et al. 2008; Shuter et al. 1998). Conversely, both individual point estimates and mean estimates of survival were below the plan target for both the KL (0.51) and SI (0.38) strains for this time period.

TABLE 4.1. Survival estimates for individual cohorts of Lake Trout from the 4 most commonly stocked strains. FL- Finger Lakes, KL-Klondike, LC-Lake Champlain, SI-Slate Island.

	STRAIN			
YEAR CLASS	**FL**	**KL**	**LC**	**SI**
2003	0.64	0.36		
2004		0.45		
2005				0.28
2006	0.80	0.54		
2007	0.82	0.59		
2008	0.86	0.59	0.84	0.56
2009			0.82	0.33
2010			0.93	0.41
2011				0.31
2012			0.92	
MEAN	**0.78**	**0.51**	**0.88**	**0.38**

Returns at Age and Longevity

Stocking events in Lake Erie have traditionally varied by jurisdiction, with numbers stocked of each strain also varying between jurisdictions. In order to assess the longevity of the most common strains, the number of returns at each age was standardized by the total number stocked to report on the number of returns at age/40,000 stocked fish. These were calculated for the most common stocking strains for the 2005-2019 time period. The analysis indicates that the Klondike strain had the highest returns at younger ages, but quickly declined and had much lower returns by age-6 and were mostly gone by age-9 (Figure 4.2). The cumulative returns by age also show this trend, with their return curve flattened by age-8 (Figure 4.3). The rapid decline at mature ages (age 5+) is thought to be caused by high mortality from Sea Lamprey. Rogers et al. (2019) found higher rates of lamprey wounding and lower survival estimates of Klondike ecotype Lake Trout stocked in Lake Erie than lean-type conspecifics. Lake Champlain strain have only been stocked for 11 years in Lake Erie but show the best combination of returns at both younger and older ages, indicative of good post-stocking survival and survival at older ages. Cumulative returns of this strain continue to increase at a steady pace. Finger Lakes strain Lake Trout, which have the longest history of stocking in Lake Erie, show moderate returns at younger ages but steady returns at older ages. Finger Lakes strain comprise the majority of Lake Trout in Lake Erie at age-10 and older, and their longevity may be related to their relatively low Sea Lamprey wounding rate and high adult survival rate. Slate Island strain had the poorest returns of any of the strains analyzed; returns of this strain were only 23 fish per 40,000 stocked with most of the returns occurring at younger ages ($\leq$ 4).

