



# 2018 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):**

- Assessment Biologist, Chelsea May, setting hoop nets in Inner Long Point Bay.
- Clockwise; Fisheries Technicians Samuel Mansfield, Jessica Patterson, Jessica Klack and Nathan Staels working on the Interagency Trawl program.

# **2018 Annual Report**

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

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## **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 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), 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.

## 1. EXECUTIVE SUMMARY STATUS OF MAJOR STOCKS

In 2018, Ontario commercial landings in Lake Erie totaled 20.4 million pounds with a landed value of \$37 million (Table 1.1). Harvest (pounds) in 2018 was composed of Walleye (35%), Yellow Perch (23%), White Perch (18%), Rainbow Smelt (13%), White Bass (10%), and other species (1%). Landed value was highest for Walleye (55%) followed by Yellow Perch (32%), White Perch (6%), White Bass (6%), Rainbow Smelt (2%) and other species(<1%). Total commercial harvest in 2018 (20.4 million pounds) was second lowest from 1960 to present, due primarily to near record low Rainbow Smelt harvest. 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 annually by the Angler Diary Program and periodically by creel surveys.

**Table 1.1** Total annual commercial fishery landings (landed weight in pounds) and value dollars by fish and statistical district for the Canadian waters of Lake Erie, 2018.

| Species                    | Landings by Statistical District |                     |                    |                    |                    | Total Landing     | Total Value         |
|----------------------------|----------------------------------|---------------------|--------------------|--------------------|--------------------|-------------------|---------------------|
|                            | OE-1                             | OE-2                | OE-3               | OE-4 <sup>a</sup>  | OE-5               |                   |                     |
| Burbot                     | 0                                | 44                  | 48                 | 15                 | 6                  | 113               | \$13                |
| Carp                       | 6,150                            | 830                 | 29                 | 0                  | 10                 | 7,019             | \$1,285             |
| Catfish                    | 9,579                            | 12,907              | 879                | 36                 | 26                 | 23,427            | \$7,420             |
| Freshwater Drum            | 27,852                           | 90,848              | 40,068             | 1,098              | 5,524              | 165,390           | \$24,812            |
| Gizzard Shad               | 821                              | 155                 | 0                  | 0                  | 0                  | 976               | \$0                 |
| Lake Whitefish             | 34,455                           | 8,344               | 1,149              | 348                | 328                | 44,624            | \$61,196            |
| Rainbow Smelt              | 0                                | 59                  | 107,450            | 1,153,126          | 1,297,200          | 2,557,835         | \$588,252           |
| Rock Bass                  | 25                               | 4                   | 0                  | 0                  | 0                  | 29                | \$10                |
| Suckers                    | 15,511                           | 17,880              | 1,868              | 0                  | 744                | 36,003            | \$8,337             |
| Walleye                    | 2,990,803                        | 2,725,870           | 872,368            | 361,836            | 272,181            | 7,223,058         | \$20,534,525        |
| White Bass                 | 702,503                          | 1,029,706           | 256,362            | 68,552             | 24,541             | 2,081,664         | \$2,089,585         |
| White Perch                | 885,692                          | 1,665,429           | 1,050,505          | 46,917             | 5,157              | 3,653,700         | \$2,146,277         |
| Yellow Perch               | 1,262,229                        | 1,271,365           | 1,694,028          | 144,669            | 241,681            | 4,613,972         | \$11,713,723        |
| Mixed <sup>b</sup>         | 2,792                            | 153                 | 0                  | 0                  | 0                  | 2,945             | \$1,726             |
| <b>Total Landing (lbs)</b> | <b>5,938,412</b>                 | <b>6,823,594</b>    | <b>4,024,754</b>   | <b>1,776,597</b>   | <b>1,847,398</b>   | <b>20,410,755</b> |                     |
| <b>Total Value (\$)</b>    | <b>\$12,909,641</b>              | <b>\$13,152,276</b> | <b>\$7,642,352</b> | <b>\$1,766,882</b> | <b>\$1,706,010</b> |                   | <b>\$37,177,161</b> |

a Excludes Inner Long Point Bay.

b A variety of incidentally caught species of little or no value

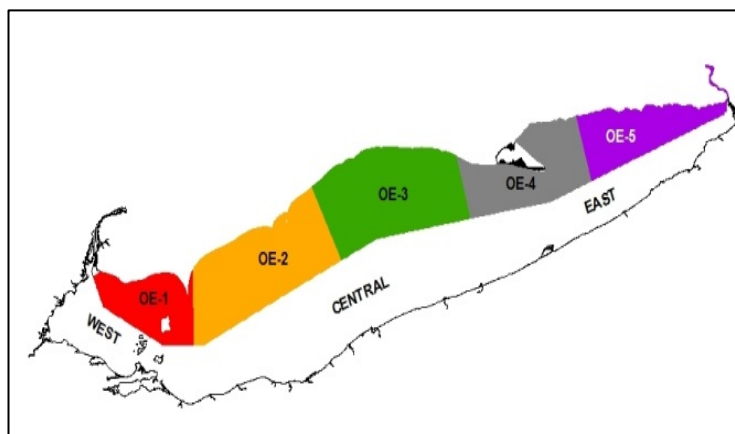


**Figure 1.1** Ontario statistical districts (OE 1-5) of Lake Erie.

### Walleye

The lakewide commercial Walleye harvest (7.2 million lbs.) in 2018 represented 102% of the 7.0 million pound quota. The 2018 harvest was well above the mean harvest from 2000 to present (5.0 million lbs.) and the mean harvest from the inception of individual transferable quotas (ITQs) (1984 to present; 6.3 million lbs.; Figure 1.2). Walleye harvest (lbs.) across statistical districts OE1 to OE5 during 2018 was 41%, 38%, 12%, 5% and 4%, respectively. The commercial Walleye fishery age composition (range: 1-19) in the west and central basins (OE-1, OE-2, OE-3), consisted mostly of age 3 and age 4 fish. Age composition of Walleye harvested in the east basin (range: 1-19) was dominated by ages 3, 4, 8 and 10+.

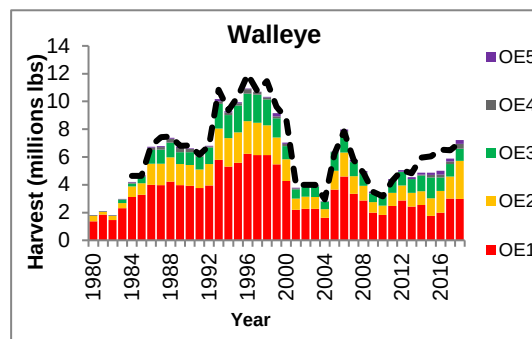


**Figure 1.2** Walleye commercial harvest by statistical district in Lake Erie, 1980-2018. Lakewide quota presented as dotted line.

Lakewide Partnership gill net surveys were comprised of Walleye ranging in age from 0 to 15. Lakewide, gill net index catches were dominated by age 3 Walleye (2015 cohort). In west and central Lake Erie, ages 1, 2 and 0 contributed significantly to catches. In the east basin, age 2 Walleye were the second most abundant age group in 2018. In 2018, the interagency west basin trawl survey caught record high numbers of age 0 Walleye whereas catches of yearlings were near average. Commercial and recreational fishing in 2019 is expected to thrive, benefiting mostly from age 4 Walleye.

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 local and migratory 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 4.6 million pounds of Yellow Perch in 2018, attaining 93% of the quota allocated. The Yellow Perch harvest in 2018 was below the mean harvest from 2000 to present (5.4 million lbs.) and the long term mean harvest from when Individual Transfer Quotas (ITQs) were introduced in 1984 (5.9 million lbs.). The distribution of harvest across statistical districts OE1 to OE5 in 2018 was 27%, 28%, 37%, 3% and 5%, respectively (Figure 1.3). Overall, Yellow Perch harvest in 2018 decreased 7% from 2017. Lakewide, harvest age composition was highest for ages 4, 3 and 2, respectively. Fishery age compositions varied seasonally and spatially. Age 2 Yellow Perch were significant in the harvest from OE5, but less common in OE's 1 to OE4 and were absent from OE's 2 and OE's 3 spring commercial fisheries.

In general, older Yellow Perch were less common, however, 6 year old fish were common in OE3 and OE4 spring fisheries. Fisheries in 2019 will continue to benefit from the 2014 cohort in west and central Lake Erie with more contribution from younger Yellow Perch in eastern Lake Erie.

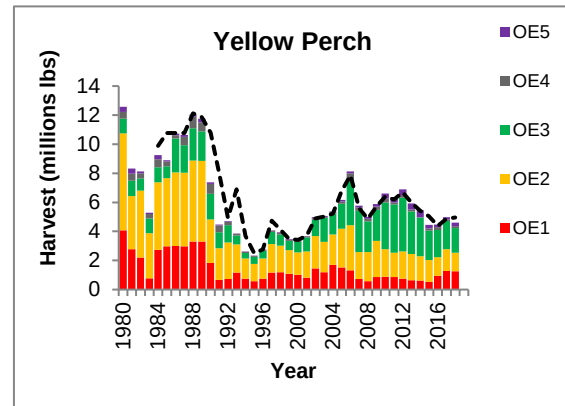


**Figure 1.3** Yellow Perch commercial harvest by statistical district in Lake Erie, 1980-2018. Lakewide quota presented as dotted line.

Partnership gill net indices were low in the west and central basin surveys and moderate in Pennsylvania Ridge and east basin surveys assessed in 2018. Ages 4, 2, 1 and 3 represented most of the Yellow Perch caught in the west and central basin projects with variation between surveys. In the east basin survey, age 2 Yellow Perch dominated catches. Yellow Perch age composition was youngest in the east, followed by the west, east-central, west-central and Pennsylvania Ridge surveys.

Based on the Partnership gill net index, along with trawl indices of age 0 and yearlings, recruitment in 2019 is expected to be moderate in the west, east central and east basins but weaker in the west-central basin. Indices of cohort strength vary spatially, but also between gear types and age groups. Age 0 trawl abundance indices in 2018 were strong in the west and east basins, indicating good recruitment potential for 2020, depending on survival of juvenile fish. 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. Ontario Ministry of Natural Resources and Forestry (OMNRF) and United States Geological Survey (USGS) research vessels completed this extensive survey again in 2018. In 2018, catch rates of age 0 Yellow Perch were 50% lower compared to 2017 while yearling Yellow Perch were 47% higher than observed in 2017. Catch rates were lower in the west-central area than in the east-central for age 0 and yearlings. 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, OMNRF, United States (US) management agencies and stakeholders, and the Quantitative Fisheries Center at Michigan State University have been collaborating in the LEPMAG process. In 2019, the LEPMAG recommended a new Yellow Perch harvest policy to the Lake Erie Committee, setting the foundation for 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, with a slight increase in 2018 (Figure 1.4). 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 2018 was 44,624 pounds, distributed across OE1 to OE5 as follows: 77%, 19%, 3%, <1% and <1% (Figure 1.4). The age composition of Lake Whitefish in the large mesh gill net fishery was comprised mainly of fish between the ages of 3 and 15, with age 3 (2015 year class), being most abundant. Age 4 Lake Whitefish was the 2<sup>nd</sup> most abundant age group represented in the large mesh gill net fishery.

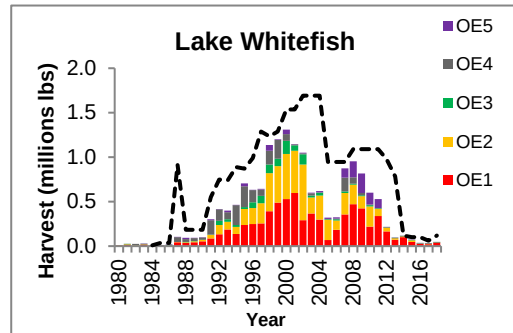


**Figure 1.4** Lake Whitefish commercial harvest by statistical district in Lake Erie, 1980-2018. Lakewide quota presented as dotted line.

Partnership gill net catch rates in central and eastern Lake Erie improved in 2018, due mainly to contributions from age 3 (2015 cohort) and 4 (2014 cohort) Lake Whitefish. The age composition from central basin, Pennsylvania Ridge and east basin surveys ranged from 0-15, with a mean age of 3.4, reflecting the appearance of new year classes during recent years. Young-of-the-year Lake Whitefish were also present in the Long Point Bay offshore trawl survey in 2018. Fishery and survey data indicate that young fish are contributing to the recovery of the Lake Whitefish population. 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 GLATOS network, the Great Lakes Fishery Commission (GLFC) and the Data Deficient Work Group.

### Rainbow Smelt

Although Rainbow Smelt are not native, they are a dominant forage species in Lake Erie and contribute significantly to Ontario's commercial fish landings. Rainbow Smelt harvest in 2018 (2.6 million lbs.) amounted to 16% of the lakewide quota (15.5 million lbs.) (Figure 1.5). Harvest in 2018 was well below the mean harvest from 2000 to present (7.2 million lbs.) and below the long term mean harvest from when ITQs were introduced in 1984 (11.3 million lbs.). Landings of Rainbow Smelt in 2018 were greatest in OE5 (51%), followed by OE4 (45%) and OE3 (4%). Harvest age composition ranged from 1 to 7 with ages 1 and 2 most abundant in the trawl harvest. Long Point Bay (LPB) trawl survey catch rates of age 0 and older Rainbow Smelt were below average in 2018. 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 Rainbow Smelt abundance (642 fish/hectare) in 2018 as the 17<sup>th</sup> percentile of the 12 year time series (2007-2018).

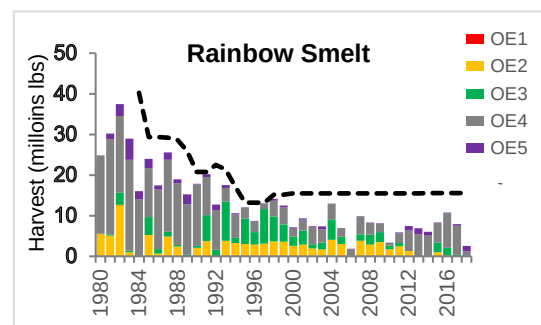


**Figure 1.5** Rainbow Smelt commercial harvest by statistical district in Lake Erie, 1980-2018. Lakewide quota presented as dotted line.

### White Bass

White Bass harvest, which is not regulated by quota in Lake Erie, totaled 2.0 million pounds in 2018. Harvest in 2018 was below the mean harvest from 2000 to present (3.5 million lbs.) and the long term mean harvest since 1984 (3.1 million lbs.). Distribution of harvest across statistical districts OE1 to OE5 in 2018 was 34%, 49%, 12%, 3% and 1%, respectively (Figure 1.6). The White Bass harvest was composed of ages ranging from 2 to 13; age 6 was most abundant.

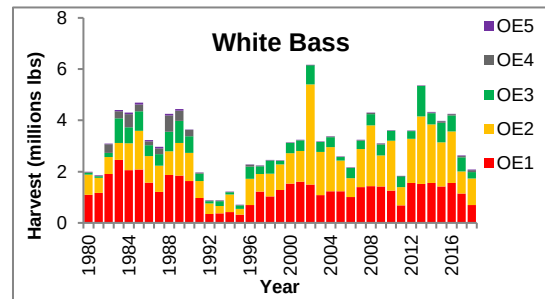


**Figure 1.6** White Bass commercial harvest by statistical district in Lake Erie, 1980-2018.

White Bass Partnership gill net abundance indices were low in the west, and central basin surveys in contrast with the Pennsylvania Ridge and east basin surveys where catch rates were above average in 2018. Catch rates declined from 2017 surveys by varying degrees across the lake. Ages 5 and 2 were the most abundant age groups lakewide; however, age 0 White Bass contributed more to the west-central basin age composition than other age groups. The youngest age composition observed in 2018 was in the west-central basin, followed by the east-central, west, Pennsylvania Ridge and east basin.

International agency and stakeholder collaboration from the Data Deficient Working Group (DDWG) has focused on White Bass status as part of the Marine Stewardship Council (MSC) certification process for the Walleye gill net fishery. White Bass are a significant by-catch species in Walleye gill nets and MSC placed a condition on the Walleye fishery requiring that White Bass be sustainably harvested in Lake Erie. The DDWG developed a White Bass assessment model with biological reference points to evaluate the sustainability of the White Bass harvest and found that the current harvest levels are within biological limits. As a result, MSC has waived the White Bass condition for the Walleye gill net fishery.

### White Perch

The White Perch is a non-native species that is not managed by quota. The commercial harvest of White Perch in 2018 totaled 3.7 million pounds. The 2018 harvest exceeded the mean harvest from 2000 to present (2.0 million lbs.) and was above the long term mean harvest since 1984 (2.1 million lbs.). White Perch harvest across statistical districts OE1 to OE5 in 2018 was: 24%, 46%, 29%, 1% and <1% (Figure 1.7). The White Perch harvest was composed of ages ranging from 2 to 13. Ages 3, 6, 4 and 7 White Perch were prevalent in the large mesh nets. Ages 3 and 2 White Perch were common in the small mesh nets with age 3 and 6 most common overall.

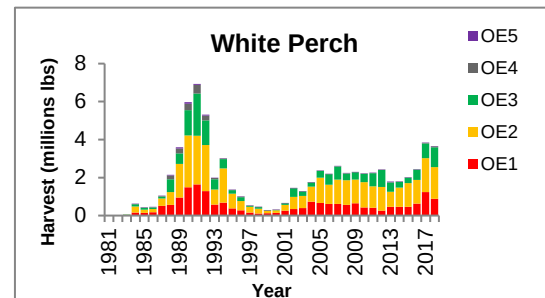


**Figure 1.7** White Perch commercial harvest by statistical district in Lake Erie, 1981-2018.

In 2018, Partnership gill net survey catch rates of White Perch were low in the west basin, moderate in central basin and the Pennsylvania Ridge surveys and higher in the east basin. Catch rates decreased from 2017 in the west, west-central basin and Pennsylvania Ridge surveys but increased significantly in the east-central and east basin surveys. Ages 0 to 9 were present lakewide in 2018 with ages 3 and 2 most abundant in varying proportions among surveys.

## 2. COMMERCIAL FISHERY

### 2.1 Lake Erie Commercial Fishery

In 2018, the total commercial landings from Ontario waters of Lake Erie was 20.4 million pounds with a total value of \$37 million. The decrease of total landings from 2017 (20%), and the total value (14%), was primarily due to the decreased harvest of Rainbow Smelt lakewide (down 5.3 million pounds) (Figure 2.1.1). The average landed value per pound for most species also decreased from 2017, contributing to the drop in total value in 2018. Harvest and landed value in 2018 are presented for each species by statistical district (Ontario Erie (OE), Figure 1.1) in Table 1.1. Total Walleye landings increased 23% from 2017 to 7.2 million pounds, resulting in 100% of the 2018 allocated quota being harvested (Table 1.1, Figure 2.1.1). Lakewide Walleye harvest by size category was: Jumbo (10%), Number 1 (85%) and Number 2 (4%). Yellow Perch landings decreased 0.4 million pounds from 2017 to 4.6 million pounds in 2018, representing 93% of allocated quota (Table 1.1, Figure 2.1.1). The landed value of Yellow Perch also decreased by 35% from 2017 to \$11.7 million as a result of the lower harvest as well as a lower price per pound in 2018.

With total landings of 44,624 lbs., Lake Whitefish harvest increased slightly from 2017 (Table 1.1, Figure 2.1.1). In 2018 Lake Whitefish continued to be a non-targeted commercial fish species; all Lake Whitefish were harvested as by-catch in other targeted fisheries. The commercial fishery harvested 37% of the 120,000 lbs. of allocated quota. Seventy-seven percent of the total harvest came from OE-1 (an increase of 7% from 2017), while 19% was harvested from OE-2, similar to 2017. Transfers of Walleye quota out of quota zone 1 (OE-1) continued in 2018 to protect fall spawning Lake Whitefish stocks; however 74% of the harvest in OE-1 occurred from October to December. The landed value of Lake Whitefish increased 49% to approximately \$61 thousand in 2018 (Table 1.1).

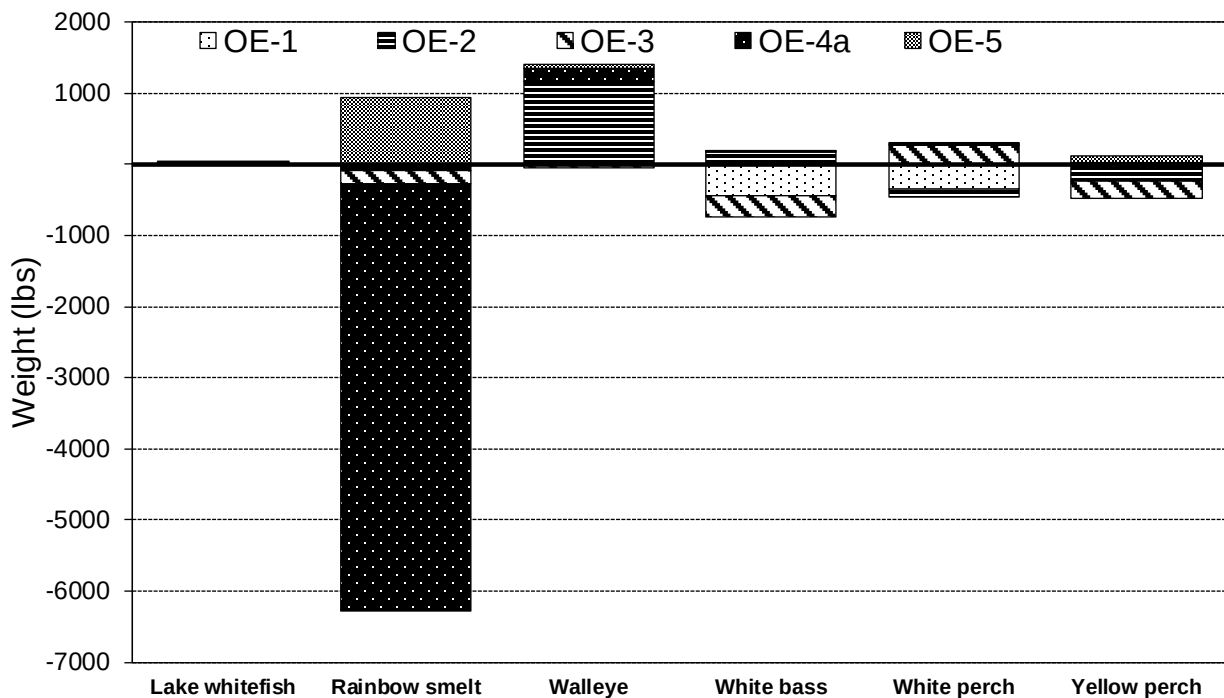


**Figure 2.1.1** Change in weight of the annual commercial fishery landings (1000's of lbs.) from 2017 to 2018 for principle species by statistical district, Lake Erie.

Rainbow Smelt harvest in 2018 had the largest decline of all species from the previous year, dropping to 2.6 million pounds; 16% of the allocated quota. This was a decrease of 68% from 2017 (Table 1.1, Figure 2.1.1). Fifty-one percent of the harvest was taken from OE-5 while 45% was harvested in OE-4 and only 4% from OE-3. Of the 155 licences with Rainbow Smelt quota, only 9 landed Rainbow Smelt in 2018, while only 4 attained more than 20% of their individual quota. The landed value of Rainbow Smelt was down 68% from 2017 to \$0.6 million (Table 1.1).

White Bass and White Perch are commercial fish species currently not regulated by quota. Total landings of White Bass decreased by 21% from 2017 to 2.1 million pounds in 2018, the majority of which occurred in statistical districts OE-1 (34%), OE-2 (50%) and OE-3 (12%) (Table 1.1, Figure 2.1.1). The landed value of White Bass decreased 22% to \$2.1 million in 2018 (Table 1.1). The total landings of White Perch decreased 5% to 3.6 million pounds from 2017, with harvest occurring primarily in statistical districts OE-2 (46%), OE-3 (29%) and OE-1 (24%) (Table 1.1, Figure 2.1.1). In 2018, White Perch total landed value declined 22% from 2017, to a value of \$2.1 million (Table 1.1).

### *Inner Long Point Bay Fishery*

The hoop and seine net fisheries of Inner Long Point Bay contribute less than one percent (0.6%) by weight to the total annual commercial harvest landed in Ontario waters of Lake Erie. In 2018, total commercial landings were 129,116 pounds (Table 2.1.1) an increase of 18% from 2017. Live fish accounted for 74% of this harvest. The value of the total commercial landings in 2018 was \$124,871, a decrease of 1% from 2017, representing 0.3% of the total landed value of the Ontario commercial fishery lakewide (Table 2.1.1).

In 2018, the total landing of Yellow Perch was 19,753 pounds, an increase of 167% from 2017, harvesting 74% of their allocated quota. The majority of Yellow Perch (94%) were caught in the spring (March and April). The landed value of Yellow Perch in 2018 dropped 21% from 2017 to \$19,103 (Table 2.1.1). In 2018, the total landing of Northern Pike was 9,578 pounds, an increase of 1% from 2017. The Inner Bay commercial fishery harvested 35% of their allocated quota in 2018. The majority of Northern Pike (93%) were caught in the spring (March and April). The landed value of Northern Pike in 2018 was \$3,080, a decrease of 2% from 2017 (Table 2.2.1).

**Table 2.1.1** Total annual commercial fishery landings  
(landed weight in pounds) and value (\$)  
by fish species for Inner Long Point Bay, 2018

| Species                     | Total Landing <sup>a</sup> | Total Value      |
|-----------------------------|----------------------------|------------------|
| Bowfin                      | 25,680                     | \$24,832         |
| Brown Bullhead              | 23,571                     | \$22,802         |
| Carp                        | 6,479                      | \$6,263          |
| Freshwater Drum             | 15                         | \$15             |
| Lepomis spp.                | 33,615                     | \$32,507         |
| Mudpuppy                    | 3,181                      | \$3,080          |
| Northern Pike               | 9,578                      | \$9,264          |
| Pomoxis spp.                | 1,844                      | \$1,783          |
| Rock Bass                   | 5,137                      | \$4,968          |
| White Perch                 | 263                        | \$254            |
| Yellow Perch                | 19,753                     | \$19,103         |
| <b>Total Landing (lbs.)</b> | <b>129,116</b>             |                  |
| <b>Total Value (\$)</b>     |                            | <b>\$124,871</b> |

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

## 2.2 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, growth characteristics and more. 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 the Lake Erie Management Unit (LEMU) uses a targeted sampling plan to sample fish species landed by the Lake Erie commercial fishery. The main objectives of catch sampling are: 1) to index the abundance of fish species; 2) to determine the size and age composition of the fish in the catch; 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 2018, a total of 16,297 fish were sampled during the commercial catch sampling program. Sampling is stratified by area (Ontario-Erie statistical district or OE; Figure 1), 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 2.2.1). 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. For simplicity, in Table 2.2.1, Lake Whitefish ages are presented using otolith ages.

