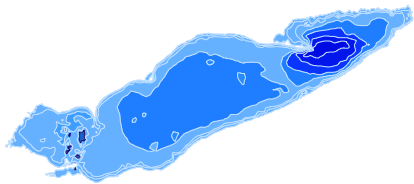


# 2019 Annual Report



Ontario Ministry of Natural Resources and Forestry  
Lake Erie Management Unit



The Lake Erie Management Unit of the Ontario Ministry of Natural Resources and Forestry is responsible for managing the fishery resources of the Ontario waters of Lake Erie as well as the upper Niagara River, the Detroit River, Lake St. Clair, and the St. Clair River.

Ontario has been responsible for managing the fishery resources of these waters since 1898. In 1992, the Lake Erie Management Unit was created to improve Ontario's ability to manage these important resources. The Unit is based in Port Dover, Wheatley and London.

**VISION:** The Lake Erie Management Unit will contribute to the environmental, social, and economic well-being of the people of Ontario through the sustainable development of fishery resources within the Lake Erie basin.

**MISSION:** To ensure the long-term health of the Lake Erie ecosystem and to promote the sustainable harvest and development of its fishery resource through sound science, assessment, regulation, and advocacy.

**GOAL:** To foster and encourage the understanding of all users and partners on the complexity of managing the fishery resource of Lake Erie, to minimize conflict, and to endorse sound fishery management practices.

Under the Joint Strategic Plan for Management of Great Lakes Fisheries, the fisheries resources of Lake Erie and Lake St Clair are managed cooperatively by Ontario and the four U.S. states – New York, Pennsylvania, Ohio and Michigan.

**Cover Photo (top to bottom):**

Nathan Staels, Wheatley Fisheries Technician, working on the Muskellunge Tagging Program on the Thames River.

Duncan Norrie and Danielle Hennink, Port Dover Fisheries Technicians, aboard the research vessel, Erie Explorer, working on the Diet Study Program.

# **2019 Annual Report**

**Ontario Ministry of Natural Resources and Forestry  
Lake Erie Management Unit**

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## **1. FORWARD**

The mission of the Lake Erie Management Unit (LEMU) is to provide leadership and direction on sustainable resource management for Lake Erie by maintaining and, where possible, enhancing the social, economic, cultural and environmental benefits of the lake's rich aquatic resources. The LEMU works to achieve this through annual fisheries assessment programs, a weight inspection program, and fisheries management activities on the Canadian waters of Lake Erie, Lake St. Clair and connecting waters.

The LEMU consults regularly with resource management partners, namely Ontario sport and commercial fish interests on Lake Erie and Lake St. Clair. The principal venue for this consultation process is the Fisheries Management Zone 19 Council. Within this group, representatives from the sport and commercial bait and food fisheries discuss emergent and long-term fisheries issues, with the Lake Erie Manager acting as chair and facilitator. In addition, the Lake Erie Management Unit participates in the Lake Erie Percid Management Advisory Group, which was established to help guide future Walleye and Yellow Perch management in Lake Erie. This group is facilitated by staff from the Quantitative Fisheries Centre of Michigan State University and consists of Lake Erie Committee members, agency staff, and stakeholders from all jurisdictions bordering Lake Erie.

In addition, the LEMU leads and supports, through collaboration with Regional Operating Division, Provincial Services Division (Science and Research Branch) and Policy Division (Natural Resources Conservation Policy Branch, and Species Conservation Policy Branch), numerous projects under the Canada Ontario Agreement on Great Lakes Water Quality and Ecosystem Health. These projects address native species restoration, state of resource science, invasive species surveillance and response, as well as ecosystem restoration.

The Province of Ontario and four U.S. States share responsibility for managing the fishery resource in Lake Erie; international cooperation is essential to the sustainable management of Lake Erie's fisheries. The Lake Erie Committee (LEC), formed under the auspices of the Great Lakes Fishery Commission, is comprised of representatives from state and provincial fisheries management agencies. This committee works to set harvest levels for the lake.

The purpose of this report is to summarize and present Ontario's fisheries program and ecosystem data for Lake Erie and Lake St. Clair. This data is incorporated with similar information from the U.S. jurisdictions and analyses are performed by various task groups to determine population status, and recommended harvest levels that are consistent with LEC objectives.

The LEMU team is pleased to present this report to our stakeholders and colleagues and welcomes any questions or comments you may have on its content.

## 2. EXECUTIVE SUMMARY STATUS OF MAJOR STOCKS

In 2019 Ontario commercial landings in Lake Erie totaled 17.4 million pounds (Table 2.1). Total commercial harvest in 2019 was the lowest from 1960 to present, due primarily to record low Rainbow Smelt harvest. Landed value in 2019 (\$30.3 million) remained above the long term average (1960-2019, \$21.4 million) and was comparable to the average since individual transferable quotas (ITQs) began in 1984 (\$30.4 million). Harvest by Ontario statistical district (OE; Figure 2.1) and species is presented (Table 2.1). Harvest (pounds) in 2019 was composed of Walleye (45%), Yellow Perch (19%), White Perch (17%), White Bass (9%), Rainbow Smelt (8%), and other species (1%). Landed value was highest for Walleye (56%) followed by Yellow Perch (29%), White Perch (7%), White Bass (6%), Rainbow Smelt (1%) and other species(<1%). In addition to commercial harvest summaries, results from Lake Erie Management Unit (LEMU) bottom trawl surveys, hydroacoustic forage species assessment, and Partnership gill net surveys are presented. Partnership gill net surveys were completed annually with Lake Erie's commercial fishing industry since 1989 and in cooperation with the Ontario Commercial Fisheries' Association (OCFA) since 1997. Characteristics of recreational fisheries in Fisheries Management Zone 19 (FMZ19) are described periodically by creel surveys.

**Table 2.1** Total annual commercial fishery landings (landed weight in pounds) and value dollars by fish species and statistical district for the Canadian waters of Lake Erie, 2019.

| Species                    | Landings by Statistical District |                     |                    |                    |                    | Total Landing     | Total Value         |
|----------------------------|----------------------------------|---------------------|--------------------|--------------------|--------------------|-------------------|---------------------|
|                            | OE-1                             | OE-2                | OE-3               | OE-4 <sup>a</sup>  | OE-5               |                   |                     |
| Brown Bullhead             |                                  | 1                   |                    |                    |                    | 1                 | \$0                 |
| Burbot                     |                                  | 32                  | 16                 |                    |                    | 48                | \$2                 |
| Carp                       | 1,703                            | 2,052               | 1,629              |                    |                    | 5,384             | \$1,167             |
| Catfish                    | 8,346                            | 11,755              | 1,696              | 12                 | 7                  | 21,816            | \$7,735             |
| Freshwater Drum            | 18,747                           | 85,552              | 13,943             | 992                | 2,341              | 121,575           | \$16,750            |
| Gizzard Shad               | 334                              | 72                  |                    |                    |                    | 406               | \$0                 |
| Lake Whitefish             | 64,099                           | 13,496              | 2,374              | 632                | 406                | 81,007            | \$110,798           |
| Rainbow Smelt              |                                  | 27                  | 10                 | 1,254,157          | 70,860             | 1,325,054         | \$304,532           |
| Rock Bass                  | 18                               | 13                  |                    |                    |                    | 31                | \$8                 |
| Suckers                    | 10,245                           | 13,905              | 2,081              |                    |                    | 26,231            | \$7,569             |
| Walleye                    | 3,621,072                        | 2,869,937           | 868,413            | 337,232            | 193,411            | 7,890,065         | \$17,066,977        |
| White Bass                 | 633,628                          | 663,640             | 286,707            | 43,755             | 13,947             | 1,641,677         | \$1,701,106         |
| White Perch                | 609,885                          | 1,750,138           | 647,946            | 23,293             | 4,499              | 3,035,761         | \$2,147,613         |
| Yellow Perch               | 847,476                          | 740,490             | 1,094,733          | 293,918            | 266,494            | 3,243,111         | \$8,890,051         |
| Mixed <sup>b</sup>         | 160                              | 53                  | 4                  |                    |                    | 217               | \$195               |
| <b>Total Landing (lbs)</b> | <b>5,815,713</b>                 | <b>6,151,163</b>    | <b>2,919,552</b>   | <b>1,953,991</b>   | <b>551,965</b>     | <b>17,392,384</b> |                     |
| <b>Total Value (\$)</b>    | <b>\$11,297,226</b>              | <b>\$10,199,284</b> | <b>\$5,751,954</b> | <b>\$1,883,796</b> | <b>\$1,122,244</b> |                   | <b>\$30,254,503</b> |

<sup>a</sup> Excludes Inner Long Point Bay.

<sup>b</sup> A variety of incidentally caught species of little or no value

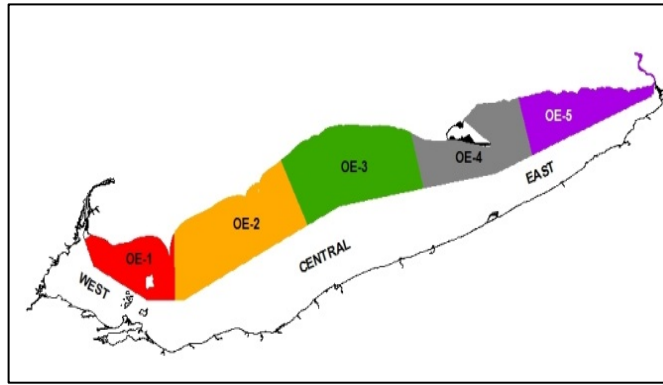


**Figure 2.1** Ontario statistical districts (OE 1-5) of Lake Erie.

## Walleye

The lakewide commercial Walleye harvest (7.9 million lbs.) in 2019 represented 100% of quota. The 2019 harvest was well above the mean harvest from 2000 to present (5.2 million lbs.) and the mean harvest from the inception of individual transferable quotas (ITQs) (1984 to present; 6.4 million lbs.; Figure 2.2). The distribution of harvest (lbs.) across statistical districts OE1 to OE5 during 2019 was 46%, 36%, 11%, 4% and 2%, respectively. The commercial Walleye fishery age composition (range: 1-18) was dominated by age 4 (2015 year class) lakewide.

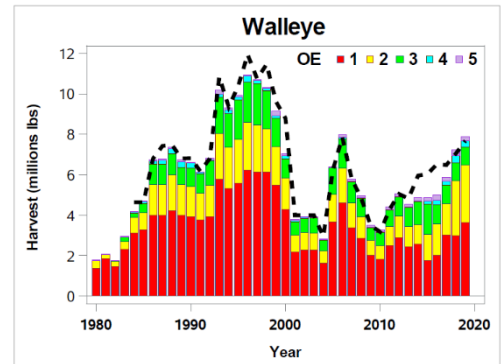


**Figure 2.2** Walleye commercial harvest by statistical district in Lake Erie, 1980-2019. Lakewide quota presented as dotted line.

Walleye catch rates in the 2019 Partnership gill net surveys were above average in the west and central basin region and ranked 3<sup>rd</sup> highest in the east basin and Pennsylvania Ridge area. The gill net surveys were comprised of Walleye ranging in age from 0 to 21. In west and central Lake Erie, ages 1, 0 and 4 comprised the largest catches of Walleye. In the east basin, age 4 Walleye dominated catches with ages 3, 2 and 1 contributing significantly to catches in 2019. The interagency west basin trawl index of Young-of-the-year (YOY) Walleye in 2019 was second highest, following the record high catch rate of YOY in 2018. Yearling Walleye catch rates in 2019 (2018 cohort) were high, but below the record level observed as age 0. With few exceptions, mean length and condition of juvenile and adult Walleye in 2019 were below average in trawl and gill net surveys. Commercial and recreational fishing in 2020 is expected to thrive, benefiting from larger age 5 Walleye and smaller age 2 recruits.

Walleye in Lake Erie are assessed and managed cooperatively by Lake Erie jurisdictions and partners. The current exploitation policy adopted in 2014 for the Total Allowable Catch (TAC) area which includes OE1-3 was developed through the Lake Erie Percid Management Advisory Group (LEPMAG) as part of a revised Walleye Management Plan

(WMP). Walleye migrations from the TAC area into the east basin are evident from Great Lakes Acoustic Telemetry Observation System (GLATOS) studies. East basin fishery performance is influenced by the abundance of migratory and local stocks. Continuous improvements to our understanding of the lakewide dynamics are accomplished through ongoing cooperative research and assessment for potential incorporation into future management plans.

### *Yellow Perch*

The commercial fishery harvested 3.2 million pounds of Yellow Perch in 2019, attaining 80% of the quota allocated. The Yellow Perch harvest in 2019 was below the mean harvest from 2000 to present (5.3 million lbs.) and the long term mean harvest from when ITQs were introduced in 1984 (5.8 million lbs.). The distribution of harvest across statistical districts OE1 to OE5 in 2019 was 26%, 23%, 34%, 9% and 8%, respectively (Figure 2.3). Overall, Yellow Perch harvest in 2019 decreased 30% from 2018. Age 5 (2014 cohort) Yellow Perch comprised the largest fraction of fish harvested in OE1, OE2 and OE3. Age 3 (2016 cohort) Yellow Perch dominated harvest in the east basin (OE4,5) and contributed significantly more to the OE3 harvest compared to the west half of the lake (OE1,2). Age 2 Yellow Perch were represented more in the OE1 fishery, with contributions declining eastward. Older Yellow Perch (ages 6 and older) were more common in the OE3 harvest in 2019 compared to other areas of the lake.

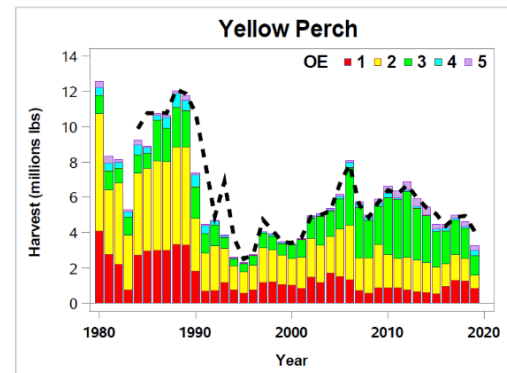


**Figure 2.3** Yellow Perch commercial harvest by statistical district in Lake Erie, 1980-2019. Lakewide quota presented as dotted line.

Partnership gill net indices for Yellow Perch experienced record low catch rates during 2019 in the west-central and east-central basin surveys. West and east basin survey catch rates were moderate or weak in 2019 relative to their respective time series, strengthened by contributions from ages 1 and 3 Yellow Perch respectively. Yellow Perch age composition was youngest in the west basin survey, becoming progressively older in surveys farther east. Length and condition at age for Yellow Perch in 2019 was generally above average or comparable for most age groups represented in all surveys.

Trawl and gill net indices of abundance for ages 0, and 1 predict significant recruitment to west basin fisheries in 2020 and 2021. Moderate or weak recruitment is expected in central basin fisheries in 2020-2021. In the east basin, weak or moderate recruitment to fisheries is expected during 2020 and 2021. Following a process developed by the Lake Erie Percid Management Advisory Group (LEPMAG), a broader assemblage of interagency Yellow Perch recruitment indices are analyzed by the Yellow Perch Task Group using multi model inference to forecast age 2 recruitment by management unit annually.

A bottom trawl survey began in 2016 in Ontario waters of the central basin after fall turnover. In 2019, catch rates of age 0 Yellow Perch were very low in the west-central basin, but higher in the east-central basin. Few yearling Yellow Perch were caught in

both central basin surveys in 2019. The benefits of this survey will accumulate over continued years of field work.

Ontario gill net fishery harvest and effort data, along with trawl and gill net survey data contribute to interagency assessment and quota recommendations. Ontario commercial and recreational fishery representatives, Ontario Ministry of Natural Resources and Forestry (OMNRF), United States (US) management agencies and stakeholders, and the Quantitative Fisheries Center at Michigan State University have been collaborating in the Lake Erie Percid Management Advisory Group (LEPMAG). Through LEPMAG, Lake Erie agencies designed and implemented a new Yellow Perch harvest policy in 2019 that represents the core of the Lake Erie Yellow Perch Management Plan.

### *Lake Whitefish*

Declining Lake Whitefish recruitment and abundance in Lake Erie resulted in major quota reductions in Ontario beginning in 2014 and continuing until 2017, followed by a marginal increase in 2018-2019 (Figure 2.4). The commercial harvest of Lake Whitefish is currently incidental and mainly occurs in large mesh gill net fisheries targeting Walleye and White Bass and to a lesser extent in trawls targeting Rainbow Smelt and in small mesh gill nets. Lake Whitefish harvest in 2019 was 81,007 pounds, the distribution across statistical districts OE1 to OE5 in 2019 was 79%, 17%, 3%, <1% and <1%, respectively (Figure 2.4). The age composition of the large mesh gill net fishery consisted mainly of ages 4 and 5, with older ages 16, 19 and 25 present. An additional non-random gill net sample in the east basin was comprised exclusively of age 2 Lake Whitefish. Incidental catch sampled from commercial Rainbow Smelt trawls included age 0 and 1 Lake Whitefish.

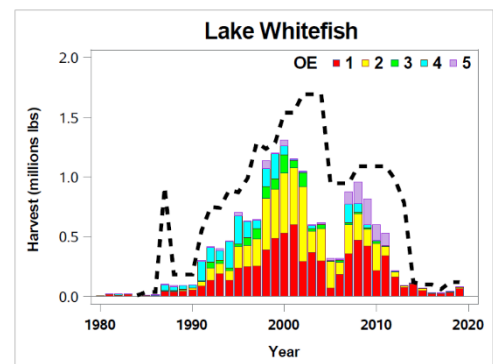


**Figure 2.4** Lake Whitefish commercial harvest by statistical district in Lake Erie, 1980-2019. Lakewide quota presented as dotted line.

Partnership Lake Whitefish gill net catch rates during 2019 in central and eastern Lake Erie dropped from 2018. Catches in 2019 were composed of Lake Whitefish ranging in age from 1 to 12 with ages 2 (46%), 4 (27%) and 5 (12%) comprising the majority of the catch. Future Lake Whitefish status is dependent upon ongoing recruitment and conservative management. OMNRF is working with partners to improve assessment and develop management strategies for Lake Whitefish through collaborative efforts of the Lake Erie Committee, the Coldwater Task Group, the Great Lakes Telemetry and Observation System (GLATOS) network, and the Great Lakes Fishery Commission.

### *Rainbow Smelt*

Although Rainbow Smelt are not native, they are a dominant forage species in Lake Erie and usually contribute significantly to Ontario's commercial fish landings. Rainbow Smelt harvest in 2019 (1.3 million lbs.) amounted to 8.5% of the lakewide quota (15.5 million lbs.) (Figure 2.5). Rainbow Smelt harvest in 2019 was the lowest observed since 1954;

the era in which Rainbow Smelt fisheries began in Lake Erie. Landings of Rainbow Smelt in 2019 were primarily in OE4 (95%) with the remainder caught in OE5 (5%). Harvest age composition ranged from 1 to 6 with ages 2 and 1 representing the majority of the trawl harvest.

The Long Point Bay (LPB) trawl catch rate of age 0 Rainbow Smelt (739.6/ha) was moderate in 2019 in contrast with the yearling and older Rainbow Smelt index (11.3/ha) which remained well below average in 2019. Hydroacoustic surveys in eastern Lake Erie describe the abundance and distribution of Rainbow Smelt available as forage and to the Rainbow Smelt fishery. Hydroacoustic analyses described yearling-and-older Rainbow Smelt abundance (180 fish/hectare) in 2019 as the lowest in the time series (2007-2019).

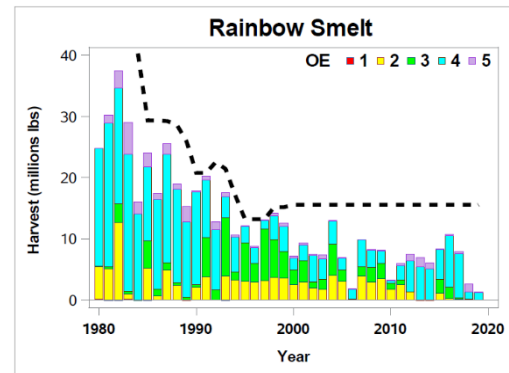


**Figure 2.5** Rainbow Smelt commercial harvest by statistical district in Lake Erie, 1980-2019. Lakewide quota presented as dotted line.

### White Bass

White Bass harvest, which is not regulated by quota in Lake Erie, totaled 1.6 million pounds in 2019. Harvest in 2019 was below the mean harvest from 2000 to present (3.4 million lbs.) and the long term mean harvest since 1984 (3.1 million lbs.). Distribution of harvest across statistical districts OE1 to OE5 in 2019 was 39%, 40%, 17%, 3% and 1%, respectively (Figure 2.6). The White Bass harvest was composed of ages ranging from 1 to 14 with ages 7, 9 and 3 representing the majority of the harvest.

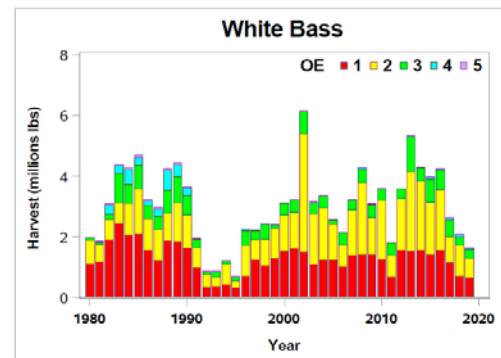


**Figure 2.6** White Bass commercial harvest by statistical district in Lake Erie, 1980-2019.

White Bass Partnership abundance indices were low in the west, and central basin surveys in contrast with moderate catch rates in the east basin and above average catch rates in the Pennsylvania Ridge survey during 2019. Age groups present in surveys ranged from ages 0 to 9. Junveniles (ages 0, 1) accounted for the largest fraction of White Bass caught in the central basin and to a lesser extent, the west basin surveys. In the east basin, juveniles were absent; while ages 7 and 3 were most abundant in the 2019 survey. White Bass age composition in the Pennsylvania Ridge included age 3 and older fish, with age 1 fish present.

### White Perch

The White Perch is a non-native species that is not managed by quota. The commercial harvest of White Perch in 2019 totaled 3.0 million pounds. The 2019 harvest exceeded the mean harvest from 2000 to present (2.1 million lbs.) and was above the long term mean harvest since 1984 (2.2 million lbs.). The distribution of White Perch harvest across statistical districts OE1 to OE5 in 2019 was: 20%, 58%, 21%, 1% and <1%, respectively

(Figure 2.7). The White Perch harvest was composed of ages ranging from 1 to 14. Ages 4, 3, and 7 were the most common age groups of White Perch sampled from the harvest.

In 2019, Partnership gill net survey catch rates of White Perch were moderate lakewide. In 2019, catch rates increased from 2018 in the west basin, were comparable to 2018 in the west-central basin but decreased in other surveys. White Perch ages ranged from 0 to 11 lakewide in 2019. Age 1 White Perch dominated catches in the west basin and to a lesser extent, in the west-central basin. Ages 4 and 3 were most abundant in varying proportions among central, east and Pennsylvania Ridge surveys.

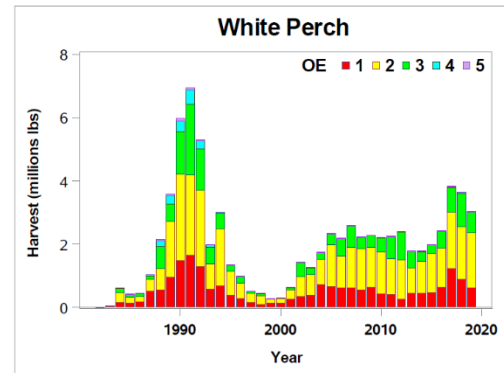


**Figure 2.7** White Perch commercial harvest by statistical district in Lake Erie, 1981-2019.

### 3. COMMERCIAL FISHERY

#### 3.1 Lake Erie Commercial Fishery

In 2019, the total commercial landings from Ontario waters of Lake Erie was 17.4 million pounds with a total value of \$30.3 million. The decrease of total landings from 2018 (15%), and the total value (19%), was primarily due to the decreased harvest of Rainbow Smelt (down 1.2 million pounds), and Yellow Perch (down 1.4 million pounds) (Figure 3.1.1). Walleye harvest was up by 0.7 million pounds. The average landed value per pound for most species also decreased in 2019, contributing to a reduction in total value. Harvest and landed value in 2019 are presented for each species by statistical district (Ontario Erie (OE), Figure 2.1) in Table 2.1.

The lakewide commercial Walleye harvest (7.9 million lbs.) in 2019 represented 100% of quota, representing an increase in harvest of 9% from 2018. (Table 2.1, Figure 3.1.1). Lakewide Walleye harvest by size category was: Jumbo (>533 mm total length, 10%), Number 1 (381-533 mm, 89%) and Number 2 (<381 mm total length, 1%). Yellow Perch landings decreased 1.4 million pounds to 3.2 million pounds in 2019, representing 80% of allocated quota (Table 2.1, Figure 3.1.1). The landed value of Yellow Perch also decreased by 24% in 2019 to \$8.9 million as a result of the lower harvest.

With total landings of 81,007 lbs., Lake Whitefish harvest nearly doubled from 2018 (Table 2.1, Figure 3.1.1). In 2019 Lake Whitefish continued to be a non-targeted commercial fish species; all Lake Whitefish were harvested as by-catch. The commercial fishery harvested 68% of the 120,000 lb allocated quota. Seventy-nine (79) percent of the total harvest came from OE-1 (an increase of 2% from 2018), while 17% was harvested from OE-2, similar to 2018. Transfers of Walleye quota out of quota zone 1 (OE-1) continued in 2019 in an attempt to help protect fall spawning Lake Whitefish stocks, however 72% of the total harvest occurred in OE-1 from October to December. The landed value of Lake Whitefish increased 81% to approximately \$111,000 in 2019 (Table 2.1).

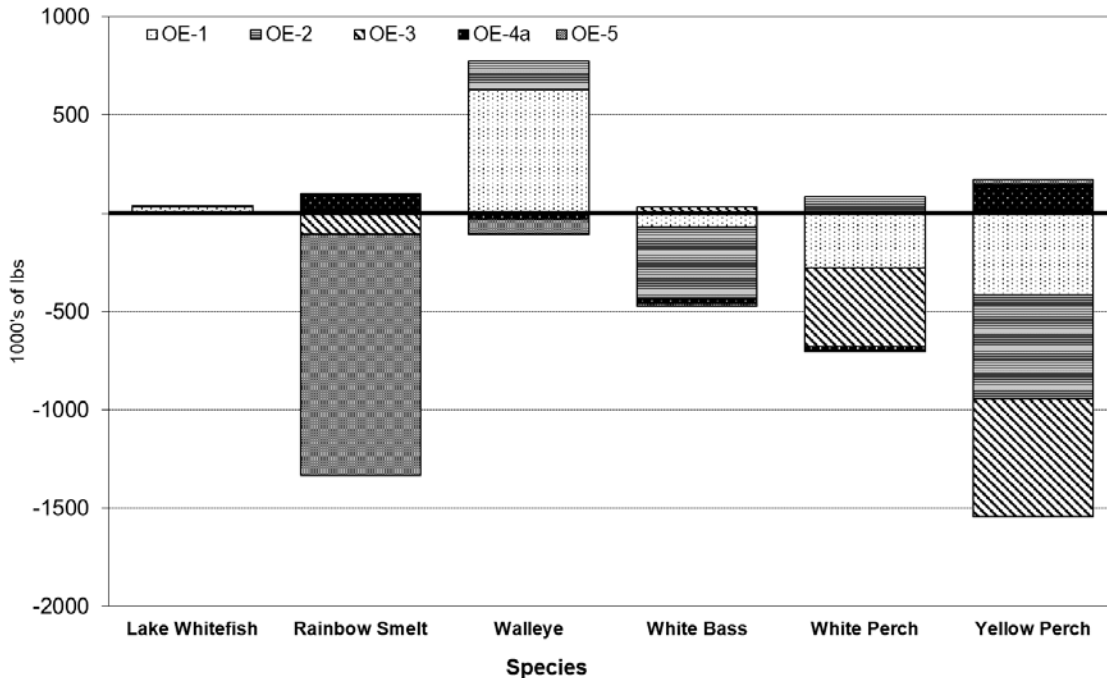


**Figure 3.1.1** Change in weight of the annual commercial fishery landings (1000's of lbs.) from 2018 to 2019 for principle species by statistical district, Lake Erie.

Rainbow Smelt harvest in 2019 had the largest decline of all species, dropping to 1.3 million pounds; 8.5% of the allocated quota. This was a decrease of 48% from 2018 (Table 2.1, Figure 3.1.1). Ninety-five percent of the harvest was taken from OE-4 while only 5% was harvested in OE-5. Of the 155 licences with Rainbow Smelt quota, only 9 landed Rainbow Smelt in 2019, while only 1 licence attained more than 20% of their individual quota. The landed value of Rainbow Smelt was down 48% to \$0.3 million (Table 2.1).

White Bass and White Perch are commercial fish species currently not regulated by quota. The total landings of White Bass decreased by 21% to 1.6 million pounds in 2019, the majority of which occurred in statistical districts OE-1 (39%), OE-2 (40%) and OE-3 (18%) (Table 2.1, Figure 3.1.1). The landed value of White Bass decreased 19% to \$1.7 million in 2019 (Table 2.1). The total landings of White Perch decreased 17% to 3.0 million pounds in 2019, with harvest occurring primarily in statistical districts OE-2 (58%), OE-3 (21%) and OE-1 (20%) (Table 2.1, Figure 3.1.1). In 2019, White Perch total landed value increased marginally from 2018, to a value of \$2.1 million (Table 2.1).

### *Inner Long Point Bay Fishery*

The hoop and seine net fishery of Inner Long Point Bay contributes less than one percent (0.7%) by weight to the total annual commercial harvest landed in Ontario waters of Lake Erie. In 2019, total commercial landings were 121,116 pounds (Table 3.1.1) a decrease of 6% from 2018. Live fish accounted for 80% of this harvest. The value of the total

commercial landings in Inner Long Point Bay during 2019 was \$117,140, a decrease of 6% from 2018.

In 2019, the total landing of Yellow Perch was 22,340 pounds, an increase of 13% from 2018, representing 83% of the allocated quota. The majority of Yellow Perch (99%) were caught in the spring (March, April and May). The landed value of Yellow Perch in 2019 increased 13% from 2018 to \$21,604 (Table 3.1.1). In 2019, the total landing of Northern Pike was 5,872 pounds, a decrease of 39% from 2018. The Inner Bay commercial fishery harvested 22% of the allocated quota in 2019. The majority of Northern Pike (83%) were caught in the spring (March, April and May). The landed value of Northern Pike in 2019 was \$5,679, a decrease of 39% from 2018 (Table 3.1.1).

**Table 3.1.1** Total annual commercial fishery landings  
(landed weight in pounds) and value (\$)   
by fish species for Inner Long Point Bay, 2019

| Species                     | Total Landing <sup>a</sup> | Total Value |
|-----------------------------|----------------------------|-------------|
| Bowfin                      | 25,325                     | \$24,497    |
| Brown Bullhead              | 26,500                     | \$25,627    |
| Carp                        | 5,980                      | \$5,789     |
| Channel Catfish             | 7                          | \$0         |
| Freshwater Drum             | 20                         | \$19        |
| Lepomis spp.                | 27,029                     | \$26,143    |
| Mudpuppy                    | 3,192                      | \$3,090     |
| Northern Pike               | 5,872                      | \$5,679     |
| Pomoxis spp.                | 1,537                      | \$1,482     |
| Rock Bass                   | 3,209                      | \$3,108     |
| White Perch                 | 105                        | \$102       |
| Yellow Perch                | 22,340                     | \$21,604    |
| <b>Total Landing (lbs.)</b> | 121,116                    |             |
| <b>Total Value (\$)</b>     |                            | \$117,140   |

<sup>a</sup> Only Inner Long Point Bay.

### 3.2 Commercial Catch Sampling Program

The commercial catch sampling program is integral to the management of Lake Erie fish stocks. This program provides information such as: age composition of the harvest, recruitment of year classes into fisheries, and growth characteristics. Information from this program is used directly in catch-at-age models used to estimate and project population abundances, which are used to determine total allowable catch. In order to carry out this program Lake Erie Management Unit (LEMU) uses a targeted sampling plan to sample fish of all species landed by the Lake Erie commercial fishery. The main objectives of catch sampling are: 1) to determine the size and age composition of the fish in the catch; 2) to index the abundance of fish species; and 3) to determine parasite

loading of commercially valuable fish. Fish attributes sampled during this program include: weight, length, age, sex, maturity, parasite loading, tumours and tags/marks.

In 2019, a total of 16,112 fish were sampled during the commercial catch sampling program. Sampling is stratified by area (Ontario-Erie statistical district or OE), season, and gear type. Species sampled include: Yellow Perch, Walleye, Lake Whitefish, White Bass, White Perch, and Rainbow Smelt. Walleye samples are categorized by group based on length (see Table 3.2.1). Walleye, Yellow Perch, White Bass and White Perch were aged using otoliths. Rainbow Smelt were aged using scales. Lake Whitefish were aged using scales and otoliths.

Lakewide 6,745 Yellow Perch were sampled during 2019. The most common age group of Yellow Perch was age 5 (2014 year class), which comprised 35% of the harvest lakewide. Age 5 fish comprised 36% of the Yellow Perch harvest in the western basin, 44% in the west-central basin, and 37% in the east-central basin. Age 3 (2016 year class) Yellow Perch were common in the east-central and eastern basins (32% and 88% of the harvest respectively).

