

2017 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):

- Clockwise; Fisheries Technicians Nathan Staels and Chris Thomas, Port Observer Scott Foster and Student Technician Dylan Sample working on Commercial Catch samples.
- Fisheries Technician Tina Werner and Rehabilitation Ecologist Tom MacDougall on the Grand River working on the Walleye Acoustic Telemetry Tagging program.

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**Ontario Ministry of Natural Resources and Forestry
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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 Port Observer program, and management activities on the Canadian waters of Lake Erie, Lake St. Clair and connecting waters.

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 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 with respect to Great Lakes ecosystems. These projects include native species restoration, state of resource science, invasive species surveillance and response, as well as ecosystem restoration.

The purpose of this report is to summarize and present Ontario's assessment and fishery 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 welcome any questions or comments you may have on its content.

1. EXECUTIVE SUMMARY STATUS OF MAJOR STOCKS

Table 1.1 Total annual commercial fishery landings (landed weight in pounds) and value (dollars) by fish species and statistical district (OE or Ontario-Erie) for the Canadian waters of Lake Erie, 2017.

Species	Landings by Statistical District					Total Landing	Total Value
	OE-1	OE-2	OE-3	OE-4 ^a	OE-5		
Brown Bullhead	28	0	0	0	0	28	\$13
Burbot	0	79	18	38	25	160	\$1
Carp	410	2,156	830	8	0	3,404	\$411
Catfish	7,809	19,066	5,699	3	187	32,764	\$10,874
Freshwater Drum	40,452	83,078	134,302	65	172	258,069	\$43,447
Gizzard Shad	98	649	0	0	0	747	\$45
Lake Whitefish	21,670	5,776	691	2,156	533	30,826	\$41,059
Rainbow Smelt	0	80,749	294,450	7,161,830	360,610	7,897,639	\$1,835,064
Rock Bass	35	2	0	0	0	37	\$14
Suckers	32,666	12,909	7,954	0	60	53,589	\$9,911
Walleye	3,013,822	1,574,769	910,035	172,361	216,692	5,887,679	\$17,717,957
White Bass	1,143,495	862,529	548,967	55,282	22,087	2,632,360	\$2,696,017
White Perch	1,230,425	1,790,502	783,654	21,089	848	3,826,518	\$2,739,598
Yellow Perch	1,277,587	1,498,437	1,932,423	115,622	158,920	4,982,989	\$17,960,071
Mixed ^b	18	9	0	0	0	27	\$33
Total Landing (lbs.)	6,768,515	5,930,710	4,619,023	7,528,454	760,134	25,606,836	
Total Value (\$)	\$15,684,666	\$12,277,546	\$11,082,204	\$2,673,230	\$1,336,869		\$43,054,515

^a Excludes Inner Long Point Bay.

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

In 2017, Ontario commercial landings in Lake Erie totaled 25.6 million pounds with a landed value of \$43 million (Table 1.1). Harvest (pounds) in 2017 was composed of Rainbow Smelt (31%), Walleye (23%), Yellow Perch (19%), White Bass (10%), White Perch (15%) and other species (1%). Landed value was highest for Yellow Perch (42%) followed by Walleye (41%), White Perch (6%), White Bass (6%), Rainbow Smelt (4%) and other species(<1%). In addition to Ontario commercial harvest summaries, results from Lake Erie Management Unit (LEMU) bottom trawl surveys, hydroacoustic forage species assessment, Long Point Bay 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.

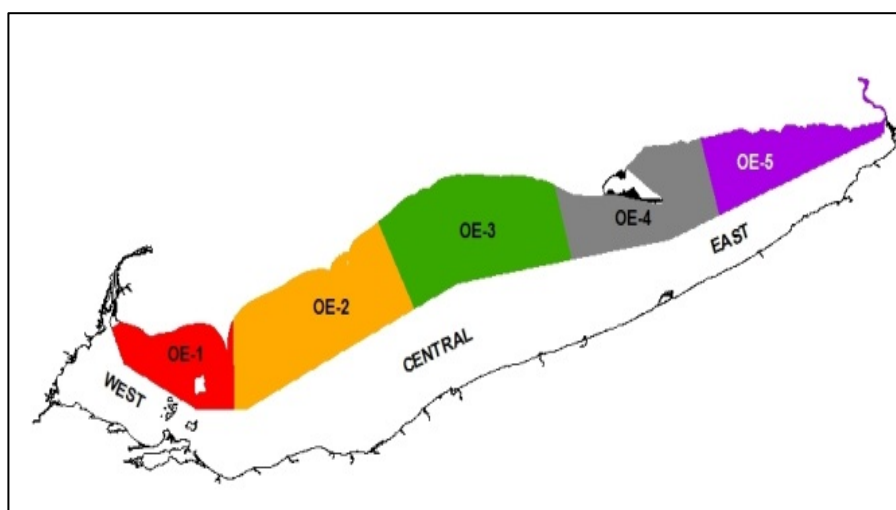


Figure 1.1 Ontario statistical districts (OE 1-5) of Lake Erie.

Walleye

The Ontario commercial Walleye harvest (5.9 million lbs.) in 2017 represented 91% of the 6.4 million pound quota. The 2017 harvest was above the mean harvest from 2000 to present (4.9 million lbs.) but below 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 2017 was 51%, 27%, 15%, 3% 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 2 and age 3 fish. Age composition of Walleye harvested in the east basin (range: 1-19.) was dominated by ages 2, 7, 3 and 14.

Walleye captured in the Partnership gill net surveys ranged in age from 0 to 18. Lakewide, gill net index catches were dominated by age 2 Walleye (2015 cohort). In west and central Lake Erie, ages 1, 3 and 0 contributed significantly to catches. The east basin catch rate for age 1 Walleye was the highest in the time series. In 2017, interagency west basin trawl surveys indicated moderate 2017 and 2016 cohorts at ages 0, and 1; respectively. Commercial and recreational fishing in 2018 is expected to thrive, benefiting mostly from age 3 Walleye.

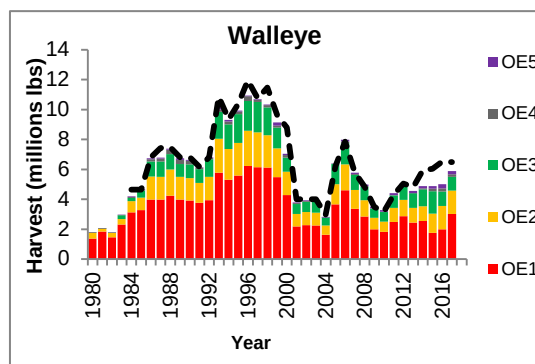


Figure 1.2 Walleye commercial harvest by statistical district in Lake Erie, 1980-2017. Ontario quota presented as dotted line.

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 Ontario commercial fishery harvested 5.0 million pounds of Yellow Perch in 2017, attaining the quota allocated. The Yellow Perch harvest in 2017 was below the mean harvest from 2000 to present (5.5 million lbs.) and the long term mean harvest from when ITQs were introduced in 1984 (5.9 million lbs.). The distribution of harvest across statistical districts OE1 to OE5 in 2017 was 26%, 30%, 39%, 2% and 3%, respectively (Figure 1.3). Overall, Yellow Perch harvest in 2017 increased 11% from 2016. Lakewide, harvest age composition was highest for ages 3, 5 and 4, respectively. Fishery age compositions varied seasonally and spatially. Age 2 Yellow Perch were significant in the harvest from OE1, OE2 and OE5, but less common in OE3 and were absent from OE4's spring and summer commercial fisheries. Older Yellow Perch were less common in OE1, OE2, and OE5 fisheries compared to OE3 and OE4 fisheries. Fisheries in 2018 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.

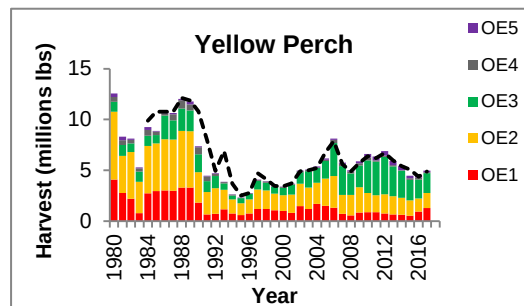


Figure 1.3 Yellow Perch commercial harvest by statistical district in Lake Erie, 1980-2017. Ontario quota presented as dotted line.

Yellow Perch catch rates in the Partnership gill net indices were moderate to high in the west and east basin surveys and moderate in central basin and Pennsylvania Ridge surveys assessed. Age 3 Yellow Perch were most abundant in west and central basin projects. In the east basin and Pennsylvania Ridge

surveys, age 1 Yellow Perch were most abundant. The Long Point Bay Yellow Perch gill net index in 2017 was above average and dominated by age 2 fish with record catches of yearlings.

Based on Partnership and Long Point Bay gill net indices, along with trawl indices of YOY and yearlings, recruitment of age 2 fish in 2018 is expected to be moderate in the west and west-central basins and stronger in the east-central and eastern basins. Indices of cohort strength vary spatially, but also between gear types and age groups. Following a process developed by the Lake Erie Percid Management Advisory Group (LEPMAG), 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.

A bottom trawl survey began in 2016 in Ontario waters of the central basin after fall turnover. OMNRF and United States Geological Survey (USGS) research vessels completed this extensive survey again in 2017. In 2017, catch rates of age 0 Yellow Perch were higher compared to 2016 while yearling Yellow Perch were slightly lower than observed in 2016. Catch rates were higher in the west-central area than in the east-central for YOY and yearlings. The benefits of this survey will accumulate over continued years of field work.

Ontario commercial 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 are currently engaged in the Lake Erie Percid Management Advisory Group (LEPMAG) process. The LEPMAG is working to improve Yellow Perch assessment, and address fishery requirements and performance indicators while contributing to the development of a 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 (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 2017 was 30,826 pounds, and was distributed across OE1 to OE5 as follows: 70%, 19%, 2%, 7% and 2% (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 2 and 25, with age 2 (2015 year class), being most abundant. Ages 3 and 14 Lake Whitefish were the 2nd and 3rd most abundant age groups represented in the large mesh gill net fishery respectively.

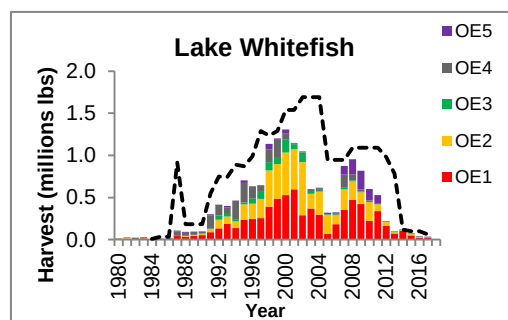


Figure 1.4 Lake Whitefish commercial harvest by statistical district in Lake Erie, 1980-2017. Ontario quota presented as dotted line.

Partnership gill net catch rates in central and eastern Lake Erie improved in 2017, due mainly to contributions from age 2 and 3 Lake Whitefish. Ages 1 and 14 Lake Whitefish were equally represented in the surveys, accounting for 8% of the catch. OMNRF is working with partners to improve assessment and develop management strategies for Lake Whitefish through collaborative efforts of the Lake Erie Committee, the Coldwater Task Group, the Great Lakes Telemetry and Observation System (GLATOS) network, the Great Lakes Fishery Commission 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 2017 (7.9 million lbs.) amounted to 51% of the Ontario quota (15.5 million lbs.) (Figure 1.5). Harvest in 2017 was above the mean harvest from 2000 to present (7.5 million lbs.) and below the long term mean harvest from when

ITQs were introduced in 1984 (11.5 million lbs.). Landings of Rainbow Smelt in 2017 were greatest in OE4 (91%), followed by OE5 (5%), OE3 (4%), and OE2 (1%). Harvest age composition ranged from 1 to 7 with ages 1, 2 and 3 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 2017. Hydroacoustic surveys in eastern and central 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 (3,201 fish/hectare) in 2017 as the 40th percentile of the 11 year time series (2007-2017).

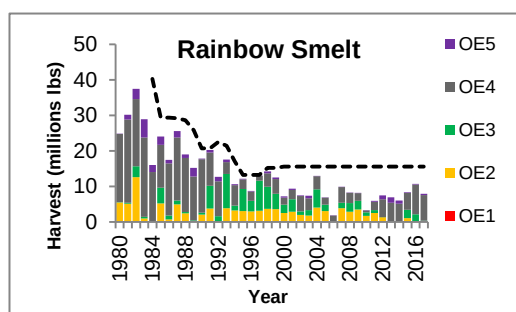


Figure 1.5 Rainbow Smelt commercial harvest by statistical district in Lake Erie, 1980-2017. Ontario quotas presented as dotted line.

White Bass

White Bass harvest by Ontario's commercial fishery, which is not regulated by quota, totaled 2.6 million pounds in 2017. Harvest in 2017 was below the mean harvest from 2000 to present (3.6 million lbs.) and the long term mean harvest since 1984 (3.1 million lbs.). Distribution of harvest across statistical districts OE1 to OE5 in 2017 was 43%, 33%, 21%, 2% and 1%, respectively (Figure 1.6). The White Bass harvest was composed of ages ranging from 1 to 10+; age 5 was most abundant.

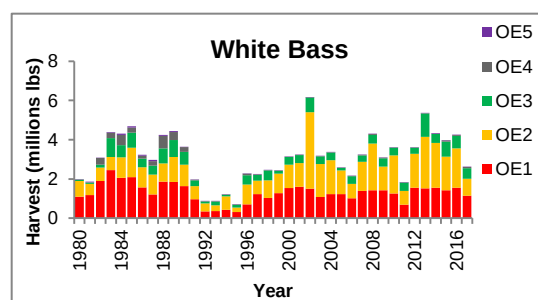


Figure 1.6 White Bass commercial harvest by statistical district in Lake Erie, 1980-2017.

White Bass Partnership abundance indices were high in the west, east basin and Pennsylvania Ridge surveys where increases in abundance from 2016 appeared significant. Catch rates were low in both central basin surveys which showed marginal increases from 2016. Yearling White Bass represented the largest fraction of lakewide catches. Older fish, notably age 5 White Bass, comprised a large proportion of fish caught in the west basin survey in 2017. Age 0 White Bass abundance was assessed as moderate to high based on west basin interagency trawling and the Partnership west and central basin surveys in 2017. Age 0 White Bass were not observed in the east basin Partnership survey during 2017.

White Perch

The White Perch is a non-native species that is not managed by quota. The Ontario commercial harvest of White Perch in 2017 totaled 3.8 million pounds. The 2017 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 2017 was: 32%, 47%, 20%, 1% and <1% (Figure 1.7). The majority (89%) of White Perch harvested was caught in gill nets with mesh sizes 76mm (3") and larger. White Perch harvest was mostly composed of ages 2 to 10+, with age 5 most common.

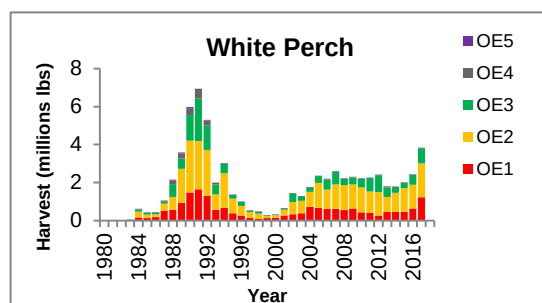


Figure 1.7 White Perch commercial harvest by statistical district in Lake Erie, 1980-2017.

In 2017, Partnership gill net survey catch rates of White Perch decreased in the west and east-central basins but increased in all other areas from 2016. White Perch abundance was relatively low in the west and east-central basin surveys, whereas indices were moderate in the east basin and high in the west-central and Pennsylvania Ridge surveys during 2017. Although a broad range of age groups were present, age 2 White Perch were common among surveys lakewide.

2. COMMERCIAL FISHERY

2.1 Lake Erie Commercial Fishery

In 2017, the total commercial landings from Ontario waters of Lake Erie was 25.6 million pounds with a total value of \$43 million (Figure 2.1.1). Despite the decrease of total landings from 2016 (6%), the total value increased (16%), primarily due to an increase of harvest of Walleye (up 0.9 million pounds), Yellow Perch (up 0.5 million pounds) and White Perch (up 1.4 million pounds). The average landed value per pound for Walleye also increased in 2017, contributing to the total value. Harvest and landed value in 2017 are presented for each species by statistical district (Ontario Erie (OE), Figure 1.1) in Table 1.1.

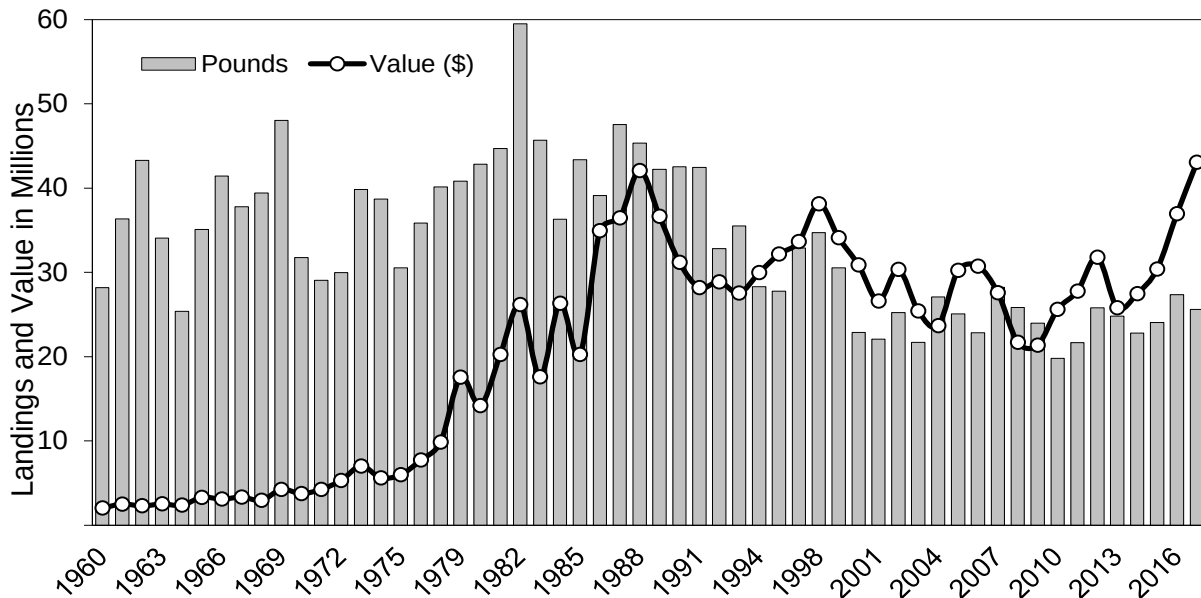


Figure 2.1.1 Commercial fishery landings (pounds) and value (\$ CDN) from the Canadian waters of Lake Erie, 1960-2017.

Total Walleye landings increased 18% to 5.9 million pounds in 2017, resulting in 84% of the 2017 allocated quota being harvested (Table 1.1). Lakewide Walleye harvest by size category was: Jumbo (19%), Number 1 (67%) and Number 2 (13%). Yellow Perch landings increased 0.5 million pounds to 5 million pounds in 2017, harvesting all of the allocated quota (Table 1.1). The landed value of Yellow Perch also increased by 10% in 2017 to \$18 million as a result of the increase in landings.

With total landings of 30,826 pounds, Lake Whitefish harvest remained fairly consistent from 2016 (Table 1.1). In 2017 all Lake Whitefish were harvested as by-catch. Quota of Lake Whitefish was reduced from 100,000 pounds in 2016 to 60,000 pounds in 2017; the commercial fishery harvested 51% of the quota allocated. Seventy percent of the total harvest came from OE-1 (a decrease of 10% from 2016), while 19% was harvested from OE-2, similar to 2016. Transfers of Walleye quota out of quota zone 1 (OE-1) continued in 2017 in an attempt to help protect fall spawning Lake Whitefish stocks, however most of the harvest in OE-1 occurred from October to December. The landed value of Lake Whitefish decreased 18% to approximately \$41,000 in 2017 (Table 1.1).

Rainbow Smelt harvest in 2017 was 7.9 million pounds; 51% of the allocated quota. This was a decrease of 26% from 2016 (Table 1.1). Ninety-one percent of the harvest was taken from OE-4 with less harvest in OE-5 (5%) and OE-3 (4%). Of the 159 licences with Rainbow Smelt quota, only 15 landed Rainbow Smelt in 2017, while only 7 attained more than 20% of their individual quota. The landed value of Rainbow Smelt was down 26% to \$1.8 million (Table 1.1).

White Bass and White Perch are commercial fish species currently not regulated by quota. The total landings of White Bass decreased by 38% to 2.6 million pounds in 2017, the majority of which occurred in statistical districts OE-1 (43%) and OE-2 (33%) (Table 1.1). The landed value of White Bass decreased 14% to \$2.7 million in 2017 (Table 1.1). The total landings of White Perch increased 58% to 3.8 million pounds in 2017, with harvest occurring primarily in statistical districts OE-2 (47%), OE-1 (32%) and OE-3 (20%) (Table 1.1). In 2017, White Perch total landed value nearly doubled that of 2016, with a value of \$2.7 million (Table 1.1).

Inner Long Point Bay Fishery

The hoop and seine net fishery of Inner Long Point Bay contributes less than one percent (0.4%) by weight of the total annual commercial harvest landed in Ontario waters of Lake Erie. In 2017, total commercial landings were 109,359 pounds. (Table 2.1.1), an increase of 1% from 2016. Of this value, live fish accounted for 77%. The value of the total commercial landings in 2017 was \$125,792, an increase of 3% from 2016, and 0.3% of the total value of the Commercial Fishery in Ontario waters of Lake Erie (Table 2.1.1).

In 2017, the total landing of Yellow Perch was 7,412 lbs., a decrease of 19% from 2016, harvesting 28% of their allocated quota. The majority of Yellow Perch (71%) were caught in the spring (March and April). The landed value of Yellow Perch in 2017 dropped 15% from 2016 to \$24,304 (Table 2.1.1). In 2017, the total landing of Northern Pike was 9,447 lbs., an increase of 8% from 2016. The Inner Bay commercial fishery harvested 35% of their allocated quota in 2017. The majority of Northern Pike (89%) were caught in the spring (March and April). The landed value of Northern Pike in 2017 was \$3,131, a decrease of 35% from 2016 (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, 2017

Species	Total Landing^a	Total Value
Bowfin	20,244	\$24,322
Brown Bullhead	27,790	\$12,401
Carp	8,054	\$2,820
Freshwater Drum	429	\$109
Lepomis spp.	25,111	\$44,799
Mudpuppy	4,511	\$4,349
Northern Pike	9,447	\$3,131
Pomoxis spp.	1,238	\$3,965
Rock Bass	4,678	\$5,338
White Perch	445	\$254
Yellow Perch	7,412	\$24,304
Total Landing (lbs.)	109,359	
Total Value (\$)		\$125,792

^a 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, and growth characteristics. Information from this program is used directly in catch-at-age models used to estimate and project population abundances, which are used to determine the recommended allowable harvest. In order to carry out this program Lake Erie Management Unit (LEMU) uses a targeted sampling plan to sample fish of all species landed by the Lake Erie commercial fishery. The main objectives of catch sampling are: 1) to determine the size and age composition of the fish in the catch; 2) to index the abundance of fish species; and 3) to determine parasite loading of commercially valuable fish. Fish attributes sampled during this program include: weight, length, age, sex, maturity, parasite loading, tumours and tags/marks.

Sampling is stratified by area (Ontario-Erie statistical district or OE), season, and gear type. Species sampled include: Yellow Perch, Walleye, Lake Whitefish, White Bass, White Perch, and Rainbow Smelt. Walleye samples are categorized by group based on length (see Table 2.2.1). Walleye and Yellow Perch were aged using otoliths. Rainbow Smelt were aged using scales. Lake Whitefish, White Bass and White Perch were aged using scales and otoliths. In Table 2.2.1, Lake Whitefish ages are presented using otolith ages, and White Bass and White Perch ages are presented using scale ages.

In 2017, a total of 17,234 fish were sampled during the commercial catch sampling program. Lakewide 6,420 Yellow Perch were sampled during 2017. The most common age group of Yellow Perch was age 3 (2014 year class), which comprised 54% of the harvest lakewide. In addition to age 3 fish, age 5 (2012 year class) Yellow Perch were common in the east central basin (38% of the harvest), and age 2 (2015 year class) Yellow Perch were common in the eastern basin (33% of the harvest).