Lakewide 7,006 Yellow Perch were sampled in 2018. The most common age group of Yellow Perch was age 4 (2014 year class), which comprised 53% of the harvest lakewide. Age 4 fish comprised 51% of the Yellow Perch harvest in the western basin, 61% in the west central basin, and 55% in the east central basin. In addition to age 4 fish, age 3 (2015 year class) Yellow Perch were common in the west and west central basins (30% and 23% of the harvest respectively). In the eastern basin the most common ages were age 2 fish (2016 year class; 55%) and age 3 fish (2016 year class; 27%).

In total, 4,508 Walleye were sampled from large and small mesh gill nets. Almost 3,800 Walleye were sampled from large mesh gill nets and over 700 Walleye were sampled from small mesh gill nets in 2018. Lakewide, 74% of the commercial Walleye harvested were age 3 (2015 year class) fish. More age 3 Walleye were harvested in the west and central basins (75% of total harvest), compared to the eastern basin (61% of total harvest). The second most common age was age 4 (2014 year class) fish with 13% of the lakewide harvest.

One hundred and eighty-three Lake Whitefish were sampled from large mesh gill nets during fall. Sixty-five percent of the Lake Whitefish sampled were from the 2015 year class (age 3 fish), and 34% were from the 2014 year class (age 4 fish).

Over 1,100 White Bass were sampled, mainly from large mesh gill nets. Over half of the White Bass sampled consisted of the 2012 year class (age 6 fish), followed by the 2010 year class (age 8 fish). In total more than 1,700 White Perch were sampled, 999 from large mesh nets and 740 from small mesh nets. Ages 3, 6, 4 and 7 White Perch were prevalent in the large mesh nets. Ages 3 and 2 White Perch were common in the small mesh nets.

More than 1,700 Rainbow Smelt were sampled from trawl nets, 34% of the Rainbow Smelt were aged, 19% were unable to be aged due to poor scales, and the remainder were only sampled for length and weight. The majority of Rainbow Smelt aged were age 1 (2017 year class). Additional species caught as by-catch in Rainbow Smelt trawls are also sampled. In 2018, species sampled as a part of Rainbow Smelt by-catch included only Yellow Perch.

**Table 2.2.1** Number of commercial fish sampled by gear type, species, statistical district (OE) and age, 2018.

| 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       |     |     |     | 119  | 63   |     |     |    |     |    | 1   |          | 183           |      |
|           | Yellow Perch   | OE-1                 | All       |     |     | 126 | 468  | 810  | 172 | 15  | 1  | 2   |    | 1   | 2        | 1597          |      |
|           |                | OE-2                 | All       |     |     | 150 | 485  | 1238 | 86  | 90  | 16 | 6   |    | 3   | 4        | 2078          |      |
|           |                | OE-3                 | All       |     |     | 139 | 282  | 1391 | 114 | 331 | 36 | 18  | 2  | 15  | 31       | 2359          |      |
|           |                | OE-4                 | All       |     |     | 19  | 96   | 47   | 6   | 41  | 17 | 10  |    | 3   | 1        | 240           |      |
|           |                | OE-5                 | All       |     |     | 350 | 200  | 123  | 6   | 21  |    | 5   |    |     | 15       | 720           |      |
|           | Walleye        | OE-1                 | Number 1  |     | 10  | 83  | 675  | 204  | 22  | 9   | 5  | 4   |    | 2   | 5        |               | 1019 |
|           |                |                      | Jumbo     |     |     |     | 15   | 73   | 30  | 9   | 21 | 12  | 9  | 45  | 6        |               | 220  |
|           |                |                      | Number 2  |     | 63  | 75  | 79   | 1    |     |     |    |     |    |     |          | 2             | 220  |
|           |                |                      | Whitegill |     |     |     | 17   | 1    |     |     |    | 1   |    |     | 1        |               | 20   |
|           |                | OE-2                 | Number 1  |     | 19  | 30  | 1068 | 104  | 8   | 2   | 10 | 1   |    | 2   | 5        |               | 1249 |
|           |                |                      | Jumbo     |     |     |     | 41   | 83   | 15  | 17  | 11 | 7   | 5  | 27  | 4        |               | 210  |
|           |                |                      | Number 2  |     | 81  | 17  | 41   |      |     |     |    |     |    |     |          | 1             | 140  |
|           |                |                      | Whitegill |     |     |     | 35   | 4    |     |     |    |     |    |     |          | 1             | 40   |
|           |                | OE-3                 | Number 1  |     | 2   | 7   | 518  | 53   | 7   | 1   | 1  |     |    |     |          | 11            | 600  |
|           |                |                      | Jumbo     |     |     |     | 9    | 33   | 8   | 4   | 2  | 1   |    | 2   | 1        |               | 60   |
|           |                |                      | Number 2  |     | 10  | 23  | 86   |      |     |     |    |     |    |     |          | 1             | 120  |
|           |                |                      | Whitegill |     | 1   | 1   | 17   | 1    |     |     |    |     |    |     |          |               | 20   |
|           |                | OE-4                 | Number 1  |     |     |     | 208  | 25   | 3   |     |    | 3   |    | 1   |          |               | 240  |
|           |                |                      | Jumbo     |     |     |     |      | 12   | 6   | 3   | 2  | 1   | 1  | 4   | 1        |               | 30   |
|           |                | OE-5                 | Number 1  |     |     | 1   | 199  | 41   | 4   | 10  | 4  | 11  | 1  | 7   | 2        |               | 280  |
|           |                |                      | Jumbo     |     |     |     |      | 1    | 1   | 2   | 2  | 7   | 1  | 6   |          |               | 20   |
|           |                |                      | Number 2  |     |     | 10  | 10   |      |     |     |    |     |    |     |          |               | 20   |
|           | White Perch    | OE-1                 | All       |     |     | 42  | 187  | 72   | 11  | 74  | 37 | 18  | 8  | 10  |          | 459           |      |
|           |                | OE-2                 | All       |     |     | 86  | 277  | 59   | 11  | 141 | 67 | 23  | 21 | 15  | 40       | 740           |      |
|           |                | OE-3                 | All       |     |     | 72  | 234  | 28   | 4   | 64  | 21 | 15  | 9  | 13  |          | 460           |      |
|           |                | OE-4                 | All       |     |     | 1   | 14   | 3    |     | 8   | 4  | 4   | 2  | 4   |          | 40            |      |
|           |                | OE-5                 | All       |     |     | 13  | 24   | 1    | 1   | 1   |    |     |    |     |          | 40            |      |
|           | White Bass     | OE-1                 | All       |     |     | 60  | 5    | 2    |     | 177 | 4  | 68  | 2  |     | 2        | 320           |      |
|           |                | OE-2                 | All       |     |     | 50  | 5    |      |     | 314 | 10 | 107 | 1  | 8   | 5        | 500           |      |
|           |                | OE-3                 | All       |     |     | 51  | 3    |      | 1   | 83  | 1  | 37  | 2  | 2   |          | 180           |      |
|           |                | OE-4                 | All       |     |     | 13  |      |      |     | 37  | 1  | 24  |    | 2   | 3        | 80            |      |
|           |                | OE-5                 | All       |     |     | 3   |      |      |     | 30  | 2  | 17  | 1  | 5   | 2        | 60            |      |
| Trawl     | Rainbow Smelt  | OE-3                 | All       |     | 32  | 28  |      |      |     |     |    |     |    |     | 66       | 120           | 246  |
|           |                | OE-4                 | All       | 2   | 164 | 77  | 54   | 18   |     |     | 1  |     |    |     | 142      | 360           | 818  |
|           |                | OE-5                 | All       |     | 187 | 13  | 10   | 1    |     |     |    |     |    |     | 126      | 320           | 657  |
|           | Yellow Perch   | OE-4                 | All       | 12  |     |     |      |      |     |     |    |     |    |     |          |               | 12   |

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.

### 2.3 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 fair and 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 2018, 45% (4,560) of 10,103 DCRs were inspected by Port Observers. Of the total 20.4 million pounds landed in 2018, 65% (13.3 million pounds) was inspected or weights were observed. By species, 61% (2.8 million pounds) of Yellow Perch and 75 % (5.4 million pounds) of Walleye harvested were inspected in 2018. 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 2018, 1023 errors were identified and corrected by Port Observers. In addition, there were 41 verbal and written warnings for failing to comply with conditions of commercial fishing licences.

### 2.4 Marine Stewardship Council Certification

In 2018, the Lake Erie Management Unit (LEMU) continued to work closely with the Ontario commercial fishing industry to ensure that MSC conditions for Walleye and Yellow Perch are being met. As described in the 2017 Annual Report, Marine Stewardship Council (MSC) Certification will apply conditions if the fishery does not achieve a specific score against one of the many performance indicators (PI). Having a set of conditions does not mean the fishery is not sustainable. Instead, conditions are corrective actions designed to ensure the certified fishery continues to improve.

The conditions imposed on the Walleye fishery are to ensure that the certified large mesh gill net fishery does not pose a serious risk to or irreversibly harm White Bass or Lake Whitefish populations in Lake Erie. To meet these conditions, evidence needs to be provided that demonstrate the fishery has negligible impacts on White Bass and Lake Whitefish and that both species are within biologically based limits.

#### *Biological Reference Points for White Bass*

In 2018, LEMU developed biological reference points for White Bass in Lake Erie to determine whether they are being harvested sustainably. Three approaches were used to define biological reference points: 1) yield per recruit (YPR), 2) spawning potential ratio (SPR), and 3) spawning stock biomass (SSB). YPR and SPR are fishing mortality based biological reference points, whereas SSB is a biomass based biological reference point. Both types of biological reference points provide thresholds that define when the fishery is considered sustainable or when the fishery may be harming the population. These biological reference points are used in conjunction with statistical catch at age (SCA) models to evaluate the status of White Bass. To do this, the results from the SCA model (1986-2017) are projected forward one year and the population is assessed relative to the various biological reference points. Forecasts suggest that the White Bass spawning stock biomass estimate for 2018 is higher than SSB biological reference points. Additionally, the harvest of White Bass is below the fishing mortality based reference points. For example, the projected SSB for White Bass in 2018 was estimated to be well above SSB based thresholds at 40%, 30%, and 20% of unfished SSB (Figure 2.4.1). White Bass status based on SCA model projections with data current to 2017 appears to be more favourable than 2018 fishery and survey performance suggests. Future model

configurations will include 2018 data. The information indicates that White Bass are being harvested within safe biological limits.

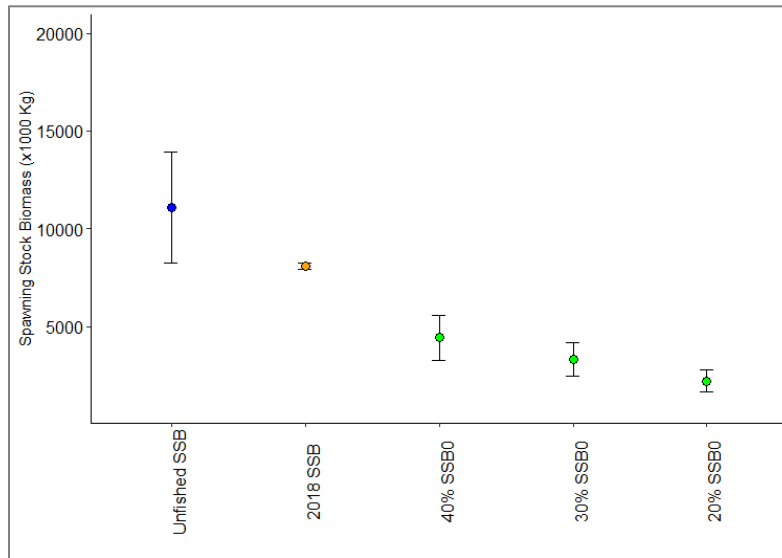


**Figure 2.4.1** Mean  $\pm$  95% CI for the unfished spawning stock biomass, spawning stock biomass in 2018, 40% of unfished spawning stock biomass, 30% of unfished spawning stock biomass, and 20% of unfished spawning stock biomass for Lake Erie White Bass. The reference point spawning stock biomass estimates (all except 2018 SSB) were calculated by projecting the White Bass SCA age 1 abundance from 1986–2017 forwards using natural mortality only. The 2018 SSB was estimated by projecting the 2017 SCAA model results forward a year.

#### *Biological Reference Points for Lake Whitefish*

In 2018, LEMU continued to support MSC certification requirements through the refinement of a Lake Whitefish statistical catch-at-age analysis (SCA) model including: 1) Principle Component Analysis (PCA) to forecast Lake Whitefish populations using recruitment indices and 2) The development of biological reference points. Due to effects on the SCA model related to recent non-target gill net fishery mesh size reductions, the SCA model configuration was modified with the addition of a gill net selectivity block and removal of incomplete trap net fishery data. The updated model configuration continued to overestimate the abundance of 2014 and 2015 cohorts relative to PCA estimates, albeit by a smaller margin than the previous SCA model. Abundance and spawner biomass estimates using SCA estimates of 2014 and 2015 cohorts were inflated and highly uncertain (Figure 2.4.2). Based on the SCA model abundance estimates, mean weight at age, assumed 2018 SCA survival estimates, and PCA recruitment estimates for 2014–2018 cohorts, spawning stock biomass (SSB) forecasts exceed the mean reference points at 20%, 30% and 40% of the unfished spawning stock biomass (SSB0) from 2019 to 2021. However, 95% confidence limits for annual SSB and SSB40% overlap each year from 2018–2021 (Figure 2.4.3). Confidence limits (95%) for SSB20% and SSB30% do not overlap with annual SSB estimates from 2018–2021. These results indicate improvement in Lake Whitefish status in Lake Erie due to recent recruitment events. Additional years of assessment will reduce uncertainty of abundance and spawner biomass estimates.

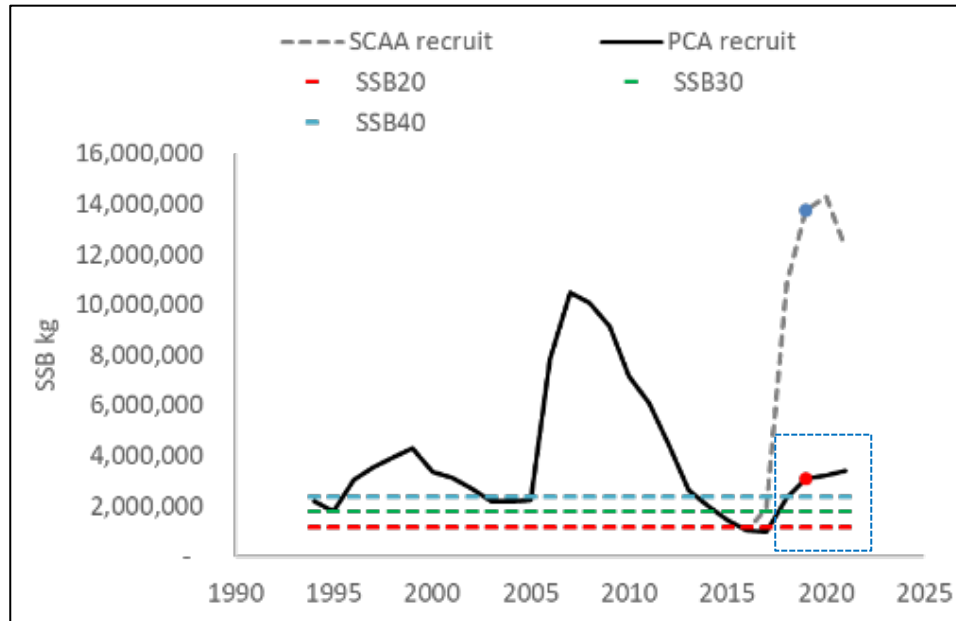


**Figure 2.4.2** Lake Whitefish spawning stock biomass (SSB) estimates for 1994 to 2018 and projections to 2019-2021. SSB from 2017 – 2021 include SCA estimates of 2014, 2015 cohort abundance, represented by the grey dotted line. SSB projected from 2017 to 2021 using PCA recruit estimates are represented by continuation of the black line. (dot = 2019). Limit reference point means for unfished spawning stock biomass at 20%, 30% and 40% of SSB<sub>0</sub> are presented as horizontal dashed lines.

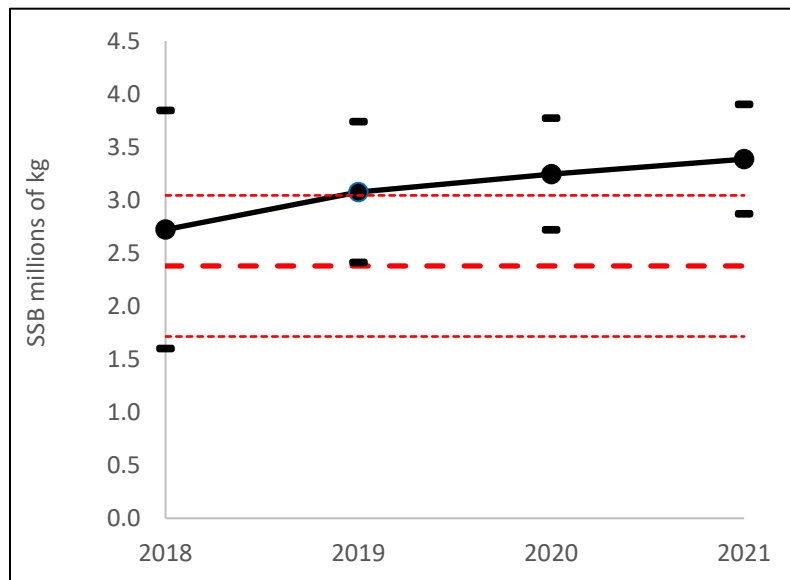


**Figure 2.4.3** Lake Whitefish spawning stock biomass (SSB) projections 2018-2021 (highlighted in Figure 2.4.2). Annual SSB (solid line) and SSB40 (dashed line) are presented with 95% confidence limits.

### 3. RECREATIONAL FISHERIES

#### 3.1 Lake Erie and Lake St. Clair Sport Fishery Diary Program

The Lake Erie and Lake St. Clair Sport Fishery Diary Program allows the Lake Erie Management Unit (LEMU) to track general trends in catch rates and angler activity targeting a variety of fish species. Anglers from both Ontario and Michigan participated in the diary program for the St. Clair System. Ontario Ministry of Natural Resources and Forestry, Lake Erie Management Unit collected information from Ontario anglers, while the Michigan Department of Natural Resources collected data from Michigan anglers. In this program, volunteer anglers complete a page in a diary for each trip taken. Items recorded include: fishing location, fishing duration, species and numbers of fish kept and released, and biological information. 2018 marks the final year of this program, and LEMU would like to thank all of the participants who contributed over the years.

In 2018, 46 volunteers from Ontario completed angler diaries in Lake Erie. Of the Ontario Sport Fishery Diary volunteers fishing in all areas, 96% have been participating in the program for three years or more. Seventy-three percent have been involved in the program for ten years or more, and 54% have been involved in the program for twenty or more years. In total there were 492 fishing trips by angler diarists in Lake Erie (Table 3.1.1). The total effort of diarists in Lake Erie was 6,886 rod hours, with 14% of the effort in the western basin, 44% in the central basin and 42% in the eastern basin.

In 2018, 53 volunteers from Michigan and Ontario completed diaries in the St. Clair System (Lake St. Clair, Detroit River and St. Clair River). There were 39 participants in Lake St. Clair, 26 participants in the Detroit River, and 24 participants in the St. Clair River (some anglers fish in more than one area). In total there were 826 fishing trips by angler diarists in the St. Clair System (Table 3.1.2). The total effort in the St. Clair System was 9,066 rod hours, with 62% of the effort in Lake St. Clair, 26% in the Detroit River and 12% in the St. Clair River.

In 2018, the Walleye catch rate was highest in the Detroit River (1.49 fish per rod hour) (Figure 3.1.1). The Walleye catch rate has been higher in the Detroit River compared to other areas of the survey for the last decade. Lake Erie eastern basin had the lowest Walleye catch rate, though highest in the time series for the basin (0.48 fish per rod hour). The Yellow Perch catch rate was highest in the eastern basin of Lake Erie (5.92 fish per rod hour) (Figure 3.1.2).

Catch rates for Rainbow Trout declined in Lake Erie central basin in 2018 (0.065 fish per rod hour) but increased in Lake Erie eastern basin (0.066 fish per rod hour). Smallmouth Bass catch rates decreased in the eastern basin of Lake Erie (0.61 fish per rod hour), but increased in Lake St. Clair in 2018 (0.26 fish per rod hour). The Muskellunge catch rate increased in Lake St. Clair (0.07 fish per rod hour) however it remained below average.

**Table 3.1.1** Total effort reported by Sport Fishery Diary Program participants in Lake Erie by area, 2018.

| Survey Area          | Number of Diarists    | Number of Trips | Number of Rods per Trip | Total Rod Hours |
|----------------------|-----------------------|-----------------|-------------------------|-----------------|
| Western Basin        | 12                    | 61              | 4.5                     | 947             |
| West-Central Basin   | 15                    | 72              | 4.7                     | 1,355           |
| East-Central Basin   | 14                    | 95              | 4.8                     | 1,672           |
| Inner Long Point Bay | 14                    | 81              | 2.7                     | 827             |
| Long Point Bay       | 5                     | 20              | 4.1                     | 281             |
| Nanticoke            | 11                    | 118             | 2.6                     | 1,024           |
| Port Colborne        | 6                     | 45              | 3.8                     | 781             |
| <b>Total</b>         | <b>46<sup>a</sup></b> | <b>492</b>      | <b>3.8</b>              | <b>6,886</b>    |

<sup>a</sup> Diarist may fish more than one survey area in a year.

**Table 3.1.2** Total effort reported by Sport Fishery Diary Program participants in the St. Clair System, 2018.

| Survey Area     | Number of Diarists    | Number of Trips | Number of Rods per Trip | Total Rod Hours |
|-----------------|-----------------------|-----------------|-------------------------|-----------------|
| Lake St. Clair  | 39                    | 423             | 3.3                     | 5,631           |
| Detroit River   | 26                    | 270             | 2.2                     | 2,385           |
| St. Clair River | 24                    | 133             | 2.3                     | 1,050           |
| <b>Total</b>    | <b>53<sup>a</sup></b> | <b>826</b>      | <b>2.9</b>              | <b>9,066</b>    |

<sup>a</sup> Diarist may fish more than one survey area in a year.

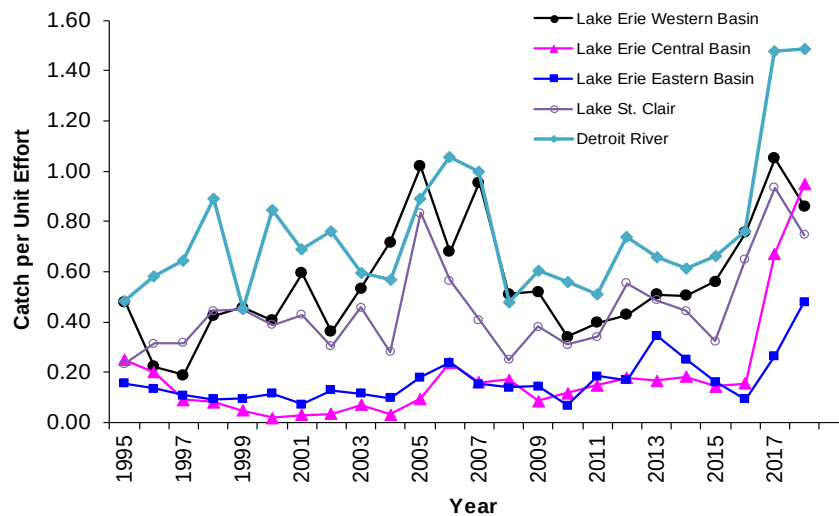


**Figure 3.1.1** Walleye catch per unit effort (fish per rod hour) by area, 1995-2018.

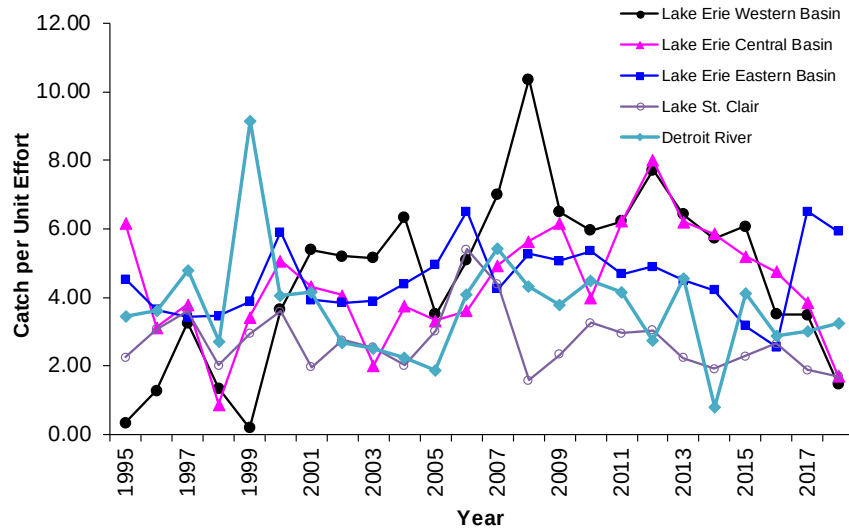


**Figure 3.1.2** Yellow Perch catch per unit effort (fish per rod hour) by area, 1995-2018.

### 3.2 St. Clair River Creel Survey

In 2018, the Lake Erie Management Unit (LEMU) conducted a roving creel survey in the St. Clair River. During the survey both boat and shore line anglers fishing the Ontario waters of the St. Clair River were counted and interviewed. The purpose of the survey was to: 1) estimate catch and harvest for all fish species, 2) measure angling effort and success, 3) document fishing methods, and 4) learn information about angler demographics.