In total, 4,159 Walleye were sampled from large and small mesh gill nets. Almost 3,500 Walleye were sampled from large mesh gill nets and 699 Walleye were sampled from small mesh gill nets in 2019. Lakewide, 77% of the commercial Walleye harvested were age 4 (2015 year class) fish. More age 4 Walleye were harvested in the west and central basins (77% of total harvest), compared to the eastern basin (72% of total harvest). The second most common age was age 2 (2017 year class) fish with 7% of the lakewide harvest.

Two hundred and thirty-six Lake Whitefish were sampled from gill nets during fall. Ages shown in Table 3.2.1 are from scales for fish less than 550 mm and otoliths for fish greater than or equal to 550 mm. Seventy-eight percent of the Lake Whitefish sampled were from the 2015 year class (age 4 fish), and 8% were from the 2014 year class (age 5 fish). The oldest Lake Whitefish sampled was 25 years. One non-random sample of Lake Whitefish was collected from gill nets targeting Walleye in OE-5 during summer. All fish in this sample were age 2 (2017 year class).

Eight hundred and ninety-nine White Bass were sampled, mainly from large mesh gill nets. Half of the White Bass sampled consisted of the 2012 year class (age 7 fish), followed by the 2010 year class (age 9 fish). In total more than 1,800 White Perch were sampled; 1,160 from large mesh nets and 659 from small mesh nets. Ages 4 and 7 White Perch were prevalent in the large mesh nets. Ages 4 and 3 White Perch were common in the small mesh nets.

More than 2,200 Rainbow Smelt were sampled from trawl nets, 42% of the Rainbow Smelt were aged, 11% were unable to be aged due to poor scales, and the remainder did not have scales collected. The majority of the aged Rainbow Smelt were age 2 (46%; 2017 year class), followed closely by age 1 (41%; 2018 year class). Additional species caught as by-catch in Rainbow Smelt trawls were also sampled. In 2019, 41 Lake Whitefish were sampled from Rainbow Smelt nets; 88% of these fish were age 0, 2% were age 1, and

the remainder were not aged. Six age 0 Walleye, and four age 1 Yellow Perch were also sampled from Rainbow Smelt nets.

**Table 3.2.1** Number of commercial fish sampled by gear type, species, statistical district (OE) and age, 2019.

| Gear Type | Species        | Statistical District | Group     | Age      |     |     |     |     |     |     |     |    |     |     | Not Aged | Total Sampled |      |
|-----------|----------------|----------------------|-----------|----------|-----|-----|-----|-----|-----|-----|-----|----|-----|-----|----------|---------------|------|
|           |                |                      |           | 0        | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8  | 9   | 10+ |          |               | UNK  |
| Gill Net  | Lake Whitefish | OE-1                 | All       |          |     |     |     | 167 | 17  |     |     |    |     | 3   |          | 187           |      |
|           |                | OE-2                 | All       |          |     |     |     | 18  | 2   |     |     |    |     |     |          | 20            |      |
|           |                | OE-5                 | All       |          |     | 29  |     |     |     |     |     |    |     |     |          | 29            |      |
|           | Yellow Perch   | OE-1                 | All       |          | 4   | 373 | 325 | 406 | 648 | 105 | 11  | 1  | 2   | 1   | 2        | 1878          |      |
|           |                | OE-2                 | All       |          |     | 190 | 249 | 302 | 534 | 35  | 31  | 2  | 2   | 5   | 1        | 1351          |      |
|           |                | OE-3                 | All       |          |     | 48  | 909 | 258 | 895 | 80  | 315 | 43 | 15  | 19  | 14       | 2596          |      |
|           |                | OE-4                 | All       |          |     | 5   | 160 | 53  | 108 | 3   | 45  | 11 | 7   | 1   | 7        | 400           |      |
|           |                | OE-5                 | All       |          |     | 2   | 470 | 17  | 14  |     |     |    |     |     | 17       | 520           |      |
|           |                | Walleye              | OE-1      | Number 1 |     |     | 43  | 55  | 791 | 60  | 2   | 1  | 2   | 2   | 4        | 1             |      |
|           | Jumbo          |                      |           |          |     |     |     | 106 | 72  | 8   | 2   | 5  | 5   | 21  | 1        |               | 220  |
|           | Number 2       |                      |           |          | 104 | 179 | 11  | 24  |     |     |     |    |     |     |          | 2             | 320  |
|           | OE-2           |                      | Number 1  |          | 11  | 36  | 37  | 927 | 56  | 5   |     | 2  | 1   | 4   |          |               | 1079 |
|           |                |                      | Jumbo     |          |     |     |     | 120 | 49  | 5   |     | 3  | 6   | 17  |          |               | 200  |
|           |                |                      | Number 2  |          | 60  | 179 | 7   | 9   |     |     |     |    |     |     |          | 2             | 257  |
|           |                |                      | Whitegill |          |     | 4   | 3   | 13  |     |     |     |    |     |     |          |               | 20   |
|           | OE-3           |                      | Number 1  |          | 5   | 35  | 12  | 469 | 15  |     | 1   |    |     |     |          | 5             | 542  |
|           |                |                      | Jumbo     |          |     |     |     | 39  | 16  | 1   |     |    | 1   | 2   | 1        |               | 60   |
|           |                |                      | Number 2  |          | 56  | 22  |     | 1   |     |     |     |    |     |     |          | 1             | 80   |
|           | OE-4           |                      | Number 1  |          | 8   | 11  | 7   | 209 | 13  | 2   | 2   |    | 2   | 1   | 5        |               | 260  |
|           |                |                      | Jumbo     |          |     |     |     | 4   | 3   | 1   |     |    | 2   |     |          |               | 10   |
|           | OE-5           |                      | Number 1  |          |     |     | 2   | 75  | 7   | 2   | 1   | 3  | 7   | 2   | 1        |               | 100  |
|           |                |                      | Jumbo     |          |     |     |     |     | 1   | 1   | 8   | 2  | 7   | 10  | 1        |               | 30   |
|           |                |                      | Number 2  |          | 15  | 4   |     | 1   |     |     |     |    |     |     |          |               | 20   |
|           | White Perch    | OE-1                 | All       |          |     | 4   | 81  | 176 | 57  | 4   | 53  | 18 | 10  | 17  |          | 420           |      |
|           |                | OE-2                 | All       |          | 9   | 18  | 153 | 390 | 74  | 9   | 120 | 57 | 21  | 28  |          | 879           |      |
|           |                | OE-3                 | All       |          |     | 4   | 126 | 205 | 38  | 10  | 62  | 24 | 21  | 10  |          | 500           |      |
|           |                | OE-5                 | All       |          |     |     | 2   | 13  | 3   |     |     | 1  |     | 1   |          | 20            |      |
|           | White Bass     | OE-1                 | All       |          | 2   | 4   | 51  | 7   |     | 1   | 111 | 3  | 47  | 6   | 7        | 239           |      |
|           |                | OE-2                 | All       |          |     | 1   | 93  | 1   |     |     | 213 | 7  | 112 | 13  |          | 440           |      |
|           |                | OE-3                 | All       |          |     |     | 47  |     |     | 1   | 95  | 4  | 26  | 6   | 1        | 180           |      |
|           |                | OE-4                 | All       |          |     |     |     |     |     |     | 10  | 1  | 9   |     |          | 20            |      |
|           |                | OE-5                 | All       |          |     |     |     |     |     | 1   | 19  |    |     |     |          | 20            |      |
| Trawl     | Rainbow Smelt  | OE-4                 | All       |          | 269 | 407 | 91  | 20  | 1   | 1   |     |    |     |     | 216      | 880           | 1885 |
|           |                | OE-5                 | All       |          |     | 119 | 22  | 2   |     |     |     |    |     |     | 25       | 160           | 328  |
|           | Lake Whitefish | OE-4                 | All       |          | 36  | 1   |     |     |     |     |     |    |     |     | 1        | 3             | 41   |
|           | Walleye        | OE-4                 | All       |          | 6   |     |     |     |     |     |     |    |     |     |          |               | 6    |
|           | Yellow Perch   | OE-4                 | All       |          | 4   |     |     |     |     |     |     |    |     |     |          |               | 4    |

Walleye Group: Number 1 = generally between 381-533 mm in total length; Jumbo = generally greater than 533 mm in total length; Number 2 = generally less than 381 mm in total length.

UNK = fish were unable to be aged due to poor or missing aging structures.

### 3.3 Port Officer Program

The commercial fish quota system requires a reliable means of monitoring the fish harvested by individual fishers. Each fisher is allocated an individual transferable quota that forms a part of their licence. Also, each commercial fishing licence has attached to it the terms and conditions respecting harvest activities that must be adhered to by the fisher. The role of the Port Observer is to monitor commercial fishing vessels for adherence to these licence conditions in a consistent manner on a lakewide basis. This is accomplished by means of on-vessel inspections of the daily harvest and the corresponding Daily Catch Report (DCR), as well as follow up audits of the DCR's for completeness and accuracy.

In 2019, 44% (4,141) of 9,365 DCRs were inspected by Port Observers. Of the 17.4 million pounds landed in 2019, 56% (9.8 million pounds) was inspected or weights were observed. By species, 47% (1.5 million pounds) of Yellow Perch and 56 % (4.5 million pounds) of Walleye harvested were inspected.

While conducting on vessel inspections, if the Port Observer identifies an error on the DCR they will gather the correct information from the licensee or designate and make corrections on the DCR. If errors are identified while conducting audits of DCR's submitted in the absence of a Port Observer, the Port Observer will gather the correct information from the licensee or designate and ensure that the correct information is entered into Commercial Fish Harvest Information System (CFHIS). In 2019, 1,070 errors were identified and corrected by Port Observers. In addition, there were 42 verbal and written warnings for failing to comply with conditions of commercial fishing licences.

### 3.4 Marine Stewardship Council Certification

In 2019, the Lake Erie Management Unit (LEMU) continued to support the Ontario Commercial Fisheries Association (OCFA) with several initiatives related to the Marine Stewardship Council (MSC) certification of commercial fisheries in Lake Erie.

#### *By-Catch and Walleye Fishery*

When the Walleye fishery received MSC certification in 2015, it was contingent on the condition that the large mesh gill net fishery targeting Walleye did not pose a serious risk to Lake Whitefish and White Bass populations, which are by-catch species in the fishery. To address this condition, LEMU developed statistical catch at age models to estimate the abundance of Lake Whitefish and White Bass in Lake Erie and assess whether their capture in Walleye nets was sustainable. Model results showed that Lake Whitefish and White Bass populations were above limit reference points and not impaired by the fishery. As a result, this condition was considered, met and closed as per the third Annual Surveillance Audit held in February 2019.

### *Yellow Perch Management Plan*

In 2019, LEMU continued to work with its Lake Erie Committee (LEC) partners, Michigan State University's Quantitative Fisheries Centre (QFC) and fishery-based stakeholder group known as the Lake Erie Percid Management Advisory Group (LEPMAG), to address MSC conditions related to Yellow Perch. More specifically, these conditions required that limit reference points be set, that well-defined harvest control rules be established, and that a mechanism be in place to reduce the exploitation rate when limit reference points are approached.

With input from the Yellow Perch Task Group (YPTG), the LEC and LEPMAG, the QFC developed and used new stock assessment models, known as P.R. models, to support a Management Strategy Evaluation (MSE) process in 2018. MSE model runs were completed for various combinations of harvest control rules for each Yellow Perch Management Unit. LEPMAG members were then asked to rank their relative preference for a selection of harvest control rules based on results from the MSE analysis. After careful consideration of LEPMAG member's advice, input from the YPTG, and LEC's desire for the long-term sustainability of Yellow Perch fisheries, the LEC decided to implement the exploitation policies detailed in Table 3.4.1. A risk tolerance ( $P^*$ ) value of 0.05 was initially used when setting the total allowable catch in 2019; however,  $P^*$  was later modified to 0.20 following additional LEPMAG consultation in October of 2019.

A draft Lake Erie Yellow Perch Management Plan was completed in 2019 and submitted to LEC and YPTG for review and comment. Finalization of the Yellow Perch Management Plan is expected to occur in 2020.

**Table 3.4.1** Harvest control rules for Yellow Perch in Lake Erie by management unit.

| Management Unit | Limit Reference Point | Risk Tolerance ( $P^*$ ) | TAC Constraint | Target Fishing Rate ( $\%F_{msy}$ ) |
|-----------------|-----------------------|--------------------------|----------------|-------------------------------------|
| MU1             | $B_{msy}$             | 0.2                      | 20%            | 28% of $F_{msy}$                    |
| MU2             | $B_{msy}$             | 0.2                      | 20%            | 35% of $F_{msy}$                    |
| MU3             | $B_{msy}$             | 0.2                      | 20%            | 32% of $F_{msy}$                    |
| MU4             | $B_{msy}$             | 0.2                      | 20%            | 34% of $F_{msy}$                    |

### *Rainbow Smelt*

In October 2019, the OCFA submitted a Fishery Improvement Project (FIP) work plan on behalf of the Rainbow Smelt commercial trawl industry. A FIP is a stakeholder led initiative that helps fisheries address specific challenges in order to help the fishery meet sustainability standards like MSC. A FIP is a rigorous process that allows the fishery to be evaluated against MSC standards and develop work plans to address priority actions

required to improve management of the fisheries. In the upcoming year, LEMU will support the FIP process by developing new Rainbow Smelt stock assessment tools for Lake Erie.

#### 4. FISHERIES ASSESSMENT PROJECTS

##### 4.1 Partnership Index Fishing: Gill Netting

Gill net surveys were completed annually in partnership with Lake Erie's commercial fishing industry since 1989 and in cooperation with the Ontario Commercial Fisheries' Association (OCFA) since 1997. Lakewide surveys were partitioned by project according to the west, west-central, east-central, Pennsylvania Ridge and eastern basins. In 2019, 133 random sites were fished across Lake Erie (Figure 4.1.1). Gangs fished overnight were 381 m in length, consisting of 14 mesh sizes ranging from 32 mm to 152 mm fished on bottom and suspended (canned) at each site. Each gang of multimesh nets fished on bottom or suspended, represents one sample. Twenty-nine (29) species from 13 families were caught in index gill nets lakewide during 2019. Arithmetic mean catch rates (fish / gang) are presented for Walleye, Yellow Perch, White Bass, White Perch, Lake Whitefish, and Lake Trout by basin (Figure 4.1.2). Catch rates are standardized to equal effort among mesh sizes and include standard canned nets and nets fished on bottom.



**Figure 4.1.1** Sites fished in Partnership index gill net surveys during 2019.

### *Walleye*

Walleye catch rates in 2019 were high, exceeding 90% of previous years in all basins except the west basin where catch rates were below average (Figure 4.1.2). Catch rates increased from 2018 in the west, west-central and east-central surveys while catch rates decreased in the east basin and Pennsylvania Ridge surveys. The lakewide age composition in 2019 ranged from 0 to 21 with ages 1, 0 and 4 most abundant in the west and central basin surveys. In the east basin survey, age 4 was most abundant, though younger ages contributed significantly. Young-of-the-year (YOY) (age 0) Walleye were present in low numbers in the west basin, were absent in the east basin and Pennsylvania Ridge surveys but age 0 catch rates exceeded all other ages in central basin surveys. Age 1 Walleye was the most abundant age group present in the west basin survey and ranked second or third in the age composition of central basin surveys but was less prominent in the east basin survey during 2019. Mean length and condition were low for juvenile and adult Walleye in 2019.

### *Yellow Perch*

Yellow Perch surveys in 2019 experienced record low catches in the west-central and east-central basin surveys and were also very low in the Pennsylvania Ridge survey (Figure 4.1.2). Catch rates in 2019 were moderate in the west basin and weaker in the east basin survey (Figure 4.1.2). Yellow Perch abundance in the west basin increased from 2018, whereas 2019 indices decreased from 2018 in surveys throughout the rest of the lake. The moderate status of Yellow Perch in the west basin was attributed mainly to the strong 2018 cohort (age 1) while the east basin population consisted mostly of age 3 Yellow Perch. Ages 1, 2 and 3 comprised the largest proportion of catches in central basin surveys with age 1 more common in the west-central basin and age 3 more significant in the east-central basin survey. Age representation ranged from 0 to 14 lakewide with the youngest age composition in the west basin, becoming progressively older eastwards. Yellow Perch mean size and condition at age was generally above average lakewide in 2019.

### *White Bass*

White Bass gill net indices in 2019 were low in the west and central basin surveys but were moderate or better in the east basin and Pennsylvania Ridge surveys respectively. Lakewide, White Bass ages ranged from 0 to 9; juveniles dominated central and west basin catches; although juveniles were not caught in the east basin survey. Adult White Bass consisted mostly of age 3 fish in the west, central and Pennsylvania Ridge surveys, while age 7 adults were more common than age 3 White Bass in eastern Lake Erie. White Bass length at age and body condition was generally near average in 2019.

### *White Perch*

White Perch catch rates in 2019 were moderate in all surveys lakewide (Figure 4.1.2). Abundance indices in 2019 doubled in the west basin, remained comparable to 2018 in the west-central basin but decreased in the east-central, Pennsylvania Ridge and east basin surveys. White Perch age composition lakewide ranged from 0 to 10. Age 1 White Perch dominated west basin catches but age 1 prevalence declined eastward. White Perch ages 3 and 4 contributed most in varying proportions to catches in the east-central, Pennsylvania Ridge and east basin surveys and to a lesser extent in the west-central basin survey in 2019. Mean length and condition of yearling-and-older (YAO) White Perch were above average in the west and central basin surveys in 2019.

### *Lake Whitefish*

Lake Whitefish are a migratory cold water species vulnerable to capture in index nets in the central basin, east basin and Pennsylvania Ridge surveys. Only 25 Lake Whitefish were caught by index gill nets lakewide in 2019. One additional Lake Whitefish was caught in auxiliary 121 mm nets. Lake Whitefish catch rates in 2019 were low in the central basin surveys and moderate in the Pennsylvania Ridge and east basin surveys (Figure 4.1.2). Relative to the previous year, Lake Whitefish indices in 2019 remained unchanged in the west-central basin but increased in the Pennsylvania Ridge survey and declined in the east-central and east basin surveys. Age groups present in lakewide catches ranged from 1 to 12. Lake Whitefish age composition in 2019 consisted mostly of ages 2 (46%), 4 (27%) and 5 (12%) with ages 1, 3 and 12 also present. Scales and otoliths were used to age Lake Whitefish. Ages are assigned based on total length; scale ages are applied when total length is <500 mm whereas otolith ages are applied when total length is  $\geq$  500 mm. None of the Lake Whitefish caught in 2019 had Sea Lamprey wounds or scars. Great Lakes Lake Whitefish are an intermediate host of the Digenean parasite *Ichthyocotylurus erraticus* (Muzzall and Whelan 2011), which populate the surface of the heart with white cysts. Heart cysts were present on 76 % of Lake Whitefish examined in 2019. In Ireland, snails, Whitefish (Pollan) and gulls represent intermediate (two) and final hosts of this parasite respectively (Harrod and Griffiths 2005). Impacts of this parasite remain uncertain.

### *Lake Trout*

Lake Trout are a native, cold water species caught mainly in the deeper waters of the east basin and Pennsylvania Ridge surveys during thermal stratification. They are caught occasionally in the east-central basin survey after fall turnover. In 2019, Lake Trout catch rates were above average in the east basin survey in contrast with below average catches observed in the Pennsylvania Ridge survey (Figure 4.1.2). Lake Trout catch rates in the east basin during 2019 were comparable to 2018 whereas catch rates increased in the

Pennsylvania Ridge survey. In 2019, 59 Lake Trout were caught in index nets; most (56) were caught in nets fished on bottom, with 2 caught in standard canned nets and 1 caught in nets fished within the thermocline.

Multi-agency efforts to restore Lake Trout in Lake Erie rely on stocking multiple strains until the population is sustained by natural reproduction. Coded-wire tags were retrieved from the nares of 49 out of 59 Lake Trout caught in index and auxiliary gill nets, revealing the following strains: Finger Lakes (32%), Slate Islands (32%), Lake Champlain (15%), Klondike (2%) and Lake Ontario (2%). Other stocked Lake Trout included 6 fish with adipose fin clips that lacked tags. Four (4) Lake Trout lacked both fin clips and tags, suggesting either a possible natural origin or fish stocked without markings. For Lake Trout caught in Partnership surveys during 2019, ages based on tagging dates ranged from 1 to 29 with age 4 most abundant (22%).

### *Species at Risk*

Two (2) Lake Sturgeon were caught and released alive during the 2019 west basin survey; their total lengths were 77 and 88 cm. Silver Chub (16) were caught exclusively in the west basin in 2019. Although catches increased from 2018 (8), Silver Chub catch rates in 2019 remained below average.

### *Other species*

Smallmouth Bass catch rates in 2019 remained below average in the west and east basin surveys, despite a significant increase in the west basin and a nominal increase in the east basin catch rate compared to 2018. Smallmouth Bass age composition ranged from ages 1 to 9 and 1 to 10 in west and east basin surveys respectively. Age 1 (2018 year class) was the most abundant age group followed by age 3 (2016 year class) in both the west and east basin surveys.

During 2019, the abundance of Sucker species varied lakewide, with high densities in the west half of the lake and moderate densities eastward. In 2019, catch rates peaked in the west-central basin for Shorthead Redhorse Suckers and Quillback Carpsuckers.

Gizzard Shad abundance in 2019 was moderate in all surveys with the exception of the west-central basin where catch rates were low. Most of the Gizzard Shad caught in the west and central basin surveys were young-of-the-year, in contrast with Pennsylvania Ridge and east basin surveys where YOY were less prevalent. In 2019, Freshwater Drum abundance was low in west basin, high in the west-central basin but was moderate in east-central, Pennsylvania Ridge and east basin assessments. Yearling Freshwater Drum represented significant proportions of catches in the west and central basin surveys, while Pennsylvania Ridge and east basin surveys were composed exclusively

of adults. During 2019, Channel Catfish abundance ranged from moderate in the west, east and Pennsylvania Ridge surveys to high in central basin surveys.

## References:

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

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

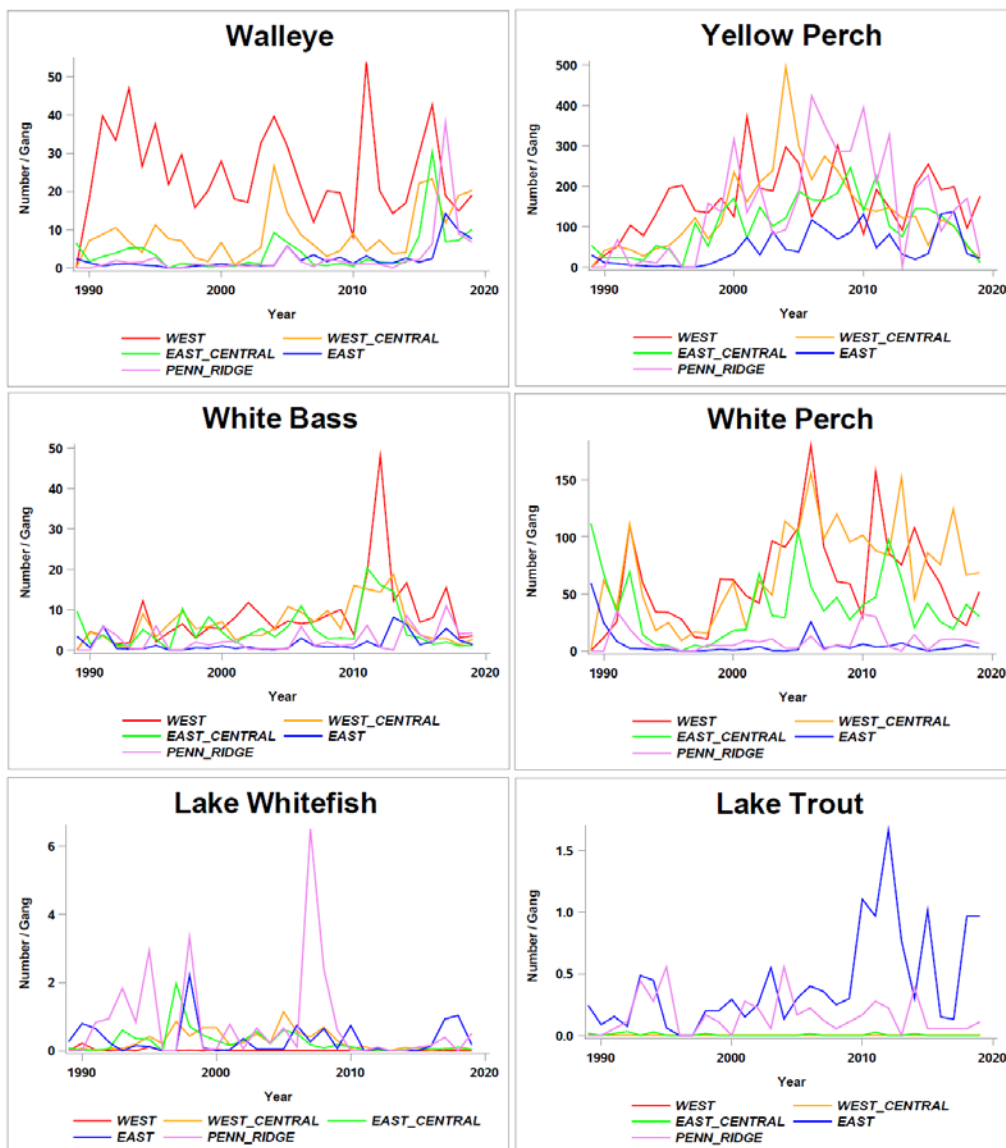


**Figure 4.1.2** Mean catch rate (fish / gang) by species, and basin for Walleye, Yellow Perch, White Bass, White Perch, Lake Whitefish and Lake Trout.

#### 4.2 Index Trawling: Western Lake Erie

The western basin interagency trawling index, conducted by Ontario and Ohio, occurs annually during August. The study is used to assess year class strength of species based on catches of young-of-the-year (YOY) and yearling-and-older fish (YAO). Catch rates of juvenile Walleye and Yellow Perch are combined with Ohio samples for recruitment indices used by Lake Erie task groups to forecast age 2 population abundance. The gear, a two seam, 33' Biloxi bottom trawl (38' ground line) with a ½" cod end liner, was towed on bottom for 10 minutes at 1.6 to 1.7 knots at 36 stations (Figure 4.2.1). Subsamples of catches from each trawl were measured on board and ages were determined for samples of juvenile Yellow Perch and Walleye. Temperature and dissolved oxygen profiles were recorded at each site. To reduce bias, an interim interagency protocol was implemented to exclude bottom trawl samples with hypoxia (dissolved oxygen concentration  $\leq 2$  mg / l). Hypoxia was present at 12 sites initially in 2019 resulting in their exclusion (Figure 4.2.1). Sites that were hypoxic were repeated later during the survey when dissolved oxygen concentrations were higher. However, four (4) sites southeast of Pelee Island remained hypoxic during the final week of the study in August; resulting in 32 normoxic samples for analyses. Mean number caught per hectare and percentile by species and age group (young-of-the-year, yearling-and-older and all ages combined) are presented for 2019, along with mean catch rates for several time periods (Table 4.2.1).

In Ontario waters, catch rates in 2019 were the second highest for YOY Walleye and above the long term (1988-2018) average for YOY Yellow Perch (Table 4.2.1). Freshwater Drum YOY, Gizzard Shad YOY and White Perch YOY indices were weak in 2019. Young-of-the-year White Bass and Rock Bass catch rates were moderate while the YOY Smallmouth Bass index was weak in 2019. Young-of-the-year fish of other species and broader taxonomic groups were absent or rare in west basin bottom trawls in 2019. Overall, YOY catch rates were low in 2019 with the largest catches from Yellow Perch, White Perch, White Bass and Walleye.

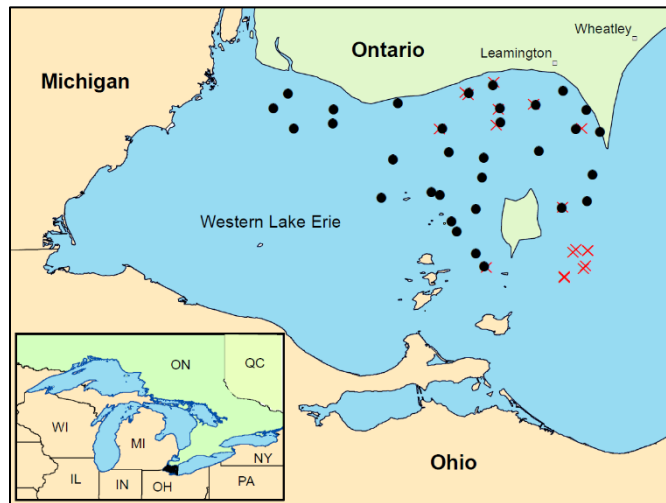


**Figure 4.2.1** Sites fished bottom trawling (dots) in Ontario waters of western Lake Erie, 2019. Trawls excluded due to hypoxia or damaged gear are indicated with a red "x".

Yearling-and-older fish indices in 2019 compared to their respective time series were high for Walleye, Common White Suckers, Shorthead Redhorse Suckers and Rock Bass. Moderate catches of YAO Yellow Perch, White Perch, Smallmouth Bass occurred in

2019. When YAO fish were partitioned according to size into yearling and age-2-and-older, yearling catch rates in 2019 represented the 94<sup>th</sup> and 87<sup>th</sup> percentiles for Walleye and Yellow Perch respectively (1988-2019).

In 2019, the catch rate of forage fish (131.8 fish/ha), consisting of species that are preyed upon during all life stages, was the lowest in the time series (Table 4.2.1). Troutperch and Round Goby accounted for 78% of forage species caught in 2019. Silver Chub, Logperch, Spottail Shiners and Rainbow Smelt comprised most of the remaining catch of forage species. Silver Chub abundance was ranked 94<sup>th</sup> percentile in 2019. The catch rate of Emerald Shiners in 2019 was the lowest in the 1988-2019 time series whereas Mimic Shiner abundance was moderate. Alewife abundance, which was historically abundant, collapsed in 2003 and has remained rare or absent (2019) from bottom trawls since.

