Lake Ontario Fish Communities and Fisheries:

2019 Annual Report of the Lake Ontario Management Unit

Ontario

Cover Photos:

(Top) Fish caught by anglers in Lake Ontario in 2019. For more information on the Lake Ontario Western Basin Fishery and migratory salmon and trout, see Sections 1.4, 1.5, 2.4, 7.1, 7.2 and 7.3

(Bottom Left) MNRF's "Ontario Explorer" docked at the Glenora Fisheries Station located on the Bay of Quinte, Lake Ontario

(Bottom Right) Young-of-the-year walleye sampled as part of the 2019 Lake Ontario and Bay of Quinte Fish Community Index Trawling. For more information on the Bay of Quinte - Eastern Lake Ontario walleye, see Sections 1.1, 1.2, 1.3, 2.2, 2.3, 7.4 and 9.11

LAKE ONTARIO FISH COMMUNITIES AND FISHERIES:

2019 ANNUAL REPORT OF THE LAKE ONTARIO MANAGEMENT UNIT

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Foreword

The Lake Ontario Management Unit (LOMU) and the Lake Ontario research staff from the Applied Research and Monitoring Section (ARMS) operating at the Glenora Fisheries Station, are pleased to provide the 2019 Annual Report of monitoring, assessment, research and management activities.

Lake Ontario fisheries are managed by the Lake Ontario Committee, consisting of the Ontario Ministry of Natural Resources and Forestry (MNRF) in partnership with New York State, under the auspices of the Great Lakes Fishery Commission. The Lake Ontario Fish Community Objectives (2013) provide bi-national fisheries management direction to protect and restore native species and to maintain sustainable fisheries. Our partners include: New York State Department of Environmental Conservation (NYSDEC), Fisheries and Oceans Canada (DFO), the U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS) and many other Ontario provincial ministries and conservation authorities and U.S. state and federal agencies, universities and non-government partners.

Glenora Fisheries Station staff delivered over forty-five field and laboratory projects in 2019 including the comprehensive long-term base monitoring program that spans over five decades. In 2019, assessment of the Canadian waters from the Niagara River to Cornwall included 120 trap net sets, 415 gill net sets in over 140 sites and 179 trawls. Across all programs, 209,448 fish were captured (comprising more than 40 species) and 4,249 calcified structures were processed for age and growth assessment. LOMU staff interviewed 4,592 anglers during the Bay of Quinte and the Western Basin of Lake Ontario creel surveys. Over 60,000 video images were recorded and processed from the Ganaraska River and Credit River video fish counter systems. MNRF Fish Culture Section and partners stocked 2.05 million fish into the Canadian waters of Lake Ontario to support species restoration and a world-class recreational trout and salmon fishery. MNRF, DFO, NYSDEC, USFWS, University of Windsor and Queen’s University researchers are using acoustic telemetry to understand the spatial ecology of many Lake Ontario species.

New for 2019:
- The Credit River migratory salmonid population was monitored with the Vaki video fish counter system.
- The Bay of Quinte long-term fish community index program was redesigned.
- The St. Lawrence River and Lake St. Francis fish community index program was redesigned.
- Chinook otolith microchemistry is being assessed as a tool to determine wild vs stocked origin.
- Fish passage efficiency was evaluated for the Ganaraska River and Credit River fishways.

We would like to express our sincere appreciation to the many partners and volunteers who contributed to the successful delivery of LOMU initiatives. Special thanks to the Ontario Federation of Anglers and Hunters and the many other partners committed to the Lake Ontario Atlantic Salmon restoration program. LOMU gratefully acknowledges the important contribution of the Lake Ontario Commercial Fishery Liaison Committee, the Fisheries Management Zone 20 Council (FMZ20) members, the Ringwood hatchery partnership with the Metro East Anglers, Chinook Net Pen Committee, Muskies Canada, the Ganaraska River Fishway Volunteers, Napanee and District Rod & Gun Club, Queen’s University and the University of Windsor and the participants in the angler diary and assessment programs.

Our team of skilled and committed staff and partners delivered an exemplary program that provides long-term benefits to the citizens of Ontario. We are pleased to share the important information about these activities and findings of the Lake Ontario Management Unit from 2019.

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This Annual Report is available online at: http://www.glfc.org/lakecom/loc/mgmt_unit/index.html

1. Index Fishing Projects

1.1 Lake Ontario and Bay of Quinte Fish Community Index Gill Netting

E. Brown, Lake Ontario Management Unit

The Lake Ontario and Bay of Quinte annual fish community index gill netting program is used to monitor the abundance and biological characteristics of a diversity of warm, cool and cold-water fish species. Data from the program are used to help manage local commercial and recreational fisheries as well as for tracking long-term changes in the aquatic ecosystem.

Gill net sampling areas are shown in Fig. 1.1.1 and the basic sampling design is summarized in Table 1.1.1. Included in the design are fixed single-depth sites, depth-stratified sampling areas, depth stratified random sites. In 2019, each site or area was visited from one to three times within specified time-frames, and with one to three gill net gangs set during each visit.

The annual index gill netting field work occurs during the summer months. Summer was chosen based on an understanding of water temperature stability, fish movement/migration patterns, fish growth patterns, and logistical considerations. The time-frames for completion of field work varies among sampling sites/areas (Table 1.1.1). This increases the probability of encountering a wide-range of water temperatures across the depth ranges sampled, both seasonally and by geographic area. In 2019, the Bay of Quinte was also sampled in June and late October. Seasonal sampling at these Bay of Quinte sites will help better assess seasonal fish distribution and abundance patterns.

Monofilament gill nets with standardized specifications are used (monofilament mesh replaced multifilament in 1992; only catches from 1992-present are tabulated here). Each gill net

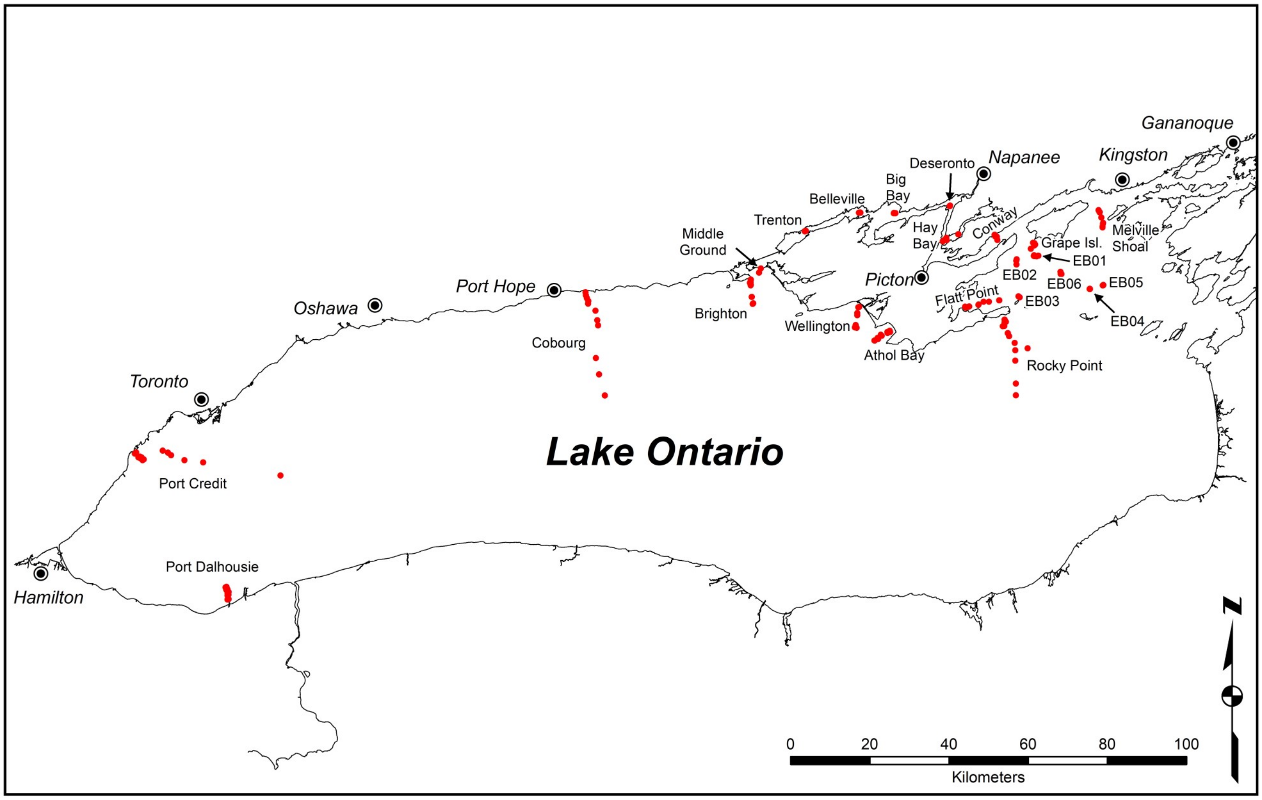


FIG. 1.1.1. Map of Lake Ontario showing fish community index gill netting sites (2019 Bay of Quinte depth stratified random sites excluded).

gang consists of a graded-series of ten monofilament gill net panels of mesh sizes from 38 mm (1½ in) to 152 mm (6 in) stretched mesh at 13 mm (½ in) intervals, arranged in sequence. However, a standard gill net gang may consist of one of two possible configurations. Either, all ten mesh sizes (panels) are 15.2 m (50 ft) in length (total gang length is 152.4 m (500 ft)), or, the 38 mm (1½ in) mesh size (panel) is 4.6 m (15 ft) in length and the remaining mesh sizes are 15.2 m (50 ft) each in length (total gang length is 141.7 m (465 ft)) (see Table 1.1.1). Note that use of the shorter 38 mm gill net panel is related to the processing time required to deal with large numbers of small fish (e.g., Alewife and Yellow Perch) caught in this small mesh size. Gill net gangs are connected in series (i.e., cork lines and lead lines attached), but are separated by a 15.2 m (50 ft) spacer to minimize "leading" of fish. The 152 mm (6 in) end of one gang is connected to the 38 mm (1 ½ in) gang of the adjoining gang. The entire gill net strap (all joined gangs) is set within 2.5 m of the site depth listed in Table 1.1.1. In 2019, only one gang was used at each site in the Bay of Quinte. The gill net set duration target ranges from 18-24 hours. Gill net catches were summed across the ten mesh sizes from 1½-6 inch. In the case where the 38 mm mesh size used was 4.6 m in length, the catch in this mesh was adjusted (i.e., multiplied by 15.2/4.6) prior to summing the ten mesh sizes. Therefore, all reported catches represent the total catch in a 152.4 m (500 ft) gang of gill net.

In 2019, 365 gill net samples were made from Jun 18 to Oct 30. Thirty-three different species and 12,794 individual fish were caught. Fifty-one percent of the observed catch was Alewife, followed by Yellow Perch (14%), White Perch (10%), Walleye (6%), and Lake Trout (6%) (Table 1.1.2). Species-specific gill net catch summaries are shown by geographic area/site in Tables 1.1.3-1.1.23. Abundance trends for the most common species caught in northeast Lake Ontario, Kingston Basin, and the Bay of Quinte (Fig. 1.1.2-1.1.4). Selected biological information is also presented below for Lake Whitefish, Cisco, Lake Trout and Walleye (Tables 1.1.24-1.1.27).

Northeast and Kingston Basin, Lake Ontario

Northeast (Brighton, Wellington, Middle Ground and Rocky Point) and Kingston Basin (Melville Shoal, Grape Island and Flatt Point) Nearshore Areas (Tables 1.1.3-1.1.9)

Six depth-stratified sampling areas (Melville Shoal, Grape Island, Flat Point, Rocky Point, Wellington and Brighton) that employ a common and balanced sampling design were used here to provide a broad picture of the warm, cool and cold-water fish community inhabiting the open-coastal waters out to about 30 m water depth in the eastern half of Lake Ontario. Results were summarized and presented graphically (Fig. 1.1.2) to illustrate abundance trends of the most abundant fish species. Middle Ground is a fixed site and represents one of our longest running gill netting locations.

Northeast (Rocky Point) and Kingston Basin (EB02 and EB06) Offshore Areas (Tables 1.1.10-1.1.12)

Offshore Rocky Point was initiated in 1997 as part of a lake wide depth stratified effort by sampling area which spans a wide depth range (7.5-140m). Two single-depth sites (EB02 and EB06) are used to monitor long-term trends in the deep-water fish community the Kingston Basin. Results were summarized and presented graphically (Fig. 1.1.3) to illustrate abundance trends of the most abundant species (Alewife, Lake Trout, Lake Whitefish, Yellow Perch, Rainbow Smelt, Cisco, Chinook Salmon and Round Goby).

Kingston Basin Fixed Sites, Seasonal (Table 1.1.13)

Four additional Kingston Basin deep gill net sampling sites have been netted since 2016; EB01, EB03, EB04 and EB05. The sampling included a seasonal component (Jun-Sep). Together, along with EB02 and EB06, this netting provided a more complete description of the Kingston Basin deep-water fish community.

Northcentral, Lake Ontario

Northcentral Depth Stratified Area, Nearshore and Offshore Areas (Cobourg; Tables 1.1.14-1.1.15)

In 2019, northcentral Lake Ontario was sampled for the sixth consecutive year using a depth-stratified by area approach, spanning a wide range of depths (7.5-140m). Two nearshore visits and one offshore visit was made to the Cobourg area, and two visits were made to the Whitby area.

TABLE. 1.1.1. Sampling design of the Lake Ontario fish community index gill netting program (Lake Ontario) including geographic and depth stratification, number of visits, number of replicate gill net gangs set during each visit (by gill net length), and the time-frame for completion of visits. Also shown is the year in which gill netting at a particular area/site was initiated and the number of prior years that netting has occurred.

						Replicates by net size[3]		Site location (approx)					
Region name	Area Name (Area code)	Design	Site name	Depth (m)	Visits	465 feet	500 feet	Latitude (dec min)	Longitude (dec min)	No.SAM (Visits x Replicates)	Time-frame	Start-up year	Number years[4]
Southwestern Lake Ontario	Port Dalhousie (PD)	Depth stratified area	PD08	7.5	2	2		431294	791615	4	Jul 21 - Sep 15	2018	2
Southwestern Lake Ontario	Port Dalhousie	Depth stratified area	PD13	12.5	2	2		431352	791622	4	Jul 21 - Sep 15	2018	2
Southwestern Lake Ontario	Port Dalhousie	Depth stratified area	PD18	17.5	2	2		431387	791622	4	Jul 21 - Sep 15	2018	2
Southwestern Lake Ontario	Port Dalhousie	Depth stratified area	PD23	22.5	2	2		431426	791647	4	Jul 21 - Sep 15	2018	2
Southwestern Lake Ontario	Port Dalhousie	Depth stratified area	PD28	27.5	2	2		431458	791667	4	Jul 21 - Sep 15	2018	2
Northwestern Lake Ontario	Port Credit (PC)	Depth stratified area	PC08	7.5	2	2		433230	793476	4	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC13	12.5	2	2		433182	793403	4	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC18	17.5	2	2		433164	793355	4	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC23	22.5	2	2		433156	793335	4	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC28	27.5	2	2		433143	793308	4	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC40	40	1		3	433269	792976	3	Jul 21 - Sep 15	2016	4
Northwestern Lake Ontario	Port Credit	Depth stratified area	PC50	50	1		3	433249	792874	3	Jul 21 - Sep 15	2016	4
Northwestern Lake Ontario	Port Credit	Depth stratified area	0060	60	1		3	433213	792808	3	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	0080	80	1		3	433190	792515	3	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	0100	100	1		3	433162	792161	3	Jul 21 - Sep 15	2014	6
Northwestern Lake Ontario	Port Credit	Depth stratified area	0140	140	1		3	433065	790735	3	Jul 21 - Sep 15	2014	6
North Central Lake Ontario	Cobourg (CB)	Depth stratified area	CB08	7.5	2	2		435701	781167	4	Jul 21 - Sep 15	2010	10
North Central Lake Ontario	Cobourg	Depth stratified area	CB13	12.5	2	2		435661	781157	4	Jul 21 - Sep 15	2010	10
North Central Lake Ontario	Cobourg	Depth stratified area	CB18	17.5	2	2		435622	781136	4	Jul 21 - Sep 15	2010	10
North Central Lake Ontario	Cobourg	Depth stratified area	CB23	22.5	2	2		435584	781109	4	Jul 21 - Sep 15	2010	10
North Central Lake Ontario	Cobourg	Depth stratified area	CB28	27.5	2	2		435549	781110	4	Jul 21 - Sep 15	2010	10
North Central Lake Ontario	Cobourg	Depth stratified area	CB40	40	1		3	435454	780943	3	Jul 21 - Sep 15	2016	4
North Central Lake Ontario	Cobourg	Depth stratified area	CB50	50	1		3	435299	780924	3	Jul 21 - Sep 15	2016	4
North Central Lake Ontario	Cobourg	Depth stratified area	0060	60	1		3	435257	780916	3	Jul 21 - Sep 15	2014	6
North Central Lake Ontario	Cobourg	Depth stratified area	0080	80	1		3	434813	780919	3	Jul 21 - Sep 15	2014	3
North Central Lake Ontario	Cobourg	Depth stratified area	0100	100	1		3	434589	780857	3	Jul 21 - Sep 15	2014	3
North Central Lake Ontario	Cobourg	Depth stratified area	0140	140	1		3	434310	780728	3	Jul 21 - Sep 15	2014	3
North Central Lake Ontario	Whitby (WH)	Depth stratified area	WH08	7.5	2	2		435038	785204	4	Aug 1-Sep 15	2019	1
North Central Lake Ontario	Whitby	Depth stratified area	WH13	12.5	2	2		435026	785158	4	Aug 1-Sep 15	2019	1
North Central Lake Ontario	Whitby	Depth stratified area	WH18	17.5	2	2		435010	785151	4	Aug 1-Sep 15	2019	1
North Central Lake Ontario	Whitby	Depth stratified area	WH23	22.5	2	2		434956	785146	4	Aug 1-Sep 15	2019	1
North Central Lake Ontario	Whitby	Depth stratified area	WH28	27.5	2	2		434926	785134	4	Aug 1-Sep 15	2019	1
Northeastern Lake Ontario	Brighton (BR)	Depth stratified area	BR08	7.5	2	2		435955	774058	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Brighton	Depth stratified area	BR13	12.5	2	2		435911	774071	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Brighton	Depth stratified area	BR18	17.5	2	2		435878	774053	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Brighton	Depth stratified area	BR23	22.5	2	2		435777	774034	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Brighton	Depth stratified area	BR28	27.5	2	2		435624	774004	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Middle Ground (MG)	Fixed site	MG05	5	2	2		440054	773906	4	Jul 21 - Sep 15	1979	41
Northeastern Lake Ontario	Wellington (WE)	Depth stratified area	WE08	7.5	2	2		435622	772011	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Wellington	Depth stratified area	WE13	12.5	2	2		435544	772027	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Wellington	Depth stratified area	WE18	17.5	2	2		435515	772025	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Wellington	Depth stratified area	WE23	22.5	2	2		435378	772050	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Wellington	Depth stratified area	WE28	27.5	2	2		435348	772066	4	Jul 21 - Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point (RP)	Depth stratified area	RP08	7.5	2	2		435510	765220	4	Jul 21-Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP13	12.5	2	2		435460	765230	4	Jul 21-Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP18	17.5	2	2		435415	765222	4	Jul 21-Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP23	22.5	2	2		435328	765150	4	Jul 21-Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP28	27.5	2	2		435285	765135	4	Jul 21-Sep 15	1988	32
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0040	40	1		3	435190	765040	3	Jul 1-Jul 31	2016	4
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0050	50	1		3	435090	765030	3	Jul 1-Jul 31	2016	4
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0060	60	1		3	434950	765029	3	Jul 1-Jul 31	1997	23
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0080	80	1		3	434633	765006	3	Jul 1-Jul 31	1997	23
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0100	100	1		3	434477	764998	3	Jul 1-Jul 31	1997	23
Northeastern Lake Ontario	Rocky Point	Depth stratified area	0140	140	1		3	434122	764808	3	Jul 1-Jul 31	1997	23
Kingston Basin (nearshore)	Flatt Point (FP)	Depth stratified area	FP08	7.5	2	2		435665	765993	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP13	12.5	2	2		435659	765927	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP18	17.5	2	2		435688	765751	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP23	22.5	2	2		435726	765541	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP28	27.5	2	2		435754	765314	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Grape Island (GI)	Depth stratified area	GI08	7.5	2	2		440537	764712	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI13	12.5	2	2		440523	764747	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI18	17.5	2	2		440476	764710	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI23	22.5	2	2		440405	764718	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI28	27.5	2	2		440470	764796	4	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Melville Shoal (MS)	Depth stratified area	MS08	7.5	2	1		441030	763500	2	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS13	12.5	2	1		441004	763470	2	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS18	17.5	2	1		440940	763460	2	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS23	22.5	2	1		440835	763424	2	Jul 1-Jul 31	1986	34
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS28	27.5	2	1		440792	763424	2	Jul 1-Jul 31	1986	34

TABLE 1.1.1. (continued). Sampling design of the Lake Ontario fish community index gill netting program (Bay of Quinte) including geographic and depth stratification, number of visits, number of replicate gill net gangs set during each visit (by gill net length), and the time-frame for completion of visits. Also shown is the year in which gill netting at a particular area/site was initiated and the number of prior years that netting has occurred.