In the Ontario waters of the St. Clair River, the total estimated effort for the survey period (May 1 to September 30 2018, 8:00 to 24:00 h) was 116,059 rod-hours. Boat anglers fished 58,468 rod-hours of effort and shore anglers fished 57,591 rod-hours of effort (Table 3.2.1). Fifty-three percent of boat effort and 65% of shore effort occurred during May and June combined. The lowest effort occurred during September, which had only 12% of total boat effort and 6% of shore effort.

Ontario resident anglers comprised 72% of the boat fishery and 59% were local residents (Counties of Essex, Kent and Lambton). Twenty-eight percent of the boat anglers were United States residents. Ontario resident anglers comprised 99% of the shore fishery and 84% were local residents. Less than one percent of the shore anglers were United States residents.

Twenty-eight species of fish were reported during the survey period. In total, 245,604 fish were caught by both boat and shore anglers. Thirty-five percent of these fish were harvested. The most commonly caught fish species were Round Goby (22% of total catch), Yellow Perch, (19% of total catch), and Rock Bass (15% of total catch).

Targeted Walleye effort from boat anglers was 54,643 rod-hours (Table 3.2.2). This was 93% of total boat effort (though anglers may target more than one species at a time). The total catch of Walleye from boat anglers was 12,572 of which 78% were harvested (Table 3.2.2). The targeted catch rate of Walleye from boat anglers was 0.225 fish per rod-hour. Targeted Walleye effort from shore anglers was 46,477 rod-hours (Table 3.2.2). This was 81% of total shore effort. The total catch of Walleye from shore anglers was

3,995 of which 60% were harvested (Table 3.2.2). The targeted catch rate of Walleye from shore anglers was 0.082 fish per rod-hour.

Targeted Yellow Perch effort from boat anglers was 13,975 rod-hours (Table 3.2.2). This was 24% of total boat effort. The total catch of Yellow Perch from boat anglers was 26,226 of which 38% were harvested (Table 3.2.2). The targeted catch rate of Yellow Perch from boat anglers was 1.694 fish per rod-hour. Targeted Yellow Perch effort from shore anglers was 42,760 rod-hours (Table 3.2.2). This was 74% of total shore effort. The total catch of Yellow Perch from shore anglers was 21,299 of which 34% were harvested (Table 3.2.2). The targeted catch rate of Yellow Perch from shore anglers was 0.362 fish per rod-hour.

**Table 3.2.1** Estimated total effort in rod-hours, by month and fishing type, in the Ontario waters of the St. Clair River, May 1 to September 30, 2018.

| Fishing Typye | Effort by Month (Rod-hours) |        |        |        |           | Total   |
|---------------|-----------------------------|--------|--------|--------|-----------|---------|
|               | May                         | June   | July   | August | September |         |
| Boat Effort   | 16,093                      | 14,963 | 11,631 | 8,886  | 6,896     | 58,468  |
| Shore Effort  | 22,347                      | 14,843 | 9,084  | 7,701  | 3,617     | 57,591  |
| Total Effort  | 38,440                      | 29,805 | 20,715 | 16,586 | 10,513    | 116,059 |

**Table 3.2.2** Total catch and harvest of all species caught by boat and shore anglers in the Ontario waters of the St. Clair River, May 1 to September 30, 2018.

| Species Name       | Boat Anglers      |                     |                   |                    |       | Shore Anglers     |                     |                   |                    |       | Boat + Shore      |                     |
|--------------------|-------------------|---------------------|-------------------|--------------------|-------|-------------------|---------------------|-------------------|--------------------|-------|-------------------|---------------------|
|                    | Total             |                     | Target            |                    | CUE   | Total             |                     | Target            |                    | CUE   | Total             |                     |
|                    | Catch<br>(# Fish) | Harvest<br>(# Fish) | Catch<br>(# Fish) | Effort<br>(rd hrs) |       | Catch<br>(# Fish) | Harvest<br>(# Fish) | Catch<br>(# Fish) | Effort<br>(rd hrs) |       | Catch<br>(# Fish) | Harvest<br>(# Fish) |
| Lake Sturgeon      | 1,272             | 0                   |                   |                    |       | 0                 | 0                   |                   |                    |       | 1,272             | 0                   |
| Longnose Gar       | 0                 | 0                   |                   |                    |       | 47                | 0                   |                   |                    |       | 47                | 0                   |
| Bowfin             | 1,131             | 0                   | 1,131             | 1,320              | 0.857 | 0                 | 0                   | 0                 | 575                | 0.000 | 1,131             | 0                   |
| Alewife            | 407               | 0                   |                   |                    |       | 0                 | 0                   |                   |                    |       | 407               | 0                   |
| Gizzard Shad       | 0                 | 0                   |                   |                    |       | 4,900             | 0                   |                   |                    |       | 4,900             | 0                   |
| Coho Salmon        | 559               | 231                 | 136               | 2,761              | 0.049 | 1,038             | 542                 | 1,035             | 11,051             | 0.094 | 1,597             | 773                 |
| Chinook Salmon     | 0                 | 0                   | 0                 | 1,064              | 0.000 | 0                 | 0                   | 0                 | 2,134              | 0.000 | 0                 | 0                   |
| Rainbow Trout      | 917               | 917                 | 0                 | 3,643              | 0.000 | 1,355             | 555                 | 1,076             | 33,385             | 0.032 | 2,272             | 1,472               |
| Atlantic Salmon    | 111               | 0                   |                   |                    |       | 45                | 45                  | 45                | 634                | 0.071 | 156               | 45                  |
| Brown Trout        | 0                 | 0                   |                   |                    |       | 0                 | 0                   | 0                 | 3,631              | 0.000 | 0                 | 0                   |
| Lake Trout         | 0                 | 0                   |                   |                    |       | 2,521             | 1,261               | 2,521             | 3,782              | 0.667 | 2,521             | 1,261               |
| Lake Whitefish     | 183               | 0                   |                   |                    |       | 136               | 49                  |                   |                    |       | 319               | 49                  |
| Northern Pike      | 3,327             | 510                 | 2,149             | 4,812              | 0.447 | 7,818             | 2,119               | 1,807             | 6,664              | 0.271 | 11,145            | 2,629               |
| Muskellunge        | 549               | 0                   | 272               | 15,474             | 0.018 | 90                | 0                   | 0                 | 7,243              | 0.000 | 639               | 0                   |
| White Sucker       | 10,435            | 762                 |                   |                    |       | 1,800             | 112                 | 122               | 812                | 0.150 | 12,235            | 874                 |
| Common Carp        | 1,163             | 0                   |                   |                    |       | 414               | 0                   |                   |                    |       | 1,577             | 0                   |
| Channel Catfish    | 859               | 0                   | 380               | 3,026              | 0.126 | 2,197             | 40                  | 1,688             | 2,156              | 0.783 | 3,056             | 40                  |
| White Perch        | 514               | 0                   |                   |                    |       | 119               | 0                   |                   |                    |       | 633               | 0                   |
| White Bass         | 8,430             | 1,358               | 4,408             | 3,340              | 1.320 | 12,518            | 1,885               | 7,505             | 7,471              | 1.005 | 20,948            | 3,243               |
| Rock Bass          | 7,189             | 0                   |                   |                    |       | 29,594            | 2,432               | 5,222             | 3,159              | 1.653 | 36,783            | 2,432               |
| Bluegill           | 0                 | 0                   |                   |                    |       | 3,334             | 0                   | 1,032             | 1,136              | 0.908 | 3,334             | 0                   |
| Smallmouth Bass    | 7,103             | 352                 | 5,039             | 18,167             | 0.277 | 4,246             | 264                 | 1,322             | 8,572              | 0.154 | 11,349            | 616                 |
| Largemouth Bass    | 1,194             | 0                   | 1,131             | 1,320              | 0.857 | 391               | 0                   |                   |                    |       | 1,585             | 0                   |
| Yellow Perch       | 26,226            | 10,014              | 23,674            | 13,975             | 1.694 | 21,299            | 7,184               | 15,499            | 42,760             | 0.362 | 47,525            | 17,198              |
| Walleye            | 12,572            | 9,753               | 12,275            | 54,643             | 0.225 | 3,995             | 2,407               | 3,792             | 46,477             | 0.082 | 16,567            | 12,160              |
| Round Goby         | 17,015            | 11,534              | 200               | 325                | 0.615 | 37,060            | 31,149              | 3,442             | 3,698              | 0.931 | 54,075            | 42,683              |
| Freshwater Drum    | 3,297             | 0                   | 40                | 286                | 0.140 | 5,314             | 54                  | 54                | 1,015              | 0.053 | 8,611             | 54                  |
| Hybrid Muskie/Pike | 848               | 0                   | 738               | 3,721              | 0.198 | 72                | 0                   |                   |                    |       | 920               | 0                   |
| Any Species        |                   |                     |                   | 14,698             |       |                   |                     |                   | 43,696             |       |                   |                     |

#### 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. The lakewide survey is partitioned by project according to the west, west-central, east-central, Pennsylvania Ridge and eastbasins. In 2018, 133 random sites were fished across Lake Erie (Figure 4.1.1). Index gill nets 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). Twenty-nine (29) species from 15 families were caught in index gill nets lakewide during 2018. Arithmetic mean catch rates (fish / gang) from standard canned nets and nets fished on bottom are presented for Walleye, Yellow Perch, White Bass, White Perch, Lake Whitefish, and Lake Trout by basin (Figure 4.1.2).

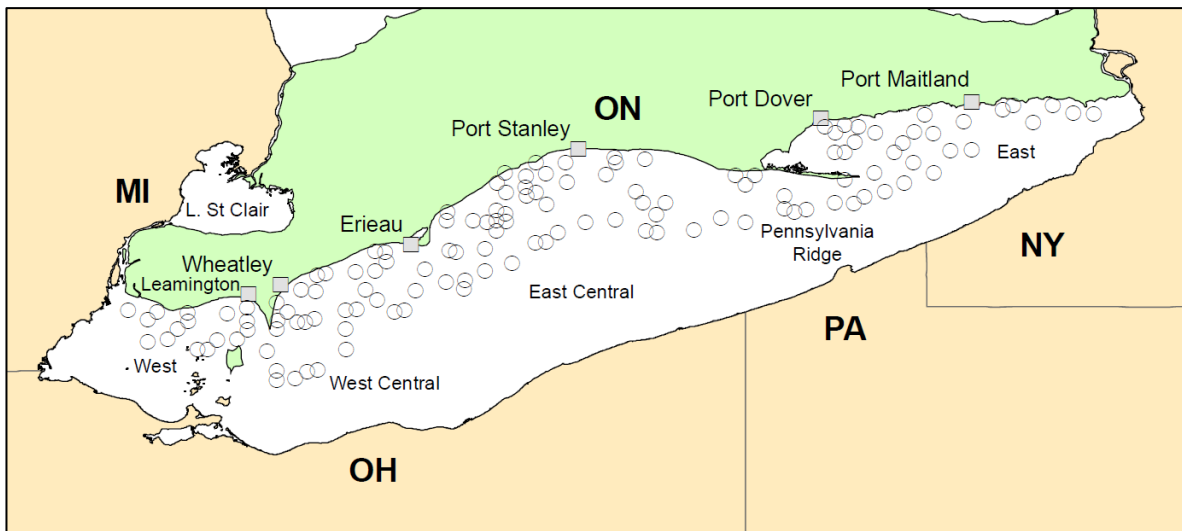


**Figure 4.1.1** Sites fished in Partnership index gill net surveys during 2018.

##### *Walleye*

Walleye catch rates in 2018 achieved the second highest levels in the east basin and Pennsylvania Ridge surveys and were greater than 89% of years surveyed in the west central and east central basin surveys, whereas the west basin Walleye index was lower than 89% of years assessed previously (Figure 4.1.2). Catch rates decreased from 2017 in the west, east basin and Pennsylvania Ridge surveys while catch rates increased marginally in the east-central and more significantly in the west-central basin survey. The lakewide age composition in 2018 ranged from 0 to 15 with age 3 (2015 cohort) most abundant across the lake. Age 1 Walleye were the second most abundant age group in the west and central basin surveys, whereas Walleye in the east basin survey included more two-year-old fish. Young of the year (YOY) (age 0) Walleye densities declined from west to east with none caught in the east basin survey. In the west and central areas combined, age 0 Walleye abundance in 2018 was 4<sup>th</sup> highest in the 30 year time series. Mean length and condition were low for Walleye over a range of age groups in 2018.

### *Yellow Perch*

Yellow Perch abundance indices in 2018 were poor in the west, west-central, and east-central basin surveys but were moderate in the Pennsylvania Ridge and east basin areas (Figure 4.1.2). Catch rates decreased from 2017 in all areas except the Pennsylvania Ridge survey, which increased moderately. Age representation was diverse, ranging from 0 to 13 lakewide, with ages 4, 2, 1 and 3 most common in the west and central basin surveys, with variation between basins. The east basin survey was dominated by age 2 fish with lesser contributions from ages 1,3 and older fish. Proportions of age 6 and older Yellow Perch were highest in the Pennsylvania Ridge survey. Age 1 Yellow Perch represented more of the catch in the west basin compared to other areas, but yearlings were present in all surveys. Yellow Perch age composition was youngest in the east, followed by the west, east-central, west-central and Pennsylvania Ridge surveys. Yellow Perch mean size and condition at age was generally near or above average in 2018.

### *White Bass*

White Bass abundance indices dropped in all areas of Lake Erie in 2018 (Figure 4.1.2). Catch rates in 2018 were poor in the west and west-central basin surveys and the lowest observed in the east-central basin times series. In contrast, White Bass catch rates in the east basin and Pennsylvania Ridge surveys were above average (Figure 4.1.2). White Bass age composition using scales ranged from 0 to 8 lakewide. Ages 5 and 2 White Bass were the most abundant age groups present lakewide. Young of the year (age 0) represented the largest fraction of White Bass caught in the west-central basin; YOY were present in all surveys except the Pennsylvania Ridge. Although adult White Bass length at age was average or higher in 2018, body condition was generally below average.

### *White Perch*

White Perch catch rates in 2018 were low in the west basin survey, moderate in both central basin surveys and the Pennsylvania Ridge whereas in the east basin, catch rates were above average (Figure 4.1.2). Abundance indices in 2018 decreased significantly from 2017 in the west and west-central basins, and slightly in the Pennsylvania Ridge survey while abundance increased in the east central and east basin surveys. White Perch age composition lakewide ranged from 0 to 9 with age 3 (2015 year class) and age 2 (2016 year class) most dominant in surveys. White Perch ages 0 and 1 were present in decreasing proportions from west to east in 2018. White Perch mean length and condition at age was above average in 2018.

### *Lake Whitefish*

Lake Whitefish are a migratory coldwater species vulnerable to capture in index nets in the central, east basin and Pennsylvania Ridge surveys. Lake Whitefish catch rates in 2018 were high in the east basin survey, moderate in the east-central basin survey but low in the west-central basin survey and none were caught in the Pennsylvania Ridge survey (Figure 4.1.2). Indices increased significantly from 2017 in the east-central and east basin but declined in the west-central basin and Pennsylvania Ridge surveys. Age groups present in lakewide catches ranged from 0 to 15. The age composition consisted mostly of age 3 (2015 cohort) and age 4 (2014 cohort) Lake Whitefish but also includes ages 0, 1, 2, 9 and 15 (2003 cohort). Recent recruitment of young Lake Whitefish is a positive sign for Lake Erie's depressed Lake Whitefish population following a prolonged period of poor recruitment.

### *Lake Trout*

Lake Trout are mainly caught in the cold 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 2018, Lake Trout catch rates were above average in the east basin survey, below average in the Pennsylvania Ridge survey and none were caught in the east central basin survey (Figure 4.1.2).

Multi-agency efforts to restore Lake Trout in Lake Erie rely on stocking multiple strains until the population is sustained by natural reproduction. All stocked Lake Trout are tagged or fin clipped (Section 5.8). Coded-wire tags were retrieved from the nares of 57 out of 66 Lake Trout caught in index and auxiliary gill nets, revealing the following strains: Finger Lakes (41%), Slate Islands (29%) and Lake Champlain (17%). Other stocked Lake Trout included 7 fish with fin clips lacking tags and 1 fish with a tag that could not be read. One Lake Trout lacked a fin clip and a tag, suggesting it may have resulted from natural reproduction. For Lake Trout caught in Partnership surveys during 2018, ages based on tagging dates ranged from 1 to 28 with age 3 most abundant (29%). To date, there has been no confirmed evidence that Lake Trout reproduce naturally in Lake Erie.

### *Species at Risk*

Four (4) Lake Sturgeon were caught in index nets during 2018, ranging in total length from 75 to 152 cm (mean 100cm). All Lake Sturgeon were caught in western Lake Erie. Following measurements and examination for external tags (absent), all Lake Sturgeon were released alive. Silver Chub were present in low numbers (8) in 2018, distributed between the west (5) and east central (3) basin surveys.

### *Other species*

Smallmouth Bass catch rates in 2018 were very low in both the west and east basin surveys. Smallmouth Bass age composition ranged from ages 0 to 2 and 0 to 10 in west and east basin surveys, respectively. Yearlings were the most abundant age group present the west basin survey, with ages 0 and 2 represented equally. Smallmouth Bass age composition was more diverse in the east basin survey during 2018, with age 2 most abundant followed by ages 4 and 7 in equal proportions. During 2018, sucker species abundance was moderate lakewide, except for Shorthead Redhorse Suckers which were more abundant in west and central basin surveys. Gizzard Shad abundance varied from low to moderate among surveys, while Alewife were present only in east-central and east basin surveys at low levels. In 2018, Freshwater Drum abundance was low in west and central basin surveys but moderate in Pennsylvania Ridge and east basin assessment. Channel Catfish abundance ranged from moderate to high across the lake in 2018, attaining a record high abundance in the east basin survey. Burbot catches in 2018 remained low relative to historic east basin and Pennsylvania Ridge time series.

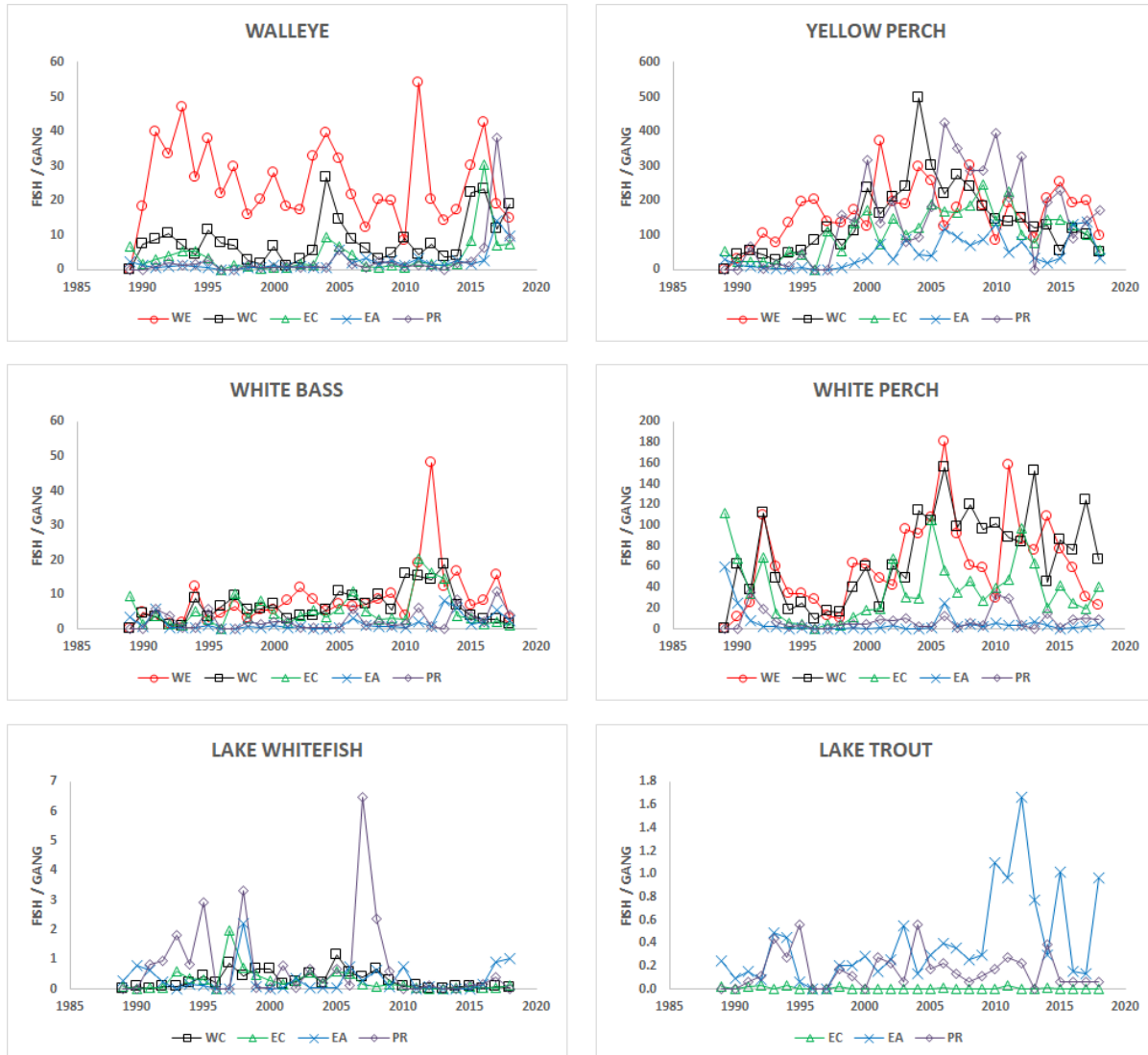


**Figure 4.1.2** Mean catch (fish / gang) by species, and basin. WE=West, WC=West Central, EC=East Central, EA=East and PR=Pennsylvania Ridge.

#### 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, yearling and older fish. Catch rates of juvenile Walleye and Yellow Perch are combined with Ohio samples for recruitment indices used by Lake Erie task groups to forecast population abundance. In Ontario, 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 ( $\leq 2\text{mg / l}$ ). Six trawls in Ontario waters were excluded from catch rate calculations in 2018 due to hypoxia (3 stations) and damaged gear (3 stations, Figure 4.2.1). 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 the 2018 field season along with mean catch rates for several time periods (Table 4.2.1).

In Ontario waters, catch rates in 2018 were record high for young-of-the-year (YOY) Walleye and nearly so for YOY Yellow Perch (Table 4.2.1). Freshwater Drum YOY and White Perch YOY indices were relatively high in 2018. Young of the year Gizzard Shad, White Bass and Smallmouth Bass catch rates were generally low in 2018. Young of the year of other species and broader taxonomic groups were absent or rare in west basin bottom trawls in 2018. Overall, YOY catch rates were high in 2018 with the largest contributions from White Perch, Yellow Perch and Walleye.

Yearling and older (YAO) fish indices in 2018 compared to their respective time series, were high for Common White Suckers, Common Carp, Walleye and Freshwater Drum. Moderate catches of Channel Catfish, Yellow Perch and Rock Bass occurred in 2018. YAO White Perch, White Bass and Quillback Carpsucker catch rates were generally low in 2018. One YAO Lake Sturgeon was caught in a bottom trawl in western Lake Erie during 2018. Other species age 1 or older that were caught during previous surveys were absent in 2018. Overall, catch rates of yearling and older fish were low in 2018.

Forage species with all age groups combined, were moderate in abundance during 2018 due mainly to record high catches of Troutperch in 2018.. Mimic Shiners were also abundant, and Tubenose Gobies were caught for the 4<sup>th</sup> consecutive year. Silver Chub and Round Gobies were present at moderate densities in 2018. Alewife, which were historically abundant, collapsed in 2003 and remained rare or absent (2018) from bottom trawls in western Lake Erie. Emerald Shiners, Spottail Shiners, Logperch and Rainbow Smelt catch rates in 2018 were low compared to previous years.

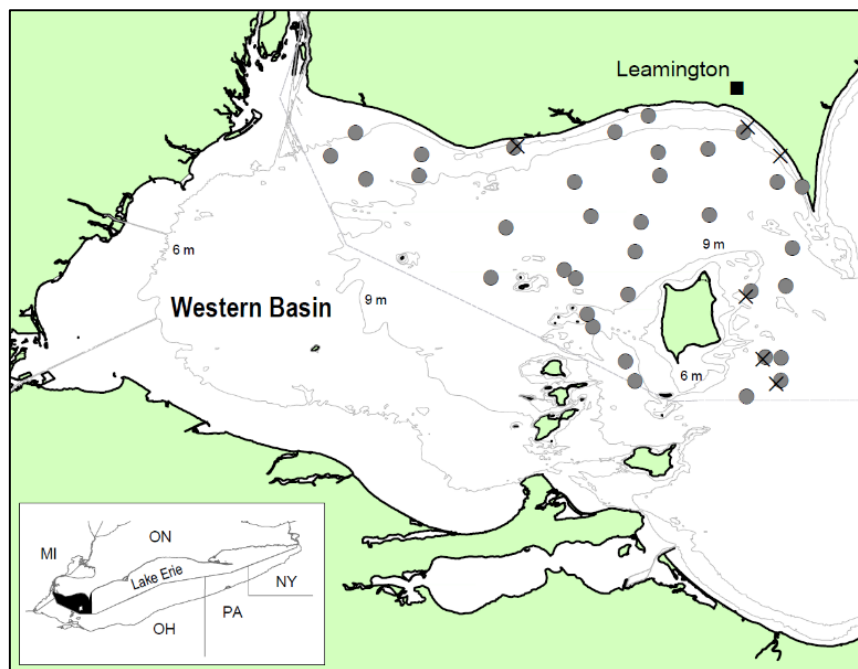


**Figure 4.2.1** Sites fished bottom trawling (dots) in Ontario waters of western Lake Erie, 2018. Trawls excluded due to hypoxia or damaged gear are indicated with “X”.