**Table 4.2.1** Number / hectare caught and percentile by fish species and age group in 2019 west basin index trawls, compared to time period means: 1988-2018, 1988-1999, 2000-2009, 2010-2018.

| Age Group(s)                         | Species              | Mean      |           |           |           | 2019    | Percentile <sub>2019</sub><br>(88-19) |
|--------------------------------------|----------------------|-----------|-----------|-----------|-----------|---------|---------------------------------------|
|                                      |                      | 1988-2018 | 1988-1999 | 2000-2009 | 2010-2018 |         |                                       |
| Young of the Year                    | Gizzard Shad         | 460.2     | 637.9     | 584.1     | 85.5      | 8.4     | 3%                                    |
|                                      | Quillback            | 0.0       | 0.1       | -         | -         | -       | 0%                                    |
|                                      | White Sucker         | 0.0       | 0.0       | -         | -         | -       | 0%                                    |
|                                      | Channel Catfish      | 0.0       | 0.1       | 0.0       | 0.0       | -       | 0%                                    |
|                                      | White Perch          | 2,115.3   | 2,309.9   | 2,242.6   | 1,714.6   | 723.6   | 16%                                   |
|                                      | White Bass           | 96.5      | 84.2      | 150.1     | 53.4      | 45.7    | 35%                                   |
|                                      | Morone sp.           | 0.0       | -         | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Centrarchidae        | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Rock Bass            | 0.4       | 0.2       | 0.4       | 0.5       | 0.1     | 45%                                   |
|                                      | Pumpkinseed          | 0.0       | -         | 0.0       | -         | -       | 0%                                    |
|                                      | Bluegill             | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Smallmouth Bass      | 1.7       | 1.7       | 2.2       | 1.2       | 0.3     | 23%                                   |
|                                      | Largemouth Bass      | 0.2       | 0.4       | 0.0       | 0.0       | -       | 0%                                    |
|                                      | White Crappie        | 0.3       | 0.8       | 0.0       | -         | -       | 0%                                    |
|                                      | Black Crappie        | 0.0       | -         | 0.0       | -         | -       | 0%                                    |
|                                      | Poxomis sp.          | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Yellow Perch         | 560.9     | 489.3     | 454.3     | 774.7     | 733.9   | 77%                                   |
|                                      | Walleye              | 30.1      | 18.1      | 16.3      | 61.5      | 252.1   | 97%                                   |
|                                      | Freshwater Drum      | 18.6      | 16.2      | 33.0      | 5.8       | 0.3     | 6%                                    |
|                                      | All                  | 3,284.3   | 3,558.7   | 3,483.1   | 2,697.4   | 1,764.3 | 29%                                   |
| Yearling and Older                   | Silver Lamprey       | 0.0       | 0.0       | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Lake Sturgeon        | 0.0       | 0.0       | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Gizzard Shad         | 1.9       | 4.6       | 0.2       | 0.1       | -       | 0%                                    |
|                                      | Lake Whitefish       | 0.0       | -         | 0.0       | -         | -       | 0%                                    |
|                                      | Northern Pike        | 0.0       | 0.0       | -         | 0.0       | -       | 0%                                    |
|                                      | Muskellunge          | 0.0       | -         | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Quillback            | 0.3       | 0.2       | 0.4       | 0.2       | -       | 0%                                    |
|                                      | Longnose Sucker      | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | White Sucker         | 1.1       | 0.5       | 1.3       | 1.7       | 2.1     | 84%                                   |
|                                      | Silver Redhorse      | 0.0       | -         | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Golden Redhorse      | 0.0       | -         | 0.1       | -         | -       | 0%                                    |
|                                      | Shorthead Redhorse   | 0.1       | 0.0       | 0.3       | 0.1       | 0.3     | 84%                                   |
|                                      | Moxostoma sp.        | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Common Carp          | 0.9       | 1.4       | 0.8       | 0.4       | 0.3     | 13%                                   |
|                                      | Yellow Bullhead      | 0.0       | -         | 0.0       | 0.0       | -       | 0%                                    |
|                                      | Brown Bullhead       | 0.4       | 0.5       | 0.7       | 0.2       | -       | 0%                                    |
|                                      | Channel Catfish      | 1.1       | 1.2       | 0.9       | 1.2       | 0.2     | 13%                                   |
|                                      | Burbot               | 0.3       | 0.9       | -         | -         | -       | 0%                                    |
|                                      | White Perch          | 122.4     | 79.4      | 204.9     | 88.2      | 72.6    | 45%                                   |
|                                      | White Bass           | 2.2       | 2.0       | 2.1       | 2.6       | 0.1     | 13%                                   |
|                                      | Rock Bass            | 0.7       | 1.0       | 0.6       | 0.2       | 0.8     | 71%                                   |
|                                      | Bluegill             | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Smallmouth Bass      | 0.4       | 0.8       | 0.2       | 0.1       | 0.1     | 48%                                   |
|                                      | Largemouth Bass      | 0.1       | 0.1       | -         | -         | -       | 0%                                    |
|                                      | White Crappie        | 0.0       | 0.0       | -         | -         | -       | 0%                                    |
|                                      | Black Crappie        | 0.0       | 0.0       | 0.0       | -         | -       | 0%                                    |
|                                      | Yellow Perch         | 191.3     | 119.1     | 286.9     | 181.5     | 189.1   | 68%                                   |
|                                      | Walleye              | 11.0      | 7.3       | 13.0      | 13.7      | 44.7    | 94%                                   |
|                                      | Freshwater Drum      | 44.5      | 33.2      | 62.7      | 39.2      | 25.1    | 29%                                   |
|                                      | Carp-Goldfish hybrid | 0.0       | -         | 0.0       | 0.0       | -       | 0%                                    |
|                                      | All                  | 378.9     | 252.4     | 575.0     | 329.6     | 335.4   | 58%                                   |
| Species With All Age Groups Combined | Alewife              | 294.6     | 654.3     | 127.6     | 0.3       | -       | 0%                                    |
|                                      | Rainbow Smelt        | 35.6      | 9.3       | 40.9      | 64.7      | 2.1     | 35%                                   |
|                                      | Cyprinidae           | 15.0      | -         | 5.3       | 45.9      | -       | 0%                                    |
|                                      | Goldfish             | 0.0       | 0.0       | 0.0       | 0.1       | -       | 0%                                    |
|                                      | Silver Chub          | 5.0       | 7.6       | 3.9       | 2.5       | 14.8    | 94%                                   |
|                                      | Emerald Shiner       | 99.5      | 51.5      | 176.9     | 77.5      | 0.5     | 0%                                    |
|                                      | Common Shiner        | 0.0       | -         | 0.0       | -         | -       | 0%                                    |
|                                      | Spottail Shiner      | 39.1      | 72.0      | 28.9      | 6.4       | 4.3     | 16%                                   |
|                                      | Spotfin Shiner       | 0.0       | 0.0       | -         | -         | -       | 0%                                    |
|                                      | Mimic Shiner         | 5.1       | 0.0       | 2.2       | 15.0      | 0.1     | 61%                                   |
|                                      | Bluntnose Minnow     | 0.0       | -         | -         | 0.0       | -       | 0%                                    |
|                                      | Blacknose Dace       | 0.0       | 0.0       | -         | -         | -       | 0%                                    |
|                                      | Nocomis sp.          | 0.0       | 0.0       | -         | -         | -       | 0%                                    |
|                                      | Notropis sp.         | 0.0       | -         | 0.0       | -         | -       | 0%                                    |
|                                      | Troutperch           | 209.2     | 196.7     | 259.7     | 169.6     | 61.8    | 16%                                   |
|                                      | Johnny Darter        | 0.1       | 0.3       | -         | 0.0       | -       | 0%                                    |
|                                      | Logperch             | 3.8       | 4.2       | 2.5       | 4.7       | 6.1     | 81%                                   |
|                                      | Brook Silverside     | 0.1       | 0.1       | 0.1       | 0.1       | -       | 0%                                    |
|                                      | Round Goby           | 60.5      | 14.9      | 125.3     | 49.2      | 41.6    | 42%                                   |
|                                      | Tubenose Goby        | 0.0       | -         | -         | 0.1       | 0.5     | 97%                                   |
|                                      | All                  | 767.5     | 1,010.9   | 773.5     | 436.3     | 131.8   | 0%                                    |
| Total                                | All Species          | 4,430.7   | 4,822.1   | 4,831.6   | 3,463.3   | 2,231.6 | 26%                                   |
|                                      | # Trawls             | 35        | 35        | 35        | 35        | 32      |                                       |

### 4.3 Long Point Bay Index Trawl Surveys

Assessment of juvenile fish in Long Point Bay consists of three independent bottom trawl surveys conducted during early fall each year in three areas (Figure 4.3.1). Surveys targeting Yellow Perch have been conducted with a 6.1 m modified Biloxi bottom trawl annually since 1980 in Inner Long Point Bay (Inner Bay Trawl Assessment) at four fixed stations and in the nearshore waters of Outer Long Point Bay (Nearshore Outer Bay Trawl Assessment) at three fixed stations. A third trawl survey was initiated in 1984 to measure recruitment of Rainbow Smelt. In this survey, a 10 m Biloxi bottom trawl is fished in the offshore waters of Outer Long Point Bay (Offshore Outer Bay Trawl Assessment) at four fixed stations. For all surveys, two consecutive trawls are towed for ten minutes at each station during each sample event. Trawling takes place once a week for five weeks. In the nearshore areas it generally occurs from late August to late September and in the offshore from late September to early November.

In addition, a new survey commenced in 2018 which has a shorter sampling period (two weeks for each area) and broader spatial coverage. To maintain the continuity of the data series, both the old and new surveys will be run each year until a correction factor can be established, at which point the old surveys will be discontinued. Data presented in this section are from the original survey design.

The 2019 sampling period occurred from September 3<sup>rd</sup> to October 2<sup>nd</sup>, 2019 at the nearshore sites and from September 29<sup>th</sup> to October 25<sup>th</sup> at the offshore sites. The old surveys were conducted throughout the sampling period, whereas the new surveys were conducted only during the first weeks.

#### *Yellow Perch*

An index of Yellow Perch abundance was introduced in 2010. This Long Point Bay composite index (LPBc) combines the annual mean abundance (number per hectare; NPHa) estimates from each of the three trawl assessments and assigns a weight to each based on survey surface area with bottom depths greater than 5 m (78.3%) and less than or equal to 5 m (21.7%).

The estimated density of young-of-the-year (YOY) Yellow Perch in Long Point Bay calculated using this index was 277 fish/ha in 2019, which is high relative to other estimates in the survey timeseries (1984-2018: mean NPHa=82, range=0-447). Density of yearling-and-older (YAO) Yellow Perch in 2019 was also high (NPHa=19) relative to the timeseries estimates (1984-2018: mean NPHa=13, range = 0-110).

### *Rainbow Smelt*

Only the Offshore Outer Bay Survey is used to assess Rainbow Smelt abundance. Abundance of young-of-the-year (YOY) was in the 59<sup>th</sup> percentile (NPHa=740) but below the long-term mean (Table 4.3.1). Abundance of yearling-and-older (YAO) Rainbow Smelt was in the 19<sup>th</sup> percentile (NPHa=11) and was also below the time series mean (Table 4.3.1).

### *Abundance by Survey Area*

Inner Bay – In 2019, the catches of YOY and YAO Yellow Perch were above the long term mean (Table 4.3.2). All other species and age classes were below average.

Nearshore Outer Bay – In 2019, the catch of YOY Yellow Perch was above the long term mean (Table 4.3.3). All other species and age classes were below average.

Offshore Outer Bay – In 2019, the catches of YOY Yellow Perch and Round Goby were above the long term mean (Table 4.3.1). All other species and age classes were below average.

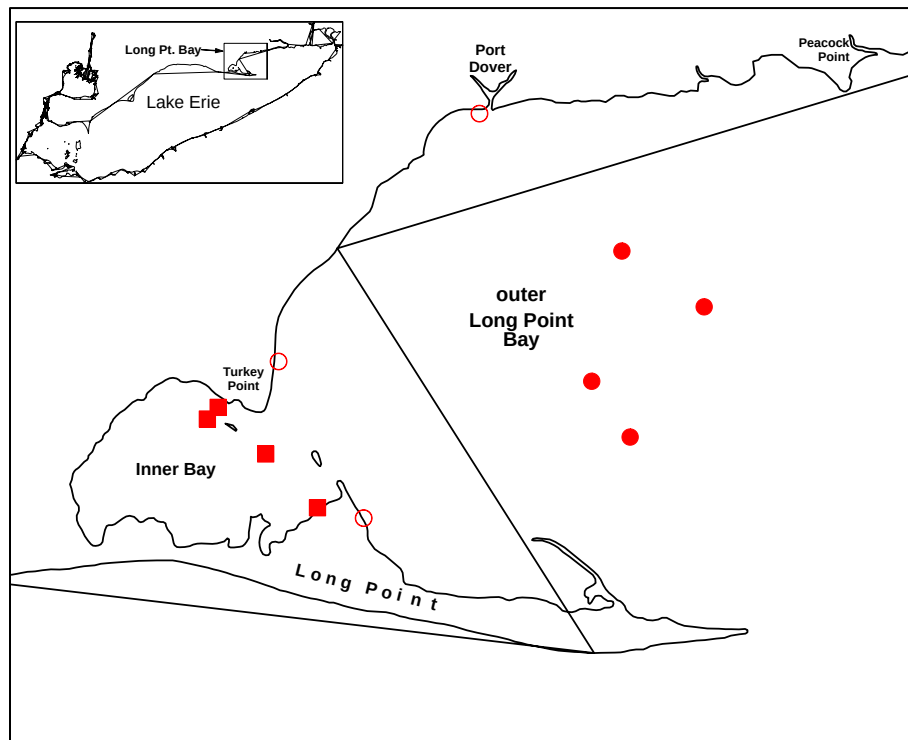


**Figure 4.3.1** Location of trawl stations where bottom trawling was conducted in Inner Bay (■), and the nearshore (○) and offshore (●) waters of Outer Long Point Bay, Lake Erie.

**Table 4.3.1** Mean number per hectare and percentile of selected young-of-the-year and yearling-and-older fish species caught in the offshore waters of Outer Long Point Bay, Lake Erie, during index bottom trawl assessments (10-m trawl), September-October 2019, and mean and range of means from 1984 to 2018.

| Species        | YOY   |            |           |            | YAO  |            |           |            |
|----------------|-------|------------|-----------|------------|------|------------|-----------|------------|
|                | 2019  |            | 1984-2018 |            | 2019 |            | 1984-2018 |            |
|                | Mean  | Percentile | Mean      | Range      | Mean | Percentile | Mean      | Range      |
| Rainbow Smelt  | 739.6 | 59%        | 981.6     | 0.9-7058.1 | 11.3 | 19%        | 387.2     | 0.1-3328.1 |
| Yellow Perch   | 179.4 | 84%        | 60.5      | 0.0-551.1  | 11.3 | 65%        | 20.4      | 0.04-201.7 |
| White Perch    | 1.3   | 70%        | 5.1       | 0.0-96.1   |      |            |           |            |
| White Bass     | 1.2   | 57%        | 10.9      | 0.0-166.2  |      |            |           |            |
| Alewife        | 0.0   | 3%         | 97.7      | 0.0-2174.5 |      |            |           |            |
| Gizzard Shad   | 0.0   | 3%         | 13.9      | 0.0-86.5   |      |            |           |            |
| Emerald Shiner | 3.8   | 27%        | 179.8     | 0.0-3388.0 | 12.5 | 38%        | 267.0     | 0.0-4200.3 |
| Round Goby*    | 194.2 | 77%        | 160.4     | 0.0-937.2  |      |            |           |            |

**Table 4.3.2** Mean number per hectare and percentile of selected young-of-the-year and yearling-and-older fish species caught in Inner Long Point Bay, Lake Erie, during index bottom trawl assessments (6.1 m trawl), September-October 2019, and mean and range from 1980 to 2018.

| Species                         | YOY   |            |           |            | YAO   |            |           |           |
|---------------------------------|-------|------------|-----------|------------|-------|------------|-----------|-----------|
|                                 | 2019  |            | 1980-2018 |            | 2019  |            | 1980-2018 |           |
|                                 | Mean  | Percentile | Mean      | Range      | Mean  | Percentile | Mean      | Range     |
| Yellow Perch                    | 532.6 | 80%        | 249.9     | 0.0-1859.5 | 206.7 | 85%        | 80.1      | 0.2-513.2 |
| Rock Bass                       | 1.2   | 27%        | 14.8      | 0.0-197.6  |       |            |           |           |
| Smallmouth Bass                 | 2.6   | 15%        | 14.0      | 0.0-91.7   |       |            |           |           |
| Largemouth Bass                 | 0.9   | 10%        | 11.3      | 0.0-96.6   |       |            |           |           |
| Spottail Shiner                 | 0.5   | 44%        | 135.6     | 0.0-983.2  | 0.1   | 41%        | 2.5       | 0.0-30.9  |
| Banded Killifish                | 3.8   | 54%        | 15.8      | 0.0-226.3  | 0.8   | 78%        | 1.0       | 0.0-17.3  |
| Johnny Darter                   | 1.0   | 29%        | 9.1       | 0.0-57.3   |       |            |           |           |
| Sunfish ( <i>Lepomis spp.</i> ) | 16.9  | 78%        | 26.8      | 0.0-184.5  |       |            |           |           |
| Round Goby*                     | 80.9  | 45%        | 106.3     | 0.6-280.5  |       |            |           |           |

**Table 4.3.3** Mean number per hectare and percentile of selected young-of-the-year and yearling-and-older fish species caught in the nearshore waters of Outer Long Point Bay, Lake Erie, during index bottom trawl assessments (6.1 m trawl), September-October 2019, and mean and range from 1980 to 2018.

| Species         | YOY   |            |           |            | YAO  |            |           |           |
|-----------------|-------|------------|-----------|------------|------|------------|-----------|-----------|
|                 | 2019  |            | 1980-2018 |            | 2019 |            | 1980-2018 |           |
|                 | Mean  | Percentile | Mean      | Range      | Mean | Percentile | Mean      | Range     |
| Yellow Perch    | 265.5 | 88%        | 91.2      | 0.5-739.9  | 10.2 | 53%        | 35.6      | 0.7-391.0 |
| White Perch     | 1.2   | 55%        | 13.8      | 0.0-120.9  |      |            |           |           |
| White Bass      | 1.2   | 80%        | 7.0       | 0.0-153.9  |      |            |           |           |
| Alewife         | 0.7   | 33%        | 55.4      | 0.0-869.7  |      |            |           |           |
| Gizzard Shad    | 4.0   | 45%        | 11.1      | 0.0-82.8   |      |            |           |           |
| Spottail Shiner | 27.5  | 30%        | 344.9     | 2.5-1508.5 | 9.2  | 48%        | 29.4      | 0.0-213.8 |
| Round Goby*     | 34.4  | 18%        | 105.3     | 0.0-359.1  |      |            |           |           |

\*Round Goby NPHA is for all ages. Round Goby was first detected in our surveys in 1999 so means and percentiles are for 1999-2018.

#### 4.4 Coldwater Assessment Survey

Since 1986, the Ontario Ministry of Natural Resources and Forestry (OMNRF) has conducted a stratified, random design, deep water August gill net assessment survey for Lake Trout and other coldwater species in conjunction with multi-jurisdictional partners. The sampling design divides the eastern basin of Lake Erie into eight sampling areas. OMNRF partners with the United States Geological Survey (USGS) to complete the survey in Ontario waters, sampling Areas A5-A8 (Figure 4.4.1). New York and Pennsylvania are responsible for sampling in their jurisdictions. Only data from Ontario waters is presented in this report. In 2019, OMNRF and USGS completed 60 net sets in Ontario waters.

The Lake Erie Lake Trout population continues to be supported by bi-national stocking efforts, as there is no evidence of natural reproduction despite more than 30 years of restoration effort. In 2019, the mean number of Lake Trout caught was 3.9 fish/lift (Figure 4.4.2). Lake Trout caught ranged in age from 2 to 18 years, with a median age of 6. Rainbow Smelt was the primary prey item identified in Lake Trout stomachs in 2019.

The mean number of Lake Whitefish was 0.12 fish/lift in 2019 (Figure 4.4.2). Lake Whitefish ranged in age from 5 to 16 years old with a median age of 6. Lake Whitefish fell into two main age classes: 5 to 10 and 15 to 20, with no fish occurring outside these classes. Despite low abundance, the presence of multiple cohorts is promising, showing evidence of reproduction. Diet analysis for Lake Whitefish was limited to only two fish.

Invertebrate prey items represented 100% of the Lake Whitefish stomach contents sampled in 2019.

Burbot catches have been consistently low since 2012, below 1 fish/lift. This trend continued in 2019 with a catch rate of 0.3 Burbot per lift (Figure 4.4.2). In 2019, Burbot caught ranged in age from 4 to 21 years old with a median age of 8. This evidence of younger year classes is promising as catches have been composed of older year classes in recent years. Round Goby and Rainbow Smelt were the main prey items found in Burbot diets in 2019.

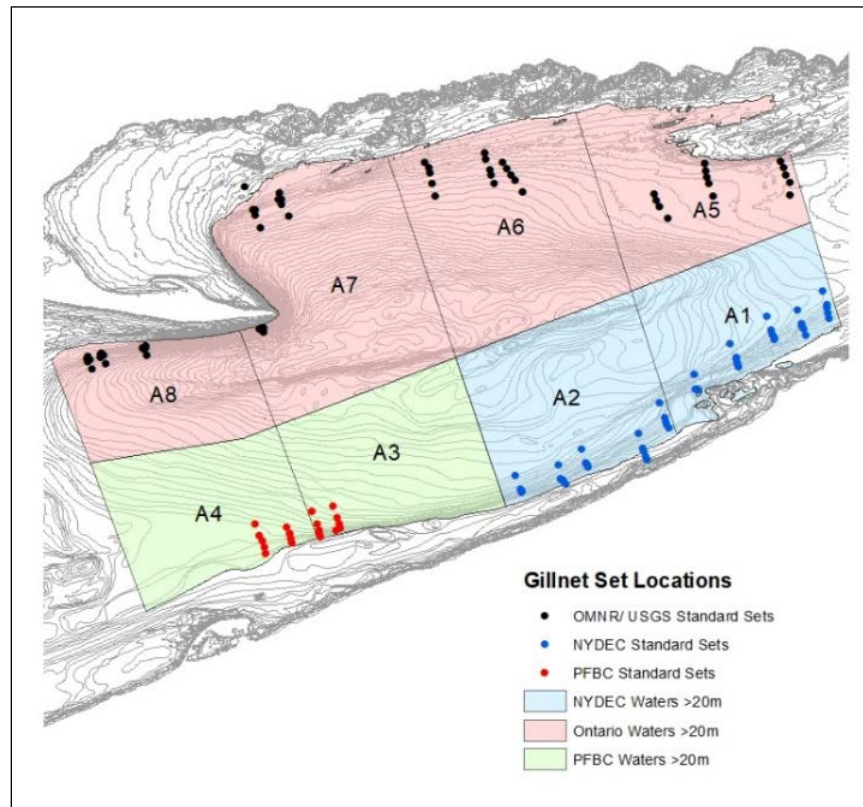


**Figure 4.4.1** Standard sampling areas used in the Coldwater Assessment survey in the east basin of Lake Erie. Circles represent the location of net sets in 2019. OMNRF and USGS set nets in Ontario waters (A5-A8), New York in A1 and A2 and Pennsylvania in A3 and A4.

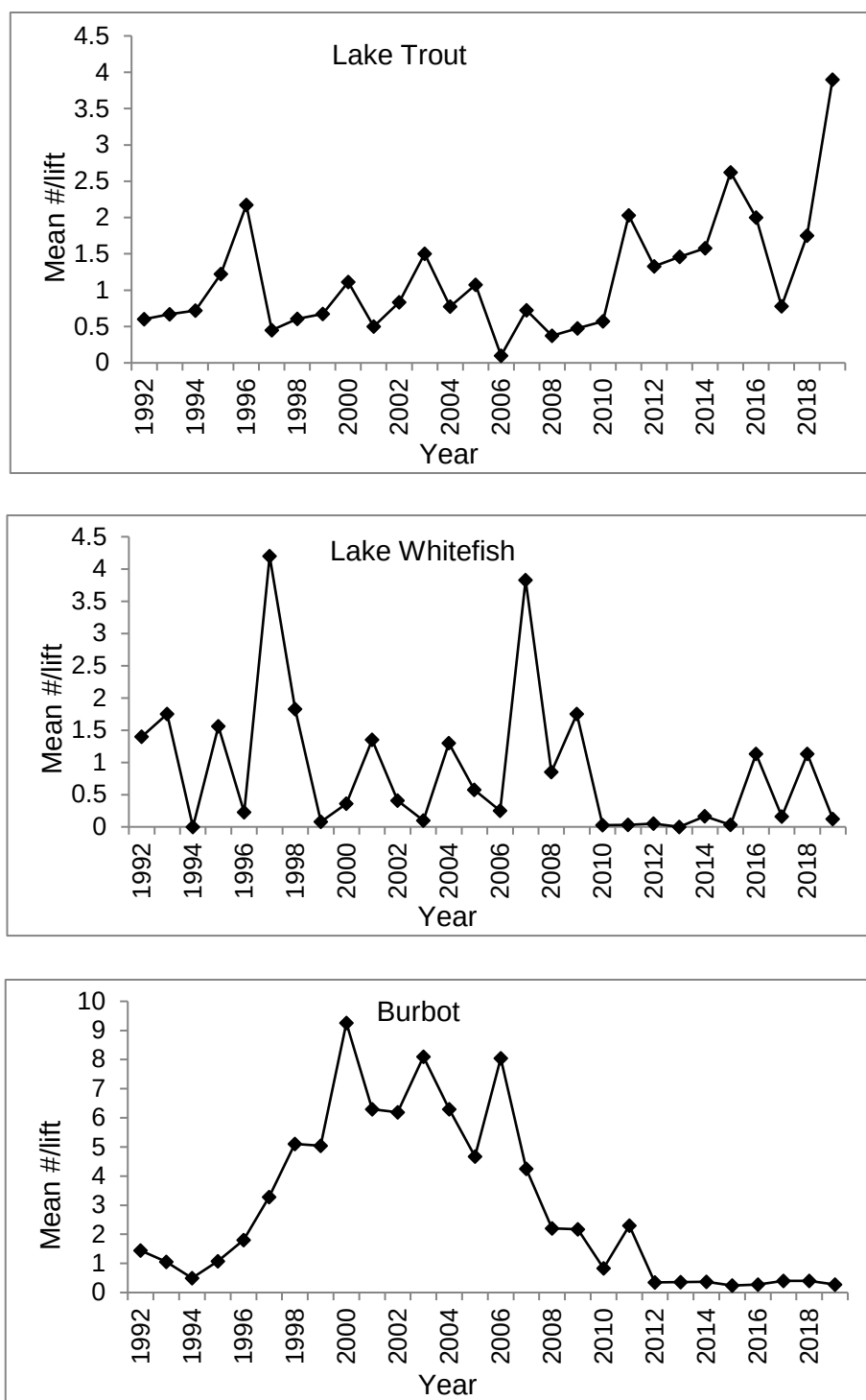


**Figure 4.4.2** Mean number of Lake Trout, Lake Whitefish and Burbot caught per net lift during interagency Coldwater Assessment gill netting in Ontario waters of eastern Lake Erie, 1992-2019.

#### 4.5 East Basin Hydroacoustic Survey

A summer fisheries hydroacoustic survey has been conducted in the east basin since 1993 to provide estimates of the distribution and abundance of Rainbow Smelt. The basin is split into 6 strata (Figure 4.5.1), and 2 randomly chosen north-south transects in each strata are surveyed, for a total of 12 transects. Companion midwater trawls were completed by New York State Department of Environmental Conservation up until 2007. In years when midwater trawling was carried out, >95% of the fish caught in coldwater habitat (metalimnion and hypolimnion) were yearling-and-older (YAO) Rainbow Smelt. In the absence of companion trawls post 2007 the acoustic data were analyzed with the assumption that all meta-hypolimnion targets above the minimum target strength threshold were YAO Rainbow Smelt. As such, we report on YAO Rainbow Smelt abundance for only coldwater habitat, as determined by temperature profile, for targets in the acoustic size range of YAO Rainbow Smelt (-59 to -40 dB). In 2019, the survey window was extended to incorporate midwater trawling to test the assumption that the meta-hypolimnion targets were still likely to be YAO Rainbow Smelt. A midwater trawl was fished throughout the water column in areas where high densities of acoustic targets were identified. Midwater trawl catches are targeted tows informed by fish density from the acoustic data collection and thus should not be interpreted as an index of abundance independently. Density estimates are processed in 800 m distance intervals along transects and an overall basin density is calculated based on an area-weighted mean of the 6 strata.

In 2019, all 10 transects were completed including those within United States (US) waters. Approximately 350 km of hydroacoustic data were collected. The basin wide average density was 180 fish/ha, representing the lowest density of YAO Rainbow Smelt relative to the time series (Figure 4.5.2). As a schooling fish, densities greater than 50,000 fish/hectare have historically been observed in Lake Erie. However, density within all 800 m intervals never exceeded 5,000 fish/hectare in 2019 (Figure 4.5.3). Midwater trawl catches confirmed the assumption that the majority of targets meeting the minimum target strength threshold in the hypo-metalimnion layer were YAO Rainbow Smelt. In total, 588 (2917 g) YAO Rainbow Smelt were caught in hypo-metalimnion tows numerically representing 40% of the total catch but accounting for 94% of the total biomass. The remainder of the catch was limited to young-of-the-year (YOY) Rainbow Smelt (percent of total N = 44%, percent of total biomass = 3%) and YOY Yellow Perch (percent of total N = 15%, percent of total biomass = 2%). The epilimnetic tows were composed of 99% YOY species (81% YOY Rainbow Smelt, 18% YOY Yellow Perch) so it is possible that catches of YOY in the meta-hypolimnion tows are a result of net contamination as the net passed through the upper layer. The largest midwater trawl catches occurred along the shore near Port Maitland (Figure 4.5.4). The spatial differences between the acoustic densities and the midwater trawl catches are likely a function of temporal separation of acoustic transects and tows in western areas of the basin; Due to the long acoustic

transect time, tows were rarely collected at the time the transects were conducted. Tows that were conducted during the transects were confined to the epilimnetic portion of the water column.

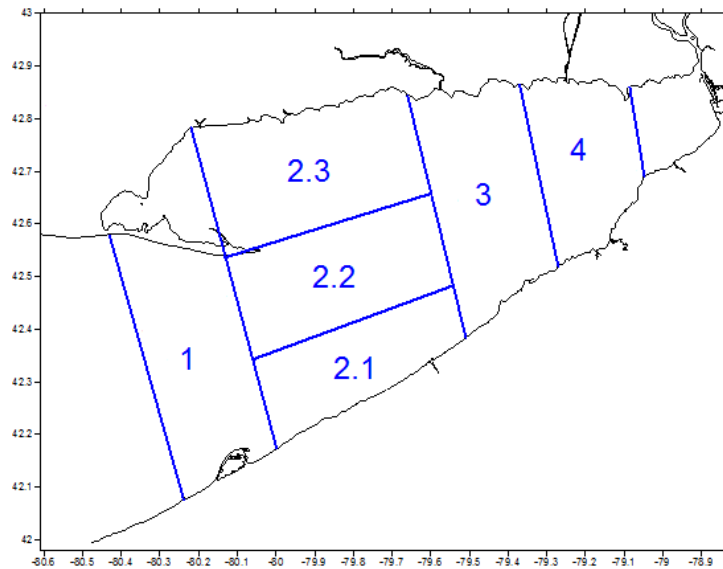


**Figure 4.5.1** The six strata in the Lake Erie east basin hydroacoustic survey.

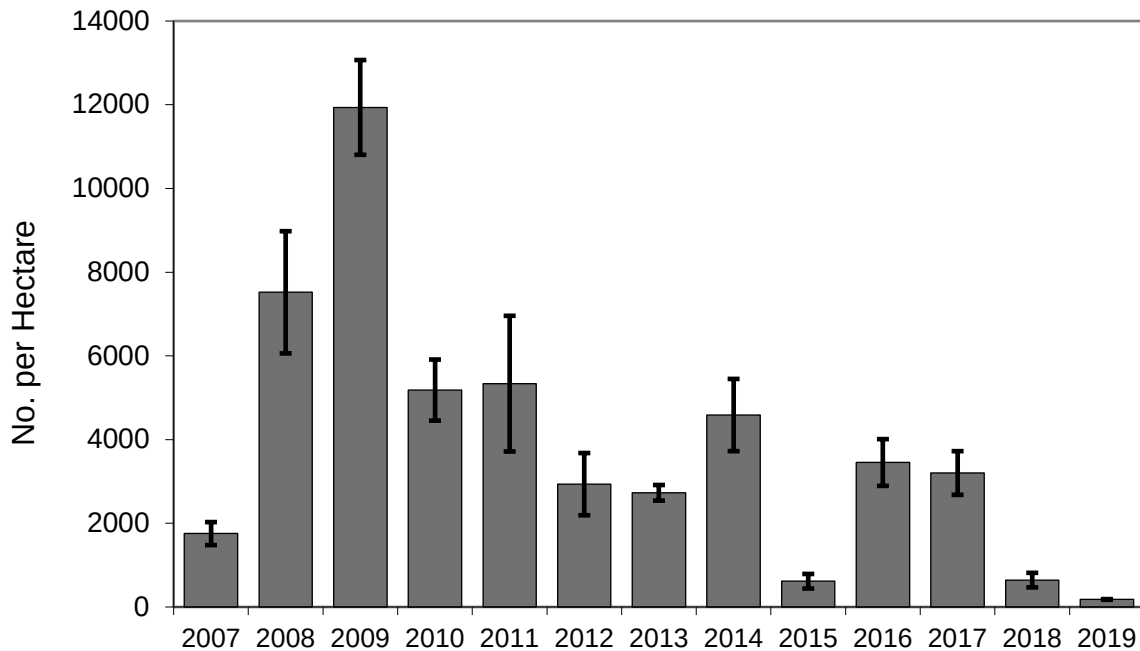


**Figure 4.5.2** Mean density (number of fish per hectare) estimates of YAO Rainbow Smelt in coldwater habitat during the July east basin hydroacoustic survey, Lake Erie, 2007-2019. Only 4 of 6 strata were sampled in 2014, only 3 of 6 strata in 2015 and only Ontario waters in 2018.

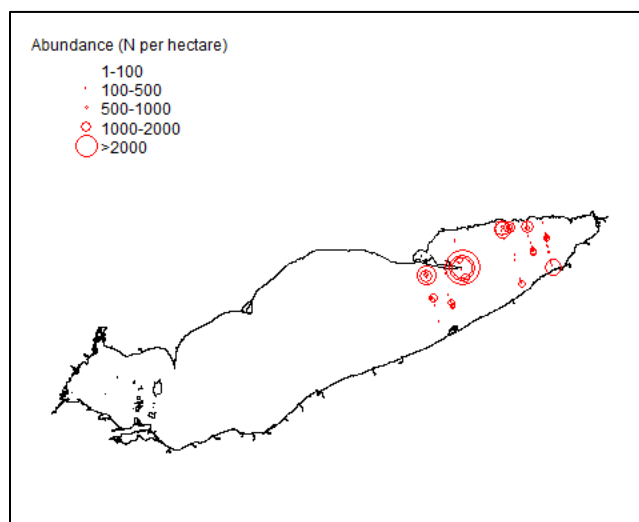


**Figure 4.5.3** Density estimates (number of fish per hectare; #/Ha) of YAO Rainbow Smelt per 800 m distance interval along transects in the July east basin hydroacoustic survey, Lake Erie. The size of the circle is scaled the density.

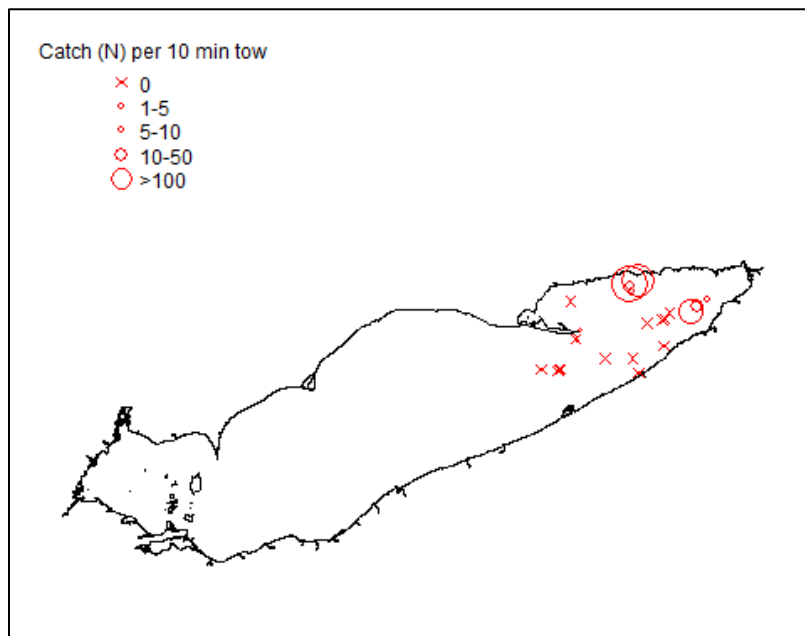


**Figure 4.5.4** Catch of YAO Rainbow Smelt per 10 min midwater trawl tow in the July east basin hydroacoustic survey, Lake Erie. The size of the circle is scaled to the total catch.