						Replicates by net size[3]		Site location (approx)					
Region name	Area Name (Area code)	Design	Site name	Depth (m)	Visits	465 feet	500 feet	Latitude (dec min)	Longitude (dec min)	No.SAM (Visits x Replicates)	Time-frame	Start-up year	Number years[4]
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB01	31	3	3		440400	764650	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	2016	4
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB02	30	3	3		440330	765050	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	1968	52
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB03	25	3	3		435820	764950	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	2016	4
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB04	27	3	3		435940	763610	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	2016	4
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB05	29	3	3		440000	763400	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	2016	4
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB06	30	3	3		440220	764210	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15-Sep 9	1968	52
Bay of Quinte	Conway	Depth stratified area	CO08	7.5	1	1		440664	765463	1	Jul 21-Aug 21	1972	48
Bay of Quinte	Conway	Depth stratified area	CO13	12.5	1	1		440649	765452	1	Jul 21-Aug 21	1972	48
Bay of Quinte	Conway	Depth stratified area	CO20	20	1	1		440643	765453	1	Jul 21-Aug 21	1972	48
Bay of Quinte	Conway	Depth stratified area	CO30	30	1	1		440620	765440	1	Jul 21-Aug 21	1972	48
Bay of Quinte	Conway	Depth stratified area	CO45	45	1	1		440601	765402	1	Jul 21-Aug 21	1972	48
Bay of Quinte	Hay Bay (HB)[2]	Depth stratified area	HB08	7.5	3	1		440656	770156	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	1959	61
Bay of Quinte	Hay Bay	Depth stratified area	HB13	12.5	3	1		440575	770400	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	1959	61
Bay of Quinte	Deseronto (DE)	Fixed site	DE05	5	3	1		441035	770339	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	2016	4
Bay of Quinte	Big Bay (BB)	Fixed site	BB05	5	3	1		440920	771360	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	1972	48
Bay of Quinte	Belleville (BE)	Fixed site	BE05	5	3	1		440914	772048	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	2016	4
Bay of Quinte	Trenton (TR)	Fixed site	TR05	5	3	1		440636	773063	3	Jun 15-Jul 15; Jul 21-Aug 21; Oct 15-Nov 15	2016	4
Bay of Quinte	Upper Bay of Quinte (UB)	Depth stratified random		1-3	4	1				4	Jun 15-Jul 15 (1); Jul 21-Aug 21(2); Oct 15-Nov 15 (1)	2019	1
Bay of Quinte	Upper Bay of Quinte (UB)	Depth stratified random		3-6	5	1				5	Jun 15-Jul 15 (2); Jul 21-Aug 21(1); Oct 15-Nov 15 (2)	2019	1
Bay of Quinte	Upper Bay of Quinte (UB)	Depth stratified random		6-12	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21(2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Middle Bay of Quinte (MB)	Depth stratified random		1-3	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21(2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Middle Bay of Quinte (MB)	Depth stratified random		3-6	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21(2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Middle Bay of Quinte (MB)	Depth stratified random		6-12	4	1				4	Jun 15-Jul 15 (1); Jul 21-Aug 21(2); Oct 15-Nov 15 (1)	2019	1
Bay of Quinte	Middle Bay of Quinte (MB)	Depth stratified random		12-20	6	1				6	Jun 15-Jul 15 (2); Jul 21-Aug 21(2); Oct 15-Nov 15 (2)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		1-3	1	1				1	Jun 15-Jul 15 (0); Jul 21-Aug 21 (1); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		3-6	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21(2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		6-12	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21 (2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		12-20	2	1				2	Jun 15-Jul 15 (0); Jul 21-Aug 21(2); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		20-35	4	1				4	Jun 15-Jul 15 (0); Jul 21-Aug 21 (4); Oct 15-Nov 15 (0)	2019	1
Bay of Quinte	Lower Bay of Quinte (LB)	Depth stratified random		>35	4	1				4	Jun 15-Jul 15 (0); Jul 21-Aug 21 (4); Oct 15-Nov 15 (0)	2019	1

[1] changed from a fixed site where the gillnet was set perpendicular to shore across contours to a depth stratified site with five depths in 1992

[2] changed from a fixed site where the gillnet was set parallel and close to shore to a depth stratified area with two depths (sites) in 1992

[3] two types of gillnet effort are used; both types consist of a graded series of mesh sizes attached in order by size from 38-153 mm at 13 mm intervals; one type has 15 ft of 38 mm mesh and 50 ft of all nine other mesh sizes the second type has 50 ft of all mesh sizes

[4] the basic sampling design of the program has been largely consistent since 1992; for years prior to 1992 consult field protocols and FISHNET project definitions for changes in sampling design.

TABLE 1.1.2. Species-specific catch in 2019 gill net sets from June 18 to October 30. "Standard catch" is the observed catch expanded to represent the catch in a 50 ft panel length of 1 1/2 inch mesh size in cases where only 15 ft was used. A total of 365 gill nets were set and 33 species comprising 12,794 fish were caught.

Species	Observed Catch	Standard Catch	Mean Weight (g)
Lake Sturgeon	1	1	1,560
Longnose Gar	259	268	1,548
Bowfin	8	8	2,506
Alewife	6,519	20,972	33
Gizzard Shad	65	74	903
Chinook Salmon	34	39	1,793
Rainbow Trout	2	2	1,521
Atlantic Salmon	4	4	2,310
Brown Trout	41	40	3,323
Lake Trout	762	774	3,713
Lake Whitefish	50	54	1,167
Cisco	175	180	490
Rainbow Smelt	6	11	18
Northern Pike	47	49	2,445
Longnose Sucker	5	5	1,563
White Sucker	112	112	774
Shorthead Redhorse	2	2	1,475
Common Carp	7	7	1,558
Brown Bullhead	26	34	319
Channel Catfish	7	7	1,649
Burbot	6	6	2,571
White Perch	1,238	1,522	121
White Bass	31	35	414
Rock Bass	65	100	97
Pumpkinseed	69	90	59
Bluegill	149	384	33
Smallmouth Bass	46	46	991
Largemouth Bass	18	27	334
Yellow Perch	1,780	4,462	74
Walleye	712	744	1,425
Round Goby	173	569	38
Freshwater Drum	340	358	1,158
Deepwater Sculpin	35	35	28

Northwest, Lake Ontario

Northwestern Depth Stratified Area, Nearshore and Offshore Areas (Port Credit; Tables 1.1.16-1.1.17)

In 2019, northwest Lake Ontario was sampled for the sixth consecutive year using a depth-stratified by area approach, spanning a wide range of depths (7.5-140m). Two nearshore visits and one offshore visit was made to the Port Credit area.

Lake-wide Depth Stratified Areas

Species specific catch per gill net by depth strata (7.5-140m) in Lake Ontario (excluding Middle Ground fixed site and Kingston Basin fixed sites and depth stratified areas) are summarized by area in Table 1.1.18. Northeast Lake Ontario includes Rocky Point nearshore/offshore, Wellington nearshore, and Brighton nearshore; Northcentral Lake Ontario includes Cobourg nearshore/offshore, and Whitby nearshore; Northwest Lake Ontario includes Port Credit nearshore and offshore; and Southwest Lake Ontario includes Port Dalhousie.

Bay of Quinte, Lake Ontario

Bay of Quinte, Fixed Sites (Conway, Hay Bay and Big Bay; Tables 1.1.19-1.1.21)

Three sites are used to monitor long-term trends in the Bay of Quinte fish community. Big Bay is a single-depth site; Hay Bay has two depths and Conway five depths. Average summer catch for the three sites are summarized graphically in Fig. 1.1.4 to illustrate abundance trends of the most abundant species from 1992-2019.

Bay of Quinte, Depth Stratified and Seasonal (Upper, Middle and Lower Bay of Quinte; Tables 1.1.22-1.1.23)

In 2019, effort was made to expend the depth and area sampled in the upper, middle and lower Bay of Quinte. To accomplish this, the Lake Ontario and Bay of Qunite Fish Community Index Gill Netting program was redesigned to reallocate a portion of Bay of Quinte fixed site sampling effort to randomly select sites within six depth strata based on their proportional representation in Bay of Quinte.

Species specific catch per gill net set by depth strata during the summer months (July/August) are shown in Table 1.1.22. The 2019 also included a seasonal component (June, July/August and October) in the upper and middle Bay of Quinte (Table 1.1.23). Together, along with fixed sites Big Bay, Hay Bay, and Conway, this netting provided a more complete description of the upper, middle, and lower Bay of Quinte fish community.

Species Highlights

Lake Whitefish

Forty-eight Lake Whitefish were caught and interpreted for age in the 2019 index gill nets (Table 1.1.24). Fish ranged in age from 1-26 years. Eighteen year-classes were represented. Twenty-three (48%) whitefish were from either the 2013, 2014 or 2015 year-classes.

Cisco

One hundred and thirty-six Cisco were caught and interpreted for age in 2019 index gill nets (Table 1.1.25). Fish ranged in age from 1-16 years. Twelve year-classes were represented. Ninety-six (71%) were from the 2014 year-classes.

Lake Trout

742 Lake Trout were caught and interpreted for age (CWT and age structures combined) in the 2019 index gill nets (Table 1.1.26). Fish ranged in age from 2-35 years. Twenty-three year-classes were represented. One hundred and sixteen (16%) Lake Trout were from either the 2012, 2013, or 2014 year-classes.

Walleye

Four hundred and fifty-two Walleye were caught and interpreted for age in the 2019 summer index gill nets (Table 1.1.27). One hundred four Walleye (23%) were age-4 (2015 year-class). In the Kingston Basin nearshore gill nets, 94% of Walleye were age-6 or greater, and in the Bay of Quinte gill nets, 96% were age-5 or less.

TABLE 1.1.3. Species-specific catch per gillnet set at **Brighton in Northeastern Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bowfin	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.05	-	-	0.10
Alewife	**34.82**	49.58	107.40	31.81	22.39	41.27	72.52	3.52	89.17	209.81	67.05	**69.45**	307.74	138.36	295.25	70.48	343.08	191.56	174.10	87.35	54.91
Gizzard Shad	**0.44**	-	-	-	-	-	-	-	-	-	0.15	**0.02**	-	-	0.05	-	-	0.20	0.05	1.45	-
Coho Salmon	**0.004**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Chinook Salmon	**0.74**	0.10	0.35	1.25	0.45	0.42	0.20	0.62	0.30	0.05	0.71	**0.44**	0.83	0.10	-	0.20	-	0.20	0.22	0.05	0.70
Rainbow Trout	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	0.10	-	-	-	-	-	0.05
Atlantic Salmon	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	0.05	-
Brown Trout	**0.12**	-	-	0.35	0.20	0.05	0.15	0.10	0.30	0.15	1.25	**0.26**	0.60	0.50	0.15	0.10	0.20	0.20	-	0.30	0.10
Lake Trout	**5.22**	1.30	1.05	0.40	0.95	0.15	0.30	0.05	-	0.05	0.10	**0.44**	0.15	0.20	0.10	0.85	0.57	1.09	0.83	0.65	1.65
Lake Whitefish	**0.42**	0.05	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	0.05	-	-
Cisco	**0.12**	-	-	0.05	-	0.10	0.10	0.05	0.25	0.05	-	**0.06**	0.05	-	0.05	0.05	0.10	0.55	0.32	0.40	0.25
Round Whitefish	**1.19**	-	0.25	0.05	0.05	-	-	-	-	-	-	**0.04**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.11**	-	-	-	-	-	-	-	-	-	0.10	**0.01**	0.22	-	0.05	-	-	-	0.17	0.10	-
Northern Pike	**0.08**	-	-	0.05	-	0.10	-	0.20	0.05	0.05	-	**0.05**	0.05	-	-	0.15	0.30	-	-	0.05	0.05
White Sucker	**0.41**	-	0.10	-	0.05	0.15	0.05	0.10	-	-	0.05	**0.05**	0.05	-	-	0.15	-	0.35	-	-	0.10
Lake Chub	**-**	-	-	-	-	-	-	-	0.17	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Common Carp	**0.12**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	0.05	-	-	-
Brown Bullhead	**0.10**	0.52	0.20	0.85	0.27	0.35	-	0.25	0.22	0.05	-	**0.27**	-	-	-	0.17	-	-	-	-	-
Channel Catfish	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
American Eel	**0.004**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Burbot	**0.05**	0.05	-	-	-	-	0.05	0.05	-	-	-	**0.02**	-	-	-	0.05	0.05	0.05	0.15	-	0.10
White Perch	**0.03**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rock Bass	**0.88**	-	0.32	0.63	0.76	0.32	0.15	0.32	0.80	0.33	0.33	**0.39**	-	1.65	-	0.22	0.05	0.47	1.52	0.37	0.57
Pumpkinseed	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Smallmouth Bass	**0.00**	-	-	-	-	-	-	-	-	-	0.05	**0.01**	-	-	-	-	-	-	-	-	-
Yellow Perch	**15.64**	-	0.50	0.50	0.33	1.16	2.99	1.57	4.83	0.17	0.17	**1.22**	-	1.98	2.36	0.17	-	1.54	-	-	-
Walleye	**0.44**	-	0.15	0.25	0.50	0.20	0.05	0.75	0.10	-	0.10	**0.21**	-	0.43	0.05	0.15	0.10	0.45	0.20	0.20	0.10
Round Goby	**-**	-	-	0.17	0.17	4.45	1.98	0.63	1.70	1.32	0.99	**1.14**	1.21	2.31	0.99	0.17	1.82	3.30	2.64	2.64	1.65
Freshwater Drum	**0.17**	-	-	0.15	0.10	-	0.05	0.05	-	-	-	**0.04**	-	-	-	-	-	-	-	0.05	-
Total catch	**61**	52	110	37	26	49	79	8	98	212	71	**74**	311	146	299	73	346	200	180	94	60
Number of species	**13**	6	9	15	12	12	12	14	11	10	12	**11**	9	8	10	13	9	14	11	13	13
Number of sets		20	20	20	20	20	20	20	20	20	20		20	10	20	20	20	20	20	20	20

TABLE 1.1.4. Species-specific catch per gillnet set at **Wellington in Northeastern Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**17.25**	20.85	50.58	62.26	38.23	83.22	137.33	1.54	79.05	447.66	215.85	**113.66**	475.42	140.74	460.72	99.79	245.34	104.95	143.58	44.79	86.81
Gizzard Shad	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	0.05
Chinook Salmon	**0.33**	0.10	0.20	0.35	1.20	0.10	0.20	0.35	0.45	-	0.10	**0.31**	0.65	-	0.15	0.15	0.15	0.25	0.10	0.52	0.10
Rainbow Trout	**-**	-	-	-	-	-	-	-	-	-	0.05	**0.01**	-	-	-	-	-	-	-	-	-
Brown Trout	**0.11**	0.15	0.30	0.15	0.40	0.15	-	0.10	0.40	0.45	1.55	**0.37**	0.60	0.80	0.40	0.05	0.15	0.30	-	0.70	0.10
Lake Trout	**7.58**	2.40	2.20	0.85	1.85	0.45	0.70	0.40	0.05	0.25	0.10	**0.93**	0.25	0.40	0.05	0.20	-	0.05	1.10	1.75	0.05
Lake Whitefish	**0.61**	0.10	0.05	-	-	-	-	-	-	-	-	**0.02**	0.35	-	-	0.20	-	0.05	-	-	0.05
Cisco	**0.11**	-	-	-	-	-	0.05	-	-	0.05	0.05	**0.02**	0.05	-	-	-	-	0.20	0.35	0.05	0.15
Round Whitefish	**0.06**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.07**	-	-	-	-	-	-	-	0.05	0.10	0.17	**0.03**	0.05	0.10	-	0.05	-	0.17	0.47	0.05	-
Northern Pike	**0.01**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	0.05	-	0.05	-	-	-	-	-	-
White Sucker	**0.05**	-	-	-	0.17	-	-	0.05	-	-	-	**0.02**	-	-	-	-	-	-	-	-	0.05
Greater Redhorse	**-**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Lake Chub	**0.03**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Common Carp	**0.02**	-	-	-	-	0.05	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	0.05	-
Brown Bullhead	**0.00**	0.05	0.10	-	0.05	0.15	-	-	-	-	-	**0.04**	-	-	-	-	-	-	-	-	-
Burbot	**0.23**	0.10	0.25	0.05	0.05	-	0.10	-	0.05	-	0.05	**0.07**	-	0.10	-	0.05	-	0.15	0.05	0.05	0.15
White Perch	**0.00**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rock Bass	**0.35**	0.17	-	0.52	0.10	0.05	-	-	0.58	-	-	**0.14**	-	-	0.05	-	-	0.10	0.10	0.05	0.27
Smallmouth Bass	**0.03**	-	-	-	-	-	-	-	-	-	-	**-**	0.05	-	-	-	-	-	-	-	-
Yellow Perch	**31.00**	12.67	6.22	17.96	10.31	14.51	7.25	23.48	17.65	25.87	14.11	**15.00**	2.47	19.87	11.71	16.80	7.50	26.95	28.91	5.98	3.39
Walleye	**0.36**	-	0.10	0.20	0.25	0.20	0.10	0.10	-	-	0.05	**0.10**	0.05	-	0.10	0.05	-	0.05	0.10	0.25	0.15
Round Goby	**-**	-	-	0.33	0.99	25.92	18.39	2.03	11.50	1.16	6.94	**6.73**	3.35	2.97	3.30	0.33	2.53	2.64	1.65	1.82	4.79
Freshwater Drum	**0.25**	-	0.05	-	0.05	0.05	-	-	-	-	-	**0.02**	-	0.10	-	-	-	-	-	-	-
Total catch	**58**	37	60	83	54	125	164	28	110	476	239	**137**	483	165	477	118	256	136	176	56	96
Number of species	**11**	9	10	11	12	11	8	8	9	7	11	**10**	12	8	9	10	5	12	10	12	13
Number of sets		20	20	20	20	20	20	20	20	20	20		20	10	20	20	20	20	20	20	20