In total, 4,545 Walleye were sampled from large and small mesh gill nets. Almost 3,000 Walleye were sampled from large mesh gill nets and over 1,500 Walleye were sampled from small mesh gill nets in 2017. Walleye sampled from small mesh gill nets were mainly number 2 Walleye (fish less than 381mm); the majority of these fish were age 2 Walleye from the large 2015 year class. Lakewide, 55% of the commercial Walleye harvest were age 2, and 30% were age 3 (2014 year class) fish. More age 2 Walleye were harvested in the west and central basins (56% of total harvest), compared to the eastern basin (30% of total harvest). In the eastern basin, the 2010 year class was 17% of the harvest and the large 2003 year class comprised 11% of the total harvest.

Two hundred and seventeen Lake Whitefish were sampled from large mesh gill nets, mainly during fall. More than half of the Lake Whitefish sampled were from the 2015 year class (age 2 fish), followed by the 2014 and 2003 year classes.

Over 1,400 White Bass were sampled, mainly from large mesh gill nets. Over half of the White Bass sampled consisted of the 2012 year class (age 5 fish), followed by the 2010 year class (age 7 fish). In total more than 1,500 White Perch were sampled, 799 from large mesh nets and 735 from small mesh nets. Ages 5 and 6 White Perch were prevalent in the large mesh nets, with age 2 fish recruiting to the gear in the fall. Ages 3 and 5 White Perch were common in the small mesh nets with age 2 fish becoming common in the summer and fall.

Over 3,000 Rainbow Smelt were sampled from trawl nets, 43% of the Rainbow Smelt were aged, 11% 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 (2016 year class) and age 2 (2015 year class). Additional species caught as by-catch in Rainbow Smelt trawls are also sampled. In 2017, species sampled as a part of Rainbow Smelt by-catch included Yellow Perch, White Bass, and Lake Whitefish.

Table 2.2.1 Number of commercial fish sampled by gear type, species, statistical district (OE) and age, 2017.

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			115	43		2								160		
		OE-2	All			13	8	1	1					34			57		
	Yellow Perch	OE-1	All			301	1287	276	30	13	3	1				8	1919		
		OE-2	All			171	969	143	247	31	20	6	6	2	3		1598		
		OE-3	All			29	913	181	908	153	62	9	16	23	25		2319		
		OE-4	All				16		79	25	16	1	11	11	1		160		
		OE-5	All			155	194	12	21	2	6		1	1	7		399		
	Walleye	OE-1	Number 1		2	369	381	52	9	11	6				4	6		840	
			Jumbo				32	30	19	28	18	7	2	48	6			190	
			Number 2		33	401	6											440	
			Whitegill				4	10	2	2				1	1			20	
		OE-2	Number 1		1	420	326	37	8	9	2	1			8	8		820	
			Jumbo				1	62	14	8	11	9	7	5	60	3		180	
			Number 2		24	484	11									1		520	
			Whitegill				54	26	3	4	3	5	2		3			100	
		OE-3	Number 1			305	240	24	8	5	4			1	2	8		597	
			Jumbo				2	12	19	17	21	9	3	8	45	4		140	
			Number 2		4	330	2									4		340	
		OE-4	Number 1					1		2	2	8	3	1	3			20	
			Jumbo						3	1	3	7	2	1	19	4		40	
			Number 2				37									1		38	
			OE-5	Number 1						8		10				2			20
				Jumbo					1	3	16	4	50	3	14	68	1		160
			Number 2		29	49										2		80	
	White Perch	OE-1	All		7	80	157	13	195	95	51	27	14	6	14		659		
		OE-2	All			140	91	18	154	59	38	25	4	3	6		538		
		OE-3	All		1	49	70	11	75	38	24	20	16	13	3		320		
		OE-5	All		1	12	2		1	1							17		
	White Bass	OE-1	All		38	24	5	10	322	34	70	7	1		6		517		
		OE-2	All		27	19		12	363	50	112	4	6	1	6		600		
		OE-3	All		1		1	4	158	30	47	8	4		7		260		
		OE-4	All					1	11	4	3				1		20		
		OE-5	All						35	14	18	1	6	3	2		79		
Trawl	Rainbow Smelt	OE-2	All		24	15	13								8	40	100		
		OE-3	All		27	9	7								11	40	94		
		OE-4	All		491	453	131	19	5		1				235	1160	2495		
		OE-5	All		30	52	21	4	1						82	160	350		
	Lake Whitefish	OE-4	All	1													1		
	White Bass	OE-4	All		2												2		
	Yellow Perch	OE-4	All		25												25		

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

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

2.3 Commercial Catch Assessment

Statistical Power and Sample Size Analysis of Lake Erie Commercial Catch Sampling Program

The commercial catch sampling program of the Lake Erie Management Unit (LEMU) collects biological information from fish caught in the commercial fishery to estimate age composition, weight-at-age and commercial harvest (in numbers of fish) by market category and spatial and temporal units (referred to as strata). Harvest estimates are used in quantitative models to estimate lakewide population abundances, and set harvest quotas. It is crucial that the commercial catch sampling program samples fisheries to produce accurate estimates of age composition, weight-at-age and robust estimates of commercial harvest. In 2014, the LEMU initiated a review of the commercial catch sampling program and quantitative evaluation of target and actual numbers of fish sampled (hereafter referred to as sample size) with a focus on Yellow Perch (*Perca flavescens*), Walleye (*Sander vitreus*), and White Bass (*Morone chrysops*) commercial catch sampling. This review included:

- 1) Review of targeted and actual sample sizes of the Commercial Catch Sampling program based on protocols and effort from 1996 to 2014.
- 2) Power¹ and sample size analysis of age composition.
- 3) Simulations of the Commercial Catch Sampling Program to examine effects of sample size on accuracy (bias) and precision of age composition and harvest estimates (numbers of fish).

Yellow Perch

Commercial catch sampling annually targets 18,040 Yellow Perch but samples, on average, 5,239 (1996-2014 average), or $27\% \pm 6\%$ (mean $\pm$ standard) of target. The lowest sample size relative to target were in statistical districts OE4 ($9\% \pm 4\%$) and OE5 ($12\% \pm 9\%$). The average sample size collected could detect a 3%-6% difference within an age-class (lakewide) with a power of 0.50-0.90², at power of 0.70 a 4% difference could be detected.

The simulations of the Yellow Perch commercial catch sampling program demonstrated that the actual sample size collected produced age composition estimates within 2% for each age-class and total harvest estimates within 2% of true values. To consistently detect an age-class that is 1% of the fishery a minimum sample size of 8-12 fish per statistical district and month would be required; however, age composition was not accurate at this sample size. Simulation analysis also demonstrated that harvest estimates tended to be overestimated (overestimation bias) with the magnitude varying based on the age structure of the fishery. This overestimation bias was $\leq 1\%$ of true harvest at a sample size of 50-60 fish per statistical district and month.

Walleye

Commercial catch sampling annually targets 28,580 Walleye composed of 10,682 No.1, and 5,966 each of Jumbos, No.2 and whitegills market categories. However, annual sample size was, on average, 4,589 (1996-2014 average), or $16\% (\pm 11\%)$ of target, with category No.1 Walleye samples closest (32%) to the target. Actual samples sizes were closest to target in stat districts OE1 (29%) and OE3 (20%). The actual sample size could detect a 3.0%–5.5 % difference within an age class (lakewide) with a power of 0.50-0.90, at power of 0.70 a 3.5% difference could be detected.

¹ The statistical "power" is a measurement of the meaningfulness of a statistical test or the ability to correctly reject a false null hypothesis. For the purpose of this analysis this means the ability to detect a difference when a difference exists. (Zar 2010).

² There is no convention on the appropriate level for statistical power but in biology 0.70 is common, this means there is a 70% chance not detecting a difference if in fact no difference exists.

The simulations of the Walleye commercial catch sampling program demonstrated that the actual sample size collected produced age composition estimates within 2% for each age-class and total harvest estimates $\leq 3\%$ of true values. Current sample sizes had a good ability to detect age-classes that were $\geq 1\%$ of the fishery. Increasing sampling by 2x or 4x does not significantly improve age composition estimates. Simulation analysis also demonstrated that harvest estimates tended to be underestimated (underestimation bias), with the greatest underestimates occurring when there was a very strong age 2 year class. At the actual sample sizes acquired, the underestimated harvest is within approximately 2%.

White Bass

Commercial catch sampling annually targets 9,020 White Bass but samples, on average, 633 (1996-2014 average), or $7\% \pm 3\%$ (mean $\pm$ standard) of target. Statistical districts OE1 (15%) and OE2 (10%) produce actual sample sizes closest to the target sample size. There was inconsistency between years in numbers of fish collected from OE3, one year of fish collected in OE4, and no fish collected in OE5. The actual sample size collected could detect an 8%-14% difference within an age-class (lakewide) with a power of 0.50-0.90, at power of 0.70 a 9% difference could detect.

The simulations of the White Bass commercial catch sampling program demonstrated that the actual sample size collected produced age composition estimates within 8% for each age-class and total harvest estimates $\leq 5\%$ of true values. Simulation analysis also demonstrated that harvest estimates tended to be overestimated with the magnitude varying based on the age structure of the fishery. This overestimation bias was $\leq 1\%$ on true harvest at a sample size of 10 fish per statistical district and $\frac{1}{2}$ year (January – June or July – December)

Conclusions and recommendations

Based on this review and quantitative evaluation, it is felt that the LEMU Commercial Catch Sampling Program adequately samples the Yellow Perch, Walleye and White Bass fisheries to produce lakewide estimates of age composition (within 2 to 8% of true composition) and harvest (within 2 to 5% of true harvest). However, some gaps were identified in sampling which, if addressed, have the potential to improve the accuracy and precision of metric estimates. LEMU continues to use the findings of this work to direct commercial catch sampling strategies to most accurately and precisely characterise the fisheries and estimate harvest.

2.4 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 2017, 36% (4,169) of 11,478 DCRs were inspected by Port Observers. Of the total 25.6 million pounds landed in 2017, 31% (7.9 million pounds) was inspected or weights were observed. By species, 34% (1.7 million pounds) of Yellow Perch and 39 % (2.3 million pounds) of Walleye harvested were inspected in 2017.

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 2017, 776 errors were identified and corrected by Port Observers. In addition, there were 66 verbal and written warnings for failing to comply with conditions of commercial fishing licences.

2.5 Marine Stewardship Certification

In 2015, the Ontario commercial fishing industry sought and received Marine Stewardship Council (MSC) certification for both Walleye and Yellow Perch. The MSC is an international non-profit organization that uses ecolabelling and fishery certification to encourage and support sustainable fishing practices.

The MSC certification process applies an independent science-based approach to measure whether a fishery is meeting standards that ensure the fishery remains healthy and productive, does not impact other species or their habitat, and is operating within relevant laws, regulations and management policies.

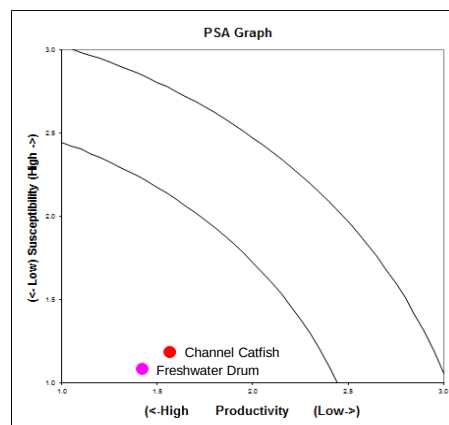


Figure 2.5.1 PSA results for Channel Catfish and Freshwater Drum.

If during the assessment process the fishery does not achieve a specific score against one of the many performance indicators (PI), then the MSC will apply conditions. 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.

For the certified Walleye and Yellow Perch fishery, conditions have been put in place regarding the by-catch of Freshwater Drum, Lake Whitefish, Channel Catfish and White Bass in the large and small mesh fisheries. These conditions are designed to ensure that Walleye and Yellow Perch fisheries do not pose a serious risk to or irreversibly harm the by-catch species.

In order to meet these conditions, the Ontario Ministry of Natural Resources and Forestry (OMNRF) (via the Lake Erie Committee) established a Data Deficient Work Group. This work group consists of agency biologists, a member of the Ohio trap net fishery, and the Ontario Commercial Fishing Association (OCFA). The group's main purpose is to gather information about the four by-catch species, apply techniques that ensure that these species are within biological based limits, and, if necessary, develop partial management strategies.

Channel Catfish and Freshwater Drum

Channel Catfish and Freshwater Drum were identified as main by-catch species in the Yellow Perch small mesh trap net fishery in Ohio. The MSC requires that the harvest of these species be within biological based limits. Failing this, a management strategy needs to be developed and implemented in order to ensure that the Ohio Yellow Perch trap net fishery does not cause irreversible harm.

Channel Catfish and Freshwater Drum are not a primary fish stock of interest and are referred to as data deficient species (i.e., limited assessment data and/or assessment tools). To demonstrate that these species were not a risk of irreversible harm, the OMNRF and OCFA applied the MSC's Productivity and Susceptibility Analysis (PSA) tool provided under the MSC risk based framework. The PSA is a data deficient tool that assess how likely the stock is to recover when depleted (productivity), and how the species interacts with the fishing gear (susceptibility). The assessed PSA scores demonstrate that

Channel Catfish and Freshwater Drum are highly productive and not vulnerable to harm from the Ohio small mesh Yellow Perch trap net fishery (Figure 2.5.1)

White Bass

Similar conditions exist for the certified Walleye fishery regarding White Bass by-catch. White Bass is a valuable commercially harvested species and is sought after by commercial fishers or caught and harvested as by-catch in the Walleye large mesh gill net fishery. Although more detailed assessment data exists for White Bass than for Channel Catfish and Freshwater Drum, refined assessment tools have not been developed.

An ADMB (Automatic Differentiation Model Builder) statistical catch-at-age (SCA) model, developed by the Ohio Department of Natural Resources and updated by Lake Erie Management Unit (LEMU), is being used to assess the status of White Bass in Lake Erie. Error rates associated with biomass estimates were fairly high for the SCA model; however, results were comparable to independent surplus production models developed independently (Allan Debertin from the University of Guelph). LEMU has started to develop biological reference points using the SCA model results in an effort to determine whether White Bass are being harvested sustainably. Two alternative approaches were used to define biological reference points: 1) yield per recruit and 2) spawning potential ratio. The biological reference points were estimated in terms of the fishing mortality that can be sustained by the population without adverse impacts. By projecting biomass forward one year and applying the fishing mortality rates estimated using the two biological reference point approaches, LEMU estimated biomass based limit reference points for White Bass in Lake Erie for 2016. The total lakewide harvest of White Bass appears to be below the limit reference points based on this preliminary work (Table 2.5.1). Overall, it appears that White Bass are being harvested within safe biological limits.

Table 2.5.1 Biological reference points, associated fishing rates, estimated biomass at the start of 2016, biomass of white bass harvested in 2016 if fished at the reference fishing rate, and the total harvest by commercial and recreational fisheries in 2016. $F_{0.1}$ is a conservative reference point from the yield per recruit analysis. F_{max} and $F_{30\% SPR}$ are upper reference limits from the yield per recruit and spawning potential ratio analyses, respectively.

Reference Point	Fishing Rate	Biomass in 2016 (kg)	Reference Point (kg)	Total Harvest in 2016 (kg)
$F_{0.1}$	0.54	26,841,267	7,768,558	2,244,433
F_{max}	0.74	26,841,267	9,907,022	
$F_{30\% SPR}$	0.80	26,841,267	10,486,409	

Lake Whitefish

A partial management strategy for Lake White fish is required to meet Marine Stewardship Council (MSC) certification conditions for the large mesh gill net Walleye fishery of Lake Erie certified in 2015. The MSC Conformity Assessment Body (CAB) recognized progress made with Lake Whitefish assessment models and examination of biological reference points reported by the Coldwater Task Group and Data Deficient Task Group. Future MSC audits will focus on the effectiveness of Lake Whitefish quota management and

Walleye quota transfers between quota areas to conserve Lake Whitefish. Future development of a Lake Whitefish Management Plan is expected to support MSC certification requirements.

3. RECREATIONAL FISHERIES

3.1 Lake Erie & Lake St. Clair Sport Fishery Diary Program

The Lake Erie & Lake St. Clair Sport Fishery Diary Program is an ongoing survey that allows the Lake Erie Management Unit 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.

In 2017, 50 volunteers from Ontario completed angler diaries in Lake Erie. Of the Ontario Sport Fishery Diary volunteers fishing in all areas, 92% have been participating in the program for three years or more. Sixty-seven percent have been involved in the program for ten years or more, and 52% have been involved in the program for twenty or more years. In total there were 603 fishing trips by angler diarists in Lake Erie (Table 3.1.1). The total effort in Lake Erie was 8,740 rod hours, with 15% of the effort in the western basin, 52% in the central basin and 33% in the eastern basin.

In 2017, 53 volunteers from Michigan and Ontario completed diaries in the St. Clair System (Lake St. Clair, Detroit River and St. Clair River). There were 36 participants in Lake St. Clair, 26 participants in the Detroit River, and 25 participants in the St. Clair River (some anglers fish in more than one area). In total there were 928 fishing trips by angler diarists in the St. Clair System (Table 3.1.2). The total effort in the St. Clair System was 10,657 rod hours, with 62% of the effort in Lake St. Clair, 24% in the Detroit River and 14% in the St. Clair River.

In 2017 the Walleye catch rate was highest in the Detroit River (1.48 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. Other areas with a high Walleye catch rate were Lake Erie western basin (1.05 fish per rod hour) and Lake St. Clair (0.94 fish per rod hour). Lake Erie eastern basin had the lowest Walleye catch rate (0.27 fish per rod hour). For the first time since 2006, the Yellow Perch catch rate was highest in the eastern basin of Lake Erie (6.51 fish per rod hour) (Figure 3.1.2). Catch rates for Yellow Perch were similar in Lake Erie's central and western basins (3.86 and 3.50 fish per rod hour respectively). The Yellow Perch catch rate was lowest in Lake St. Clair (1.88 fish per rod hour).

Other species targeted by anglers participating in the program include: Rainbow Trout, Smallmouth Bass, Muskellunge. Catch rates for Rainbow Trout declined in Lake Erie in 2017 (0.13 fish per rod hour in Lake Erie central basin and 0.029 fish per rod hour in Lake Erie eastern basin). Smallmouth Bass catch rates increased in the eastern basin of Lake Erie (0.99 fish per rod hour), but declined in Lake St. Clair in 2017 (0.71 fish per rod hour). The Muskellunge catch rate increased in Lake St. Clair (0.05 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, 2017.

Survey Area	Number of Diarists	Number of Trips	Number of Rods per Trip	Total Rod Hours
Western Basin	13	94	3.9	1,303
West-Central Basin	15	95	5.0	2,196
East-Central Basin	20	138	4.3	2,364
Inner Long Point Bay	15	94	2.6	841
Long Point Bay	8	30	3.0	295
Nanticoke	8	87	2.4	670
Port Colborne	8	65	3.4	1,071
Total	50^a	603	3.6	8,740

^a 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, 2017.

Survey Area	Number of Diarists	Number of Trips	Number of Rods per Trip	Total Rod Hours
Lake St. Clair	36	481	3.0	6,609
Detroit River	26	281	2.0	2,564
St. Clair River	25	166	2.3	1,483
Total	53^a	928	2.7	10,657

^a Diarist may fish more than one survey area in a year.

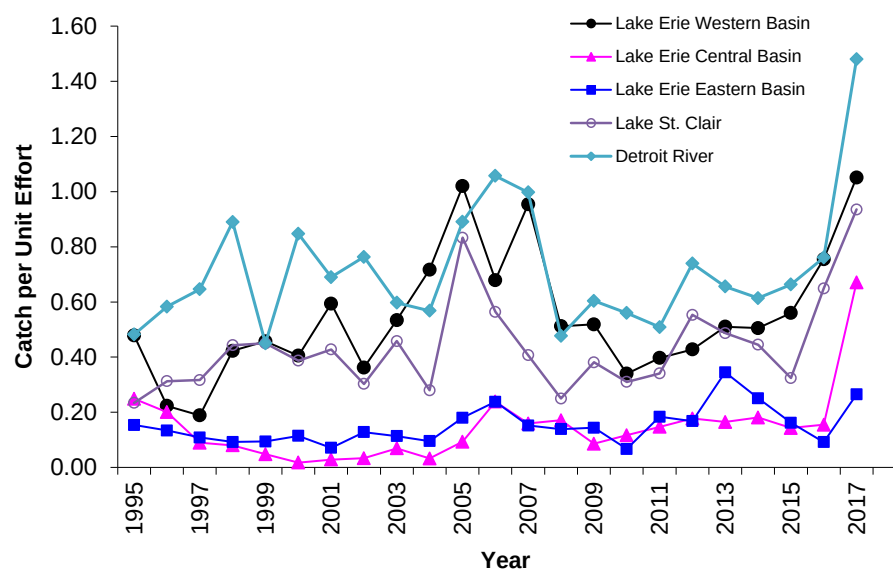


Figure 3.1.1 Walleye catch per unit effort (fish per rod hour) by area, 1995-2017.

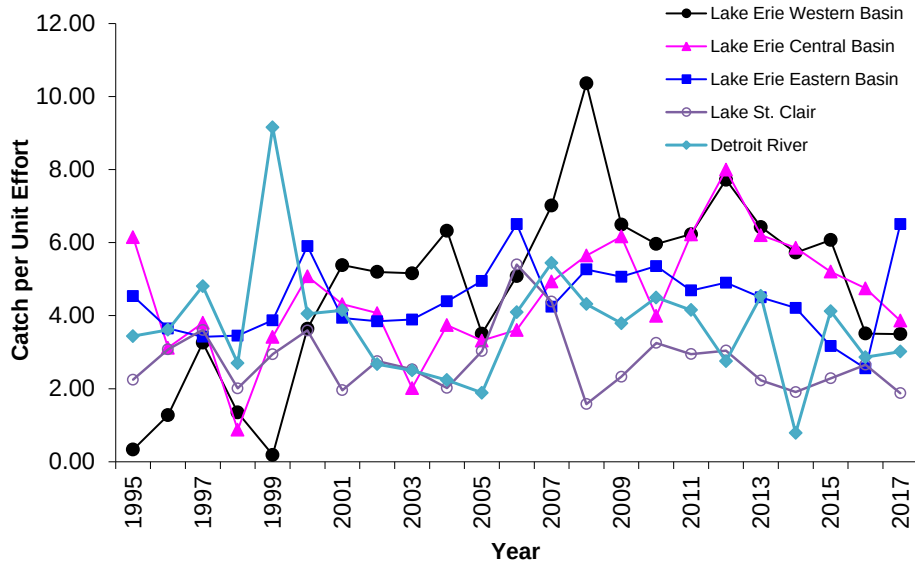


Figure 3.1.2 Yellow Perch catch per unit effort (fish per rod hour) by area, 1995-2017.

3.2 Lake St. Clair Creel Survey

In 2017, an international aerial creel survey was conducted in Lake St. Clair. The survey was coordinated by the Michigan Department of Natural Resources (MDNR) and funded in part by the United States Geological Survey (USGS). Ontario Ministry of Natural Resources and Forestry (OMNRF), Lake Erie Management Unit (LEMU) staff interviewed anglers on the Canadian side of Lake St. Clair. Data analysis was completed by MDNR.

During the survey, recreational fishing effort was determined using an aerial boat count. A designated plane flew over the lake twice a week to count fishing boats in all areas of Lake St. Clair. On the ground, creel crews on the Canadian and American sides of the lake interviewed boat anglers at access points. This survey only included the daytime boat fishery; the nighttime fishery and the shoreline fishery were not included. The purpose of the survey was to: 1) estimate catch and harvest for all fish species, 2) measure angling effort and success, 3) monitor the age and length composition of fish, 4) document fishing methods, and 5) learn information about angler demographics.

The survey ran from April to October 2017. There were over one million hours of angler effort in Lake St. Clair during the study period (Table 3.2.1). Forty-six percent of total effort occurred in Ontario waters. In Ontario, 26% of the effort occurred during July and 25% during September.