#### 4.6 Central Basin Midwater Trawling: Hydroacoustic Survey

In 2001, a hydroacoustic survey was initiated to describe trends in forage abundance and species composition in the central basin of Lake Erie. Initially the Ohio Department of Natural Resources (ODNR) (RV Grandon) and Ontario Ministry of Natural Resources and Forestry (OMNRF) (RV Keenosay) collected acoustic and midwater trawl data respectively, after which, in 2003, the USGS RV Musky II began collecting acoustic data. More recently, the United States Geological Survey (USGS) RV Muskie and ODNR RV Grandon navigate the central basin at night, detecting acoustic signals that discriminate sizes and numbers of fish, also referred to as *pinging*. The midwater trawl net fished from the Keenosay has a 3 m square opening, with 102, 76, 51, and 25 mm graded meshes running from the gape to the 13 mm cod-end.

Survey protocol involves nocturnal collection of acoustic data accompanied by midwater trawl catches along 8 transects during July in the central basin. From July 8 to July 12, 2019, pelagic trawls from the RV Keenosay occurred along four transects in Ontario waters of central Lake Erie, accompanied by the RV Muskie “pinging” along three of these transects. Additional transects were sampled in United States (US) waters by the RV Grandon. From ½ hour before sunset to ½ hour before sunrise, the Keenosay conducted nine 20 minute trawls at 3 knots along three transects and completed eight trawls along the last transect (Figure 4.6.1). Trawls targeted forage concentrations in the hypolimnion (deep, cold layer below the thermocline), near the thermocline (thermal transition layer) and in the epilimnion (warm layer above the thermocline). Species and life stage compositions from trawl catches were applied to the nearest acoustic detections, describing densities, distribution and the composition of forage in central Lake Erie. Water temperature and dissolved oxygen profiles were measured repeatedly along each transect in order to describe thermal layers and dissolved oxygen status.

Densities of yearling-and-older (YAO) Rainbow Smelt and Emerald Shiners in the central basin remained low in 2019, whereas age 0 or young-of-the-year (YOY) Rainbow Smelt densities were relatively high. The largest catches of YAO Rainbow Smelt occurred on the transect intersecting Erieau, near shore (Figure 4.6.1). YOY Rainbow Smelt were broadly distributed with higher densities in eastern transects (Figure 4.6.1). Emerald Shiner catches were low in the 2 western transects and absent from the 2 eastern transects (Figure 4.6.1). Midwater trawl total catch consisted mostly of YOY Rainbow Smelt (56%), YAO Rainbow Smelt (21%), YOY Yellow Perch (17%), YOY Gizzard Shad (3%) and groups representing less than 1 % of fish caught: YOY White Bass, YOY Walleye, YAO Freshwater Drum, Walleye ages 2 and older, Emerald Shiners, YAO White Perch, YAO Yellow Perch, YAO White Bass, Logperch and YOY Morone species (White Bass or White Perch genus) as well as some smaller YOY fish that couldn't be identified. Although YOY Rainbow Smelt were the most abundant species/age group caught, these

small fish are not fully vulnerable to the gear; abundance of YOY Rainbow Smelt is underestimated relative to other species and age groups.

In 2020, the design of the central basin hydroacoustic / midwater trawl project may be improved with a new protocol implemented during the 2020 field season. For more information please refer to the Report of the Lake Erie Forage Task Group (2020), available online: <http://www.glfc.org>.

## Reference:

Forage Task Group. 2020. Report of the Lake Erie Forage Task Group, March 2020. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission.

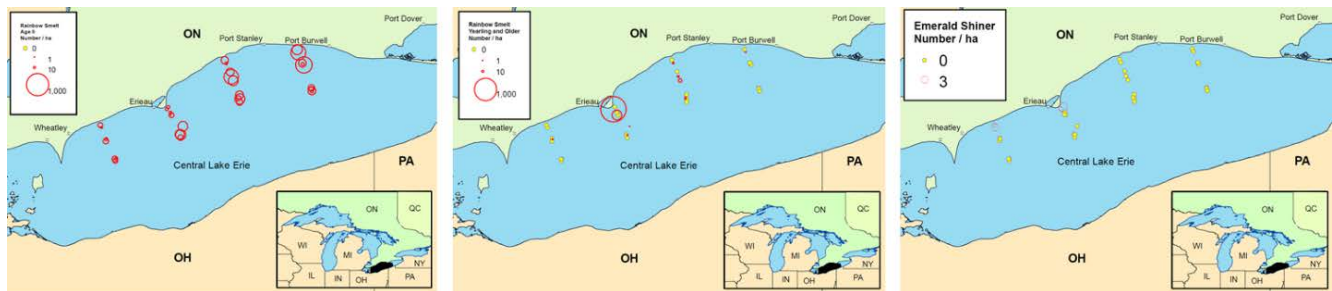


**Figure 4.6.1** Midwater trawl catch per hectare of age 0 Rainbow Smelt (left), yearling and older Rainbow Smelt (middle) and Emerald Shiners (right).

## 5. FISHERIES MANAGEMENT PROJECTS

### 5.1 Lake Erie Asian Carp Surveillance Program

The Asian Carps of concern to Great Lakes managers include four species of fish: Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*Hypophthalmichthys molitrix*), Black Carp (*Mylopharyngodon piceus*), and Grass Carp (*Ctenopharyngodon idella*). Three of these species (Bighead, Silver, and Grass Carp) have become naturalized in the United States. Two of these species (Bighead and Silver Carps) have dispersed north up the Mississippi River basin and have the potential to colonize the Great Lakes. Grass Carp have been observed within Lake Erie and have spawned in United States waters of the Lake Erie watershed (Embke et al, 2016).

Environmental DNA (eDNA) is genetic material which is shed by living or dead organisms into the environment. The presence of eDNA in the environment indicates that the

organism may have been present. The collection of eDNA provides a method for detecting species present in low abundance, which may not be found through conventional surveys. In September 2012, the Lake Erie Management Unit (LEMU) commenced a field program utilizing eDNA to assess if Asian Carps are present in the Canadian waters of Lake Erie or the St. Clair System. This program has continued through 2019, with water samples tested for Bighead, Silver, Black, and Grass Carp eDNA.

The LEMU Asian Carp surveillance program sampling occurred from May to July 2019. Water samples were taken from 90 sites in Lake Erie, Lake Erie tributaries, Lake St. Clair, Thames River, Sydenham River, and Lake Huron tributaries (Figure 5.1.1). Seventy-two of these sites were sampled twice.

Environmental DNA water sampling followed the University of Notre Dame protocol (Mahon et al, 2010). Three water samples were taken during each sampling event, for a total of 486 individual water samples, in order to verify any potential positive results. The LEMU Wheatley and Port Dover offices filtered the water samples. Filtered samples were sent to Dr. Chris Wilson (Aquatic Research and Monitoring Section, Trent University) for DNA amplification by Polymerase Chain Reaction (PCR) and enzyme gel electrophoresis.

In 2019, there were no positive detections for eDNA of any Asian Carp species. In addition to the directed eDNA sampling, LEMU index netting programs (described in this report) found no Asian Carp in Lake Erie and Lake St. Clair.

The Ontario commercial fishery in Lake Erie works with LEMU to report catches of invasive species. The commercial fishery uses a variety of fishing methods, including gill nets, trap nets, and trawls. In 2019 there were approximately 36,691 km of gill nets deployed, 1,146 hours of trawling, and 740 days of trap netting by the commercial fishery in Lake Erie. In 2019, no Asian Carps were submitted to the Lake Erie Management Unit by commercial fishers.

## References:

- Embke, H.S., P.M. Kocovsky, C.A. Richter, J.J. Pritt, C.M. Mayer, and S.S. Qian. 2016. First direct confirmation of Grass Carp spawning in a Great Lakes tributary. *Journal of Great Lakes Research*, 42(4): 899-903.
- Mahon, A. R., A. Rohly, M. Budny, E. Elgin, C. L. Jerde, W. L. Chadderton, and D. M. Lodge. 2010. Environmental DNA Monitoring and Surveillance: Standard Operation Procedures. Report to the United States Army Corps of Engineers, Environmental Laboratories, Cooperative Environmental Studies Unit, Vicksburg, Mississippi. CESU agreement #W912HZ-08-2-0014, modification P00007.

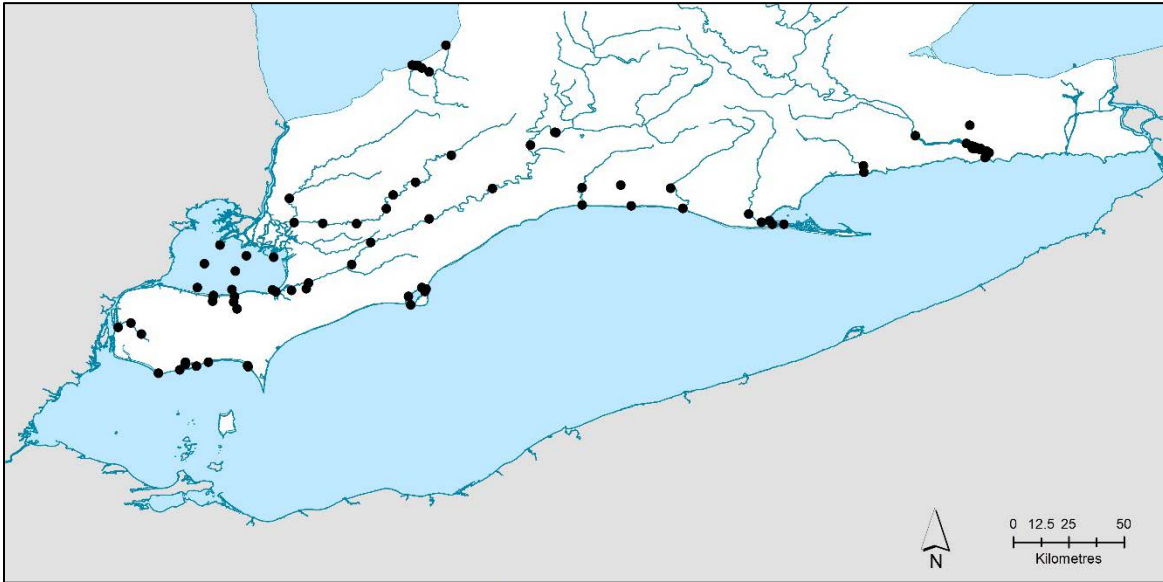


**Figure 5.1.1** Location of eDNA sample sites for 2019 Asian Carp surveillance program.

## 5.2 Central Basin Bottom Trawling

In 2016, the Lake Erie Management Unit (LEMU) began a trawling survey to assess young-of-the-year (YOY) and yearling-and-older (YAO) fish in the Ontario waters of Lake Erie's central basin. This survey was devised as a response to a lack of recruitment data, in this part of the lake, for Yellow Perch in particular.

In 2019, thirty-nine sample locations were chosen based on a Universal Transverse Mercator (UTM) 5 minute grid. Two boats were used in the survey: Ontario Ministry of Natural Resources and Forestry (OMNRF) RV Erie Explorer, and OMNRF RV Keenosay (Figure 5.2.1). The Erie Explorer fished 16 sites in the east-central basin using a 33 foot Biloxi bottom trawl with 1 inch cod-end with 0.5 inch liner. The trawl duration of the Erie Explorer was 10 minutes on the bottom at 1.6 knots. The Keenosay fished 23 sites in the west-central basin using a two seam 33 foot Biloxi bottom trawl, with a 38 foot ground line and a 1 inch cod-end with 0.5 inch liner. The trawl duration of the Keenosay was 10 minutes on bottom at 1.7 knots. The survey occurred in the fall in order to fish after lake turnover and avoid hypoxia in the central basin.

Trawl catches were sorted by species and age group. Age groups based on length were classified as young-of-year, yearling, yearling-and-older, age 2 and older, and all ages. Catch rates by boat may not be directly comparable to each other due to differences in fishing gear and fishing method. However, relative abundance indices, for both boats, were expressed as arithmetic mean catch per hectare for the entire central basin and for the west and east-central basins separately.

In 2019, the most commonly caught species were Rainbow Smelt (all ages) with 292.65 fish per hectare, followed by Round Goby (all ages; 27.90 fish per hectare) and YOY Walleye (27.83 fish per hectare). Rainbow smelt catch rates were higher in the east-central basin (431.41 fish per hectare) compared to the west-central basin (196.12 fish per hectare) (Table. 5.2.1).

In 2019, 14.79 YOY Yellow Perch were caught per hectare, this was similar to the catch in 2018 (14.84 fish per hectare). Catch rates for YOY Yellow Perch were higher in the east-central basin (32.45 fish per hectare), compared to the west-central basin (2.51 fish per hectare) (Table 5.2.1). The catch of yearling Yellow Perch decreased in 2019 to 4.11 fish per hectare from 9.30 fish per hectare in 2018. Catch rates of yearling Yellow Perch in 2019 were similar between basins but was the lowest observed in the 2016-2019 east-central basin time series (3.24 fish per hectare). The catch rate of age 2 and older Yellow Perch also decreased in 2019 to 4.96 fish per hectare from 11.07 fish per hectare in 2018. This was the third consecutive year of decreasing catch rates of age 2 and older Yellow Perch in this survey. Catch rates of age 2 and older Yellow Perch in 2019 were the lowest observed in both basins (2016-2019) but was higher in the east-central basin (7.51 fish per hectare) compared to the west-central basin (3.19 fish per hectare) (Table. 5.2.1).

The catch of YOY Walleye increased in 2019 to 27.83 fish per hectare from 18.53 fish per hectare in 2018. In 2019, YOY Walleye catch rates were the highest observed in both basins since 2016. Catch rates of YOY Walleye were higher in the west-central basin (36.51 fish per hectare) compared to the east-central basin (15.53 fish per hectare) (Table 5.2.1). Catch rates of yearling Walleye were up slightly in 2019 (1.98 fish per hectare) compared to 2018 (0.41 fish per hectare), with slightly higher catches in the west-central basin (2.51 fish per hectare) compared to the east-central basin (1.22 fish per hectare) (Table 5.2.1).

The catch of YOY White Perch decreased from 24.43 in 2018 to 16.96 fish per hectare in 2019. YOY White Bass catch decreased from 4.95 fish per hectare in 2018 to 2.96 fish per hectare in 2019.

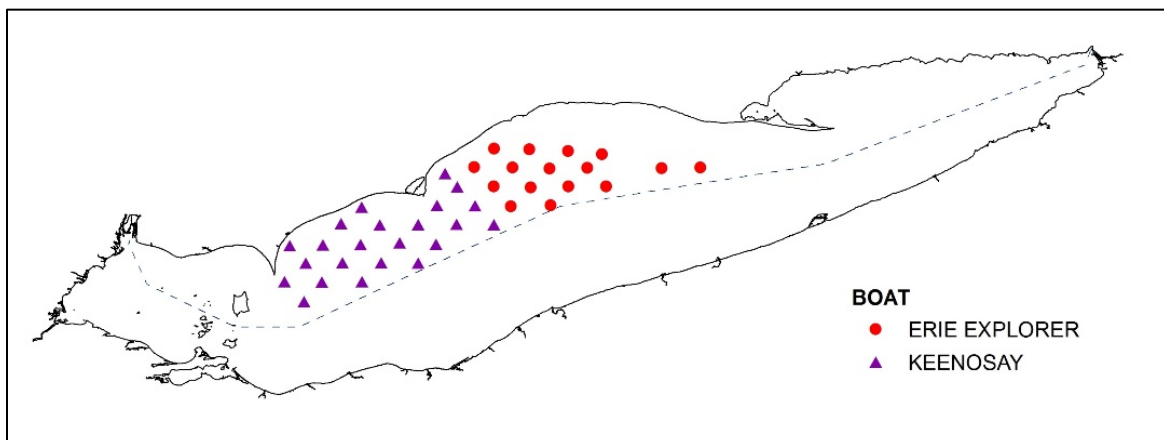


**Figure 5.2.1** 2019 Central Basin Bottom Trawl Program sites by boat.

**Table 5.2.1** Catch per hectare by species and life stage in the Central Basin Bottom Trawl Program west-central and east-central basins, 2016 to 2019.

| Species (lifestage)            | West-Central Basin |        |        |        | East-Central Basin |        |        |        |
|--------------------------------|--------------------|--------|--------|--------|--------------------|--------|--------|--------|
|                                | 2016               | 2017   | 2018   | 2019   | 2016               | 2017   | 2018   | 2019   |
| Alewife (all ages)             |                    |        |        |        | 0.07               | 0.08   |        |        |
| Channel Catfish (YAO)          | 0.38               | 0.24   | 0.16   |        | 0.21               |        |        |        |
| Common Carp (all ages)         |                    | 0.17   | 0.16   |        |                    |        |        |        |
| Cyprinidae (all ages)          |                    |        |        | 0.73   |                    |        |        |        |
| Emerald Shiner (all ages)      | 7.97               | 6.82   | 1.17   |        | 46.74              |        | 2.70   | 0.25   |
| Freshwater Drum (YOY)          | 1.58               | 0.33   | 15.63  | 5.99   | 0.20               |        | 0.68   | 0.24   |
| Freshwater Drum (YAO)          | 21.53              | 16.70  | 13.45  | 25.81  | 2.72               | 6.41   | 8.35   | 12.69  |
| Gizzard Shad (YOY)             | 0.41               | 1.40   | 0.33   | 2.70   | 3.08               | 0.74   | 0.67   | 2.22   |
| Gizzard Shad (YAO)             | 0.62               |        | 0.86   |        | 3.42               |        | 0.10   | 0.99   |
| Lake Whitefish (YAO)           | 0.17               | 0.05   |        |        |                    |        | 0.08   |        |
| Mimic Shiner (all ages)        | 0.36               | 3.93   | 0.30   |        |                    | 0.63   |        |        |
| Rainbow Smelt (all ages)       | 243.55             | 242.50 | 130.56 | 196.12 | 452.16             | 407.18 | 109.38 | 431.41 |
| Round Goby (all ages)          | 25.39              | 40.37  | 8.32   | 29.58  | 10.64              | 16.44  | 10.94  | 25.48  |
| Silver Chub (all ages)         |                    |        |        |        | 0.10               |        |        |        |
| Spottail Shiner (all ages)     |                    | 0.38   |        | 1.13   |                    | 0.28   |        |        |
| Trout-perch (all ages)         | 0.15               | 3.93   | 0.44   |        |                    |        |        |        |
| Walleye (YOY)                  | 1.04               | 1.27   | 30.68  | 36.51  | 0.07               |        | 2.09   | 15.35  |
| Walleye (yearling)             | 12.58              | 0.51   | 0.71   | 2.51   | 13.60              |        |        | 1.22   |
| Walleye (age 2 and older)      | 5.06               | 3.06   | 2.59   | 0.73   | 6.95               | 1.37   | 1.97   |        |
| White Bass (YOY)               | 2.84               | 1.77   | 8.21   | 3.63   | 4.12               | 0.19   | 0.54   | 1.99   |
| White Bass (YAO)               | 1.75               | 0.78   | 1.49   | 0.37   | 2.98               | 0.71   | 0.28   | 0.51   |
| White Perch (YOY)              | 15.63              | 65.10  | 28.35  | 14.34  |                    | 0.60   | 2.89   | 10.75  |
| White Perch (YAO)              | 65.63              | 40.47  | 11.04  | 14.60  | 27.99              | 52.42  | 42.55  | 20.35  |
| White Sucker (YAO)             | 0.05               | 0.15   |        |        |                    |        | 0.17   | 0.75   |
| Yellow Perch (YOY)             | 4.59               | 33.40  | 11.75  | 2.51   | 5.84               | 24.80  | 19.03  | 32.45  |
| Yellow Perch (yearling)        | 12.06              | 4.86   | 2.34   | 4.72   | 4.45               | 8.48   | 18.71  | 3.24   |
| Yellow Perch (age 2 and older) | 38.96              | 28.59  | 6.98   | 3.19   | 14.80              | 19.93  | 16.61  | 7.51   |

### 5.3 Lake Erie Limnology

#### *Overview*

The Lake Erie Management Unit (LEMU) uses several sources of information to monitor the base of the food web and the environmental conditions which impact it. Collectively referred to as the Limnology Program, this monitoring includes standardized sampling as part of a bi-national lakewide initiative, coordinated through the Forage Task Group (FTG) of the Lake Erie Committee (LEC), but it also involves sampling which occurs in association with a host of other programs and projects conducted independently by LEMU. In addition to monitoring the trophic status of the lake, components are used to inform such things as the timing of fisheries assessments (e.g. Partnership Index netting relative to thermal stratification; Section 4.1) or to link environmental cues to fish behaviour (e.g. Acoustic telemetry projects; Section 6.). This section details information from the lakewide program however it should be noted that significant progress was made in 2019 to compile, check and edit, the broader Lake Erie datasets in order to create an inclusive LEMU Limnology database (see Section 7.4, below).

Lakewide FTG-coordinated limnology, referred to as Lower Trophic Level Assessment (LTLA), has occurred annually since 1999 and involves sampling at each of six core Ontario stations bi-weekly, between May and October. These six core stations compliment sampling conducted at 10 stations in United States (US) waters in order to describe lake and basin wide trophic conditions and trends through time (Figure 5.3.1). Metrics such as temperature, dissolved oxygen, and light attenuation are measured at regular depth intervals from the surface to the lake bed in order to construct a profile through the water column. Other parameters such as total phosphorus (TP), chlorophyll-a (CHL-a), and zooplankton and phytoplankton samples, are collected from the entire water column by consolidated sampling; however, at stations and times where the water column is thermally stratified only the productive and warmer upper layer (epilimnion) is consolidated. Benthic invertebrates sampling was discontinued in 2019, a consensus agreement between FTG agencies and the LEC.

A sub-set of the LTLA core-station parameters is measured at 4 additional stations in Lake Erie and 8 stations in Lake St. Clair (See Section 5.4). Additionally, water temperature is logged throughout the season at hourly intervals at key locations using either an array of probes suspended throughout the water column or, in shallow water, one location near bottom (Figure 5.3.1).

### *2019 Assessment*

With few exceptions, core LTLA stations were sampled bi-weekly for the entire May-October sampling season; All stations sampled for at least 10 of the 12 planned sampling events. All LTLA data was compiled and uploaded to the FTG database in February 2012. Phytoplankton samples were archived for future analysis. Zooplankton samples from W5, W8, WC1, WC3, E2 and E3 were included in a COA-funded initiative to process archived and current zooplankton (see Section 7.5, below).

Basin wide LTLA summaries, using the bi-national core-station data, are prepared by the FTG annually and reported each March. One focus of the report is a description of the trophic state (level of productivity) of the lake relative to objectives laid out in Lake Erie's Fish Community Goals and Objectives (FCGO; Ryan et al., 2003). These objectives aim for moderate productivity (mesotrophy) in the west, central, and east basin nearshore, while targeting lower productivity (oligotrophy) for the colder, deeper, eastern basin offshore. In 2019, using an index of trophic state based on TP, water transparency and CHL-a, it was determined that the central basin was meeting its mesotrophic target, while the west basin, despite improving slowly over time, was still deemed too productive. The low productivity of the east basin was below target in the nearshore but met the offshore oligotrophic target. According to the long term LTLA dataset, trends across Lake Erie in recent years indicate that overall productivity is slowly declining (Forage Task Group, 2020).

In recent years individual indexes of productivity (nutrients and algal biomass) have been notably lower in Ontario waters, relative to bi-national basin averages. In 2019, mean TP concentrations in Ontario waters, relative to LTLA basin averages were lower in the western, central, and eastern basins by 65%, 45% and 15% respectively. Algal biomass (as measured by CHL-a) was similarly lower than the LTLA basin averages by 27%, 7%,

and 2% in the western, central, and nearshore waters of the eastern basins; respectively. Offshore in the eastern basin, CHL-a was higher by 7%, than the basin average.

The disparity is greatest in the western basin which would be considered hyper-eutrophic based on basin wide TP (40ug/L) and CHL-a (10.2 ug/L) whereas Ontario waters give a mixed signal based on TP (13.2 ug/L; mesotrophic) and CHL-a (eutrophic; 7.5 ug/L). Some of this disparity may be due to the high nutrient influence of the Maumee River, Ohio, and to the variable influence of loadings from the Detroit River to various parts of the western basin. The central basin is similarly classified as eutrophic basin wide but mesotrophic in Ontario waters based on TP concentrations (19.5 and 10.7ug/L; respectively). In the central basin, both basin wide and Ontario mean CHL-a concentrations result in a classification of mesotrophic (4.1 and 4.4 ug/L; respectively). Both approaches, for both TP and CHL-a, classify the eastern basin, nearshore and offshore, as oligotrophic.

Comparisons between nearshore and offshore values for TP and CHL-a in Ontario waters in 2019 are shown in Figure 5.3.2. In 2019, the most obvious deviation from trophic status targets occurred in the nearshore of the eastern basin where productivity was well below target for both metrics. The central basin offshore was, on average, within the mesotrophic target. In the west, both the offshore station and the nearshore station gave the same signal, namely eutrophic CHL-a and mesotrophic TP values. Both were influenced by very high values recorded on the first sampling day in May 2019, thought to be associated with high loading under spring tributary flows.

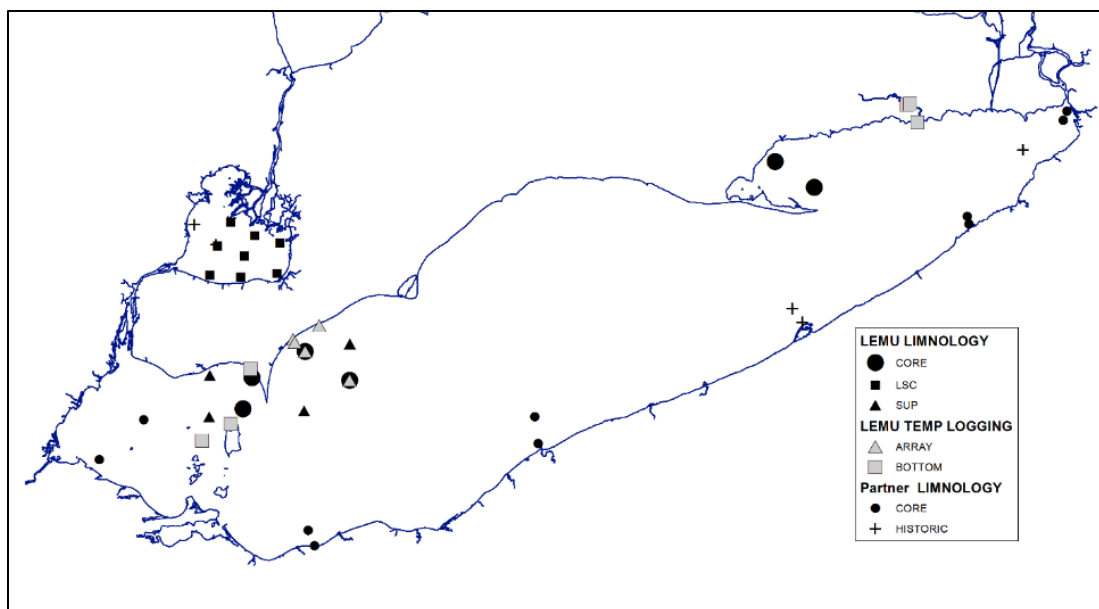


**Figure 5.3.1** Limnology Program sampling locations. Core FTG-LTLA stations are indicated with a solid circle; large circles designate LTLA stations sampled by LEMU. Historic LTLA stations are indicated with an "X". Auxiliary LEMU stations are indicated with solid triangles; Lake St. Clair stations are indicated with solid squares. Continuous temperature logging is indicated for both water column arrays (white triangle-with dot) and lake bed loggers (shaded triangle-with dot).

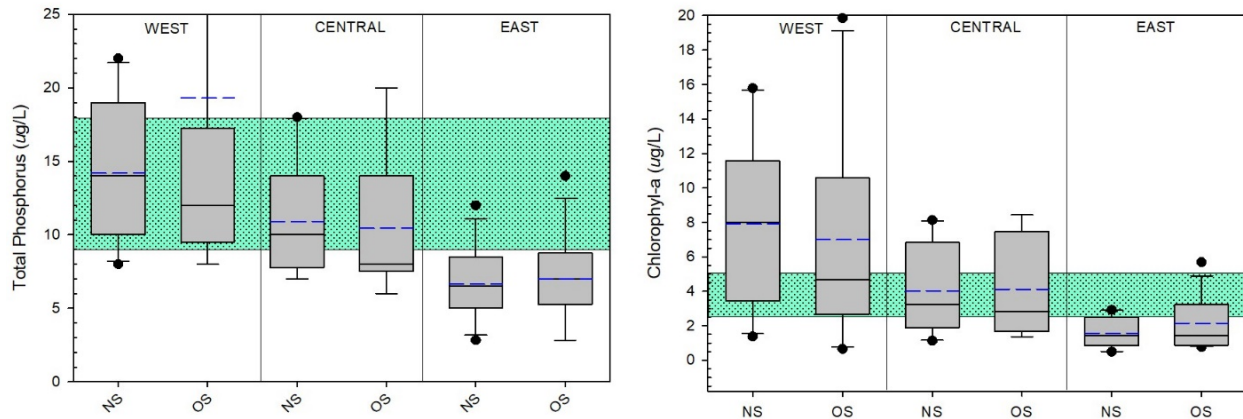


**Figure 5.3.2** Total Phosphorus (TP) and Chlorophyll-a (CHL-a) concentrations at Nearshore (NS) and Offshore (OS) Core LTLA stations in Ontario waters between May and October 2019. Box upper and lower extents indicate the 75th and 25th percentile value, respectively; the within box lines indicate the median (solid) and mean (dashed) values. Outliers are shown with dots. The range of values indicative of Mesotrophic conditions is shown with a stippled box. Note: All areas have a mesotrophic target except OS east basin where the target is oligotrophic (TP <9µg/L; CHL-a < 2.5µg/L).

## References:

Forage Task Group. 2019. Report of the Lake Erie Forage Task Group, March 2020. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission, Markham, Ontario, Canada.

Ryan, P.A., R. Knight, R. MacGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-community goals and objectives for Lake Erie. Great Lakes Fish. Comm. Spec. Publ. 03-02. 56 p.

## 5.4 Lake St. Clair Limnology

The objective Lake St. Clair Limnology program is to monitor the base of the food web and the environmental conditions in Lake St. Clair. Lower trophic monitoring provides crucial information about the base of the food web that supports fisheries; helps address emerging issues such as effects of Harmful Algal Blooms (HABs) and climate change; and, provides important contextual information when responding to specific incidents including fish kills and hypoxic events. When originally implemented in 2011, the objective of the Lake St. Clair program was to monitor water clarity, plankton/seson abundance and composition to establish pre-invasion baseline condition and monitoring for changes consistent with the presences of the planktivorous Bighead (*Hypophthalmichthys nobilis*), and Silver Carps (*Hypophthalmichthys molitrix*) in Lake St. Clair. This original objective

no longer remains because a measurable response in water clarity, plankton/seson abundance and composition across Lake St. Clair would likely require a significant number of individuals be present, rendering it ineffectiveness as a surveillance tool for the early stages of an invasion by Bighead and Silver Carp.

Since 2011, the Lake Erie Management Unit (LEMU) has sampled eight sites bi-weekly between May and October across the lake. These sites were selected based on Leach (1972) to be representative of nearshore and offshore areas of Lake St. Clair. Physical chemical and biological parameters are collected, including temperature, DO, pH, conductivity, green/blue-green algae concentration, turbidity, secchi depth, and water samples for nutrients, chlorophyll, zooplankton and seson analysis. Seson analysis is unique to the Lake St. Clair program and compares the seson from a 110  $\mu\text{m}$  filtered water sample to a “raw” a unfiltered water sample. The 110  $\mu\text{m}$  filter is intended to mimic the planktivorous Asian carp (i.e. Bighead and Silver Carps) feeding and remove the portion of the seson they may consume. To acquire enough water for nutrient, chlorophyll and seson sub-sampling, five evenly spaced water samples from the water column are collected. Starting in 2018, protocols for the Lake St. Clair program were standardized with the Lake Erie program and brought inline with contemporary program objectives. This means that the Lake St. Clair program ceased collection of seson samples and began collecting 3 instead of 5 water column samples for nutrient and chlorophyll analysis.

With the standardization of protocols between Lake St. Clair and Lake Erie programs in 2018, and the 2019 development of a single database to handle all limnological data (see Section 7.4), LEMU will implement limnological sampling in both lakes under a single program moving forward.

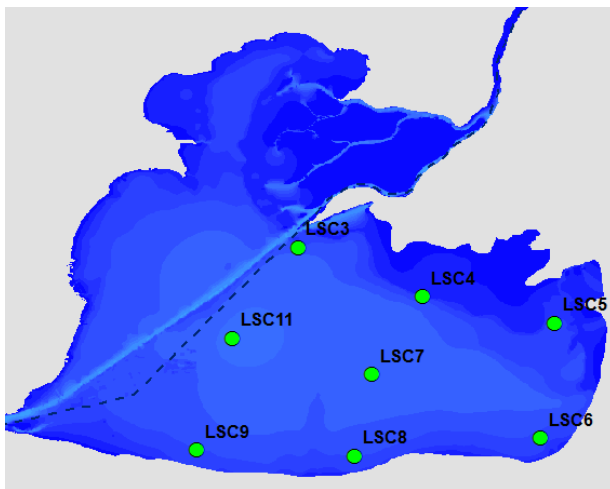


**Figure 5.4.1** Lake St. Clair bathymetry map of the bi-weekly sampled limnology stations.

#### Reference:

Leach, J.H. 1972. Distribution of Chlorophyll a and related variable in Ontario Waters of Lake St. Clair. Internat. Assoc Great Lakes Res. Proc. 15<sup>th</sup> conf. 80-86.