**Table 4.2.1** Ontario Index trawl catch rates (number per hectare caught) and percentile by fish species and age group, 2018 compared to time period means.

| Age Group(s)                         | Species              | Mean      |           |           |           | Percentile <sub>2018</sub> |         |
|--------------------------------------|----------------------|-----------|-----------|-----------|-----------|----------------------------|---------|
|                                      |                      | 1988-2017 | 1988-1999 | 2000-2009 | 2010-2017 | 2018                       | (88-18) |
| Young of the Year                    | Gizzard Shad         | 474.3     | 637.9     | 584.1     | 91.8      | 34.7                       | 20%     |
|                                      | 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          | 2,101.2   | 2,309.9   | 2,242.6   | 1,611.4   | 2,540.2                    | 73%     |
|                                      | White Bass           | 98.4      | 84.2      | 150.1     | 55.3      | 38.6                       | 30%     |
|                                      | Morone sp.           | 0.0       | -         | 0.0       | 0.0       | -                          | 0%      |
|                                      | Centrarchidae        | 0.0       | -         | -         | 0.0       | -                          | 0%      |
|                                      | Rock Bass            | 0.4       | 0.2       | 0.4       | 0.6       | -                          | 0%      |
|                                      | Pumpkinseed          | 0.0       | -         | 0.0       | -         | -                          | 0%      |
|                                      | Bluegill             | 0.0       | -         | -         | 0.0       | -                          | 0%      |
|                                      | Smallmouth Bass      | 1.7       | 1.7       | 2.2       | 1.3       | 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         | 510.8     | 489.3     | 454.3     | 613.6     | 2,063.8                    | 97%     |
|                                      | Walleye              | 17.9      | 18.1      | 16.3      | 19.5      | 397.6                      | 100%    |
|                                      | Freshwater Drum      | 18.4      | 16.2      | 33.0      | 3.3       | 25.2                       | 83%     |
|                                      | All                  | 3,223.7   | 3,558.7   | 3,483.1   | 2,397.0   | 5,100.3                    | 87%     |
| Yearling and Older                   | Silver Lamprey       | 0.0       | 0.0       | 0.0       | 0.0       | -                          | 0%      |
|                                      | Lake Sturgeon        | 0.0       | 0.0       | 0.0       | 0.0       | 0.1                        | 77%     |
|                                      | 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       | 0.1                        | 33%     |
|                                      | Longnose Sucker      | 0.0       | -         | -         | 0.0       | -                          | 0%      |
|                                      | White Sucker         | 1.1       | 0.5       | 1.3       | 1.6       | 2.8                        | 97%     |
|                                      | 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%      |
|                                      | Moxostoma sp.        | 0.0       | -         | -         | 0.0       | -                          | 0%      |
|                                      | Common Carp          | 0.9       | 1.4       | 0.8       | 0.4       | 1.0                        | 77%     |
|                                      | Yellow Bullhead      | 0.0       | -         | 0.0       | 0.0       | -                          | 0%      |
|                                      | Brown Bullhead       | 0.5       | 0.5       | 0.7       | 0.2       | -                          | 0%      |
|                                      | Channel Catfish      | 1.1       | 1.2       | 0.9       | 1.3       | 1.0                        | 63%     |
|                                      | Burbot               | 0.3       | 0.9       | -         | -         | -                          | 0%      |
|                                      | White Perch          | 126.0     | 79.4      | 204.9     | 97.4      | 14.8                       | 13%     |
|                                      | White Bass           | 2.3       | 2.0       | 2.1       | 2.9       | 0.3                        | 27%     |
|                                      | Rock Bass            | 0.7       | 1.0       | 0.6       | 0.2       | 0.4                        | 53%     |
|                                      | Bluegill             | 0.0       | -         | -         | 0.0       | -                          | 0%      |
|                                      | Smallmouth Bass      | 0.4       | 0.8       | 0.2       | 0.1       | -                          | 0%      |
|                                      | 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         | 194.2     | 119.1     | 286.9     | 190.8     | 106.9                      | 40%     |
|                                      | Walleye              | 11.0      | 7.3       | 13.0      | 14.2      | 10.2                       | 70%     |
|                                      | Freshwater Drum      | 44.3      | 33.2      | 62.7      | 37.8      | 50.6                       | 70%     |
|                                      | Carp-Goldfish hybrid | 0.0       | -         | 0.0       | 0.0       | -                          | 0%      |
|                                      | All                  | 385.2     | 252.4     | 575.0     | 347.3     | 188.2                      | 23%     |
| Species With All Age Groups Combined | Alewife              | 304.4     | 654.3     | 127.6     | 0.4       | -                          | 0%      |
|                                      | Rainbow Smelt        | 36.7      | 9.3       | 40.9      | 72.7      | 0.5                        | 17%     |
|                                      | Cyprinidae           | 15.3      | -         | 5.3       | 50.8      | 6.1                        | 67%     |
|                                      | Goldfish             | 0.0       | 0.0       | 0.0       | 0.1       | -                          | 0%      |
|                                      | Silver Chub          | 5.0       | 7.6       | 3.9       | 2.5       | 2.4                        | 43%     |
|                                      | Emerald Shiner       | 102.4     | 51.5      | 176.9     | 85.7      | 11.7                       | 20%     |
|                                      | Common Shiner        | 0.0       | -         | 0.0       | -         | -                          | 0%      |
|                                      | Spottail Shiner      | 40.2      | 72.0      | 28.9      | 6.6       | 5.0                        | 20%     |
|                                      | Spotfin Shiner       | 0.0       | 0.0       | -         | -         | -                          | 0%      |
|                                      | Mimic Shiner         | 4.9       | 0.0       | 2.2       | 15.6      | 10.1                       | 90%     |
|                                      | Bluntnose Minnow     | -         | -         | -         | -         | 0.3                        | 100%    |
|                                      | Blacknose Dace       | 0.0       | 0.0       | -         | -         | -                          | 0%      |
|                                      | Nocomis sp.          | 0.0       | 0.0       | -         | -         | -                          | 0%      |
|                                      | Notropis sp.         | 0.0       | -         | 0.0       | -         | -                          | 0%      |
|                                      | Troutperch           | 193.3     | 196.7     | 259.7     | 105.2     | 684.8                      | 100%    |
|                                      | Johnny Darter        | 0.1       | 0.3       | -         | 0.0       | -                          | 0%      |
|                                      | Logperch             | 3.9       | 4.2       | 2.5       | 5.3       | 0.7                        | 30%     |
|                                      | Brook Silverside     | 0.1       | 0.1       | 0.1       | 0.1       | -                          | 0%      |
|                                      | Round Goby           | 61.8      | 14.9      | 125.3     | 52.8      | 20.6                       | 37%     |
|                                      | Tubenose Goby        | 0.0       | -         | -         | 0.2       | 0.1                        | 87%     |
|                                      | All                  | 768.4     | 1,010.9   | 773.5     | 398.1     | 742.3                      | 63%     |
| Total                                | All Species          | 4,377.3   | 4,822.1   | 4,831.6   | 3,142.3   | 6,030.8                    | 80%     |
|                                      | # Trawls             | 35        | 35        | 35        | 36        | 35                         |         |

### 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 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 with a 6.1-m modified Biloxi bottom trawl. 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 occurs from late August to late September and in the offshore from late September to early November.

A new survey commenced in 2018 to shorten the sampling period to two weeks for each survey and increase the spatial coverage, as analysis indicated there were changes in the fish community over the five week period that may have been due to changes in environment (e.g., decreasing temperature through the sampling period) and not necessarily abundance, and because a large portion of the bay is not surveyed. 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 survey will be discontinued. Data presented below are from the original survey design.

#### *Yellow Perch*

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

The composite index indicated that the 2018 year class was above average (NPHa=329) relative to the long-term mean (1980-2017: mean NPHa=82, range=0-447). Density of yearling and older (YAO) Yellow Perch in 2018 was below average (NPHa=3) relative to the long-term mean (1980-2017: 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 58<sup>th</sup> percentile (mean NPHa=585) but below the long-term mean (Table 4.3.1). Abundance of YAO Rainbow Smelt was in the 6<sup>th</sup> percentile (mean NPHa=0) and below the time series mean (Table 4.3.1).

### Other Species

Inner Bay – Catches of YOY Yellow Perch, YOY *Lepomis* spp. and Round Goby were high in 2018 (Table 4.3.2). All others were at or below average (Table 4.3.2).

Nearshore Outer Bay – In 2018, YOY Yellow Perch, YOY White Perch and Round Goby NPHa were above the long term mean (Table 4.3.3). All other species and age classes were below average.

Offshore Outer Bay – In 2018, YOY Yellow Perch catches were above the long-term mean (Table 4.3.1). All other species and age classes were below average.

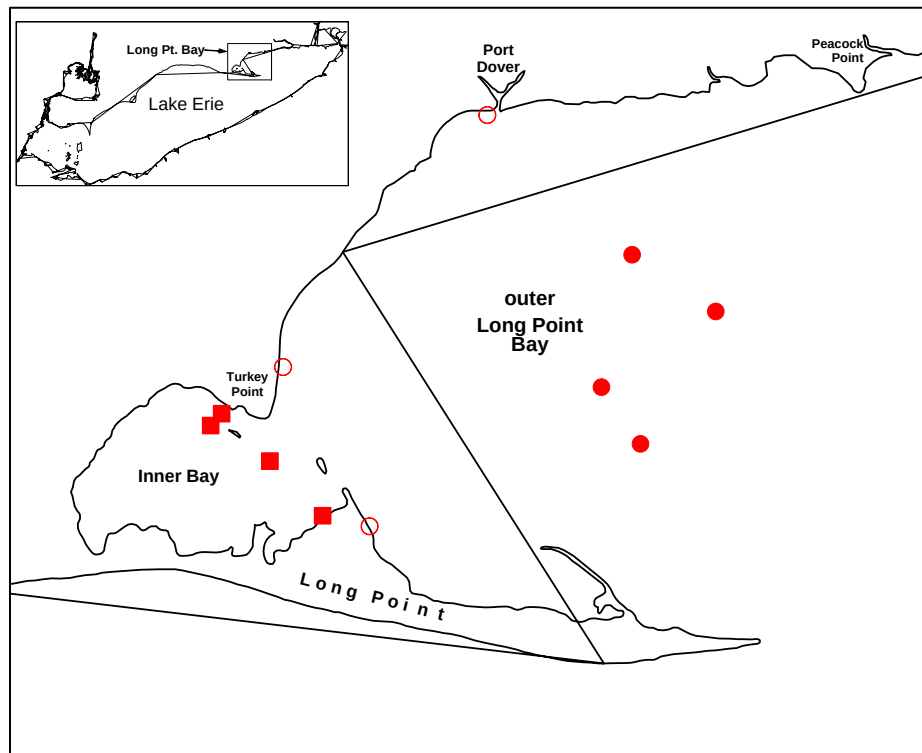


**Figure 4.3.1** Location of trawl stations where bottom trawling was conducted in Inner Bay (■), and the nearshore (○) and offshore (●) waters of Outer Long Point Bay, Lake Erie.

**Table 4.3.1** Mean number per hectare and percentile of selected young-of-the-year and earling-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 2018, and mean and range of means from 1984 to 2017.

| Species        | YOY   |            |           |            | YAO  |            |           |            |
|----------------|-------|------------|-----------|------------|------|------------|-----------|------------|
|                | 2018  |            | 1984-2017 |            | 2018 |            | 1984-2017 |            |
|                | Mean  | Percentile | Mean      | Range      | Mean | Percentile | Mean      | Range      |
| Rainbow Smelt  | 584.8 | 58%        | 993.3     | 0.9-7058.1 | 0.1  | 6%         | 398.5     | 0.1-3328.1 |
| Yellow Perch   | 204.1 | 86%        | 56.3      | 0.0-551.1  | 7.1  | 58%        | 20.8      | 0.04-201.7 |
| White Perch    | 1.0   | 67%        | 5.3       | 0.0-96.1   |      |            |           |            |
| White Bass     | 7.1   | 78%        | 11.4      | 0.0-166.2  |      |            |           |            |
| Alewife        | 0.0   | 3%         | 100.6     | 0.0-2174.5 |      |            |           |            |
| Gizzard Shad   | 0.0   | 3%         | 14.3      | 0.0-86.5   |      |            |           |            |
| Emerald Shiner | 0.7   | 11%        | 185.1     | 0.0-3388.0 | 1.3  | 14%        | 274.9     | 0.0-4200.3 |
| Round Goby*    | 64.2  | 61%        | 92.5      | 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), August-September 2018, and mean and range from 1980 to 2017.

| Species                        | YOY   |            |           |            | YAO  |            |           |           |
|--------------------------------|-------|------------|-----------|------------|------|------------|-----------|-----------|
|                                | 2018  |            | 1980-2017 |            | 2018 |            | 1980-2017 |           |
|                                | Mean  | Percentile | Mean      | Range      | Mean | Percentile | Mean      | Range     |
| Yellow Perch                   | 818.3 | 90%        | 234.9     | 0.0-1859.5 | 41.0 | 53%        | 81.1      | 0.2-513.2 |
| Rock Bass                      | 2.3   | 35%        | 15.1      | 0.0-197.6  |      |            |           |           |
| Smallmouth Bass                | 3.6   | 15%        | 14.3      | 0.0-91.7   |      |            |           |           |
| Largemouth Bass                | 1.8   | 25%        | 11.5      | 0.0-96.6   |      |            |           |           |
| Spottail Shiner                | 0.5   | 45%        | 139.1     | 0.0-983.2  | 0.1  | 0%         | 2.6       | 0.0-30.9  |
| Banded Killifish               | 3.9   | 55%        | 16.1      | 0.0-226.3  | 0.0  | 3%         | 1.0       | 0.0-17.3  |
| Johnny Darter                  | 2.8   | 55%        | 9.3       | 0.0-57.3   |      |            |           |           |
| Sunfish ( <i>Lepomis</i> spp.) | 69.0  | 83%        | 25.7      | 0.0-184.5  |      |            |           |           |
| Round Goby*                    | 110.5 | 57%        | 106.1     | 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), August-September 2018, and mean and range from 1980 to 2017.

| Species         | YOY   |            |           |            | YAO  |            |           |           |
|-----------------|-------|------------|-----------|------------|------|------------|-----------|-----------|
|                 | 2018  |            | 1980-2017 |            | 2018 |            | 1980-2017 |           |
|                 | Mean  | Percentile | Mean      | Range      | Mean | Percentile | Mean      | Range     |
| Yellow Perch    | 204.1 | 90%        | 73.4      | 0.5-667.7  | 7.1  | 31%        | 37.2      | 0.7-391.0 |
| White Perch     | 38.6  | 85%        | 13.5      | 0.0-120.9  |      |            |           |           |
| White Bass      | 7.4   | 82%        | 7.1       | 0.0-153.9  |      |            |           |           |
| Alewife         | 0.0   | 3%         | 57.7      | 0.0-869.7  |      |            |           |           |
| Gizzard Shad    | 1.6   | 21%        | 11.6      | 0.0-82.8   |      |            |           |           |
| Spottail Shiner | 36.7  | 33%        | 362.0     | 2.5-1508.5 | 3.3  | 33%        | 30.9      | 0.0-213.8 |
| Round Goby*     | 315.1 | 95%        | 45.9      | 0.0-359.1  |      |            |           |           |

\*Round Goby NPha is for all ages. Round Goby was first detected in our surveys in 1999 so means are for 1999-2017.

#### 4.4 Long Point Bay Adult Fish Community Survey

##### *Study Area and Sampling Design*

Lake Erie Management Unit has conducted an annual gill net survey in Long Point Bay since 1986 to monitor the composition of the fish community, and describe the abundance and biological characteristics of important sport and commercial species over time. The standard study area encompasses the nearshore waters of Long Point Bay from the minimum depth (3.7 m) that the gear can be set, to the 9.1 m depth contour. The Outer Bay is partitioned into three sampling areas (Areas 1, 2 and 4) then further partitioned into sampling grids (0.5 X 0.5 nautical miles) and 2 depth strata, 3.7-5.5 m and 5.5-9.1 m. Inner Bay was sampled previously and referred to as Area 3 but hasn't been included in the survey in recent years. An additional depth stratum was sampled on an exploratory basis between 2011 and 2017, referred to as the extended survey, to examine the distribution and abundance of fish species, especially Yellow Perch, in deeper offshore areas of Long Point Bay not covered by the standard survey design. The deep stratum extends from 9.1-20 m. One area was sampled each week on a rotational basis. Within that area, two randomly selected grids per depth stratum are sampled each week (i.e., four grids). Sampling runs for 10 weeks.

The Long Point Bay Adult Fish Community Survey was evaluated as part of the Program Review process begun by LEMU in 2017

Analysis of this program has led LEMU Biologists to the following conclusions:

- June mean catch per unit effort (CPE) for the majority of species is different than the 10 week survey mean. However, July and August mean CPEs for the majority of species are similar to the 10 week survey mean. (Analysis was carried out by Michael Thorn).
- The standard survey is currently used in the Yellow Perch model. Despite its small spatial extent, the survey has a lot of influence in the model, such that LEMU and multi-jurisdictional partners LEMU have questioned whether it should be included.
- Yellow Perch are distributed evenly between the three depth strata.

- The deepest stratum is included in the Partnership Index Fishing Gillnet Survey.
- The standard survey area is heavily used by the recreational fishery. It is a productive part of the lake with high biodiversity not currently sampled in other programs.

LEMU continues to consider the best path forward for the Long Point Bay Adult Fish Community Survey.

#### 4.5 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 4.5.1). New York and Pennsylvania are responsible for sampling in their jurisdictions. Only data from Ontario waters is presented in this report. In 2018, OMNRF and USGS completed 60 net sets in Ontario waters.

The Lake Erie Lake Trout population continues to be supported by binational stocking efforts, as there is no evidence of natural reproduction despite more than 30 years of restoration effort. In 2018, the mean number of Lake Trout caught was 1.8 fish/lift (Figure 4.5.2). Lake Trout caught ranged in age from 2 to 30 years, with a median age of 6. Rainbow Smelt and Round Goby were the main prey items in Lake Trout diets in 2018.

The mean number of Lake Whitefish was 1.1 fish/lift in 2018 (Figure 4.5.2). Lake Whitefish ranged in age from 2 to 18 years old with a median age of 5. Lake Whitefish fell into two main age classes: 2 to 6 and 15 to 16, with few fish occurring outside these classes. Despite low abundance, the presence of younger cohorts is promising, showing evidence of reproduction. Diet analysis is not performed for Lake Whitefish due to time constraints.

Burbot catches have been consistently low since 2012, below 1 fish/lift. This trend continued in 2018 with a catch rate of 0.4 Burbot per lift (Figure 4.5.2). In 2018, Burbot caught ranged in age from 4 to 24 years old with a median age of 6. 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 2018.

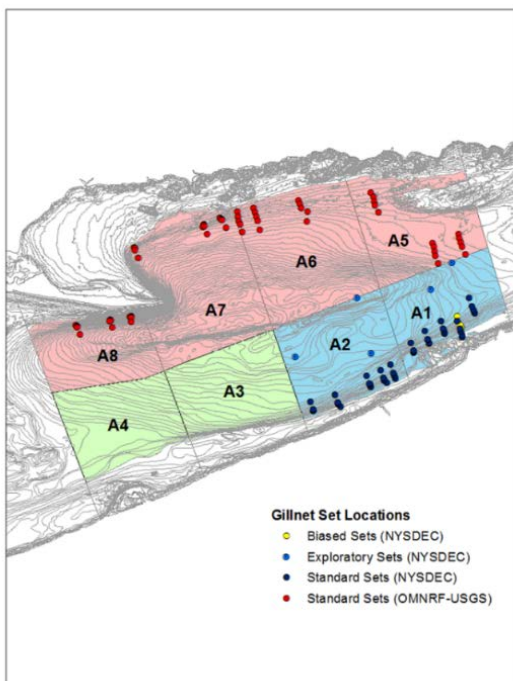


**Figure 4.5.1** Standard sampling areas used in the Coldwater Assessment survey in the east basin of Lake Erie. Circles represent the location of net sets in 2018. OMNRF and USGS set nets in Ontario waters (A5-A8), New York in A1 and A2 and Pennsylvania in A3 and A4. Pennsylvania did not sample in 2018 due to vessel constraints.

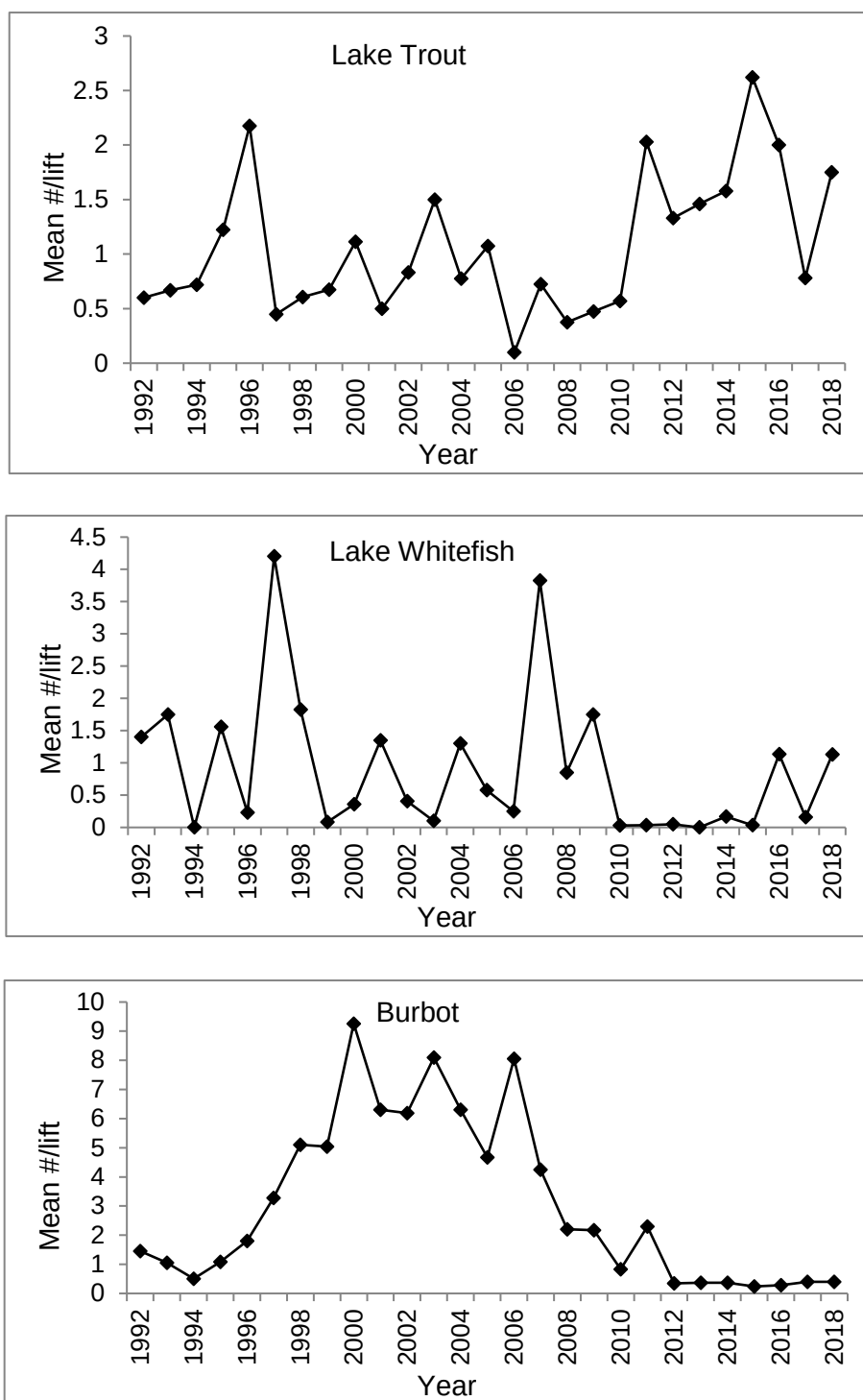


**Figure 4.5.2** Mean number of Lake Trout, Lake Whitefish and Burbot caught per net lift during interagency Coldwater Assessment gill netting in Ontario waters of eastern Lake Erie, 1992-2018.

#### 4.6 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 4.6.1), and 2 randomly chosen north-south transects in each strata are surveyed, for a total of 12 transects. Companion mid-water trawls were completed by New York State Department of Environmental Conservation in the past but due to vessel limitations, those data have not been collected since 2007. In years when mid-water trawling was carried out, >95% of the fish caught in coldwater habitat (metalimnion and hypolimnion) were yearling and older (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). Density estimates are processed in 800 m distance intervals along transects.

In 2018, only Ontario waters were sampled due to travel restrictions. 10 transects were completed with approximately 170 km of hydroacoustic data collected. The basin-wide average density was 642 fish/ha, representing a low density of YAO Rainbow Smelt relative to the time series (Figure 4.6.2). As a schooling fish, densities greater than 50,000 fish/hectare can occur in Lake Erie. However, density was always below 10,000 fish/hectare in 2018 (Figure 4.6.3).