In Ontario waters, the most commonly caught species was Yellow Perch, where almost one half million Yellow Perch were caught (Table 3.2.2). Sixty-seven percent of the Yellow Perch were caught during September and October, and 39% were harvested. The targeted catch rate of Yellow Perch was 4.51 fish per angler hour, and 20% of effort in Ontario waters was directed towards Yellow Perch. In Ontario, 94,115 Walleye were caught during the survey. Thirty-nine percent of Walleye were caught in June and 83% were harvested. The targeted catch rate of Walleye was 0.55 fish per angler hour. Thirty-six percent of effort in Ontario waters was directed towards Walleye.

Over 90,000 Smallmouth Bass were caught in Ontario waters, 35% of these were caught in July and only 12% were harvested. Almost 8,000 Muskellunge were caught in Ontario waters, 35% of these were caught in September and none were harvested.

Fewer Yellow Perch were caught in Michigan waters compared to Ontario waters (Table 3.2.3). However, Michigan anglers caught more than twice as many Smallmouth Bass, Largemouth Bass, and Rock Bass compared to Ontario anglers. A similar number of Walleye were caught in both jurisdictions, however fewer Walleye were harvested in Michigan waters compared to Ontario waters. This is due to the 38.1cm minimum size limit for Walleye in Michigan; Ontario does not have a minimum size limit for Walleye in Lake St. Clair. Sixty-three percent of Walleye measured in Ontario waters were less than 38.1cm in total length, and 72% of Walleye sampled from Ontario anglers were age 2.

Table 3.2.1 Estimated total effort in angler hours, by month and area in the Lake St. Clair international creel survey, 2017.

Area	Effort in Angler Hours by Month							Total
	April	May	June	July	August	September	October	
Ontario	5,530	24,057	76,273	117,651	66,343	116,282	53,995	460,132
Michigan	8,823	73,544	90,678	216,064	56,191	63,818	31,661	540,779
Total	14,353	97,602	166,951	333,716	122,534	180,100	85,656	1,000,911

Table 3.2.2 Estimated catch by month and total harvest in Ontario waters during the Lake St. Clair international creel survey, 2017.

Species	Total Catch By Month - Ontario								Total Harvest
	April	May	June	July	August	September	October	Total	
Black Crappie	54	-	109	504	-	-	-	668	54
Bluegill	-	4,260	807	2,965	276	2,152	-	10,461	2,212
Channel Catfish	-	546	1,870	948	1,611	2,749	555	8,279	319
Freshwater Drum	-	1,030	4,830	3,383	1,796	3,845	7,409	22,293	-
Largemouth Bass	54	132	3,330	5,041	1,410	3,498	9,556	23,020	2,689
Muskellunge	-	253	975	918	1,183	2,725	1,661	7,715	-
Northern Pike	-	587	3,156	1,194	1,059	1,039	701	7,737	453
Rock Bass	108	627	5,829	2,526	455	538	246	10,329	605
Smallmouth Bass	162	1,282	15,567	31,493	12,174	13,125	16,641	90,444	10,522
Walleye	1,775	12,899	36,793	17,120	7,959	8,669	8,901	94,115	78,503
White Bass	423	1,659	6,742	4,032	1,691	4,978	6,938	26,463	1,646
White Perch	-	846	2,071	-	276	646	230	4,069	296
Yellow Perch	-	12,662	42,375	53,480	54,834	192,086	136,231	491,668	190,299
Other	-	-	269	1,049	201	978	331	2,830	1,302
Grand Total	2,575	36,784	124,724	124,654	84,926	237,028	189,400	800,091	288,901

Table 3.2.3 Estimated catch by month and total harvest in Michigan waters during the Lake St. Clair international creel survey, 2017.

Species	Total Catch By Month - Michigan								Total Harvest
	April	May	June	July	August	September	October	Total	
Black Crappie	456	18	-	-	-	-	215	689	188
Bluegill	60	2,434	442	1,936	676	3,102	1,322	9,973	3,160
Channel Catfish	-	220	330	886	411	476	122	2,445	474
Freshwater Drum	55	905	1,134	3,256	1,124	957	1,374	8,805	282
Largemouth Bass	927	10,572	8,016	26,673	3,876	4,219	1,643	55,926	1,419
Muskellunge	87	555	630	1,067	497	712	360	3,909	39
Northern Pike	222	3,113	2,618	2,743	816	577	486	10,574	211
Rock Bass	9	14,076	30,502	12,239	3,540	1,215	258	61,839	7,481
Smallmouth Bass	3,194	35,949	52,712	74,650	15,420	9,093	3,629	194,647	5,717
Walleye	389	17,011	15,867	41,431	5,329	2,719	1,944	84,690	42,620
White Bass	43	21,600	5,218	4,583	1,455	288	62	33,248	5,416
White Perch	-	-	-	3,038	819	253	137	4,247	291
Yellow Perch	693	5,353	10,696	111,334	30,650	34,380	33,863	226,970	66,946
Other	59	1,076	1,175	2,786	-	219	291	5,606	3,267
Total	6,194	112,883	129,340	286,623	64,613	58,212	45,705	703,569	137,511

3.3 Angler Outreach

In 2015 the Provincial Services Division (PSD) set out the 2015-2016 to 2020-2021 strategic direction. This document aligns PSD directives to the Ontario Ministry of Natural Resources and Forestry (OMNRF) and the Government of Ontario. One PSD goal was to “Increase public awareness of Ontario’s natural resources and importance of ecological sustainability”. This PSD goal relates to the OMNRF’s goal of “promoting knowledge of Ontario’s natural resources, their management and opportunities for their enjoyment” and the Government of Ontario goal of being a “leader on environmental sustainability and



Figure 3.3.2 Lake Erie Management Unit staff collecting biological information at the Colchester Walleye Derby.



Figure 3.3.1 Lake Erie Management Unit Outreach.

climate change mitigation”. To address the PSD goal, the Lake Erie Management Unit (LEMU) implemented an angler outreach campaign. The 2017 objective of the outreach campaign was to increase the presence of the LEMU in the Lake Erie angling community.

In 2017, LEMU outreach included attendance at seven public events with an information booth (Figure 3.3.1; Figure 3.3.2). Educational handout materials included a LEMU/OMNRF factsheet, Great Lakes Fishery Commission (GLFC) factsheets, 2017 fishing regulations, invasive species brochures and information about youth employment opportunities. LEMU biologists also gave several presentations to local groups including the Strait Line Anglers (Grimsby, ON), South-West Outdoors Club (Wheatley, ON) and the Belle River Chapter of Muskies Canada



Figure 3.3 Lake Erie Management Unit booth at the Chatham-Kent and Lambton Children's Water Festival.

(Belle River, ON), on varying aspects of the LEMUs work in the Lake Erie basin. LEMU also sent representatives to the Toronto Sportsman Show (Mississauga, ON), which attracted thousands of outdoor enthusiasts. Finally, LEMU participated in the Chatham-Kent and Lambton Children's Water Festival. At the multiday festival LEMU staff engaged many young students with a display of native and non-native fish species from Lake Erie (Figure 3.3.3).

Table 3.3.1 Summary of 2017 Angler outreach events.

Event	Location	Date	Duration	People Engaged
Toronto Sportsman Show	Mississauga	Mar 15-19, 2017	5 days	500+
Muskies Canada - Belle River Chapter (presentation)	Belle River	May 14, 2017	1 hr	20
Harrow Colchester South Lion's Walleye Derby	Colchester	Jun 10, 2017	6 hrs	120+
AMA Sportsmen Kids Fishing Derby	Amherstburg	Jun 18, 2017	4 hrs	100
444 Walleye Tournament	Port Colborne	Jun 24, 2017	6 hrs	20
SWOC Kids Fishing Derby	Wheatley	Jul 8, 2017	4 hrs	100+
PCMYC Kids Fishing Derby	Port Glasgow	Jul 9, 2017	6 hrs	75
Sun Splash	Belle River	Jul 13, 2017	6 hrs	255
Leamington Walleye Derby	Leamington	Jul 15, 2017	6 hrs	50
Chatham-Kent & Lambton Children's Water Festival	Chatham	Oct 3-5, 2017	3 days	300+
Strait Line Anglers (presentation)	Grimsby	Nov 7, 2017	1 hr	35
South-West Outdoors Club (presentation)	Wheatley	Dec 12, 2017	1 hr	75
Total			≈ 100 hrs	1500+

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 eastern basins. In 2017, 133 random sites were fished across Lake Erie (Figure 4.1.1). Index gill nets fished overnight were 381m in length, consisting of 14 mesh sizes ranging from 32mm to 152mm fished on bottom and suspended (canned). Twenty nine (29) species from 14 families were caught in index gill nets lakewide during 2017. 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).

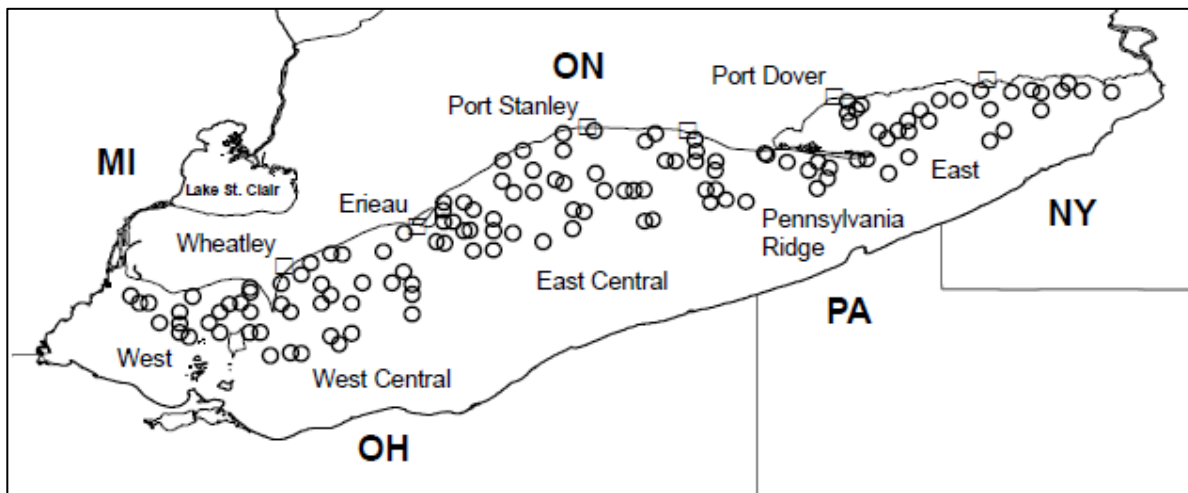


Figure 4.1.1 Sites fished in Partnership index gill net surveys during 2017.

Walleye

Walleye catch rates in 2017 achieved record high levels in the east basin and Pennsylvania Ridge surveys, and were above average in the west central and east central basin surveys, whereas the west basin Walleye index was lower than 70% of years assessed previously (Figure 4.1.2). Catch rates decreased from 2016 in the west, west central and east central basin surveys while increasing dramatically in the east basin and Pennsylvania Ridge surveys. The lakewide age composition in 2017 ranged from 0 to 18 with age 2 (2015 cohort) most abundant across the lake. Age 1 Walleye were the second most abundant age group in the east and west basins. Age 3 Walleye (2014 year class) comprised 5% of lakewide catches but represented greater proportions of Walleye caught in the west half of the lake. Young of the year (age 0) fish were present in the west, west central and east basin surveys. Lakewide, age 2 Walleye were smaller than average in 2017.

Yellow Perch

Yellow Perch abundance indices were high in the east and west basin surveys, but were moderate or weaker in the east central and west central basins respectively in 2017 (Figure 4.1.2). Catch rates increased significantly in the Pennsylvania Ridge survey, marginally in the west and east basin surveys,

but decreased in the west central and east central basin indices from 2016. Age groups ranged from 1 to 14 lakewide, with age 3 most common in west and central basin surveys. Age 1 Yellow Perch were most abundant in the east basin, but were also prevalent in the Pennsylvania Ridge and east central basin surveys. Age 5 contributed significantly to Pennsylvania Ridge and east central basin Yellow Perch catch composition. Yellow Perch mean size at age was generally above average or close to average in 2017.

White Bass

White Bass abundance indices were high in the west, east and Pennsylvania Ridge surveys but appeared weak in both central basin surveys in 2017 (Figure 4.1.2). Catch rates in 2017 improved significantly from 2016 in the west, east, and Pennsylvania Ridge surveys but only marginal increases were observed in the central basin surveys. White Bass age composition lakewide ranged from 0 to 9. Yearling (2016 cohort) White Bass were the most abundant age group present in all surveys during 2017, followed by age 5 (2012 cohort). Young of the year (age 0) White Bass were present only in the west and central basin surveys. White Bass size at age appeared average or better in 2017.

White Perch

White Perch catch rates in 2017 were high in the west central and Pennsylvania Ridge surveys, moderate in the east basin survey but indices were low to moderate in the west and east central basin surveys (Figure 4.1.2). Abundance indices in 2017 increased from 2016 in the west central, east and Pennsylvania Ridge surveys while decreases were observed in the west and east central basin surveys. White Perch age composition lakewide ranged from 0 to 9 with age 2 (2015 year class) most dominant in all surveys. Young of the year (age 0) White Perch were present only in the west and central basin surveys. Mean lengths of White Perch were above average for multiple age groups in 2017.

Lake Whitefish

Lake Whitefish are a migratory cold water species vulnerable to capture in index nets in the central, east basin and Pennsylvania Ridge surveys. Lake Whitefish catch rates in 2017 were high in the east basin survey, moderate in the Pennsylvania Ridge survey and low in the two central basin surveys (Figure 4.1.2). Indices increased significantly from 2016 in the west central, east and Pennsylvania Ridge surveys but decreased in the east central basin survey. Age groups present in lakewide catches ranged from 1 to 14. Age composition was comprised of age 2 (2015 cohort) followed by age 3 (2014 cohort), age 1 (2016 cohort) and age 14 (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 2017, Lake Trout catch rates were low in the east basin and Pennsylvania Ridge surveys 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. Coded-wire tags were retrieved from the nares of 6 out of 10 Lake Trout caught in index nets, revealing the following strains: Slate Island (4), Finger Lakes (1) and Lake Champlain (1). For Lake Trout caught in index gear, ages based on tagging dates ranged from 2 to 9. There is no evidence that Lake Trout reproduce naturally in Lake Erie.

Species at Risk

A record number of Lake Sturgeon (13) were caught in index nets during 2017, ranging in total length from 44 to 76cm (mean 62cm). 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 catch (49) was moderate during 2017, distributed between the west (34) and east central (15) basin surveys.

Other species

Smallmouth Bass catch rates in 2017 were low in both the west and east basin surveys. Smallmouth Bass age composition ranged from ages 1 to 7 and 1 to 12 in west and east basin surveys respectively. Yearlings were the most abundant age group present in both surveys; however, Smallmouth Bass age composition was more diverse in the east basin compared to the west basin survey. During 2017, Sucker species were abundant in west and central basin surveys, but remained low in the east basin, consistent with a regional declining trend. Freshwater Drum abundance ranged from low to moderate lakewide in 2017. Burbot catches in 2017 increased marginally from recent years but remained low relative to the historic time series.

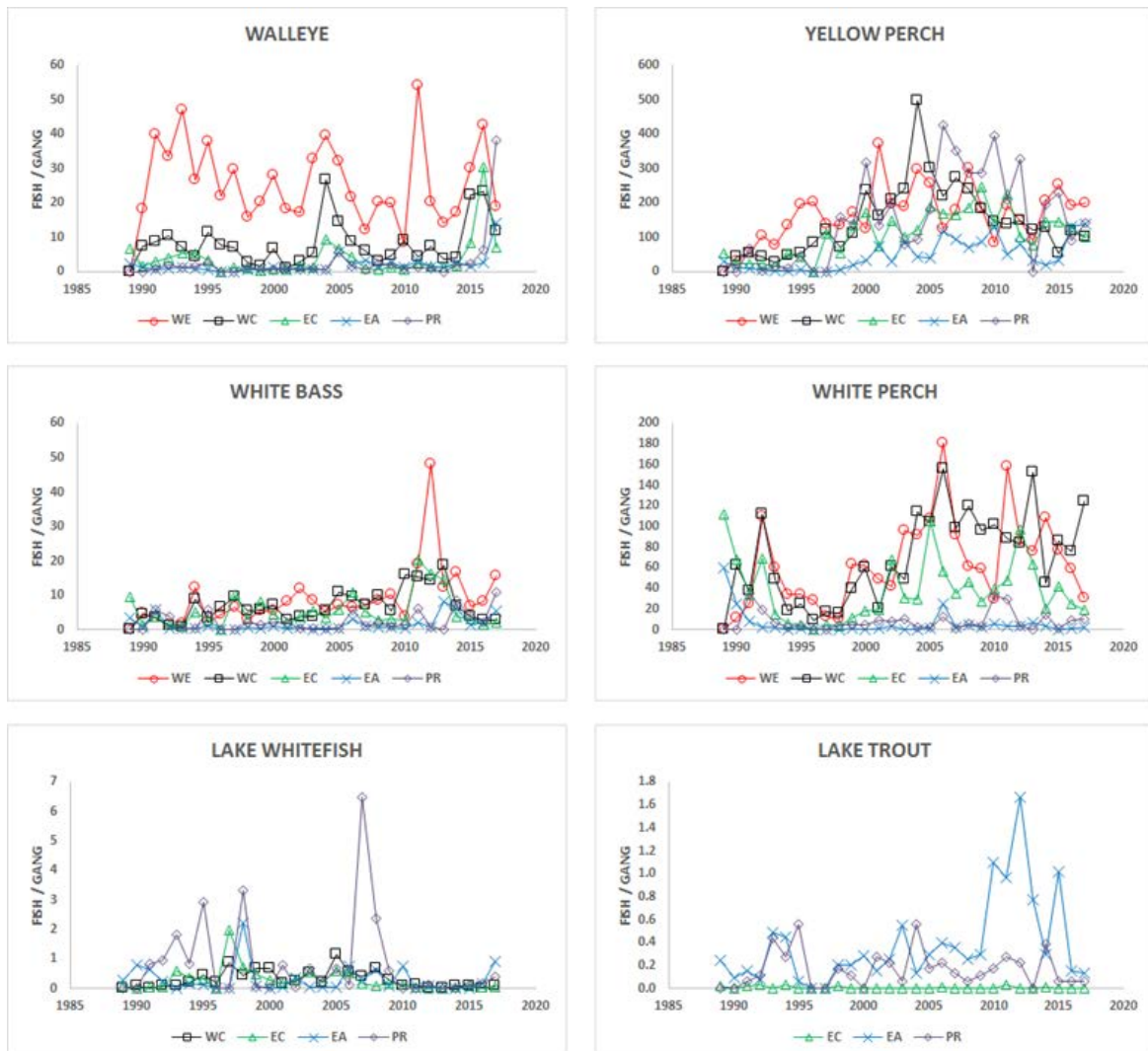


Figure 4.1.2 Mean catch (fish/gang) by species, and basin. WE=West, WC=West Central, C=East Central, EA=East, PR=Pennsylvania Ridge.

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. 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 1.7 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. Mean number caught per hectare and percentile by species and age group (young of the year, yearling and older and all ages) are presented for the 2017 field season along with mean catch rates for time periods: 1988-2016, 1988-1999, 2000-2009, 2010-2016 (Table 4.2.1).

In Ontario waters, catch rates in 2017 were high for young-of-the-year (YOY) Yellow Perch and moderately high for YOY Walleye. White Perch, White Bass, Freshwater Drum and Gizzard Shad YOY indices were moderate in 2017. YOY Smallmouth Bass and Rock Bass YOY catches are always low relative to other species caught in this survey. In 2017, Rock Bass YOY catch rates were moderate while Smallmouth Bass YOY catches were low compared to their respective time series.

Catch rates of yearling and older (YAO) Walleye were relatively high in 2017 due to the contribution of Walleye ages 2, 1 and 3 respectively. The yearling and older Yellow Perch index in 2017 was low to moderate with age groups 3, 2, 1, 4 and 5 represented in order of decreasing abundance. Yearling Yellow Perch catch rates were low in 2017, despite appearing moderate in strength as YOY in 2016. White Bass and White Perch YAO indices were moderate and weak in 2017 respectively. YAO White and Shorthead Redhorse Sucker catch rates in 2017 were high relative to past years. Densities of yearling and older Freshwater Drum, Smallmouth Bass, Rock Bass and Quillback Carpsuckers were moderate during 2017. Catches of YAO Channel Catfish and Common Carp were relatively low in 2017 compared to past decades.

Abundance indices of forage species that include all age groups were very low for Emerald Shiners, and were somewhat low for Spottail Shiners and Troutperch in 2017 (Table 4.2.1). Alewife and Silver Chub (SAR: Special Concern) catch rates were moderate in 2017 compared to past years. Rainbow Smelt, Mimic Shiners, Logperch, Round Goby and Tubenose Goby catch rates in 2017 were high compared to previous years.

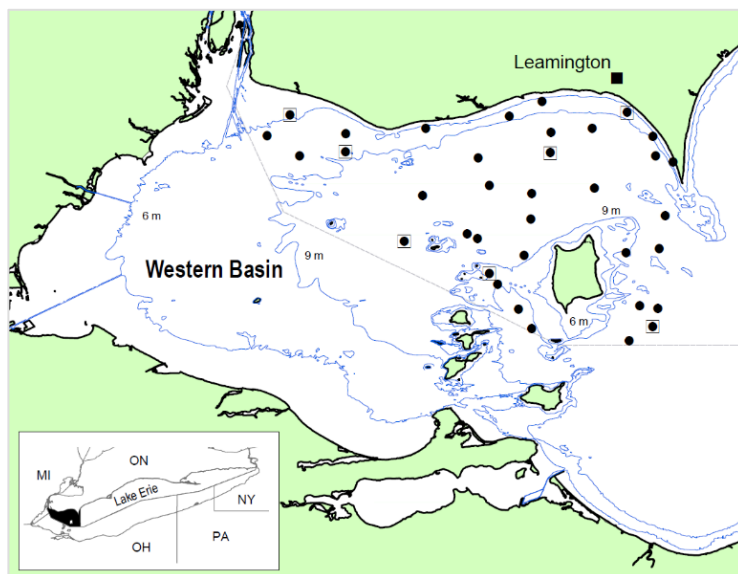


Figure 4.2.1 Sites fished bottom trawling (dots) in Ontario waters of western Lake Erie, 2017. Squares represent sites repeated with a midwater trawl during the last week of August.

Table 4.2.1 Number per hectare caught by fish species and age group for 2017 compared to time period means: 1988-2016, 1988-1999, 2000-2009, 2010-2016. Percentile for 2017 in relation to entire time series.