## 5.5 Fish Contaminants and Microcystin Sampling

Fish are valuable indicators of aquatic ecosystem health because contaminant concentrations in the tissues can represent the cumulative condition in the sediments and water with contaminants originating from benthic and pelagic exposure. Furthermore, when fish are consumed, they form a vector of contaminants from the environment to humans. Since the 1970s, the Fish Contaminant Monitoring Program of the Ontario Ministry of the Environment Conservation and Parks (MECP), in partnership with the Ontario Ministry of Natural Resources and Forestry (OMNRF), have been monitoring contaminant concentration including: Mercury, Chromium, Lead, Cadmium, Mirex, Polychlorinated biphenyls (PCBs), Dioxins/Furans, Toxaphene, PerFluoroAlkyl and PolyFluoroAlkyl Substances (PFAS), Selenium, Arsenic, PolyBrominated Diphenyl Ethers (PBDEs), PolyChlorinated Naphthalenes (PCNs) in Ontario fish. The data collected in this program is used to produce MECP's "Eating Ontario Fish" guide, which details safe consumption advisory guidelines for various species across Ontario's many lakes, rivers, and streams. The data is also used to detect spatial and temporal patterns in fish contaminant levels, understand contaminant dynamics, identify sources of contaminants, track progress of remedial actions, determine effectiveness of regulator strategies, and develop predictive models.

To support this initiative, the Lake Erie Management Unit (LEMU) annually collects samples of the consumed portion of fish flesh for MECP. The LEMU can leverage existing programs, where possible, and use capital assets (including facilities and vessels) in targeted sampling efforts, as needed. In 2019, the LEMU provided MECP with 259 samples of skinless, boneless fillet from various fish species collected across the Lake Erie basin (Table 5.5.1)

**Table 5.5.1** Numbers of fish by species sampled by LEMU in 2019 for MECP Fish Contaminant Monitoring program.

| <b>Species</b>  | <b>N</b>   |
|-----------------|------------|
| Black Crappie   | 20         |
| Channel Catfish | 15         |
| Common Carp     | 20         |
| Freshwater Drum | 20         |
| Lake Whitefish  | 40         |
| Rainbow Trout   | 4          |
| Smallmouth Bass | 20         |
| Walleye         | 40         |
| White Bass      | 56         |
| Yellow Perch    | 24         |
| <b>Total</b>    | <b>259</b> |

In 2015, MECP's Fish Contaminant Monitoring Program and the LEMU collaboratively developed and implemented an initiative to improve the understanding of microcystin toxin dynamics between algal blooms and fish flesh. These blooms, primarily composed of *Microcystis aeruginosa* cyanobacteria (blue-green algae) have been attributed to declining water quality, increased nutrient loadings and climate change. In recent years, the frequency and intensity of blooms have increased and understanding the effects within the ecosystem remain a high priority for many of the regulatory agencies around the basin. Of specific concern for MECP and OMNRF is the potential risk to the safe consumption of fish. One study (Poste et al. 2011) suggested that the microcystin hepatotoxin produced during these blooms may accumulate under certain conditions in fish flesh to levels that could pose human health risks for safe consumption. A more recent study has pointed out that microcystin toxin concentration in Lake Erie fish flesh is dynamic, a factor of species, bloom intensity and spatial location of the fish relative to the bloom and may not reach levels that pose a significant concern for human health in the general population (Wituszynski et al. 2017).

To help understand the dynamics of microcystin toxin in consumed Lake Erie fish species, the LEMU has annually collected samples of fish and water in spatial (inside and outside) and temporal relation (before, during, and after) to blooms. In support of this collaborative initiative, the LEMU has leveraged existing programs, including commercial catch sampling and limnology, in addition to collecting targeted samples as needed using the research vessel, Keenosay. This research primarily focused on Walleye, Yellow Perch, and White Bass with other species being sampled opportunistically (see Table 5.5.2 for the 2019 samples collected). Fish flesh, liver and water samples were sent to the MECP fish contaminant monitoring lab for analysis.

Preliminary results from Walleye and Yellow Perch samples detected microcystin toxin in livers but detected limited microcystin toxin in most of the flesh samples. These preliminary results suggest that fish had indeed been exposed to microcystin toxin but that the toxin had not translated into toxin concentrations in the consumed portion of flesh. These preliminary results generally support the finding of Wituszynski et al. (2017).

In 2019, the LEMU concluded the field collections of fish for this study. MECP's Fish Contaminant Monitoring Program collaborative continues to analyse the collection samples. Broad questions of interest that continue to be explored with the collection samples include: uptake and retention times, peak-bloom to peak-concentration in fish dynamics, and spatial relation of blooms to toxin concentrations in fish flesh.

**Table 5.5.2** Number of fish sampled by LEMU in 2015-2019 for Microcystin testing by MECP Fish contaminant monitoring program.

| <b>Species</b> | <b>2015</b> | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>N</b>   |
|----------------|-------------|-------------|-------------|-------------|-------------|------------|
| Walleye        | 179         |             | 67          | 77          | 10          | 333        |
| White Perch    | 3           |             | 8           |             |             | 11         |
| White Bass     | 1           |             | 10          | 19          | 10          | 40         |
| Yellow Perch   | 160         |             | 70          | 88          | 120         | 438        |
| <b>Total</b>   |             |             |             |             |             | <b>822</b> |

### References:

Poste, A.E., Hecky, R.E., Guildford, S.J. 2011. Evaluating Microcystin exposure risk through Fish Consumption. Environ.Sci. Technol, 45, 5806-5811.

Wituszynski, D.M., Hu, C., Zhang, F., Chaffin, J.D., Lee, J., Ludsin, S.A., Martin, J.F. 2017. Microcystin in Lake Erie fish: risk to human health and relationship to cyanobacteria blooms. J. Great Lakes Res. 43, 1084 – 1090.

### 5.6 Inner Long Point Bay Adult Fish Community Hoop Net Survey

In 2018, Lake Erie Management Unit began a new fishery-independent survey targeting adult fish in Inner Long Point Bay. Catches in the Inner Bay hoop and seine net commercial fisheries are reported in Table 3.1.1 of this report. In 2018 nets were set in both spring and summer to determine the best timing for the survey. Results of the 2018 field season indicated that catches in the spring had a greater diversity of species present and favored larger fish. It was subsequently determined that the survey would take place in the spring and would utilize a minimum of 30 net sets as recommended by the Nearshore Community Index Netting Protocol.

2019 represented the first official year of this program. Thirty-one, four foot hoop nets were set for approximately 24 hours in randomly selected sites (Figure 5.6.1) between March 26th and April 4th. In total 1,832 fish, representing 14 species, were caught during the program. Sunfish species were the most abundant with Bluegill (n= 523) and Pumpkinseed (n= 380) representing 49% of the total catch. In addition, 5 Warmouth, a sunfish species, were caught in the assessment and represent the only provincially designated Species at Risk captured. Other abundant fish species included Brown Bullhead (16%), Bowfin (9%), Rock Bass (7%), Northern Pike (7%), and Yellow Perch (7%) (Table 5.6.1).

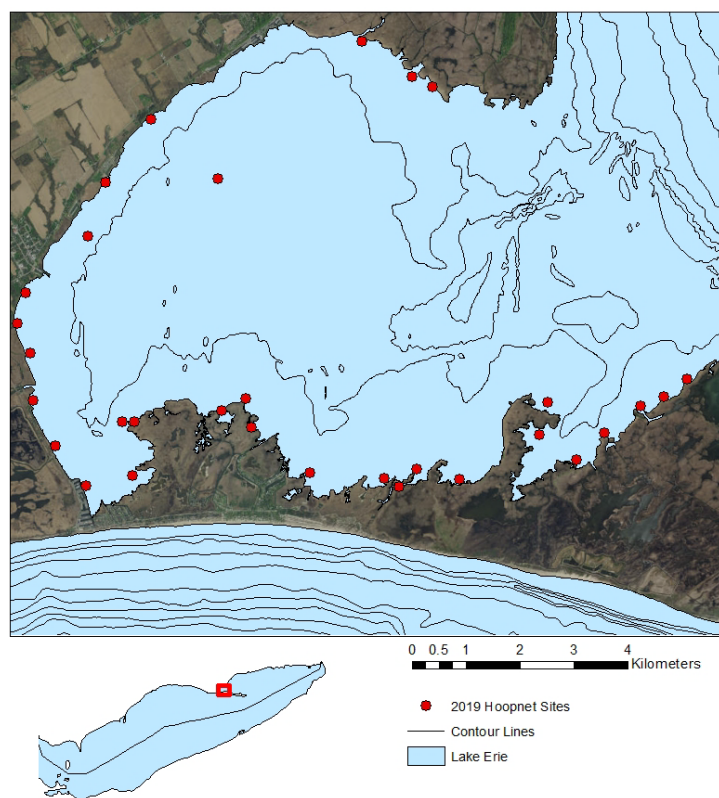


**Figure 5.6.1** Sites sampled for the Inner Long Point Bay Adult Fish Community Hoop Net Survey, 2019.

**Table 5.6.1** Total number of individuals for each fish taxa caught in the Inner Long Point Bay Adult Fish Community Hoop Net Survey, 2019.

| Common Name     | Scientific Name                | Count |
|-----------------|--------------------------------|-------|
| Bowfin          | <i>Amia calva</i>              | 166   |
| Northern Pike   | <i>Esox lucius</i>             | 131   |
| White Sucker    | <i>Catostomus commersonii</i>  | 6     |
| Goldfish        | <i>Carassius auratus</i>       | 2     |
| Common Carp     | <i>Cyprinus carpio</i>         | 7     |
| Golden Shiner   | <i>Notemigonus crysoleucas</i> | 1     |
| Brown Bullhead  | <i>Ameiurus nebulosus</i>      | 296   |
| Rock Bass       | <i>Ambloplites rupestris</i>   | 141   |
| Pumpkinseed     | <i>Lepomis gibbosus</i>        | 380   |
| Bluegill        | <i>Lepomis macrochirus</i>     | 523   |
| Largemouth Bass | <i>Micropterus salmoides</i>   | 22    |
| Black Crappie   | <i>Pomoxis nigromaculatus</i>  | 17    |
| Warmouth*       | <i>Lepomis gulosus</i>         | 5     |
| Yellow Perch    | <i>Perca flavescens</i>        | 135   |

\* indicates species classified as Special Concern by COSSARO, O. Reg. 139/14, s. 1.

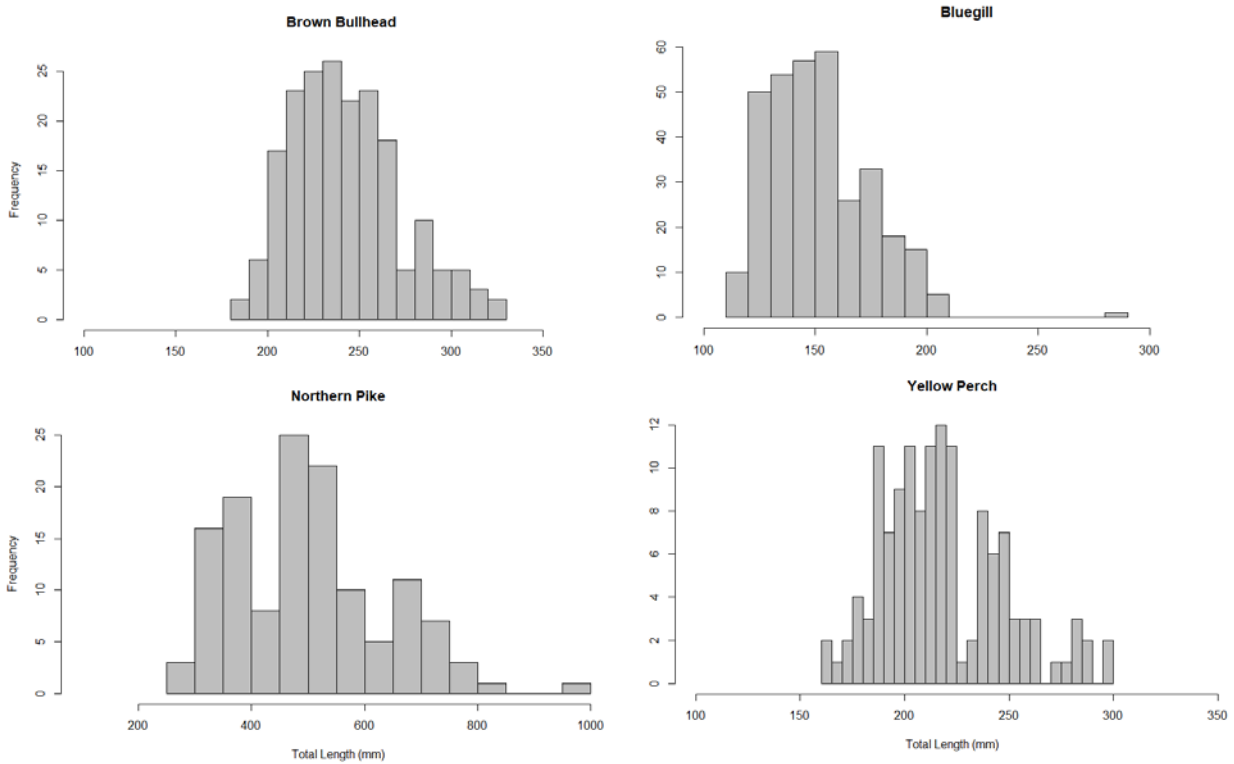


**Figure 5.6.2** Length Frequency for select commercial fishery-targeted species caught during the 2019 Inner Long Point Bay Adult Fish Community Hoop Net Survey.

## 5.7 Lake Trout Stocking

### *Annual Stocking*

Efforts to Rehabilitate Lake Trout through stocking have occurred in Lake Erie since at least the early 1980s. The most recent bi-national Lake Trout management strategy (Markham et al. 2008; A Strategic Plan for the Rehabilitation of Lake Trout in Lake Erie, 2008-2020) recommended expanding, in an informed way, the distribution and diversity of stocking locations. Up to that point, all stocking had occurred in United States (US) waters of the eastern basin of the lake, primarily in New York with some occurring in Pennsylvania. Concurrent with the development of the strategy, efforts to map and classify the lake-bottom revealed several potentially suitable locations on the north shore of the eastern basin in Ontario waters.

Ontario Ministry of Natural Resources and Forestry–Lake Erie Management Unit (OMNRF-LEMU) officially began stocking Lake Trout into Lake Erie in 2008. The strain chosen was *Slate Islands Origin*, a native Lake Superior strain known for spawning on flat, shallow shoals. The OMNRF Fish Culture Station at Chatsworth supplies Slate Island strain Lake Trout (ST-LT) for Ontario's Lake Erie annual commitment of 50,000 yearling

fish. Due to the inherent vagaries of rearing fish, total numbers produced and stocked have ranged between 50,000 (planned production) and 59,055 (Table 5.7.1). Slate Island Lake Trout were not available for the first year of stocking and so Lake Manitou strain was used. In 2019, OMNRF stocked 53,285 yearling ST-LT. Co-incident with the Ontario stocking, 198,000 LT (Lake Champlain- and Finger Lakes-strain) were stocked into the US waters of Lake Erie by the US Fish and Wildlife Service in order to meet US partner agency commitments under the management strategy.

All Lake Trout stocked into Lake Erie are marked, ideally using a small “coded-wire” tag (CWT) injected into the snout cartilage which, upon extraction and reading, can be used to identify the strain, stocking location and age of individuals caught in fisheries or assessment programs. Tagged fish are marked externally by clipping (removing) the adipose fin. In infrequent instances when coded-wire tags were not used, fish were marked with alternate fin-clips such that all stocked fish in Erie are theoretically similarly identifiable. The fish culture facility provides estimates of the proportion of tagged fish where tags and clips are missed or lost. No supplemental, non-tagged fish were stocked in 2019.

Planned stocking takes place in April or May each year. At Port Dover, Lake Trout delivered by truck, are loaded onto the OMNRF vessel Erie Explorer where they are held in insulated, oxygenated tanks for transport to the offshore stocking location at Nanticoke Shoal. Travel to the shoal which lies approximately 2 km offshore and 10 km from port takes approximately 45 minutes after which the fish are released via hose into waters approximately 15 m deep. On occasion, when weather has prevented stocking by boat, fish have been shore-stocked, by truck, at Port Maitland. In 2019, stocking took place on May 13<sup>th</sup>, 14<sup>th</sup>, and 15<sup>th</sup> (~ 17.5K LT/day) when lake water temperature at bottom (10 m depth) was ~ 7°C.

### *Assessment*

Lake Trout stocked by OMNRF contribute to the coldwater fish community of the eastern basin as evidenced by their presence in standardized gillnet surveys. Despite being stocked in smaller numbers relative to strains stocked in US waters, in 2019, ST-LT constituted 32% and 28% of the Lake Trout catch in the Partnership Index (Section 4.1) and the Ontario portion of the Coldwater Assessment (Section 4.4), respectively. In contrast LEMU-stocked ST-LT were only present in 3% of Coldwater Assessment catches from New York and Pennsylvania waters. Despite having been stocked for more than 10 years, older ages of ST-LT are rare. In 2019, 54% of the 83 ST-LT caught in the basin wide Coldwater Assessment were Age 4 (stocked in 2016) however only 5% were older than 4 years (one fish each from stocking years 2015, 2014, 2012, and 2010).

### *Natural Reproduction*

In 2019, Lake Trout potentially from wild origin (no fin clips or CWTs) were caught in both the Coldwater Assessment and the Partnership Index programs. However, because of their low frequency (1.6% overall) natural reproduction was not inferred because hatchery clip error and tag loss estimates range between 2.5 and 3% annually.

**Table 5.7.1** Lake Trout stocking by LEMU 2006–2019. All numbers represent spring stocking of yearling fish except for recent supplemental stocking (\*) of fall fingerlings in November. CLIP = fin clip; CWT = coded wire tag.

|                      | Year        | Strain              | Number         | Mark       | Hatchery          | Method      | Location               |
|----------------------|-------------|---------------------|----------------|------------|-------------------|-------------|------------------------|
| <b>Planned</b>       | 2008        | Lake Manitou        | 50,000         | CLIP       | White Lake        | Boat        | Nanticoke Shoal        |
|                      | 2009        | Slate Island        | 56,923         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2010        | Slate Island        | 51,077         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2011        | Slate Island        | 55,867         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2012        | Slate Island        | 55,332         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2013        | Slate Island        | 54,190         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2014        | Slate Island        | 55,629         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2015        | Slate Island        | 55,308         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2016        | Slate Island        | 59,055         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2017        | Slate Island        | 50,284         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | 2018        | Slate Island        | 51,284         | CWT        | Chatsworth        | Boat        | Nanticoke Shoal        |
|                      | <b>2019</b> | <b>Slate Island</b> | <b>53,285</b>  | <b>CWT</b> | <b>Chatsworth</b> | <b>Boat</b> | <b>Nanticoke Shoal</b> |
| <b>Supplemental</b>  | 2006        | Slate Island        | 88,000         | CLIP       | Chatsworth        | Shore       | Port Maitland          |
|                      | 2010        | Michipicoten        | 38,817         | CLIP       | Chatsworth        | Shore       | Port Maitland          |
|                      | 2010        | Seneca              | 14,000         | CLIP       | White Lake        | Shore       | Port Maitland          |
|                      | 2010        | Seneca              | 8,962          | CLIP       | Harwood           | Boat        | Nanticoke Shoal        |
|                      | 2010        | Slate Island        | 14,000         | CLIP       | White Lake        | Shore       | Port Maitland          |
|                      | 2016*       | Seneca              | 26,916         | CLIP       | Normandale        | Boat        | Nanticoke Shoal        |
|                      | 2017*       | Seneca              | 17,043         | CLIP       | Normandale        | Boat        | Nanticoke Shoal        |
|                      | 2018*       | Seneca              | 16,289         | CLIP       | Normandale        | Boat        | Nanticoke Shoal        |
| <b>TOTAL STOCKED</b> |             |                     | <b>872,261</b> |            |                   |             |                        |

## 5.8 Connecting Waterways Fish Community Assessment

The St. Clair, Detroit and Niagara river systems connect Lake Huron, Lake St. Clair, Lake Erie and Lake Ontario in a network of waterways which span nearly 600 km of the Great Lakes – St. Lawrence Seaway System. These connecting waterways serve as crucial transportation networks and drinking water sources, while also supporting important recreational and subsistence fisheries. Extensive development within the connecting waterways has led to significant environmental changes that resulted in their designation as Areas of Concern within the Great Lakes Water Quality Agreement (2012) between the U.S. and Canada. Despite this, these rivers have been identified as biodiversity

hotspots and represent important spawning, nursery, refuge, and foraging habitat for a variety of native fish species. The objective of the connecting waterways fish community assessment is to monitor the small and large bodied fish community present in the Detroit, Niagara, and St. Clair Rivers. The fish community in each river was sampled using a combination of boat electrofishing, large mesh gill nets, and small benthic trawls.

In 2019, a total of 58, 40, and 57 sites were fished in the Detroit, Niagara, and St. Clair Rivers, respectively. Boat electrofishing, large mesh gill nets, and benthic trawls were fished at 18-21 sites in each river; however, rocky substrate in the Niagara River prevented the use of benthic trawling. Sample sites were selected in each river using an unstratified generalized random tessellation procedure, which is a spatially balanced, probabilistic sampling procedure (Stevens and Olsen 2004). Shallow waters ( $\leq 2$  m) were sampled using boat electrofishing, whereas deeper waters ( $> 2$  m) were sampled using gill nets and benthic trawls. Boat electrofishing was conducted along 100 m shoreline transects in a downstream direction. North American standard large mesh gill nets were set parallel to shore for 24 hours (two gangs per net; mesh sizes: 38, 51, 64, 76, 89, 102, 114, and 127 mm). Benthic trawls were towed for 300 m at  $\sim 5$  km/h in a downstream direction (head rope: 6 m, foot rope: 6.7 m, cod end mesh: 12 mm).

The catch from each gear type was identified to the lowest taxonomic group possible (species or genus), counted, and up to 30 randomly selected individuals were sampled for total length. Additionally, scale samples were taken from Yellow Perch, Walleye, Smallmouth Bass, Largemouth Bass, White Bass, Muskellunge, and Northern Pike for age interpretation. Fish processing was conducted in the field and live fish were released post-processing.

A total of 5993 individual fish representing 54 different species were captured during the program (Figures 5.8.1 and 5.8.2). Of the species captured, Channel Darter, Grass Pickerel, and Spotted Sucker are listed as Special Concern by the Ontario Endangered Species Act (2007). In the Detroit River, Yellow Perch, Brook Silverside, and Emerald Shiner had the highest relative abundance out of the 39 species and 1 genus captured (*Ictiobus* sp.; Figure 5.8.1). Yellow Perch relative abundance was high across all fishing gears and depths, whereas Brook Silverside and Emerald Shiner were only captured in shallow waters by boat electrofishing. In the St. Clair River, Walleye and Yellow Perch had the highest relative abundance out of the 35 species captured (Figure 5.8.2). Walleye were primarily captured in deeper waters by large mesh gill nets, while Yellow Perch were mostly captured in shallow water by boat electrofishing. In the Niagara River, Smallmouth Bass had the highest relative abundance out of the 38 species and 3 genera captured (*Lepomis* sp., *Luxilus* sp., and *Moxostoma* sp.; Figure 5.8.2). Smallmouth Bass were captured primarily by large mesh gill nets in deep waters. The relative abundance of all other species was low and rather uniformly distributed, unlike the other connecting waterways.

## References:

- Stevens, D.L., and A.R. Olsen. 2004. Spatially balanced sampling of natural resources. *Journal of the American Statistical Association* 99:262-278.
- Gibson-Reinemer, D.K., B.S. Ickes, and J.H. Chick. 2017. Development and assessment of a new method for combining catch per unit effort data from different fish sampling gears: multi gear mean standardization (MGMS). *Canadian Journal of Fisheries and Aquatic Sciences* 74: 8-14.

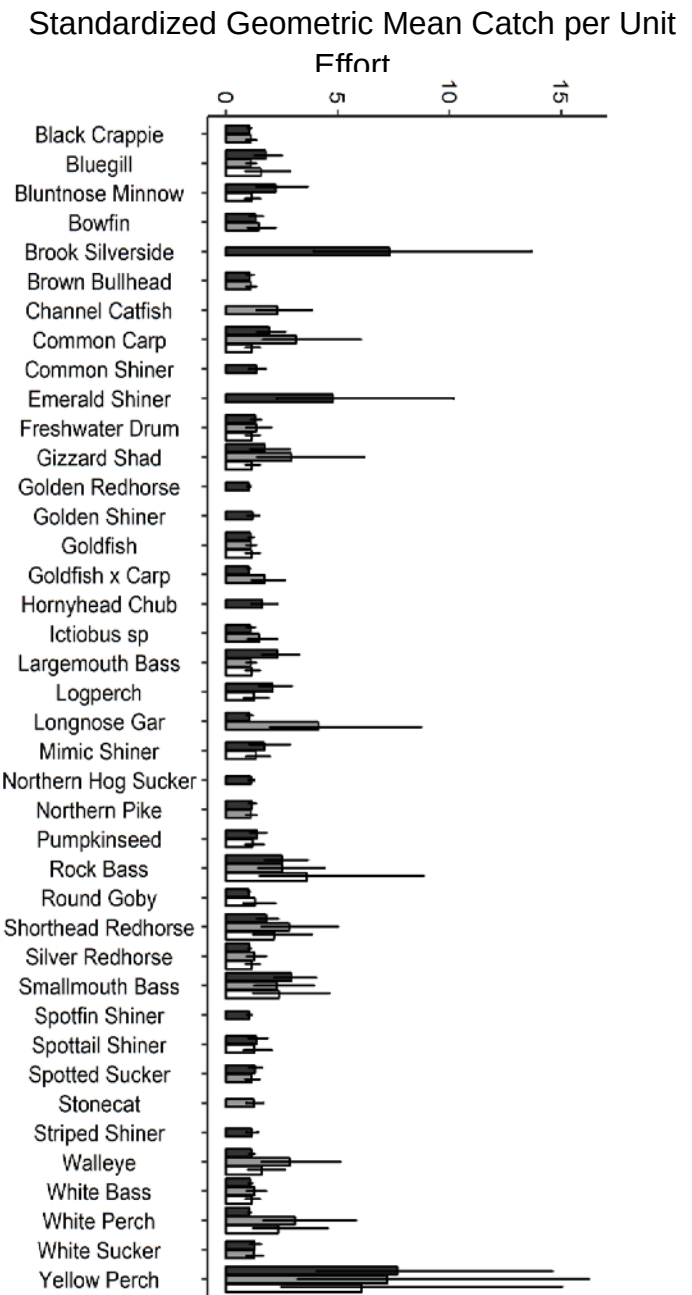
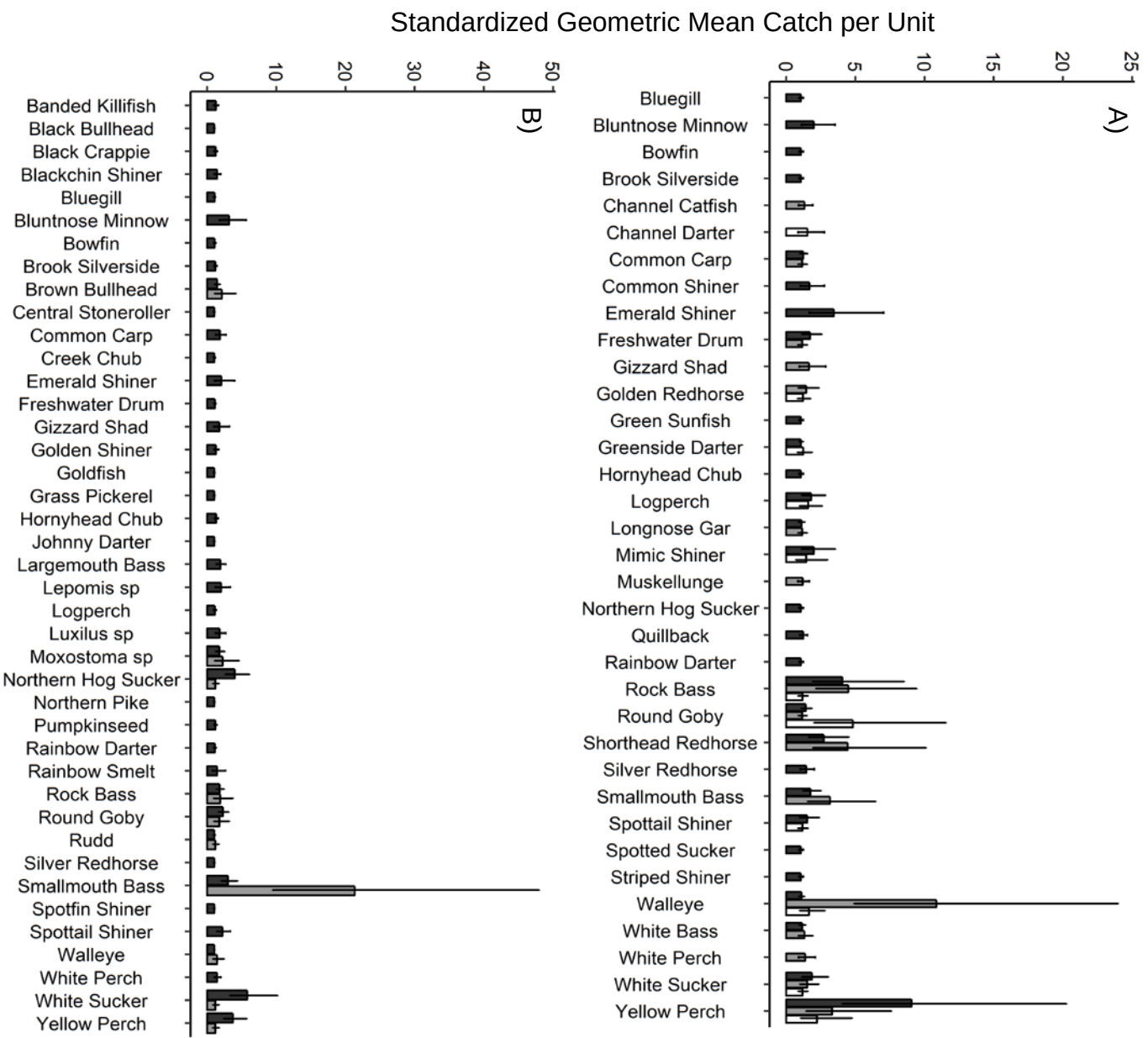


**Figure 5.8.1** Standardized geometric mean catch per unit effort (CPUE) for each species captured by boat electrofishing (dark grey), gill netting (light grey), and benthic trawling (white) in the Detroit River. A value of 1 was added to catch data prior to log transformation. Error bars represent 95 % confidence intervals. CPUE was standardized using Multi Gear Mean Standardization (Gibson-Reinemer et al. 2017).

**Figure 5.8.2**

Standardized geometric mean catch per unit effort (CPUE) for each species captured by boat electrofishing (dark grey), gill netting (light grey), and benthic trawling (white) in the (A) St. Clair and (B) Niagara Rivers. Benthic trawling was not conducted in the Niagara River. A value of 1 was added to catch data prior to log transformation. Error bars represent 95 % confidence intervals. CPUE was standardized using Multi Gear Mean Standardization (Gibson-Reinemer et al. 2017).

## 6. ACOUSTIC TELEMETRY / TAGGING PROJECTS

The spatial ecology and movement of fish has remained a mystery for many researchers and fisheries managers. Whether known or assumed, where, when and how fish move through their environment forms the basis of their ecological niche and the foundation for defining biologically relevant management units and defining stocks in fisheries management. Contemporary telemetry technology has begun to open opportunities for tracking the movements of fish previously not possible.

Acoustic telemetry shows great promise as a tool for tracking movements of fish through the aquatic environment. Acoustic telemetry systems work by implanting an acoustic transmitter (or tag) into a fish and deploying acoustic receivers throughout a body of water. The transmitter emits a distinct acoustic “ping” which the receiver picks up when the transmitter is in proximity (Figure 6.0.1). The distinct acoustic pings are then translated into unique identifications of individual fish. By strategically placing a series of receivers throughout a water body a researcher can determine positions (Figure 6.0.2) and examine movements of individual fish to test scientific hypotheses and answer questions relevant to fisheries research and management.



**Figure 6.1.** How acoustic telemetry works.

In 2010, the Great Lakes node of the Ocean Tracking Network known as the Great Lakes Acoustic Telemetry Observatory System (GLATOS) was established. This collaborative effort of Canadian and United States (US), state/provincial federal and academic partners oversees projects tagging fish, the deployment and maintenance of acoustic receivers and most importantly handling a database that stores the millions of detections created annually. To date the network of GLATOS receivers in Lake Erie has been the most extensive across the Great Lakes basin. From 2013 to 2015, lines of receivers were deployed across the lake from the Canadian to US coast to identify movements of fish between west, central and east basin (Figure 6.0.2). In 2016, receiver deployment shifted to a grid pattern to increase coverage and detection efficiency (Figure 6.0.2). In 2017, the extensive central basin grid of receivers expanded to include parts of east and west basin.