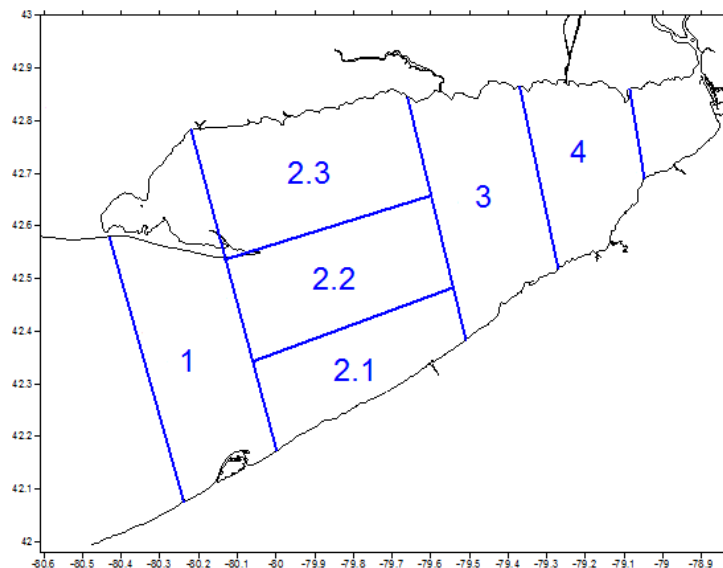


**Figure 4.6.1** The six strata in the Lake Erie east basin hydroacoustic survey.

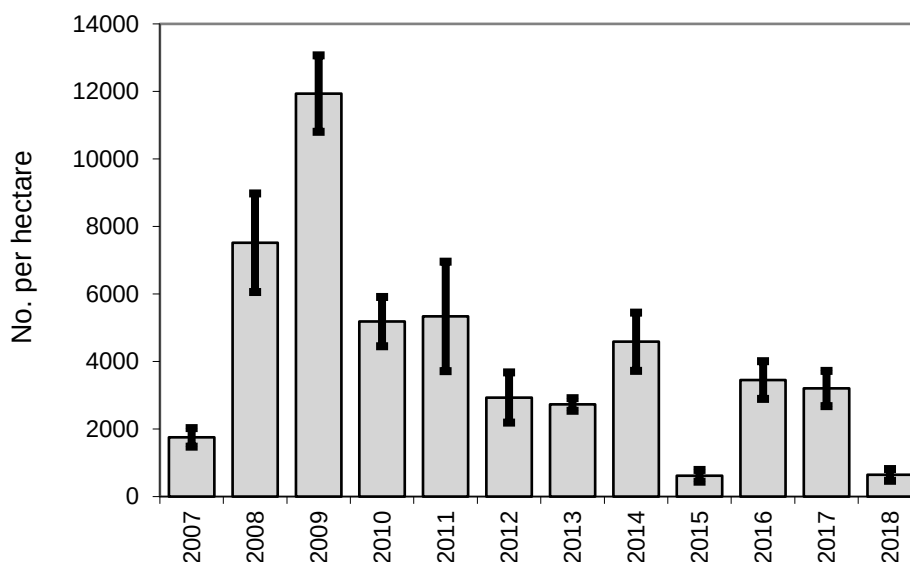


**Figure 4.6.2** Mean density (number of fish per hectare) estimates of YAO Rainbow Smelt in coldwater habitat during the July east basin hydroacoustic survey, Lake Erie, 2007-2018. Only 4 of 6 strata were sampled in 2014, only 3 of 6 strata in 2015 and only Ontario waters in 2018.

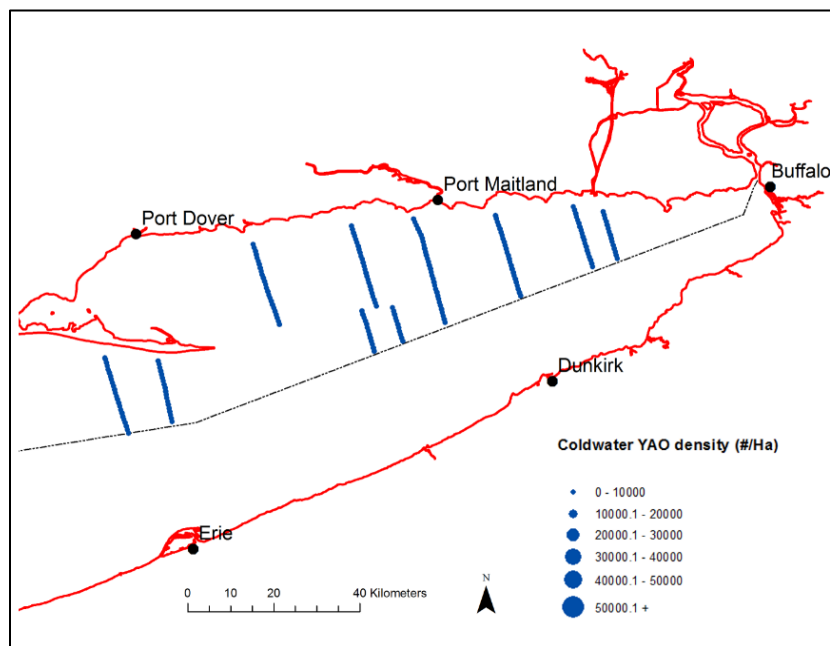


**Figure 4.6.3** Density estimates (number of fish per hectare; #/Ha) of YAO Rainbow Smelt per 800 m distance interval along transects in the July east basin hydroacoustic survey, Lake Erie. Only Ontario waters were sampled in 2018. The size of the circle is representative of the density.

## 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 U.S. 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 2018, with water samples tested for Bighead, Silver, Black, and Grass Carp eDNA.

The LEMU Asian Carp surveillance program sampling occurred from May to July 2018. Water samples were taken from 94 sites in Lake Erie, Lake Erie tributaries, Lake St. Clair, Thames River, Sydenham River, and Lake Huron tributaries (Figure 5.1.1). Seventy-three of these sites were sampled twice and five sites were sampled three times.

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 531 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 PCR and enzyme gel electrophoresis.

In 2018, three water samples were positive for Grass Carp eDNA. These samples were collected in Big Creek (1), Belle River (1), and Lake St. Clair (1). In response to these detections, Ontario Ministry Of Natural Resources and Forestry (OMNRF) staff collected additional water samples at and near these sites. There were no further eDNA detections as a result of follow up sampling. 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 2018 there were approximately 34,907 km of gill nets deployed, 995 hours of trawling, and 960 days of trap netting by the commercial fishery in Lake Erie.

Two Grass Carps were captured in commercial trap nets in the western basin of Lake Erie. One was captured on May 16, 2018. It was 87.1 cm in length and 8.3 kg. The fish was surrendered to Fisheries and Oceans Canada, who determined that the fish was triploid. A second Grass Carp was captured on July 3 2018. This fish was 96.2 cm in length and 9.6 kg. It was also surrendered to Fisheries and Oceans Canada, who determined that the fish was also triploid. Triploid individuals cannot reproduce.

## 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.

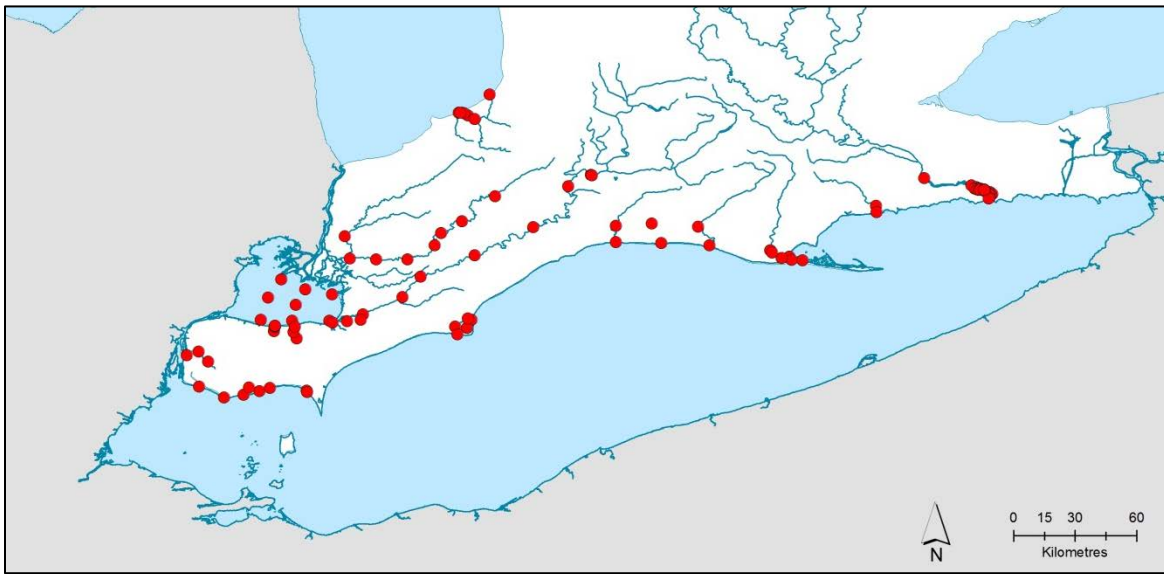


**Figure 5.1.1** Location of eDNA sample sites for 2018 Asian Carp surveillance program.

## 5.2 Central Basin Bottom Trawling

In 2016, Lake Erie Management Unit (LEMU) began a trawling survey to assess young-of-year and yearling and older fish in the Ontario waters of Lake Erie's central basin. This survey was devised as a response to a lack of recruitment data for Yellow Perch in particular. The survey was fished in coordination with the United States Geological Survey (USGS).

In 2018, thirty-five sample locations were chosen based on a Universal Transverse Mercator (UTM) 5 minute grid. Three boats were used in the survey: USGS RV Muskie II, Ontario Ministry of Natural Resources and Forestry (OMNRF) RV Erie Explorer, and OMNRF RV Keenosay (Figure 5.2.1). The Muskie II performed acoustic transects in 10 grids, using a scientific echosounder (Biosonics DT-X, with a split-beam 120 kHz transducer), to determine the feasibility of trawling in these grids. After acoustic data analysis was conducted with Visual Habitat software, only four of these grids were determined to be suitable for trawling. The Muskie II fished these four locations, using a four-seam 36.8 ft headline bottom trawl, with a 46.6 ft foot line, 2.4 inch polyethylene body mesh, and 0.5 inch mesh cod-end liner. The trawl duration of the Muskie II was 10 minutes on bottom at 3.0 knots. The Erie Explorer fished 15 sites in the east-central basin using a 33 ft Biloxi bottom trawl with 1 inch cod-end with 0.5 inch liner. Two of these sites were fished in grids that were also fished by the Muskie II (grids 177 and 201). The trawl duration of the Erie Explorer

was 10 minutes on the bottom at 2.5 knots. The Keenosay crew fished 21 sites in the west-central basin using a two seam 33 ft Biloxi bottom trawl, with a 38 ft 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 (YOY), yearling, yearling and older (YAO), 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 all boats, were expressed as arithmetic mean catch per hectare for the entire central basin and for the west and east central basins separately.

In 2018, the most commonly caught species were Rainbow Smelt (all ages) with 121.56 fish per hectare, followed by YAO White Perch with 24.43 fish per hectare. In 2018, 14.84 YOY Yellow Perch were caught per hectare, these fish were distributed throughout the central basin with higher catches in the east central basin (Figure 5.2.2). This was a decrease from the number of YOY Yellow Perch caught in 2017 (29.87 fish per hectare), however it was higher than the catch rate of YOY Yellow Perch in 2016 (5.14 fish per hectare) (Figure 5.2.2). The catch of yearling Yellow Perch increased slightly in 2018 to 9.30 fish per hectare from 6.34 fish per hectare in 2017. However, the catch rate of age 2 and older Yellow Perch decreased in 2018 to 11.07 fish per hectare from 25.04 fish per hectare in 2017. The catch of YOY Walleye increased greatly in 2018 to 18.53 fish per hectare from 0.75 fish per hectare in 2017, most of these fish were caught in the west-central basin. The catch of YOY White Perch decreased from 38.64 in 2017 to 17.53 fish per hectare in 2018. YOY White Bass catch increased from 1.12 fish per hectare in 2017 to 4.95 fish per hectare in 2018.

Results from the 2016 Central Basin Bottom Trawl Survey indicated possible differences in catch rates between the three boats. In 2017, a comparison trawl survey was conducted to determine fishing power correction factors for the vessels used in the Central Basin Bottom Trawl survey. Unfortunately, low catches and poor weather prevented the determination of fishing power correction factors. Additional comparison trawling planned for fall 2018 did not occur due to weather conditions.

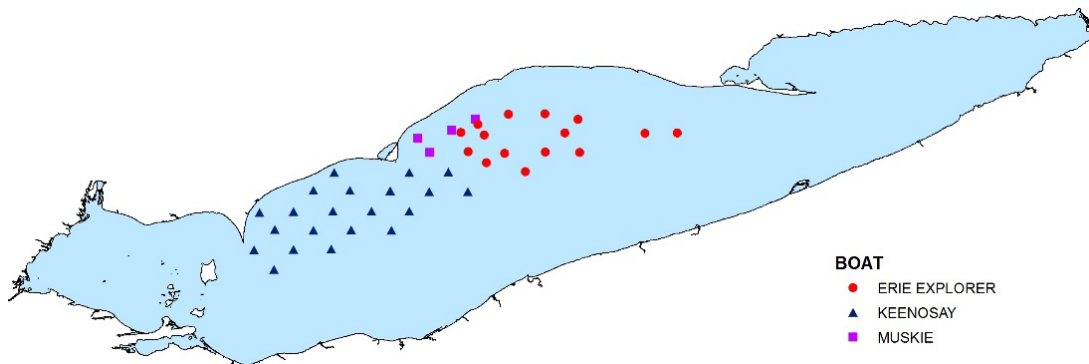


**Figure 5.2.1** 2018 Central Basin Bottom Trawl Program sites by boat.

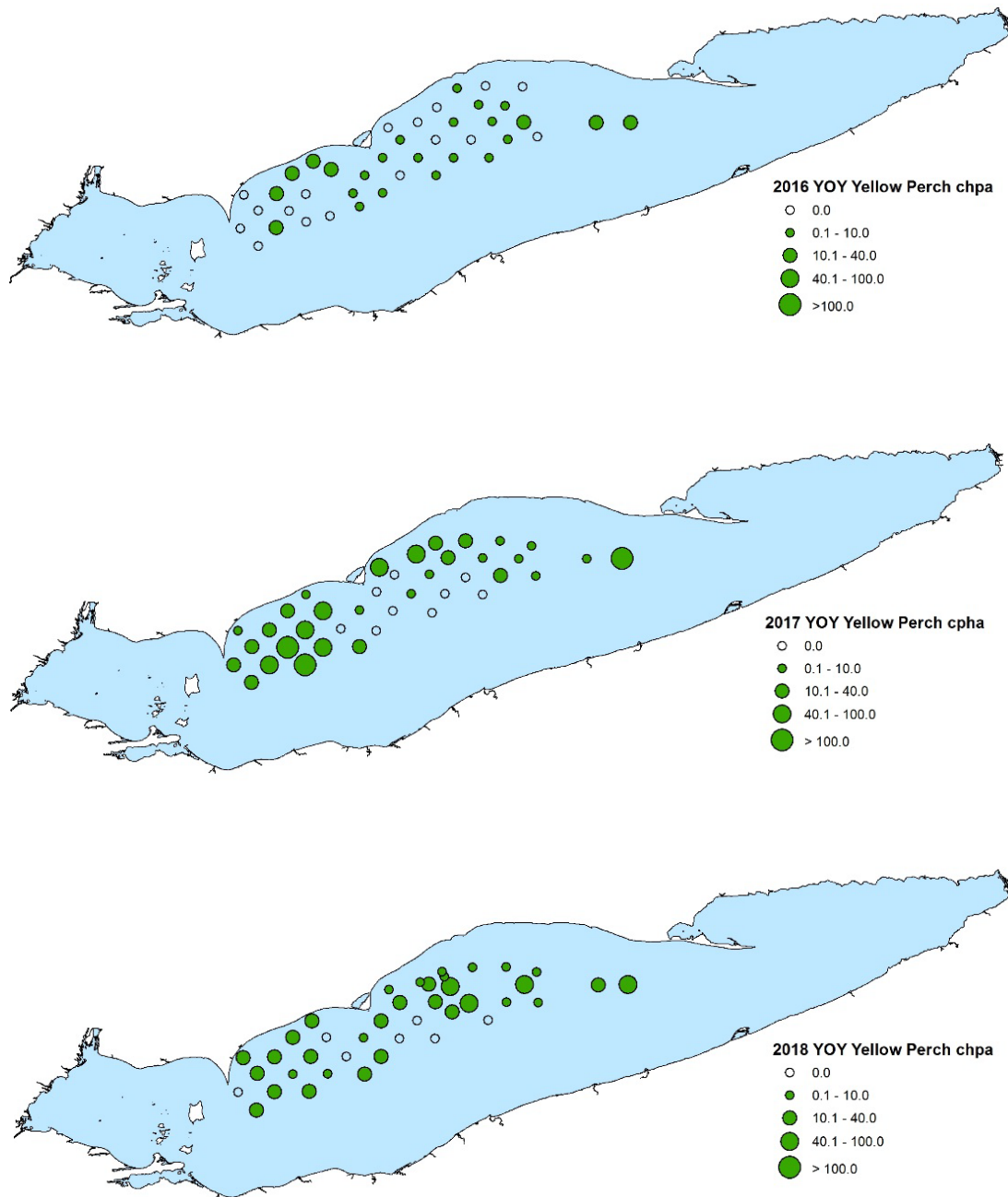


**Figure 5.2.2** Catch per hectare of YOY Yellow Perch in the Central Basin Bottom Trawl Program, 2016, 2017 and 2018.

### 5.3 Lake Erie Limnology

#### *Program 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.).

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 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.

A sub-set of the core-station parameters is measured at 4 additional stations in Lake Erie and 8 stations in Lake Saint Clair (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).

#### *2018 Assessment*

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 2018, 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 was 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, 2019).

In recent years, low productivity has been particularly pronounced when examining both TP and, to a lesser extent CHL-a, in Ontario waters, relative to values in US waters. In 2018, mean TP concentrations in Ontario waters, relative to overall binational basin averages [Ontario / basin-wide], were: 11.6 / 31.7  $\mu\text{g/L}$  in the west; 10.0 / 23.5  $\mu\text{g/L}$  in the central; and 4.8 / 7.6  $\mu\text{g/L}$  in the east basin. This pattern of lower Ontario-water productivity was less pronounced when considering mean CHL-a in Ontario waters compared to basin averages in the west (5.2 / 5.8  $\mu\text{g/L}$ ) and central (4.8 / 5.3  $\mu\text{g/L}$ ) basins. Mean CHL-a in Ontario waters is the same as the basin average (1.6  $\mu\text{g/L}$ ). One consequence of these lower Ontario productivity values is that the western basin would be considered mesotrophic in Ontario and eutrophic in US waters.

Some of this disparity may be due to the high nutrient influence of the Maumee River, OH, and to the variable influence of loadings from the Detroit River to various parts of the western basin.

Comparisons between nearshore and offshore values for TP and CHL-a in Ontario waters in 2018 are shown in Figure 5.3.2. In 2018, the most obvious deviation from trophic status targets occurred in the nearshore of the eastern basin where productivity was well below target. The central basin offshore was, on average, more oligotrophic and thus also lower than the mesotrophic target.

Phosphorus concentrations in the nearshore have implications for such environmental issues as: harmful algal blooms; lake bed anoxia; and the proliferation of nuisance attached algae such as *Cladophora sp.* (particularly in the western, central and eastern basins; respectively).

With few exceptions, core LTLA stations were sampled bi-weekly for the entire May-Oct 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 2019. Zooplankton and Phytoplankton samples were archived for future analysis. Data from auxiliary sampling at non-core stations was reviewed and stored on local LEMU servers. Preliminary work continued toward itemizing data management needs which pertain not only to the core and non-core limnology sampling, but to all sampling and monitoring where any limnology parameters are measured by LEMU. Examples of this auxiliary data include profiles of temperature and oxygen taken during fishery assessment programs (Section 4) or through projects asking specific research questions (e.g. Section 6). Phytoplankton and Chl-a data collected at some stations using a fluoroprobe, is an example of a non-LTLA parameter, originally collected as part of a research program.

A new laboratory analysis was introduced in 2017 to address difficulties with detecting low levels of TP during previous years' sampling. The lower detection limit was improved from 5ug/L to 4ug/L and the problem of samples where TP could not be detected, encountered in 2015 and 2016, was greatly reduced. Regardless, efforts continue to determine if the low TP in Ontario water collections might be an artifact of sampling or laboratory methods. Duplicate samples will be collected in 2019 and sent to the lab analysing US samples in addition to the regular Ontario lab.

Program review within both the LEMU and the FTG in 2017 resulted in several revisions to protocols for the 2018 sampling year. Recognizing that LTLA sampling in Lake St. Clair by Michigan Department of Natural Resources (MDNR) has been discontinued (Figure 5.3.1; historic sites) select LEMU limnology stations were incorporated into the binational LTLA program. Benthic sampling was discontinued in 2018. LEMU continues to explore the possibility of deploying seasonal logging stations in sections of the lake currently under-sampled in Ontario waters (e.g. eastern portion of the central basin). Review and implementation of proposed program changes and data management options will continue into 2019.

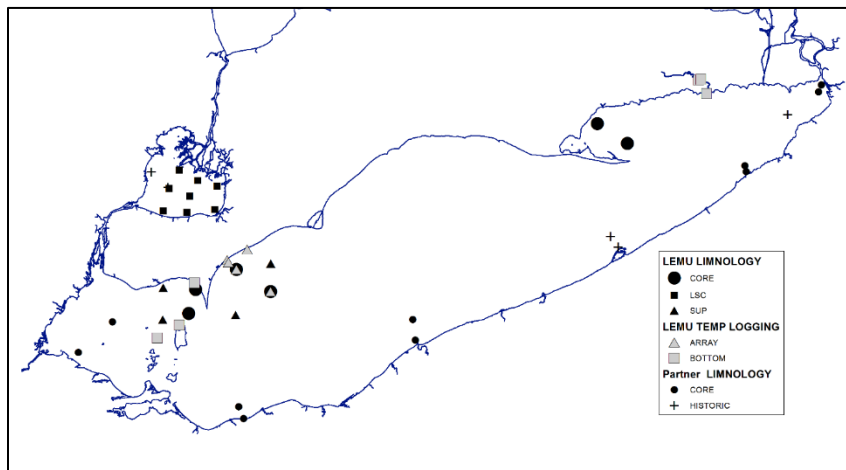


**Figure 5.3.1** Limnology Program sampling locations. Core FTG-LTLA stations are indicated with a solid circle; large circles designate LTLA stations sampled by LEMU. Historic LTLA stations are indicated with an "+". Auxiliary LEMU stations are indicated with solid triangles; Lake St. Clair stations 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).

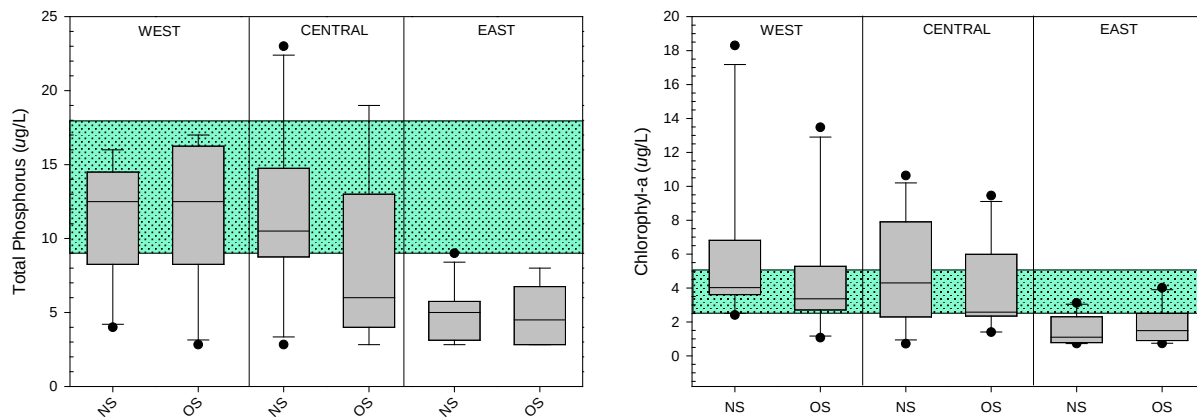


**Figure 5.3.2** Total Phosphorus (TP) and Chlorophyll-a (CHL-a) concentrations at Nearshore (NS) and Offshore (OS) Core LTLA stations in Ontario waters between May and October 2018. Box upper and lower extents indicate the 75<sup>th</sup> and 25<sup>th</sup> percentile value, respectively; the within-box line indicates the mean. 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 <9ug/L; CHL-a < 2.5ug/L).

## References:

Forage Task Group. 2019. Report of the Lake Erie Forage Task Group, March 2018. 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. 56p.

#### 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, and plankton/ seston 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*). This original objective no longer remains because it was determined that a measurable response in water clarity, plankton/ seston abundance and composition across Lake St. Clair would likely require a significant number of individuals be present, rendering it ineffective 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 historical sampling (Leach1972) to be representative of nearshore and offshore areas of Lake St. Clair. Physical chemical and biological parameters are collected, including temperature, dissolved oxygen, pH, conductivity, green/blue-green algae concentration, turbidity, secchi depth, and water samples for nutrients, chlorophyll, zooplankton and seston analysis. Seston analysis is unique to the Lake St. Clair program and compares the seston from a 110 µm filtered water sample to a “raw” unfiltered water sample. The 110 µm filter is intended to mimic the planktivorous Asian carp (i.e. Bighead and Silver) feeding and remove the portion of the seston they may consume. To acquire enough water for total phosphorus, chlorophyll-a and seston sub-sampling, five evenly spaced water samples from the water column are collected. Starting in 2018, protocols for the Lake St. Clair 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 seston 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, LEMU will implement limnological sampling in both lakes under a single program moving forward. In 2019, LEMU will continue to work on integrating historical data collected within each program and developing efficient data handling procedures that are adaptable to the various needs of LEMU's limnological data.