TABLE 1.1.5. Species-specific catch per gillnet set at **Rocky Point (nearshore sites only) in Northeastern Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**131.93**	105.42	141.61	86.90	155.51	293.30	142.82	135.36	231.74	176.68	662.38	**213.17**	530.40	127.84	512.07	192.74	135.43	225.92	69.31	166.90	46.78
Chinook Salmon	**0.23**	-	0.10	0.25	0.55	0.15	0.27	0.10	0.15	-	0.70	**0.23**	0.20	-	0.25	0.15	0.05	0.43	0.15	0.45	0.10
Rainbow Trout	**-**	-	-	-	-	-	0.05	-	-	-	-	**0.01**	-	-	0.05	-	-	-	-	-	-
Atlantic Salmon	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Brown Trout	**0.09**	-	1.20	0.05	0.25	0.25	0.45	0.10	0.50	-	0.80	**0.36**	1.55	1.10	0.95	0.05	0.15	0.15	-	0.85	0.10
Lake Trout	**5.40**	1.67	0.80	0.10	0.60	-	0.47	0.05	0.25	0.05	0.32	**0.43**	1.35	4.10	0.75	1.90	1.10	0.40	0.20	1.03	1.00
Lake Whitefish	**0.69**	0.05	-	0.30	0.10	0.05	0.10	0.05	0.25	0.45	-	**0.14**	0.10	0.30	0.10	0.10	-	-	-	-	0.05
Cisco	**0.07**	-	-	-	-	-	-	-	-	-	-	**-**	0.05	-	-	-	-	0.05	0.20	0.05	0.05
Chub	**-**	0.17	-	-	-	-	-	-	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.03**	-	-	-	-	-	-	-	0.17	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Northern Pike	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	0.05	-
White Sucker	**0.04**	0.05	-	-	-	-	-	0.05	-	-	-	**0.01**	-	-	-	-	-	-	0.05	0.05	-
Lake Chub	**0.11**	-	0.17	-	-	-	-	0.05	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Common Carp	**0.01**	-	-	-	0.10	0.05	-	-	-	-	-	**0.02**	-	-	-	-	-	-	0.05	-	-
Brown Bullhead	**-**	-	-	-	0.05	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Channel Catfish	**-**	-	-	-	-	-	-	-	-	0.05	-	**0.01**	-	-	-	-	-	-	-	-	-
Stonecat	**0.01**	0.70	0.17	0.05	-	0.10	0.05	0.27	-	-	-	**0.13**	-	-	-	-	-	-	-	-	-
Burbot	**0.28**	0.15	0.35	0.10	0.05	0.30	-	-	-	-	0.05	**0.10**	-	-	-	0.05	-	0.05	-	-	-
White Perch	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	0.05						
Rock Bass	**0.31**	0.32	0.53	0.87	0.05	0.35	0.55	0.63	0.86	0.32	0.86	**0.53**	0.05	0.73	0.48	0.27	0.98	0.17	0.65	0.43	0.33
Smallmouth Bass	**1.05**	0.70	0.65	0.67	0.80	0.42	0.42	0.52	0.55	0.15	0.50	**0.54**	0.20	0.53	0.37	0.10	0.10	0.77	1.07	1.33	0.75
Yellow Perch	**0.06**	-	-	-	-	0.17	0.81	0.88	0.22	0.33	1.75	**0.42**	0.60	0.66	-	-	-	0.17	0.17	-	-
Walleye	**0.67**	-	0.25	0.10	0.80	1.60	0.65	0.85	0.65	0.15	0.45	**0.55**	0.10	0.20	0.70	1.10	1.15	0.20	1.75	1.88	1.10
Round Goby	**-**	-	-	-	-	2.15	8.48	71.25	9.50	28.26	15.93	**13.56**	6.54	7.60	13.88	4.51	0.83	7.07	8.26	9.14	1.32
Freshwater Drum	**0.19**	0.10	0.05	0.05	0.30	-	0.10	-	0.20	0.15	0.15	**0.11**	-	-	-	-	-	-	-	0.10	-
Total catch	**141**	109	146	89	159	299	155	210	245	207	684	**230**	541	143	530	201	140	235	82	182	52
Number of species	**10**	10	11	11	12	12	13	13	12	10	11	**12**	11	9	11	10	8	11	11	12	10
Number of sets		20	20	20	20	20	20	20	20	20	20		20	10	20	20	20	20	20	20	20

TABLE 1.1.6. Species-specific catch per gillnet set at **Flatt Point in the Kingston Basin of Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	0.05	-
Lake Sturgeon	**0.01**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Alewife	**78.18**	45.97	5.17	6.87	101.38	141.78	203.18	140.02	297.45	305.56	620.72	**186.81**	908.17	818.60	337.43	11.57	293.48	487.80	885.96	133.43	98.19
Gizzard Shad	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	0.15	-
Chinook Salmon	**0.16**	-	-	-	0.35	0.05	-	0.10	-	-	0.05	**0.06**	0.05	0.15	-	-	-	-	-	0.05	0.10
Rainbow trout	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.15							
Brown Trout	**0.02**	0.10	-	-	-	-	0.10	-	0.10	0.05	0.10	**0.05**	0.55	0.55	0.20	0.05	-	-	0.05	0.10	0.15
Lake Trout	**10.72**	2.47	0.75	1.25	0.98	0.88	0.30	1.22	0.92	2.07	1.00	**1.18**	1.95	0.60	2.20	2.45	0.70	0.72	0.25	0.50	1.10
Lake Whitefish	**4.17**	4.60	2.72	0.85	2.80	0.55	0.20	1.30	0.75	0.15	0.25	**1.42**	0.25	0.95	0.20	0.05	0.42	0.35	0.05	0.05	0.27
Cisco	**0.83**	-	-	0.10	-	0.05	-	-	-	-	-	**0.02**	-	0.05	0.05	-	-	0.15	0.05	0.05	0.15
Coregonus sp.	**0.00**	0.05	-	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.22**	-	-	-	-	-	0.05	-	0.05	-	0.10	**0.02**	-	-	-	-	-	-	-	-	-
Northern Pike	**0.08**	0.10	-	-	0.05	0.15	0.05	0.05	0.25	0.15	0.10	**0.09**	0.10	0.10	-	0.05	0.65	0.15	0.15	0.05	0.10
White Sucker	**0.98**	0.45	0.45	0.70	1.00	0.60	0.35	0.20	0.50	0.05	0.20	**0.45**	0.30	0.25	-	-	0.05	-	-	-	-
Brown Bullhead	**0.05**	-	0.05	0.05	0.05	0.05	-	0.05	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Stonecat	**-**	0.05	0.05	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Burbot	**0.02**	0.10	-	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
White Perch	**0.02**	-	-	0.10	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Rock Bass	**0.87**	0.53	0.05	0.05	0.22	-	0.70	0.25	0.27	0.05	-	**0.21**	0.73	0.52	0.17	-	0.17	-	0.73	0.88	1.41
Smallmouth Bass	**0.06**	-	0.10	0.05	-	-	-	-	-	-	-	**0.02**	-	0.05	-	-	-	0.05	-	0.05	0.10
Yellow Perch	**22.70**	5.24	5.02	8.62	41.35	29.83	51.51	20.53	5.77	5.06	12.17	**18.51**	9.58	2.32	0.22	1.16	1.75	2.97	1.47	-	0.17
Walleye	**0.10**	-	-	-	-	0.05	0.05	0.05	0.10	0.15	0.25	**0.07**	0.10	0.10	-	-	0.15	0.10	-	0.05	0.25
Round Goby	**-**	-	-	-	0.99	4.96	12.26	8.18	1.70	0.50	2.81	**3.14**	1.49	3.97	0.17	-	0.50	0.99	2.31	1.49	0.50
Freshwater Drum	**0.08**	-	-	-	-	-	-	-	-	-	-	**-**	0.05	-	-	-	-	0.05	-	0.05	0.05
Total catch	**119**	60	14	19	149	179	269	172	308	314	638	**212**	923	828	341	15	298	493	891	137	103
Number of species	**10**	11	9	11	10	11	11	11	11	10	11	**11**	12	14	8	6	9	10	9	14	13
Number of sets		20	20	20	20	20	20	20	20	20	20		20	20	20	20	20	20	20	20	20

TABLE 1.1.7. Species-specific catch per gillnet set at **Grape Island in the Kingston Basin of Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lake Sturgeon	**0.01**	0.05	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Alewife	**116.14**	155.14	15.03	47.83	42.83	225.83	376.62	153.49	358.67	244.82	719.98	**234.02**	1,244.67	675.03	463.46	43.11	225.54	1,135.89	930.37	677.92	164.60
Chinook Salmon	**0.02**	-	-	-	-	0.15	-	0.10	-	-	-	**0.03**	-	-	-	-	-	-	-	0.10	-
Brown Trout	**0.02**	-	-	-	0.05	0.05	0.10	-	-	-	0.05	**0.03**	0.25	0.10	0.10	0.10	-	-	-	0.15	0.05
Lake Trout	**6.56**	0.30	0.57	0.45	0.10	0.15	0.15	0.57	0.05	0.40	0.20	**0.29**	0.20	0.20	1.78	2.27	1.70	0.25	0.35	0.72	1.35
Lake Whitefish	**2.86**	0.20	0.20	0.15	-	0.10	0.10	0.20	0.10	0.10	0.10	**0.13**	0.10	0.10	0.15	-	-	0.20	0.40	0.05	0.35
Cisco	**0.08**	-	-	-	-	-	-	-	-	-	0.15	**0.02**	0.05	-	0.10	0.05	-	0.40	0.25	0.32	0.25
Rainbow Smelt	**0.03**	-	-	-	-	-	-	-	-	0.05	-	**0.01**	-	-	-	-	-	-	-	-	-
Northern Pike	**-**	-	-	-	-	-	-	0.05	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
White Sucker	**0.04**	-	-	0.05	-	-	-	0.05	0.05	-	-	**0.02**	0.10	0.05	-	0.05	0.05	0.10	0.30	0.30	0.05
Silver Redhorse	**0.00**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Brown Bullhead	**-**	-	-	0.15	0.17	-	0.05	-	-	-	-	**0.04**	-	-	-	-	-	-	-	-	-
Channel Catfish	**0.02**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Stonecat	**0.04**	-	0.17	0.43	0.33	-	-	-	-	-	-	**0.09**	-	-	-	-	-	-	-	-	-
Burbot	**0.17**	-	0.10	0.05	-	-	-	-	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Threespine Stickleback	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White perch	**0.07**	-	-	0.10	0.10	0.05	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Rock Bass	**1.43**	1.01	0.05	0.72	0.33	0.17	0.37	0.93	1.01	0.43	0.35	**0.54**	0.05	0.80	0.20	0.05	0.17	0.22	0.05	0.38	0.05
Smallmouth Bass	**0.68**	0.15	0.48	0.47	0.48	0.05	0.52	0.15	0.35	0.32	0.25	**0.32**	0.50	0.85	0.50	0.27	0.45	0.60	0.70	2.02	0.30
Yellow Perch	**14.36**	3.54	19.72	18.54	45.07	12.18	18.13	15.82	7.44	6.98	6.91	**15.43**	4.61	0.98	2.63	1.37	2.25	1.70	2.88	2.29	0.98
Walleye	**2.90**	0.50	0.10	0.80	0.37	0.20	2.55	0.50	0.95	0.15	1.05	**0.72**	0.70	1.30	0.40	0.35	1.40	0.90	1.30	1.25	-
Round Goby	**-**	-	-	1.32	49.22	4.51	8.35	7.97	1.09	-	1.65	**7.41**	1.16	1.42	1.98	-	0.22	0.50	0.88	2.15	0.50
Freshwater Drum	**0.28**	0.05	-	0.20	-	-	0.05	-	0.05	-	0.05	**0.04**	-	-	-	-	-	-	-	0.10	-
Total catch	**146**	161	36	71	139	243	407	180	370	253	731	**259**	1,252	681	471	48	232	1,141	937	688	168
Number of species	**11**	9	9	16	11	11	11	11	10	8	11	**11**	11	10	10	9	8	10	10	13	10
Number of sets		20	20	20	20	20	20	20	20	20	20		20	20	20	20	20	20	20	20	20

TABLE 1.1.8 Species-specific catch per gillnet set at **Melville Shoal in the Kingston Basin of Lake Ontario**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	2000 mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2010 mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lake Sturgeon	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.05	-	-	-
Alewife	**71.63**	40.83	39.19	14.14	82.41	177.38	195.64	83.04	134.66	496.46	620.85	**188.46**	666.70	223.18	553.63	93.28	170.89	805.59	710.49	490.25	294.79
Gizzard Shad	**0.00**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Chinook Salmon	**0.03**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.05	-	0.05	-
Rainbow Trout	**-**	-	-	-	-	-	-	0.05	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Brown Trout	**-**	-	-	-	-	-	0.05	-	0.10	-	0.15	**0.03**	0.05	0.05	-	0.05	-	-	-	-	0.10
Lake Trout	**3.54**	0.10	0.05	0.05	0.05	-	0.05	0.05	0.10	0.40	0.15	**0.10**	1.02	0.10	0.35	1.00	0.55	0.20	0.25	0.25	0.20
Lake Whitefish	**1.59**	0.10	0.20	0.30	-	-	-	0.05	-	-	-	**0.07**	-	-	-	-	-	-	-	-	-
Cisco	**0.04**	-	-	-	-	-	-	-	-	-	0.20	**0.02**	0.05	0.05	-	0.05	0.27	0.38	0.90	0.20	-
Coregonus sp.	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.08**	-	-	-	-	-	-	-	0.17	-	0.05	**0.02**	-	-	-	-	-	-	-	-	-
Northern Pike	**0.07**	0.10	0.10	0.05	-	-	-	-	-	0.10	0.10	**0.05**	-	-	-	-	0.05	0.05	-	-	-
White Sucker	**0.03**	0.05	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	0.05	-	-
Greater Redhorse	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Moxostoma sp.	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Common Carp	**0.02**	-	-	0.05	0.10	-	-	-	0.05	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Channel Catfish	**0.15**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Stonecat	**0.03**	0.33	0.43	-	-	0.50	-	-	-	-	-	**0.13**	-	-	-	-	-	-	-	-	-
Burbot	**0.10**	-	-	-	0.05	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
White Perch	**0.20**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rock Bass	**1.88**	1.99	0.98	1.33	2.25	1.84	1.82	1.72	3.16	0.80	1.28	**1.72**	1.20	1.89	0.42	1.99	1.51	1.02	1.33	0.58	0.40
Pumpkinseed	**-**	0.17	-	-	-	-	-	-	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Smallmouth Bass	**0.53**	0.42	0.25	0.40	0.27	0.15	0.20	0.57	0.70	0.25	0.60	**0.38**	0.40	1.00	-	0.87	0.10	0.20	0.70	0.37	0.70
Yellow Perch	**28.76**	12.57	26.57	20.20	49.72	16.14	44.66	38.74	18.75	9.75	25.97	**26.31**	10.38	8.82	3.92	12.58	6.03	6.11	13.68	7.33	4.50
Walleye	**8.73**	4.63	3.90	3.50	5.08	4.45	5.25	7.30	4.55	7.50	12.45	**5.86**	10.10	7.05	0.55	11.70	7.00	6.95	12.55	9.35	9.10
Round Goby	**-**	-	-	-	9.02	9.80	5.34	4.84	2.18	1.16	0.50	**3.28**	0.71	1.16	1.16	-	0.50	-	0.83	1.21	-
Freshwater Drum	**0.09**	0.05	-	0.05	-	-	-	0.22	-	-	0.10	**0.04**	0.05	-	-	-	0.05	-	-	-	-
Total catch	**118**	61	72	40	149	210	253	137	164	516	662	**227**	691	243	560	122	187	821	741	510	310
Number of species	**12**	12	9	12	9	7	8	10	10	8	12	**10**	10	9	6	8	10	10	9	9	7
Number of sets		20	20	20	20	20	20	20	20	20	20		20	20	20	20	20	20	20	20	10

TABLE 1.1.9. Species-specific catch per gill net set at **Middle Ground in Northeastern Lake Ontario**, 1992-2019 (no sampling in 2012). Annual catches are averages for 2 gill net gangs set during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gill nets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Longnose Gar	**-**	-	-	0.25	-	-	-	-	-	-	-	**0.03**	-		-	-	-	-	-	-	-
Alewife	**3.61**	0.83	0.83	-	-	-	-	-	0.83	8.26	3.30	**1.40**	190.83		39.90	23.96	56.17	-	2.48	-	71.87
Gizzard Shad	**0.39**	-	-	-	-	0.50	-	0.25	-	-	0.25	**0.10**	-		-	-	-	-	0.25	2.25	-
Brown Trout	**0.11**	-	-	-	-	-	0.25	-	0.25	0.50	0.25	**0.13**	0.25		-	-	-	-	-	-	0.25
Lake Trout	**0.90**	-	-	-	-	-	0.25	-	-	-	-	**0.03**	-		-	-	-	-	-	-	1.25
Northern Pike	**0.34**	-	-	0.50	-	0.25	0.25	1.50	1.00	1.25	0.25	**0.50**	1.25		1.25	2.00	1.00	0.50	0.50	0.50	1.25
White Sucker	**1.40**	1.50	3.08	-	2.08	0.75	1.25	4.00	2.25	1.00	5.83	**2.17**	3.25		-	-	0.25	3.65	1.00	0.75	1.00
Silver redhorse	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-		-	-	-	-	-	0.25	-
Common Carp	**0.41**	0.50	-	0.75	0.50	-	-	-	-	-	-	**0.18**	-		-	-	0.25	0.75	0.25	-	0.25
Brown Bullhead	**1.42**	2.00	0.50	2.15	0.25	1.58	0.83	0.75	0.25	-	-	**0.83**	0.25		-	-	-	-	0.25	-	0.25
White Perch	**0.08**	-	-	-	-	-	-	-	-	-	-	**-**	-		0.50	-	-	-	-	0.25	-
Rock Bass	**1.47**	1.08	0.25	0.50	0.75	0.50	-	1.08	-	-	0.25	**0.44**	-		0.25	-	-	1.65	1.08	0.25	1.08
Pumpkinseed	**0.18**	-	-	-	-	-	-	-	-	-	-	**-**	-		-	-	-	-	-	-	-
Bluegill	**0.06**	-	-	-	-	-	-	-	-	-	-	**-**	0.25		-	-	-	-	-	-	-
Smallmouth Bass	**0.02**	-	-	-	0.25	-	-	0.25	-	-	-	**0.05**	-		-	-	-	-	-	-	-
Largemouth Bass	**0.06**	-	-	-	-	-	-	-	-	-	-	**-**	-		-	-	-	-	-	-	-
Yellow Perch	**56.68**	43.38	60.90	25.86	68.12	29.34	105.73	29.26	44.35	22.65	13.64	**44.32**	68.09		80.52	25.53	43.78	75.99	38.12	10.86	51.84
Walleye	**2.44**	0.25	0.50	1.00	0.50	0.75	1.25	3.50	0.75	0.75	0.25	**0.95**	0.25		0.50	2.33	-	4.00	0.50	1.00	3.83
Freshwater Drum	**0.57**	-	0.25	-	3.00	0.25	-	0.50	-	0.50	-	**0.45**	-		-	-	-	0.25	-	1.50	-
Total catch	**70**	50	66	31	75	34	110	41	50	35	24	**52**	264		123	54	101	87	44	18	133
Number of species	**8**	7	7	7	8	8	7	9	7	7	8	**8**	8		6	4	5	7	9	9	10
Number of sets		4	4	4	4	4	4	4	4	4	4		4	-	4	4	4	4	4	4	4