Age Group	Species	Mean				Percentile	
		1988-2016	1988-1999	2000-2009	2010-2016	2017	(88-17)
Young of the Year	Gizzard Shad	486.9	637.9	584.1	89.0	111.14	41%
	Quillback	0.0	0.1	-	-	0	0%
	White Sucker	0.0	0.0	-	-	0	0%
	Channel Catfish	0.0	0.1	0.0	0.0	0	0%
	White Perch	2,114.8	2,309.9	2,242.1	1,598.7	1700.48	62%
	White Bass	99.6	84.2	150.0	53.9	64.85	55%
	Morone sp.	0.0	-	0.0	0.0	0	0%
	Centrarchidae	0.0	-	-	0.0	0	0%
	Rock Bass	0.4	0.2	0.4	0.6	0.3	55%
	Pumpkinseed	0.0	-	0.0	-	0	0%
	Bluegill	0.0	-	-	0.0	0	0%
	Smallmouth Bass	1.8	1.7	2.2	1.4	0.21	17%
	Largemouth Bass	0.2	0.4	0.0	0.0	0	0%
	White Crappie	0.3	0.8	0.0	-	0	0%
	Black Crappie	0.0	-	0.0	-	0	0%
	Poxomis sp.	0.0	-	-	0.0	0	0%
	Yellow Perch	497.1	489.3	454.3	571.7	907.02	86%
	Walleye	17.9	18.1	16.3	19.9	16.86	72%
	Freshwater Drum	18.7	16.2	32.8	3.0	6.07	55%
	All	3,237.8	3,558.7	3,482.4	2,338.4	2806.93	55%
Yearling and Older	Silver Lamprey	0.0	0.0	0.0	0.0	0	0%
	Lake Sturgeon	0.0	0.0	0.0	0.0	0	0%
	Gizzard Shad	2.0	4.6	0.2	0.2	0	0%
	Northern Pike	0.0	0.0	-	0.0	0	0%
	Muskellunge	0.0	-	0.0	0.0	0	0%
	Quillback	0.3	0.2	0.4	0.2	0.1	34%
	Longnose Sucker	0.0	-	-	0.0	0	0%
	White Sucker	0.9	0.5	1.3	1.2	4.03	100%
	Silver Redhorse	0.0	-	0.0	0.0	0	0%
	Golden Redhorse	0.0	-	0.1	-	0	0%
	Shorthead Redhorse	0.1	0.0	0.3	0.1	0.11	69%
	Moxostoma sp.	0.0	-	-	0.0	0	0%
	Carp	0.9	1.4	0.8	0.4	0.33	21%
	Yellow Bullhead	0.0	-	0.0	0.0	0	0%
	Brown Bullhead	0.5	0.5	0.7	0.2	0	0%
	Channel Catfish	1.1	1.2	0.9	1.4	0.42	28%
	White Perch	129.5	79.4	204.8	107.6	25.72	21%
	White Bass	2.3	2.0	2.1	3.1	1.13	59%
	Rock Bass	0.7	1.0	0.6	0.2	0.31	34%
	Bluegill	0.0	-	-	0.0	0	0%
	Smallmouth Bass	0.4	0.8	0.2	0.1	0.1	34%
	Largemouth Bass	0.1	0.1	-	-	0	0%
	White Crappie	0.0	0.0	-	-	0	0%
	Black Crappie	0.0	0.0	0.0	-	0	0%
	Yellow Perch	197.8	119.1	286.9	205.3	89.07	28%
	Walleye	11.0	7.3	13.0	14.4	12.13	76%
	Freshwater Drum	44.7	33.2	62.6	38.8	30.65	34%
	Carp-Goldfish hybrid	0.0	-	0.0	0.0	0	0%
	Other	0.4	0.9	0.0	-	0	0%
	All	392.8	252.4	574.8	373.5	164.1	21%
All Ages	Alewife	314.9	654.3	127.6	0.4	0.42	41%
	Rainbow Smelt	29.2	9.3	40.9	46.6	254.98	100%
	Cyprinidae	12.4	-	5.3	43.8	100.28	97%
	Goldfish	0.1	0.0	0.0	0.2	0	0%
	Silver Chub	5.1	7.6	3.9	2.5	2.12	41%
	Emerald Shiner	105.8	51.5	176.9	97.3	4.74	10%
	Common Shiner	0.0	-	0.0	-	0	0%
	Spottail Shiner	41.3	72.0	28.9	6.3	8.96	28%
	Spotfin Shiner	0.0	0.0	-	-	0	0%
	Mimic Shiner	1.6	0.0	2.2	3.3	102.12	100%
	Nocomis sp.	0.0	0.0	-	-	0	0%
	Notropis sp.	0.0	-	0.0	-	0	0%
	Troutperch	197.3	196.7	259.6	109.3	76.68	28%
	Johnny Darter	0.1	0.3	-	0.0	0	0%
	Logperch	3.7	4.2	2.5	4.7	9.41	90%
	Brook Silverside	0.1	0.1	0.1	0.1	0	0%
	Round Goby	60.3	14.9	125.3	45.4	104.22	79%
	Tubenose Goby	0.0	-	-	0.1	0.71	100%
	Other	0.0	0.0	-	-	0	0%
	All	771.9	1,010.9	773.3	360.0	664.64	62%
All Age Groups	All Species	4,402.5	4,822.1	4,830.5	3,071.9	3635.67	41%
	# Trawls	35	35	35	35	36	

In response to concerns about the potential influence of low dissolved oxygen (hypoxia) affecting fish vertical distribution during the west basin bottom trawl survey, an interim interagency protocol was implemented to exclude samples with hypoxia (≤ 2 mg / l) retroactively from 2009. Since 2012, midwater trawl gear was used to describe the vertical distribution of species in response to low dissolved oxygen at 7 sites fished previously during the bottom trawl survey (Figure 4.2.1). The gear is intended to fish with a three metre square opening, with 102, 76, 51, and 25 millimetre graded mesh running from the gape to 13 millimetre mesh in the cod-end. Trawl duration was 10 minutes at 3.0 knots. Over the course of the study (2012-2017), hypoxia when present, was not extensive. Catches of juvenile Yellow Perch, Walleye and White Perch were highest on bottom, with low or zero catches in the middle or upper portion of the water column (Table 4.2.2). Emerald Shiner was the only species more abundant in pelagic trawls than bottom trawls. Spottail Shiners were caught exclusively in bottom trawls. Some species were more abundant in bottom trawls but with significant catches in pelagic trawls including YOY Gizzard Shad, Alewife, YOY White Bass, Rainbow Smelt and Brook Silversides. Due to infrequent hypoxia in the west basin during August, the annual west basin midwater trawl survey has been discontinued but may occur in the future if hypoxia becomes extensive during the west basin interagency trawl survey.

Table 4.2.2 Number per hectare caught by fish species and age group at the bottom, middle and top of the water column at 7 trawl stations in western Lake Erie. Annual mean temperature and dissolved oxygen among stations are presented for 2012-2017. YOY = Young of the year YAO = Yearling and older Unspecified age groups include all ages.

	BOTTOM						MIDDLE						TOP					
	2012	2013	2014	2015	2016	2017	2012	2013	2014	2015	2016	2017	2012	2013	2014	2015	2016	2017
YOY Yellow Perch	227.4	335.3	1,305.1	1,077.6	331.3	935.7	30.8	-	-	-	-	18.1	-	-	2.7	-	-	-
YAO Yellow Perch	77.1	27.4	2.5	94.4	166.1	9.7	-	-	-	1.6	-	7.2	0.5	-	-	-	-	-
YOY White Perch	9,337.9	209.9	401.0	1,120.6	373.6	1,077.9	19.4	-	-	-	4.5	7.9	-	-	-	0.5	8.2	0.5
YAO White Perch	105.3	115.9	0.8	13.5	288.0	13.5	-	-	-	-	-	-	-	-	-	-	-	-
YOY White Bass	72.8	5.8	3.7	11.3	6.1	9.1	11.9	-	3.4	2.6	0.8	0.9	5.3	0.5	3.5	8.7	0.6	-
YAO White Bass	1.7	5.3	4.0	2.1	0.6	1.6	-	-	1.7	-	-	0.9	-	-	-	-	-	-
YOY Freshwater Drum	0.5	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-
YAO Freshwater Drum	53.6	10.5	1.8	1.5	23.1	10.7	-	-	-	-	-	-	-	-	-	-	-	-
YOY Smallmouth Bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YAO Smallmouth Bass	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YOY Rock Bass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YAO Rock Bass	-	-	-	0.5	1.1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
YOY Walleye	5.8	-	5.0	40.7	7.7	26.5	-	-	-	-	-	1.8	-	-	-	-	-	-
Yearling Walleye	6.2	1.6	0.8	4.6	70.7	0.5	-	-	-	-	3.1	-	-	-	0.6	-	1.1	-
Age 2 and Older Walleye	1.5	1.1	0.5	-	2.8	9.7	0.9	-	-	-	0.8	-	-	-	-	-	-	-
YOY Channel Catfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YAO Channel Catfish	1.0	0.5	-	-	1.6	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Alewife	1.3	62.1	-	-	-	8.6	0.9	19.2	-	-	-	4.7	1.0	10.8	-	-	-	1.6
YOY Gizzard Shad	589.8	591.3	219.7	135.1	286.6	1,397.8	46.1	67.0	108.9	296.6	97.6	17.6	77.1	108.4	556.7	586.3	4.9	57.8
YAO Gizzard Shad	0.6	-	-	0.5	0.6	1.1	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Smelt	7.5	106.4	497.3	137.7	1.7	1,357.3	0.9	0.9	28.7	147.3	1.5	1,263.0	-	5.1	59.3	400.1	4.1	224.5
YOY Common White Suckr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YAO Common White Suckr	0.6	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-
Round Goby	14.4	-	-	23.1	14.9	14.4	-	-	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	7,040.9	3,859.4	949.1	2,671.3	371.5	301.2	10,323.3	15,892.3	4,200.8	5,077.0	475.6	828.6	7,742.2	15,672.4	3,340.3	10,506.6	114.1	230.9
Spottail Shiner	0.6	-	0.5	1.0	2.7	19.8	-	-	-	-	-	-	-	-	-	-	-	-
Silver Chub	5.1	6.3	-	0.5	5.0	1.1	-	-	-	-	-	-	-	-	-	-	-	-
Common Carp	0.6	2.6	-	0.5	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-
Logperch	-	0.5	-	-	1.2	2.1	-	-	0.8	-	-	-	-	-	-	-	-	-
Troutperch	89.1	55.7	-	11.6	19.4	46.9	-	-	-	-	-	-	-	-	-	-	-	-
YOY White Crappie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YOY Black Crappie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Sturgeon	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyprinid	3.9	7.4	-	17.3	-	0.5	-	-	-	-	-	0.9	-	-	-	4.6	-	-
Brook Silverside	44.4	2.7	61.4	23.4	118.6	1.1	1.1	-	-	27.3	82.7	-	69.9	3.2	16.6	20.1	21.4	-
Total	17,690	5,409	3,453	5,390	2,095	5,249	10,435	15,979	4,344	5,552	666	2,152	7,896	15,800	3,980	11,527	154	515
Number of Trawls	7	7	7	7	7	7	4	4	5	7	5	4	7	7	7	7	7	7
Mean DO ¹ mg/l	7.0	8.0	9.7	8.8	5.9	8.6	8.1	8.7	8.5	8.8	6.8	9.0	8.3	8.6	8.8	8.8	6.8	9.1
Minimum DO ¹ mg/l	5.8	7.5	7.6	7.9	1.1	7.8	8.1	8.6	8.5	8.0	5.8	8.0	8.1	7.8	8.5	8.1	3.2	8.5
Mean Temperature ¹ °C	24.3	23.8	23.3	22.3	24.5	22.4	24.2	23.6	23.8	22.9	25.2	22.2	24.3	23.9	24.0	22.6	25.3	22.3

¹ Dissolved oxygen at depth trawl was fished.

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). Two nearshore area surveys targeting Yellow Perch with a 6.1m modified Biloxi bottom trawl have been conducted annually since 1980; at four fixed stations in Inner Long Point Bay (Inner Bay Trawl Assessment) and at three fixed stations in the nearshore waters of Outer Long Point Bay (Nearshore Outer Bay Trawl Assessment). A third trawl survey was initiated in 1984 to measure recruitment of Rainbow Smelt. In this survey, a 10m 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.

In 2017, weekly trawling for the two nearshore surveys occurred from August 30th to September 25th and for offshore survey from September 24th to November 7th. The nearshore surveys were completed but due to weather, one day of trawling was lost in the offshore area.

Relative abundance indices are expressed as arithmetic mean catch (number) per hectare (NPHa).

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 5m (78.3%) and less than or equal to 5m (21.7%) according to the following equation:

$$LPBc_i = (OOB_i \times 0.783) + \frac{(IB_i \times 0.217)}{2} + \frac{(NOB_i \times 0.217)}{2},$$

where LPBc_i is the Yellow Perch composite index in year i, and OOB_i, IB_i and NOB_i are the perch mean NPHa estimates for each of the three Long Point Bay trawl assessments in year i; Offshore Outer Bay (OOB), Inner Bay (IB), and Nearshore Outer Bay (NOB).

The composite index indicated that the catch rate of the 2017 Yellow Perch year class (NPHa=66) was lower than the long-term mean (1980-2016: mean NPHa=75). Density of yearling and older (YAO) Yellow Perch in 2017 (NPHa=4) was also below average (1980-2016: mean NPHa=13).

Rainbow Smelt

Only offshore sites are used to estimate Rainbow Smelt abundance. Abundance of young-of-the-year (YOY) was below average in 2017 (2017 NPHa=372) relative to the long-term mean (1984-2016: mean NPHa=1012). Abundance of YAO Rainbow Smelt was also down (NPHa=0) relative to the time series mean (1984-2016: mean NPHa=411) (Table 4.3.1).

Other Species

Inner Bay – Catches of all species were lower than the long-term means (Table 4.3.2). The downward trend in NPHa of forage species, eg., Spottail Shiner and Banded Killifish, continued in 2017.

Nearshore Outer Bay – In 2017, YOY Yellow Perch NPHa was above the long term mean, as was Round Goby (Table 4.3.3). All other species and age classes were below average. While Alewife catches were

below the long-term mean, they were higher than has been observed in recent years.

Offshore Outer Bay – In 2017, both YOY and YAO Yellow Perch NPHa were higher than the long-term mean, as was Round Goby (Table 4.3.1). All other species were below average. Though lower than the long-term mean, Alewife catches were up relative to the previous three years.

Despite the decline in the abundance of the forage base, growth and abundance of predators, such as Walleye and Yellow Perch, continue to be strong, as will be seen in other sections of this report.

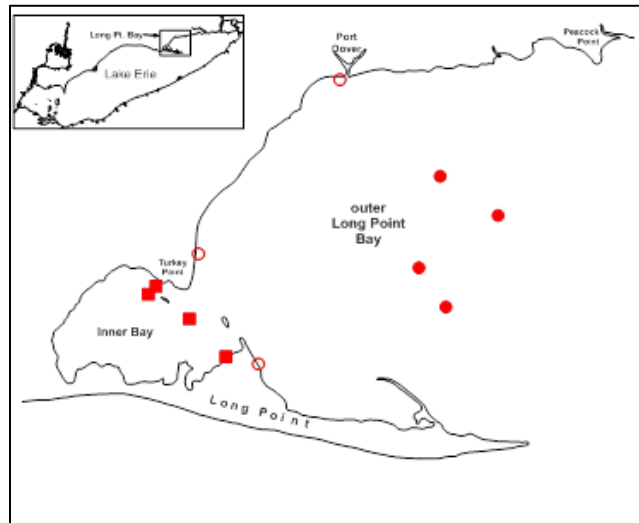


Figure 4.3.1 Location of trawl stations where bottom trawling was conducted in Inner Bay (■), and the nearshore (○) and offshore (●) waters of Outer Long Point Bay, Lake Erie.

Table 4.3.1 Relative abundance (mean number per hectare) of selected young-of-the-year and yearling-and-older fish species caught in the offshore waters of Outer Long Point Bay, Lake Erie, during index bottom trawl assessments (10m trawl), September-October, 2017, and mean from 1984 to 2016. – indicates that species of this age class are not captured in this survey.

Species	YOY		YAO	
	2017 Mean	1984-2016 Mean	2017 Mean	1984-2016 Mean
Rainbow Smelt	372	1012	0	411
Yellow Perch	65	56	49	15
White Perch	0	5	-	-
White Bass	0	11	-	-
Alewife	36	103	-	-
Gizzard Shad	2	15	-	-
Emerald Shiner	0	191	0	283
Round Goby*	138	91		

Table 4.3.2 Relative abundance (mean number per hectare) 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 (6.1m trawl), August-September, 2017, and mean 1980 to 2016.

Species	YOY		YAO	
	2017	1980-2016	2017	1980-2016
	Mean	Mean	Mean	Mean
Yellow Perch	52	241	2	88
Rock Bass	0	16	1	10
Smallmouth Bass	2	15	0	1
Largemouth Bass	1	12	1	1
Spottail Shiner	0	151	0	3
Banded Killifish	0	17	0	1
Jonny Darter	1	10	0	1
Sunfish (<i>Lepomis</i> spp.)	0	28	1	20
Round Goby*	28	105		

Table 4.3.3 Relative abundance (mean number per hectare) 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 (6.1m trawl), August-September, 2017, and mean from 1980 to 2016. – indicates that species of this age class are not captured in this survey.

Species	YOY		YAO	
	2017	1980-2016	2017	1980-2016
	Mean	Mean	Mean	Mean
Yellow Perch	84	73	9	36
White Perch	1	14	-	-
White Bass	0	7	-	-
Alewife	28	58	-	-
Gizzard Shad	4	14	-	-
Spottail Shiner	38	362	3	31
Round Goby*	93	46	-	-

*Round Goby NPHa is for all ages. Round Goby was first detected in our surveys in 1999 so means are for 1999-2016.

4.4 Long Point Bay Adult Fish Community Survey

Study Area and Sampling Design

The Lake Erie Management Unit has conducted an annual gillnet 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 has been sampled on an exploratory basis since 2011, 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. This deep stratum extends from 9.1-20 m.

One area is 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 in the standard survey; six grids in the extended survey). Sampling runs for 10 weeks.

One monofilament net composed of single 50-foot panels of 1.25, 1.5 and 1.75 in stretched mesh and 2 panels each of 2, 2.25, 2.5, 2.75, 3, 3.5, 4, 4.5, 5, 5.5 and 6 in stretched mesh, was set in each grid. The total length of a monofilament gang is 1250 ft. Each gang is fished overnight for approximately 24 hours. Observed numbers and biomass of catches in the 1.25, 1.5 and 1.75 in panels are doubled to standardize catch to an equivalent 100 foot panel length. Catches in the 5.5 and 6 in panels are excluded from analysis.

Fish Community

In 2017, the three most abundant species in the survey were Yellow Perch, Gizzard Shad and Smallmouth Bass. Catches of all three species were above the long term means (Table 4.4.1). Age-2 Yellow Perch represented 76% of the 2017 catch, showing strong evidence of recruitment of the 2015 year class.

Walleye and Smallmouth Bass catches were the highest observed in the time series. Conversely, White Perch, White Bass, Freshwater Drum, White Sucker and Round Goby catches were down. While Alewife numbers are low compared to the long term mean (Table 4.4.1), they are up relative to the previous three years, when catches ranged from 0-8 per km.

Rock Bass, Longnose Gar and Redhorse Sucker catches remain stable relative to survey means (Table 4.4.1).

Depth Distribution of Abundant Species

Yellow Perch and Gizzard Shad were distributed relatively evenly across all three depth strata. Smallmouth Bass were most abundant in the shallow depth strata and decreased in abundance with increasing depth.

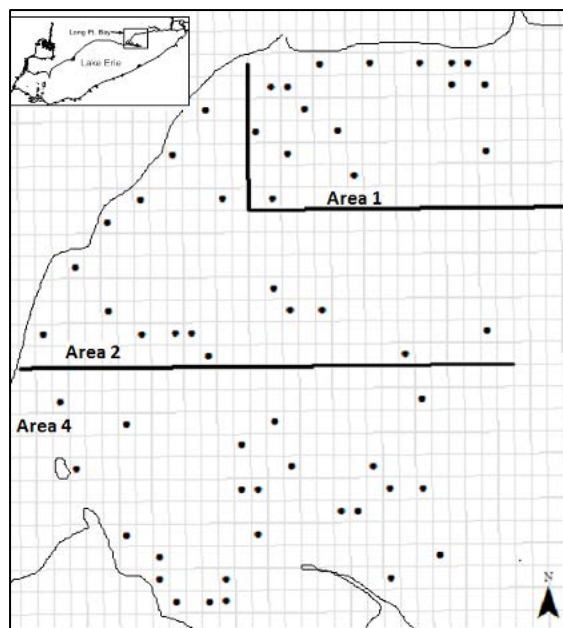


Figure 4.4.1 Location of gillnetting sites in the Long Point Bay Adult Fish Community Survey, Lake Erie, June to August, 2017.

Table 4.4.1 Mean number per kilometre of selected fish species caught in the extended survey of the Long Point Bay Adult Fish Community Survey, June to August, 2017. Long term means (1986-2016) are also presented.

Species	2017	1986-2016 Mean
Yellow Perch	514	406
Smallmouth Bass	104	46
White Perch	15	54
White Bass	7	15
Rock Bass	30	26
Walleye	14	2
Freshwater Drum	25	39
Alewife	93	281
Gizzard Shad	106	45
Longnose Gar	3	3
White Sucker	4	11
Redhorse sucker	3	4
Round Goby	3	11

4.5 Coldwater Assessment Survey

Since 1986, Ontario Ministry of Natural Resources and Forestry (OMNRF) has conducted a stratified random, transect-based, temperature-dependent deepwater 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. New York State Department of Environmental Conservation (NYSDEC) and Pennsylvania Fish and Boat Commission (PAFBC) are responsible for sampling in their jurisdictions, Areas A1-A2 and A3-4, respectively (Figure 4.5.1). Only data from Ontario waters will be presented in this report. In 2017, OMNRF and USGS completed 50 net sets in Ontario waters. OMNRF lost one day to weather and equipment failure.

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 2017, the mean number of Lake Trout caught was 1.0 fish/lift (Figure 4.5.2). Lake Trout caught ranged in age from 1 to 15 years old, with an average age of 7. Rainbow Smelt and Round Goby are the main prey items in Lake Trout diets.

After several years of catches of or near 0, the mean number of Lake Whitefish increased to 1.1 fish/lift in 2016. However, it again declined in 2017 to 0.2 (Figure 4.5.2). All Lake Whitefish caught in 2017 were 2 to 4 years of age. Despite low abundance, the presence of younger cohorts is promising, showing evidence of reproduction, which was also observed in 2016. 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 2017 with a catch rate of 0.4 Burbot per lift (Figure 4.5.2). In 2017, Burbot caught ranged in age from 2 to 20 years old with an average age of 6.7 (down from 13.1 in 2016) and 61% of Burbot caught were age 2-4 (whereas 65% of fish caught in 2016 were age 10+). This evidence of reproduction is promising for a species that has been composed of older year classes in recent years. Round Goby and Rainbow Smelt are the main prey items found in Burbot diets.

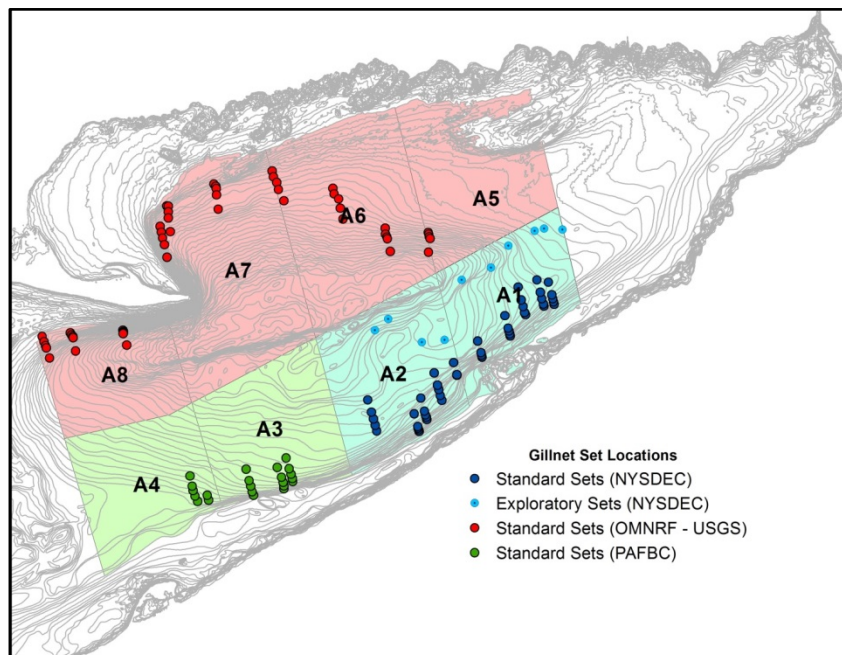


Figure 4.5.1 Standard sampling areas used in the Coldwater Assessment survey in Ontario waters of the East Basin of Lake Erie. Circles represent the location of net sets in 2017. Depth contours are NOAA 1m contours.