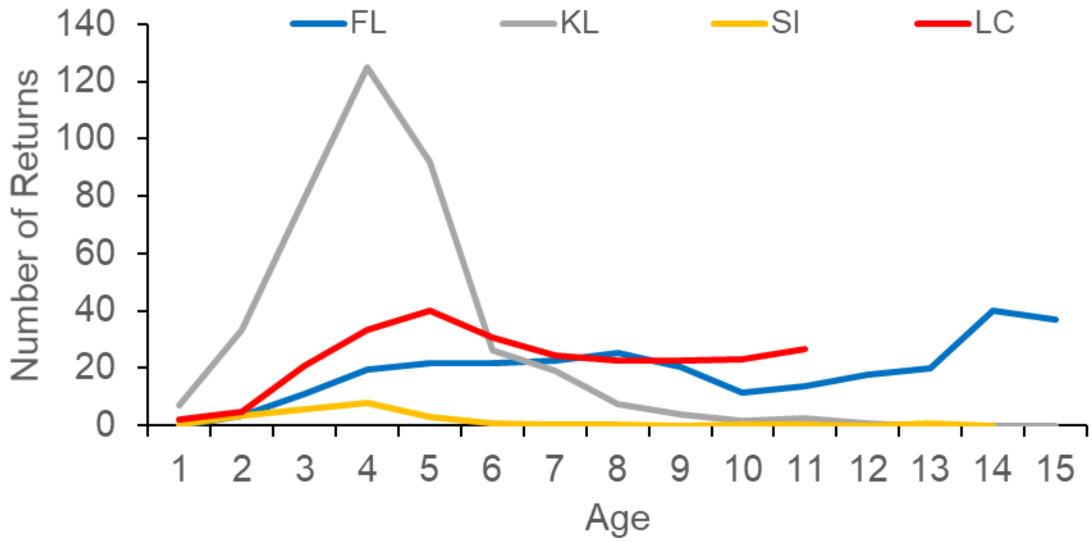

FIGURE 4.2. Number of returns of Lake Trout caught in assessment gill nets in Lake Erie from each of the 4 most frequently stocked strains between 2008-2019. FL- Finger Lakes, KL-Klondike, SI- Slate Island, LC-Lake Champlain.

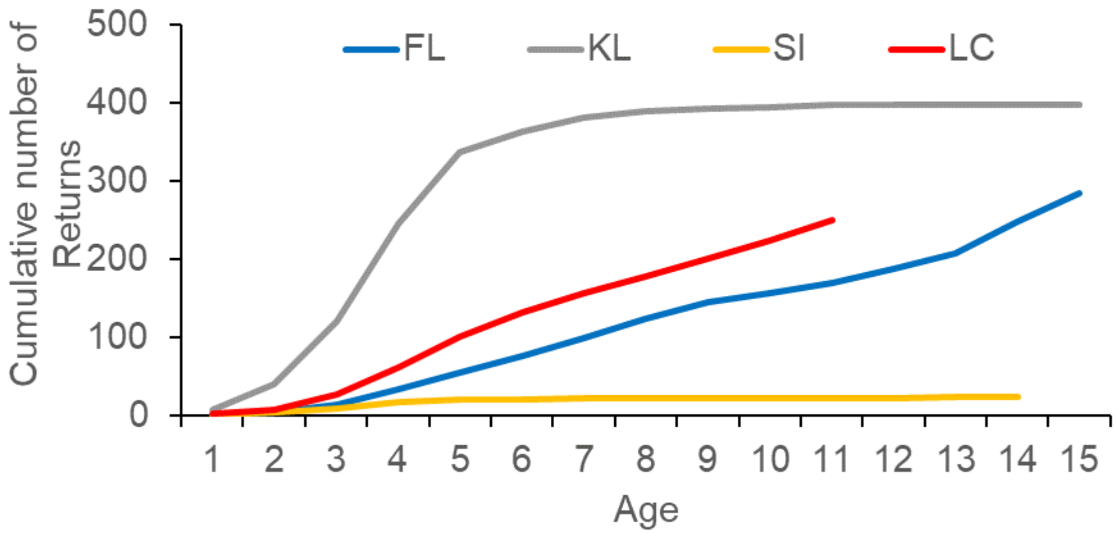

FIGURE 4.3. Cumulative number of returns of Lake Trout caught in assessment gillnets in Lake Erie from each of the 4 most frequently stocked strains between 2008-2019. FL- Finger Lakes, KL-Klondike, SI- Slate Island, LC- Lake Champlain.

Stocking Location

The number of stocking sites increased between 2008-2019 to include sites in both Ontario and Ohio jurisdictional waters (Figure 4.4). Over that period the greatest number of Lake Trout have been stocked in Dunkirk, New York (1,044,833) as well as Nanticoke Shoal in Ontario (704,582). New stocking locations in Ohio at Fairport Harbor and Catawba have received 359,909 and 406,735 fish respectively since 2012. To assess how each of these locations performed, “successful” stocking will be inferred by the presence of fish from each stocking location in the annual Coldwater Assessment Survey (CWA). For clarity, stocking locations will be grouped into 4 regions. East basin south (EBsouth) will include all Lake Trout stocked in Pennsylvania and New York. East basin north (EBNorth) will include all Lake Trout stocked in Ontario, Canada. Central basin (CentralBasin) will include all Lake Trout stocked at Fairport Harbor in Ohio. Western basin (WesternBasin) will include all Lake Trout stocked at Catawba in Ohio.