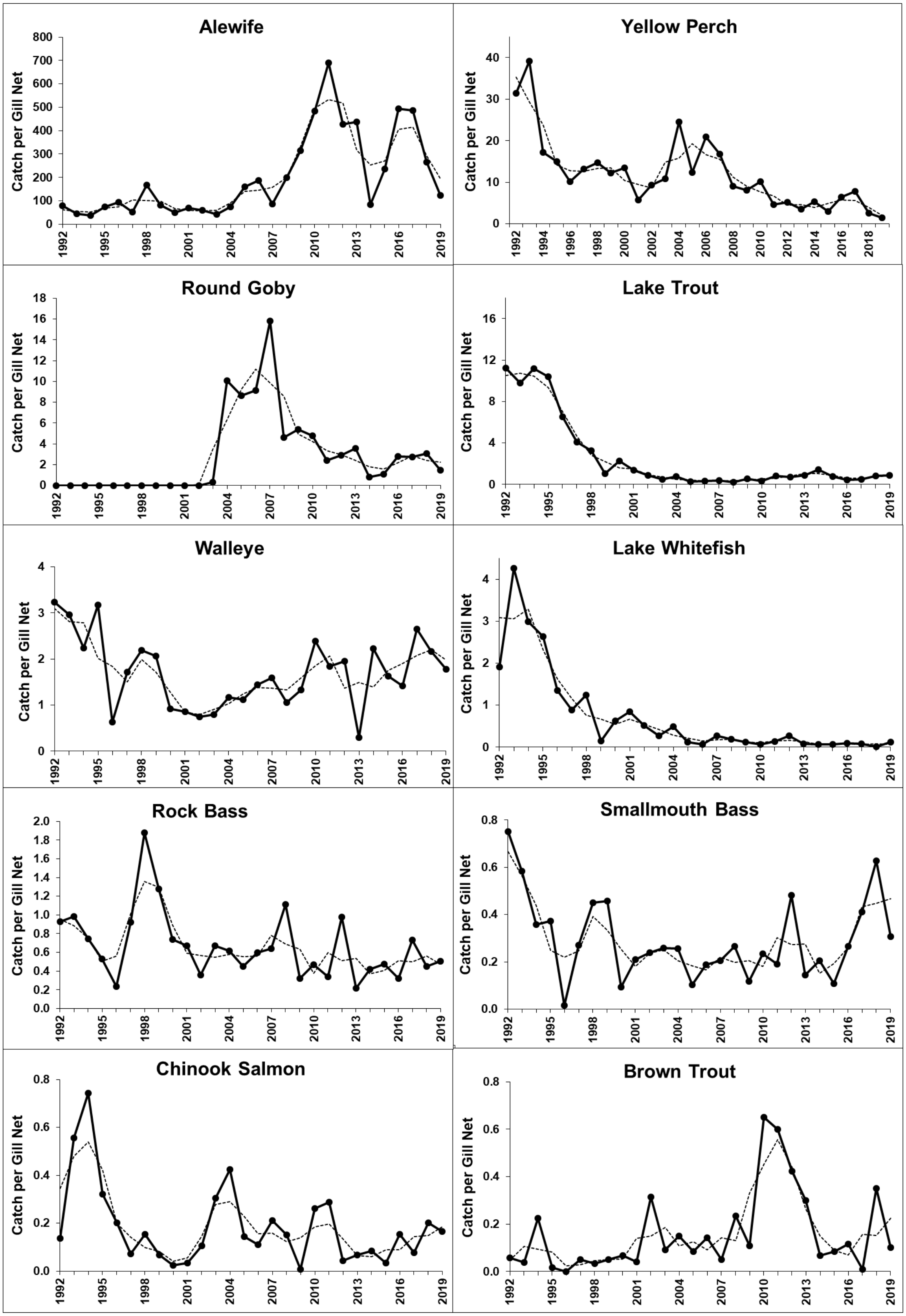


FIG. 1.1.2. Abundance trends for the most common species caught in gill nets at six depth-stratified transects (nearshore out to 30 m) in northeastern Lake Ontario (Melville Shoal, Grape Island, Flatt Point, Rocky Point, Wellington and Brighton; see Fig. 1.1.1). Annual catch per gill net values are unweighted means. Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.1.10. Species-specific catch per gillnet set at **Rocky Point (offshore sites only) in Northeastern Lake Ontario**, 1997-2019 (no sampling in 2006, 2007 or 2010). Annual catches are averages for 2 or 3 gillnet gangs set at each of up to 6 depths (40, 50, 60, 80, 100 or 140 m) during the visit during early-summer. Mean catches for 1997-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1997-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**4.69**	12.25	0.38	9.21	14.46	1.83			23.92	40.67		**14.67**	35.13	2.58	13.50	41.46	62.71	42.22	7.28	22.72	1.44
Lake Trout	**5.05**	6.81	6.25	4.17	2.17	1.83			1.46	1.88		**3.51**	2.42	2.00	5.92	1.46	4.00	7.33	5.11	2.78	4.89
Lake Whitefish	**0.50**	0.13	-	0.08	-	0.08			0.25	0.50		**0.15**	0.13	-	0.67	0.67	0.29	0.39	-	-	-
Cisco	**0.13**	-	0.13	0.08	0.21	-			-	-		**0.06**	-	-	-	0.04	0.04	-	-	-	0.06
Coregonus sp.	**-**	-	-	-	-	-			-	-		**-**	-	-	-	-	0.04	-	-	-	-
Rainbow Smelt	**0.41**	-	0.19	-	-	-			0.08	0.08		**0.05**	0.08	-	0.08	0.13	-	-	-	-	-
Burbot	**0.09**	-	-	-	0.04	-			-	-		**0.01**	-	-	-	-	-	-	-	-	-
White Perch	**-**	-	-	-	-	-			-	-		**-**	-	-	-	-	-	0.06	-	-	-
Round Goby	**-**	-	-	-	-	-			-	-		**-**	-	0.08	-	-	0.04	0.22	-	-	-
Slimy Sculpin	**0.08**	0.06	-	0.04	0.04	-			0.08	-		**0.03**	-	-	-	-	-	-	-	-	-
Deepwater Sculpin	**-**	-	-	-	-	-			-	-		**-**	-	-	-	-	0.04	-	0.17	-	0.11
Total catch	**11**	19	7	14	17	4			26	43		**18**	38	5	20	44	67	50	12	26	6
Number of species	**6**	4	4	5	5	3			5	4		**4**	4	3	4	5	7	5	3	2	4
Number of sets		16	16	24	24	24	-	-	24	24	-		24	12	12	24	24	18	18	18	18

TABLE 1.1.11. Species-specific catch per gillnet set at **EB02 in the Kingston Basin of Lake Ontario**, 1992-2019. Annual catches are averages for 3-8 gillnet gangs set during each of 2-3 visits. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Lake Sturgeon	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Alewife	**40.00**	17.83	0.25	0.25	8.67	1.75	4.50	3.25	2.92	7.46	157.00	**20.39**	2.45	60.75	9.13	1.50	15.21	356.88	30.95	2.94	7.09
Chinook Salmon	**0.05**	0.25	-	0.04	0.04	-	-	0.04	-	0.13	0.08	**0.06**	-	0.13	0.04	-	0.17	0.11	0.22	0.67	0.44
Rainbow Trout	**-**	-	-	-	-	-	-	-	-	-	-	**-**	0.04	-	-	-	-	-	-	-	-
Atlantic Salmon	**-**	-	-	-	-	-	-	-	0.04	-	-	**0.00**	-	-	-	-	-	-	-	-	-
Brown Trout	**0.02**	0.08	-	-	-	-	-	-	0.04	-	0.21	**0.03**	0.04	-	-	-	0.08	-	0.11	-	-
Lake Trout	**20.57**	1.58	0.75	1.54	0.88	0.42	1.50	2.08	3.58	2.33	1.63	**1.63**	2.10	0.88	2.38	4.17	4.88	1.78	2.73	2.70	5.67
Lake Whitefish	**3.76**	0.25	0.42	0.08	0.17	-	0.25	0.17	0.46	0.08	0.04	**0.19**	0.13	-	-	0.13	-	-	-	0.22	0.56
Cisco	**0.20**	-	-	-	0.04	-	-	-	-	-	0.21	**0.03**	0.04	-	0.08	-	0.21	1.00	0.67	0.11	1.78
Rainbow Smelt	**0.56**	-	-	-	0.04	0.04	0.08	0.04	-	0.17	0.17	**0.05**	-	-	0.04	-	0.04	-	-	-	-
Burbot	**0.05**	0.08	-	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Trout-perch	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White Perch	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Rock Bass	**-**	-	-	-	-	-	-	-	-	-	0.04	**0.00**	-	-	-	-	-	-	-	-	-
Smallmouth Bass	**-**	-	-	-	-	-	-	-	-	0.04	-	**0.00**	-	-	-	-	0.04	-	-	-	-
Yellow Perch	**0.09**	-	0.28	0.04	2.92	0.50	0.71	0.17	0.42	0.13	0.25	**0.54**	0.04	0.13	0.04	-	0.04	0.22	-	-	-
Walleye	**0.04**	-	-	-	0.04	-	-	-	0.04	-	-	**0.01**	-	-	-	-	-	-	-	-	0.11
Round Goby	**-**	-	-	-	0.13	0.04	0.17	0.08	-	-	0.04	**0.05**	-	-	0.04	0.04	-	-	-	-	-
Freshwater drum	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Sculpin sp.	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Total catch	**65**	20	2	2	13	3	7	6	8	10	160	**23**	5	62	12	6	21	360	35	7	16
Number of species	**7**	6	4	5	9	5	6	7	7	7	10	**7**	7	4	7	4	8	5	5	5	6
Number of sets		12	12	24	24	24	24	24	24	24	24		24	16	24	24	24	9	9	9	9

TABLE 1.1.12. Species-specific catch per gillnet set at **EB06 in the Kingston Basin of Lake Ontario**, 1992-2019. Annual catches are averages for 3-8 gillnet gangs set during each of 2-3 visits. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
	mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Lake Sturgeon	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Alewife	**28.50**	15.67	0.58	0.79	2.79	1.88	2.46	6.44	11.25	1.29	75.88	**11.90**	17.96	13.19	13.75	1.46	1.08	33.78	253.98	0.73	38.77
Chinook Salmon	**0.02**	-	-	-	-	0.08	-	-	0.04	-	-	**0.01**	0.08	0.19	0.08	-	-	0.11	-	-	-
Rainbow Trout	**-**	-	-	-	-	-	-	0.04	-	-	-	**0.00**	-	-	0.04	-	-	-	-	-	-
Brown Trout	**-**	-	0.08	-	-	0.04	-	0.08	0.04	0.04	0.04	**0.03**	-	0.13	-	-	0.04	-	-	-	-
Lake Trout	**21.88**	1.58	2.33	2.04	2.79	2.04	2.46	2.63	3.38	2.96	4.96	**2.72**	3.29	4.44	4.13	4.08	5.04	4.11	0.67	2.00	2.78
Lake Whitefish	**6.36**	0.58	0.42	0.25	2.54	0.29	0.33	0.42	1.79	0.46	0.92	**0.80**	0.92	0.75	0.50	0.13	0.17	0.11	0.11	-	0.33
Cisco	**0.03**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.19	0.17	-	0.50	0.11	2.78	0.33	3.11
Rainbow Smelt	**0.52**	-	-	-	-	-	0.04	-	-	0.04	-	**0.01**	0.04	0.06	0.04	-	-	-	-	-	-
Common Carp	**-**	-	-	-	0.04	-	-	-	-	-	-	**0.00**	-	-	-	-	-	-	-	-	-
American Eel	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Burbot	**0.13**	0.17	0.08	0.04	0.04	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
White Perch	**0.01**	-	-	0.04	-	-	-	-	-	-	-	**0.00**	-	-	-	-	-	-	-	-	-
Smallmouth Bass	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	0.11
Yellow Perch	**-**	-	-	0.04	-	-	-	-	0.21	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Walleye	**0.01**	-	-	-	-	-	0.04	-	-	-	-	**0.00**	0.04	-	-	-	-	-	-	-	-
Round Goby	**-**	-	-	-	-	0.04	0.13	0.26	-	-	0.08	**0.05**	0.17	-	-	-	-	-	0.37	-	-
Lake Whitefish x Cisco	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	0.11	-	-
Total catch	**57**	18	4	3	8	4	5	10	17	5	82	**16**	23	19	19	6	7	38	258	3	45
Number of species	**6**	4	5	6	5	6	6	6	6	5	5	**5**	7	7	7	3	5	5	6	3	5
Number of sets		12	12	24	24	24	24	24	24	24	24		24	16	24	24	24	9	9	9	9

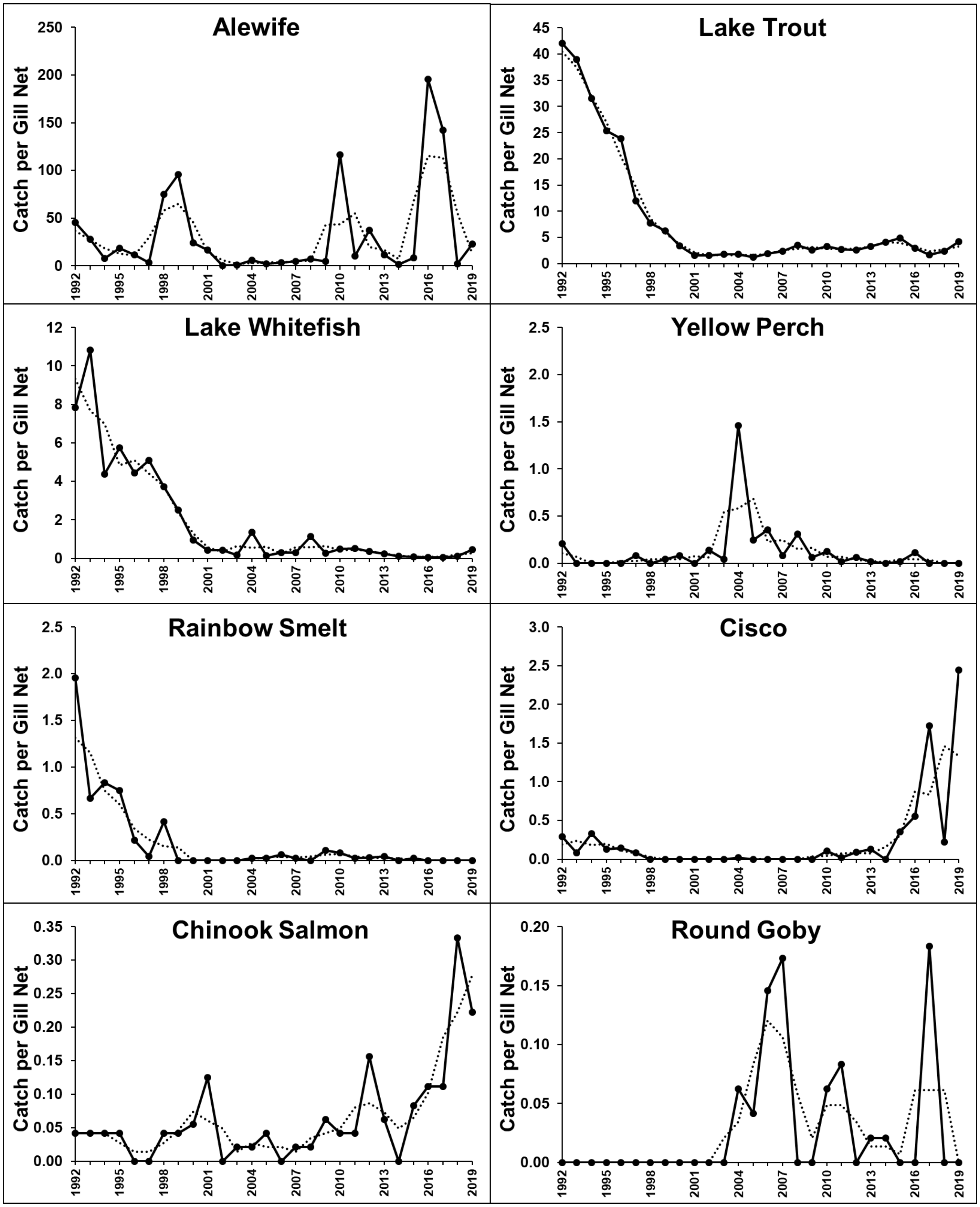


FIG. 1.1.3. Abundance trends (annual means) for the most common species caught in gill nets at the Kingston Basin deep sites, in eastern Lake Ontario (EB02 and EB06; see Fig. 1.1.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.1.13. Seasonal species-specific catch per gillnet set at six sites (**EB01, EB02, EB03, EB04, EB05, EB06**) in the **Kingston Basin** of Lake Ontario, 2019. Catches are averages for 3 gillnet gangs set during each of 3 visits (June, July August). The total number of species caught and gillnets set are indicated.

	EB01			EB02			EB03			EB04			EB05			EB06			All sites
Species	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Mean
Alewife	9.91	12.12	-	16.86	3.30	1.10	8.81	33.04	-	2.20	-	-	32.28	3.30	2.20	3.30	113.01	-	13.41
Chinook Salmon	-	-	1.00	-	-	1.33	-	-	0.33	-	-	-	-	-	0.33	-	-	-	0.17
Lake Trout	1.33	2.33	6.33	3.00	4.00	10.00	4.33	10.00	14.33	11.00	7.87	4.00	1.67	0.67	0.33	5.00	0.67	2.67	4.97
Lake Whitefish	0.33	-	2.00	-	-	1.67	-	-	0.33	0.33	1.00	1.67	-	-	-	-	0.33	0.67	0.46
Cisco	-	-	11.00	-	-	5.33	-	1.00	5.33	-	-	0.33	-	-	0.33	-	6.33	3.00	1.81
White Bass	-	-	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02
Rock Bass	-	-	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02
Smallmouth Bass	-	-	3.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.20
Yellow Perch	-	-	10.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.58
Walleye	-	-	2.00	-	-	0.33	-	-	-	-	-	-	-	-	-	-	-	-	0.13
Freshwater Drum	-	-	2.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.15
Total catch	12	14	39	20	7	20	13	44	20	14	9	6	34	4	3	8	120	7	22
Number of species	3	2	10	2	2	6	2	3	4	3	2	3	2	2	4	2	4	4	11
Number of sets	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	54

TABLE 1.1.14. Species-specific catch per gill net set at **Cobourg (nearshore sites only) in Northcentral Lake Ontario**, 2010-2019. Annual catches are averages for 2 gill net gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. The total number of species caught and gill nets set each year are indicated.

Species	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	351.96	196.13	56.77	23.78	7.48	136.71	271.45	200.83	222.05	153.24
Gizzard Shad	-	-	-	-	-	-	0.05	-	-	-
Coho Salmon	-	-	0.10	-	0.05	-	0.25	-	0.05	-
Chinook Salmon	0.68	2.05	1.82	0.44	0.40	0.20	1.70	0.05	0.30	-
Rainbow Trout	0.51	0.25	0.80	0.05	-	-	0.10	-	0.10	0.05
Atlantic Salmon	-	-	-	-	-	-	-	-	-	0.05
Brown Trout	0.13	0.65	0.50	0.42	0.25	0.40	0.65	0.05	0.45	-
Lake Trout	0.37	0.05	-	1.26	0.70	0.37	0.10	0.52	1.80	2.42
Lake Whitefish	-	0.05	-	-	-	-	0.05	-	-	-
Cisco	-	-	-	-	-	-	0.05	-		
Round Whitefish	0.07	0.05	-	-	-	-	-	-	-	-
Rainbow Smelt	-	0.33	-	-	-	-	-	-	-	0.17
White Sucker	0.10	0.37	0.50	0.26	0.15	0.20	0.05	-	0.10	-
Greater Redhorse	-	-	0.10	-	-	-	-	-	-	-
Burbot	-	-	-	-	0.05	-	-	-	0.10	-
Smallmouth Bass	-	0.05	-	-	-	-	-	0.05	-	-
Yellow Perch	0.33	-	0.10	-	-	-	-	0.05	-	-
Walleye	0.03	-	0.40	-	0.05	0.10	0.10	0.05	0.05	0.05
Round Goby	2.20	9.91	3.30	0.40	0.17	1.65	2.20	6.61	3.30	0.99
Freshwater Drum	-	0.05	0.10	-	-	-	-	-	-	-
Total catch	356	210	65	27	9	140	277	208	228	157
Number of species	10	12	11	7	9	7	12	8	10	7
Number of sets	30	20	10	19	20	20	20	20	20	20

TABLE 1.1.15. Species-specific catch per gill net set at **Cobourg (offshore sites only) in Northcentral Lake Ontario**, 1997, 1998, and 2014-2019. Annual catches are averages for 2 or 3 gill net gangs set at each of 4-6 depths (40, 50, 60, 80, 100 and 140 m) during each of 1-2 visits during summer. The total number of species caught and gill nets set each year are indicated.

Species	1997	1998	2014	2015	2016	2017	2018	2019
Alewife	67.16	42.75	29.75	171.50	23.00	338.18	75.38	4.56
Brown Trout	-	-	0.08	-	-	-	-	-
Lake Trout	0.50	0.88	0.17	0.42	3.11	1.11	0.44	1.11
Cisco	-	0.13	-	-	0.17	-	-	-
Rainbow Smelt	2.88	0.50	-	-	-	-	-	-
Round Goby	-	-	-	-	-	0.06	-	-
Slimy Sculpin	0.06	-	-	-	-	-	-	-
Deepwater Sculpin	-	-	3.67	0.25	0.89	0.61	0.11	0.50
Total catch	71	44	30	172	26	339	76	6
Number of species	4	4	4	3	4	4	3	3
Number of sets	16	16	12	12	18	18	18	18

TABLE 1.1.6. Species-specific catch per gillnet set at **Port Credit (nearshore sites only) in Northwestern Lake Ontario**, 2014-2019. Annual catches are averages for 2 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during summer. The total number of species caught and gillnets set each year are indicated.