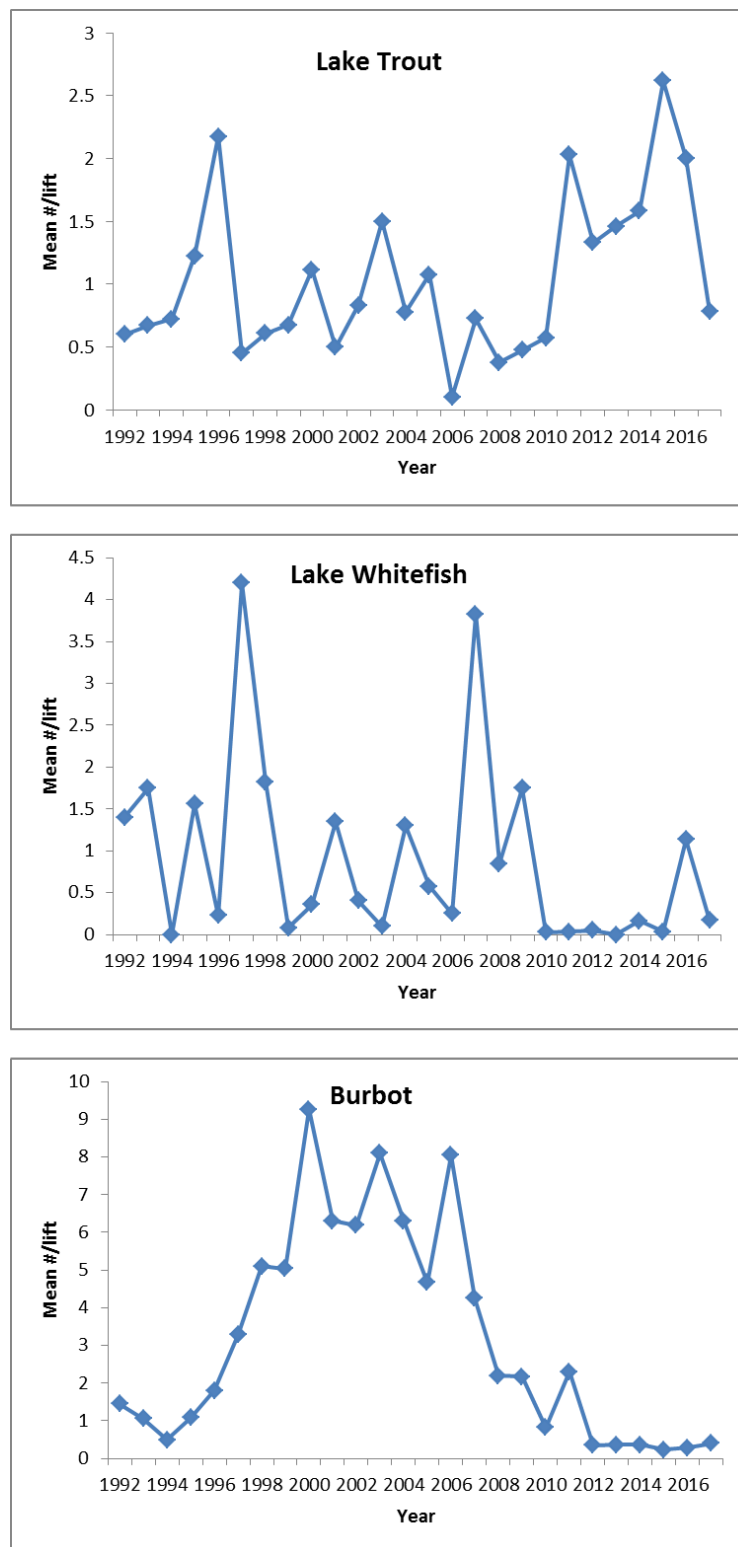


Figure 4.5.2 Mean number of Lake Trout, Lake Whitefish and Burbot caught per net lift during interagency Coldwater Assessment gill netting in Ontario waters of eastern Lake Erie, 1992-2017.

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 800m distance intervals along transects.

In 2017, the 12 transects were completed between July 17th and 25th with approximately 270km of hydroacoustic data collected. Basin wide average density was 3201 fish/ha, representing a moderate density of YAO Rainbow Smelt in the east basin since 2007 (Figure 4.6.2). The largest observed density of fish was northeast of Erie, Pennsylvania, while few YAO Rainbow Smelt were detected in the most eastern stratum (Figure 4.6.3).

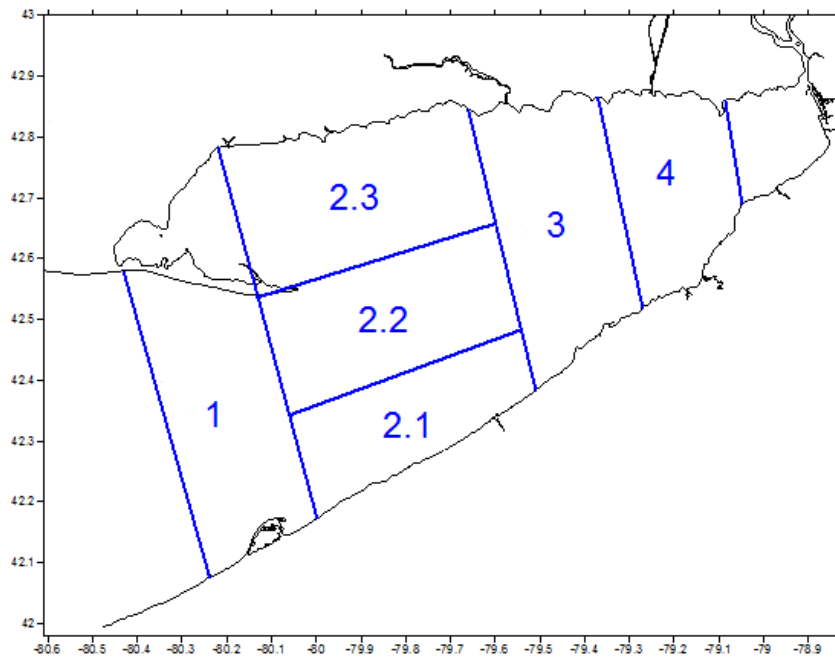


Figure 4.6.1 The six strata in the Lake Erie east basin hydroacoustic survey.

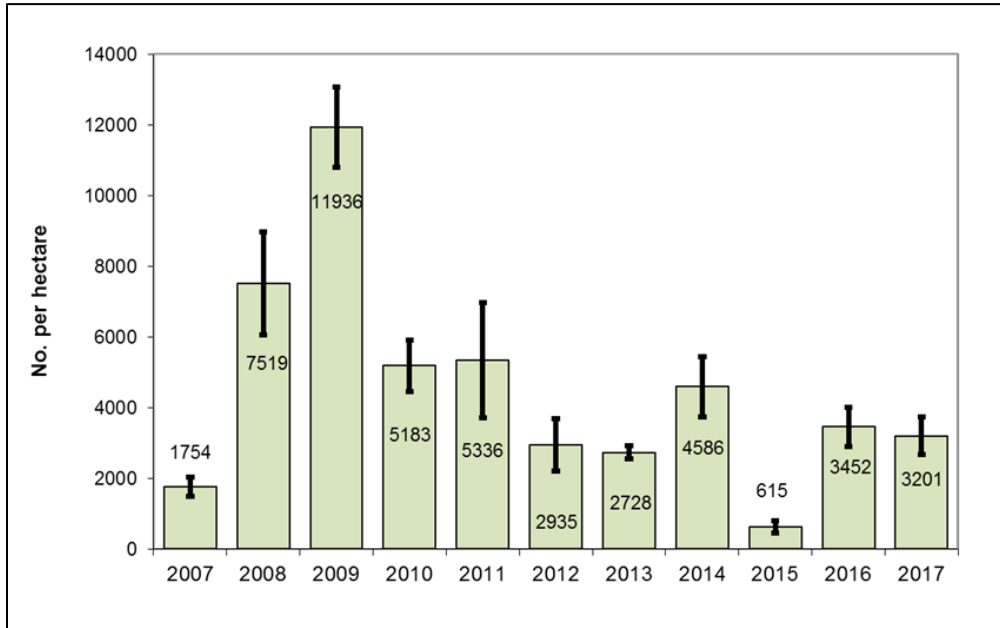


Figure 4.6.2 Mean density (number of fish per hectare) estimates and standard error bars of YAO Rainbow Smelt in coldwater habitat during the July east basin hydroacoustic survey, Lake Erie, 2007-2017.

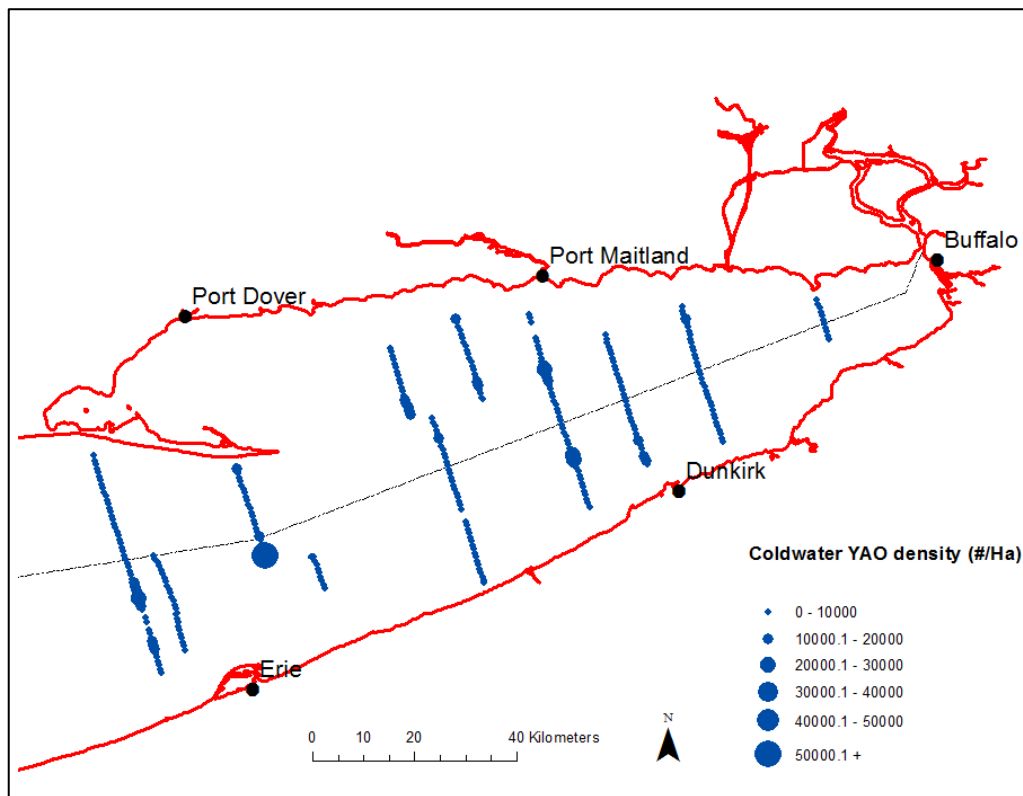


Figure 4.6.3 Density estimates (number of fish per hectare; #/Ha) of YAO Rainbow Smelt per 800m distance interval along transects in the July east basin hydroacoustic survey, Lake Erie, 2017. The size of the circle is representative of the density.

5. FISHERIES MANAGEMENT PROJECTS

5.1 Lake Erie Asian Carp Surveillance Program

The Asian Carps referred to here 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 Carps) 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, 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 2017, with water samples tested for Bighead, Silver, Black, and Grass Carp eDNA.

The LEMU Asian Carp surveillance program occurred from May to July 2017. Water samples were taken from 99 sites in Lake Erie, Lake Erie tributaries, Lake St. Clair, Thames River, Sydenham River, and Lake Huron tributaries (Figure 5.1.1). Sixty-nine of these sites were sampled twice and six 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 540 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 PCR and enzyme gel electrophoresis.

In 2017, six water samples were positive for Grass Carp eDNA. These samples were collected in the Thames River (2), Sydenham River (2), Belle River (1), and Cedar Creek (1). In response to these detections, LEMU collected additional water samples at and near these sites, and performed electrofishing at selected sites. There were no further eDNA detections and no Asian Carps were found during electrofishing. 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 2017 there were approximately 38,593 km of gill nets deployed, 2,846 hours of trawling, and 415 trap net lifts by the commercial fishery in Lake Erie. No Asian Carps were reported by commercial fishers in 2017.

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.

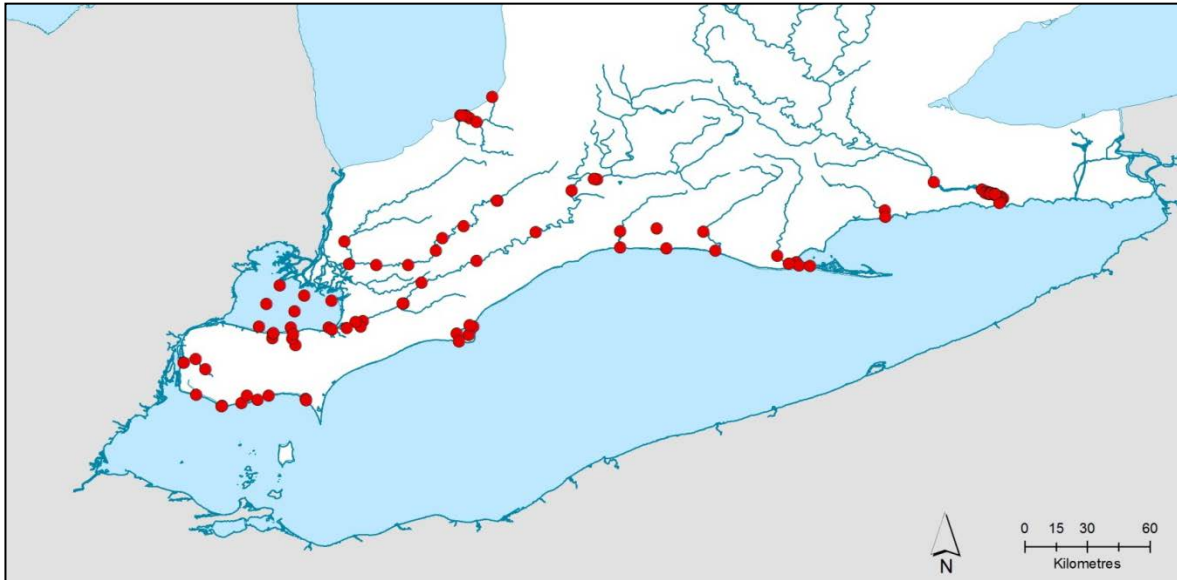


Figure 5.1.1 Location of eDNA sample sites for 2017 Asian Carp surveillance program.

5.2 Central Basin Bottom Trawling

In 2016, 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 2017, forty-five sample locations were targeted using a UTM 5 minute grid. Three boats were used in the survey: Ontario Ministry of Natural Resources and Forestry (OMNRF) RV Keenosay, USGS RV Muskie II, and OMNRF RV Erie Explorer (Figure 5.2.1). The Keenosay fished 15 sites in the west-central basin using a two seam 33 foot Biloxi bottom trawl, with a 38 foot ground line and a 1 inch cod-end with 0.5 inch liner. The trawl duration of the Keenosay was 10 minutes on bottom at 1.7 knots. The Muskie II fished 15 sites spread across the west-central and east-central basins, using a four-seam 11.2m headline bottom trawl, with a 14.2m foot line, 6cm polyethylene body mesh, and 14mm mesh cod-end liner. The trawl duration of the Muskie II was 10 minutes on bottom at 3.0 knots. The Erie Explorer fished 9 sites in the east-central basin using a 33 foot Biloxi bottom trawl with 1 inch cod-end with 0.5 inch liner. The Erie Explorer was unable to complete six sites due to rocky substrates tearing nets and poor weather. The trawl duration of the Erie Explorer was 10 minutes on the bottom at 2.5 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 were classified as young-of-year (YOY), yearling, yearling and older (YAO), age 2 and older, and all ages based on length. 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 2017, the most commonly caught species were Rainbow Smelt with 310.06 fish per hectare, followed by yearling and older White Perch with 45.37 fish per hectare. 29.84 YOY Yellow Perch were caught per hectare, these fish were distributed throughout the central basin (Figure 5.2.2). This was an increase from the number of YOY Yellow Perch caught in 2016 (5.14 fish per hectare). The yearling-and-older catch of Yellow Perch decreased slightly from 37.07 in 2016 to 31.48 fish per hectare in 2017. The catch of YOY Walleye increased slightly in 2017 to 0.75 fish per hectare from 0.61 fish per hectare in 2016. However the catch rate of yearling Walleye decreased from 13.03 in 2016 to 0.30 fish per hectare in 2017. This was due to the large 2015 year class observed as yearlings in 2016. The catch of YOY White Perch increased from 8.77 in 2016 to 38.64 fish per hectare in 2017, however yearling and older White Perch catch rate decreased slightly to 45.37 fish per hectare in 2017 from 49.10 fish per hectare in 2016. YOY White Bass catch decreased from 3.40 fish per hectare in 2016 to 1.12 fish per hectare in 2017. Yearling and older White Bass catch also decreased from 2.29 fish per hectare in 2016 to 0.75 fish per hectare in 2017.

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. The RV Keenosay, RV Erie Explorer, and RV Muskie II conducted 23 side by side trawls over 2 days during October 2017. Unfortunately, catches were low and poor weather prevented further trawling. Due to low catches and inadequate number of trawls, fishing power correction factors could not be determined. This comparison trawling will continue next year to improve the sample size.

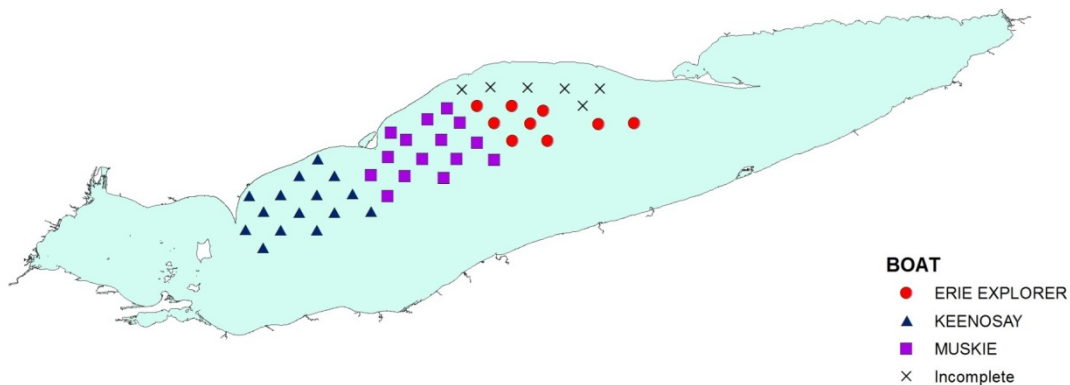


Figure 5.2.1 Central basin bottom trawl sites by boat. X's indicate incomplete trawls.

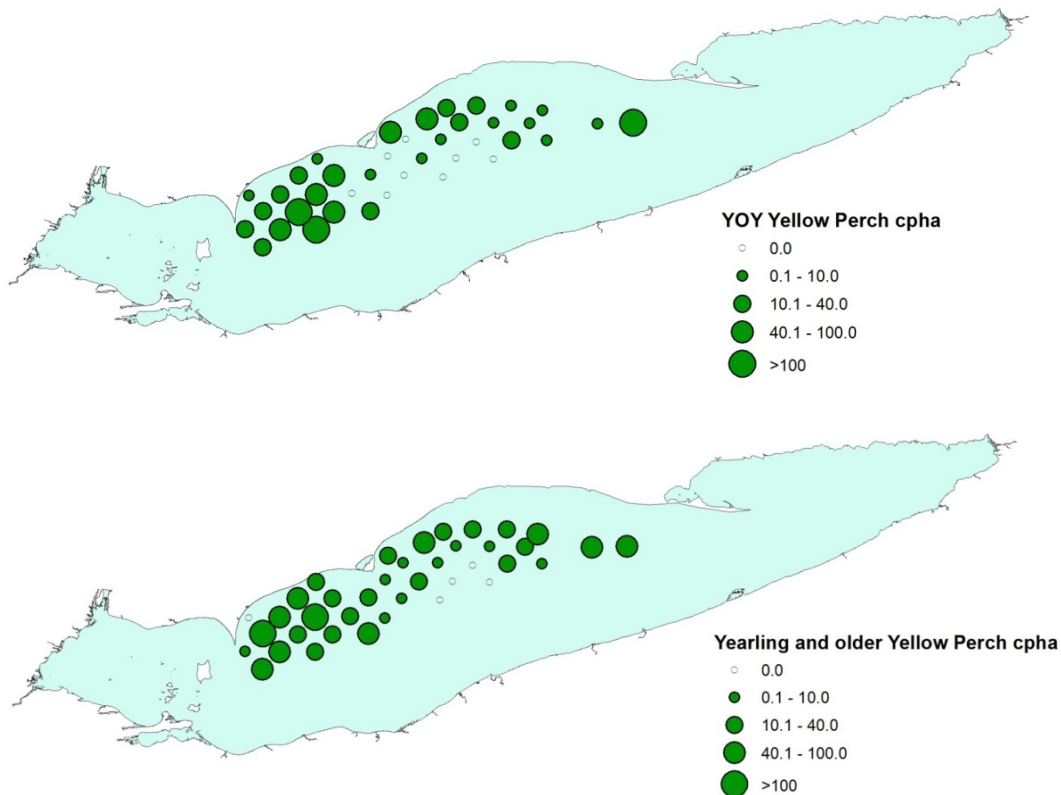


Figure 5.2.2 2017 catch per hectare of YOY Yellow Perch, and yearling-and-older Yellow Perch.

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 recognizes environmental sampling which occurs in association with a host of other programs and projects conducted independently by LEMU.

The lakewide FTG coordinated limnology component, referred to as Lower Trophic Level Assessment (LTLA), has occurred annually since 1999 and involves sampling at each of six core 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. Benthic invertebrates are collected twice a year; in spring and early fall.

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

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 western, central, and eastern basin nearshore, while targeting lower productivity (oligotrophy) for the colder, deeper, eastern basin offshore. In 2017, using an index of trophic state based on TP concentration, water transparency and Chl-a, it was determined that the central basin was meeting its mesotrophic target, while the western basin was deemed too productive. The eastern basin met both its nearshore and offshore targets. According to the long term LTLA dataset, trends across Lake Erie in recent years indicate that overall productivity is slowly declining (Forage Task Group, 2018).

In Ontario waters, an examination of the data at smaller scales often reveals local conditions not captured by the FTG basin wide summaries. For example, in recent years, and again in 2017, total phosphorus in Ontario nearshore waters was low, relative to both whole basin as well as nearshore only calculated values (Figure 5.3.2). 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).

2017 Assessment

The full sampling program was completed in 2017 and LTLA data was compiled and uploaded to the FTG database in February 2018. 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.

Within the LEMU there is an ongoing, concerted effort to recognize that environmental data is collected much more broadly than in just the limnology program. Measures of conditions such as temperature and oxygen are collected for specific purposes during fishery assessment programs and through projects asking explicit research questions (e.g. acoustic telemetry projects). Phytoplankton count data, collected using a fluoroprobe, is an example of a non-LTLA parameter, originally collected as part of a research program but now regularly measured. Review of the management of this data and the best way to make it more broadly useable continues.

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 2ug/L and the problem of samples where TP could not be detected, encountered in 2015 and 2016, was eliminated.

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 MDNR has been discontinued (Figure 5.3.1; historic sites) select LEMU limnology stations will be incorporated into the LTLA exercise going forward. Benthic sampling will be discontinued in 2018. In 2017 LEMU began exploring 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 2018.