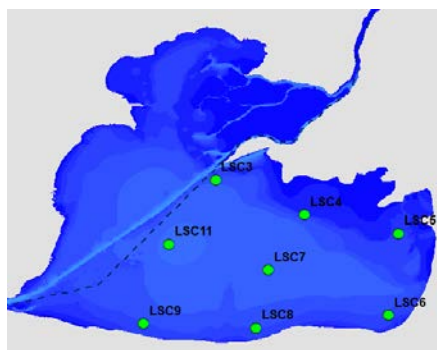


**Figure 5.4.1** Lake St. Clair bathymetry map of the bi-weekly sampled limnology stations.

#### **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

Fish are valuable indicators of aquatic ecosystem health because contaminant concentrations in tissues can represent the cumulative condition in the sediments and water with 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 publishes 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 of capital assets (including our facilities and vessels) for targeted sampling efforts, as needed. In 2018, the LEMU provided MECP with 334 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 2018  
for MECP's Fish contaminant  
monitoring program.

| <b>Species</b>  | <b>N</b>   |
|-----------------|------------|
| Black Crappie   | 20         |
| Bluegill        | 17         |
| Brown Bullhead  | 20         |
| Channel Catfish | 5          |
| Gizzard Shad    | 3          |
| Lake Whitefish  | 20         |
| Largemouth Bass | 20         |
| Northern Pike   | 12         |
| Pumpkinseed     | 20         |
| Rock Bass       | 7          |
| Smallmouth Bass | 40         |
| Walleye         | 50         |
| White Bass      | 50         |
| White Sucker    | 20         |
| Yellow Perch    | 30         |
| <b>Total</b>    | <b>334</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 potential risk to safe consumption. One study (Poste et al 2011) suggested that the microcystin hepato-toxin produced during these blooms may accumulate under certain conditions, in fish flesh to levels that could pose human health risks. It has subsequently been shown that microcystin toxin concentration in Lake Erie fish flesh is a factor of species, bloom intensity and spatial location of the fish relative to the bloom and therefore 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 annually collects samples of fish and water in spatial proximity (inside and outside) and temporal relation (before, during, and after) to a bloom. In support of this collaborative initiative, the LEMU can leverage existing programs such as commercial catch sampling, limnology in addition to collecting targeted samples as needed using our research vessels. The focus is primarily on Walleye, Yellow Perch, and White Bass but other species are sampled opportunistically (see Table 5.5.2 for the 2018 samples collected). Fish flesh, liver and water samples are sent to the MECP fish contaminant monitoring lab for analysis.

Preliminary results from Walleye and Yellow Perch sampled at the peak of the 2015 bloom detected variants of microcystin toxin in livers but failed to detect these microcystin variants in most of the flesh samples. These preliminary results suggest that at the time the fish were collected they had been exposed to microcystin toxin but that the toxin had not translated into toxin concentrations had not concentrated in the consumed portion of flesh. These preliminary results generally support the finding of Wituszynski et al. (2017).

The LEMU and MECP's Fish contaminant monitoring program collaborative continues to explore the relationship with Lake Erie's algal blooms and the microcystin hepato-toxin in fish. Broad questions of interest include: uptake and retention times, peak-bloom to peak-concentration in fish dynamics, and spatial relation of a bloom and toxin concentration in fish flesh.

**Table 5.5.2** Number of fish by species sampled by LEMU in 2018 for Microcystin testing by MECP's fish contaminant monitoring program.

| Species      | N          |
|--------------|------------|
| Walleye      | 80         |
| White Bass   | 17         |
| Yellow Perch | 88         |
| <b>Total</b> | <b>185</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 Thames River Gear Comparison Study

Monitoring river systems is difficult because the aquatic habitat changes from the headwaters to the mouth, especially in large systems. Headwaters are mostly shallow (< 1 m deep) and can be easily traversed by foot. The accessibility of wadeable waters makes them the preferred target of monitoring programs and the Ontario Ministry of Natural Resources and Forestry (OMNRF) has been active in the development of the Ontario Stream Assessment Protocol for wadeable systems (Stanfield 2017). Rivers become wider and deeper as you move downstream, and the aquatic habitat transitions to a series of deep runs and pools (> 2 m deep) that are punctuated by wadeable riffles. This section of river is considered semi-wadeable because of the mixture of shallow and deep habitats. Large rivers eventually transition to non-wadeable habitat, whereby the river can only be traversed by boat. The distinct habitat found in each river section prevents a single sampling protocol from applying to the entire length of a large river system. The OMNRF has developed a few habitat specific protocols that can be used within the semi-wadeable and non-wadeable sections of large rivers (e.g., Jones and Yunker 2010; Jones 2011); however, there is a lack of protocols with which to comprehensively monitor fish communities within semi-wadeable and non-wadeable river sections. To address this, Lake Erie Management Unit (LEMU) conducted a gear comparison study in the Thames River to determine what gear(s) are required to effectively characterize and monitor the small-bodied fish community in the semi- and non-wadeable sections of large rivers. Small-bodied fish are generally forage fish, such as members of cyprinidae, or young juvenile fish that are less than 200 mm long (Schultz et al. 2016). The small-bodied fish community was chosen as the focus of the study because fishing gears are inherently size selective, and the small-bodied community is often the most diverse and poorly characterized component of large river fish communities.

#### *Non-Wadeable River Section*

Boat electrofishing, small-mesh gill nets, and benthic trawling were evaluated as potential gears for sampling the non-wadeable section of the Thames River. Each gear was fished at 30 sites located between Kent Bridge and Lighthouse Cove in August of 2018. Sample sites were chosen by first selecting thirty 600 m sampling reaches using a generalized random tessellation stratification design (Stevens and Olsen 2004). Then, the 600 m sampling reaches were broken into 100 m subreaches, whereby boat electrofishing, small-mesh gill nets, and benthic trawling were randomly assigned to subreach 2, 4, and 6 (subreaches numbered in downstream direction). The same subreach could not be sampled with all three gears because of the bias that can occur due to disturbance and/or the removal of fish (i.e., gill netting). As a result, each gear was used within a 600 m sampling reach, which is a small enough area to reasonably assume similar fish communities are available for each gear to sample.

A total of 3881 individuals were captured representing a total of 41 species of fish (Tables 5.6.1). Boat electrofishing captured the highest number of individuals (2803) and species (38 sp.). Trawling captured more individuals (618) than gill netting (460), whereas gill netting captured more species (23 sp.) than trawling (9 sp.; Tables 5.6.1). Furthermore, boat electrofishing captured 14 unique species (i.e., species only captured by that gear), whereas gill netting (2) and trawling (1) captured few unique species. Overall,

boat electrofishing appeared to be the most efficient and effective gear when sampling the non-wadeable section of the Thames River.

### *Semi-Wadeable Section*

In the semi-wadeable section, backpack electrofishing and seine netting were evaluated as sample gears in the wadeable riffles, and fyke and gill netting were evaluated as sample gears in the non-wadeable runs. The semi-wadeable section extends from Thamesville upstream past the forks of the Thames River (beyond London). A total of ten sites were fished in September and October 2018. These sites were clustered around the Big Bend Conservation Area because there is public access to the river from this property (Location: 42.64237 degrees N, -81.70739 degrees East). Sites were systematically fished using all gears in an upstream and downstream direction from the boat launch. A sample site consisted of a riffle and a downstream run (i.e., riffle-run complex). Gill nets were only fished at three sites because excessive leaf buildup impaired their ability to capture fish and, therefore, no results are presented for gill nets.

A total of 1992 individuals were captured in the Thames River semi-wadeable section representing 36 species (Table 5.6.2). The Northern Madtom (threatened) and Greenside Darter (special concern) were the only species at risk (SAR) captured during the study. Shoreline backpack electrofishing and fyke netting captured the most species in the riffles and runs, respectively. (Table 5.6.2). An intermediate number of species was captured by middle riffle backpack electrofishing and shoreline seine netting, whereas middle riffle seine netting captured the least number of species (Table 5.6.2). The greatest number of unique species was captured by fyke netting (9 sp.), followed by backpack electrofishing along the shore (4 sp.), and backpack electrofishing in the middle of a riffle (1 sp.; Table 5.6.2).

No single gear captured a representative fish community relative to that captured by all gears combined (Table 5.6.2). The riffle gears (backpack electrofishing and seine netting) captured darter species not present in the fyke net catches, whereas the fyke net captured centrarchid and catostomid species not present in the catches of riffle gears. When considering combinations of riffle-run gears, the best combination was middle riffle and shoreline backpack electrofishing with fyke netting. This combination captured most of the species detected at the site-level and all the species at the community-level (Table 5.6.2). In contrast, many species went undetected by the seine net – fyke net combinations because of the poor performance of the seine net in the riffle habitat (Table 5.6.2).

Further details of this study can be found in the full report entitled “Thames River Small Fish Community” (Thorn, 2019).

### **References:**

Jones, N.E. (2011). Electrofishing rivers: nearshore community sampling methodologies for Ontario's flowing waters. OMNRF, Aquatic Research Series 2011-06, Peterborough, Ontario.

Jones, N.E. and Yunker, G. (2010). Riverine index netting manual of instructions. OMNRF, Aquatic Research Series 2010-01, Peterborough, Ontario.

Schultz, L.D., Mayfield, M.P., and Whitlock, M.S. (2016). Sample sizes needed to describe length-frequency of small-bodied fishes: an example using larval Pacific lamprey. *Journal of Fish and Wildlife Management* 7: 315-322.

Stanfield, L. (2017). Ontario stream assessment protocol – version 10.0. OMNRF, Technical Publications – Fisheries Assessment Protocols.

Stevens, D.L., and Olsen, A.R. (2004). Spatially balanced sampling of natural resources. Journal of the American Statistical Association 99: 262-278.

**Table 5.6.1** Number of individuals captured by boat electrofishing, gill netting, and benthic trawling in the non-wadeable section of the Thames River in 2018. Shaded areas represent species unique to one gear.

| Common Name        | Boat E. | Gill Net | Trawl |
|--------------------|---------|----------|-------|
| Black Crappie      | 3       |          |       |
| Bluegill           | 477     |          |       |
| Bluntnose Minnow   | 235     |          |       |
| Bowfin             | 6       |          |       |
| Brindled Madtom    |         |          | 2     |
| Brook Silverside   | 9       |          |       |
| Brown Bullhead     | 1       |          |       |
| Channel Catfish    | 10      | 48       | 214   |
| Common Carp        | 34      | 1        |       |
| Emerald Shiner     | 31      | 10       | 2     |
| Flathead Catfish   | 1       |          |       |
| Freshwater Drum    | 22      | 39       | 26    |
| Ghost Shiner       | 206     |          | 344   |
| Gizzard Shad       | 685     | 137      | 5     |
| Golden Redhorse    | 25      |          | 1     |
| Goldfish           | 3       |          |       |
| Green Sunfish      | 25      |          |       |
| Buffalo            | 17      |          |       |
| Largemouth Bass    | 199     | 1        |       |
| Logperch           | 6       | 2        |       |
| Longnose Gar       | 4       | 40       |       |
| Northern Pike      | 15      | 1        |       |
| Pumpkinseed        | 226     | 1        |       |
| Quillback          |         | 1        |       |
| Rock Bass          | 184     | 9        |       |
| Round Goby         | 1       |          | 15    |
| Shorthead Redhorse | 22      | 4        |       |
| Silver Chub        |         | 1        |       |
| Silver Redhorse    | 7       |          |       |
| Smallmouth Bass    | 30      | 1        |       |
| Spotfin Shiner     | 24      | 1        |       |
| Spottail Shiner    | 1       |          |       |
| Spotted Sucker     | 50      |          |       |
| Trout-Perch        | 1       | 13       | 9     |
| Walleye            | 1       | 5        |       |
| White Bass         | 34      | 16       |       |
| White Crappie      | 6       | 10       |       |
| White Perch        | 3       | 94       |       |
| White Sucker       | 1       |          |       |
| Yellow Bullhead    | 12      | 2        |       |
| Yellow Perch       | 186     | 23       |       |

**Table 5.6.2** Number of individuals captured for each species by middle riffle backpack electrofishing (M-BE), middle riffle seine netting (M-SN), riffle shoreline backpack electrofishing (S-BE), riffle shoreline seine netting (S-SN), and fyke netting in the semi-wadeable section of the Thames River in 2018. Shaded areas represent species unique to one gear.

| Common Name         | M-BE | M-SN | S-BE | S-SN | Fyke Net |
|---------------------|------|------|------|------|----------|
| Black Crappie       |      |      |      |      | 1        |
| Blacknose Dace      |      |      | 1    |      |          |
| Blackside Darter    | 4    |      | 7    | 1    |          |
| Bluegill            |      |      | 1    | 1    | 4        |
| Bluntnose Minnow    |      |      | 55   | 26   | 245      |
| Central Stoneroller |      |      | 6    |      | 5        |
| Channel Catfish     | 2    | 1    | 7    |      | 19       |
| Creek Chub          |      |      | 4    |      | 3        |
| Emerald Shiner      | 1    | 1    | 22   | 26   | 32       |
| Fantail Darter      | 2    |      | 3    |      |          |
| Ghost Shiner        | 1    |      | 25   | 25   | 1168     |
| Gizzard Shad        |      |      |      | 1    | 5        |
| Golden Redhorse     | 1    | 1    | 1    | 2    | 2        |
| Green Sunfish       |      |      |      |      | 1        |
| Greenside Darter    | 6    |      | 7    | 2    | 1        |
| Hornyhead Chub      |      |      | 1    |      |          |
| Logperch            | 3    |      | 1    |      |          |
| Longnose Gar        |      |      |      |      | 2        |
| Moxostoma sp.       |      |      |      |      | 6        |
| Northern Hog Sucker | 5    | 3    | 2    |      |          |
| Northern Madtom     | 1    |      |      |      |          |
| Rock Bass           |      |      | 3    |      | 11       |
| Rosyface Shiner     |      |      | 5    |      |          |
| Round Goby          | 2    |      | 5    | 2    |          |
| Shorthead Redhorse  |      |      |      |      | 5        |
| Silver Redhorse     |      |      |      |      | 3        |
| Smallmouth Bass     |      |      |      | 1    | 1        |
| Spotfin Shiner      |      | 1    | 20   | 4    | 56       |
| Spottail Shiner     |      |      |      |      | 1        |
| Spotted Sucker      |      |      | 1    |      | 2        |
| Stonecat            | 1    |      |      | 1    | 8        |
| Trout-Perch         |      |      | 2    |      | 3        |
| White Bass          |      |      | 1    |      |          |
| White Crappie       |      |      |      |      | 2        |
| White Perch         |      |      |      |      | 6        |
| White Sucker        |      |      | 10   | 2    | 8        |
| Yellow Bullhead     |      |      |      |      | 72       |

### 5.7 Inner Long Point Bay Adult Fish Community Hoopnet 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 2.1.1 of this report. 2018 was an exploratory year for this survey, and nets were set in spring and summer to determine the best timing for the survey. 4' hoop nets were set for ~24 hours in random sites between 24 April and 7 May ( $n = 18$  net sets) and 19 July and 1 August ( $n = 17$  net sets).

In spring, 19 species were caught versus 13 in summer. Only data on commercial species will be presented here. Commercial species were caught in this survey in higher numbers in the spring than summer, other than *Lepomis* sp. and Common Carp, with some commercial species not caught in summer (Table 5.7.1). Further, the length distribution of quota species (Yellow Perch and Northern Pike) favoured larger fish in spring (Figure 5.7.2 and 5.7.3). Based on these results, the survey will subsequently take place in spring only with at least 30 net sets, following the Nearshore Community Index Netting protocol sample size recommendation for detecting annual changes in fish communities.

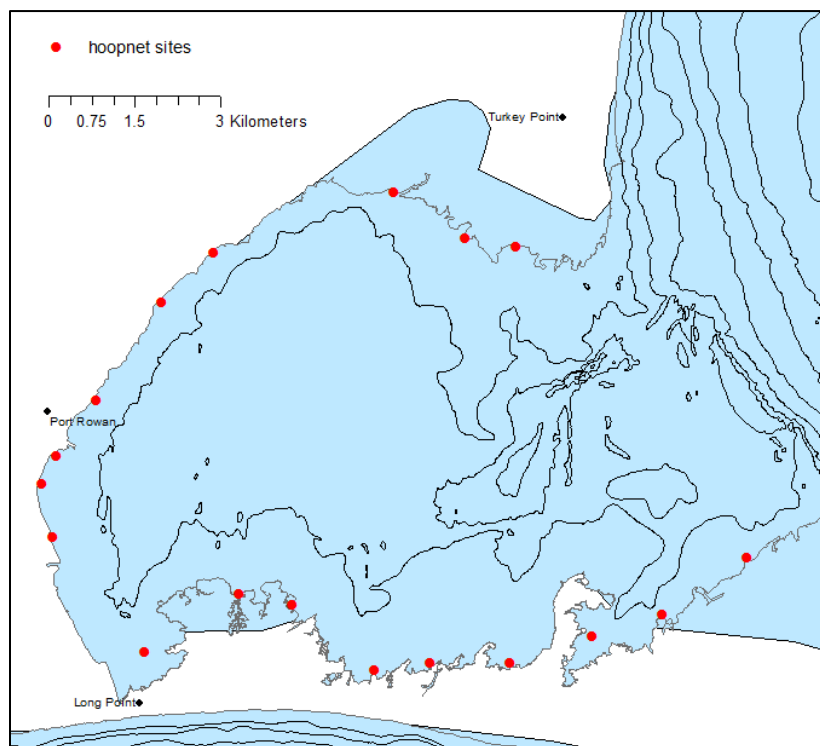


**Figure 5.7.1** Hoop net sites in the Inner Long Point Bay exploratory adult fish community survey, Lake Erie.

**Table 5.7.1** Total catch of commercial species in the Inner Long Point Bay exploratory adult fish community survey, Lake Erie, indexed by number of net sets (standardized to n = 17).

| Species         | Spring | Summer |
|-----------------|--------|--------|
| Longnose Gar    | 1.9    | 1      |
| Bowfin          | 31.2   | 11     |
| Northern Pike   | 22.7   | 8      |
| Common Carp     | 6.6    | 10     |
| Brown Bullhead  | 969.0  | 11     |
| White Perch     | 4.7    | 0      |
| White Bass      | 2.8    | 0      |
| Rock Bass       | 100.1  | 26     |
| Bluegill        | 113.3  | 209    |
| Pumpkinseed     | 330.6  | 378    |
| Largemouth Bass | 6.6    | 5      |
| Black Crappie   | 32.1   | 13     |
| Yellow Perch    | 59.5   | 8      |
| Mudpuppy        | 1.9    | 0      |

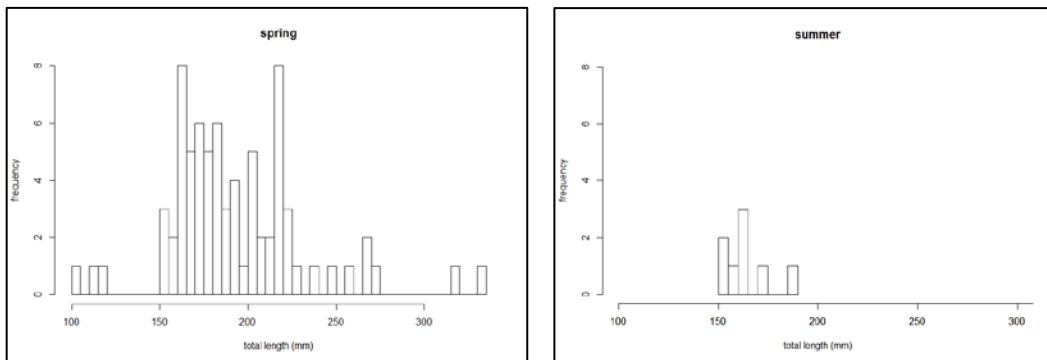


**Figure 5.7.2** Length distribution of Yellow Perch caught in the Inner Long Point Bay spring and Summer exploratory adult fish community surveys, Lake Erie (spring n = 75, summer n = 8).

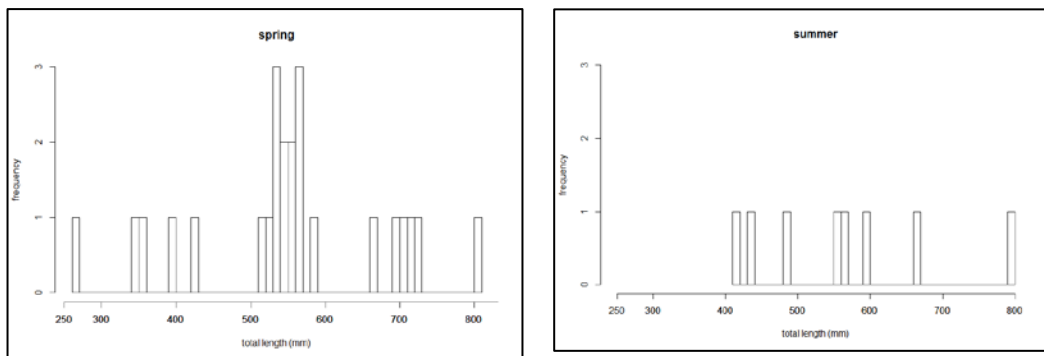


**Figure 5.7.3** Length distribution of Northern Pike caught in the Inner Long Point Bay spring and summer exploratory adult fish community surveys, Lake Erie (spring n = 24, summer n = 8).

## 5.8 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 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. Total numbers produced and stocked annually have ranged between 50,000 and 59,055 (Table 5.8.1). Slate Island Lake Trout were not available for the first year of stocking and so Lake Manitou strain was used. In 2018, 51,284 yearling LT were stocked. 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. In infrequent instances when coded-wire tags were not used (see *Supplemental Stocking*; below), fish were marked with fin-clips such that all stocked fish in Erie are theoretically similarly identifiable. Stocking typically takes place in April or May each year oof shore. On occasion, when weather has prevented stocking by boat, fish have been shore-stocked, by truck, at Port Maitland.

### *Supplemental Stocking*

In addition to its annual commitment to stock 50K yearlings between 2008 and 2020, LEMU has stocked additional Lake Trout as follows: i) In 2006, 88K surplus ST-LT were stocked to offset a deficiency in planned stocking in Pennsylvania waters; ii) In 2010 LEMU accepted 76K surplus Lake Trout of various strains identified in the Ontario fish culture system; and iii) For three years beginning in 2016, LEMU accepted fall fingerling Lake Trout, produced as a by-product of wild collections by Fish Culture Section undertaken to replenish broodstock for Seneca Lake-strain Lake Trout (Table 5.8.1). These last stockings are noteworthy because these were conducted in November and were fall-fingerling Lake Trout (although they were reared in high growth conditions and were larger than typical spring-stocked yearlings). Recently agencies on the Great Lakes have begun favouring Seneca-strain Lake Trout for their perceived superior survival rates, particularly with regard to sea lamprey induced mortality.

### *Assessment*

Lake Trout stocked by OMNRF contribute to the coldwater fish community of the eastern basin as evidenced by their presence in standardized gill net surveys. Despite being stocked in smaller numbers relative to strains stocked in US waters, in 2018, ST-LT constituted 29% and 17% of the Lake Trout catch in the Partnership Index (Section 4.1) and the Ontario portion of the Coldwater Assessment (Section 4.5), respectively. Four of five Lake Trout caught in the Long Point Bay Adult Fish Community Survey (Section 4.4) were LEMU stocked ST-LT. In contrast LEMU-stocked ST-LT were only present in 2% of Coldwater Assessment catches from New York waters. Despite having been stocked for more than 10 years, older

ages of ST-LT are rare. In 2018, only 8% and 11% of ST-LT from the basin-wide Coldwater Assessment and Partnership Index, respectively, were older than 3 years.

#### *Natural Reproduction*

In 2018, 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 (2% and 1.5% of the catch; respectively) natural reproduction was not inferred because hatchery clip error and tag loss estimates range between 2.5 and 3% annually.

**Table 5.8.1** Lake Trout stocking by LEMU 2006 – 2018. All numbers represent spring stocking of yearling fish except for recent supplemental stocking (\*) of fall fingerlings in November. CWT = coded wire tag.

|               | YEAR         | STRAIN              | NUMBER         | MARK        | HATCHERY          | METHOD      | LOCATION               |
|---------------|--------------|---------------------|----------------|-------------|-------------------|-------------|------------------------|
| PLANNED       | 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        |
|               | <b>2018</b>  | <b>Slate Island</b> | <b>51,284</b>  | <b>CWT</b>  | <b>Chatsworth</b> | <b>Boat</b> | <b>Nanticoke Shoal</b> |
|               |              |                     |                |             |                   |             |                        |
| SUPPLEMENTAL  | 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        |
|               | <b>2018*</b> | <b>Seneca</b>       | <b>16,289</b>  | <b>CLIP</b> | <b>Normandale</b> | <b>Boat</b> | <b>Nanticoke Shoal</b> |
| TOTAL STOCKED |              |                     | <b>818,976</b> |             |                   |             |                        |
|               |              |                     |                |             |                   |             |                        |

## 5.9 Lake St. Clair Fish Community Assessment

Lake St. Clair is a large, highly productive body of water that is connected to two great lakes and straddles an international border. On both sides of the border, Lake St. Clair supports a significant recreational fishery of Walleye, Yellow Perch, Smallmouth Bass, and Muskellunge. Thousands of angler hours are spent on Lake St. Clair in pursuit of recreational fish, which contributes to the local economy through job creation and revenue generation. Recently, the Lake Erie Management Unit conducted a program review and identified Lake St. Clair as a monitoring gap that needed to be addressed. In response, the Lake St. Clair recreational fish community assessment was developed to monitor the abundance and biological characteristics of recreationally important fish species in Lake St. Clair. A secondary objective of the program was to collect information about the broader fish community.

In 2018, a total of 60 gill net sets were fished in Lake St. Clair between June 6<sup>th</sup> and July 12<sup>th</sup> (Figure 5.9.1). A net set consisted of two gill nets strapped together using a 3 meter spanner. Each gill net was 1.8 meters tall and 25 meters long with panels of 38, 51, 64, 76, 89, 102, 114, 127 mm mesh (panel: 1.8 H x 3.1 W). The total length of the full set was ~ 53 meters. The gill net sets were fished on bottom for a period of 16-22 hours.

Sites were allocated using a depth stratified, random design. The depth strata used for this program were 1-4 meters and 4-8 meters, whereby 25 and 35 sites were allocated to each strata, respectively. The sites were also allocated relative to three sampling areas within Lake St. Clair (Figure 5.9.1). These areas were selected as spatial extents that could be reasonably traversed by a sampling crew in a day. Crews rotated through the sampling areas on a weekly basis until all the sampling was complete. The crews visited the sampling areas in random order to prevent temporally biasing the data.

All captured species were identified, enumerated, and measured for total length. The bulk mass of all fish was also measured. Recreationally important species received more detailed sampling and were weighed, sexed, assessed for gonad condition, and had aging structures removed. Species considered recreationally important were Walleye, Yellow Perch, Smallmouth Bass, White Bass, Muskellunge, Northern Pike and Tiger Muskellunge.

A total of 2,244 individuals were captured representing 25 species (Table 5.9.1). Additionally, a suspected redhorse hybrid was identified to the level of genus (*Moxostoma* spp.). The most abundant species in the catch were Yellow Perch (24% of total catch), Gizzard Shad (21%), Walleye (9%), White Perch (7%), and Shorthead Redhorse (7%; Table 5.9.1). The highest biomass in the catch was of Gizzard Shad (19% of total biomass), Channel Catfish (15%), Longnose Gar (11%), Walleye (10%), and Northern Pike (8%; Table 5.9.1). No species at risk were captured during the program.