Species	2014	2015	2016	2017	2018	2019
Sea Lamprey	-	-	-	0.10	-	-
Alewife	24.12	358.58	234.44	315.76	100.23	41.21
Gizzard Shad	-	-	-	0.10	-	-
Chinook Salmon	0.10	0.20	0.10	0.50	-	-
Rainbow Trout	-	-	-	0.20	-	-
Atlantic Salmon	-	0.10	-	-	-	0.10
Brown Trout	-	0.10	-	0.40	0.05	0.15
Lake Trout	1.20	0.80	0.20	0.10	0.15	0.30
Lake Whitefish	-	-	-	-	-	0.05
Longnose Sucker	-	0.20	0.10	-	-	0.25
White Sucker	0.20	1.50	0.20	0.60	0.25	0.50
White Perch	-	-	-	0.10	-	-
Rock Bass	-	-	-	0.10	0.27	-
Smallmouth Bass	-					0.05
Round Goby	-	1.32	5.72	6.58	7.77	7.27
Total catch	26	361	235	318	101	43
Number of species	4	8	6	11	6	7
Number of sets	10	10	10	10	20	20

TABLE 1.1.17. Species-specific catch per gill net set at **Port Credit (offshore sites only) in Northwestern Lake Ontario**, 2014-2019. Annual catches are averages for 3 gillnet gangs set at each of 4-6 depths (40, 50, 60, 80, 100, and 140 m) during summer. The total number of species caught and gillnets set each year are indicated.

Species	2014	2015	2016	2017	2018	2019
Alewife	79.92	7.33	4.33	39.11	7.06	1.61
Chinook Salmon	-	-	0.06	-	-	-
Lake Trout	1.17	1.42	2.94	1.00	1.06	1.33
Burbot	-	-	0.06	-	-	-
Round Goby	-	-	-	0.33	-	-
Deepwater Sculpin	2.00	1.42	2.06	1.00	0.83	1.33
Total catch	83	10	9	41	9	4
Number of species	3	3	5	4	3	3
Number of sets	12	12	18	18	18	18

TABLE 1.1.18. Species-specific catch per depth strata a depth-stratified areas in Lake Ontario; **Northeast** (Rocky Point nearshore/offshore, Wellington nearshore, Brighton nearshore), **Northcentral** (Cobourg nearshore/offshore, Whitby nearshore), **Northwest** (Port Credit nearshore/offshore), and **Southwest** (Port Dalhousie nearshore), 2019. Catches are averages for 2 or 3 gill net gangs during each of 1 or 2 visits during summer. The total number of species caught and number of gill nets set are indicated.

	Northeast											Northcentral										
Site depth (m)	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140
Lake Sturgeon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bowfin	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alewife	51.58	26.38	10.91	156.70	68.60	2.00	0.67	-	3.00	1.67	1.33	167.41	273.11	193.35	64.68	46.51	11.00	-	1.33	12.00	2.67	0.33
Gizzard Shad	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinook Salmon	-	-	0.33	0.92	0.25	-	-	-	-	-	-	-	0.13	-	-	0.13	-	-	-	-	-	-
Rainbow Trout	-	-	0.08	-	-	-	-	-	-	-	-	0.13	-	-	-	-	-	-	-	-	-	-
Atlantic Salmon	-	-	-	-	-	-	-	-	-	-	-	0.13	-	-	-	-	-	-	-	-	-	-
Brown Trout	-	0.08	0.25	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake Trout	0.33	0.67	1.00	0.83	1.67	11.67	11.00	5.00	1.00	0.33	0.33	1.50	2.75	0.50	0.50	1.29	3.33	2.67	0.33	-	0.33	-
Lake Whitefish	-	-	-	-	0.17	-	-	-	-	-	-	-	-	0.13	-	-	-	-	-	-	-	-
Cisco	-	0.08	0.42	0.17	0.08	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Smelt	-	-	-	-	-	-	-	-	-	-	-	-	-	0.54	0.13	-	-	-	-	-	-	-
Northern Pike	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longnose Sucker	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White Sucker	0.17	-	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Burbot	-	-	-	0.08	0.33	-	-	-	-	-	-	-	-	-	0.13	-	-	-	-	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock Bass	1.66	0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smallmouth Bass	0.92	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow Perch	5.57	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye	2.00	0.25	-	-	-	-	-	-	-	-	-	0.13	-	-	-	-	-	-	-	-	-	-
Round Goby	1.65	1.65	0.28	6.88	2.48	-	-	-	-	-	-	3.72	12.80	8.67	0.83	1.65	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Deepwater Sculpin	-	-	-	-	-	-	-	-	-	-	0.67	-	-	-	-	-	-	-	-	0.33	1.00	1.67
Total catch	64	30	13	166	74	14	12	5	4	2	2	173	289	203	66	50	14	3	2	12	4	2
Number of species	11	8	8	7	8	3	2	1	2	2	3	6	4	5	5	4	2	1	2	2	3	2
Number of sets	12	12	12	12	12	3	3	3	3	3	3	8	8	8	8	8	3	3	3	3	3	3

TABLE 1.1.18. (continued)

	Northwest											Southwest				
Site depth (m)	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140	7.5	12.5	17.5	22.5	27.5
Lake Sturgeon	-	-	-	-	-	-	-	-	-	-	-	0.25	-	-	-	-
Bowfin	-	-	-	-	-	-	-	-	-	-	-	0.25	-	-	-	-
Alewife	4.96	39.08	14.29	80.88	66.84	4.00	-	2.00	1.33	1.33	1.00	0.83	16.52	4.13	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinook Salmon	-	-	-	-	-	-	-	-	-	-	-	0.83	-	-	-	-
Rainbow Trout	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atlantic Salmon	0.25	-	-	0.25	-	-	-	-	-	-	-	0.25	-	-	-	-
Brown Trout	0.25	0.25	-	0.25	-	-	-	-	-	-	-	1.50	1.50	2.75	0.25	-
Lake Trout	-	-	-	0.50	1.00	3.00	2.00	0.67	1.00	1.00	0.33	-	-	2.50	19.08	23.83
Lake Whitefish	-	-	-	-	0.25	-	-	-	-	-	-	-	-	-	-	-
Cisco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Smelt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pike	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longnose Sucker	-	0.50	0.50	0.25	-	-	-	-	-	-	-	-	-	-	-	-
White Sucker	1.75	0.50	-	-	0.25	-	-	-	-	-	-	0.25	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-	-	0.50	-	-	-	-
Burbot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White Perch	-	-	-	-	-	-	-	-	-	-	-	0.50	-	-	-	-
Rock Bass	-	-	-	-	-	-	-	-	-	-	-	1.50	-	-	-	-
Smallmouth Bass	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow Perch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-	-	1.00	-	-	-	-
Round Goby	-	17.35	2.48	5.78	10.74	-	-	-	-	-	-	0.83	1.65	1.65	2.48	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-	-	0.25	-	-	-	-
Deepwater Sculpin	-	-	-	-	-	-	-	-	-	0.33	7.67	-	-	-	-	-
Total catch	7	58	17	88	79	7	2	3	2	3	9	9	20	11	22	24
Number of species	5	5	3	6	5	2	1	2	2	3	3	13	3	4	3	1
Number of sets	4	4	4	4	4	3	3	3	3	3	3	4	4	4	4	4

TABLE 1.1.19. Species-specific catch per gillnet set at **Conway in the Bay of Quinte**, 1993-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 20, 30 and 45 m) during each of 1-3 visits during summer. Mean catches for 1993-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1993-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**0.00**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	0.05	-	-	-	-	-
Lake Sturgeon	**0.00**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.05	-	-	-
Longnose Gar	**0.00**	0.05	-	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Alewife	**46.74**	8.25	2.90	6.00	16.20	69.45	11.55	19.35	71.00	74.95	175.35	**45.50**	176.44	112.70	86.30	54.60	137.08	468.20	37.10	4.12	9.25
Gizzard Shad	**0.01**	-	-	-	0.05	-	-	0.20	0.10	-	-	**0.04**	0.10	-	-	-	-	-	0.05	-	-
Chinook Salmon	**0.03**	0.05	-	0.05	0.10	-	-	0.10	0.10	0.10	0.05	**0.06**	0.15	-	-	0.10	0.10	-	0.17	0.17	0.66
Rainbow Trout	**-**	-	-	-	-	0.05	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Atlantic Salmon	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Brown Trout	**0.29**	0.10	0.05	0.35	0.10	0.25	0.25	0.15	0.45	0.15	0.05	**0.19**	0.40	-	0.05	-	-	-	-	0.05	-
Lake Trout	**2.02**	0.75	2.30	1.75	2.05	2.75	1.15	1.35	0.95	0.10	0.15	**1.33**	0.95	1.80	2.25	2.80	1.65	3.15	1.78	2.12	0.80
Lake Whitefish	**0.96**	0.45	0.25	0.75	0.10	0.60	0.30	0.25	0.20	0.05	0.20	**0.32**	0.30	0.20	0.40	0.05	0.15	0.55	0.15	0.15	0.66
Cisco	**0.19**	0.20	-	-	-	-	0.05	-	0.10	0.05	0.15	**0.06**	-	0.15	-	-	0.45	0.75	0.58	-	-
Coregonus sp.	**0.00**	-	-	-	0.05	-	-	-	-	-	-	**0.01**	-	-	-	0.05	-	-	-	-	-
Rainbow Smelt	**0.08**	0.20	-	-	0.05	0.20	0.05	-	0.35	0.10	0.15	**0.11**	0.10	-	0.10	-	0.25	0.10	0.43	0.05	-
Northern Pike	**0.04**	0.05	-	0.05	-	-	-	0.05	0.05	-	0.05	**0.03**	-	-	-	0.10	-	-	-	-	0.20
White Sucker	**2.36**	3.30	2.60	2.15	1.05	0.60	0.45	1.45	0.55	0.30	0.20	**1.27**	0.05	0.05	0.10	0.10	0.05	0.55	0.50	0.45	0.20
Silver Redhorse	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Moxostoma sp.	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Common Carp	**0.04**	-	-	-	-	-	-	0.05	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Brown Bullhead	**0.05**	0.05	-	0.10	0.20	0.15	0.90	0.35	-	-	-	**0.18**	0.05	-	-	-	-	-	-	-	-
Channel Catfish	**0.02**	0.05	0.05	-	-	0.05	-	-	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Stonecat	**-**	0.05	0.05	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Burbot	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Trout-perch	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White Perch	**1.95**	-	0.05	0.85	2.65	-	0.85	1.25	1.15	0.15	0.05	**0.70**	0.50	0.30	2.30	-	0.05	0.05	0.82	4.44	3.00
White Bass	**-**	-	-	-	-	-	-	-	-	-	-	**-**	0.05	-	-	-	-	-	-	0.15	-
Morone sp.	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	0.05	-	-
Rock Bass	**2.19**	0.45	0.90	0.15	0.15	0.50	0.95	3.85	2.05	0.20	0.95	**1.02**	0.95	0.05	0.40	0.40	0.30	1.00	0.10	0.60	0.86
Pumpkinseed	**0.03**	0.05	0.05	0.05	-	-	-	0.05	-	-	-	**0.02**	-	-	-	-	-	-	-	-	-
Smallmouth Bass	**0.31**	0.05	-	-	-	0.05	0.15	0.15	0.05	-	0.15	**0.06**	0.10	0.10	0.05	-	-	-	0.10	0.05	-
Yellow Perch	**84.25**	65.50	77.50	48.65	33.15	28.00	57.25	18.20	26.10	11.60	16.25	**38.22**	25.75	11.40	25.60	7.10	3.00	12.65	95.87	29.94	23.73
Walleye	**8.23**	1.00	1.45	2.70	1.05	1.25	1.90	2.50	1.60	1.40	1.25	**1.61**	2.10	0.60	1.00	0.35	0.80	0.65	6.90	4.30	2.20
Round Goby	**-**	-	1.00	11.00	31.05	0.80	0.15	0.10	0.25	-	0.05	**4.44**	-	0.05	-	-	-	-	-	-	-
Freshwater Drum	**0.54**	0.05	0.10	0.15	0.65	0.50	1.20	1.35	0.75	0.40	0.75	**0.59**	3.25	0.10	0.40	0.05	-	0.05	1.40	1.70	1.20
Total catch	**150**	81	89	75	89	105	77	51	106	90	196	**96**	211	128	119	66	144	488	146	48	43
Number of species	**13**	19	14	15	15	15	15	18	17	13	16	**16**	16	12	12	11	11	12	14	14	11
Number of sets		20	20	20	20	20	20	20	20	20	20		20	20	20	20	20	20	20	20	5

TABLE 1.1.20. Species-specific catch per gillnet set at **Hay Bay in the Bay of Quinte**, 1992-2019. Annual catches are averages for 1-3 gillnet gangs set at each of 2 depths (7.5 and 12.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**-**	-	-	-	-	-	-	-	0.13	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Lake Sturgeon	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Longnose Gar	**-**	-	-	-	-	-	-	0.13	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Alewife	**8.33**	19.25	8.13	-	1.25	0.25	7.50	3.75	0.13	9.75	28.75	**7.88**	12.00	5.38	3.75	4.88	13.13	57.25	4.27	46.63	8.76
Gizzard Shad	**0.71**	-	0.25	-	-	-	0.50	0.13	0.13	-	-	**0.10**	-	0.38	5.38	-	1.25	-	-	0.17	-
Chinook Salmon	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.13	-	-	0.13	-	-	-	-
Rainbow Trout	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.08	-	-	-
Brown Trout	**0.01**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Lake Trout	**0.12**	-	-	0.25	-	-	-	-	-	-	-	**0.03**	-	-	-	-	-	0.33	0.08	-	-
Lake Whitefish	**0.06**	0.13	-	-	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	0.08	-	0.08	-
Cisco	**3.79**	1.00	0.13	-	0.13	-	-	0.13	-	0.13	10.25	**1.18**	0.38	0.25	-	-	-	0.42	0.67	0.58	1.50
Coregonus sp.	**0.04**	-	-	-	-	-	-	-	0.13	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.19**	-	0.25	-	-	-	0.13	-	-	0.38	-	**0.08**	-	-	-	-	0.13	-	-	-	0.50
Northern Pike	**1.00**	0.88	0.13	0.38	-	0.50	0.38	1.13	1.00	0.50	3.00	**0.79**	0.38	0.13	-	0.25	0.13	0.67	0.50	1.19	-
White Sucker	**6.12**	5.63	2.88	2.25	6.13	1.50	1.75	1.38	2.50	4.25	8.75	**3.70**	2.25	2.75	0.88	5.38	3.38	3.92	8.75	6.25	4.50
River Redhorse	**-**	-	-	-	-	-	-	0.13	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Common Carp	**0.23**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	0.13	-	-	-	-	-	-
Golden Shiner	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.25	0.13	-	0.50	1.33	-	0.08	-
Spottail Shiner	**0.01**	-	-	-	-	-	-	0.13	-	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Brown Bullhead	**0.94**	0.88	0.13	0.25	0.25	0.38	0.88	0.38	0.50	-	-	**0.36**	-	-	-	0.25	0.13	-	-	-	-
Channel Catfish	**0.01**	-	-	0.13	0.13	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Burbot	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White Perch	**11.00**	0.50	5.38	8.38	14.50	0.13	30.13	16.25	20.75	9.38	1.75	**10.71**	4.00	7.88	55.63	1.00	0.63	2.92	3.16	28.57	7.00
White bass	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.13	-	-	-	0.25	0.25	0.33	1.00
Rock Bass	**0.03**	-	-	-	-	-	-	-	0.13	-	-	**0.01**	-	-	-	-	-	-	-	-	-
Pumpkinseed	**0.86**	1.13	1.00	0.63	2.13	0.38	0.63	0.75	0.75	0.75	0.75	**0.89**	0.75	-	-	0.50	-	0.08	0.33	2.08	-
Bluegill	**-**	-	-	-	-	-	-	-	-	-	-	**-**	0.13	-	-	-	-	-	-	-	-
Smallmouth Bass	**0.10**	0.13	0.13	-	-	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Black Crappie	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	0.13	-	-	0.08	-	-	-
Yellow Perch	**154.09**	144.13	112.13	110.50	86.00	142.75	64.00	102.00	98.88	81.63	210.00	**115.20**	94.63	35.75	6.13	53.50	37.25	113.58	99.64	91.02	90.50
Walleye	**4.39**	2.50	3.75	2.75	2.13	0.88	1.75	2.50	1.13	2.75	2.00	**2.21**	1.50	1.25	2.88	2.13	0.75	2.00	3.08	2.88	3.50
Round Goby	**-**	-	0.25	0.25	0.25	0.13	-	-	-	-	-	**0.09**	-	-	-	-	-	-	-	-	-
Freshwater Drum	**1.08**	0.25	3.13	1.25	6.63	2.50	8.25	1.00	0.88	1.00	0.75	**2.56**	0.25	0.63	3.88	2.75	0.13	0.42	2.94	1.92	-
Total catch	**193**	176	138	127	120	149	116	130	127	111	266	**146**	116	55	79	71	58	183	124	182	117
Number of species	**14**	12	14	11	11	10	11	14	13	10	9	**12**	10	12	10	9	12	15	11	13	8
Number of sets		8	8	8	8	8	8	8	8	8	4		8	8	8	8	8	12	12	12	2

TABLE 1.1.21. Species-specific catch per gillnet set at **Big Bay in the Bay of Quinte**, 1992-2019. Annual catches are averages for 1-2 gillnet gangs set during each of 1-4 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold.** The total number of species caught and gillnets set each year are indicated.