LEMU is actively involved in several acoustic telemetry projects including Lake Erie Lake Whitefish Acoustic Telemetry Tagging (Section 6.1), Grand River Walleye/East Basin Mixed Fishery (Section 6.2), and Muskellunge Tagging Lake St. Clair Offshore (Section 6.3). Other telemetry projects that LEMU actively supports or are involved with include Lake Trout Habitat Use (Section 6.4), Lake St. Clair Tributary Walleye Tagging (Section 6.6) and Lake St. Clair–Detroit River Muskellunge Spawning Survey (Section 6.7).

In addition to acoustic telemetry studies, conventional tagging projects on Lake Erie and connecting waters have used external Monel, metal jaw and Floy tags, and internal Passive Integrated Transponder (PIT) tags to describe fish stock movements, survival and exploitation and estimate the size of populations. The LEMU projects that used traditional tagging techniques include Lake St. Clair Tributary Walleye Tagging (Section 6.6) and Lake St. Clair–Detroit River Muskellunge Spawning Survey (Section 6.7), describe in further detail below.

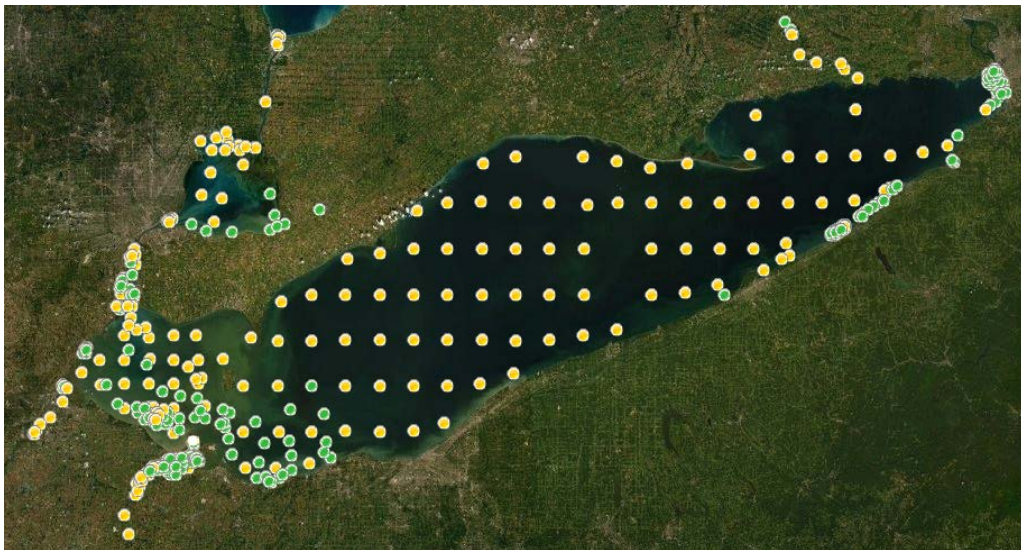


**Figure 6.2** Network of GLATOS acoustic receivers in 2019. (Maps retrieved from <http://glatos.glos.us/map>, March 20, 2020). Green circles are retrieved receivers (may or may not have been redeployed), yellow circles are currently operating receivers.

## 6.1 Lake Erie Lake Whitefish Acoustic Telemetry Tagging

In Lake Erie, Lake Whitefish are sought mainly by commercial fisheries. Lake Whitefish abundance declined recently in Lake Erie due to poor recruitment. Lake Whitefish are managed by quota in Ontario waters of Lake Erie; however, a formal harvest policy has not been implemented. An acoustic telemetry - tagging study was initiated to enhance assessment and management of Lake Whitefish. Using Great Lakes Telemetry Observation System (GLATOS) acoustic receivers throughout Lake Erie and connecting waters, Ontario Ministry of Natural Resources and Forestry (OMNRF), Ohio Department of Natural Resources (ODNR), United States Geological Survey (USGS), United States Fish and Wildlife Services (USFWS) and Great Lakes Fishery Commission (GLFC) began an acoustic telemetry study to monitor movements associated with spawning, post spawning, seasonal habitat utilization, and emigration from Lake Erie. Harvest of tagged fish may provide spatial and temporal patterns of exploitation to inform assessment models and management options. The acoustic tagging project began in Ohio waters of western Lake Erie in 2015 expanding into Ontario waters near Little Chick and Hen Islands in 2016, 2017 and the Detroit River mouth in 2018-2019. Internal acoustic transmitters and external Floy tags were applied to Lake Whitefish. Rewards (\$100 US) were provided to fishers for the return of the tagged Lake Whitefish, acoustic and Floy tags. Since 2015, 239 Lake Whitefish were tagged in Lake Erie with 18 tagged Lake Whitefish recaptured by commercial fishers up to 2019 (Table 6.1.1). The coverage of GLATOS receivers has grown during the Lake Whitefish tagging study (Figure 6.1.1). Detections of individual tagged Lake Whitefish during 2015 to 2019 are presented in Figure 6.1.1. Increased detections since 2016 reflect the greater number of receivers deployed and

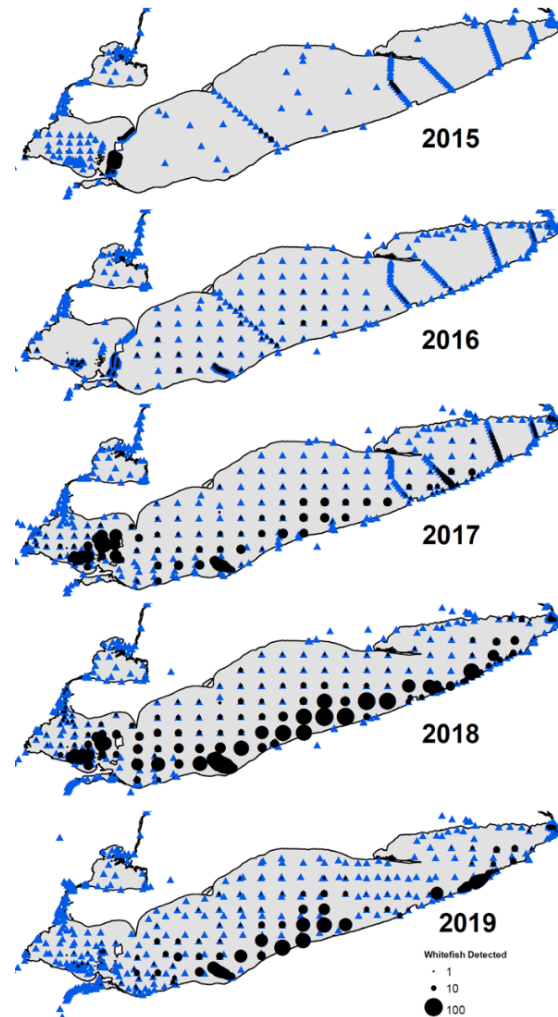


**Figure 6.1.1** Detections of Lake Whitefish with implanted transmitters (black dots) at acoustic receiver stations (blue triangles) in the GLATOS network 2015-2019. Symbol (dot) size varies with the number of individual Lake Whitefish detected. Detections during 2019 do not include the second half of the year.

more Lake Whitefish tagged. Tagged Lake Whitefish were detected in all basins of Lake Erie seasonally, favouring southern portions of central Lake Erie (Figure 6.1.1). Spawning migrations to western Lake Erie were observed for Lake Whitefish tagged during 2015-2017. To date, a single male Lake Whitefish ascended the Detroit River during November 2018. This Lake Whitefish was tagged near Hen Island during 2017.

**Table 6.1.1** Number of Lake Whitefish tagged and recaptured by year from 2015-2019.

| Tag Year     | Tag Location                | # Tagged   | Year of Recapture |          |          |          | Total     |
|--------------|-----------------------------|------------|-------------------|----------|----------|----------|-----------|
|              |                             |            | 2016              | 2017     | 2018     | 2019     |           |
| 2015         | Maumee Bay                  | 10         | 0                 | 1        | 0        | 0        | 1         |
| 2016         | Hen Island - Little Chicken | 37         | 3                 | 0        | 0        | 1        | 4         |
| 2017         | Crib Reef                   | 25         | 0                 | 1        | 0        | 1        | 2         |
| 2017         | Hen Island - Little Chicken | 55         | 0                 | 5        | 1        | 1        | 7         |
| 2017         | Niagara Reef                | 25         | 0                 | 0        | 0        | 0        | 0         |
| 2018         | Detroit River mouth         | 2          | 0                 | 0        | 0        | 0        | 0         |
| 2019         | Crib Reef                   | 50         | 0                 | 0        | 0        | 0        | 0         |
| 2019         | Detroit River mouth         | 35         | 0                 | 0        | 0        | 4        | 4         |
| <b>Total</b> |                             | <b>239</b> | <b>3</b>          | <b>7</b> | <b>1</b> | <b>7</b> | <b>18</b> |

## 6.2 Grand River Walleye / East Basin Mixed Fishery

### *Overview*

Walleye originating in the Grand River, Ontario are known to be genetically distinct within Lake Erie and are thought to contribute to fisheries in the eastern basin of the lake. The following project involves the ongoing use of acoustic telemetry together with genetic stock analysis to investigate the behavioural ecology of Grand River Walleye as it pertains to: i) requirements for, and impediments to, spawning; and ii) contributions to eastern basin commercial fisheries.

The extreme lower reaches of the Grand River have little habitat suitable for spawning by Walleye. A low-head dam at Dunnville, 8 km upstream from the river mouth, imposes a complete barrier on most migratory fish moving upstream from Lake Erie. It is estimated that of all the Walleye spawning habitat in the lower 42 km of river, 98% (246 ha), occurs upstream of this first barrier. A fishway constructed in 1995 had limited success at improving upstream access, has fallen into disrepair, and is currently assumed impassable for Walleye. A spring aggregation of Walleye occurs downstream of the dam annually. Starting in 2001, Lake Erie Management Unit (LEMU) assessment efforts focussed on surveying the population demographics and physically moving individuals past the barrier.

In 2015 LEMU departed from the goal of maximizing access (lifting all captured Walleye over the barrier) in favour of asking specific migratory behaviour and access research questions using a smaller number of Walleye implanted with acoustic telemetry tags. Between 2015 and 2018, a tagging target of 70 Walleye (35 males; 35 females) was met, the exception being 2017 when only 57 Walleye were tagged. In 2019, an additional 12 Walleye were tagged, bringing the project total to 279 tags deployed. Stationary acoustic receivers, able to detect individual fish were deployed within the river (n=12) and in the lake (n=14) and once retrieved and downloaded, detection data was combined with that from several other Lake Erie telemetry projects via the Great Lakes Acoustic Observation System (GLATOS) collaborative database. Within the river, receiver stations were located to monitor Walleye movement relative to key habitat areas based on historical Walleye spawning habitat maps (Figure 6.2.1), recently corroborated by habitat suitability surveys conducted in 2019 (Section 7.1; below). Greater than 1,300 receivers (numbers vary seasonally) able to detect Grand River Walleye are deployed throughout the lake by GLATOS collaborators. Based on tag battery life, data is expected to continue to be received through 2024. Funding for this work came primarily from the Great Lakes Protection Fund (Section 7) with additional support (equipment) and logistical help (oversight of recapture rewards) from the Great Lakes Fishery Commission.

Through the end of November 2019, Grand River tagged Walleye had been detected over 4.7 million times on 292 receivers distributed throughout the river and Lake Erie system. To date, 38 tags have been recaptured and returned from both the sport (n=35) and commercial (n=3) fisheries. On average, 10% of the tagged fish at large are harvested each year. Much (74%) of the sport harvest within the first year occurs within the river on fish released above the dam, 66% of which are caught immediately above the main weir, presumably as they attempt to pass downstream. Based on continued detections, at least 140 of the 279 Walleye tagged since 2015 were still at large in November 2019 (after accounting for fishing and surgery mortality). Tagged Walleye in this project have gone up to 400 days before first detection and so it is likely that some, tagged in 2018 and 2019, may still be detected. Updates of detection data from receivers in the lake for 2019 will not become available until early summer 2020.

### *Grand River Spawning*

Of the 282 Walleye tagged and placed above the dam at Dunnville between 2015 and 2019, 80% moved upstream to at least the town of Cayuga (the downstream extent of what is considered suitable Walleye spawning habitat) and at least 23% were detected at the town of Caledonia (the upstream extent of suitable habitat) where receiver coverage was incomplete and where a dam acts as the second upstream barrier from Lake Erie. All upstream movements occurred quickly after release, within early to mid April, and subsequent last detections in these areas occurred no later than the last week in May. A receiver monitoring McKenzie Creek, a subwatershed previously suspected of providing spawning habitat, detected 14% of the fish for only brief periods each spring. Only two of the 282 fish given access have remained upstream of the Dunnville dam, the remainder drop below, usually within the first 6 months at large. No Walleye detected downstream of Dunnville has subsequently been detected upstream except for those captured and manually moved above. Preliminary analysis of the behaviour of fish released above, relative to those released below, suggests that the dam at Dunnville imposes a

downstream, as well as an upstream, impediment to migratory Walleye. The dataset is currently being used as part of an MSc thesis at the University of Waterloo (H. Quinn-Austin; M. Servos) and thus answers to outstanding questions regarding the behavioral ecology of this stock, within the river, and relative to the dam, are anticipated for 2020.

### *Grand River Walleye in Lake Erie*

It is becoming apparent that a considerable proportion of the tagged Grand River walleye do not range as widely as other eastern stocks, let alone those from further west. Thirty percent have not been detected in the lake beyond Mohawk Bay off the river mouth at Port Maitland. Many make use of nearshore waters between the Niagara River and Long Point Bay (Figure 6.2.1) but do not utilize deeper waters of the eastern basin to the extent that eastern basin south shore stocks (e.g. Van Buren Bay, New York) or western basin stocks do (Matley et al. 2020). While ranging in the nearshore, Grand River Walleye regularly return to the river throughout the season. The ultimate home-range characterization, including the timing of movement, has implications for the susceptibility of this stock to the fisheries of the eastern basin (see Mixed Fishery; below). The timing of the pre-spawning aggregation and use of the river above and below the dam will be used to help inform ongoing decisions about improving access and dam remediation in the lower river.

### *East Basin Mixed-Stock Walleye Fishery*

The Walleye resource of the eastern basin of Lake Erie is composed of both local and western basin-origin stocks. Understanding how local and migratory Walleye stocks contribute to this mixed-stock fishery, and how this varies spatially, seasonally, and annually is important for sustainable management. Initial plans to use acoustic telemetry to estimate individual stock contributions to eastern basin fisheries were abandoned when preliminary attempts to tag Walleye from the mixed eastern population during summer months in 2017 resulted in high mortality. The question is now being addressed using genetic analysis.

A genetic mixed stock fishery project, titled “Stock structure and contribution of west and east basin walleye to recreational and commercial fisheries in Lake Erie”, is being funded by Ohio Sea Grant and involves a collaboration between Ontario Ministry of Natural Resources and Forestry (OMNRF) and New York State Department of Environmental Conservation (NYSDEC), Ohio State University (OSU), United States Geological Survey (USGS), and Ohio Department of Natural Resources (ODNR). Nominally the project had two objectives: 1) To develop a reliable molecular toolkit to discriminate between western and eastern basin walleye spawning stocks; and 2) To use this toolkit to quantify the contributions from both basins to recreational and commercial fisheries in eastern Lake Erie. However, the use of state-of-the-art genetic techniques (Restriction-site Associated DNA Sequencing; RAD-seq) provides high confidence that at least some individual stock contributions (particularly the Grand River) will be similarly assigned. Fin clips were collected in 2016-2018 from both the Ontario commercial fishery and the New York sport fishery operating in the eastern basin.

In 2019, 59 samples from the Grand River spring aggregation (collected 2016-2018) were combined with 325 samples from nine other spawning locations, genotyped and then used to describe a Lake Erie Walleye baseline population structure. Despite low levels of differentiation between east and west basins, individual samples reassigned to the correct basin (or to the more specific “Ontario Grand River” category), with greater than 90% accuracy (Ludsin et al., 2020). With confidence that individual fish could be accurately assigned to basin, 477 samples from the 2017 Ontario commercial fishery and 499 samples from the New York sport fishery were successfully genotyped. Ontario sample selection was weighted to reflect total harvest by area (Figure 6.2.1), but also recognized harvest by month. Preliminary results suggest that in 2017, eastern basin stocks made up a substantial portion of the harvest for both commercial and sport fisheries ( $\geq 25\%$ ) particularly early in the season ( $>50\%$ ). The proportion of western contributions increased through the summer into September, a pattern coincident with expectations based on recent telemetry studies tracking western basin Walleye migrations to the east (Raby et al, 2018).

Surprisingly, none of the samples from the 2017 commercial harvest assigned as “Grand River”, in contrast to an earlier study where up to 20% of 2000 commercial fishery samples assigned as Grand River stock using mitochondrial DNA (Wilson, 2003). Several factors may play into the absence of detectable Grand River fish contributions to the 2017 fishery, including low relative abundance. A within year mark-recapture estimate of the Grand River spawning population in 2005 was ~15,000, however spring catch rates in recent years have been too low to repeat the estimate. Since 2015 it has been difficult to capture the small number necessary for acoustic tagging (above). There also seems to be a disparity between where samples for the genetic study were collected and the current range of Grand River Walleye within the lake (Figure 6.2.1). Analysis will continue into 2020.

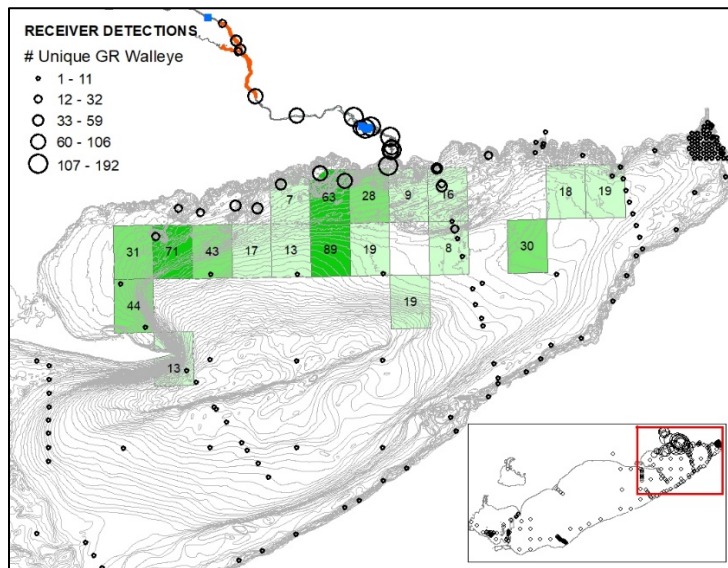


**Figure 6.2.1** Detections of Grand River-tagged Walleye relative to the Southern Grand River, the eastern basin of Lake Erie, and Lake Erie proper (inset) between April 2015 - November 2019. Green boxes indicate areas where the 2017 commercial fishery was sampled for genetic stock analysis (# samples indicated); Blue squares indicate dams on the river; Orange river perimeter indicates areas of substrate suitable for Walleye spawning.

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### 6.3 Muskellunge Tagging Lake St. Clair Offshore

The St. Clair - Detroit River System (SCDRS) supports a valuable, world-class Muskellunge fishery. However, our understanding of the ecology, survival, and effects of the intensive sport fishery on this species remains limited. For example, contributions of SCDRS Muskellunge to Lake Erie are unknown and the potential metapopulation structure within the region (Lake Huron - Lake Erie) have yet to be tested. Also, since the Muskellunge fishery in the SCDRS is predominately catch-and-release, post-release mortality and the population-level effects require a better understanding to predict impacts on the fishery.

Using the Great Lakes Acoustic Telemetry Observation System (GLATOS), a collaboration of Michigan Department of Natural Resources (MDNR), Ohio Department of Natural Resources (ODNR), United States Geological Survey (USGS) and Ontario Ministry of Natural Resources and Forestry (OMNRF) started to tag Muskellunge in the SCDRS in 2016. The objective of this project is to track movements of Muskellunge within the SCDRS and Western Lake Erie and potentially into Lake Huron. Tracking individual fish enables the identification of migratory behaviours, habitat use, mortality and population structuring to provide ecological insights crucially important for the management of this valuable recreational fishery.

In 2019, OMNRF tagged 14 fish off Belle River (ON) and 14 fish in the Thames River. MDNR tagged 18 fish in Anchor Bay (MI) and Ohio DNR tagged 4 fish in the west basin of Lake Erie. This adds to the 51 muskies tagged during 2016-2018 for a total of 141 (Table 6.3.1). Five, Vemco VR2W acoustic receivers were deployed around the

perimeter of Lake St. Clair in Ontario waters (Figure 6.3.1). These receivers were purchased and donated by Muskies Canada. Deployment of a receiver at the location to the east of the Thames River mouth has been abandoned because it has been consistently lost over the last two years. In 2019 this receiver was snagged by an angler who cut the rope connecting the two anchors because they did not know what it was. Four additional receivers were purchased through OMNRF Special purpose account (SPA) funding and deployed in the Thames River. Six receivers were deployed around the perimeter of Lake St. Clair in Michigan waters by MDNR with financial support from Muskies Inc. (Figure 6.3.1).

In the fall of 2018, the 5 OMNRF receivers in Lake St. Clair were redeployed. Only 2 of the receivers were recovered in the spring of 2019, with the three receivers along the southern shoreline lost. In the spring 2019, the full 9 OMNRF receivers array were redeployed with all receivers successfully retrieved in late fall 2019. These receivers detected 89 individual Muskellunge, 102 Lake Sturgeon, 26 Common Carp and 7 Walleye. All detection records from the Ontario receivers have been submitted to the GLATOS network to contribute data to various GLATOS projects. Dependent on funding, OMNRF will tag an additional 20 fish in 2020 and will deploy receivers for the lifespan of the tags (5 years), until approximately 2024-2025.

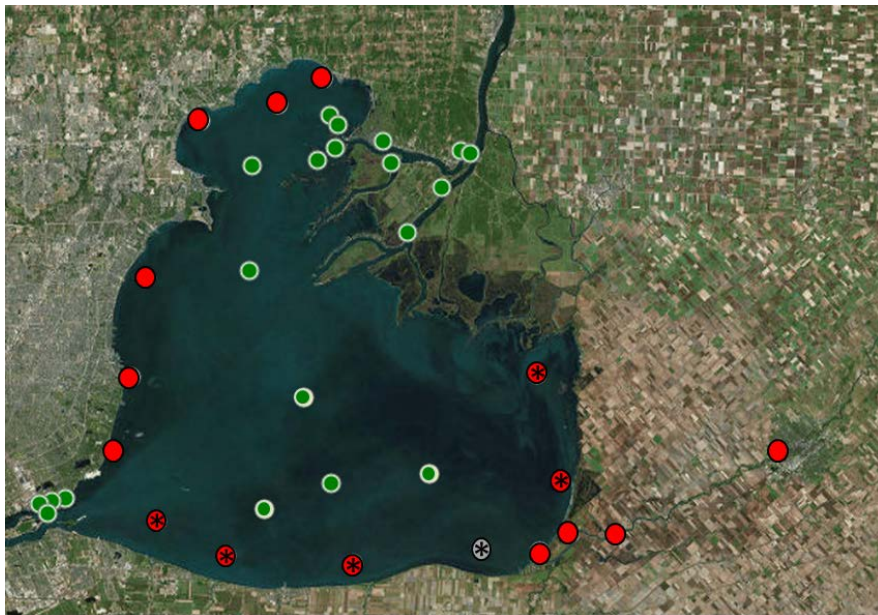


**Figure 6.3.1** GLATOS receivers in Lake St. Clair in 2018-2019. Red circles indicate a receiver deployed as part of the SCDRS Musky tagging project. Grey circle indicates an abandon deployment location. Asterisked receivers in Ontario waters were purchased through donations from Muskies Canada, Belle River Chapter and the National office, and remaining 3 receivers purchased using OMNRF Special Purpose Account funds.

To date, there are over 1.1 million detection records from 141 tagged fish. As of December 2019, evidence suggests between 121-127 of the tagged fish remain at large (Table 6.3.1). Preliminary data analysis has started to reveal:

- 1) Long distance migrations (see Figure 6.3.2).
- 2) Periods of rapid movements over defined areas (1-10 km) or rapid migrations over long distances (10–100 km).
- 3) Potential seasonal movements, site fidelity (foraging and spawning) and home ranges.
- 4) Movement of fish down the Detroit River into West basin of Lake Erie, lack of movement up the St. Clair River into Lake Huron.

**Table 6.3.1** Summary of tagging events and fish still believe to be at large (or alive) based on GLATOS receiver detections as of December 2019.

| Year         | Month | Tagging event              | Agency | Total Tagged | Believed still at large |
|--------------|-------|----------------------------|--------|--------------|-------------------------|
| 2016         | May   | Detroit River, MI          | MDNR   | 20           | 7                       |
|              | Oct   | Thames River, ON           | OMNRF  | 19           | 15-19                   |
| 2017         | Nov   | Belle River, ON (offshore) | OMNRF  | 18           | 17                      |
| 2018         | Apr   | West Basin - Lake Erie     | ODNR   | 2            | 2                       |
|              | May   | Anchor Bay, MI             | MDNR   | 10           | 8-10                    |
|              | Oct   | Belle River, ON (offshore) | OMNRF  | 22           | 22                      |
| 2019         | Apr   | West Basin - Lake Erie     | ODNR   | 4            | 4                       |
|              | May   | Anchor Bay, MI             | MDNR   | 18           | 18                      |
|              | Oct   | Belle River, ON (offshore) | OMNRF  | 14           | 14                      |
|              | Oct   | Thames River, ON           | OMNRF  | 14           | 14                      |
| <b>Total</b> |       |                            |        | <b>141</b>   | <b>121-127</b>          |

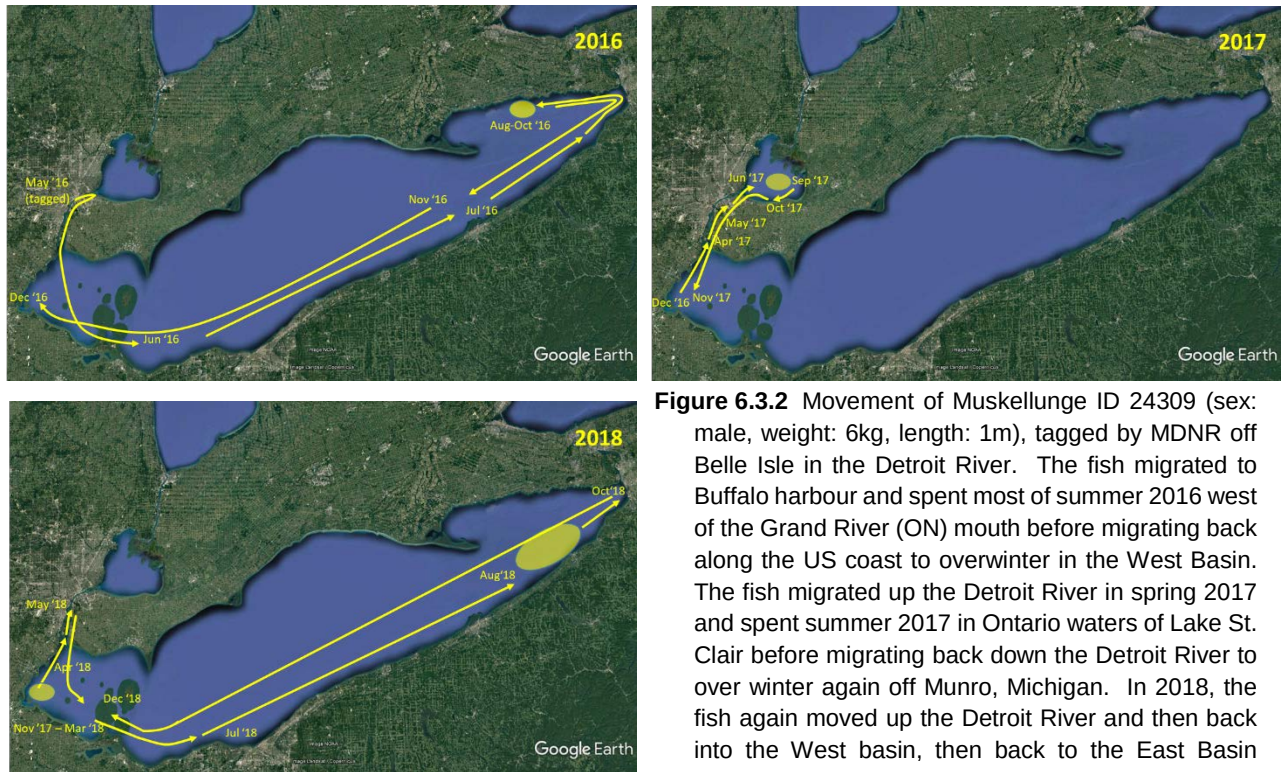


**Figure 6.3.2** Movement of Muskellunge ID 24309 (sex: male, weight: 6kg, length: 1m), tagged by MDNR off Belle Isle in the Detroit River. The fish migrated to Buffalo harbour and spent most of summer 2016 west of the Grand River (ON) mouth before migrating back along the US coast to overwinter in the West Basin. The fish migrated up the Detroit River in spring 2017 and spent summer 2017 in Ontario waters of Lake St. Clair before migrating back down the Detroit River to over winter again off Munro, Michigan. In 2018, the fish again moved up the Detroit River and then back into the West basin, then back to the East Basin during the summer and back to West Basin for the winter.

## 6.4 Lake Trout Habitat Use

### *Overview*

The Lake Erie Management Unit (LEMU) is working collaboratively with Lake Erie Committee (LEC) partner agencies to address data gaps currently preventing the realization of approaches recommended in the committee's "Strategic Plan for the Rehabilitation of Lake Trout". In particular, the plan identifies the need to increase stocking in a strategic way, by targeting areas with potential to be Lake Trout spawning habitat. Previous work to map and identify sites with substrate and slope suitable for Lake Trout spawning resulted in the identification of some potential areas. Efforts to determine use of these areas during spawning time, by fishing in late fall were repeatedly confounded by weather. Reports of Lake Trout aggregations during fall, over unmapped and uncharacteristic substrate, together with the logistic impossibility of mapping on the scale thought necessary, led to a proposal to use acoustic telemetry to find out where Lake Trout choose to situate during late fall.

The approach involved capturing and tagging a total of 90 Lake Trout per year, for two years, from three different parts of the lake during May, presuming that fall spawning aggregations would have dispersed from spawning areas by this time. Concurrent with tagging, receivers would be deployed, spanning the entire circumference of the nearshore waters of the eastern basin.

Lake Trout were caught and tagged in May in 2016, 2017 and 2018. Faulty tags, which had the potential to interfere with both transmission and reception, were deployed in 2017 necessitating additional tagging in 2018 and making interpretation of 2017 data difficult. Not counting the faulty tags, which transmitted continuously and used up battery power quickly, a total of 170 Lake Trout were tagged in the following proportions: New York waters (n=81); Pennsylvania waters (n= 22); and Ontario waters (n=67). In 2014 and 2018, additional Lake Trout were tagged opportunistically in Ohio waters of the western basin of the lake (n=26).

In addition to utilizing the Great Lakes Acoustic Telemetry Observation System (GLATOS) network of receivers, the project deployed 32 receivers in proximity (overlapping ranges), ringing the circumference of the eastern basin in order to monitor nearshore areas (<10 depth), including areas previously mapped during Lake Trout habitat surveys (Figure 6.4.1). Preliminary results were promising as many of the tagged fish showed an affinity for specific shorelines after turnover of thermal stratification and in association with drops in water temperature. The configuration of project receivers has been modified annually, evolving alongside our understanding of spatial use of the nearshore during spawning time. In 2018 and again in 2019, some perimeter locations were modified to free-up receivers and additional receivers were obtained in order to set up a Positioning System (VPS) grid array in key areas that would allow for exact positioning of individuals detected within the grid. The 2018 VPS array was deployed in Pennsylvania waters, close to the New York state line and the 2019 VPS array was deployed 22 km to the east in New York waters (Figure 6.4.1).

To date, 542 receivers have detected Lake Trout within Lake Erie. One individual moved down the Niagara River and was detected on receivers as far afield as the Bay of Quinte in Lake Ontario. The highest number of individual Lake Trout have been detected by receivers in deeper areas of the eastern basin of the lake and in the nearshore in association with the New York and Pennsylvania border (Figure 6.4.1). It is expected that tags deployed in 2018 will continue to transmit through 2023. Data collection and analysis will continue in 2020. It is anticipated that results from the VPS analysis will point to precise locations of aggregation from which preferred Lake Trout habitat can be more accurately described. Genetic analysis of DNA collected from tagged fish, planned for 2020, is expected to reveal strain identity, from which general stocking location can be inferred. It is possible that behaviour could be linked to both variables.

The project will conclude in 2020. It is notable that the receivers deployed for this project have proven beneficial for other acoustic projects in the basin, notably the Grand River Walleye project (Section 6.2). This project was funded primarily through the Great Lakes Fish and Wildlife Restoration Act. Additional support came from OMNRF, through the Great Lakes Protection Fund (Section 7), the GLFC, and GLATOS. Partners include New York State Department of Environmental Conservation, The Great Lakes Fishery Commission, the US Geological Survey, Pennsylvania Fish and Boat Commission, Ohio Department of Natural Resources, and the US Fish and Wildlife Service and Michigan State University.