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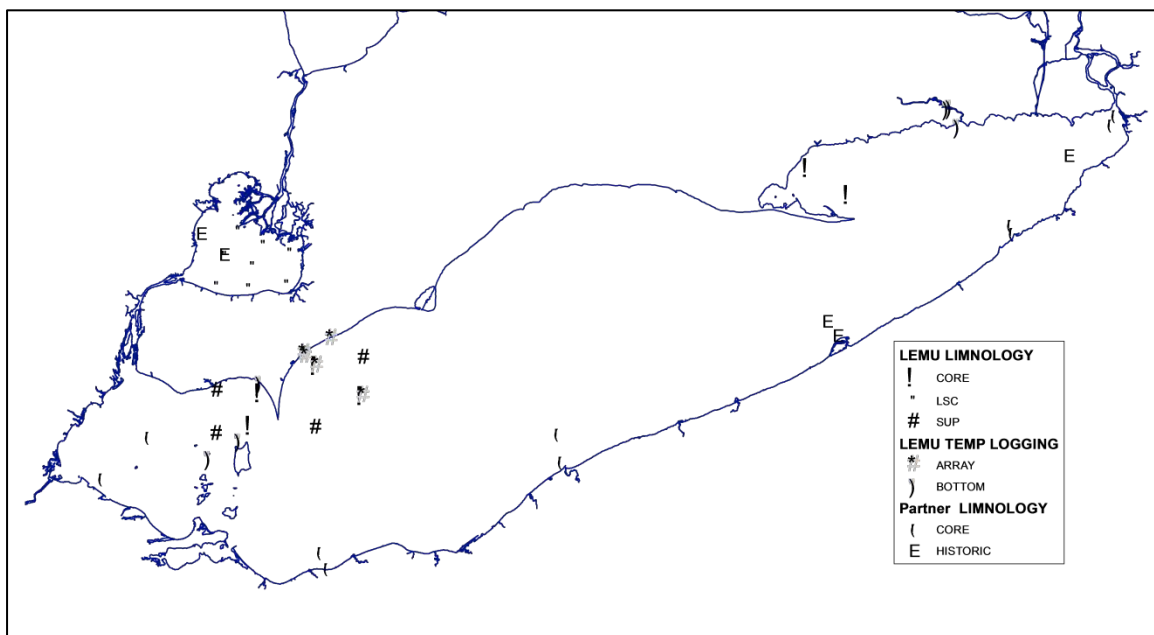


Figure 5.3.1 Limnology Program sampling locations. Core FTG-LTLA stations are indicated with a solid circle; large circles designate LTLA stations sampled by LEMU. Historic LTLA stations are indicated with an "+". Auxiliary LEMU stations are indicated with triangles and squares; Lake St. Clair stations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

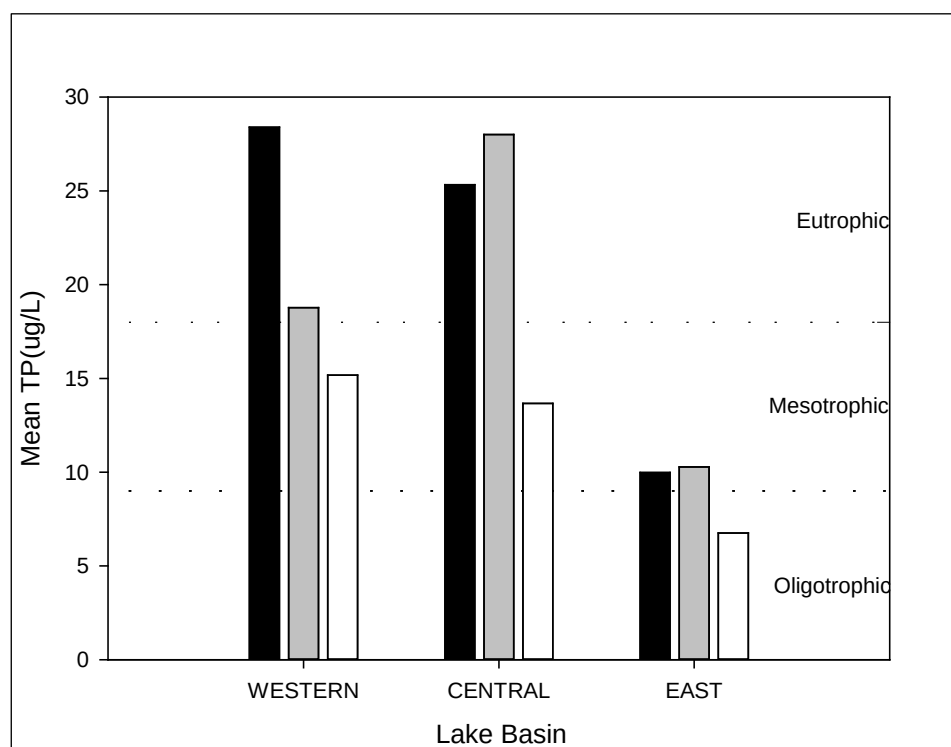


Figure 5.3.2. Mean 2017 (May-October) Total Phosphorus (TP) concentrations calculated for each lake basin using: i) All LTLA sampling stations (black bars); ii) All Nearshore LTLA stations (grey bar); iii) Only LTLA stations in Ontario nearshore waters. Break points between trophic states are shown with dotted lines.

5.4 Long Point Bay Diet Program

Stomach content analysis is carried out for fish collected in the Long Point Bay Nearshore Fish Community Survey. In Long Point Bay in 2017, Round Goby continued to be the dominant food source for many species, occurring in 68%, 78%, 43% and 42% of non-empty Yellow Perch, Smallmouth Bass, Rock Bass and White Bass stomachs, respectively (Table 5.4.1). Rainbow Smelt is also an important prey fish, particularly for Walleye, where it occurred in 91% of stomachs, as well as for White Bass (58%) and Smallmouth Bass (22%). The most common invertebrate prey were chironomids and Bythotrephes.

Table 5.4.1 Percent occurrence of prey items found in non-empty stomachs from fish collected in the Long Point Bay Nearshore Fish Community Assessment, June-August, 2017.

Species	% Occurrence of Prey Items				# of Stomachs
	Round Goby	Rainbow Smelt	Chironomids	Bythotrephes	
Smallmouth Bass	78	22	25	0	32
Yellow Perch	68	0	25	10	237
Rock Bass	43	0	0	0	14
White Bass	42	58	0	0	19
Walleye	6	91	0	0	34
White Perch	0	0	65	29	17

5.5 Lake St. Clair Nearshore Assessment Program

Lake St. Clair is home to a highly diverse assemblage of warm water fish species. It provides critical habitat for several economically important species and many species at risk. The Lake St. Clair Nearshore Assessment Program (LSCNAP) began when the Ontario Ministry of Natural Resources' Wheatley Fisheries Research Station conducted a juvenile fish study to gather young-of-year (YOY) fish data from 1970–1977. From 1979 to 1996 the program was carried out intermittently due to resource constraints. In 2005, the program was restarted as a pilot project and became an annual assessment activity in 2007. Although the program was originally designed to assess annual abundances of YOY fish species, this objective remains only as a secondary goal. The contemporary objective of the LSCNAP is to assess and track changes in the nearshore fish community with an emphasis on forage fish species. The program also serves as a surveillance program for aquatic invasive species (AIS) and as a monitoring program for species at risk.

The LSCNAP samples eight fixed sites along the Canadian shores from June 1 to July 31 (Figure 5.5.1). At each site, duplicate 30m transects are performed using a small mesh (5mm x 2mm) beach seine that is 9.7m x 1.2m in dimension. The seine net is believed to retain all fish with fork lengths greater than 27mm (MacLennan 1979). The sample sites were visited weekly from 2005–2015 and have been visited bi-weekly since 2016. An analysis by Marklevitz (2016; LEMU Internal Report) found that the reduction in sampling frequency did not appreciably affect the fish community data collected by the program. After each seine haul, all captured species are identified and enumerated, and the length of up to 30 randomly selected individuals from each species is measured.

In 2017, a total of 16,003 fish were captured in Lake St. Clair representing at least 35 species from 14 different families (Figure 5.5.2). Species richness at the individual sites ranged from 10 (Bradley Marsh) to 24 species (Belle River East; Figure 5.5.1). The mean ($\pm$ SE) catch per unit effort (CPUE = fish/seine)

varied considerably among the sites and ranged from 32 ± 7 (Bradley Marsh) to 360 ± 136 (Puce River). The mean ($\pm$ SE) CPUE in 2017 was 231 ± 47 , which is greater than the 147 ± 43 in 2016 and similar to the long term CPUE of 189 ± 19 from 2007-2016.

The majority of fish captured were YOY (74%), whereas adults represented a small proportion of the catch (26%). Of the YOY fish captured, White Perch represented the largest proportion of the total catch (29%) followed by Brook Silverside (13%), Gizzard Shad (12%) and Yellow Perch (11%). Generally, the relative catch of Yellow Perch, both YOY and adults, is below 5% for the time-series and 2017 represents a substantial increase in the number of Yellow Perch captured. The mean ($\pm$ SE) CPUE for Yellow Perch in 2017 was also high at 28.2 ± 9.8 , which is much greater than the time-series mean CPUE of 6.1 ± 2.8 . The LSCNAP regularly captures several other sport fish, including Smallmouth Bass, Largemouth Bass, and White Bass. The mean CPUE for Smallmouth Bass was low in 2017 (mean $\pm$ SE: 0.58 ± 0.33) relative to the time-series (2.1 ± 0.6). Similarly, the mean ($\pm$ SE) CPUE for Largemouth Bass was 1.4 ± 0.7 in 2017, which is below the time-series mean CPUE of 6.8 ± 2.2 . Finally, the CPUE for White Bass was high in 2017 (mean $\pm$ SE: 3.6 ± 1.7) relative to the time-series (1.3 ± 0.4). No YOY Walleye or Muskellunge were captured in 2017. Walleye and Muskellunge are captured infrequently by the LSCNAP and the absence of these species is not an indicator of their status in Lake St. Clair.

Several invasive species and species-at-risk were captured by the LSCNAP in 2017. Four invasive species were captured: Common Carp (2 fish), Round Goby (147 fish), Tubenose Goby (19 fish), and White Perch (4,706 fish). These invasive species were already known to inhabit Lake St. Clair and no new invasive species were detected. Two species-at-risk were captured: the Pugnose Shiner (9 fish) and Eastern Sand Darter (2 fish). Pugnose Shiners have been captured consistently between 2007 and 2017 in Lake St. Clair; however, the Eastern Sand Darter has only appeared in surveys for the last two years.

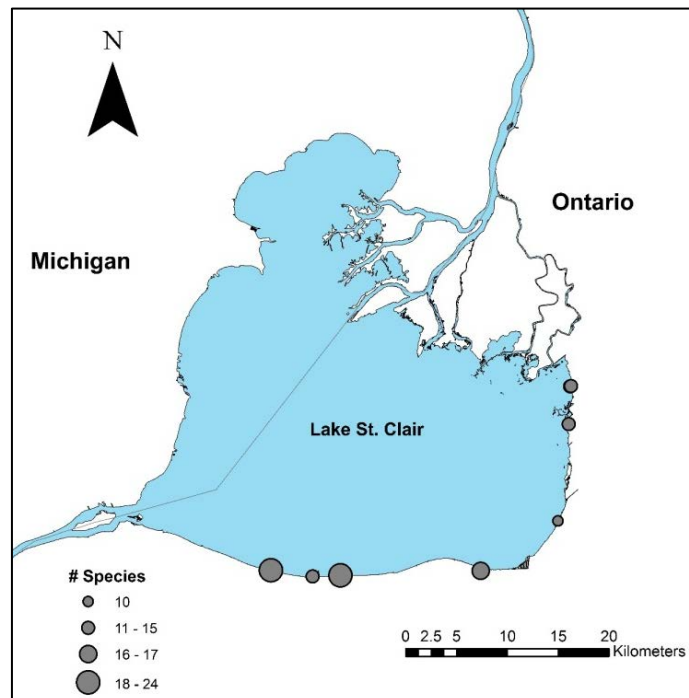


Figure 5.5.1 Map of the Lake St. Clair Nearshore Assessment Program seine sites (grey points). The size of the symbol for each site reflects the total number of species captured at that site in 2017. The Mitchell's Bay sample area in the north-eastern corner of Lake St. Clair has inshore and offshore sampling sites, which appear on the map as a single site due to their close proximity.

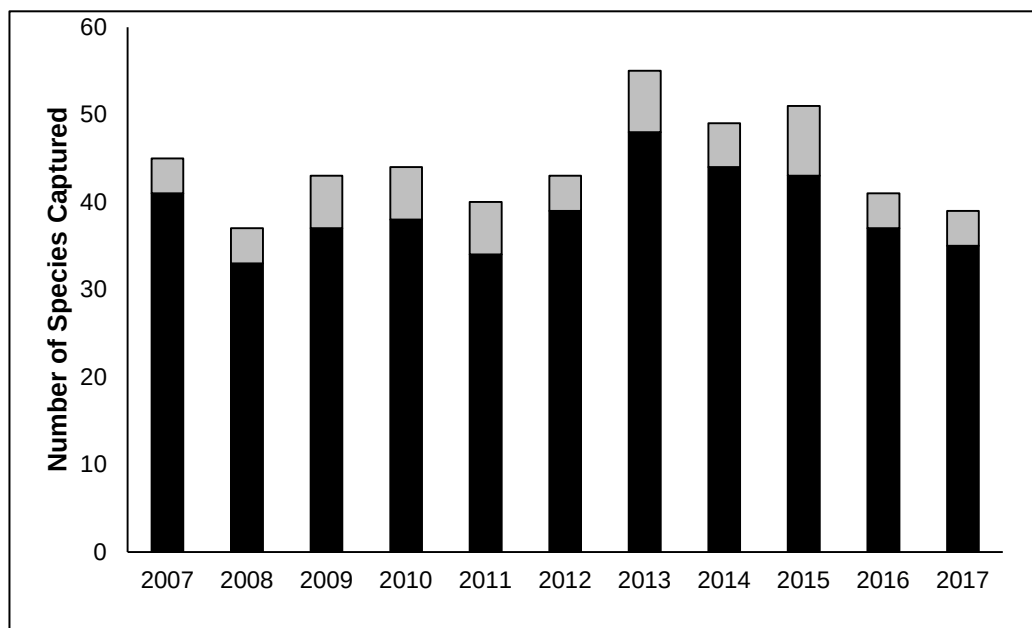


Figure 5.5.2 Number of species captured each year by the Lake St. Clair Nearshore Assessment Program from 2007 to 2017. The black bars represent the number of positively identified species and the grey bars represent fish identified to family/functional groups.

5.6 Fish Contaminants and Microcystin Sampling

Fish are valuable indicators of aquatic ecosystem health because contaminant concentrations in the tissues can represent cumulative exposure to both benthic and pelagic contaminants. 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 and Climate Change (MOECC), in partnership with the Ontario Ministry of Natural Resources and Forestry (OMNRF), have been monitoring contaminant concentrations in fish tissue which include: 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). The data collected in this program is used to produce MOECC'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 portions of fish for MOECC. The LEMU is able to leverage existing programs, where possible, and use capital assets (including facilities and vessels) in targeted sampling efforts, as needed. In 2017, the LEMU provided MOECC with 301 samples of skinless, boneless fillet from various fish species collected across the Lake Erie basins (Table 5.6.1).

Table 5.6.1 Numbers of fish by species sampled
By LEMU in 2017 for MOECC Fish
Contaminant monitoring program.

Species	N
Bluegill	20
Brown Trout	5
Channel Catfish	2
Common Carp	27
Coho Salmon	1
Freshwater Drum	21
Lake Trout	10
Rainbow Smelt	10
Rainbow Trout	20
Rock Bass	20
Smallmouth Bass	11
Walleye	40
White Bass	20
White Crappie	17
White Perch	77
Total	301

In 2015, MOECC'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 MOECC and OMNRF is the potential risk to the safe consumption of fish. 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 for safe consumption. However it appears 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 may not reach levels that pose a significant concern for human health in the general population (Wituszynski et al. 2017).

To help uncover the dynamics of microcystin toxin in consumed Lake Erie fish species, the LEMU annually collects samples of fish and water in spatial (inside and outside) and temporal relation (before, during, and after) to a bloom. In support of this collaborative initiative, the LEMU is able to leverage existing programs such as commercial catch and limnological sampling in addition to collecting targeted samples using, the RV Keenosay. The focus is primarily on Walleye, Yellow Perch, and White Bass but other species are sampled opportunistically (see Table 5.6.2 for the 2017 samples collected). Fish flesh, liver and water samples are sent to the MOECC fish contaminant monitoring lab for analysis.

Preliminary results from Walleye and Yellow Perch sampled at the peak of the 2015 bloom include the detection of 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 was collected they had been exposed to microcystin toxin but that the toxin had not translated into toxin concentrations in

commonly consumed portions of the fish. These preliminary results generally support the finding of Wituszynski et al. (2017).

The LEMU and MOECC'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 5.6.2 Number of fish by species sampled by LEMU in 2017 for Microcystin testing by MOECC Fish contaminant monitoring program.

Species	N
Walleye	74
White Bass	10
White Perch	5
Yellow perch	70
Total	159

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., Ludsins, 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.

6. ACOUSTIC TELEMETRY/TAGGING PROJECTS

The spatial ecology and movement of fish species has remained a elusive for many researchers and fisheries managers. Where, when and how fish move through their environment helps define their ecological niche and, ideally for fisheries managers, can form the the foundation for defining biologically relevant management units and stocks. 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. 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 signal which the receiver picks up when the transmitter is in proximity (Figure 6.1). This unique signal allows for the identification of individual fish.



Figure 6.1 How Acoustic telemetry works.

In 2010, the Great Lakes node of the Ocean Tracking Network known as the Great Lakes Acoustic Telemetry Observatory System (GLATOS) was established. This collaborative effort of Canadian and US, state/provincial federal and academic partners was formed in order to synergistically provide individual acoustic telemetry projects the ability to combine sets of receivers into a large-scale network. The collaborative provides training, knowledge dissemination, and coordination to the Great Lakes acoustic telemetry community but its main strength is in giving individual researchers access to the full compliment of Great Lakes receivers. To date the network of GLATOS receivers in Lake Erie has been the most extensive across the Great Lakes basins. 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 basins. In 2016, receiver deployment shifted to a grid pattern to increase coverage and detection efficiency. In 2017, the extensive central basin grid of receivers expanded to include parts of east and west basins (Figure 6.2). Lake Erie Management Unit (LEMU) is actively involved in several project including Lake Erie Lake Whitefish, Grand River Walleye, Lake Trout habitat, Rondeau Bay Carp, and Lake St. Clair Muskellunge (summarized below). Other projects that LEMU actively supports or is involved with include west/central basin Walleye habitat and mixed stock analysis.

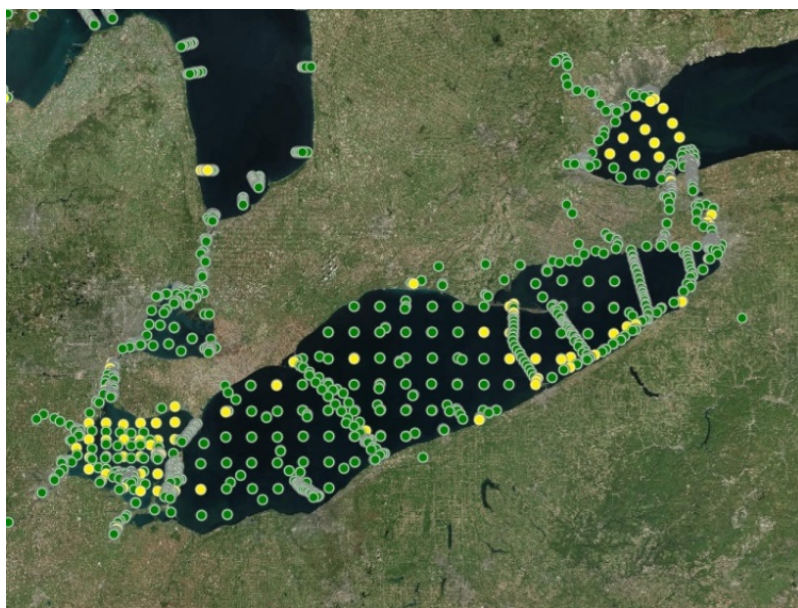


Figure 6.2 Network of Great Lakes Acoustic Telemetry Observatory System (GLATOS) acoustic receivers in 2017. (Maps retrieved from <http://glatos.glos.us/map>, April 16, 2018). Green circles are receivers retrieved (may or may not have been redeployed), yellow circles are currently operating .

6.1 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 Telemetry Observation System (GLATOS) acoustic receivers throughout Lake Erie and connecting waters, Ontario Ministry of Natural Resources and Forestry (OMNRF), Ohio Department of Natural Resources (ODNR), United States Geological Survey (USGS), United States Fish and Wildlife Services (USFWS) and Great Lakes Fishery Commission (GLFC) began an acoustic telemetry study to monitor movements associated with spawning, post spawning, seasonal habitat utilization, and emigration from Lake Erie. Harvest of tagged fish may provide spatial and temporal patterns of exploitation to inform assessment models and management considerations. The acoustic tagging project began in Ohio waters of western Lake Erie in 2015, expanding to include Ontario waters near Little Chick Island in 2016 and 2017. Internal acoustic transmitters and external Floy tags (Figure 6.1.1) were applied to Lake Whitefish following sedation. If caught, rewards (\$100 US) are awarded to fishers for the return of the tagged fish, acoustic and Floy tags. Since 2015, 152 Lake Whitefish were tagged in Lake Erie with 11 tagged Lake Whitefish recaptured by commercial fishers up until spring of 2018 (Table 6.1.1). The coverage of GLATOS receivers has grown since the onset of the Lake Whitefish tagging study (Figure 6.1.2). Detections of tagged Lake Whitefish during 2015, 2016 and 2017 are presented in Figure 6.1.2. Increased detections in 2016 and 2017 reflect the increased number of receivers deployed and greater numbers of Lake Whitefish tagged during 2016 and 2017. Tagged Lake Whitefish were detected in all basins of Lake Erie seasonally, favouring southern portions of the lake (Figure 6.1.2). Detections recorded during 2017 include the first half of the year, as acoustic receivers are retrieved periodically to download data. Emigration from Lake Erie has not been observed during the study. Acoustic tagging is scheduled to continue in 2018.

Table 6.1.1 Number of Lake Whitefish tagged by year of tagging from 2015-2017. Number of Lake Whitefish recaptured by fisheries by year of recapture and tagging from 2015-2018.

Tag Year	Tagged	Recapture Year				Total
		2015	2016	2017	2018 *	
2015	10	0	0	1	0	1
2016	37	0	3	0	0	3
2017	105	0	0	6	1	7
Total	152	0	3	7	1	11

* to spring 2018



Figure 6.1.1 A tagged Lake Whitefish caught by the commercial fishery in 2017. An external Floy tag is visible.

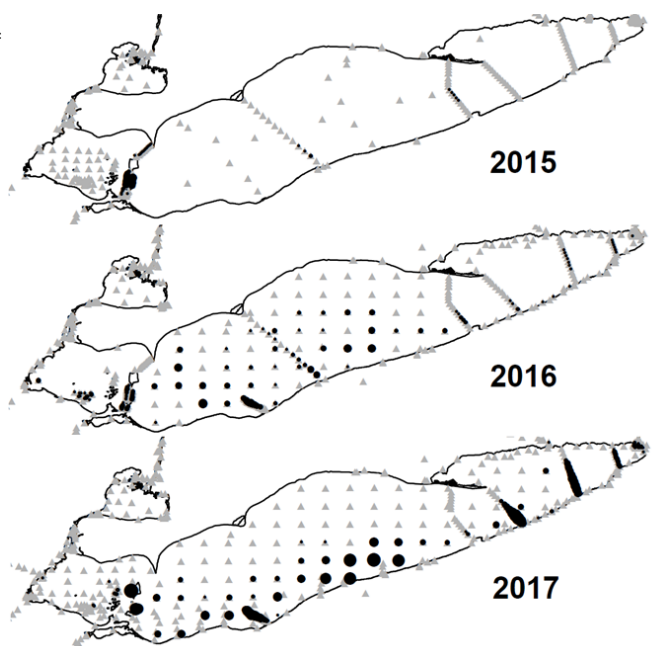


Figure 6.1.2 Detections of implanted transmitters (dots) at acoustic receiver stations (triangles) in the GLATOS network 2015-2017. Symbol (dot) size varies with the number of individual Lake Whitefish detected. Acoustic receivers were active during all or part of each year presented.

6.2 Grand River Walleye Acoustic Telemetry Tagging

Overview

Walleye originating in the Grand River, Ontario have been shown to be genetically distinct within the Lake Erie basins 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, 8km 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 fish way 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. Starting in 2015 and continuing through 2018, 70 Walleye (35 male; 35 female) from Grand River spring aggregations are targeted to be tagged annually as part of a Great Lakes Telemetry Observation System (GLATOS) project (Spatial Ecology and Migration of Adult Walleye in the Eastern Basin of Lake Erie). In each year, half were to be released above the Dunnville dam, and half below. Acoustic receivers are located at key locations in the lower river relative to the river mouth, the fish way, the Dunnville Dam and the next upstream barrier at Caledonia (Figure 6.2.1). These fish would of course also be detectable by the wider network of GLATOS receivers deployed throughout Lake Erie (Figure 6.2.3). In addition to transmitting a signal to be detected, all tags were outfitted with a logger, able to record temperature every 4 hours for the first year that the fish was at large. In order to recover temperature data, tags would need to be recovered.