	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lake Sturgeon	**0.02**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	0.17	-
Longnose Gar	**1.39**	1.00	1.00	0.17	1.00	1.50	3.00	0.33	2.50	3.77	6.50	**2.08**	2.33	3.83	12.83	0.17	1.67	3.63	3.75	2.49	4.00
Alewife	**0.70**	-	0.88	1.67	3.17	-	0.75	-	1.00	2.67	1.00	**1.11**	0.50	0.50	0.17	2.17	2.17	2.38	3.47	1.27	-
Gizzard Shad	**7.23**	2.13	6.63	2.00	0.17	42.17	0.25	1.00	3.67	-	3.33	**6.13**	88.50	10.83	-	-	1.50	3.75	2.17	0.17	-
Lake Whitefish	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	0.17	-	-	-	-	-	-	-
Cisco	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
Northern Pike	**0.68**	0.13	0.13	-	0.17	0.17	0.50	0.17	-	-	-	**0.13**	-	-	-	-	-	0.25	0.17	0.17	-
Mooneye	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White Sucker	**7.30**	3.50	9.25	2.33	5.33	2.50	5.00	2.50	4.33	3.33	3.67	**4.18**	4.00	7.00	5.50	3.50	7.00	4.13	8.50	9.67	9.00
Silver Redhorse	**-**	-	-	-	-	-	-	-	-	-	0.17	**0.02**	-	-	-	-	-	-	-	0.17	-
Shorthead Redhorse	**-**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	0.13	-	-	-
Moxostoma sp.	**0.04**	0.13	-	0.17	-	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Common Carp	**0.30**	-	-	0.17	0.17	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-	-	-	-
Brown Bullhead	**6.72**	6.75	5.50	1.83	2.33	0.83	2.00	0.83	0.67	0.67	-	**2.14**	0.17	0.50	1.17	0.33	0.67	0.50	1.72	1.67	2.00
Channel Catfish	**0.37**	-	0.13	-	0.17	-	0.25	-	-	0.17	-	**0.07**	-	-	0.17	0.17	-	0.50	0.67	0.17	-
Burbot	**0.04**	-	-	-	-	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-	-
White Perch	**90.12**	22.00	36.38	59.83	130.50	79.50	196.75	119.00	127.50	123.17	92.00	**98.66**	91.83	138.00	144.17	17.17	35.67	76.75	141.44	73.64	196.22
White Bass	**0.08**	-	0.13	-	-	-	-	0.17	0.17	-	-	**0.05**	-	0.17	-	0.33	0.50	1.38	0.17	1.00	5.00
Rock Bass	**0.26**	-	-	-	-	0.17	-	-	-	-	-	**0.02**	-	-	0.17	-	0.83	-	0.17	-	-
Pumpkinseed	**3.97**	17.00	8.25	0.83	4.33	0.33	3.25	0.50	1.00	0.67	0.17	**3.63**	0.83	1.00	2.50	0.67	0.50	1.63	0.67	0.83	-
Bluegill	**0.57**	7.13	3.75	0.50	0.33	2.50	6.50	5.33	3.17	5.55	6.67	**4.14**	6.83	1.17	11.33	4.33	11.83	0.63	0.33	0.67	25.61
Smallmouth Bass	**1.11**	0.50	-	-	-	-	0.50	-	-	0.17	-	**0.12**	-	-	-	-	-	-	-	-	-
Largemouth Bass	**0.02**	-	-	-	-	-	0.25	-	-	-	0.17	**0.04**	-	-	-	-	-	-	-	-	-
Black Crappie	**0.11**	0.25	0.38	0.33	0.17	0.17	2.25	1.00	0.33	-	-	**0.49**	-	-	-	-	-	-	-	-	-
Yellow Perch	**138.65**	190.63	182.88	115.33	109.67	103.00	119.00	16.50	63.00	129.54	43.17	**107.27**	47.17	17.67	26.67	71.67	59.00	39.63	36.52	67.30	55.35
Walleye	**16.88**	4.50	7.63	6.50	8.00	5.83	10.75	5.33	9.17	8.00	10.83	**7.65**	6.33	5.17	17.17	6.33	5.33	7.25	9.27	6.17	6.00
Round Goby	**-**	-	-	0.33	0.33	0.50	-	-	-	-	-	**0.12**	-	-	-	-	-	-	-	-	-
Freshwater Drum	**15.50**	21.25	7.38	7.33	7.33	9.50	19.75	11.33	6.50	8.67	4.83	**10.39**	5.50	3.33	5.33	4.83	10.33	28.38	11.50	7.00	10.00
Total catch	**292**	277	270	199	273	249	371	164	223	286	173	**248**	254	189	227	112	137	171	221	173	313
Number of species	**14**	14	15	15	16	14	16	13	13	12	12	**14**	11	12	12	12	13	14	15	16	9
Number of sets		8	8	6	6	6	4	6	6	6	6		6	6	6	6	6	8	6	6	1

TABLE 1.1.22. Species-specific catch per gill net set by depth at all **Bay of Quinte** gill net site locations (fixed and depth-stratified random sites combined), summer 2019. The total catch and the number of species caught and gill nets set are indicated.

	Depth Strata (m)					
Species	1-3	3-6	6-12	12-20	20-35	>35
Longnose Gar	1.66	3.85	-	-	-	-
Bowfin	0.40	-	-	-	-	-
Alewife	47.32	4.52	29.58	12.23	28.42	-
Gizzard Shad	7.00	1.11	-	-	-	-
Chinook Salmon	-	-	-	0.41	-	-
Brown Trout	-	-	-	-	0.06	-
Lake Trout	-	-	-	0.25	1.80	2.20
Lake Whitefish	-	-	-	-	0.92	0.20
Cisco	-	-	-	0.50	1.04	-
Rainbow Smelt	-	-	-	0.13	-	0.20
Northern Pike	3.26	0.89	-	0.13	-	-
White Sucker	0.40	3.22	0.63	3.00	-	-
Common Carp	0.40	-	-	-	-	-
Golden Shiner	4.17	-	-	-	-	-
Brown Bullhead	2.46	1.75	-	-	-	-
Channel Catfish	0.60	-	-	-	-	-
White Perch	15.64	81.98	4.04	0.75	-	-
White Bass	1.80	1.55	0.38	-	-	-
Rock Bass	1.20	0.44	1.20	-	-	-
Pumpkinseed	5.06	4.98	-	-	-	-
Bluegill	1.06	31.43	-	-	-	-
Largemouth Bass	2.86	0.37	-	-	-	-
Black Crappie	0.20	-	-	-	-	-
Yellow Perch	78.54	95.94	76.15	89.42	19.44	-
Walleye	8.12	19.14	3.66	0.75	0.06	-
Freshwater Drum	19.26	10.17	0.50	0.38	-	-
Total catch	201	261	116	108	52	3
Number of species	20	15	8	11	7	3
Number of net sets	5	9	8	7	5	5

TABLE 1.1.23. Seasonal species-specific catch per gill net set at **upper, middle and lower Bay of Quinte** gill net site locations (fixed and depth-stratified random sites combined), 2019. The total catch and the number of species caught and gill nets set are indicated.

	Upper			Middle			Lower
Species	Spring	Summer	Fall	Spring	Summer	Fall	Summer
Longnose Gar	7.47	4.77	24.71	-	-	-	-
Bowfin	0.14	-	0.29	-	0.10	-	0.05
Alewife	32.44	5.51	-	0.20	5.03	-	32.53
Gizzard Shad	0.86	3.78	1.04	-	1.10	2.98	-
Chinook Salmon	-	-	-	-	-	0.20	0.17
Brown Trout	-	-	-	-	-	0.20	0.01
Lake Trout	-	-	-	-	0.10	0.40	1.00
Lake Whitefish	-	-	0.86	0.20	-	-	0.28
Cisco	0.14	-	3.29	3.26	0.40	2.86	0.26
Rainbow Smelt	-	-	-	0.66	0.10	-	0.05
Northern Pike	0.86	1.14	1.14	-	1.00	0.40	0.25
White Sucker	2.86	1.67	1.00	0.60	2.50	1.80	0.70
Silver Redhorse	0.14	-	-	-	-	-	-
Common Carp	-	0.11	-	-	0.10	0.80	-
Golden Shiner	-	-	1.09	-	2.08	-	-
Brown Bullhead	0.43	2.56	0.29	-	0.50	-	-
Channel Catfish	-	0.11	-	-	0.20	0.80	-
White Perch	32.39	79.76	22.12	0.20	11.22	56.51	1.22
White Bass	0.43	2.21	-	0.20	0.60	0.86	-
Rock Bass	1.04	-	0.29	-	0.90	0.60	0.53
Pumpkinseed	2.52	5.68	0.29	-	1.80	-	0.05
Bluegill	7.04	31.90	6.66	-	0.10	-	-
Smallmouth Bass	0.43	-	-	-	-	0.20	-
Largemouth Bass	0.47	1.18	0.90	-	0.70	-	-
Black Crappie	-	-	-	-	0.10	-	-
Yellow Perch	96.81	70.32	20.60	110.13	120.01	35.14	35.34
Walleye	13.61	8.36	19.56	0.40	9.86	22.20	3.73
Freshwater Drum	16.04	17.62	0.43	-	2.93	7.66	0.35
Total catch	216	237	105	116	161	134	77
Number of species	19	16	17	9	22	16	16
Number of net sets	7	9	7	5	10	5	20

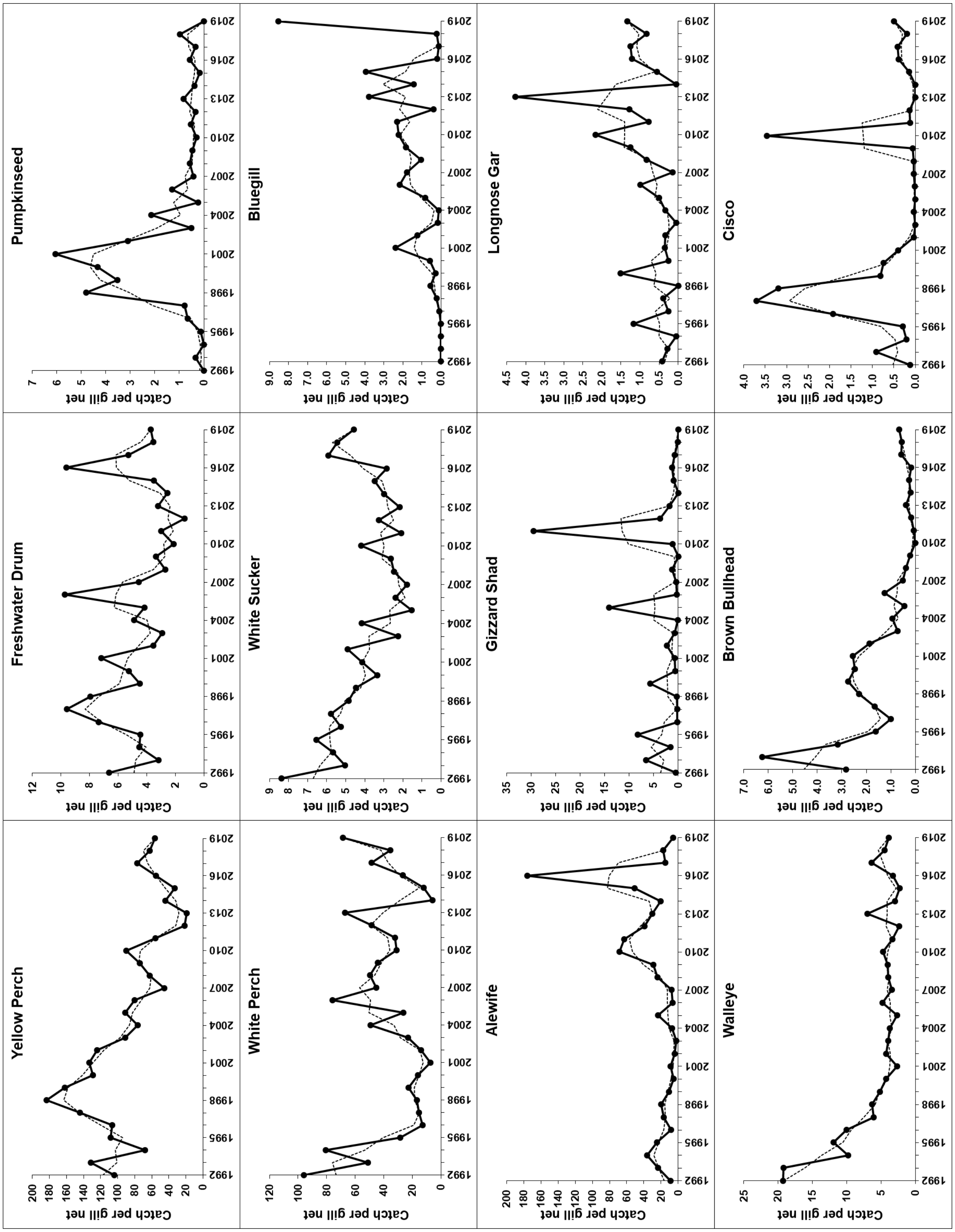


FIG. 1.1.4. Abundance trends (annual means) for the most common species caught in gill nets at three areas in the Bay of Quinte (Conway, Hay Bay and Big Bay; see Fig. 1.1.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.1.24. Age distribution of **48 Lake Whitefish** sampled from index gill nets, by region, during 2018. Also shown are mean fork length and mean weight.

	Age (years) / year-class																		
	1	2	4	5	6	7	8	9	10	11	13	14	15	16	18	19	25	26	
Region	2018	2017	2015	2014	2013	2012	2011	2010	2009	2008	2006	2005	2004	2003	2001	2000	1994	1993	Total
Bay of Quinte	-	1	1	-	1	-	-	-	1	2	-	1	-	1	1	1	-	-	10
Kingston Basin (nearshore)	1	-	1	2	3	-	2	-	-	-	-	-	-	-	-	-	-	1	10
Kingston Basin (offshore)	-	1	5	6	4	3	1	1	-	-	-	-	2	1	-	-	1	-	25
Northeast	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2
Northwest	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Total aged	1	2	7	8	8	3	3	1	1	2	1	3	2	2	1	1	1	1	48
Mean fork length (mm)	173	203	373	425	422	450	514	514	507	504	477	506	516	515	505	464	630	544	
Mean weight (g)	47	89	651	871	935	1,066	1,687	1,842	1,761	1,535	1,275	1,525	1,709	1,820	1,257	1,218	3,380	2,284	

TABLE 1.1.25. Age distribution of **136 Cisco** sampled from index gill nets, by region, 2018. Also shown are mean fork length and mean weight.

	Age (years) / year-class															
	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	
Regions	2018	2017	2016	2015	2014	2013	2012	2010	2009	2008	2007	2006	2005	2004	2003	Total
Bay of Quinte	1	9	-	2	5	-	1	1	-	-	-	1	2	-	-	22
Kingston Basin (nearshore)	-	-	-	-	7	1	-	-	-	-	-	-	-	-	-	8
Kingston Basin (offshore)	-	5	2	6	78	2	-	2	1	-	-	-	-	-	1	97
Northeast	-	2	-	1	6	-	-	-	-	-	-	-	-	-	-	9
Total aged	1	16	2	9	96	3	1	3	1	-	-	1	2	-	1	136
Mean fork length (mm)	170	251	293	332	344	330	368	362	405	-	-	364	334	-	400	
Mean weight (g)	49	200	310	490	515	474	621	615	861	-	-	565	471	-	494	

TABLE 1.1.26. Age distribution of **742 Lake Trout** sampled from index gill nets, by region, during 2019. Also shown are mean fork length and mean weight.

	Age (years) / year-class																								
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	35	
Regions	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1984	Total
Bay of Quinte	7	3	3	2	-	4	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
Kingston Basin (nearshore)	2	8	16	9	3	5	3	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	50
Kingston Basin (offshore)	4	27	75	31	20	31	12	7	8	6	5	17	6	4	2	3	1	1	-	-	-	1	1	-	262
Middle Ground	-	-	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Northeast	-	5	23	15	15	13	6	15	6	9	6	14	6	3	1	-	-	-	-	-	-	-	-	-	137
Northcentral	-	5	13	21	11	3	2	4	1	2	1	1	-	-	-	-	2	-	-	-	-	-	-	-	66
Northwest	2	4	20	34	31	51	3	17	9	10	7	1	6	-	-	2	1	1	-	1	-	-	-	1	201
Total aged	15	52	152	113	82	107	27	46	25	27	19	34	18	7	3	5	4	2	-	1	-	1	1	1	742
Mean fork length (mm)	319	424	547	605	610	640	682	701	730	731	750	761	773	789	787	797	814	758	-	753	-	758	834	751	
Mean weight (g)	399	1,009	2,230	3,078	3,372	3,870	4,895	5,228	5,753	5,989	6,196	6,468	7,067	7,575	7,194	7,305	8,253	6,315	-	5,406	-	6,044	8,755	5,789	

TABLE 1.1.27. Age distribution of **452 Walleye** sampled from **summer** index gill nets, by region, 2019. Also shown are mean fork length, mean weight, mean GSI (females), and percent mature (females). GSI = gonadal somatic index calculated for females only as log10 (gonad weight + 1)/log10(weight). Note that a GSI greater than approximately 0.25 indicates a mature female.

	Age (years) / year-class																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Region	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	Total
Bay of Quinte	19	41	76	93	70	3	2	3	2	1	2	-	1	-	-	-	-	-	-	-	313
Kingston Basin (nearshore)	-	-	1	3	2	2	3	9	7	6	23	14	5	6	5	5	1	1	2	1	96
Middle Ground	4	6	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Northeast	-	-	-	5	1	1	-	2	-	1	2	3	2	-	1	3	1	1	-	2	25
Northcentral	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Northwest	-	-	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Total aged	23	47	79	104	73	7	7	14	9	8	27	17	8	6	6	8	2	2	2	3	452
Mean fork length (mm)	232	327	418	455	494	560	591	599	601	601	620	635	670	640	624	658	668	666	594	654	
Mean weight (g)	130	416	870	1,157	1,484	2,232	2,856	2,851	2,941	2,837	3,253	3,499	4,074	3,679	3,556	3,850	4,048	4,123	2,857	3,337	
Mean GSI femals	0.06	0.14	0.20	0.24	0.27	0.32	0.43	0.43	0.42	0.29	0.42	0.44	0.47	0.47	0.50	0.45	0.50	0.44	-	0.35	
Proportion mature	0.00	0.04	0.13	0.58	0.63	0.75	1.00	1.00	1.00	0.50	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	0.67	

1.2 Lake Ontario and Bay of Quinte Fish Community Index Trawling

E. Brown, Lake Ontario Management Unit

Bottom trawling has been used to monitor the relative abundance of small fish species and the young of large-bodied species in the fish community since the 1960s. After some initial experimentation with different trawl specifications, two trawl configurations (one for the Bay of Quinte and one for Lake Ontario) were routinely employed (see trawl specifications Table 1.2.1).

In the Kingston Basin of eastern Lake Ontario, six sites, ranging in depth from about 20 to 35 m, were visited about four times annually up until 1992 when three sites were dropped. From 1992 to 2015, three visits were made to each of three sites annually, and four replicate ½ mile trawls are made during each visit. After 1995, a deep water site was added outside the Kingston Basin, south of Rocky Point (visited twice annually with a trawling distance of 1 mile; about 100 m water depth), to give a total of four Lake sites (Fig. 1.2.1). In 2014, a second trawl site/ depth was added at Rocky Point (60 m) and two trawl sites at each of Cobourg and Port Credit (60 and 100 m depths at both locations). In 2015, the Lake Ontario trawling was expanded significantly to include several more sampling depths at each of Rocky Point, Cobourg, and Port Credit. In 2016, 2017 and 2018, the three Kingston Basin sites that were dropped in 1992, were added back in to the sampling design, and trawling was not done at Cobourg and Port Credit (note that these sites were sampled in spring and fall prey fish assessments). In 2019, trawling was not done at Cobourg, Port Credit and Rocky Point, further, the seasonal component was dropped (note that these sites were sampled in spring and fall prey fish assessments). In the Bay of Quinte, six fixed-sites, ranging in depth from about 4 to 21 m, are visited annually on two or three occasions during mid to late-summer. Four replicate ¼ mile trawls are made during each visit to each site. The 2019 bottom trawl sampling design is shown in Table 1.2.2.

Twenty-nine species and nearly 55,000 fish were caught in 57 bottom trawls in 2019 (August, Table 1.2.3). Round Goby (52%), White Perch (16%) and Yellow Perch (11%) collectively made up 79% of the catch by number. Species-specific catches in the 2019 trawling program are shown in Tables 1.2.4-1.2.13.

TABLE 1.2.1. Bottom trawl specifications used in Eastern Lake Ontario and Bay of Quinte Fish Community sampling.