Length distributions, weight distributions, and age compositions are presented for the recreationally important fish species (Table 5.9.2). The interpretation of this data is limited because 2018 was the first year of the program; however, the data will eventually allow for an assessment of recreational fish populations as more years of data are added.

**Table 5.9.1** Common name, scientific name, catch, and biomass of each species captured by the Lake St. Clair Fish Community Assessment in 2018.

| Common Name        | Scientific Name                              | Catch | Biomass (Kg) |
|--------------------|----------------------------------------------|-------|--------------|
| Silver Lamprey     | <i>Ichthyomyzon unicuspis</i>                | 2     | -            |
| Longnose Gar       | <i>Lepisosteus osseus</i>                    | 152   | 135.6        |
| Bowfin             | <i>Amia calva</i>                            | 1     | 1.4          |
| Gizzard Shad       | <i>Dorosoma cepedianum</i>                   | 477   | 238.6        |
| Rainbow Trout      | <i>Oncorhynchus mykiss</i>                   | 1     | 0.3          |
| Northern Pike      | <i>Esox lucius</i>                           | 43    | 98.7         |
| Muskellunge        | <i>Esox masquinongy</i>                      | 6     | 22.4         |
| Mooneye            | <i>Hiodon tergisus</i>                       | 5     | 1.8          |
| Quillback          | <i>Cariodes cyprinus</i>                     | 2     | 2.0          |
| White Sucker       | <i>Catostomus commersoni</i>                 | 1     | 1.1          |
| Silver Redhorse    | <i>Moxostoma anisurum</i>                    | 22    | 25.7         |
| Golden Redhorse    | <i>Moxostoma erythrurum</i>                  | 13    | 8.3          |
| Shorthead Redhorse | <i>Moxostoma macrolepidotum</i>              | 162   | 90.1         |
| Moxostoma sp.      | <i>Moxostoma</i> sp.                         | 1     | 0.5          |
| Common Carp        | <i>Cyprinus carpio</i>                       | 5     | 21.2         |
| Channel Catfish    | <i>Ictalurus punctatus</i>                   | 115   | 191.5        |
| White Perch        | <i>Morone americana</i>                      | 161   | 29.8         |
| White Bass         | <i>Morone chrysops</i>                       | 108   | 50.6         |
| Rock Bass          | <i>Ambloplites rupestris</i>                 | 64    | 12.0         |
| Pumpkinseed        | <i>Lepomis gibbosus</i>                      | 1     | 0.1          |
| Bluegill           | <i>Lepomis macrochirus</i>                   | 1     | 0.1          |
| Smallmouth Bass    | <i>Micropterus dolomieu</i>                  | 70    | 60.8         |
| Yellow Perch       | <i>Perca flavescens</i>                      | 531   | 54.4         |
| Walleye            | <i>Sander vitreus</i>                        | 192   | 121.1        |
| Freshwater Drum    | <i>Aplodinotus grunniens</i>                 | 105   | 82.6         |
| Tiger Muskellunge  | <i>Esox lucius</i> x <i>Esox masquinongy</i> | 3     | 16.3         |

**Table 5.9.2** Median (minimum-maximum) total length, weight, and age of recreationally important fish species captured during the Lake St. Clair Fish Community Assessment in 2018.

| Species           | Total Length (mm) | Weight (grams)   | Age      |
|-------------------|-------------------|------------------|----------|
| Walleye           | 399 (208-661)     | 532 (67-2422)    | 3 (1-15) |
| Yellow Perch      | 200 (139-325)     | 92 (27-465)      | 4 (2-9)  |
| Smallmouth Bass   | 379 (210-482)     | 832 (138-2045)   | 4 (2-17) |
| White Bass        | 341 (255-418)     | 457 (188-874)    | 5 (2-10) |
| Muskellunge       | 850 (384-985)     | 4076 (267-5993)  | -        |
| Northern Pike     | 729 (508-862)     | 2186 (804-4139)  | -        |
| Tiger Muskellunge | 885 (826-1049)    | 4190 (3567-8586) | -        |

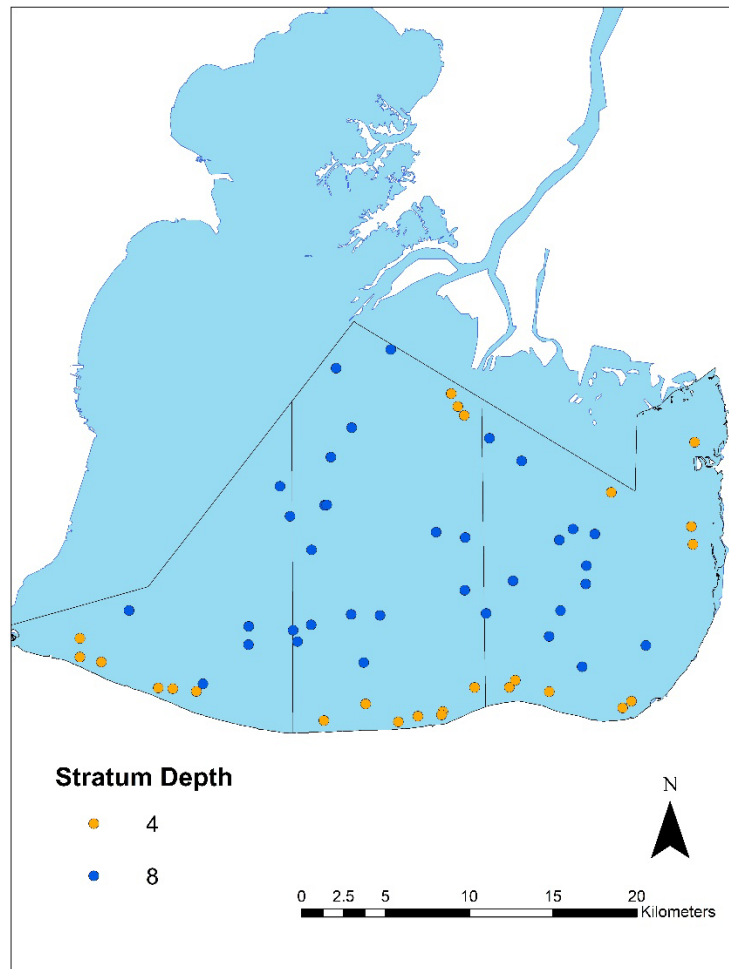


**Figure 5.9.1** Lake St. Clair Fish Community Assessment sample sites in 2018. The outlined sections indicate the sampling areas on the Ontario side of the lake.

## 6. ACOUSTIC TELEMETRY / TAGGING PROJECTS

The spatial ecology and movement of many fish species 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 biological 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 available.

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 pick up when the transmitter is in proximity (Figure 6.1a). The distinct acoustic pings are then translated into a distinct identifications of individual fish. By strategically placing a series of receivers throughout a water body a researcher can triangulate position (Figure 6.1b) and examine movements of individual fish to answer scientific hypotheses or questions relevant to fisheries management.

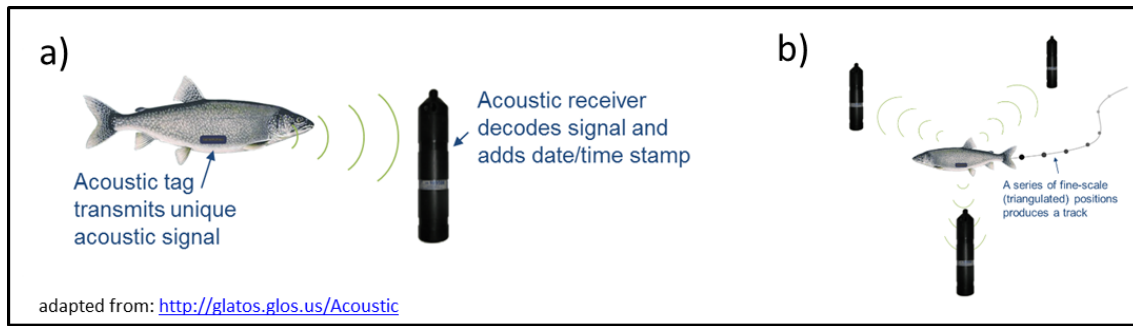


**Figure 6.1** How Acoustic telemetry works.

In 2010, the Great Lakes node of the Ocean Tracking Network known as the Great Lakes Acoustic Telemetry Observation System (GLATOS) was established. This collaborative effort of Canadian and US, State/provincial federal and academic partners oversees project tagging fish, the deployment and maintenance of acoustic receivers and most importantly handing 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. In 2016, receiver deployment was changed to a grid pattern to increase coverage and detection efficiency (Figure 6.2). In 2017, the extensive central basin grid of receivers expanded to include parts of east and west basin. The Lake Erie Management Unit (LEMU) is actively involved in several acoustic telemetry projects including Lake Erie Whitefish (Section 6.1), Grand River Walleye/east basin Mixed Fishery (Section 6.2), and Lake St. Clair Muskellunge (Section 6.3). Other telemetry projects that LEMU actively supports or are involved with include east basin Lake Trout Habitat Use (Section 6.4), Rondeau Bay Carp (Section 6.6) and west/central basin Walleye habitat and mixed stock analysis (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. Conventional Walleye tagging in the Thames and Sydenham Rivers took place from 2013-2016 with recaptures submitted from fisheries up to 2018. The distributions of tagged Walleye recaptures are described in Section 6.5.

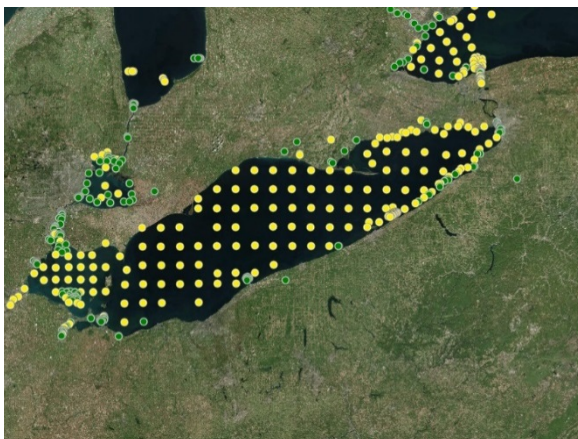


**Figure 6.2** Network of GLATOS acoustic receivers in 2018. (Maps retrieved from <http://glatos.glos.us/map>, January 9, 2019). Green circles are retrieved receivers (may or may not have been redeployed), yellow circles are currently operating receivers.

### 6.1 Lake Erie Lake Whitefish Acoustic Telemetry Tagging

In Lake Erie, Lake Whitefish are sought mainly by commercial fisheries. In recent years, Lake Whitefish abundance declined in Lake Erie due to poor recruitment. Although Lake Whitefish are managed by quota in Ontario waters of Lake Erie, a formal harvest policy is lacking. An acoustic telemetry - tagging study was initiated to enhance assessment and management of Lake Whitefish. Using Great Lakes Acoustic 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 Service (USFWS) and Great Lakes Fishery Commission (GLFC) began an acoustic telemetry study to monitor Lake Whitefish 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. 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, 154 Lake Whitefish were tagged in Lake Erie with 11 tagged Lake Whitefish recaptured by commercial fishers up to 2018 (Table 6.1.1). The coverage of GLATOS receivers has grown during the Lake Whitefish tagging study (Figure 6.1.1). Detections of tagged Lake Whitefish during 2015 to 2018 are presented in Figure 6.1.1. Increased detections from 2016 to 2018 reflect the greater number of receivers deployed and cumulative numbers of deployed tags; with additional Lake Whitefish tagged during 2016 and 2017. 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 2015-2016. The spawning behaviour of Lake Whitefish tagged during 2017 will be described after additional 2018 data are downloaded. Emigration from Lake Erie has not been observed during the study.

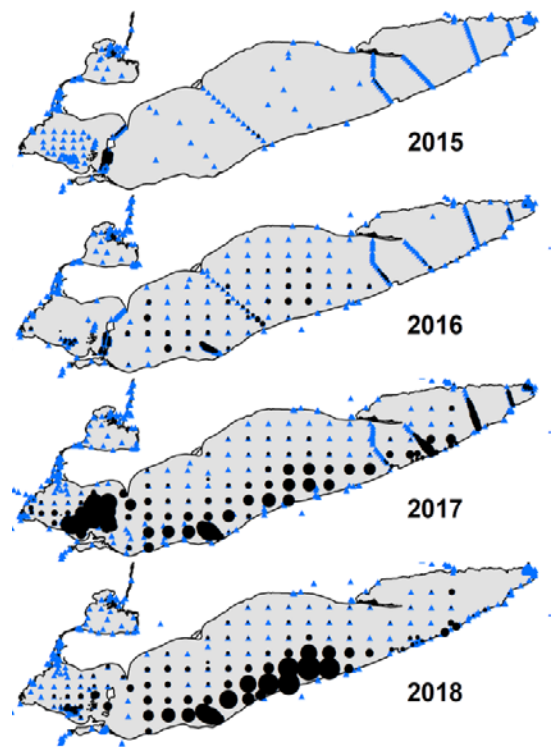


**Figure 6.1.1** Detections of Lake Whitefish with implanted transmitters (black dots) at acoustic receiver stations (blue triangles) in the GLATOS network 2015-2018. Symbol (dot) size varies with the number of individual Lake Whitefish detected. Detections during 2018 do not include the second half of the year.

**Table 6.1.1** Number of Lake Whitefish tagged by year from 2015-2018. Number of Lake Whitefish recaptured by fisheries by year 2015-2018.

| Tag Location               | Year of Tagging | # Tagged | Recaptures By Year |      |      |      |       |
|----------------------------|-----------------|----------|--------------------|------|------|------|-------|
|                            |                 |          | 2015               | 2016 | 2017 | 2018 | Total |
| Maumee River               | 2015            | 10       | 0                  | 0    | 1    | 0    | 1     |
| Hen/Little Chick           | 2016            | 37       |                    | 3    | 0    | 0    | 3     |
| OH Reefs, Hen/Little Chick | 2017            | 105      |                    |      | 6    | 1    | 7     |
| Detroit River              | 2018            | 2        |                    |      |      | 0    | 0     |
| Total                      |                 | 154      | 0                  | 3    | 7    | 1    | 11    |

## 6.2 Grand River Walleye / East Basin Mixed Fishery

### *Overview*

Walleye originating in the Grand River, Ontario are known to be genetically distinct within the Lake Erie basin and are thought to contribute to fisheries in the eastern basin of the lake. The extreme lower reaches of the 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 of the Walleye spawning habitat in the lower 42km of river (246 ha), 98% 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 sizeable spring aggregation of Walleye (~ 15,000 in 2005) occurs downstream of the dam annually. Since 2001, efforts have been directed at assessing the aggregation and physically moving individuals past the barrier.

In 2015 Lake Erie Management Unit (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. For each year of the study, 70 Walleye (35 males; 35 females) would receive an internal acoustic tag and half would be lifted over the barrier while half would be left below. In 2018, 70 Walleye were tagged bringing the total number tagged for the project to 267 (the goal of 70 fish was not reached in 2017). Each tag was marked with a “\$100 Reward Sticker” from which the assumption was made that the recapture reporting rate would be 100%. Most (255) of the deployed tags were outfitted with temperature loggers which would record the temperature of the fish 6 times/day for 11 months, accessible if the fish was caught and tag returned. The acoustic tags have a battery life of 5 years and so data is expected to continue to be received through 2024. Regardless, preliminary results and trends continue to become available. Funding for this project 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.

### *2018*

Through the end of November 2018, Grand River tagged Walleye had been detected over 4 million times on 263 receivers distributed throughout the river and Lake Erie system. To date, 34 tags have been recaptured and returned from both the sport (n=31) and commercial (n=3) fisheries. On average, 10% of the tagged fish at large are harvested each year. Much (74%) of the harvest within the first year occurs on fish released above the dam, 66% of which are caught immediately above the main weir, presumably as they attempt to pass downstream. In the winter of 2018/19, three tags were returned from the ice fishery that occurs immediately below the dam. Based on continued detections, at least 140 of the 267 Walleye tagged since 2015 were still at large in November 2018 (after accounting for fishing and surgery mortality). Tagged Walleye in this project have gone as long as 400 days before first detection and so it is likely that some, tagged in 2018, may still be detected. Updates of detection data from receivers in the lake will not become available until early summer 2019. It is becoming apparent that a considerable proportion of the tagged Grand River Walleye do not range as widely as other eastern basin stocks, those produced on shoals and tributaries in New York. 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 New York- or western basin-origin Walleye do. While ranging in the nearshore, Grand River Walleye periodically return to the river mouth 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 dam remediation in the lower river. Further information about the project can be found at: <https://glatos.glos.us/home/project/EGRWE>

### *Related Projects*

This project is closely associated with a broader eastern basin Walleye acoustic project being led by the New York State Department of Environmental Conservation (NYSDEC). Both benefit from participation and collaboration with: Pennsylvania Fish and Boat Commission (PFBC); Ohio Department of Natural Resources (ODNR); Great Lakes Fishery Commission (GLFC); Michigan State University (MSU); Ohio State University (OSU); and the United States Geological Survey (USGS). Additional collaborations and data sharing resulting from this project include two University of Windsor (Aaron Fisk; GLIER), initiatives. One is looking at the timing, demographics, and drivers of western basin Walleye occupancy in the eastern basin (lead: Graham Raby), and the second is looking at habitat use (depth and temperature) by Walleye in Lake Erie (lead: Jordan Matley). Work at Ohio State University is using the Grand River data in a larger effort to understand spawning site fidelity for Lake Erie Walleye (lead: Stu Ludson/Andrew Bade)

### *Mixed Fishery*

Initial plans were made to use acoustic telemetry to estimate individual stock contributions to eastern basin fisheries. This was to have been accomplished by tagging fish caught in the eastern basin during the summer, assuming a mixture of western migrants and eastern basin stocks. Subsequent detections of these fish during spawning time, would allow for individual-based stock assignments. This was abandoned after preliminary attempts to tag Walleye during summer months in 2017 resulted in high mortality. The question of stock contributions to mixed eastern basin fisheries is now being addressed using genetic analysis. Fin clips collected during recent acoustic tagging at spawning locations throughout the lake will be used to characterize stocks. Fin clips were collected in 2016-2018 from both the Ontario commercial fishery and the New York sport fishery operating in the eastern basin. This project has two objectives: 1) To develop a reliable molecular toolkit to discriminate between west and east 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 will be similarly assigned; The Grand River stock in particular is genetically distinct, even using older methods. Initial results are anticipated for fall 2019. The 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 OMNRF and NYSDEC, OSU, USGS, and ODNR.

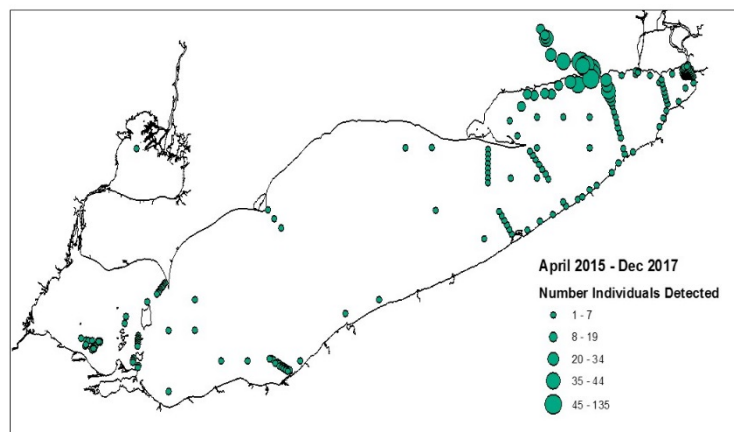


**Figure 6.2.1** Locations of acoustic telemetry receivers that have detected at least one Walleye, acoustically tagged within the Grand River during spring 2015, 2016, and 2017, and 2018. The size of the circle indicates the relative number of individual fish detected at each location.

### 6.3 Spatial ecology of Muskellunge in the St.Clair- Detroit River System

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, any use of Lake Erie by SCDRS Muskellunge is 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 subsequent population-level effects need to be better understood in order 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 2018, 22 Muskellunge were tagged by (OMNRF) off Belle River (ON) and 10 tagged by MDNR in Anchor Bay (MI). Previously 57 muskies were tagged during 2016 and 2017. Six, Vemco VR2W acoustic receivers were purchased and deployed around the perimeter of Ontario waters of Lake St. Clair by OMNRF through financial support from Muskies Canada (Figure 6.3.1). Six receivers were deployed around the perimeter of Michigan waters of Lake St. Clair by MDNR with financial support from Muskies Inc. (Figure 6.3.1). Three additional receivers were purchased through OMNRF Special purpose account (SPA) funding and deployed in the Thames River (Figure 6.3.1).

Eight of the nine Ontario receivers were successfully retrieved in late fall 2018. These receivers detected, 57 individual Muskellunge, 76 Lake Sturgeon, 33 Sea Lamprey, 24 Common Carp and 1 Walleye. All detection records from the Ontario receivers have been submitted to the GLATOS network to contribute data to various GLATOS projects. Deployment of receivers will continue for the lifespan of the tags (5yrs). Dependent on funding, OMNRFs future plans include tagging additional fish (20 fish /yr. until 2020) and the continued deployment of receivers (see Figure 6.3.1) until approximately 2024 (life span of the acoustic tags) or until recordings of fish on receivers cease.

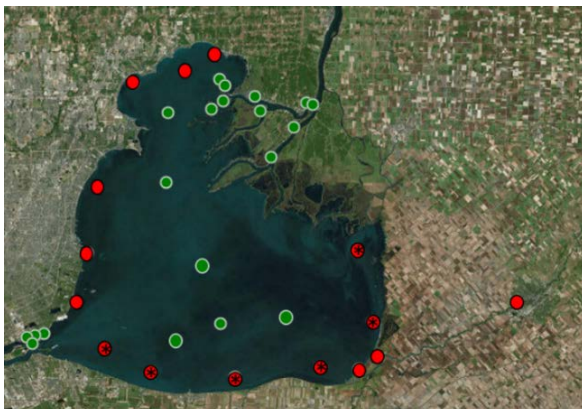


**Figure 6.3.1** GLATOS receivers in Lake St. Clair in 2018. Red circles indicate a receiver deployed as part of the SCDRS Musky tagging project. Green circles indicate other GLATOS receivers. Asterisked receivers in Ontario waters were purchased through donations from Muskies Canada and the National office, and remaining 3 receivers purchased using OMNRF Special Purpose Account funds.

To date, there are over 570,569 detection records from 89 tagged fish. As of December 2018, between 69 –75 of the tagged fish are believed to remain at large (Table 6.3.1). Preliminary data analysis reveals some interesting patterns. For example:

- 1) Long distance migrations (see Figure 6.3.2);
  - For example: Muskellunge ID 24309 (sex: male, weight: 6 kg, length: 1 m), tagged by MDNR off Belle Isle in the Detroit River, May 2016 migrated passed Buffalo harbour and spent most of summer 2016 west of the Grand River (ON) mouth. This fish then migrated back along the US coast to overwinter (2016-17) in the West Basin of Lake Erie. In spring 2017, this fish migrated up the Detroit River and spent summer 2017 in the Ontario waters of Lake St. Clair. This fish then migrated back down the Detroit River to again over winter (2017-18) in the West Basin of Lake Erie. In 2018, the fish moved up the Detroit River and then back into west basin and was last detected near the Ohio reefs in June 2018 prior to retrieval of receivers at the beginning of July 2018.
- 2) Periods of rapid movements over defined areas (1-10km) or rapid migrations over long distances (10–100km);
- 3) Potential seasonality of 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 believed to be at large based on GLATOS receiver detections as of Dec 2018.

| Year         | Month | Tagging Event              | Agency | Total Tagged | Believed Still at Large |
|--------------|-------|----------------------------|--------|--------------|-------------------------|
| 2016         | May   | Belle Isle, MI             | MDNR   | 8            | 4                       |
|              | May   | Wyandotte, MI              | MDNR   | 12           | 3                       |
|              | Oct   | Thames River, ON           | OMNRF  | 19           | 15-19                   |
| 2017         | Nov   | Belle River, ON (offshore) | OMNRF  | 18           | 17                      |
| 2018         | May   | Anchor Bay, MI             | MDNR   | 10           | 8-10                    |
|              | Oct   | Belle River, ON (offshore) | OMNRF  | 22           | 22                      |
| <b>Total</b> |       |                            |        | <b>89</b>    | <b>69-75</b>            |



**Figure 6.3.2** Movement of Muskellunge ID 24309 from May 2016- July 2018.

#### 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. Some of the tags used would have the ability to transmit temperature and depth information would therefore add a thermal ecology aspect to the study. Concurrent with tagging, receivers would be deployed, spanning the entire circumference of the nearshore waters of the eastern basin. By making use of the larger Great Lakes Acoustic Telemetry Observation System (GLATOS) network of receivers in Lake Erie, the project could secondarily address questions about movement between basins.

In 2016, 96 Lake Trout were tagged; approximately equally between fish caught in the waters of Pennsylvania (by United States Geological Survey (USGS); New York (by New York State Department of Environmental Conservation (NYSDEC); and Ontario (by Ontario Ministry of Natural Resources and Forestry-Lake Erie Management Unit (OMNRF-LEMU)). Thirty-two receivers were deployed around the circumference of the eastern basin from September to December 2016 (Figure 6.4.1). They were spaced so as to afford overlap in detection ability and were also specifically located on areas of previously mapped habitat where possible. 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. Unfortunately tagging in 2017 was suspended when a technical flaw in the tags was revealed, but not before deploying 42 tags with the potential to interfere with any acoustic telemetry projects in the lake. Analysis to learn the scope and magnitude of the problem occupied much of 2017. Analysis of battery life of the faulty tags and GLATOS detections concluded that the problem would not last beyond 2017. No detections of faulty tags have occurred beyond October 30, 2017.