Beginning in 1982, the U.S Fish and Wildlife Service, in partnership with the New York Department of Environmental Conservation and the Pennsylvania Fish and Boat Commission began stocking of at least 160,000 yearling Lake Trout in Lake Erie (Figure 4.5). This began what has been a long history of stocking activity along the southern shore of Lake Erie’s east basin. In 2006, 88,000 yearling Lake Trout were stocked in Ontario at Port Maitland. Regular stocking in Ontario has continued annually since 2008 at Nanticoke Shoal. Lastly, in 2012 two new sites in Ohio, Catawba in the west basin and Fairport Harbor in the central basin, began to receive annual stockings of 40,000 Lake Trout.

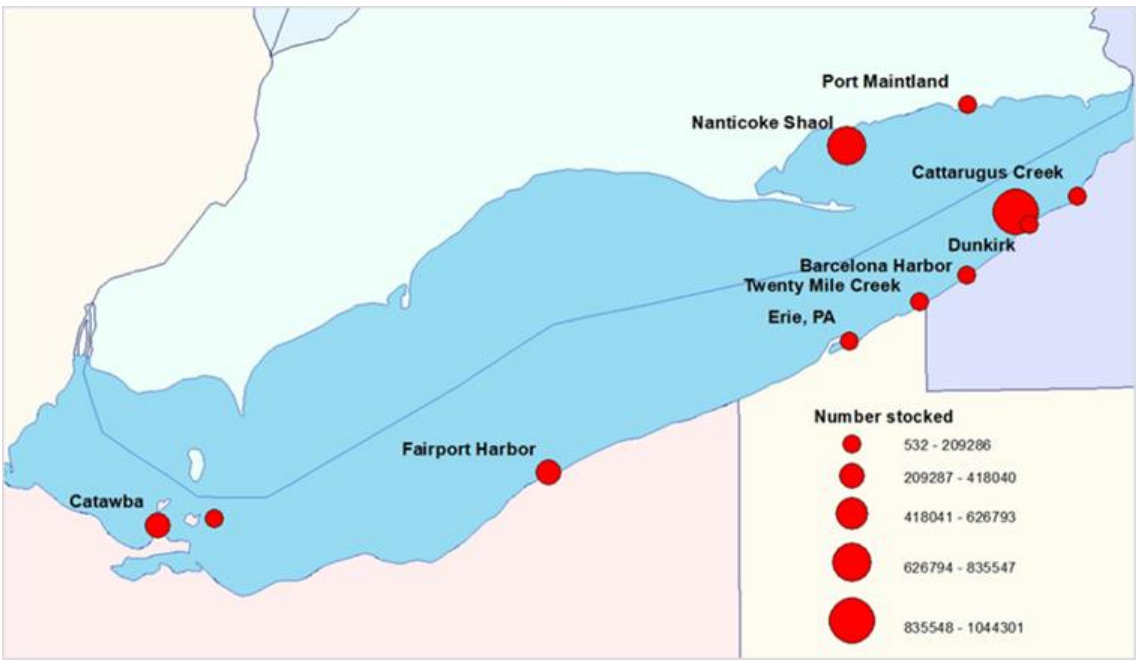

FIGURE 4.4. Map of Lake Trout stocking sites in Lake Erie between 2008-2019. Diameter of the circles corresponds to the number of yearling and fall fingerling Lake Trout stocked at each location.