	3/4 Western (Poly) (Bay Trawl)	3/4 Yankee Standard No. 35 (Lake Trawl)
Head Rope Length (m)	14.24	12
Foot Rope Length (m)	19	17.5
Side Brail Height (m)	2	1.9
Mesh Size (front)	4" knotted black poly	3.5" knotted green nylon
Twine Type (middle)	3" knotted black poly	2.5" knotted nylon
Before Codend	2" knotted black poly 1.5" knotted black nylon 1" knotted black nylon	2" knotted nylon (chafing gear)
Codend Mesh Size	0.5" knotted white nylon	0.5" knotless white nylon
Remarks:	Fishing height 2.0 m FISHNET gear dimensions as per Casselman 92/06/08	Fishing height 1.9 m FISHNET gear dimensions as per Casselman 92/06/08
GRLEN:length of net	N/A	N/A
GRHT:funnel opening height	2.25 m	2.3 m
GRWID:intake width	6.8 m	9.9 m
GRCOL:1 wt,2 bl,3 gn	2	7 (discoloured)
GRMAT:1 nylon,2 ploypr.	2	1
GRYARN:1 mono,2 multi	2	2
GRKNOT:1 knotless,2 knots	2	2

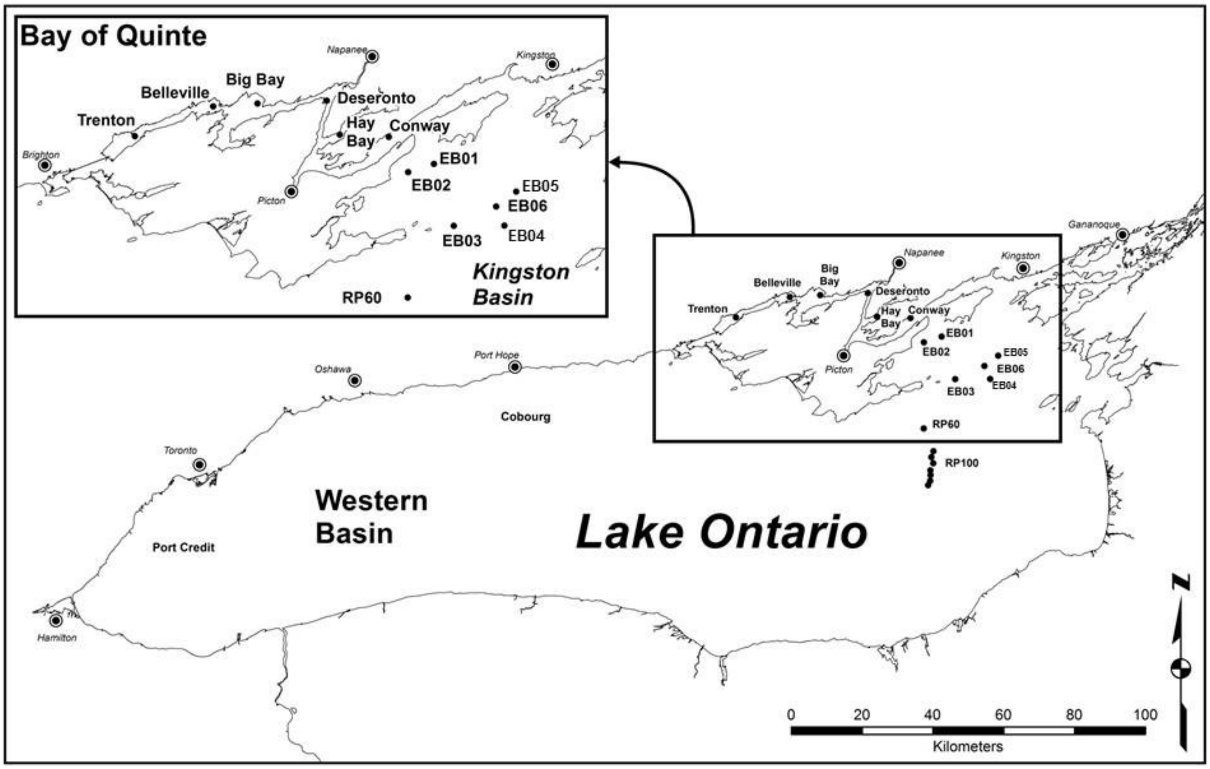


FIG. 1.2.1. Map of north eastern Lake Ontario. Shown are eastern Lake Ontario and Bay of Quinte fish community index bottom trawling site locations.

TABLE 1.2.2. Sampling design of the Lake Ontario fish community index bottom trawling program including geographic stratification, number of visits, number of replicate trawls made during each visit, and the time-frame for completion of visits. Also shown is the year in which bottom trawling at a particular area was initiated and the number of years that trawling has occurred. Note that in 2019 only,.4 replicate trawls were conducted at EB03

						Site location					
Region name	Area Name (Area code)	Site name	Depth (m)	Visits*	Replicates x duration	Latitude	Longitude	Visits x reps	Time-frame	Start year	Number years
Kingston Basin	Eastern Basin (EB)	EB01	30	1	1 x 5 minute	440400	764720	1	Aug 1-Sep 9	2016	4
Kingston Basin	Eastern Basin (EB)	EB02	30	1	1 x 5 minute	440280	765120	1	Aug 1-Sep 9	1972	48
Kingston Basin	Eastern Basin (EB)	EB03**	21	1	4 x 5 minute**	435780	764810	4	Aug 1-Sep 9	1972	48
Kingston Basin	Eastern Basin (EB)	EB04	35	1	1 x 5 minute	435680	763700	1	Aug 1-Sep 9	2016	4
Kingston Basin	Eastern Basin (EB)	EB05	33	1	1 x 5 minute	440110	763540	1	Aug 1-Sep 9	2016	4
Kingston Basin	Eastern Basin (EB)	EB06	35	1	1 x 5 minute	435940	763910	1	Aug 1-Sep 9	1972	48
Bay of Quinte	Conway (LB)	BQ17	21	2	4 x 6 minutes	440650	765420	8	Aug 1-Sep 15	1972	48
Bay of Quinte	Hay Bay (MB)	BQ15	5	2	4 x 6 minutes	440650	770175	8	Aug 1-Sep 15	1972	48
Bay of Quinte	Deseronto (UB)	BQ14	5	2	4 x 6 minutes	441000	770360	8	Aug 1-Sep 15	1972	48
Bay of Quinte	Big Bay (UB)	BQ13	5	2	4 x 6 minutes	440975	771360	8	Aug 1-Sep 15	1972	48
Bay of Quinte	Belleville (UB)	BQ12	5	2	4 x 6 minutes	440920	772010	8	Aug 1-Sep 15	1972	48
Bay of Quinte	Trenton (UB)	BQ11	4	2	4 x 6 minutes	440600	773120	8	Aug 1-Sep 15	1972	48

TABLE 1.2.3. Species-specific total bottom trawl catch in August 2019. Frequency of occurrence (FO) is the number of trawls, out of a possible 57, in which each species (29 species and 54,712 individual fish) was caught.

Species	FO	Catch	Biomass (kg)	Mean weight (g)
Bowfin	1	1	1.766	1765.8
Alewife	33	2,321	6.756	2.9
Gizzard shad	18	544	6.190	11.4
Lake trout	6	11	0.313	28.5
Lake whitefish	3	3	0.087	29.0
Rainbow smelt	9	700	7.111	10.2
White sucker	16	40	11.794	294.9
Common carp	4	4	24.378	6094.5
Spottail shiner	37	471	2.721	5.8
Brown bullhead	26	234	67.746	289.5
Channel catfish	2	3	0.678	226.0
American eel	4	6	6.180	1030.1
Trout-perch	38	2,785	3.854	1.4
White perch	41	8,944	56.661	6.3
White bass	23	104	1.084	10.4
Morone sp.	9	417	0.106	0.3
Rock bass	7	14	1.259	89.9
Pumpkinseed	34	1,409	42.537	30.2
Bluegill	31	722	10.809	15.0
Smallmouth bass	3	3	0.020	6.7
Largemouth bass	7	59	0.313	5.3
Black crappie	2	3	0.631	210.3
Lepomis sp.	23	500	0.177	0.4
Yellow perch	45	6,219	88.547	14.2
Walleye	33	127	17.736	139.7
Johnny darter	4	7	0.019	2.7
Logperch	11	46	0.118	2.6
Round goby	34	28,214	64.622	2.3
Freshwater drum	41	800	93.341	116.7
Totals		54,712	517.56	

Lake Ontario

Kingston Basin (Tables 1.2.4 – 1.2.7)

Bottom trawls were conducted at six sites in Kingston Basin in August 2019. Four species were caught with the most abundant species being Round Goby and Rainbow Smelt (Table 1.2.4). Trends in species-specific catch per trawl are shown in Tables 1.2.5, 1.2.6 and 1.2.7 for EB02, EB03 and EB06, respectively. Trend through time catches for most common species are shown in Fig. 1.2.2.

Bay of Quinte

Conway, Hay Bay, Deseronto, Big Bay, Belleville, and Trenton (Tables 1.2.8-1.2.13)

Bottom trawls were conducted six sites in the Bay of Quinte in August 2019. Species-specific catch per trawl at each site shown in Tables 1.2.8-1.2.13. Bottom trawl results were summarized across the six Bay of Quinte sites and presented graphically to illustrate abundance trends for major species in Fig. 1.2.3. All species show significant abundance changes over the long-term.

Species Highlights

Catches of age-0 fish in 2019 for selected species and locations are shown in Tables 1.2.14-1.2.18.

TABLE 1.2.4. Species-specific catch per trawl at six sites (**EB01, EB02, EB03, EB04, EB05, EB06**) in Kingston Basin of Lake Ontario, 2019. Catches are averages for 1 to 4 trawls during on visit in the summer. The total number of fish and species caught and trawls conducted

Species	EB01	EB02	EB03	EB04	EB05	EB06	Total
Alewife	0.000	0.000	0.602	0.000	0.000	2.410	0.502
Lake Whitefish	0.000	0.000	1.205	0.000	0.000	0.000	0.201
Rainbow smelt	0.000	2.410	415.322	0.000	12.048	0.000	71.630
Round Goby	4019.178	973.148	13601.625	2403.794	1183.629	480.087	3776.910
Total Catch	4019	973	54407	2404	1184	480	33992
Number of species	1	2	4	1	2	2	4
Number of trawls	1	1	4	1	1	1	9

TABLE 1.2.5. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB02**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

								Year													
	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**1220.379**	203.397	20.917	19.500	27.100	0.000	0.417	11.000	0.667	72.429	464.097	**81.952**	1.667	24.291	288.143	2.667	44.417	110.093	68.273	44.177	0.000
Rainbow Trout	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lake Trout	**0.202**	0.000	0.083	0.083	0.000	0.583	0.167	0.583	0.500	0.000	0.167	**0.217**	0.000	0.333	0.333	0.167	0.750	1.000	0.000	0.000	0.000
Lake Whitefish	**3.203**	0.167	0.000	0.583	0.400	0.250	0.000	0.167	0.000	0.250	0.000	**0.182**	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cisco	**0.362**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.083	0.000	0.000	0.000	0.000
Coregonus sp.	**0.006**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**440.950**	29.667	7.917	0.917	5.000	19.750	28.750	3.583	5.667	114.416	14.667	**23.033**	1.083	10.333	3.917	8.833	2.917	1.667	0.803	59.438	2.410
Emerald Shiner	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Burbot	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Threespine Stickleback	**13.395**	18.750	34.417	49.500	6.200	9.000	0.167	0.000	0.000	0.000	0.000	**11.803**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**4.675**	0.250	0.000	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.042**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.019**	0.000	0.000	0.000	0.700	0.333	0.083	0.000	0.000	0.000	0.083	**0.120**	0.000	0.167	0.000	0.000	0.000	0.000	0.803	0.000	0.000
Walleye	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Johnny Darter	**0.077**	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.000	**0.040**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.083	250.100	24.833	40.083	119.750	26.667	169.907	143.933	**77.536**	8.083	77.144	28.500	31.083	76.313	163.026	133.333	949.369	973.148
Sculpin sp.	**0.046**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**2.084**	0.417	0.667	44.083	74.900	0.750	0.167	0.000	0.000	0.000	0.000	**12.098**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Deepwater Sculpin	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.667	0.000	0.000	0.000	0.000
Total catch	**1685**	253	64	115	365	56	70	135	34	357	623	**207**	11	112	321	43	125	276	203	1053	976
Number of species	**9**	6	5	8	8	7	7	5	4	4	6	**6**	3	6	4	4	6	4	4	3	2
Number of trawls		12	12	12	10	12	12	12	12	12	12		12	12	12	12	12	3	3	3	1

TABLE 1.2.6. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB03**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

							Year													
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**704.463**	57.375	21.375	8.000	168.385	14.833	15.250	33.917	156.339	0.000	0.250	**47.572**	0.125	33.292	75.500	43.125	1.875	13.857	30.522	15.663	0.602
Gizzard Shad	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chinook Salmon	**0.014**	0.000	0.000	0.000	0.000	0.667	0.000	0.000	0.000	0.000	0.000	**0.067**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
Lake Trout	**0.847**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.083	0.000	**0.033**	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000
Lake Whitefish	**14.412**	0.000	0.000	43.938	2.333	50.000	3.000	1.417	0.000	0.083	4.667	**10.544**	0.125	0.000	0.000	0.000	0.375	0.000	0.000	0.000	1.205
Cisco	**0.292**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.125	0.000	0.000	0.000	1.500	1.000	0.000	0.000	0.000
Rainbow Smelt	**517.419**	20.000	207.511	109.245	1.917	25.667	20.625	21.500	0.250	11.583	217.947	**63.624**	30.750	3.250	111.500	20.625	343.832	135.829	185.808	4573.742	415.322
White Sucker	**0.093**	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.130**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**42.456**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.083	**0.033**	0.375	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000
American Eel	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brook Stickleback	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Threespine Stickleback	**32.894**	67.375	680.287	459.421	2781.754	116.083	8.500	0.000	0.000	0.000	0.000	**411.342**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**689.171**	175.000	592.212	56.298	255.161	3.417	3.750	0.417	0.000	0.000	0.000	**108.625**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
White Perch	**0.032**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pumpkinseed	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Smallmouth Bass	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.093**	0.000	0.000	0.625	0.083	0.000	0.500	0.167	0.125	0.000	0.000	**0.150**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
Walleye	**0.236**	0.000	0.000	0.063	0.000	0.000	0.125	0.000	0.000	0.417	0.000	**0.060**	0.250	0.250	0.000	0.000	0.000	0.286	0.000	0.000	0.000
Johnny Darter	**0.875**	0.000	0.000	9.875	32.833	0.167	0.000	0.000	0.000	0.000	0.000	**4.288**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.000	0.333	732.449	850.448	910.409	1100.409	2552.195	1079.944	**722.619**	2322.465	960.945	410.800	1968.925	1309.488	157.097	2300.515	4610.311	13601.625
Freshwater Drum	**0.046**	0.000	0.000	0.000	0.083	0.000	0.125	0.000	0.125	0.000	0.000	**0.033**	0.000	0.250	0.000	0.000	0.500	0.143	0.000	0.000	0.000
Sculpin sp.	**0.194**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mottled Sculpin	**0.000**	0.000	0.000	0.688	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.069**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**0.370**	0.000	0.250	6.750	10.833	0.083	0.000	0.000	0.000	0.000	0.000	**1.792**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total catch	**2004**	320	1502	695	3254	943	902	968	1257	2565	1303	**1371**	2354	998	598	2033	1658	308	2517	9200	14019
Number of species	**10**	4	5	10	10	9	9	9	5	6	7	**7**	8	5	4	4	8	6	3	3	4
Number of trawls		8	8	16	12	12	8	12	8	12	12		8	7	8	8	8	7	6	6	4

TABLE 1.2.7. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB06**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

						Year															
	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**85.631**	5.583	0.250	0.083	1.250	0.417	8.000	0.917	0.667	10.833	1.083	**2.908**	0.667	0.625	0.583	0.000	0.000	1.333	0.803	0.803	2.410
Lake Trout	**0.611**	0.083	0.083	0.083	0.083	0.000	0.000	0.000	0.000	0.000	0.000	**0.033**	0.000	0.125	0.000	0.000	0.250	0.000	0.000	0.000	0.000
Lake Whitefish	**4.546**	0.000	0.167	0.167	0.250	0.000	0.000	0.083	0.000	0.000	0.083	**0.075**	0.000	0.000	0.000	0.000	0.083	0.000	0.000	0.000	0.000
Cisco	**0.028**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**743.701**	21.417	6.750	0.250	25.083	142.583	23.917	0.583	1.000	3.500	73.167	**29.825**	18.917	112.933	8.750	0.333	0.000	1.333	0.000	12.851	0.000
Threespine Stickleback	**7.722**	2.583	47.750	11.417	7.500	13.917	1.083	0.000	0.000	0.000	0.000	**8.425**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**0.991**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Johnny Darter	**0.000**	0.000	0.000	0.000	0.333	0.000	0.000	0.000	0.000	0.000	0.000	**0.033**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.000	0.000	0.000	5.000	82.934	1.667	8.667	877.914	**97.618**	1.917	200.416	208.949	0.333	0.083	453.048	19.277	219.051	480.087
Sculpin sp.	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.803	0.000	0.000
Slimy Sculpin	**0.083**	0.083	0.000	3.583	399.183	15.750	0.250	0.000	0.000	0.500	1.500	**42.085**	0.000	0.125	0.167	0.000	0.000	0.000	0.000	0.000	0.000
Deepwater Sculpin	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.167	**0.025**	0.000	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000
Total catch	**843**	30	55	16	434	173	38	85	3	24	954	**181**	22	314	218	1	2	456	21	233	482
Number of species	**6**	5	5	6	7	4	5	4	3	5	6	**5**	3	5	4	2	4	3	3	3	2
Number of trawls		12	12	12	12	12	12	12	12	12	12		12	8	12	12	12	3	3	3	1

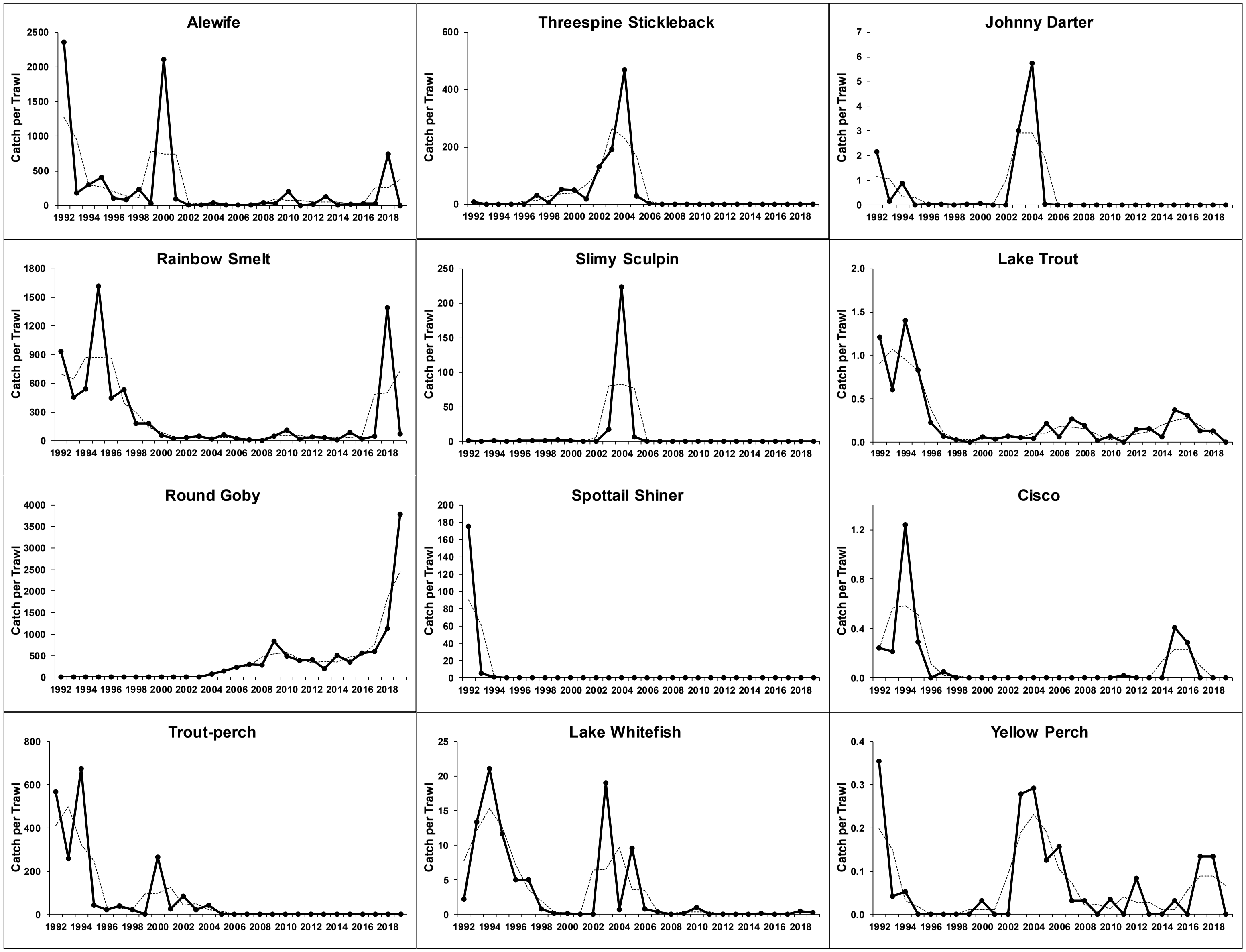


FIG. 1.2.2. Abundance trends (annual means) for the most common species caught in bottom trawls at three to six sites in the Kingston Basin, eastern Lake Ontario (EB01, EB02, EB03, EB04, EB05, EB06); see Fig. 1.2.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.2.8. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Conway** (24 m depth), Bay of Quinte. Catches are the mean number of fish observed at each site for the number of trawls indicated. Total catch and number of species caught are indicated.