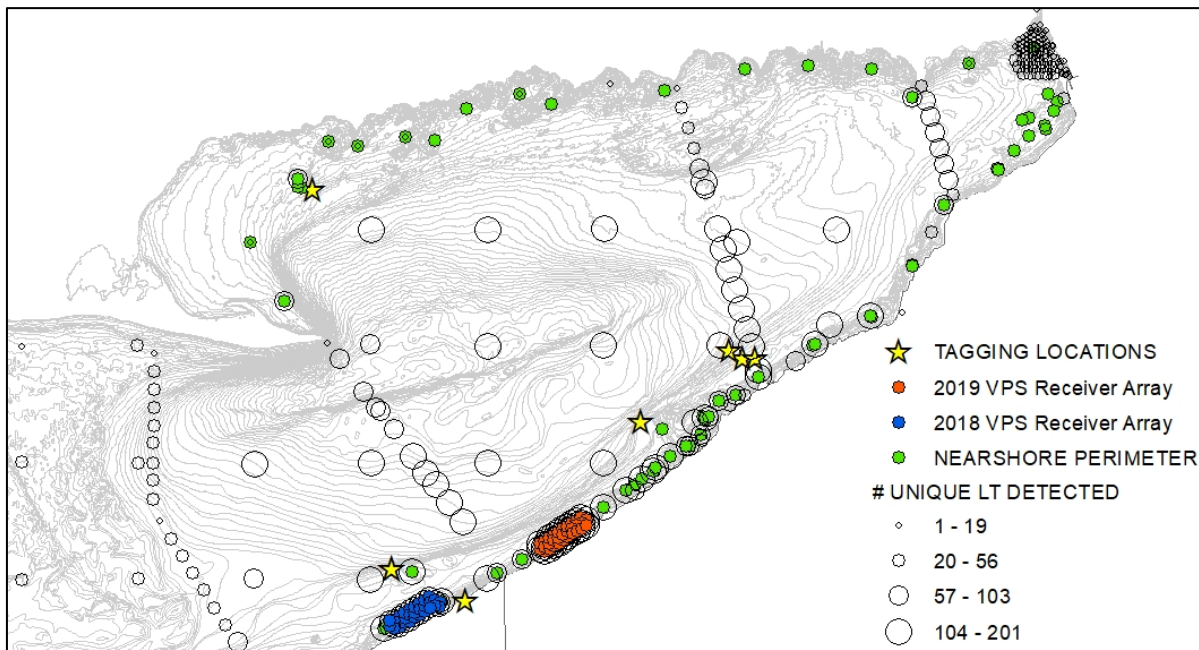


**Figure 6.4.1** Detections of acoustically tagged Lake Trout in the eastern basin of Lake Erie. Open Circles are proportional to the number of unique individual Lake Trout detected at each receiver. Star symbols represent tagging locations. Green circles represent perimeter receivers. VPS array receivers are represented by Blue circles (2018) and Red circles (2019).

#### 6.5 Lake Erie West and Central Basin Walleye Mixed Stock Fisheries Acoustic Telemetry Tagging

Walleye in Lake Erie are assessed and managed cooperatively by agencies from Ontario, Michigan, Ohio, Pennsylvania and New York. Internationally, Lake Erie is partitioned into a Total Allowable Catch (TAC) area consisting of the west and central basins of Lake Erie and a non-TAC area represented by eastern Lake Erie. TACs are determined annually by Lake Erie Committee (LEC) consensus on outcomes from the Recommended Allowable Harvest (RAH) and harvest control rules specified in the current Walleye Management Plan. For practical reasons, Walleye harvested in the TAC area are considered a single stock for assessment and allocation. However, Walleye are a homing species that spawns on reefs and in rivers throughout the Lake Erie watershed. Lake Erie Walleye spawning aggregations during spring and dispersal after makes it difficult to assess the contributions of local stocks to fisheries that may vary temporally and spatially. In addition, the existence of multiple smaller stocks in the east and the lakewide mixture of stocks during summer and fall increases the challenge of understanding Walleye population dynamics in Lake Erie.

Beginning in 2017, Ohio Department of Natural Resources, New York State Department of Environmental Conservation, United States Geological Survey, Michigan State University, Ohio State University, and the Ontario Ministry of Natural Resources and Forestry began a mixed stock tagging assessment of Lake Erie Walleye. The primary objective is to quantify the relative contribution of individual Walleye stocks to commercial and recreational fisheries in Lake Erie. Over several years, the study will describe temporal and spatial variability of Walleye stock contributions to fisheries.

Walleye were collected by angling and gill netting to estimate the spatial and temporal contribution of each stock to Lake Erie's recreational and commercial fisheries. Tagging took place during seasons when stocks were believed to be mixed. Walleye were tagged with internal V13-1H 69kHz acoustic transmitters and external Floy tags. Tagged fish are detected by acoustic receivers distributed broadly throughout the Great Lakes, including near Walleye spawning reefs and in rivers that are part of the Great Lakes Acoustic Telemetry Observation System (GLATOS). Rewards (\$100 US) are provided to fishers returning acoustic transmitter tags to fishery management agencies.

From 2017 to 2019, 616 Walleye were tagged in western and central Lake Erie. During this period, 131 tagged Walleye were harvested by recreational (58) and commercial (73) fisheries (Figure 6.5.1). Mixed stock Walleye tagging is scheduled to continue in 2020. Additional information is available at <https://glatos.glos.us/home/project/WAEMF>.



**Figure 6.5.1** A Walleye that was tagged in the mixed stock fishery acoustic telemetry study and harvested in 2019.

## 6.6 Lake St. Clair Tributary Walleye Tagging

The Thames River extends from its mouth at Lake St. Clair through agricultural and urban environments to higher elevations upstream of London. To its north, the Sydenham River is a smaller tributary of the St. Clair system which extends from the mouth at the Chancel Ecarte upstream over 100 km. Walleye spawning stocks that were historically abundant in these rivers, supported recreational, commercial and Indigenous fisheries in the

Thames and Sydenham Rivers, Lake St. Clair and the connected waters of the Great Lakes. Walleye were tagged by the Ontario Ministry of Natural Resources and Forestry (OMNRF) in the Sydenham River during 2013 and in the Thames River (2014-2016) to describe movement, survival, abundance, exploitation and biological characteristics of these stocks. Recaptures of tagged Walleye were reported by fisheries through 2019.

From 2013-2016, metal butt end tags were crimped to the left lower jaw and passive integrated transponder (PIT) tags were implanted ventrally near the heads of Walleyes. In 2016, external, highly visible Floy tags were also applied to all Walleye to compare retention of tag types. To address the reporting rate of non-reward tags for population modelling, 35% of tags applied to Sydenham River Walleye were reward tags whereas 20% of tags applied to Thames River Walleye offered rewards upon return of the tags to OMNRF. Thames River tags were also divided according to information printed on tags: a phone number or mailing address to compare the response by fishers.

Of 399 Walleye tagged in the Sydenham River in 2013, 21 recaptures were reported by fishers from 2013 to 2019 (Table 6.6.1). No tagged Walleye were caught in 2019. Walleye tagged in the Sydenham River were caught by recreational (20 fish or 95%) and Lake Erie commercial (1 fish or 5%) fisheries. Walleye capture locations ranged from western Lake Erie to the St. Clair River with recaptures distributed among the St. Clair River (43%), Sydenham River (33%), Lake St. Clair (19%), and Lake Erie (5%) (Figure 6.6.1). The majority (76%) of Walleye tagged in the Sydenham River were caught from May to August, with recaptures occurring during other months except March, April, November and December. The highest annual recapture rate for reward tags was 4.3% in 2013 compared to 1.5% for non-reward tags (R/NR ratio=2.84). Most Sydenham River Walleye recaptured from 2013-2019 were taken by Ontario (76%), followed by Michigan (24%) fishers. For Walleye tagged in the Sydenham River, the average duration from tagging to capture was 412 days (1.1 years) with a range of 11 to 2,050 days.

From 2014 to 2016, 914 Walleye were tagged in the Thames River. Since 2014, 94 tagged Walleye were captured by recreational fisheries (91 fish or 97%), commercial fisheries in western and central Lake Erie (2 fish) and the Indigenous gill net fishery in Lake St. Clair (1 fish). Four tagged Walleye were caught in 2019; one was tagged in 2015 whereas three were tagged in 2016. An additional tagged Walleye was caught in the St. Clair River by an angler in 2019; the source could not be determined as the Floy tag was not legible. Recaptures by fisher residency were Michigan (55%), Ontario (36%), Ohio (5%), Illinois (1%), Missouri (1%) and Wisconsin (1%). The spatial distribution of Thames River Walleye recaptures ranged from central Lake Erie to the mouth of Saginaw Bay, Lake Huron (Figure 6.6.1). The largest fraction of Walleye were recaptured in the St. Clair River (34%), Lake St. Clair (28%), followed by the Detroit River (20%), the Thames River (12%), with 4% from Lake Erie and 2% from Lake Huron (Figure 6.6.1). The majority (74%) of Walleye tagged in the Thames River were caught from May to August,

though recaptures occurred during all months. The proportion of tagged Walleye caught during the first year at large reflects the magnitude of fishery exploitation. In subsequent years, the recapture rates are influenced by annual mortality including deaths due to natural causes. The largest fraction of recaptures for all tag types (4.3%, 5.9%, 8.4%) took place during the years in which tags were applied (2014, 2015, 2016) (Table 6.6.1). In 2016, 17.5 % of Walleye tagged with reward tags and 6.2% of Walleye tagged with non-reward tags were captured that same year, reflecting increased exploitation in 2016 and/or a higher reporting rate for Walleye tagged with more visible Floy tags compared to the previous two years in which jaw and PIT tags were applied. In 2016, the ratio of reward: non-reward tags reported caught was 2.82. When comparing all Walleye tagged in the Thames River 2014-2016 and all recaptures up to 2019, the ratio of reward: non-reward tags recovered was 2.2. A high proportion (57%) of Walleye triple tagged in 2016 that were recaptured from 2016-2019 lacked jaw tags when reported whereas only 5% were missing Floy tags. This suggests that earlier rates of tag recaptures were underestimated due to loss of crimped metal jaw tags applied in 2014 and 2015. While this finding supports continued use of Floy tags for external marking, Floy tags become worn over time; one recovered Floy tag could not be read in 2019. The reported recaptures of Walleye tagged in 2016 with address labels (55%) was comparable the return rate of tags with phone contact labels (45%). Neither method (address vs phone) appeared significantly better; the OMNRF label was present on all tags providing multiple options for reporting tagged fish. The average number of days until capture was 324 days (0.9 years) with a range of 15 to 5,010 days.

**Table 6.6.1** Percentage (%) of tagged Walleye that were recaptured by year of tagging, tag type (reward, non-reward), sex, and year of recapture for Walleye tagged in the Sydenham River (top) and Thames River (bottom) through 2019.

| Sydenham River  |         |        | Non-Reward Tags<br>Year of Recapture |      |      |      |      |      |      | Reward Tags<br>Year of Recapture |       |       |      |      |      |      | All Tags<br>Year of Recapture |        |      |      |      |      |      |      |      |
|-----------------|---------|--------|--------------------------------------|------|------|------|------|------|------|----------------------------------|-------|-------|------|------|------|------|-------------------------------|--------|------|------|------|------|------|------|------|
| Year of Tagging | Sex     | Tagged | 2013                                 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Tagged                           | 2013  | 2014  | 2015 | 2016 | 2017 | 2018 | 2019                          | Tagged | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 2013            | Male    | 230    | 1.3%                                 | 2.2% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 96                               | 4.2%  | 1.0%  | 0.0% | 1.0% | 0.0% | 0.0% | 0.0%                          | 326    | 2.1% | 1.8% | 0.0% | 0.3% | 0.3% | 0.0% | 0.0% |
| (PIT / Jaw)     | Female  | 12     | 0.0%                                 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 4                                | 25.0% | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0%                          | 16     | 6.3% | 6.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
|                 | Unknown | 19     | 5.3%                                 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 38                               | 2.6%  | 2.6%  | 0.0% | 0.0% | 0.0% | 2.6% | 0.0%                          | 57     | 3.5% | 1.8% | 0.0% | 0.0% | 0.0% | 1.8% | 0.0% |
|                 | All     | 261    | 1.5%                                 | 1.9% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% | 138                              | 4.3%  | 2.2%  | 0.0% | 0.7% | 0.0% | 0.7% | 0.0%                          | 399    | 2.5% | 2.0% | 0.0% | 0.3% | 0.3% | 0.3% | 0.0% |

| Thames River          |         |        | Non-Reward Tags<br>Year of Recapture |      |      |      |      |      |        | Reward Tags<br>Year of Recapture |       |       |      |       |       |        | All Tags<br>Year of Recapture |      |      |      |      |      |  |
|-----------------------|---------|--------|--------------------------------------|------|------|------|------|------|--------|----------------------------------|-------|-------|------|-------|-------|--------|-------------------------------|------|------|------|------|------|--|
| Year of Tagging       | Sex     | Tagged | 2014                                 | 2015 | 2016 | 2017 | 2018 | 2019 | Tagged | 2014                             | 2015  | 2016  | 2017 | 2018  | 2019  | Tagged | 2014                          | 2015 | 2016 | 2017 | 2018 | 2019 |  |
| 2014                  | Male    | 107    | 1.9%                                 | 0.9% | 0.0% | 0.9% | 0.0% | 0.0% | 29     | 3.4%                             | 3.4%  | 0.0%  | 0.0% | 0.00% | 0.00% | 136    | 2.2%                          | 1.5% | 0.0% | 0.7% | 0.0% | 0.0% |  |
| (PIT/Jaw)             | Female  | 27     | 14.8%                                | 0.0% | 3.7% | 0.0% | 0.0% | 0.0% | 6      | 0.0%                             | 0.0%  | 0.0%  | 0.0% | 0.00% | 0.00% | 33     | 12.1%                         | 0.0% | 3.0% | 0.0% | 0.0% | 0.0% |  |
|                       | Unknown | 70     | 4.3%                                 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 14     | 7.1%                             | 7.1%  | 0.0%  | 0.0% | 0.00% | 0.00% | 84     | 4.8%                          | 1.2% | 0.0% | 0.0% | 0.0% | 0.0% |  |
|                       | All     | 204    | 4.4%                                 | 0.5% | 0.5% | 0.5% | 0.0% | 0.0% | 49     | 4.1%                             | 4.1%  | 0.0%  | 0.0% | 0.00% | 0.00% | 253    | 4.3%                          | 1.2% | 0.4% | 0.4% | 0.0% | 0.0% |  |
| 2015<br>(PIT/Jaw)     | Male    | 178    |                                      | 6.7% | 2.2% | 0.0% | 0.0% | 0.0% | 47     |                                  | 10.6% | 10.6% | 0.0% | 0.00% | 0.00% | 225    |                               | 7.6% | 4.0% | 0.0% | 0.0% | 0.0% |  |
|                       | Female  | 31     |                                      | 0.0% | 6.5% | 0.0% | 0.0% | 0.0% | 8      |                                  | 37.5% | 0.0%  | 0.0% | 0.00% | 0.00% | 39     |                               | 7.7% | 5.1% | 0.0% | 0.0% | 0.0% |  |
|                       | Unknown | 62     |                                      | 0.0% | 0.0% | 0.0% | 3.2% | 1.6% | 14     |                                  | 0.0%  | 0.0%  | 0.0% | 0.00% | 0.00% | 76     |                               | 0.0% | 0.0% | 0.0% | 2.6% | 1.3% |  |
|                       | All     | 271    |                                      | 4.4% | 2.2% | 0.0% | 0.7% | 0.4% | 69     |                                  | 11.6% | 7.2%  | 0.0% | 0.00% | 0.00% | 340    |                               | 5.9% | 3.2% | 0.0% | 0.6% | 0.3% |  |
| 2016<br>PIT/Jaw/Floy) | Male    | 191    |                                      |      | 6.8% | 1.0% | 1.0% | 1.0% | 46     |                                  |       | 17.4% | 8.7% | 0.00% | 2.17% | 237    |                               |      | 8.9% | 2.5% | 0.8% | 1.3% |  |
|                       | Female  | 12     |                                      |      | 8.3% | 0.0% | 8.3% | 0.0% | -      |                                  |       |       |      |       |       | 12     |                               |      | 8.3% | 0.0% | 8.3% | 0.0% |  |
|                       | Unknown | 55     |                                      |      | 3.6% | 5.5% | 3.6% | 0.0% | 17     |                                  |       | 17.6% | 0.0% | 0.00% | 0.00% | 72     |                               |      | 6.9% | 4.2% | 2.8% | 0.0% |  |
|                       | All     | 258    |                                      |      | 6.2% | 1.9% | 1.9% | 0.8% | 63     |                                  |       | 17.5% | 6.3% | 0.00% | 1.59% | 321    |                               |      | 8.4% | 2.8% | 1.6% | 0.9% |  |

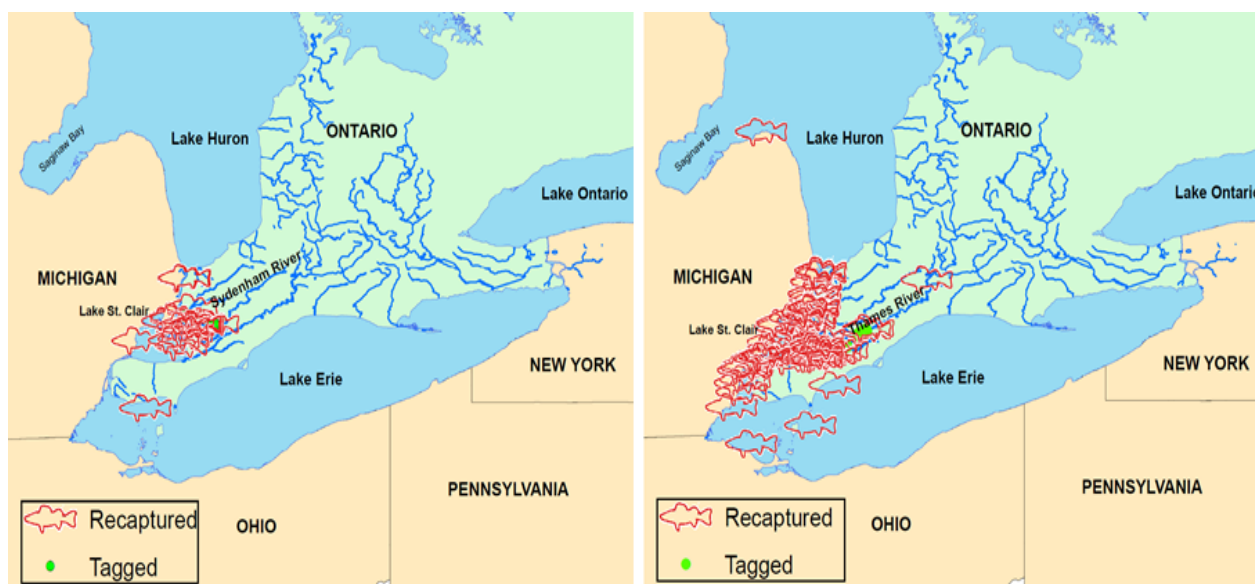


**Figure 6.6.1** Fishery recapture locations and Walleye tagging sites in the Sydenham River (left) and the Thames River (right). Recaptures include up to 2019.

#### 6.7 Lake St. Clair – Detroit River Muskellunge Spawning Survey

Muskellunge are an important top predator and sportfish in the Lake St. Clair – Detroit River (LSC-DR) system. The LSC-DR system supports one of the largest Muskellunge fisheries in the province. Despite this, little is known about their life history in the LSC-DR system. Spawning represents a particularly important life history stage for Muskellunge because they spawn in shallow, vegetated habitat that is highly vulnerable to present and future stressors in the LSC-DR system, including water level fluctuations, sedimentation, shoreline augmentation, and the loss of coastal wetlands. Thus, the spawning habitat of Muskellunge represents a priority habitat for the protection and management of the species. The objective of the LSC-DR Muskellunge Spawning Survey is to determine when and where Muskellunge spawn in the LSC-DR system. A secondary objective is to evaluate the degree of spatial overlap between spawning aggregations of Northern Pike and Muskellunge.

The 2019 LSC-DR Muskellunge Spawning Survey took place in two stages. The first stage was a surveillance effort meant to determine when spawning commenced in the system. A boat electrofishing crew sampled 1 km sections of the eastern Lake St. Clair shoreline each week beginning April 10, 2019. Captured Northern Pike, Muskellunge, and Muskellunge – Northern Pike hybrids (hereafter hybrids) were counted and assessed for gonad condition (e.g., ready to spawn or not). Shoreline sections containing suitable Muskellunge spawning habitat were selected for sampling at the discretion of the crew. By May 2, 2019, Muskellunge were being captured consistently and the second stage

commenced. The second stage involved the systematic sampling of the eastern Lake St. Clair shoreline between Mitchell's Bay and Tremblay Creek over a three week period (May 13-31, 2019; 35 shoreline sections). All captured Northern Pike, Muskellunge, and hybrids were measured for total and fork length, assessed for gonad condition, checked for Sea Lamprey wounds, and tagged using both an external loop tag and an internal PIT (passive integrated transponder) tag. Additional opportunistic sampling occurred in the lower Thames River (Jeanette's Creek and below; May 15,17, 23 and 30, 2019) and Detroit River (June 3-6, 2019).

A total of 33 Muskellunge and 115 Northern Pike were captured during the spawning survey (Table 6.7.1). Of these fish, 17 Muskellunge and 76 Northern Pike were tagged. The remainder of the captured fish consisted of untagged adult fish (5 Muskellunge and 31 Northern Pike) and juveniles (TL < 400 mm: 11 Muskellunge and 8 Northern Pike). Most of the tagged Muskellunge from Lake St. Clair were captured within or near the Thames River (Figure 6.7.1). In the Detroit River, the tagged Muskellunge were mostly captured around Peche Island and Grassy Island (Figure 6.7.2). Of the Muskellunge tagged, only one female and five males were of spawning condition (i.e., loose gametes). Juvenile Muskellunge were primarily captured around Mitchell's Bay in Lake St. Clair. Northern Pike were ubiquitous in the system and captured in most of the vegetated areas along the eastern shore of Lake St. Clair and in the Detroit River. Of the tagged Northern Pike, only two males were of spawning condition. Juvenile Northern Pike were captured in Mitchell's Bay and in the Detroit river near LaSalle and Amherstburg.

A total of three Muskellunge and one Northern Pike were recaptured in 2019. Two of the recaptured Muskellunge were originally tagged in Lake St. Clair (Tremblay Creek and St. Lukes) and one in the Thames River (near river mouth). All three Muskellunge were recaptured in the fall within or near the Thames River by anglers (2 fish) and OMNRF technicians (1 fish). The Northern Pike was recaptured during week 2 of the survey within 2 km of its original tagging location by OMNRF technicians. All recaptured fish were released.

**Table 6.7.1** Number of captured, tagged, untagged, and juvenile Muskellunge and Northern Pike from the Lake St. Clair–Detroit River Muskellunge Spawning Survey. Time Period designates the stage of the project. Untagged fish represent adult fish that were not tagged (e.g., too small for loop tag). Juvenile fish were those <400 mm in length. Several Muskellunge and Northern Pike were opportunistically tagged during the surveillance period to increase the total number of fish tagged during the program.

| Species       | Time Period   | # Captured | # Tagged | # Untagged | # Juveniles |
|---------------|---------------|------------|----------|------------|-------------|
| Muskellunge   | Surveillance  | 15         | 1        | 4          | 10          |
|               | Week 1        | 4          | 4        | 0          | 0           |
|               | Week 2        | 3          | 2        | 1          | 0           |
|               | Week 3        | 5          | 5        | 0          | 0           |
|               | Detroit River | 6          | 5        | 0          | 1           |
| Northern Pike | Surveillance  | 32         | 18       | 12         | 2           |
|               | Week 1        | 16         | 12       | 3          | 1           |
|               | Week 2        | 22         | 13       | 7          | 2           |
|               | Week 3        | 25         | 17       | 8          | 0           |
|               | Detroit River | 20         | 16       | 1          | 3           |

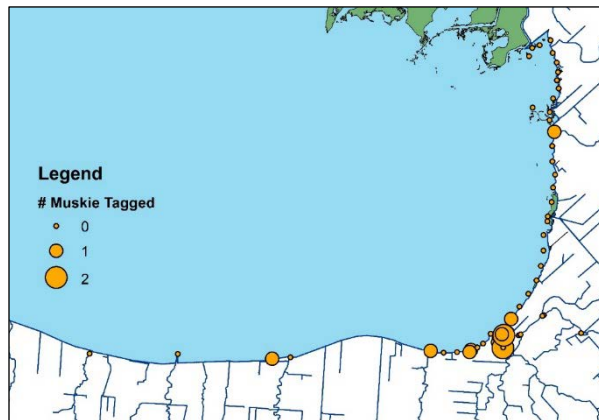


**Figure 6.7.1** Number of Muskellunge tagged in Lake St. Clair at each site sampled between April 23 to May 31, 2019.

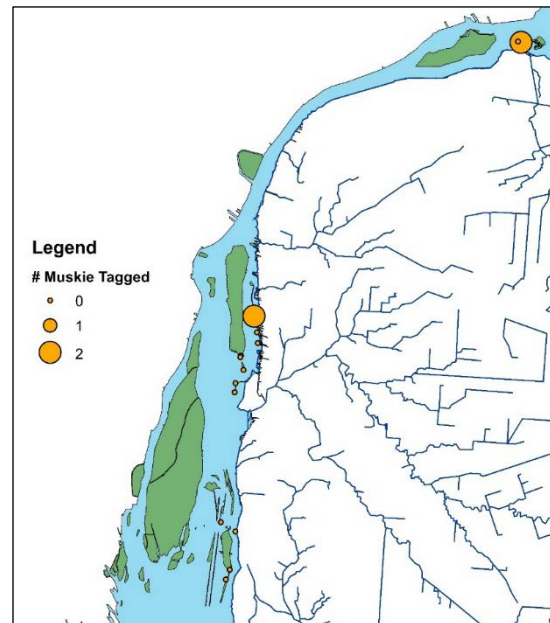


**Figure 6.7.2** Number of Muskellunge tagged in Detroit River at each site sampled between June 3 to June 6, 2019.

## **7. CANADA – ONTARIO AGREEMENT ON GREAT LAKES WATER QUALITY AND ECOSYSTEM HEALTH**

The Lake Erie Management Unit (LEMU) hosts the Ontario Ministry of Natural Resources and Forestry (OMNRF) Great Lake Protection Fund (GLFP) coordinator for the Lake Erie Basin. The role of the coordinator is to facilitate OMNRFs commitments to the Canada - Ontario Agreement (COA) on Great Lake Water Quality and Ecosystem Health, commonly referred to as the COA agreement. The COA agreement specifies the roles and responsibilities of the federal and provincial governments as they collectively meet the Canadian commitments of the bi-national Great Lakes Water Quality Agreement (GLWQA). The primary role of the GLPF coordinator is to coordinate the OMNRF-GLFP work plan for the Lake Erie Basin among various OMNRF units/sections.

During 2019-20, negotiations to develop a new COA agreement for 2020-2025, occurred between the provincial and federal governments. A draft agreement was posted for public consultation on July 5, 2019. Following a 60 day public comments period, the lead provincial (Ministry of Environment, Conservation and Parks) and federal (Environment and Climate Change Canada) agencies began work to finalize a new COA agreement. At the time of writing this report, finalization of the 2020-2025 COA agreements was still pending. In parallel to the COA negotiations during 2019, the LEMU together with other units/ sections within the OMNRF developed a new GLFP work plan for 2020-2025.

The 2019/2020 fiscal year represented the final year of the 2015-2020 GLFP work plan. To meet several changes within the Ministry the 2015-2020 GLFP work plan had to be modified in 2019-2020 which included the addition of new projects, and the re-development of some existing projects. Additionally, 2019/20 was the Cooperative Science and Monitoring Initiative (CSMI) year for Lake Erie which brought additional support for projects to address priorities within that initiative. Summaries of the work completed through GLFP projects are contained in Sections 5.1, and 7.1- 7.5 of this report.

**Table 7.1** List of Great Lake Protection Fund projects in the Lake Erie Basin 2019-2020 work plan.

| <b>Project #</b> | <b>Project Name</b>                                                                              | <b>Implementing Unit</b> |
|------------------|--------------------------------------------------------------------------------------------------|--------------------------|
| 02-10            | Grand River /Lake Erie Interface Restoration                                                     | LEMU                     |
| 02-19            | Native coldwater species restoration                                                             | LEMU                     |
| 02-22            | St. Clair River – Areas of Concern (AOC)                                                         | LEMU                     |
| 02-23            | Detroit River AOC fish and aquatic habitat restoration - priority actions for delisting          | LEMU                     |
| 02-26            | Niagara River-AOC Fish Assessment                                                                | LEMU                     |
| 02-43            | CSMI – Predator diet study                                                                       | LEMU                     |
| 02-44            | Lake Whitefish acoustic telemetry to understand mortality, exploitation and critical habitat use | LEMU                     |
| 05-23            | Asian Carp Surveillance                                                                          | LEMU                     |

### 7.1 Grand River Habitat Suitability Mapping

Migratory river-spawning fish are integral to the Great Lakes. In Lake Erie, there are ~48 known migratory species. Nearly half of these species are highly valued, socially and economically, as they are sought by anglers and commercial fishers alike. Access to suitable habitat in Lake Erie tributaries like the Grand and Thames River is important for sustained fish production. This project helped OMNRF identify and map habitat for the purpose of protecting and/or restoring native aquatic species in the Southern Grand River between the town of Caledonia and Lake Erie. The Habitat Suitability Index (HSI) used was based on work conducted in the Maumee River (Collier 2018), and focussed on species' preferences for substrate, water velocity, and water depth. Substrate needed to be collected through field surveys while velocity and depth were modelled with the help of data and expertise from the Grand River Conservation Authority (GRCA).

A substrate survey was conducted with a consumer-grade side scan sonar (SSS; Hummingbird Helix 9, 455 KHz) between July and October 2019. A total of 201 sonar swaths were completed, and 154 substrate grab samples were collected to ground truth interpretation of the resulting images. For wadable sections where the use of SSS was not possible, areas of discrete substrate type, based on visual observation, were mapped using a Toughbook computer tablet and the *Collector for ArcGIS* App. *SonarWiz 7* software (Chesapeake Technologies 2014) was used to perform post-processing enhancement of the SSS images; poor quality data was excluded. Enhanced SSS images, grab sample data, field-mapped polygons and historical substrate transect information were used collectively to manually construct a continuous spatial substrate layer in ArcGIS. Mapping in the section of river downstream of the town of Cayuga was greatly aided by substrate grab data provided by OMNRF-Science and Research Branch (S. Reid; ARMS).

River analysis modelling software (HEC-RAS; United States Army Corp of Engineers) was used to estimate water velocity. The parameters in the model were assigned by the GRCA and included cross sectional and bathymetric depth data previously collected by Lake Erie Management Unit (LEMU) (Cayuga to Port Maitland), GRCA historic cross-sections and recently collected LiDAR<sup>1</sup> data (Caledonia to Cayuga) as well as hourly flow at the town of York (GRCA monitoring gauge station). Continuous raster surfaces of mean April and May velocities was computed in HEC-RAS Mapper using depth and velocity at cross-sections, as well as the high-resolution LIDAR layer. A bathymetry surface was created by combining LiDAR data (Caledonia-Cayuga; GRCA) with a pre-existing bathymetric layer; OMNRF). Finally, the substrate type, depth (m) and velocity (m/s) layers were converted using R statistical package to habitat suitability index classes of “good” (0.8 - 1), “moderate” (0.31 – 0.79) and “poor” (0 - 0.3), consistent with those previously developed for spawning and age 0 life stages of Lake Sturgeon in the Maumee River (Collier 2018). Overall suitability maps for spawning and age 0 Lake Sturgeon were estimated using the geometric mean of habitat suitability indexes for substrate, depth and velocity for each life stage.

HSI modelling showed that 13.6% (152.2 ha) of the Southern Grand River downstream of the town of Caledonia (Total study area 1121 ha) can be classified as “good” habitat for spawning Lake Sturgeon. However, the vast majority of this “good” habitat is inaccessible to migrating Lake Sturgeon due to the presence of a low-head dam 8 km upstream from Lake Erie, at the town of Dunnville (Figure 7.1.1). The dam imposes a complete barrier to non-jumping fish. The portions of the study area classified as “moderate” spawning habitat for Lake Sturgeon (25%; 277 ha) similarly occur almost exclusively upstream of the barrier at Dunnville. The proportion of the area deemed poor (61% or 691.5 ha) mainly occurs downstream of Cayuga (Figure 7.1.1).

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<sup>1</sup> Copyright © Grand River Conservation Authority, 2020

This work also demonstrated that there is abundant “good” (30%; 338.3 ha) and “moderate” (68.4%; 767.3 ha) habitat for age 0 Lake Sturgeon downstream of Caledonia (Figure 7.1.1). Less than 2% of the study area is classified as “poor” habitat for age 0 Sturgeon. This project provides a solid foundation for fish habitat protection, restoration and enhancement in the Southern Grand River. Furthermore, the methodology and data developed for this project will be used to run similar analyses for other species of interest (e.g. Walleye) and can be applied to other key tributaries such as the Thames and Sydenham Rivers.

## Reference:

Collier, J. J. (2018). *Creating a Spatially-Explicit Habitat Suitability Index Model for Lake Sturgeon (Acipenser fulvescens) in the Maumee River, Ohio* (Doctoral dissertation, The University of Toledo, Toledo, Ohio USA).