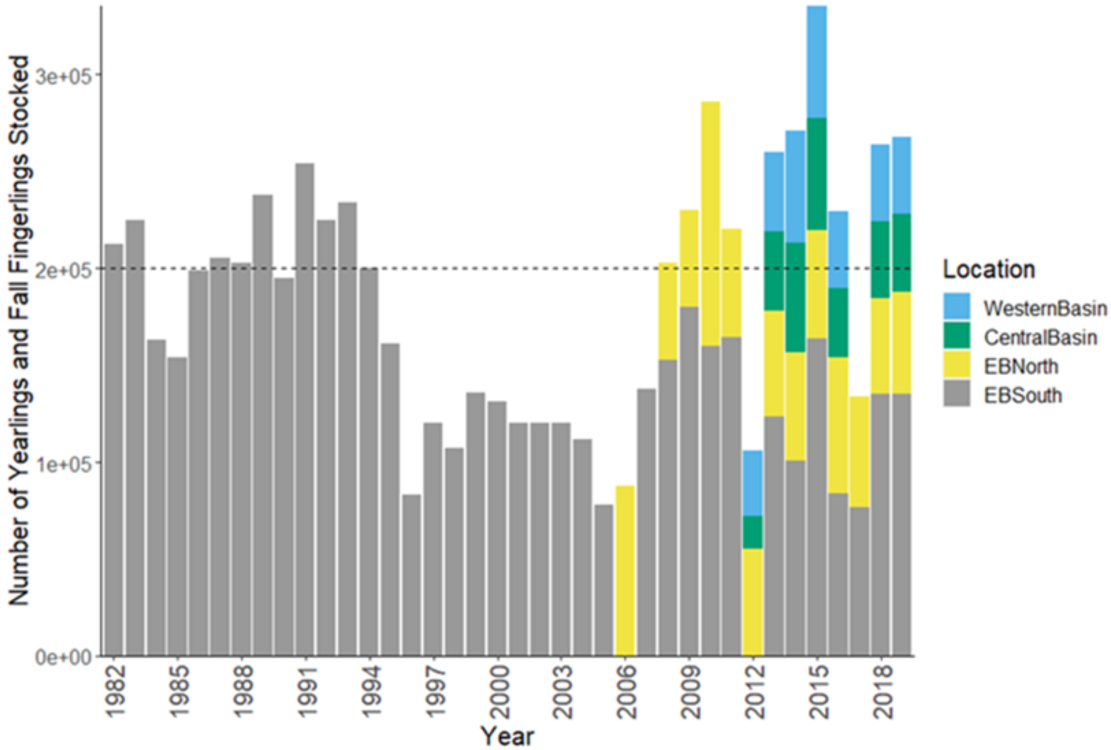

FIGURE 4.5. Annual number of yearling and fall fingerling Lake Trout stocked in Lake Erie. WesternBasin- West Basin, CentralBasin- Central Basin, EBNorth- North shore of the East Basin, EBSouth- South shore of the East Basin.

To assess stocking location performance, the mean annual catch per unit effort of Lake Trout from each stocking location was assessed. Lake Trout are a long-lived species and in Lake Erie Lake Trout over 20 years of age are relatively common. Therefore, the longer history and more intensive stocking along the southern shore of the east basin has produced a Lake Trout population which is dominated by these fish (Figure 4.6.A). To correct for this the mean annual CPE was standardized by the cumulative number of stocked fish from each location to produce a standardized mean annual CPE/40,000 Lake Trout stocked. Review of the standardized CPE values reveals that fish stocked in along the northern shoreline in Ontario exist in higher numbers in Ontario waters (Figure 4.6.B). As well, fish stocked along the southern shore in New York and Pennsylvania exist in higher numbers in New York and Pennsylvania. In general, fish tend to exist in higher numbers close to the area that they were stocked. In addition, this analysis reveals the poor representation of fish stocked in the western basin at Catawba. Fairport Harbor in the central basin and Catawba in the western basin each received paired stockings of yearling and fall fingerling trout beginning in 2012. Despite being stocked in lower overall numbers, fish from the central basin are represented in all 4 jurisdictional areas and are well represented in New York and Pennsylvania.