### *2018*

Ninety-eight tags were deployed in May of 2018; 38 in NY waters, 22 in PA waters, and 38 in ON waters. In addition to the planned tagging in the eastern basin, Lake Trout captured in fall Ohio trap nets, have been tagged in both 2014 (n=7) and 2018 (n=19). Discounting the 42 expired faulty tags from 2017, by spawning time in 2018, 135 tagged Lake Trout were contributing to the assessment of fall habitat use. In addition to the 32 receivers monitoring the nearshore circumference of the eastern basin, one site in Pennsylvania waters was chosen to deploy 32 additional receivers in a VPS fine scale grid. This would allow for calculation of high-resolution positioning (within metres) of fish in the area where the highest number of detections occurred in previous years. Together with the expanded grid of GLATOS receivers in the eastern basin, 2018 had the best coverage of coldwater habitat to date. The north shore perimeter and much of the eastern basin grid receivers will not be recovered and downloaded until summer 2019. Recoveries to date have produced over 6M detections of 196 tagged Lake Trout (not counting the 2017 faulty tags). The distribution of these detections to date is shown in Figure 6.4.1 which indicates that receivers that have detected the highest number of individuals occur on the south shore of the eastern basin proximal to the Pennsylvania and New York border; in general favouring much of the south shore of the basin

An unanswered question relating to the origin, strain, and stocking location of each of the tagged fish presently confounds interpretation of habitat use by Lake Trout in Lake Erie. Despite attempts to tag fish from different areas of the lake (Figure 6.4.1), it is likely that many of those tagged were originally stocked in New York and Pennsylvania. To determine if stocking location has an influence on home range and fall occupancy, it will be necessary to know the origins of each of the stocked fish. As Ontario stocked fish are of a unique strain, DNA analysis, using fin clips obtained during tagging, will be used to assign stocking location (north shore vs south shore) to each fish. Fin clip samples are being sent to United States Fish and Wildlife Service (USFWS), Northeast Fishery Center in Lamar, PA for analysis and results are expected in 2019.

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, above). 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 Great Lakes Fishery Commission (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. Further information can be found at: <https://glatos.glos.us/home/project/LELTM>.

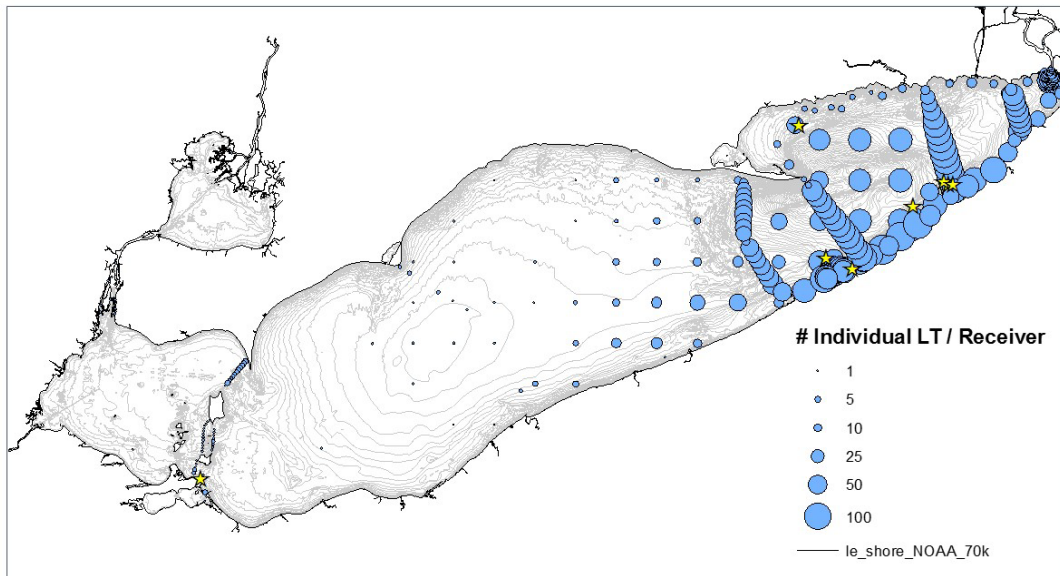


**Figure 6.4.1** Detections of acoustically tagged Lake Trout in Lake Erie. Circle symbols are proportional to the number of unique individual LT detected at each receiver. Star symbols represent tagging locations.

#### 6.5 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, Sydenham Rivers, Lake St. Clair and connected waters of the Great Lakes. Walleye were tagged by 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.

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 evaluate the response by fishers.

Of 399 Walleye tagged in the Sydenham River in 2013, 21 recaptures were reported by fishers from 2013 to 2018 (Table 6.5.1). Only 1/399 (0.3%) Walleye tagged was reported in 2018. Walleye tagged in the Sydenham River were caught by recreational (20 or 95%) and Lake Erie commercial (1 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

6.5.1). 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 2013-2018 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 2050 days.

From 2014 to 2016, 914 Walleye were tagged in the Thames River. Since 2014, 90 tagged Walleye were captured by recreational fisheries (87 or 97%), commercial fisheries in western and central Lake Erie (3) and the Indigenous gill net fishery in Lake St. Clair (1). Recaptures by fisher residency were Michigan (56%), Ontario (36%), Ohio (6%), 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 6.5.1). The largest fractions of Walleye recaptured were from the St. Clair River (33%), Lake St. Clair (28%), followed by the Detroit River (20%), the Thames River (12%) with 4% from Lake Erie and 3% from Lake Huron (Figure 6.5.1). The majority (76%) 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 6.5.1). 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. 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 2018, the ratio of reward: non-reward tags recovered was 2.23. A high proportion (53%) of Walleye triple tagged in 2016 that were recaptured from 2016-2018 lacked jaw tags when caught whereas 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. This finding supports continued use of Floy tags for external marking. On occasion however, Floy tag numbers appear worn and numbers may not be distinguishable. The return rate of tags with address labels (59%) was comparable to the return rate of tags with phone contact labels (41%) 2014-2018. The OMNRF label was present on all tags however, providing multiple options for reporting tagged fish.

**Table 6.5.1** 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). Recaptures include 2018.

| Sydenham River      |         | Non-Reward Tags   |      |        |      |      |      |      |      |      |        | Reward Tags       |      |      |      |      |      |        |      |      |      | All Tags          |      |      |  |  |
|---------------------|---------|-------------------|------|--------|------|------|------|------|------|------|--------|-------------------|------|------|------|------|------|--------|------|------|------|-------------------|------|------|--|--|
|                     |         | Year of Recapture |      |        |      |      |      |      |      |      |        | Year of Recapture |      |      |      |      |      |        |      |      |      | Year of Recapture |      |      |  |  |
|                     |         | Year of Tagging   | Sex  | Tagged | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Tagged | 2013              | 2014 | 2015 | 2016 | 2017 | 2018 | Tagged | 2013 | 2014 | 2015 | 2016              | 2017 | 2018 |  |  |
| 2013<br>(PIT / Jaw) | 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% | 326  | 2.1%   | 1.8% | 0.0% | 0.3% | 0.3%              | 0.0% |      |  |  |
|                     | 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% | 16   | 6.3%   | 6.3% | 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% | 57   | 3.5%   | 1.8% | 0.0% | 0.0% | 0.0%              | 1.8% |      |  |  |
|                     | 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% | 399  | 2.5%   | 2.0% | 0.0% | 0.3% | 0.3%              | 0.3% |      |  |  |

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

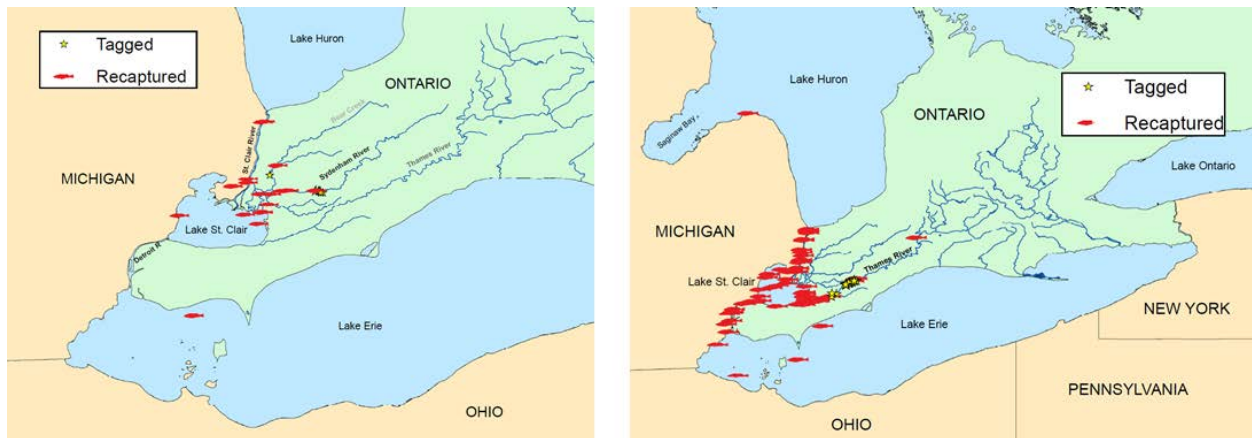


**Figure 6.5.1** Fishery recapture locations and Walleye tagging sites in the Sydenham River (left) and the Thames River (right).

## 6.6 Rondeau Bay Carp

Asian Carps (see 5.1 for species) are considered imminent threats to the Great Lakes because they are known to spread rapidly and are predicted to severely disrupt ecosystem functioning in the Great Lakes (Cudmore et al. 2012). In response, Fisheries and Oceans Canada (DFO) and the Ontario Ministry of Natural Resources and Forestry (OMNRF) developed an Asian Carp surveillance program with the objective of monitoring the Canadian waters of the Great Lakes for Asian Carp and, in the event of a sighting, rapidly respond to prevent the establishment of a reproducing population. A rapid response typically consists of an electrofishing boat being dispatched to an area of interest and exhaustively shocking all potential Asian Carp habitat. Electrofishing is often coupled with other techniques, most commonly trammel nets, to increase the probability an Asian Carp is captured. Though these rapid responses are standard procedure, the ability of existing boat electrofishing and netting surveillance efforts have not been formally evaluated.

The objective of this study was to evaluate the ability of Asian Carp rapid response exercise to locate individual fish within a large search area. Common carp (*Cyprinus carpio*) in Rondeau Bay, Lake Erie were used as a model to estimate the probability that a fish would be located (i.e., detection probability). In 2017, 20 Common Carp were caught in Rondeau Bay, tagged (internal acoustic tags and external loop tags) and released back into Rondeau Bay. One tagged fish was located out of 918 captured Common Carp after three mock boat electrofishing rapid responses, which resulted in a very low cumulative detection probability (5%). It was hypothesized that the low capture probability of the boat electrofishing rapid response in 2017 could be improved with the addition of trammel nets, which were added when the experiment was repeated in 2018.

A total of 239 Common Carp were tagged in Rondeau Bay using T-bar anchor tags between June 28 and August 30, 2018. The tags were applied to the dorsal musculature located at the base of the dorsal fin. The OMNRF then attempted to recapture these tagged fish using mock Asian Carp rapid responses that used a combination of boat electrofishing (20' Smith Root boat with two anode arrays) and trammel net sets (600' long x 14' tall; 18" outer and 4" inner mesh). The trammel nets were set in two different ways depending on the electrofishing location: if fishing took place in an embayment, the trammel nets were used to close off the bay to prevent the escape of fish, and 2) if fishing was along an open shoreline, the trammel nets were

set from the shore in a “L” shape and the electrofishing boat was used to herd fish into the net. Trammel nets were not set when boat electrofishing took place in a canal. Only Common Carp were netted and enumerated when fishing an area. Based on the movements of acoustically tagged Common Carp in 2017, it was assumed that no fish emigrated from Rondeau Bay during the study (i.e., a closed system).

In 2018, the OMNRF completed three mock Asian Carp responses in Rondeau Bay: 23-24 July, 30-31 August, and 11 October (Table 6.6.1). A total of 307 Common Carp were captured during the three mock Asian Carp responses and only one tagged individual was recaptured on 23 July 2018 despite the large amount of effort expended during study (Table 1). The tagged individual was recaptured in the same canal that it was originally tagged on 28 June 2018. The cumulative detection probability across all three surveillance efforts was very low and estimated to be 1%. The trammel nets provided little additional benefit to the rapid responses. Only two Common Carp were captured by the trammel net, whereas 305 Common Carp were captured by boat electrofishing. Furthermore, the trammel net was cumbersome to set/retrieve and was often clogged with aquatic vegetation that needed to be removed frequently, which reduced the number of sites that could be fished in a day relative to boat electrofishing alone.

It appears that the current Asian Carp rapid response methodology is ineffective at locating common carp individuals, even when using multiple gears. The cumulative detection probability was estimated to be 5% and 1% in 2017 and 2018, respectively. These detection probabilities represent conservative (lowest) estimates given the number of fish tagged in each year. Thus, it is plausible that the detection probability could be even lower. There are two primary ways in which the detection probability could be improved: 1) the use of additional gears (Trebitz et al. 2009, Hoffman et al. 2016); and/or 2) increasing the amount of effort expended (Hoffman et al. 2011). Overall, the relative rarity of new invaders makes them inherently difficult to capture and it is clear that an effective surveillance program requires substantial resources even when using multiple gears (Hoffman et al. 2011).

The early detection and removal of a new aquatic invasive species (AIS) is a crucial component of any AIS management plan (Lodge et al. 2006). The rapid responses used to capture and identify Asian carp in Lake Erie nearshore areas is relatively ineffective and will not reliably detect individuals until they are abundant. As a result, there is a need to further evaluate the methodology employed during surveillance efforts and whether the current rapid response program is able to meet its objective.

**Table 6.6.1** The boat electrofishing effort and the number of Common Carp captured, tagged with T-bar anchor tags, and recaptured (i.e., captured with a tag) during each sampling event.

| Event                | Date               | Effort (hours) | # Captured | # Tagged | # Recaptured |
|----------------------|--------------------|----------------|------------|----------|--------------|
| Pre-Response Tagging | June 28-29, 2018   | 4.06           | 87         | 87       | -            |
| Mock Response 1      | July 23-24, 2018   | 4.25           | 163        | 143      | 1            |
| Mock Response 2      | August 30-31, 2018 | 4.64           | 84         | 9        | 0            |
| Mock Response 3      | October 11, 2018   | 2.40           | 58         | 0        | 0            |

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### 6.7 Lake Erie Walleye Mixed Stock 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 in the TAC area to estimate the spatial and temporal contribution of each stock to Lake Erie's recreational and commercial fisheries in the west and central basins. 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 2018, 481 Walleye were tagged in western and central Lake Erie. During this period, 64 tagged Walleye were harvested by recreational (30) and commercial (34) fisheries. Mixed stock Walleye tagging is scheduled to continue in 2019. Additional information about this study is available at <https://glatos.glos.us/home/project/WAEMF>.



**Figure 6.7.1** A Walleye tagged in the mixed stock fishery acoustic telemetry study harvested in 2018.

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

The Lake Erie Management Unit (LEMU) hosts Ontario Ministry of Natural Resources and Forestry's (OMNRF) COA Coordinator for the Lake Erie basin. The role of this coordinator is to facilitate OMNRFs commitments to the Canada - Ontario Agreement on Great Lakes 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 binational Great Lakes Water Quality Agreement (GLWQA). To address MNRFs Commitment within COA, members of the LEMU and Regional Operations Division (ROD) out of the Aylmer and Vineland offices implement a coordinated workplan within the Lake Erie Basin. The 2018/19 fiscal year was year four of five-year for the 12 projects on the 2015-2020 work plan (Table 7.1). However, due to provincial spending and hiring directives during the 2018/19 fiscal year, only the Asian Carp Surveillance program (05-23) and the Grand River /Lake Erie Interface Restoration (02-10) proceeded as planned.

**Table 7.1** List of GLPF projects in the Lake Erie basin on the 2015-2020 GLFP work plan.

| <b>Project #</b> | <b>Project Name</b>                                                                     | <b>Implementing Unit</b> |
|------------------|-----------------------------------------------------------------------------------------|--------------------------|
| 02-05            | Lower Thames River Habitat Restoration Program                                          | ROD - Aylmer             |
| 02-06            | Essex coastal-nearshore wetland restoration project                                     | ROD - Aylmer             |
| 02-10            | Grand River /Lake Erie Interface Restoration                                            | LEMU                     |
| 02-12            | Wetland Evaluations – Lake Erie Wetlands (west and central basin)                       | ROD - Aylmer             |
| 02-17            | Rondeau Bay Watershed Rehabilitation Project                                            | LEMU/ROD - Aylmer        |
| 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                                                       | ROD – Vineland           |
| 02-27            | Niagara Region – AOC and Nearshore Habitat Restoration                                  | ROD – Vineland           |
| 02-30            | Long Point Coastal Restoration Project                                                  | ROD - Aylmer District    |
| 02-38            | NR-AOC Coastal Wetlands                                                                 | ROD – Vineland           |
| 05-23            | Asian Carp Surveillance                                                                 | LEMU                     |

## APPENDIX A Operational Field and Lab Schedule 2018

| Field and Lab Projects                                    | Dates              | Species Assessed, Monitored, or Stocked                      | Project Lead     | Location  | Funding Source |
|-----------------------------------------------------------|--------------------|--------------------------------------------------------------|------------------|-----------|----------------|
| Lake Erie Commercial Catch Sampling                       | April-November     | Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch | Belore           | Wheatley  | SPA            |
| Contaminant Sampling                                      | April-November     | Multiple Species                                             | Benoit           | Wheatley  | SPA            |
| Lake Erie Temperature Loggers                             | April-November     | Limnology                                                    | Genereaux        | Wheatley  | SPA            |
| Lake Erie & Lake St. Clair Sport Fishery Diary            | April-November     | Multiple Species                                             | Belore           | Wheatley  | SPA            |
| Lake Erie Limnology                                       | May-October        | Limnology                                                    | MacDougall       | Wheatley  | SPA            |
| Lake St. Clair Limnology                                  | May-September      | Limnology                                                    | Marklevitz       | Wheatley  | SPA            |
| Asian Carp eDNA Monitoring                                | May-July           | Asian Carp                                                   | Belore           | Wheatley  | COA            |
| Mixed Stock Walleye tagging (O. DNR partnership)          | April, November    | Walleye                                                      | Cook             | Wheatley  | SPA            |
| St. Clair River Creel                                     | April-September    | Multiple Species                                             | Belore/Thorn     | Wheatley  | SPA            |
| Lake St. Clair Sport Fish Assessment                      | June-July          | Multiple Species                                             | Thorn            | Wheatley  | SPA            |
| Rondeau Bay Common Carp tagging                           | June-September     | Common Carp                                                  | Thorn            | Wheatley  | SPA            |
| Lake Erie Central Basin Hydro Acoustics                   | July               | Multiple Species                                             | Cook             | Wheatley  | SPA            |
| West Basin Interagency Trawling                           | August             | Multiple Species                                             | Cook             | Wheatley  | SPA            |
| Thames River Gear Assessment                              | August-October     | Multiple Species                                             | Thorn            | Wheatley  | SPA            |
| Partnership Index                                         | August-October     | Multiple Species                                             | Cook             | Wheatley  | SPA/CRF        |
| Lake St. Clair Muskellunge acoustic tagging               | October            | Muskellunge                                                  | Thorn/Marklevitz | Wheatley  | SPA            |
| Lake Erie Central Basin trawling                          | October            | Yellow Perch, multiple species                               | Belore           | Wheatley  | SPA            |
| Lake Whitefish Acoustic tagging                           | November           | Lake Whitefish                                               | Cook             | Wheatley  | CRF            |
| Age and Growth                                            | Continuous         | Multiple Species                                             | Multiple         | Wheatley  | SPA            |
| Lake Erie Limnology                                       | May-October        | Limnology                                                    | MacDougall       | Pt. Dover | SPA            |
| Lake Erie Commercial Catch Sampling                       | Apr-November       | Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch | Belore           | Pt. Dover | SPA            |
| Asian Carp eDNA Monitoring                                | June, July         | Asian Carp                                                   | Belore           | Pt. Dover | COA            |
| East Basin Fishery DNA Collection                         | May-October        | Walleye                                                      | MacDougall       | Pt. Dover | SPA            |
| Contaminant Sampling - LPB & Eastern Basin                | Apr-November       | Multiple Species                                             | Multiple         | Pt. Dover | SPA            |
| Long Point Bay Temperature Loggers                        | Mar-October        | Limnology                                                    | Ives             | Pt. Dover | SPA            |
| Grand River Walleye Tagging and Monitoring                | April - October    | Walleye                                                      | MacDougall       | Pt. Dover | SPA/COA/GLFC   |
| Lake Trout Acoustic Tagging                               | May                | Lake Trout                                                   | MacDougall       | Pt. Dover | SPA            |
| Lake Trout Stocking                                       | May, November      | Lake Trout                                                   | MacDougall       | Pt. Dover | SPA            |
| Lake Trout Tag Removal                                    | Continuous         | Lake Trout                                                   | MacDougall       | Pt. Dover | SPA            |
| Cold Water Survey                                         | August             | Lake Trout, Burbot, Lake Whitefish                           | May              | Pt. Dover | SPA            |
| Long Point Bay Adult Index Gillnetting                    | June-August        | Multiple Species                                             | May              | Pt. Dover | SPA            |
| Long Point Bay Nearshore Trawling                         | August, Sept       | Multiple Species                                             | May              | Pt. Dover | SPA            |
| Long Point Bay Offshore Trawling                          | Sept-November      | Multiple Species                                             | May              | Pt. Dover | SPA            |
| Central Basin Trawling                                    | October            | Multiple Species                                             | May              | Pt. Dover | SPA            |
| Lake Erie Eastern Basin Hydro Acoustics                   | July               | Smelt and Other Pelagic Forage Fish                          | May              | Pt. Dover | SPA            |
| Inner Long Point Bay Adult Fish Community Hoop Net Survey | April-May July-Aug | Multiple Species                                             | May              | Pt. Dover | SPA            |
| Age and Growth                                            | Continuous         | Multiple Species                                             | Multiple         | 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 2018**

| Agency / Organizaiton        | Data Requested                                                                               |
|------------------------------|----------------------------------------------------------------------------------------------|
| Central Michigan University  | Lake St Clair and Detroit River Creel data                                                   |
| COSEWIC                      | Silver Lamprey Observations                                                                  |
| NOAA                         | Lake St Clair trap Net Survey Catch Rates                                                    |
| Stakeholder                  | Yellow Perch abundance trends and Sport Diary catch rates                                    |
| MSU                          | Asian Carp eDNA sample locations                                                             |
| Small Craft Harbours / DFO   | Commercial landed value, Lake Erie ports                                                     |
| ODNR, USGS                   | Partnership gillnet survey data; manuscript addressing Walleye depth distribution            |
| USGS                         | White Bass (fish) and data (commercial samples) from central Lake Erie for contaminant study |
| OMNRF, LOMU                  | Yellow Perch Lake Erie commercial harvest & value                                            |
| OSU                          | Trawl fish length data, west basin 2009-2010                                                 |
| USFWS                        | Partnership survey lamprey wounding data                                                     |
| USFWS                        | Coldwater survey lamprey wounding data                                                       |
| USGS                         | Long Point Bay Index Trawl data for EPA Forage SOLEC reporting                               |
| USFWS                        | Coldwater Survey Lake Trout data for EPA SOLEC reporting                                     |
| USGS                         | Rainbow Smelt (fish) and data (Long Point Bay Index Trawl) for Lake Erie genetics study      |
| University of Windsor, OMNRF | Rainbow Smelt (fish) and data (Long Point Bay Index Trawl) for stable isotopes study         |
| DFO                          | Warmouth observations                                                                        |
| DFO                          | 2016 and 2017 Commercial Harvest and Value - All Great Lakes                                 |
| DFO                          | Number of Lake Erie Licences Issued and Number of Licence Holders                            |

## **APPENDIX C - LAKE ERIE MANAGEMENT UNIT STAFF 2018**

### **WHEATLEY**

320 Milo Road, Wheatley, ON N0P 2P0  
Tel: 519-825-4684 Fax: 519-825-3163

Brian Locke – Lake Manager  
Emily Slavik – Assessment Supervisor  
Stephen Marklevitz – A/COA Coordinator  
Tyler Genereaux – Operations Coordinator  
Tyler Verburg – Port Observer Coordinator  
Andy Cook – Assessment Biologist  
Megan Belore – Assessment Biologist  
Karen Soper – Systems Officer  
Craig McDonald – Vessel Master  
Christine Benoit – Fisheries Technician  
Chris Gignac – Fisheries Technician  
Aida Baptista – Administrative Assistant

#### ***Seasonal Staff:***

Mike Thorn – A/Aquatic Ecosystem Biologist  
Chris Thomas – Fisheries Technician  
Joey Battaglia – Fisheries Technician  
Nathan Staels – Fisheries Technician  
Sam Mansfield – Fisheries Technician  
Jessica Klack – COA Fisheries Technician  
Mike Broser – Creel Crew  
Mike Delorme – Creel Crew  
Scott Foster – Port Observer  
Steven Mailloux – Port Observer  
Adrienne Elgie - Student  
Britney Firth – Student  
Jessica Patterson – Student

### **SCIENCE AND RESEARCH SECTION**

Yingming Zhao – Research Scientist  
Dylan Sample – Student  
Serena Gaffan - Student

### **LONDON**

659 Exeter Road, London, ON N6E 1L3  
Tel: 519-873-4611 Fax: 519-873-4645

Richard Drouin – Lead Management Biologist

### **PORT DOVER**

49 Passmore Avenue, Unit 7  
P.O. Box 429, Port Dover, ON N0A 1N0  
Tel: 519-583-0981 Fax: 519-583-1547

Paulette Penton – A/Fisheries Ecology Supervisor  
Shelley Kilby – A/Fisheries Ecology Supervisor  
Dixie Greenwood – Operations Coordinator  
Gord Ives – Vessel Master  
Tom MacDougall – Rehabilitation Ecologist

#### ***Seasonal Staff:***

Chelsea May – A/Assessment Biologist  
Tina Werner – Fisheries Technician  
Heather Harrison – Fisheries Technician  
Duncan Norrie – Fisheries Technician  
Nathan Trebych – Port Observer/Fisheries Technician  
Lindsay Laroche – Port Observer  
Hope Kuhn – Student  
Marion Mummery – Student

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