2017

Due to problems with logistics and low catch-per-effort (CPE) only 57 Walleye were tagged in 2017. Most of these (38) were released above the Dunnville dam. This increased the total number of fish in the study to 197. During the course of the year, 5 fish were reported as angler recaptures and their tags were returned. By the end of 2017, of the 20 tags returned since the beginning of the study, temperature data was successfully downloaded from 19 loggers. Temperature loggers deployed for an extended period before recapture provide data that tends to corroborate estimates, generated from acoustic receiver data, of the seasonal timing of use, by migratory Walleye, of river and lake habitat. For lake-run individuals, temperature tended to diverge from river temperatures in May and June, remain cooler through the summer months and converge again in the fall. This can be followed by another divergence in mid-winter when Walleye temperatures tend to be warmer than river water (Figure 6.2.2). These presumed movements in and out of the river tend to be captured by receivers at the river's mouth. Future analysis will consider river flow as well as temperature as behavioural cues.

By December 2017, 194 of the 197 acoustic tagged Grand River Walleye had registered a total of 2,620,866 detections by receivers within the Grand River and Lake Erie; detections per individual fish ranged from 4 to 235,636. Three of the tagged Walleye were never detected. While many (44 %) of the tagged fish were detected within the eastern basin of the lake, a small number were detected in the central (3 fish) and western (4 fish) basins of the lake. A large proportion of fish were only detected within the river to date. Recognizing that the Dunnville dam imposes an impediment to downstream movement (see Summary below), it is expected that some portion of fish recently placed above the dam will be detected within the lake over a longer time frame. Regardless, more Grand River Walleye appear to be resident than had previously been assumed. Of those which use the lake, most are detected within a limited portion of the eastern basin between the river mouth and Long Point (Figure 6.2.3).

Through a GLATOS facilitated collaboration, Grand River Walleye detection data was provided to a larger Lake Erie Walleye migration and spawning site fidelity analysis in 2017. Preliminary results from this work indicate that Grand River Walleye have a relatively small home-range, relative to other Lake Erie Walleye stocks, and show differences with regard to the timing of spring spawning (Andrew Bade, Ohio State University).

This study is ongoing. Recognizing that there is a lag time between detections of fish and the recovery and uploading of data to the central database, some preliminary observations about migratory movement can still be made at this point including:

- i) Fish placed above the Dunnville dam in April move to sections of the river previously deemed to be suitable Walleye habitat for up to two weeks before moving back downstream.
- ii) The dam imposes an impediment to downstream movement by Walleye. Movement downstream, presumably post-spawning, pauses just upstream of the dam for periods of weeks or months. Lake-run Walleye not given upstream access return to the lake relatively quickly.
- iii) Movements from lake to river in fall, winter and early spring appear to be associated with high flow events in the river as well as the temperature differential between the two environments.

A re-configuration of Lake Erie receivers from transect lines to a basin wide grid, initiated in 2017 and continuing into future years may reveal a greater use of the eastern basin by Grand River Walleye. The degree of use of the eastern basin nearshore did not come to light until a series of receivers deployed around the circumference of the basin by another GLATOS project (see Section 6.4 below) occurred in the fall of 2016. The acoustic tags used in this study have an estimated battery life of six years and so some will continue to transmit data through 2024.

This project was funded primarily through the Canada Ontario Agreement, with additional assistance from the Great Lakes Fishery Commission. Partners include New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, Ohio Department of Natural Resources, Great Lakes Fishery Commission, Michigan State University, Ohio State University, and the US Geological Survey.

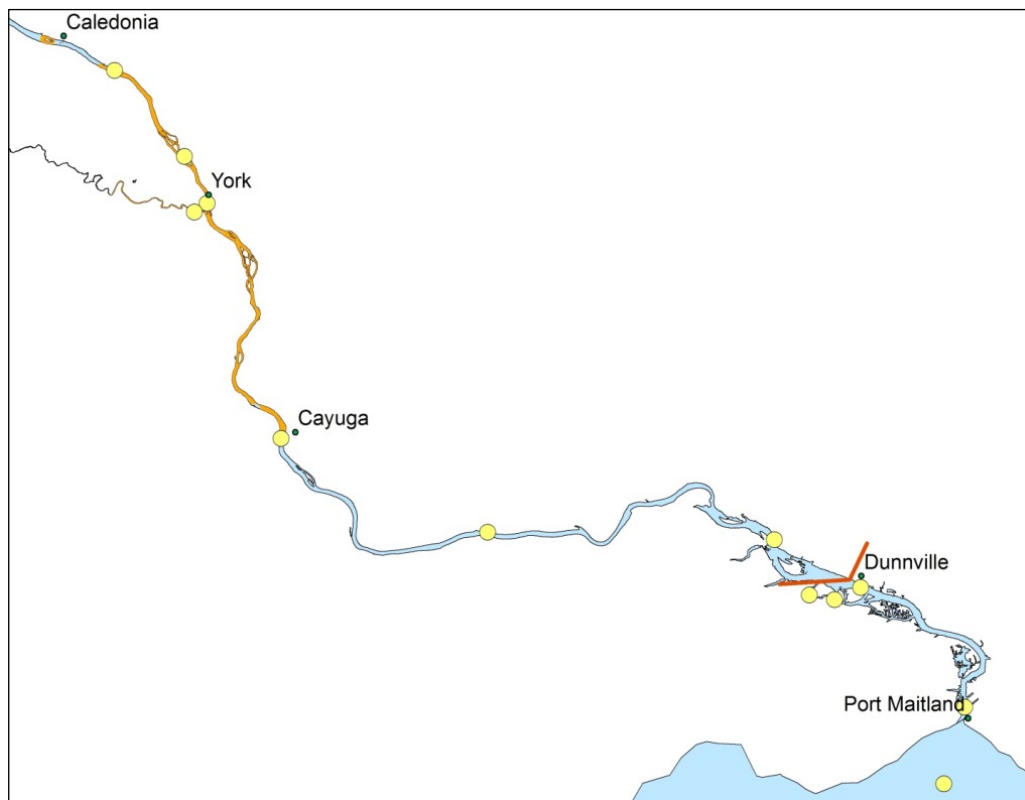


Figure 6.2.1 Acoustic Receiver locations within the lower 42km of the Grand River. Receivers (yellow circles) are shown relative to town centres (green dots); the river mouth at Port Maitland, the lowhead dam at Dunnville (red line), and previously mapped habitat deemed suitable for Walleye spawning (orange).

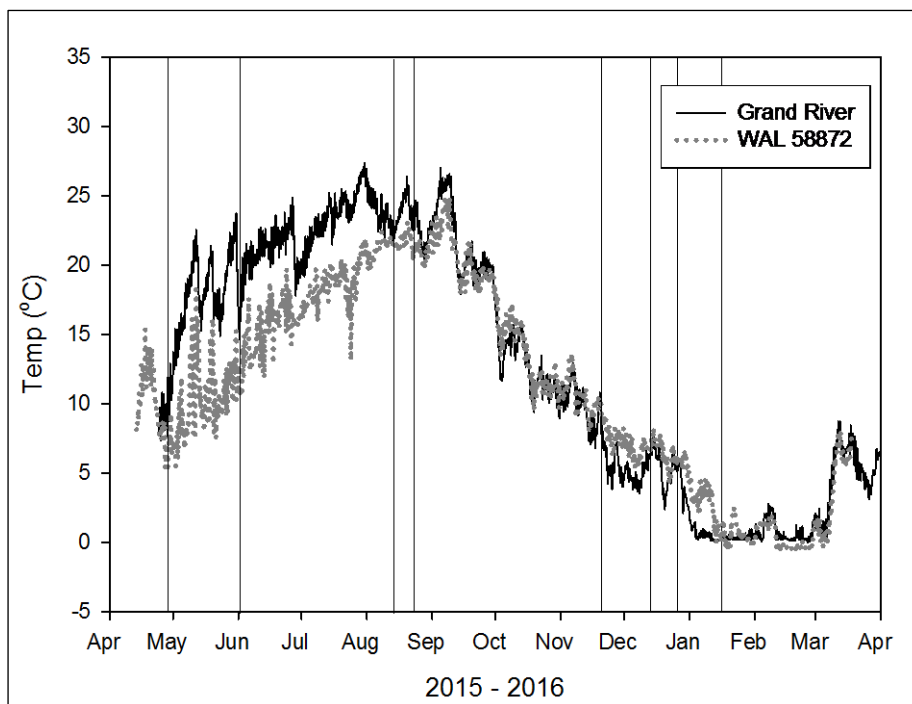


Figure 6.2.2 The internal temperature of an individual Walleye (acoustic ID 58872), relative to the temperature of the Grand River at Dunnville, April 2015 to April 2016. Dates when the Walleye was detected by acoustic receivers at the river mouth are indicated with vertical lines.

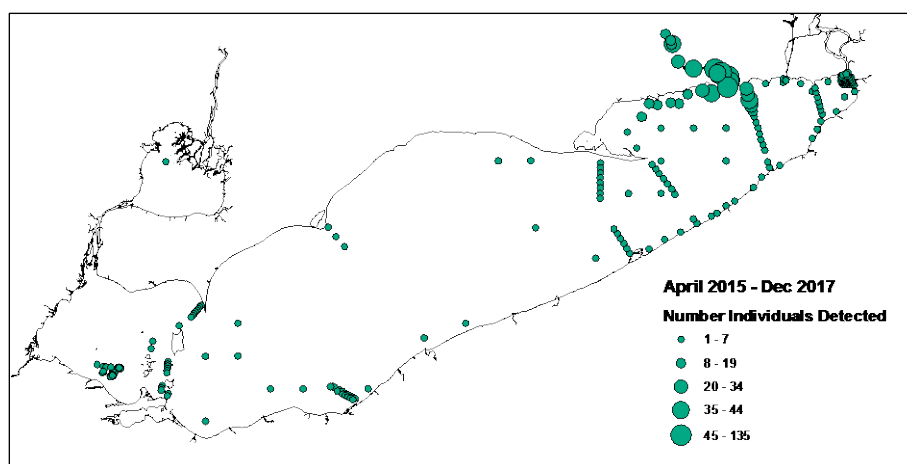


Figure 6.2.3 Locations of acoustic telemetry receivers that have detected at least one Walleye, acoustically tagged within the Grand River during spring 2015, 2016, and 2017. The size of the circle indicates the relative number of individual fish detected at each location.

6.3 Muskellunge Tagging in Lake St. Clair and the Thames River

Project collaborators:

Jan-Michael Hessenauer	Michigan Department of Natural Resources
Cleyo Harris	Michigan Department of Natural Resources
Matt Faust	Ohio Department of Natural Resources
Darryl Hondorp	United States Geologic Survey

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

The objective of this project is to understand the spatial and temporal patterns of Muskellunge movement within the SCDRS and Lake Erie, which in turn will provide important information for the management of this valuable recreational fishery. To address this objective, acoustic tags were implanted into Muskellunge within the SCDRS starting in 2016 as a part of a collaborative bi-national project among the 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). Tagging and tracking individual fish enables us to collect data on migratory behaviours, habitat use, mortality, and population structuring. The acoustic tags are tracked using hydrophone receivers placed on the lake/river bottom throughout the SCDRS and Lake Erie. The receivers are part of the Great Lakes Acoustic Telemetry Observation System (GLATOS), which is a bi-national cooperative data sharing system that allows receiver data to be shared among researchers and management agencies within the Great Lakes.

In 2017, 18 Muskellunge were tagged by OMNRF in Lake St. Clair off of Belle River (ON waters). These fish added to the 20 fish tagged by MDNR in the Detroit River (US waters) and 19 fish tagged by OMNRF and MDNR in the Thames River (ON waters) during 2016. A total of seven receivers were deployed in Lake St. Clair as part of this program in 2017. Four acoustic receivers were purchased through financial support from Muskies Canada and deployed by the OMNRF in the Canadian waters, and three receivers were purchased through financial support from the Hugh C. Beaker Foundation (Muskies Inc.) and deployed by the MDNR in American waters (Figure 6.3.1). Two additional receivers purchased through OMNRF Special Purpose Account (SPA) funding were placed into the Thames River (Figure 6.3.1). Eight of these nine receivers were successfully retrieved in late fall 2017. These receivers detected at least 32 individual Muskellunge, 67 Lake Sturgeon, and 11 Common Carp. The detections for the latter two species have been submitted to the GLATOS network to contribute data to other GLATOS projects. Deployment of receivers will continue for the lifespan of the tags (5yrs) or until recordings of fish on receivers cease. Dependent on funding, OMNRFs future plans include tagging additional fish (20 fish/yr until 2020) and deploying additional receivers (see Figure 6.3.1) in 2018.

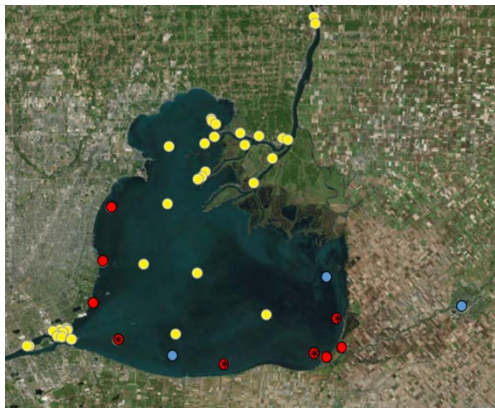


Figure 6.3.1 GLATOS receivers in Lake St. Clair in 2017 and proposed for 2018. Red circles indicate a receiver deployed as part of the SCDRS Muskellunge tagging project. Receivers in Michigan water were purchased using funding from the Hugh C Beaker Foundation (Muskies Inc.), asterisked receivers in Ontario waters were donated by the Muskies Canada (Belle River Chapter and the National office) and remaining 2 receivers were purchased using OMNRF Special Purpose Account funding. Blue circles are proposed new receiver locations for 2018.

To date, there are over 301,659 detection records from the 57 tagged fish. As of December 2017, evidence suggests between 40–47 of the tagged fish remain at-large (Detroit River = 5-11 of 20 fish; Thames River = 18 of 19 fish; Belle River 17-18 of 18 fish). The other fish are assumed to have died. Preliminary data analysis has revealed some interesting patterns. For example:

- 1) Long distance migrations (see Figure 6.3.2);
- 2) Apparent foraging site fidelity to the Thames River in the fall - 16 of 18 fish tagged in fall 2016 within the Thames River returned in fall 2017;
- 3) Apparent spawning site fidelity in the Detroit River in the spring - 5 of 11 fish tagged in May within the Detroit River returned to within 1km of collection site in May 2017;
- 4) Movement behaviours including periodic rapid movements over defined areas (1-10km) or rapid migrations over long distances (10–100km).

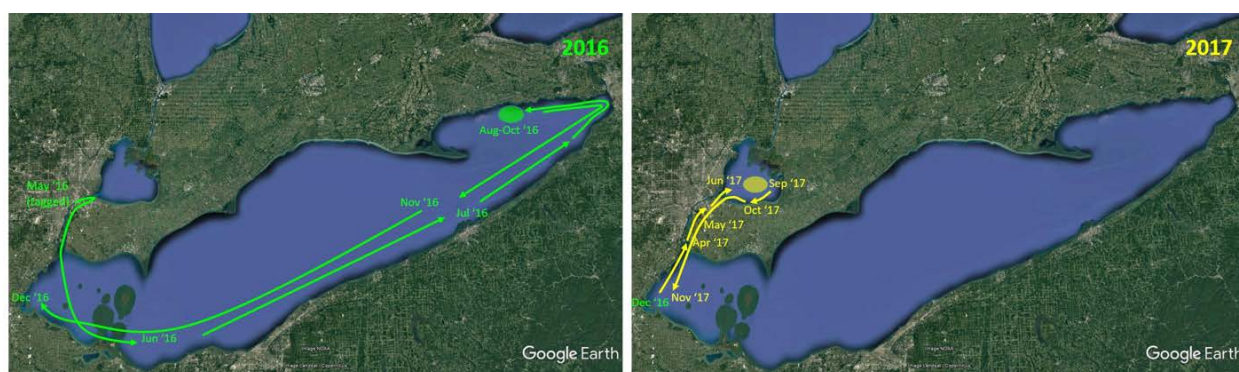


Figure 6.3.2 Movement of Muskellunge ID 24309 (sex: Male, weight: 6kg, length: 100cm), tagged by MDNR off Belle Isle in the Detroit River. The fish migrated to Buffalo Harbour and spent most of summer 2016 west of the Grand River (ON) mouth before migrating back along the US coast of Lake Erie to overwinter in the west basin. The fish migrated back up the Detroit River in spring 2017 and spent summer 2017 in the Ontario waters of Lake St. Clair before apparently migrating back down the Detroit River and was last detected off of Munro, Michigan.

6.4 Lake Trout Habitat Use

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 involves capturing and tagging Lake Trout in different parts of the lake during May, presuming that fall spawning aggregations have dispersed, together with the deployment of receivers spanning the entire circumference of the nearshore waters of the eastern basin (Figure 6.4.1). 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. The use of some acoustic tags with the ability to transmit temperature and depth information would add a thermal ecology aspect to the study.

Ninety Lake Trout were tagged in 2016; 30 each 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.

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Plans to tag 90 Lake Trout in May of 2017 were called off when it was discovered that a fault in tag manufacture resulted in transmissions that would potentially interfere with acoustic telemetry projects in the lake. Between LEMU and USGS, 29 faulty tags were deployed before the problem was identified. Analysis to learn the scope and magnitude of the problem occupied much of 2017. Regardless, the nearshore circumference ring of receivers was once again deployed in late August 2017; with LEMU deploying receivers between the tip of Long Point and Fort Erie. Analysis of battery life of the faulty tags and GLATOS detections concluded that the problem would not last beyond 2017. A deployment of 90 tags in fish from the three areas was planned for May 2018. The project will conclude in 2019. 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 (see Section 6.2 above).

This project was funded primarily through the Great Lakes Fish and Wildlife Restoration Act. Additional support came from OMNRF, the Canada Ontario Agreement, 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.

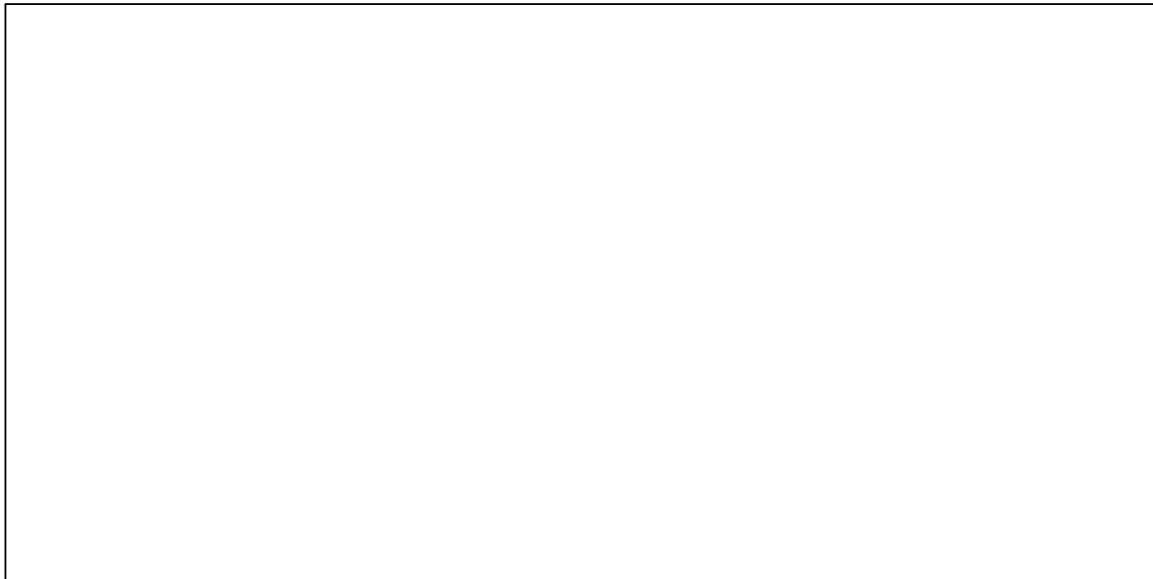


Figure 6.4.1 Location of receivers deployed to detect the presence of Lake Trout during spawning time in the eastern basin of Lake Erie. Receivers locations (circles), NOAA 1m contours (grey), and locations of previously identified Lake Trout habitat potential (hatched boxes).

6.5 Thames River and Sydenham River 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 aboriginal fisheries in the Thames, Sydenham Rivers, Lake St. Clair and connected waters of the Great Lakes. Walleye were tagged by Ontario Ministry of Natural Resources and Forestry (OMNRF) in the Sydenham River during 2013 and in the Thames River (2014-2016) in order 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. Thirty-five percent of tags applied in the Sydenham River and twenty percent of tags applied in the Thames River offered rewards upon return of the tags to OMNRF to address the reporting rate of non-reward tags for population modelling. 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, 20 recaptures were reported by fishers from 2013 to 2017 (Table 6.5.1). Walleye tagged in the Sydenham River were caught by recreational (19) and Lake Erie commercial (1) fisheries. Walleye capture locations ranged from western Lake Erie to the St. Clair River with most recaptures in Lake St. Clair and its tributaries (Figure 6.5.1). The geographic midpoint of recaptures was near the mouth of the Sydenham River (Figure 6.5.1). 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 2013-2017 were taken by Ontario (75%), followed by Michigan (25%) fishers.

From 2014 to 2016, 914 Walleye were tagged in the Thames River. Since 2014, 85 tagged Walleye were captured by recreational fisheries (82), commercial fisheries in western and central Lake Erie (2) and the aboriginal fishery in Lake St. Clair (1). Recaptures by residency were Michigan (54%), 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 fraction of Walleye were recaptured in Lake St. Clair (31%), followed by the St. Clair River (27%), Detroit River (21%), with 5% from Lake Erie and 5% from Lake Huron (Figure 6.5.1). The centroid for all recaptures was near the St. Clair River delta, Lake St. Clair (Figure 6.5.1). 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 was 2.82. A high proportion (49%) of Walleye tagged in 2016 that were recaptured lacked jaw tags whereas only 5% were missing Floy tags. This suggests that earlier rates of tag recaptures were underestimated due to loss of crimped metal jaw tags. This finding encourages future use of Floy tags for external marking. Return rates of tags with address labels were higher than tags with phone contact labels. 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 up to spring 2018.