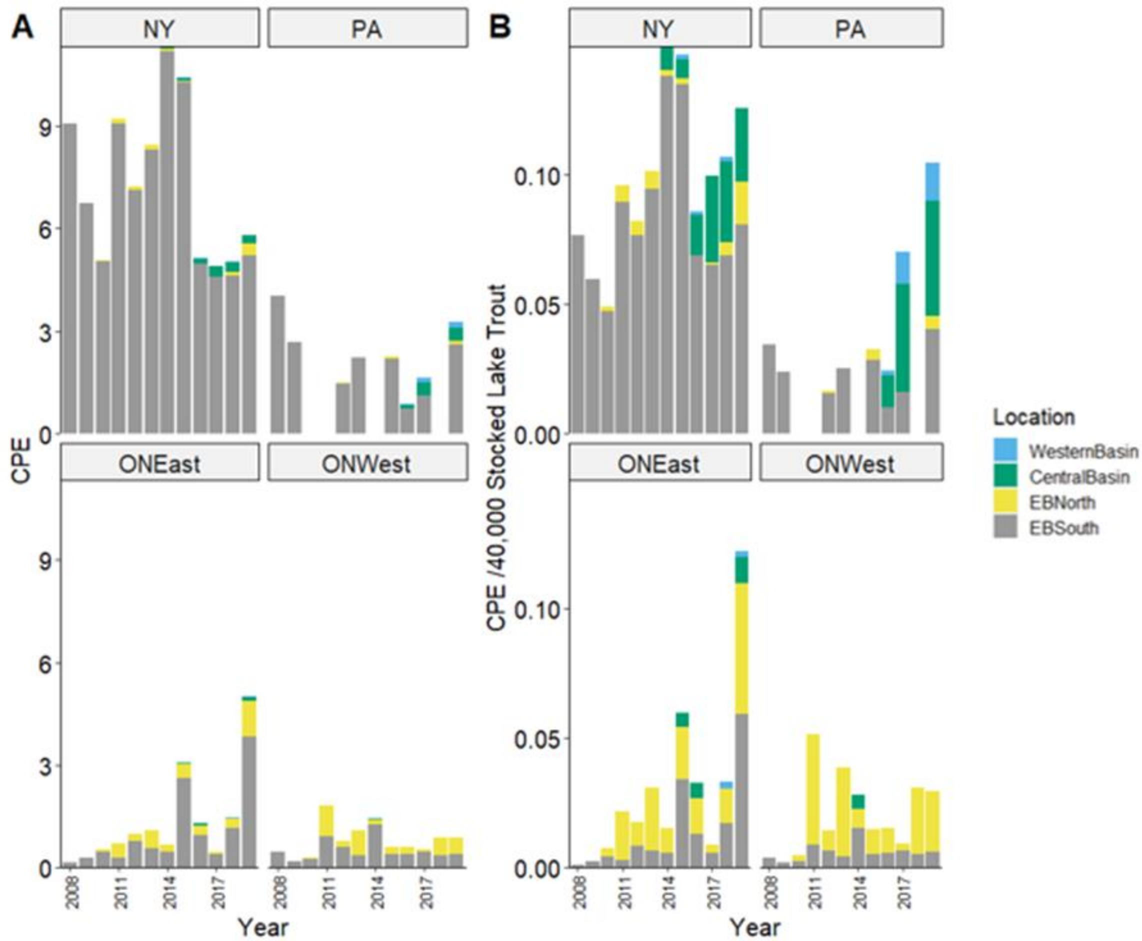

FIGURE 4.6. **A:** Mean annual catch per unit effort (CPE) of Lake Trout in Lake Erie from four stocking locations caught in CWA gillnets in each jurisdiction, 2008-2019. **B**: Mean annual CPE/ 40,000 stocked Lake Trout from four stocking locations caught in CWA gillnets in each jurisdiction, 2008-2019. Jurisdictions: NY- New York, PA- Pennsylvania, ONEast- Eastern half of Lake Erie's eastern basin in Ontario waters, ONWest- Western half of Lake Erie's Eastern basin in Ontario waters.