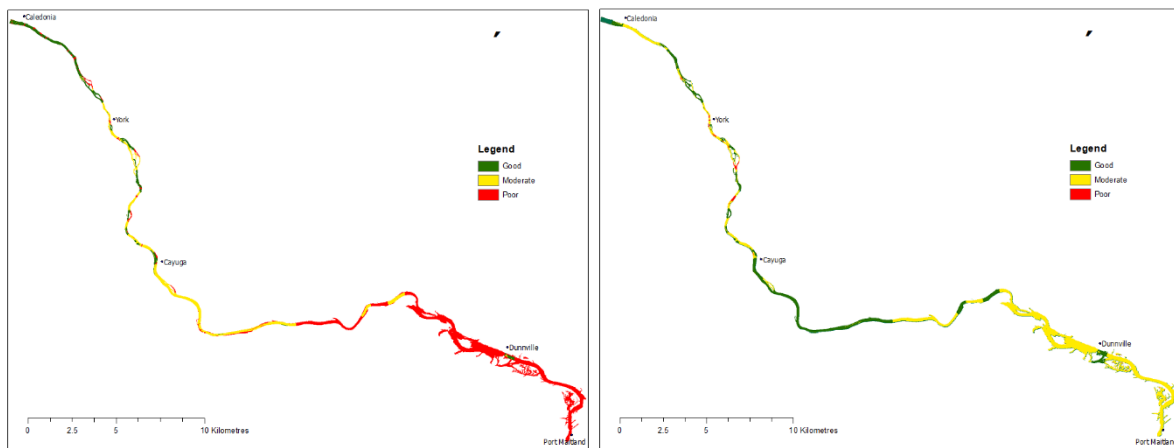


**Figure 7.1.1** Habitat Suitability for Spawning (left panel) and Age 0 (right panel), Lake Sturgeon based on substrate and seasonal mean (1974-2019) velocity and depth.

## 7.2 Cooperative Science and Monitoring Initiative (CSMI) Diet Study

The bi-national Cooperative Science and Monitoring Initiative (CSMI) is an intensive, management-related, scientific examination of each Great Lake on a five-year rotational basis. The science and monitoring results from intensive field sampling programs are used to assess and report on the state of the lake in annual reports and lakewide action and management plans. CSMI is a commitment within Annex 10 (Science) of the Great Lakes Water Quality Agreement and OMNRF support is within Annex 10 (Science) in the 2015-2020 Canada-Ontario Agreement (COA). In 2019 the CSMI rotation again returned to Lake Erie following the past CSMI year in 2014.

The bi-national Lake Erie Partnership identifies science and monitoring priorities for each CSMI year through coordinated efforts among governmental agencies and engagement with community partners. For 2019, CSMI priorities in Lake Erie focused on the effects of manageable and non-manageable factors resulting from the significant changes observed in the lake's ecosystem including nutrient loading/harmful algal bloom, invasive species (including Dreissenids and others) and climate change on the production of desired fish species. To address this priority the Lake Erie Management Unit (LEMU) along with the Aquatic Research and Monitoring Section (ARMS) implemented a lakewide, diet composition study for key fish species within Lake Erie's fish community.

The forage base across Lake Erie is in decline, raising concerns for the sustained production of the lake's fisheries. While top-down predation pressure by piscivores is likely a major factor of this decline bottom-up food availability and quality, other factors such as the presence of invasive species (e.g. spiny water flea, Dreissenid mussels, round gobies) and climate change may have significant impacts. Evidence is already suggesting the declining forage base is having impacts on the Lake Erie fish community including decreasing length-at-length in Walleye and potential prey switching in piscivores diets to higher proportions of spiny-rayed fish (Forage Task Group 2020).

Studying food web dynamics is fundamental to understanding the potential causes and consequences of the declining forage base. This information is crucial to helping managers identify if, and what, management actions might be taken to address the issue. The 2019 CSMI diet study examined the diet composition in key Lake Erie piscivore and forage species including Walleye, Yellow Perch, White Perch, White Bass Lake Whitefish, Lake Trout, Burbot, Rainbow Trout, Rainbow Smelt and Gizzard Shad. The objectives of this diet study were to:

- (1) Identify current forage base and determine seasonal diet composition of key Lake Erie fish species, representing different trophic guilds.
- (2) Evaluate predation demand on Rainbow smelt.
- (3) Examine potential prey switching through comparison with historical data, and
- (4) Compare traditional visual and contemporary molecular (DNA) content analysis approaches.

A total of 3,996 juvenile and adult fish were collected lakewide using a combination of targeted and opportunistic sampling efforts. Whole intestinal tracks were dissected from all fish and preserved in 95% ethanol for analysis. Technical experts at the LEMU's Port Dover office visually identified and quantified stomach contents of all samples. After visual identification, stomachs content samples were transferred to the Dr. Daniel Heath's lab at the Great Lakes Institute of Environmental Research (GLIER, University of Windsor) for DNA analysis. Work is presently underway to complete visual and genetic

analysis of these samples. Reporting on this project will occur as part of the CSMI reporting cycle and a summary will be presented in a future LEMU annual report.

The goals of this comprehensive examination of diet composition will provide information on the lower trophic bioenergetics within the Lake Erie food web. The project will directly contribute to the Lake Erie Forage Task Group's study on predator condition (2019-2020). Evaluation of the predation demand by Lake Erie piscivores on Rainbow Smelt will directly address priority actions/questions needed for the Marine Stewardship Certification (MSC) of the Ontario Commercial Rainbow Smelt fishery. Finally, the comparison of visual and molecular techniques for stomach contents analysis will provide crucial cross-validation needed to relate historical and contemporary diet studies.

### **Reference:**

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

### **7.3 Coldwater Assessment Extension**

The annual Coldwater Assessment (CWA) survey is an interagency gillnet assessment of the fish communities present in the hypolimnetic habitat in the eastern basin of Lake Erie. The CWA has been conducted in Ontario waters since 2000 and separates the eastern basin of Lake Erie into 8 sampling units, four of which are found in Ontario (A5-A8). The sampling protocol uses the position of the thermocline to determine net placement. Five, 600ft. gangs of gillnet are subsequently set in a string along a North–South transect beginning at the edge of the thermocline and ending approximately 1.25 km away. Twelve of these strings of nets are distributed evenly between each sampling area for a total of 60 gangs set each year in Ontario waters. This survey design focuses effort in water depths ranging from 80-120 ft. deep and underrepresents the deep water habitat present in the center of the eastern basin (Figure 7.3.1).

In August 2019 an exploratory Deepwater Area (DWA) survey was conducted as an extension to the annual Coldwater Assessment survey. The underrepresented deep water habitat was identified, for sampling areas 6 and 7, as the center of the basin with depths greater than 140ft. of water (Figure 7.3.1). Sampling effort in the DWA matched the effort from the Coldwater Assessment and was distributed using a randomized tessellation approach. Fifteen, 600 ft. gangs of gillnet were set in each sampling area. To maintain comparability between the two surveys five gangs were set in a string in the DWA along one of the transects used in the CWA survey and 10 gangs were set in random locations in each area.

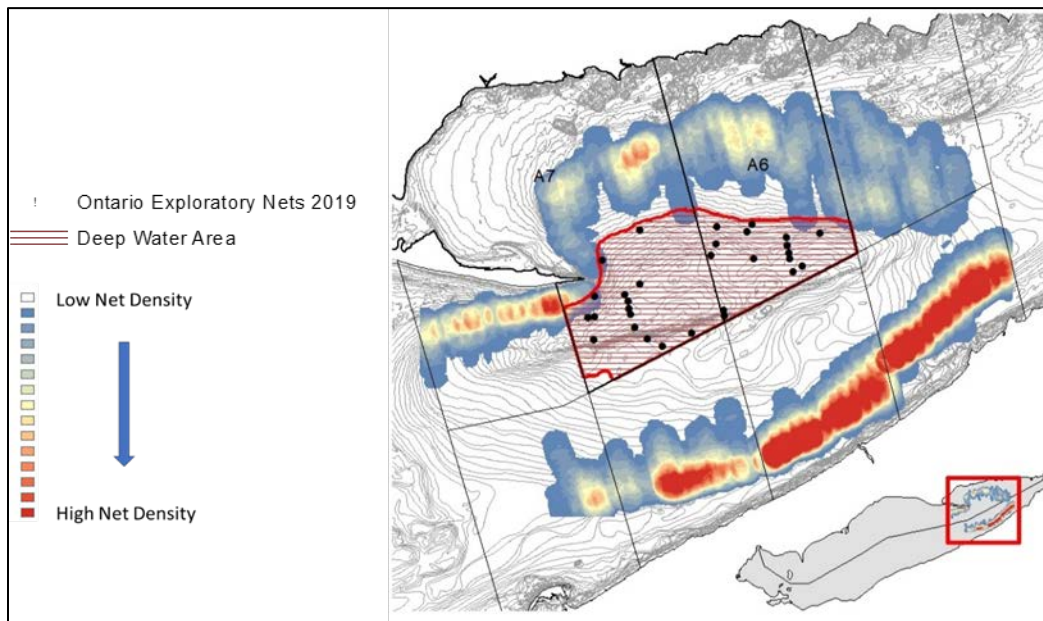


**Figure 7.3.1** Coldwater assessment survey area in the eastern basin of Lake Erie. Heatmap represents the density of traditional Coldwater Assessment net sets between 2000-2018. Area highlighted by red bars indicates the extent of the Deepwater Area (DWA). Black dots represent experimental deep water sets from 2019.

Lake Trout represented 97% of the total catch in the DWA. Therefore, all subsequent analysis to follow was performed using Lake Trout catches only. Lake Trout caught in both the DWA and CWA ranged from 2-18 years old, however a greater proportion of older fish were caught in the DWA than in the CWA (Figure 7.3.2). Given the shorter legacy of stocking in Ontario waters this difference in fish age corresponds to the much smaller number of Ontario origin fish caught in the deep water survey (4%) than in the Coldwater Assessment (46%).

Trends in Lake Trout catches varied similarly between the two assessments. Catches in both surveys were much greater in Area 6 than in Area 7. However, catches in the DWA were significantly lower than those observed in the CWA (Figure 7.3.3). This difference could be the result of differences in catchability between gangs of nets set in a string and single gangs of net set in random locations. While a comparison of catch rates between single gang sets and string sets showed no significant differences between the two, the comparison lacked a large enough sample size to be truly meaningful. Alternatively, if lower catch rates in the DWA truly represent lower fish abundance in these areas, then underrepresentation of this habitat in the standard Coldwater assessment, may have resulted in an overestimation of basin wide Lake trout abundance. This work supports future initiatives to review the CWA survey design and redistribute sampling effort across the basin.

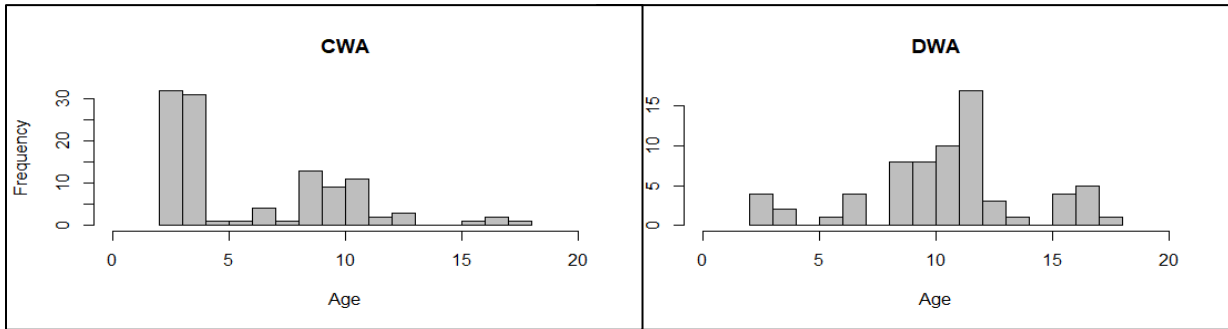


**Figure 7.3.2** Frequency distribution of ages from Lake Trout caught in areas 6 and 7 during the annual Coldwater Assessment (left) and the exploratory Deepwater survey (right) in 2019.

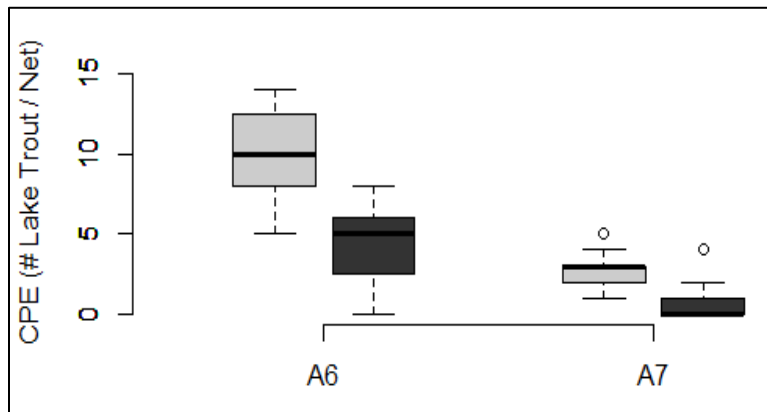


**Figure 7.3.3** Catch per unit effort of Lake Trout caught in areas 6 and 7 in the Coldwater Assessment (light) and the Deepwater assessment (dark) in 2019.

#### 7.4 Limnology Database

The Lake Erie Management Unit (LEMU) collects information on the limnological conditions of Lake Erie through a dedicated Limnology Program (Section 5.3). This program supports a coordinated lakewide limnology monitoring initiative, the Lower Trophic Level Assessment (LTLA), by supplying data that feeds into a bi-national database. This LTLA database is designed to store data summaries of specific parameters from dedicated Limnology Program stations. The LEMU, however, collects limnology data that is more detailed than the summaries reported to the LTLA, with additional parameters that are of interest to LEMU researchers. In addition, the LEMU collects limnological data as part of other research programs that could be useful in a broader context. As a result, the creation of a LEMU Limnology Database was proposed for the 2019/2020 season.

The goal of the LEMU Limnology Database is to create a standardized, flexible means to store limnological data that allows for easy input, access, and analysis. The initial stage of database formation focused on reformatting and proofing the data from the standard Limnology Program (Section 5.3), as well as the Lake St. Clair Limnology Program (Section 5.4). This involved compiling the raw depth-profile data for all sampling events conducted from 1998 to 2019, accounting for different collection methods used over this period, and standardizing all other parameters measured as part of these programs. The second stage involves compiling and standardizing limnology data collected through contemporary LEMU research programs, as well as creating an efficient input method capable of handling data from a variety of project types. A total of 23 programs are planned to be included as part of this stage (Table 7.4.1), including all of the Fisheries Assessment Projects and most of the Fisheries Management Projects documented in this report. This stage also involved compiling data from the West Basin Temperature Array, which records temperature at six stations every half hour for the entire year. The final step of this project will involve digitizing historic limnology data for input into the LEMU Limnology Database.

The first and second stages of this project are close to completion. The main work to be completed in 2020 includes the creation of accessible forms for data input, as well as the compilation of data from the final few programs. Work on the third stage is ongoing with the assessment of historic datasheets underway.

**Table 7.4.1** Summary of LEMU's monitoring and assessment programs / projects that collected limnology data. Site type refers to whether the data was collected at a recurring station, or an independent point. Record type indicates how the sample was collected. EB = Eastern Basin, LSC = Lake St. Clair, DO = Dissolved Oxygen, Secchi = Secchi Depth, Sal = Salinity, Chl-a = Chlorophyll-a, BGA = Blue Green Algae

| Program / Project                 | No. of Records | Limnology Data Range                       | Site Type | Record Type      | Variables Collected |     |        | Other Variables / Comments                        |
|-----------------------------------|----------------|--------------------------------------------|-----------|------------------|---------------------|-----|--------|---------------------------------------------------|
|                                   |                |                                            |           |                  | Temp                | DO  | Secchi |                                                   |
| Asian Carp eDNA                   | 1332           | 2012-2019                                  | Point     | Surface          | X                   | X   | X      |                                                   |
| Central Basin Acoustics           | 389            | 2008-2009, 2011-2013, 2019                 | Station   | Surface / Bottom | X                   | X   |        |                                                   |
|                                   |                | 2001, 2003-2019                            |           | Profile          | X                   | X   |        | Conductivity, pH, TDS, Sal, Turbidity             |
| Central Basin Grid Trawl          | 258            | 2016-2019                                  | Station   | Surface / Bottom | X                   | X   | X      |                                                   |
|                                   |                | 2016, 2018-2019                            |           | Profile          | X                   | X   |        | Conductivity, pH, TDS, Turbidity, Sal, Chl-a, BGA |
| Coldwater Assessment              | 656            | 2000-2003, 2011-2013, 2015, 2019           | Point     | Profile          | X                   | X   |        | Conductivity, pH, Turbidity, Chl-a, BGA           |
|                                   |                | 2012-2019                                  |           | Data Logger      | X                   |     |        | Continuous Gear Temperatures [HOBO]               |
| Connecting Waters                 | 222            | 2002, 2004-2011, 2013-2015, 2017-2018      | Point     | Data Logger Avg  | X                   |     |        | Average of Continuous Gear Temperature data.      |
|                                   |                | 2019                                       |           | Bottom           | X                   | X   | X      | Conductivity, pH                                  |
| CSMI Diet Study                   | ----           | 2019                                       | ----      | -----            | ---                 | --- | ---    | Input in progress.                                |
| EB Hydroacoustics                 | 537            | 1995, 1997, 1999-2018                      | Point     | Profile          | X                   | X   |        | Conductivity, pH, Turbidity, Chl-a, BGA           |
| EB Walleye Stock ID               | 119            | 1999-2004                                  | Point     | Profile          | X                   |     | X      |                                                   |
| EB Partnership Trawl              | 218            | 1991-1994                                  | Point     | Surface / Bottom | X                   | X   | X      |                                                   |
| Interagency Trawl                 | 1569           | 1987-2014, 2016-2017, 2019                 | Station   | Surface / Bottom | X                   | X   | X      |                                                   |
|                                   |                | 2012-2013, 2015-2019                       |           | Profile          | X                   | X   |        | Conductivity, pH, TDS, Turbidity, Sal, Chl-a, BGA |
| Juvenile Index Trawl <sup>1</sup> | 3011           | 1980-2019                                  | Station   | Surface / Bottom | X                   | X   | X      |                                                   |
|                                   |                | 1997-2000, 2002-2019                       |           | Profile          | X                   | X   |        | Conductivity, pH, Turbidity, Chl-a, BGA           |
| Long Point Bay Gill Net           | 1601           | 1986-2011, 2017-2018                       | Point     | Surface / Bottom | X                   |     | X      |                                                   |
|                                   |                | 2011-2017                                  |           | Profile          | X                   |     |        | Continuous Gear Temperatures [HOBO]               |
| Long Point Bay Grid Trawl         | 230            | 2012-2018                                  | Station   | Data Logger      | X                   |     |        |                                                   |
|                                   |                | 2008-2016                                  |           | Profile          | X                   |     |        | Continuous Gear Temperatures [HOBO]               |
| Long Point Bay Hoop Net           | 67             | 2018-2019                                  | Point     | Data Logger      | X                   |     |        |                                                   |
| LSC Fish Community                | 120            | 2018                                       | Point     | Misc. Point      | X                   | X   | X      |                                                   |
| LSC Muskies Assessment            | 106            | 2019                                       | Point     | Bottom           | X                   | X   |        | Conductivity                                      |
| LSC Muskies Tagging               | 7              | 2017-2019                                  | Station   | Data Logger      | X                   |     |        | Continuous Annual Temperature [HOBO]              |
| LSC Nearshore Index               | 789            | 2005, 2007-2017                            | Station   | Surface          | X                   |     | X      |                                                   |
| Partnership Gill Net / YSI        | 3824           | 1989-2019                                  | Station   | Surface / Bottom | X                   | X   | X      |                                                   |
|                                   |                | 2001-2019                                  |           | Profile          | X                   | X   |        | Conductivity                                      |
| Walleye Tagging                   | 203            | 1990-1995, 1997-1998, 2000-2001, 2005-2008 | Point     | Surface          | X                   |     | X      |                                                   |
|                                   |                | 2012-2017                                  |           | Surface / Bottom | X                   | X   | X      |                                                   |
| West Basin Midwater Trawl         | 216            | 2012-2013, 2015-2017                       | Station   | Profile          | X                   | X   |        | Conductivity, pH, ORP                             |
| Winter Clupeids                   | 79             | 1999-2003                                  | Station   | Profile          | X                   | X   | X      | Conductivity, pH                                  |
| Yellow Perch Tagging              | 249            | 2010-2015                                  | Point     | Misc. Point      | X                   | X   | X      |                                                   |

<sup>1</sup>The profile data associated with the Juvenile Index Trawl is only collected during the deepwater section of the survey.

## 7.5 Zooplankton

A large archive of zooplankton samples collected as part of the Lake Erie Management Unit (LEMU) Limnology program (Section 5.3; above) was targeted for analysis in 2019. A quantitative description of lower trophic levels that included the productivity and composition of zooplankton communities throughout the lake, would be useful when investigating such issues as nutrient loading and declines in planktivorous forage fish species. Funded through the Great Lakes Protection Fund / Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health, external contractors were identified who could taxonomically identify, enumerate, and create estimates of density and biomass for Great Lakes zooplankton.

Archived samples from the Wheatley and Port Dover offices were collected, matched against newly compiled, edited and quality controlled historical field collection data (see Section 7.4; Limnology database) and shipped off for enumeration. The historical archive included samples from 24 stations in both Lake St. Clair (n=12) and Lake Erie (n=12). Samples had typically been collected bi-weekly from early May until the second week in October. For this exercise samples from six stations in Lake Erie (two stations each from the western, west-central, and eastern basins), collected between May and September, from 2015 through 2019, were chosen. Some archived samples were deemed lost, due to desiccation or loss of preservative. In total, 248 samples were chosen for enumeration and quantification.

The methodology used was consistent with that used by Lake Erie partner agencies, ensuring that the resulting data is compatible with the Lower Trophic Level Assessment (LTLA) database; a Forage Task Group (FTG) commitment to Lake Erie Committee (LEC) (see Section 5.3; above). Estimates were derived using either *Zebra2* or *Zebra5* software; both approaches used the same species length/weight relationships (from Downing and Rigler, 1984 and Hillbricht-Ilkowska and Stanczykowska 1969) for deriving biomass estimates from mean lengths. In this way, derived biomass is not only suitable for inclusion in the LTLA, but it is also comparable to historical Lake Erie data and with contemporary collections conducted by the Department of Fisheries and Oceans and Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS).

Data received is being incorporated into the LTLA database and analysis relative to fisheries management questions has begun and will continue into 2020. In 2019, discussions began with DFO-GLLFAS about the utility of coordinating sampling into the future so that, at the very least, there is not an overlap in zooplankton effort between LEMU and DFO on Lake Erie. These discussions will continue into 2020 and will include an examination of recently acquired data for the purposes of re-examining the current zooplankton sampling design in order to identify redundancies as well as deficiencies.

**References:**

Downing, J.A. and F.H. Rigler. 1984 A manual on methods for the assessment of secondary productivity in freshwaters. IBF Handbook No 17. 2nd edition. Blackwell Scientific Publications, Oxford, Great Britain.

Hillbricht-Ilkowska, A. and A. Stanczykowska. 1969 The production and standing crop of planktonic larvae of *Dreissena polymorpha* in two Mazurian lakes. Pol. Arch. Hydrobiol. 16(29): 193-203.

# APPENDIX A Operational Field and Lab Schedule 2019

| Field and Lab Projects                                        | Dates             | Species Assessed, Monitored, or Stocked                      | Project Lead (Bio) | Project Lead (Tech) | Location            | Funding Source |
|---------------------------------------------------------------|-------------------|--------------------------------------------------------------|--------------------|---------------------|---------------------|----------------|
| Lake St. Clair - Detroit River Muskellunge Spawning Survey    | April - June      | Muskellunge                                                  | Thorn              | Gignac/Thomas       | Wheatley            | SPA            |
| Lake Erie Commercial Catch Sampling                           | April-November    | Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch | Belore             | Thomas              | Wheatley            | SPA            |
| Contaminant Sampling                                          | April-November    | Multiple Species                                             |                    | Benoit              | Wheatley            | SPA            |
| Lake Erie Temperature Loggers                                 | April-November    | Limnology                                                    |                    | Staelis             | Wheatley            | SPA            |
| Asian Carp eDNA Monitoring                                    | May-July          | Asian Carp                                                   | Belore             | Thomas              | Wheatley            | COA            |
| Lake Erie Limnology                                           | May-October       | Limnology                                                    | MacDougall         | Klack               | Wheatley            | SPA            |
| Lake St. Clair Limnology                                      | May-September     | Limnology                                                    | Marklevitz         | Klack               | Wheatley            | SPA            |
| Lake Erie Central Basin Hydro Acoustics                       | July              | Multiple Species                                             | Cook               | Gignac              | Wheatley            | SPA            |
| CSMI Lake Erie Diet study                                     | July-November     | Multiple Species                                             | Marklevitz         | Harrison/Staelis    | Wheatley/Port Dover | COA            |
| Connecting Waters St. Clair & Detroit Rivers                  | July-September    | Multiple Species                                             | Thorn              | Thomas              | Wheatley            | COA            |
| West Basin Interagency Trawling                               | August            | Multiple Species                                             | Cook               | Gignac              | Wheatley            | SPA            |
| Partnership Index                                             | August-November   | Multiple Species                                             | Cook               | N/A                 | Wheatley            | SPACRF         |
| Lake Erie Central Basin trawling                              | October           | Yellow Perch, multiple species                               | Belore             | Gignac              | Wheatley            | SPA            |
| Lake St. Clair Muskellunge acoustic tagging                   | October           | Muskellunge                                                  | Thorn/Marklevitz   | Staelis             | Wheatley            | SPA            |
| Lake Whitefish Acoustic tagging                               | November          | Lake Whitefish                                               | Cook               | Staelis/Thomas      | Wheatley            | CRF            |
| Age and Growth                                                | Continuous        | Multiple Species                                             | Multiple           |                     | Wheatley            | SPA            |
| Lake Erie Limnology                                           | May-Oct           | Limnology                                                    | MacDougall         | Werner              | Pt. Dover           | SPA            |
| Lake Erie Commercial Catch Sampling                           | Apr-Nov           | Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch | Belore             | Trebych             | Pt. Dover           | SPA            |
| Asian Carp eDNA Monitoring                                    | June, July        | Asian Carp                                                   | Belore             | Mummery             | Pt. Dover           | COA            |
| East Basin Fishery DNA Collection                             | May-Oct           | Walleye                                                      | MacDougall         | Werner              | Pt. Dover           | SPA            |
| Contaminant Sampling- LPB & Eastern Basin                     | Apr-Nov           | Multiple Species                                             |                    | Norrie              | Pt. Dover           | SPA            |
| Long Point Bay Temperature Loggers                            | Mar-Oct           | Water temps - Long Point Bay, Port Dover Intake, 2 Gas Wells | MacDougall         | Ives                | Pt. Dover           | SPA            |
| Lake Erie Limnology                                           | May-October       | Limnology                                                    | MacDougall         | Werner              | Pt. Dover           | SPA            |
| Grand River Walleye Tagging and Monitoring                    | April - October   | Walleye                                                      | MacDougall         | Harrison            | Pt. Dover           | SPACOA         |
| Lake Trout Stocking                                           | May, November     | Lake Trout                                                   | MacDougall         | Norrie              | Pt. Dover           | SPA            |
| Lake Trout Tag Removal                                        | Continuous        | Lake Trout                                                   | MacDougall         | Trebych             | Pt. Dover           | SPA            |
| Cold Water Survey                                             | August            | Lake Trout, Burbot, Lake Whitefish                           | Heerschap          | Gough               | Pt. Dover           | SPA            |
| Long Point Bay Nearshore Trawling                             | August, September | Multiple Species                                             | Bonsall            | Werner              | Pt. Dover           | SPA            |
| Long Point Bay Offshore Trawling                              | Sept-November     | Multiple Species                                             | Bonsall            | Werner              | Pt. Dover           | SPA            |
| Central Basin Trawling                                        | October           | Multiple Species                                             | Bonsall            | Werner              | Pt. Dover           | SPA            |
| Deepwater Assessment                                          | August            | Multiple Species                                             | Heerschap          | Gough               | Pt. Dover           | SPA            |
| Lake Erie Eastern Basin Hydro Acoustics                       | July              | Lake Trout, Burbot, Lake Whitefish                           | Holden             | Gough               | Pt. Dover           | SPA            |
| 2019 CSM Diet Composition Study of Key Lake Erie Fish Species | June-January      | Smelt and Other Pelagic Forage Fish                          | Marklevitz         | Norrie              | Pt. Dover           | SPA            |
| Habitat Stability Index Grand River                           | July-November     | Multiple Species                                             | MacDougall/Oumer   | Harrison            | Pt. Dover           | COA            |
| Connecting Waters Fish Community Assessment Niagara River     | August-September  | Habitat                                                      | Thorn              | Hennick             | Pt. Dover           | COA            |
| Inner Long Point Bay Adult Fish Community Hoop Net Survey     | April-May         | Multiple Species                                             | May                | Norrie              | Pt. Dover           | COA            |
| Age and Growth                                                | Continuous        | Multiple Species                                             | Multiple           | Ives                | Pt. Dover           | SPA            |

Note: SPA = Special Purpose Account, COA = Canada Ontario Agreement, GLFC= Great Lakes Fisheries Commission, CRF=Consolidated Revenue Fund

The Lake Erie Management Unit has administered an assessment program which has focused on providing information to guide fisheries management decisions and native species restoration. A number of the field projects are integrated with U.S. partners and provide information that informs both commercial and recreational needs. Regular projects are funded through the Special Purpose Account (SPA) and subsidiary projects through the Canadian Ontario (COA) on Great Lakes water quality and ecosystem health. Appendix A provides a list of current projects and related funding sources.

# APPENDIX B – LAKE ERIE MANAGEMENT UNIT DATA REQUEST LOG 2019

| Date of Request  | Agency/<br>Organization Name | Requester's<br>Surname | Requester's<br>First Name | Data Requested                                                                            | Data Provided by                         | Date Data<br>Provided |
|------------------|------------------------------|------------------------|---------------------------|-------------------------------------------------------------------------------------------|------------------------------------------|-----------------------|
| June 27, 2019    | USGS - Lake Superior         | Gorman                 | Owen                      | Long Point Bay index trawl CPUE time series data                                          | Chelsea May                              | June 27, 2019         |
| April 29, 2019   | DFO                          | Stacey                 | Joshua                    | Inner Bay Spotted Gar catches - hoop net survey and commercial fishery                    | Chelsea May/Karen Soper                  | May 7, 2019           |
| April 10, 2019   | Nature Conservancy           | Sakas                  | Alexis                    | Lake Whitefish commercial harvest and effort. Lake Whitefish commercial catch sample data | Megan Belore/Karen Soper                 | September 9 2019      |
| July 18, 2019    | DFO                          | Eric                   | Smyth                     | Rondeau Bay Carp tagging data                                                             | Michael Thorn                            | July 22, 2019         |
| January 15, 2019 | MSC                          | Casselman              | John                      | Interagency trawl results - Walleye, Yellow Perch;                                        | Andy Cook                                | January 16, 2019      |
| January 15, 2019 | MSC                          | Casselman              | John                      | Partnership results - Yellow Perch, Walleye                                               | Andy Cook                                | January 16, 2019      |
| October 1 2019   | Ohio State University        | Ludsin                 | Stu                       | West Basin Interagency trawl data                                                         | Andy Cook                                | October 29 2019       |
| April 9 2019     | DFO                          | Hossain                | Monir                     | West Basin Interagency trawl data                                                         | Andy Cook                                | May 28 2019           |
| April 9 2019     | DFO                          | Hossain                | Monir                     | West Basin Midwater trawl data                                                            | Andy Cook                                | May 28 2019           |
| April 9 2019     | DFO                          | Hossain                | Monir                     | Central Basin Midwater trawl data                                                         | Andy Cook                                | May 28 2019           |
| April 9 2019     | DFO                          | Hossain                | Monir                     | Partnership Index Gill Net data - all                                                     | Andy Cook                                | May 28 2019           |
| Feb 2019         | USFWS                        | Treska                 | Ted                       | Partnership Index Gill Net and Auxiliary Deep Net data                                    | Andy Cook                                | March 18 2019         |
| January 31 2019  | University of Toledo         | Amidon                 | Zachary                   | Partnership Lake Whitefish indices                                                        | Andy Cook                                | January 31 2019       |
| March 19, 2019   | DFO                          | Durofil                | Robert                    | Commercial Fish licence information                                                       | Karen Soper                              | April 1, 2019         |
| May 28, 2019     | Consultant                   |                        |                           | Lake St. Clair Seine, Gill Net, and Trap Net catch data (Mitchell's Bay)                  | Megan Belore/Michael Thorn/Tom MacDougal | September 20, 2019    |
| October 17, 2019 | MSC                          | Vito                   | Romito                    | Lake Erie White Bass stock assessment results                                             | Michael Thorn                            | November 1, 2019      |

## APPENDIX C – LAKE ERIE MANAGEMENT UNIT STAFF 2019

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Megan Belore – Assessment Biologist  
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Craig McDonald – Vessel Master  
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Chris Gignac – Fisheries Technician  
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Chris Thomas – Fisheries Technician  
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Chelsea May – Assessment Biologist  
Heather Harrison – Fisheries Technician  
Marion Mummery – Fisheries Technician  
Duncan Norrie – Fisheries Technician  
Tina Werner – Fisheries Technician  
Matthew Heerschap – COA Biologist  
Danielle Hennink – COA Fisheries Technician  
Cassandra Orfanakos – COA Fisheries Technician  
Nathan Trebych – Port Observer/COA Fisheries Technician  
Aaron Zuwala – A/Port Observer  
Sarah Gough – SEO Assistant Tech/COA Fisheries Technician  
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