Sydenham River		Non-Reward Tags				Reward Tags					All Tags							
		Year of Recapture				Year of Recapture					Year of Recapture							
		Tagged	2013	2014	2017	Tagged	2013	2014	2016	2017	Tagged	2013	2014	2016	2017			
2013	Male	230	1.3%	2.2%	0.4%	96	4.2%	1.0%	1.0%	0.0%	326	2.1%	1.8%	0.3%	0.3%			
(PIT / Jaw)	Female	12	0.0%	0.0%	0.0%	4	25.0%	25.0%	0.0%	0.0%	16	6.3%	6.3%	0.0%	0.0%			
	Unknown	19	5.3%	0.0%	0.0%	38	2.6%	2.6%	0.0%	0.0%	57	3.5%	1.8%	0.0%	0.0%			
	All	261	1.5%	1.9%	0.4%	138	4.3%	2.2%	0.7%	0.0%	399	2.5%	2.0%	0.3%	0.3%			
Thames River		Non-Reward Tags						Reward Tags					All Tags					
		Year of Recapture						Year of Recapture					Year of Recapture					
		Tagged	2014	2015	2016	2017	2018	Tagged	2014	2015	2016	2017	Tagged	2014	2015	2016	2017	2018
2014	Male	107	1.9%	0.9%	0.0%	0.9%	0.0%	29	3.4%	3.4%	0.0%	0.0%	136	2.2%	1.5%	0.0%	0.7%	0.0%
(PIT/Jaw)	Female	27	14.8%	0.0%	3.7%	0.0%	0.0%	6	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%	14	7.1%	7.1%	0.0%	0.0%	84	4.8%	1.2%	0.0%	0.0%	0.0%
	All	204	4.4%	0.5%	0.5%	0.5%	0.0%	49	4.1%	4.1%	0.0%	0.0%	253	4.3%	1.2%	0.4%	0.4%	0.0%
2015	Male	178		6.7%	2.2%	0.0%	0.0%	47		10.6%	10.6%	0.0%	225		7.6%	4.0%	0.0%	0.0%
	(PIT/Jaw) Female	31		0.0%	6.5%	0.0%	0.0%	8		37.5%	0.0%	0.0%	39		7.7%	5.1%	0.0%	0.0%
	Unknown	62		0.0%	0.0%	0.0%	1.6%	14		0.0%	0.0%	0.0%	76		0.0%	0.0%	0.0%	1.3%
	All	271		4.4%	2.2%	0.0%	0.4%	69		11.6%	7.2%	0.0%	340		5.9%	3.2%	0.0%	0.3%
2016	Male	191			6.8%	1.0%	0.0%	46			17.4%	8.7%	237			8.9%	2.5%	0.0%
	(PIT/Jaw/Floy) Female	12			8.3%	0.0%	0.0%	-					12			8.3%	0.0%	0.0%
	Unknown	55			3.6%	5.5%	1.8%	17			17.6%	0.0%	72			6.9%	4.2%	1.4%
	All	258			6.2%	1.9%	0.4%	63			17.5%	6.3%	321			8.4%	2.8%	0.3%

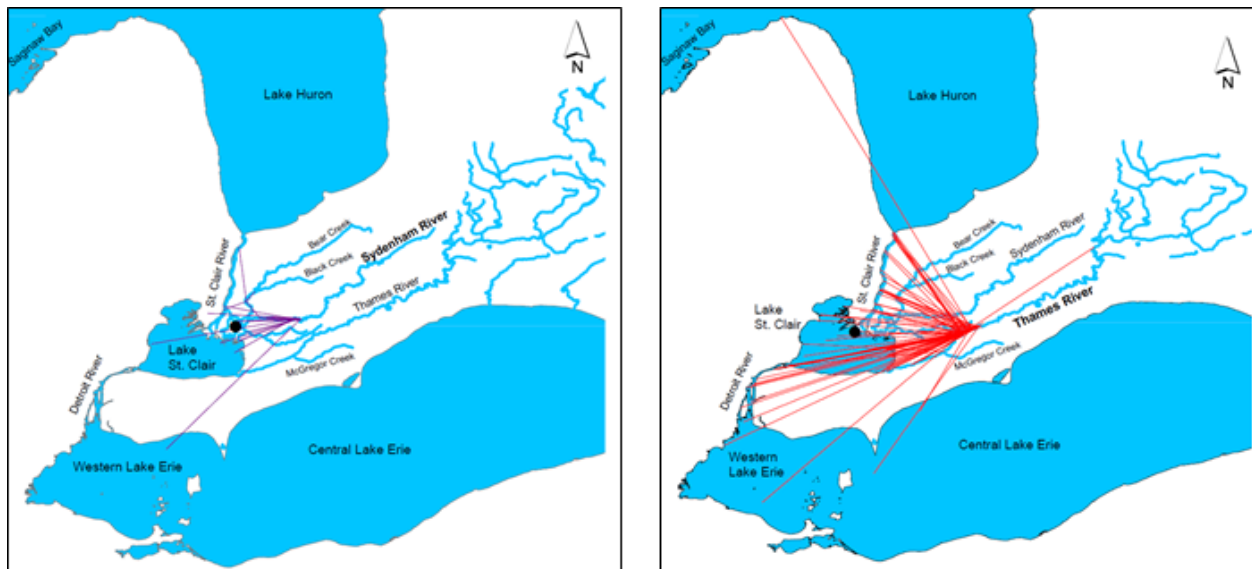


Figure 6.5.1 Fishery recapture locations linked to Walleye tagging sites in the Sydenham River (left) and the Thames River (right). Centroid or midpoint of recapture locations are indicated by solid dots.

6.6 Rondeau Bay Carp

Asian Carp are considered one of the most imminent threats to the Great Lakes because they are known to spread rapidly and are predicted to severely disrupt ecosystem function within the Great Lakes if they became established (Cudmore et al. 2012). In response, Fisheries and Oceans Canada (FOC) 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 responding 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. Though such an approach is standard procedure, the ability of existing boat electrofishing surveillance efforts has not been formally evaluated.

The objective of this study was to evaluate the ability of boat electrofishing surveillance efforts to locate individual fish within a large search area. We used Common Carp (*Cyprinus carpio*) in Rondeau Bay, Lake Erie as a model to estimate the probability a fish will be located (i.e. capture probability). We did this by tagging (loop and acoustic) twenty Carp in Rondeau Bay on 27 June 2017 and exhaustively searching the nearshore area for tagged individuals with a boat electrofisher on three separate occasions. All Carp captured during the electrofishing events were enumerated and checked for tags. We monitored the mouth of Rondeau Bay using acoustic receivers to identify any tagged individuals that left the bay during the study in order to correct our capture probability estimates.

Three electrofishing surveillance efforts were successfully completed in Rondeau Bay: July 24-26, 2017, September 7-8, 2017, and October 10-13, 2017. Most of the nearshore areas of Rondeau Bay were electrofished during these events, which provided a level of coverage and effort greater than or equal to a typical response by the OMNRF (Figure 6.6.1). A total of 918 Carp were captured during the three surveillance efforts and only one tagged fish was recaptured on July 24, 2017 despite the large amount of effort expended during study (24.9 hours of shocking). The tagged individual was recaptured less than a kilometer away from the original release location of the tagged fish. The cumulative capture probability across all three surveillance efforts was low and estimated to be 5%. No tagged individuals left Rondeau Bay during the study period. Overall, it appeared that electrofishing surveillance efforts were ineffective at locating individuals.

The precision of the detection probability estimate could have been improved if we tagged a greater number of Carp in the bay. However, tagging a limited number of individuals allowed us to calculate detection probabilities, while also providing a more realistic representation of an early stage invasion scenario. Often, a small number of individuals are responsible for the initial stages of colonization and it is these few individuals that a surveillance response is required to locate (e.g. released aquarium fish or fish from ballast water; Grigorovich et al. 2003, Ricciardi 2006).

The detection probability could be improved by using multiple gears simultaneously (Trebitz et al. 2009, Hoffman et al. 2016). Such a technique is often employed by FOC when conducting Asian Carp responses, whereby electrofishing is used in conjunction with gill nets or trammel nets. The use of multiple gear types increases the probability a fish will encounter and be caught by a surveillance effort, assuming the target species is vulnerable to a gear being used (i.e. cumulative detection probability). However, the relative rarity of new invaders makes them inherently difficult to capture and an effective monitoring program generally 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 current electrofishing surveillance efforts used to capture

and identify Asian Carp in Lake Erie nearshore areas is relatively ineffective and will not reliably detect individuals until they are fairly 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 meeting its objective. An additional study incorporating multiple gear types is planned for the 2018 field season to further evaluate the effectiveness of surveillance efforts.

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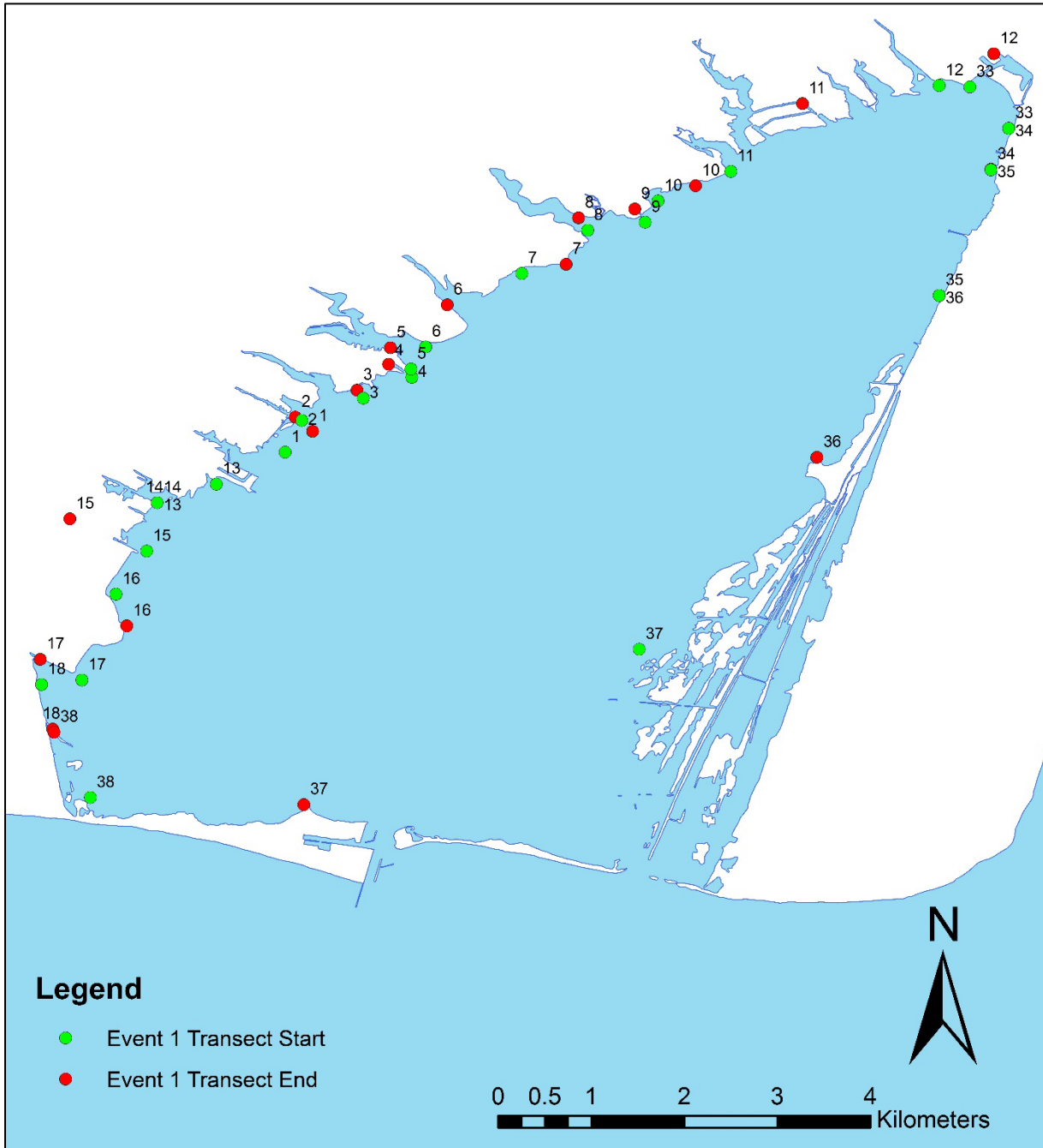


Figure 6.6.1 Locations for the beginning and end of each electrofishing transect completed during surveillance effort one in Rondeau Bay on July 24-26, 2017. Several transects were conducted up and down canals, which resulted in the start and end coordinates overlapping (i.e. appearing in the same place). Surveillance efforts two and three had comparable levels of electrofishing effort. The numbers associated with each point on the map are transect ID numbers and are not necessarily consecutive.

7. HABITAT RESTORATION

The Lake Erie Management Unit (LEMU) hosts the Ontario Ministry of Natural Resources and Forestry's (OMNRF) position of Great Lake Protection Fund (GLPF) Coordinator for the Lake Erie basin. The role of this coordinator is to facilitate OMNRF's commitments to the Canada-Ontario Agreement on Great Lake Water Quality and Ecosystem Health, commonly referred to as the COA agreement. The COA agreement specifies the roles and responsibilities of the federal and provincial governments as they collectively meet the Canadian commitments of the binational Great Lakes Water Quality Agreement (GLWQA). The primary role of the Lake Erie GLPF coordinator is to coordinate the OMNRF-GLPF work plan within the Lake Erie basin. The 2017/2018 fiscal year was year 3 of a five year (2015-2020) GLPF work plan. In 2017, 12 projects with a \$919,000 total budget were implemented by OMNRF - Regional Operation Division in Aylmer (Aylmer District) and Vineland (Guelph District) and the Lake Erie Management Unit - across the Lake Erie basin (see table 7.1).

Table 7.1 List of the Great Lakes Protection Fund projects in the Lake Erie basin.

PROJECT #	PROJECT NAME
02-05	Lower Thames River Habitat Restoration Program
02-06	Essex coastal-nearshore wetland restoration project
02-10	Grand River /Lake Erie Interface Restoration
02-12	Wetland Evaluations - Lake Erie Wetlands (west and central basins)
02-17	Rondeau Bay Watershed Rehabilitation Project
02-22	St. Clair River - Areas of Concern (AOC)
02-23	Detroit River AOC fish and aquatic habitat restoration - priority actions for delisting
02-26	Niagara River - AOC Fish Assessment
02-27	Niagara Region - AOC and Nearshore Habitat Restoration
02-30	Long Point Coastal Restoration Project
02-38	Niagara River - AOC Coastal Wetlands
05-23	Asian Carp Surveillance

In addition to a coordination role, the GLPF coordinator also participates in provincial, federal/ provincial and binational task teams, and advisory and steering committees. In 2017, these included:

- Niagara River, St. Clair River, and Detroit River AOC committees
- Great Lakes Water Quality agreement- annex meetings
- Lake Erie Partnership Working Group
- Lake Erie Lake Management Plan (LAMP) - writing team
- 2019 Coordinated Science Monitoring Initiative (CSMI) priority development
- Nearshore Framework
- Canada – Ontario Lake Erie Action Plan

Habitat projects implemented through the LEMU are profiled below.

7.1 Detroit River Area Of Concern Wetland Restoration

The Great Lakes Water Quality Agreement (GLWQA) has identified the Detroit River as an Area of Concern (AOC). This area was designated as having elevated levels of environmental harm, described as impairment of beneficial uses. In the Detroit River two of those Beneficial Use Impairments (BUI's) are

related to the loss of fish and wildlife habitat and populations. Through the Canada-Ontario Agreement (COA), the Ontario Ministry of Natural Resources and Forestry (OMNRF) is working with partners to help restore fish and wildlife habitat and populations. Loss of wetlands was identified in the Detroit River Stage 1 report as the leading cause of the BUI related to loss of fish and wildlife and restoration of these wetlands is a priority action identified in the Detroit River Canadian Clean-up Pathway to Delisting.

In 2017, the OMNRF partnered with the Essex Region Conservation Authority to implement a wetland restoration on private land. Under this partnership, the OMNRF was able to work with a number of willing landowners willing to take actions on their private property to further restore and protect fish and wildlife habitat

These landowners supported efforts to undertake a feasibility study for the purpose of re-designing an existing water control structure to better manipulate water levels and to promote submergent and emergent wetland plant growth and to better control invasive *Phragmites* in an effort to restore a 70 acres wetland at the mouth of the Canard River.



Partners also worked with private landowners to construct up to 5 acres of wetland capable of receiving storm event run-off including, where applicable, the installation of a spillway and planting of native wetland and upland vegetation.

7.2 St. Clair River Area Of Concern Habitat Restoration

Similar to the Detroit River, the St. Clair River has been identified as an AOC within the GLWQA. In 1985, the extensive urbanization, industrial and agricultural land use activities within the St. Clair River and its watershed resulted in the impairment of 9 of 14 beneficial uses. Since that time, three BUIs have been restored and several others have seen significant improvements. However, “Loss of Fish and Wildlife Habitat” BUI remains impaired despite the significant work towards removing this BUI.

Historically fish and wildlife habitat was lost due to filling, draining, dredging and shoreline hardening for industrial, urban, agricultural and navigational uses. This loss or degradation of fish and wildlife habitat has included fish spawning, nursery and rearing sites has been identified as one of the causes resulting in the reduction and loss of fish and wildlife populations. One of the unique issues in the St. Clair River proper is the need to protect the shoreline of this narrow (300m-1200m wide) major shipping channel from high wave energy and flow. This presents a unique challenge to the restoration of naturalized shorelines.

Partnering with the St. Clair Region Conservation Authority, the LEMU has used GLPF funding to aid in improving fish and wildlife habitat. Between 2015 and 2016, funding was used for smaller wetland and barrier to fish migration removal projects and in the development of a Fish and Wildlife management Plan. Starting in 2017 work began to address the larger shoreline hardening issues in the St. Clair River with planned projects along the shorelines of Aamjiwnaang First Nations and Courtright, Ontario.

The completed Aamjiwnaang Shoreline project involved the installation of habitat pods (25m) along the shoreline and a series of Finger Groynes (20m into river, 50m along shoreline or 0.1 Ha of in channel fish habitat). The Aamjiwnaang First Nation has plans add fishing piers and docks to improve accessibility to the river and fishing opportunities for their members in the future.

In 2017, engineering plans were developed, permitting processes completed and additional funding partners secured for the Courtright shoreline project. Work is scheduled to begin on the first 90m section of shoreline in winter of 2018. This section will include habitat pods within an armor stone shoreline matrix similar to work previously completed in Guthrie Park (Figure 7.2.1).



Figure 7.2.1 Guthrie Park Shoreline work. The left image shows an aquatic/wetland habitat pod and the right image a terrestrial habitat pod, outlined in yellow. This project naturalized the shoreline of the shipping channel while maintaining erosion control in the St. Clair River. Similar work will be done at the Courtright shoreline project site.

7.3 Grand River Decision Analysis

Overview

The ecosystem of the lower Grand River, commonly referred to as the Southern Grand River (SGR), has been recognized as degraded for some time. Considerable funds and effort has gone into documenting the exact nature of impediments to not only fish passage (see Section 6.2 above) but also water quality, species diversity and wetland function and fish community health. As much of the problem was deemed to be associated with hydrologic dysfunction, additional effort and funds were directed at modelling, using both physical and computer models. The nature of the impaired estuarine environment proved challenging to conceptualize. To better inform the models, additional fieldwork was conducted on a number of occasions. Examples of fieldwork include the collection of finer scale bathymetric measures, and high resolution LiDAR data (Light Detection and Ranging) for more accurate topography.

Together with Environment and Climate Change Canada and facilitated by ESSA Technologies, a series of workshops were initiated in 2014 in order to carry out a Structured Decision Analysis (DA). The goal was to come to a conclusion as to the best way to realize habitat restoration in this complex environment. The problem statement that came out of the first meeting was:

The hydrologic effects of the Dunnville dam in combination with the effects of other human activities (e.g. addition of nutrients and contaminants from sewage treatment plants, agricultural production and other land based activities such as clearing riparian and adjacent areas) is limiting the natural functioning of the ecological processes in the

historical SGR estuary. This diminishes the intrinsic ecological value of the historical SGR estuary resulting in diminished social, cultural and economic benefits.

During subsequent facilitated meetings, a series of alternative habitat rehabilitation actions were derived. These included actions across a broad spatial scale including i) at Dunnville; ii) Lake Erie and Estuary; iii) watershed wide; and iv) at Caledonia. A water management plan, led by the Grand River Conservation Authority and finalized in 2014, took on much of the watershed-wide actions, allowing the DA to focus in on the section of SGR immediately downstream of Caledonia.

Broad categories of actions included: Dam Removal (Dunnville and Caledonia); Fish Passage (Dunnville and Caledonia); Enhance Riparian Habitat; Establish wetlands at outfall of wastewater treatment plants; Harvest Control (Walleye and Channel Catfish); Removal of Small Barriers on Tributaries; Improve Land Use Practices; Modification of Piers at River Mouth; Boating regulations to reduce bank erosion and turbidity; Habitat Restoration / Creation

In order to compare and rank alternative actions, a series of Performance Measures (PMs) were suggested which, described components of the desired restored ecosystem.

2017

Much of 2017 was spent fleshing-out and documenting PMs, in an informed way, such that predictions could be made as to the effect of each alternative action on each PM. This involved soliciting expert opinion and often meant revisiting and re-running models. With the completion of a PM document, a workshop to rank alternatives, and complete the DA, will take place in 2018.

APPENDIX A
Operational Field and Lab Schedule 2017

Field and Lab Projects	Dates	Species Assessed, Monitored, or Stocked	Project Lead	Location	Funding Source
Lake Erie Commercial Catch Sampling	Apr-Nov	Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch	Belore	Wheatley	SPA
Contaminant Sampling	Apr-Nov	Multiple Species	Benoit	Wheatley	SPA
Lake Erie Temperature Loggers	Apr-Nov	Limnology	Genereaux	Wheatley	SPA
Lake Erie & Lake St. Clair Sport Fishery Diary	Apr-Nov	Multiple Species	Belore	Wheatley	SPA
Lake St. Clair Creel	Apr-Oct	Multiple Species	Belore	Wheatley	SPA
Lake Erie Limnology	May-Oct	Limnology	MacDougall	Wheatley	SPA
Lake St. Clair Limnology	May-Sept	Limnology	Marklevitz	Wheatley	SPA
Asian Carp eDNA Monitoring	May-Jul	Asian Carp	Belore	Wheatley	COA
Mixed Stock Walleye tagging (O. DNR partnership)	May - Jul	Walleye	Cook	Wheatley	SPA
Lake St. Clair Nearshore Assessment	Jun-Jul	Multiple Species	Thorn	Wheatley	SPA
Rondeau Bay Common Carp tagging	Jun-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
West Basin Mid water Trawling	August	Multiple Species	Cook	Wheatley	SPA
Partnership Index	Aug-Nov	Multiple Species	Cook	Wheatley	SPA
Thames River Musky acoustic tagging (M. DNR partnership)	Oct	Musky	Cook	Wheatley	SPA/CRF
Lake Erie Central Basin trawling	Oct	Multiple Species	Marklevitz	Wheatley	SPA
L. Whitefish Acoustic tagging	Nov	L. Whitefish	Belore	Wheatley	SPA
Age and Growth	Continuous	Multiple Species	Cook	Wheatley	CRF
Lake Erie Limnology	May-Oct	Multiple Species	Multiple	Wheatley	SPA
Lake Erie Commercial Catch Sampling	Apr-Nov	Chlorophyll, Zooplankton	MacDougall	Pt. Dover	SPA
Asian Carp eDNA Monitoring	June, July	Walleye, Y. Perch, R. Smelt, L. Whitefish, W. Bass, W. Perch	Belore	Pt. Dover	SPA
East Basin Fishery DNA Collection	May-Oct	Asian Carp	Belore	Pt. Dover	COA
Contaminant Sampling- LPB & Eastern Basin	Apr-Nov	Walleye	MacDougall	Pt. Dover	SPA
Long Point Bay Temperature Loggers	Mar-Oct	Multiple Species	Multiple	Pt. Dover	SPA
Grand River Walleye Tagging and Monitoring	April - Oct	Water temps - L. P. Bay, Pt. Dover Intake, 2 Gas Wells	Ives	Pt. Dover	SPA
Lake Trout Acoustic Tagging	May	Walleye	MacDougall	Pt. Dover	SPA/COA/GLFC
Lake Trout Tag Removal	May, Nov	Lake Trout	MacDougall	Pt. Dover	SPA
Cold Water Survey	Continuous	Lake Trout	MacDougall	Pt. Dover	SPA
Long Point Bay Adult Index Gillnetting	Aug	Lake Trout	MacDougall	Pt. Dover	SPA
Long Point Bay Nearshore Trawling	Jun-Aug	Lake Trout, Burbot, Lake Whitefish	May	Pt. Dover	SPA
Long Point Bay Offshore Trawling	Aug, Sept	Multiple Species	May	Pt. Dover	SPA
Central Basin Trawling	Sept-Nov	Multiple Species	May	Pt. Dover	SPA
Lake Erie Eastern Basin Hydro Acoustics	October	Multiple Species	May	Pt. Dover	SPA
Diet Study	July	Smelt and Other Pelagic Forage Fish	May	Pt. Dover	SPA
Age and Growth	June-Jan	Multiple Species	Harrison	Pt. Dover	SPA
	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 - LEMU DATA REQUEST LOG 2017

Agency / Organization	Data Requested
USGS	Harvest by Management Unit 2009-2016
ROM	Silver Chub Assessment Data - trawl, gillnet surveys
Parsons Consulting / MTO	Assessment & harvest data- Leamington Ferry Dock rehabilitation project
Angler	Walleye status information - reports (WTG, LEMU Status of Major Stocks)
ODNR	Partnership Gill net site locations 1989-2016
MSU	Thames River Walleye Tagging data
U of Toronto	Silver Chub Assessment data - coordinates
USGS	Silver Chub trawl data
MOECC	Multiple species length distributions, size at age from multiple assessment programs
OSU	Interagency trawl data
SUNY-ESF	Yellow Perch otolith samples from trawl & gill net surveys with electronic data
USFWS	Partnership Gill Net Sea Lamprey wounding data
USGS	Silver Chub trawl data
MNRF Research / U of Windsor	Fish collection - all sources. Isotope foodweb project.
University of Toledo	Lake Whitefish commercial harvest by age
NMandrak Consulting	River Darter observation records
Central Michigan University	Lake St Clair and Detroit River Creel data
USGS	Lake St.Clair Nearshore assessment
DFO	Lake St.Clair Nearshore assessment
U of Michigan	Lake St.Clair Limnology

APPENDIX C - LAKE ERIE MANAGEMENT UNIT STAFF 2017

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Aida Baptista – Administrative Assistant

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Matthew Werner – Fisheries Technician
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