Stocking Target

The number of Lake Trout stocked (all jurisdictions and all strains combined) and returns in the Coldwater Assessment Survey at age-5 were analyzed to determine if a relationship existed between stocking number and returns at first maturity. For the entire dataset using data between 1996-2015, little relationship existed between the total number of Lake Trout stocked and CPE at age-5 (R^2=0.05; Figure 4.7.A). However, many variables can affect this relationship, including stocking strain, stocking location, stocking numbers per stocking location, and variability in post-stocking survival. Many of these variables change annually. To mitigate some of this variability, this analysis was also conducted on stockings and returns from New York, and then further broken down for just FL strain fish from New York. A stronger relationship was evident when stocking location and strain were removed as confounding variables (R^2=0.52; Figure 4.7.B). While this analysis does not indicate a specific number of Lake Trout that need to be stocked to achieve a target adult CPE, it does show that, in general, higher concentrated stocking ($\geq$ 80,000 fish) is more effective for increasing adult returns compared to smaller stockings ($\leq$ 40,000).

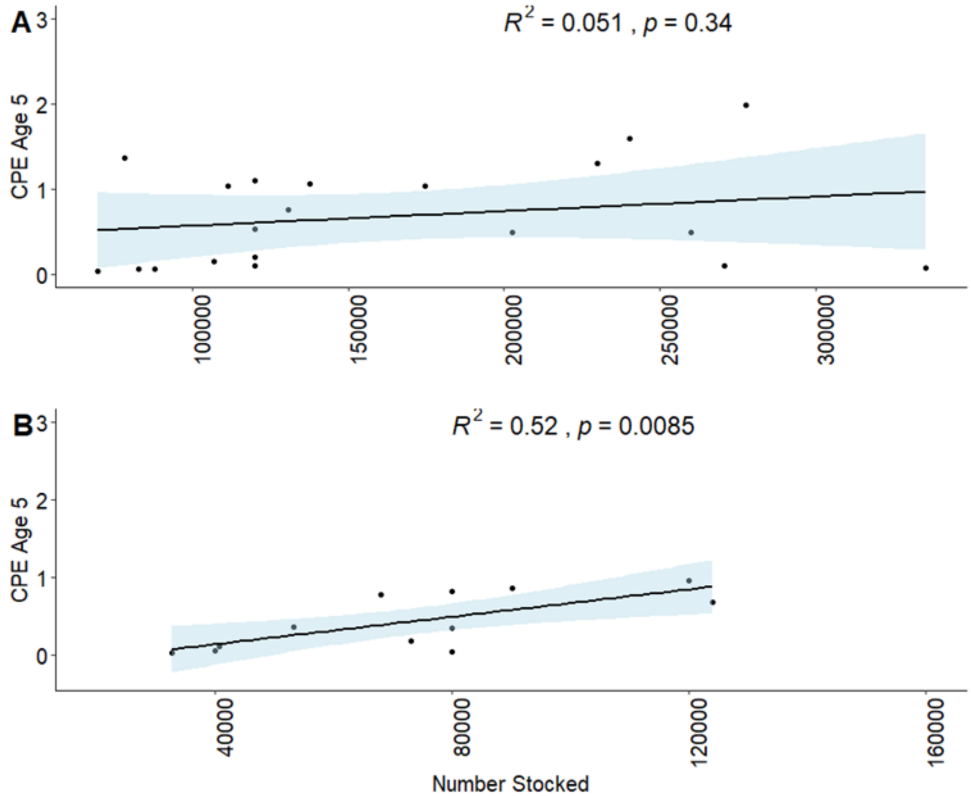

FIGURE 4.7: **A:** Linear relationship between the number of stocked Lake Trout in all Lake Erie jurisdictions and the CPE of Age-5 Lake Trout. **B:** Linear relationship between the number of Finger Lakes strain Lake Trout stocked in New York and the CPE of Age-5 Finger Lakes strain Lake Trout caught in New York. Blue shading indicates the standard error of the estimate.

Life Stage Performance

Several years of paired stockings of fall fingerlings and spring yearlings were conducted at both Catawba, OH in the west basin and Fairport, OH in the central basin to determine which life stage, if any, produced the best returns at these locations. Paired stockings occurred for the 2012, 2014, and 2015-year classes. Successful survival, inferred by adult returns, of fall fingerlings were only evident from the 2012 and 2014 stocking at Fairport; returns from all other fall fingerling stocks were poor regardless of location (Figure 4.8). Returns at Catawba were poor for either life stage of Lake Trout stocked. Returns of yearling Lake Trout were much higher compared to fall fingerling in all three stocking years at Fairport. These results indicate that yearling Lake Trout remain the best life stage for targeted stockings, and that the low rewards of continuing to stock Lake Trout at Catawba should be considered given the new fish community goals and objectives for Lake Trout.

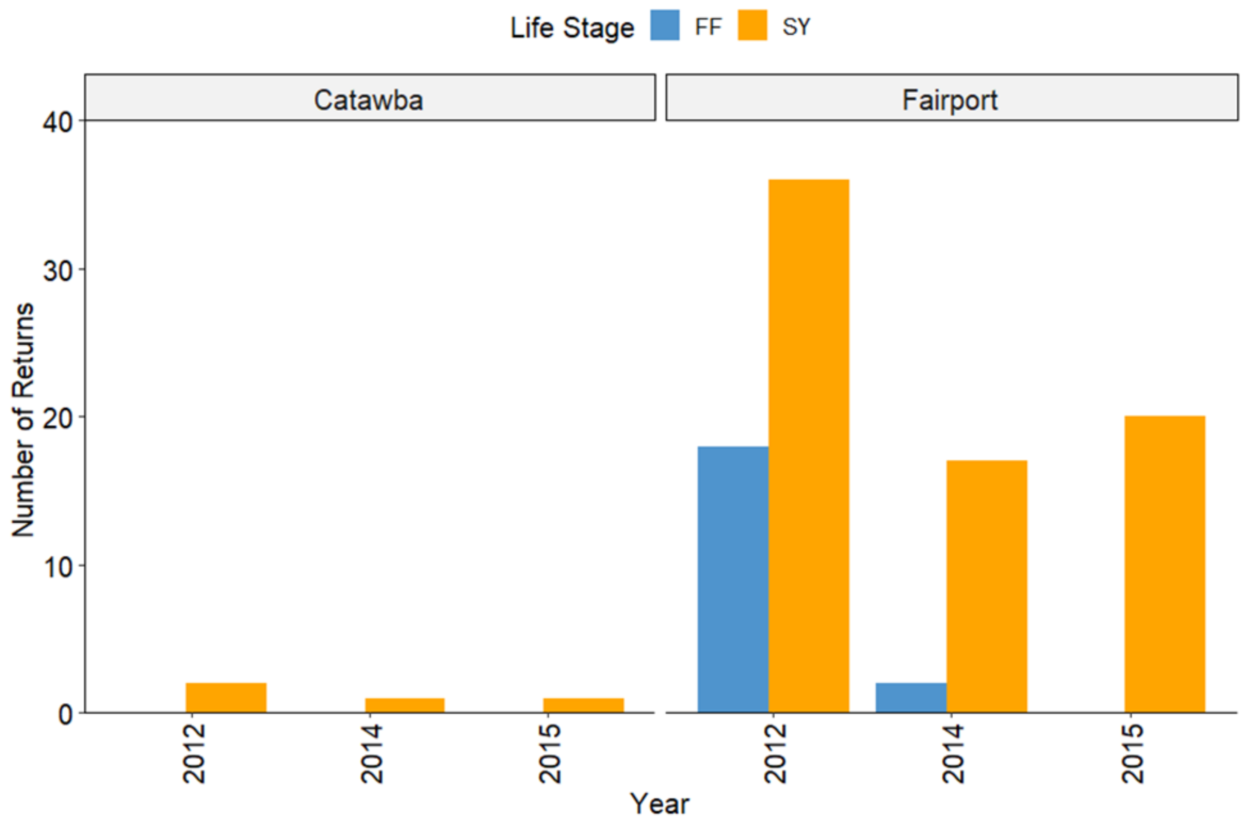

FIGURE 4.8. Number of returns of Fall Fingerling (FF) and Spring Yearling (SY) Lake Trout from paired stocking events in Catawba, OH and Fairport Harbor, OH

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