						Year															
	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Silver Lamprey	**0.000**	0.000	0.000	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Alewife	**121.972**	0.000	0.000	2.250	1.917	0.417	9.667	0.083	214.622	1.583	0.333	**23.087**	375.352	0.125	14.875	97.809	11.750	85.332	4.625	4.875	0.250
Gizzard Shad	**0.000**	0.000	0.000	0.000	0.000	0.000	1.167	0.000	0.000	0.000	0.000	**0.117**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chinook Salmon	**0.028**	0.000	0.000	0.000	0.000	0.167	0.083	0.000	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000
Brown Trout	**0.000**	0.000	0.125	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.029**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lake Trout	**0.014**	0.000	0.250	0.000	0.417	0.000	0.000	0.000	0.000	0.000	0.000	**0.067**	0.000	0.125	0.375	0.000	0.250	0.000	0.000	1.625	1.375
Lake Whitefish	**13.208**	1.000	1.000	8.083	0.750	3.083	3.833	4.750	0.250	0.333	0.333	**2.342**	0.625	0.000	7.000	2.250	0.125	0.000	2.375	2.000	0.125
Cisco	**2.301**	0.000	0.250	3.000	0.083	7.667	4.500	2.000	0.167	0.000	6.333	**2.400**	8.250	23.500	1.625	11.750	1.750	3.375	1.250	2.750	0.000
Coregonus sp.	**0.000**	0.000	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000
Rainbow Smelt	**112.713**	0.000	39.625	10.167	3.583	6.750	0.083	25.167	1.083	0.083	0.000	**8.654**	0.625	0.500	8.750	29.875	7.000	0.500	12.000	46.750	0.500
White Sucker	**4.412**	134.836	28.750	6.667	7.417	4.750	3.167	11.250	0.500	0.000	0.167	**19.750**	0.500	1.375	1.375	0.000	0.875	1.250	1.250	0.000	0.750
Moxostoma sp.	**0.000**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**0.000**	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.063**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
American Eel	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000
Burbot	**0.000**	0.000	0.000	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Threespine Stickleback	**0.019**	0.000	0.000	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**132.813**	139.443	58.234	53.667	43.333	12.250	0.500	1.000	13.000	0.083	0.000	**32.151**	0.500	0.000	1.125	38.875	2.750	0.500	10.125	0.375	0.000
White Perch	**0.116**	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.000	0.250	0.167	**0.342**	5.500	0.250	0.375	0.000	0.000	0.125	0.125	0.000	0.125
White Bass	**0.000**	0.000	0.000	0.000	0.000	0.000	0.833	0.000	0.000	0.000	0.000	**0.083**	1.125	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000
Rock Bass	**0.028**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bluegill	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**12.597**	134.715	181.251	178.153	58.667	53.750	146.584	20.000	108.980	8.250	56.956	**94.731**	125.915	70.580	59.875	47.000	22.375	34.000	15.000	4.625	43.375
Walleye	**2.764**	1.250	0.000	0.250	1.000	0.083	0.417	0.417	0.083	0.000	0.333	**0.383**	0.375	0.000	0.000	0.125	0.125	0.375	0.250	0.625	0.000
Johnny Darter	**0.306**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.500	282.241	79.167	127.225	40.833	173.211	89.723	80.768	146.979	**102.065**	261.710	203.978	103.471	81.375	175.493	247.749	149.175	176.274	223.736
Freshwater Drum	**0.000**	0.125	0.000	0.250	0.000	0.083	0.500	0.000	0.083	0.000	0.000	**0.104**	0.000	0.000	0.000	0.000	0.000	0.000	0.375	0.000	0.250
Sculpin sp.	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mottled Sculpin	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**0.079**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total catch	**403**	412	310	545	197	216	215	238	428	91	212	**286**	780	301	199	309	223	373	197	240	270
Number of species	**9**	7	9	12	12	11	14	9	10	7	8	**10**	11	9	10	9	11	10	12	9	9
Number of trawls		8	8	12	12	12	12	12	12	12	12		8	8	8	8	8	8	8	8	8

TABLE 1.2.9. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Hay Bay** (7 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																				
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**204.149**	566.143	21.125	1.750	67.067	72.097	394.507	695.331	631.710	713.136	967.999	**413.086**	561.676	530.946	360.990	498.796	411.086	1364.539	321.008	1325.918	17.500
Gizzard Shad	**10.153**	2.625	0.125	0.000	0.125	0.000	0.375	0.125	7.000	0.750	4.000	**1.513**	1.375	100.159	3.250	0.000	24.875	117.900	3.125	5.000	0.375
Lake Whitefish	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cisco	**0.056**	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.100**	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**3.958**	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.375	0.000	0.000	**0.050**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike	**0.069**	0.000	0.000	0.125	0.000	0.000	0.000	0.125	0.000	0.125	0.000	**0.038**	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000
White Sucker	**3.579**	3.500	0.125	5.875	8.250	0.000	0.625	4.875	3.000	0.000	3.625	**2.988**	4.375	2.125	3.625	3.250	2.125	0.000	1.875	0.625	0.750
Common Carp	**0.343**	0.250	0.000	0.000	0.000	0.875	0.000	0.000	0.750	0.125	0.000	**0.200**	0.000	0.125	0.000	0.000	0.000	0.000	0.125	0.000	0.250
Golden Shiner	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000	**0.013**	0.000	0.375	0.125	0.000	0.125	6.000	0.000	0.000	0.000
Common Shiner	**0.000**	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fathead Minnow	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000
Brown Bullhead	**15.046**	32.750	15.750	8.000	10.375	10.500	15.000	8.875	0.750	3.500	2.500	**10.800**	0.250	1.750	5.375	2.125	1.500	0.750	2.625	0.125	0.375
Channel Catfish	**0.028**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.125	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000
American Eel	**1.579**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Burbot	**0.023**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**65.125**	5.750	2.750	3.750	77.500	1.750	3.000	59.500	6.625	3.750	4.375	**16.875**	22.875	1.125	6.250	4.625	25.375	0.250	1.250	3.375	23.625
White Perch	**94.666**	9.250	132.573	14.750	495.340	24.625	504.187	27.500	163.757	167.704	54.875	**159.456**	73.281	57.750	271.752	0.875	7.250	27.500	215.836	117.847	47.750
White Bass	**0.185**	0.000	0.000	1.750	0.125	0.125	1.375	1.375	0.875	0.500	2.000	**0.813**	9.500	0.250	0.000	0.125	1.625	9.750	0.125	2.750	2.000
Sunfish	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.028**	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.125	**0.025**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pumpkinseed	**10.231**	19.625	11.875	0.750	4.625	1.125	44.500	11.375	8.625	0.250	13.250	**11.600**	0.875	2.500	4.000	2.750	0.875	4.625	10.500	0.250	29.750
Bluegill	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.125	3.625	0.125	0.250	**0.413**	0.125	0.375	0.125	0.000	0.000	0.000	0.375	0.125	0.500
Smallmouth Bass	**0.000**	0.000	1.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.125**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.000**	0.250	1.750	0.000	0.000	0.000	0.000	0.000	0.375	1.375	2.125	**0.588**	1.000	1.250	0.125	0.000	0.000	0.000	0.000	0.375	0.000
Black Crappie	**0.000**	0.000	0.000	0.000	0.000	1.375	0.875	0.000	0.000	0.000	0.000	**0.225**	0.500	0.000	0.125	0.000	12.625	2.000	0.125	0.000	0.000
Lepomis sp.	**0.000**	0.000	0.000	0.000	0.000	13.375	0.000	0.000	0.000	0.000	0.000	**1.338**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000
Yellow Perch	**372.617**	726.620	856.879	119.203	551.884	278.670	580.861	906.704	138.067	146.065	206.695	**451.165**	14.125	61.500	96.130	274.987	212.839	117.355	63.244	71.625	146.819
Walleye	**7.333**	7.125	3.250	1.750	3.125	4.125	7.125	8.500	13.375	5.000	8.500	**6.188**	7.750	3.375	3.250	7.000	10.500	2.500	8.625	3.125	2.125
Johnny Darter	**0.079**	0.000	1.750	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	**0.188**	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000
Logperch	**0.046**	0.250	0.000	0.000	0.125	0.375	0.250	1.250	0.250	0.250	0.125	**0.288**	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.250	0.000
Brook Silverside	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.875	**0.088**	0.000	0.375	0.125	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.125	1.250	14.250	3.500	40.125	6.000	17.125	11.375	1.625	2.375	**9.775**	0.125	3.500	0.875	2.125	7.375	0.000	0.250	0.250	0.125
Freshwater Drum	**2.773**	4.375	4.875	6.875	10.500	16.375	39.125	6.000	5.000	5.125	11.125	**10.938**	8.250	6.250	11.875	2.375	3.250	5.375	30.125	5.125	12.250
Slimy Sculpin	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total catch	**792**	1380	1055	179	1233	466	1598	1749	996	1050	1285	**1099**	706	774	768	800	722	1659	659	1537	284
Number of species	**15**	16	15	13	15	14	17	17	18	18	18	**16**	17	19	19	15	16	13	16	16	14
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8	8	8	8

TABLE 1.2.10. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Deseronto** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

						Year															
	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Longnose Gar	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Alewife	**120.590**	180.074	47.625	277.403	55.380	54.219	106.270	1037.631	217.123	16.250	447.062	**243.903**	1017.115	332.364	1099.888	511.081	141.988	701.081	805.217	149.680	43.750
Gizzard Shad	**54.324**	32.000	20.875	11.875	1.375	22.000	62.100	29.250	109.387	47.539	20.500	**35.690**	53.000	453.242	67.765	0.125	73.125	304.873	6.000	29.375	0.250
Rainbow Smelt	**0.028**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike	**0.028**	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
White Sucker	**1.028**	0.625	0.375	1.250	1.250	0.125	0.375	0.375	0.625	2.625	0.125	**0.775**	1.375	0.375	4.875	4.000	1.750	0.375	4.375	0.500	2.875
Lake Chub	**0.000**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.278**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.125	**0.025**	0.375	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.250
Emerald Shiner	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	1.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**29.194**	25.250	25.000	35.625	1.500	18.875	54.750	28.750	104.125	38.625	18.000	**35.050**	40.250	25.625	29.250	126.375	69.500	124.064	47.750	21.125	22.625
Brown Bullhead	**24.250**	69.250	10.625	21.500	37.000	12.500	11.625	18.125	2.500	4.000	1.000	**18.813**	1.250	5.625	27.580	13.250	2.875	4.625	12.000	4.625	18.500
Channel Catfish	**0.083**	0.000	0.000	0.000	0.125	0.250	0.125	0.000	0.000	0.000	0.000	**0.050**	0.000	0.000	0.125	0.125	0.000	0.000	0.125	0.125	0.000
Ictalurus sp.	**0.000**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
American Eel	**0.861**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.250	0.125	0.000	0.000	0.000	0.250	1.000	0.625
Trout-perch	**35.125**	4.750	7.500	0.125	4.500	6.000	12.375	18.375	550.279	226.843	1.750	**83.250**	58.875	4.250	122.986	6.000	165.895	16.000	73.875	18.375	92.751
White Perch	**273.179**	10.250	194.882	306.265	3076.179	237.616	794.071	226.216	298.129	811.713	25.250	**598.057**	658.175	276.439	341.366	27.250	24.625	204.583	1118.446	319.683	106.280
White Bass	**0.403**	0.000	0.000	0.500	1.625	1.250	4.250	0.375	0.000	1.250	0.250	**0.950**	4.500	0.750	0.000	0.125	4.000	16.500	2.625	0.500	6.125
Sunfish	**0.125**	0.375	0.000	0.000	0.000	0.000	1.375	0.000	0.125	0.000	0.000	**0.188**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.014**	0.125	1.750	0.250	0.000	0.000	0.000	0.000	0.000	0.500	0.250	**0.288**	0.000	0.125	0.250	0.000	0.125	0.000	0.250	0.000	0.375
Pumpkinseed	**15.042**	118.095	17.500	67.500	19.500	14.750	15.500	19.125	11.500	30.500	11.000	**32.497**	26.000	3.750	9.375	36.500	28.000	63.250	39.375	3.000	93.625
Bluegill	**0.014**	0.500	0.125	4.500	0.000	0.125	0.875	0.375	0.000	0.250	1.250	**0.800**	2.750	3.875	1.750	0.125	0.250	0.375	0.625	0.000	9.625
Smallmouth Bass	**0.500**	0.500	0.125	1.000	1.250	0.625	0.250	0.000	0.000	0.250	0.000	**0.400**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.083**	0.000	1.125	0.000	0.250	1.125	2.125	0.000	0.125	0.375	2.750	**0.788**	2.375	1.750	5.500	0.000	0.125	7.000	0.375	0.625	0.375
Black Crappie	**0.028**	0.125	0.625	0.125	0.000	1.750	1.375	4.875	0.000	3.375	0.125	**1.238**	0.125	0.625	2.875	0.250	6.250	0.125	0.250	0.000	0.375
Lepomis sp.	**0.000**	0.000	0.000	0.000	0.000	483.734	0.000	1.000	0.250	0.000	1.875	**48.686**	0.000	0.000	3.250	0.250	0.250	8.000	0.000	0.125	0.875
Yellow Perch	**320.934**	412.720	555.437	683.480	152.149	1031.209	638.509	1087.358	531.795	219.331	66.231	**537.822**	1466.894	126.916	247.843	425.715	967.424	656.154	332.890	421.890	351.550
Walleye	**17.486**	12.500	2.875	7.500	15.125	5.000	5.250	9.875	19.875	15.875	1.875	**9.575**	11.875	4.875	3.500	22.375	18.875	14.750	10.375	14.750	4.500
Johnny Darter	**0.403**	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.063**	0.000	0.000	0.000	0.250	0.625	0.000	0.125	0.125	0.875
Logperch	**0.278**	1.000	0.125	0.375	0.000	3.625	0.125	0.750	2.875	23.625	0.250	**3.275**	2.875	0.000	0.125	1.500	2.000	0.125	0.375	0.125	2.125
Brook Silverside	**0.306**	0.000	0.000	0.000	0.000	0.750	0.000	0.000	0.000	0.000	3.000	**0.375**	0.125	2.750	0.125	0.000	0.000	0.625	0.000	0.000	0.000
Round Goby	**0.000**	1.250	11.500	16.125	20.625	117.305	4.625	4.250	4.500	2.750	1.625	**18.456**	1.625	13.875	2.000	0.375	10.750	6.875	1.125	4.375	0.500
Freshwater Drum	**9.111**	16.500	1.875	15.375	15.625	8.250	22.000	24.000	10.125	11.500	0.875	**12.613**	7.375	7.125	10.375	2.625	2.250	10.250	16.625	46.750	13.875
Total catch	**904**	887	900	1451	3403	2021	1738	2511	1863	1457	605	**1684**	3357	1266	1981	1178	1521	2140	2473	1037	773
Number of species	**16**	20	19	19	16	21	20	16	15	19	20	**19**	20	20	20	18	20	18	21	19	22
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8	8	8	8

TABLE 1.2.11. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Big Bay** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	1992-2000					Year						**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Longnose Gar	**0.111**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000
Alewife	**33.495**	0.000	224.952	0.000	407.516	35.750	13.000	0.375	190.282	37.875	332.829	**124.258**	52.055	122.472	313.093	100.931	36.500	120.414	0.500	60.343	52.000
Gizzard Shad	**228.179**	0.000	52.250	23.250	58.375	25.875	2.250	2.250	68.745	0.000	66.222	**29.922**	52.250	82.732	3.375	0.125	99.696	1112.491	3.375	1.875	2.375
Rainbow Smelt	**0.039**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.125	0.000
Northern Pike	**0.056**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
White Sucker	**4.031**	0.750	2.875	1.125	1.375	0.875	0.125	0.375	0.375	0.625	3.750	**1.225**	2.500	2.000	1.250	2.875	0.500	1.625	1.125	0.875	0.250
Moxostoma sp.	**0.007**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.545**	0.250	0.000	0.500	0.375	0.250	0.875	0.125	0.375	0.000	1.000	**0.375**	1.375	0.375	0.125	0.000	0.000	0.500	0.375	0.125	0.000
Emerald Shiner	**0.042**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**16.069**	12.125	63.625	8.875	20.250	56.250	18.625	15.375	10.625	19.500	37.625	**26.288**	53.750	92.750	11.000	82.728	43.750	52.625	26.250	11.375	9.250
Brown Bullhead	**29.570**	16.375	32.625	38.000	23.750	12.125	54.625	9.750	8.750	3.000	4.750	**20.375**	4.250	1.875	6.375	7.875	1.375	2.625	4.375	3.000	1.375
Channel Catfish	**0.151**	0.000	0.125	0.000	0.000	0.125	0.375	0.000	0.000	0.000	0.000	**0.063**	0.000	0.000	0.125	0.500	0.125	0.250	0.125	0.125	0.125
Ictalurus sp.	**0.000**	0.375	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.038**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
American Eel	**0.337**	0.125	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.375	0.000	0.000	0.125
Trout-perch	**23.320**	1.375	9.125	5.000	3.125	21.625	21.000	14.000	65.875	67.750	45.625	**25.450**	86.750	40.875	64.250	643.990	71.875	46.000	48.000	50.750	60.024
White Perch	**446.656**	18.250	793.237	145.125	1499.098	554.616	1252.318	363.567	456.729	1117.116	190.786	**639.084**	1552.354	240.164	540.939	34.250	52.250	211.330	817.221	138.319	397.124
White Bass	**1.221**	0.000	2.125	0.000	0.250	2.625	3.875	0.250	0.750	8.250	0.375	**1.850**	2.375	0.375	0.750	0.625	1.750	1.250	1.875	2.250	0.875
Morone sp.	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17.250	0.000
Sunfish	**1.708**	50.000	0.000	0.000	0.000	0.000	25.250	0.000	9.750	0.000	0.000	**8.500**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.000**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pumpkinseed	**18.612**	83.875	64.125	67.625	36.625	3.750	6.875	1.875	5.750	12.125	5.875	**28.850**	10.250	4.500	16.250	2.125	5.875	23.125	11.125	0.250	6.500
Bluegill	**1.930**	124.875	13.625	14.625	0.750	9.625	6.750	16.000	3.875	10.375	4.250	**20.475**	13.000	3.250	2.125	2.250	13.625	10.375	12.875	1.375	8.250
Smallmouth Bass	**0.032**	0.125	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.038**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.000**	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.125	1.500	1.625	**0.375**	0.125	9.500	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Black Crappie	**0.356**	0.625	0.500	0.375	0.375	1.000	2.625	0.250	0.125	0.250	0.000	**0.613**	0.000	0.000	0.000	0.000	0.625	0.125	0.000	0.000	0.000
Lepomis sp.	**0.000**	0.000	66.625	0.000	0.000	1060.443	0.000	4.125	56.481	41.500	170.465	**139.964**	0.500	59.625	5.250	10.750	49.250	18.250	1.000	70.625	18.250
Yellow Perch	**62.998**	381.125	153.463	107.650	200.266	90.623	99.395	33.750	660.643	197.790	184.258	**210.896**	435.501	121.071	82.625	577.728	164.461	321.134	26.000	50.375	13.375
Walleye	**10.485**	7.500	6.125	19.250	16.875	6.500	8.125	8.750	28.125	10.750	7.250	**11.925**	26.750	11.000	4.125	23.375	18.250	10.000	2.875	6.875	3.875
Johnny Darter	**0.037**	1.250	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.150**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Logperch	**0.053**	0.125	0.000	0.250	0.000	0.000	0.125	0.250	3.250	2.250	0.000	**0.625**	0.125	0.000	0.125	3.125	0.000	0.000	0.000	0.125	0.000
Brook Silverside	**0.069**	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.375	**0.050**	0.000	1.125	0.625	0.000	0.250	1.500	0.125	0.000	0.000
Round Goby	**0.000**	0.000	0.125	1.375	15.750	9.500	4.750	50.423	1.125	0.625	0.375	**8.405**	0.750	1.625	0.625	0.375	1.250	0.000	0.625	1.125	0.250
Freshwater Drum	**10.894**	21.750	24.375	9.000	15.625	125.520	178.465	139.361	14.625	11.625	51.500	**59.185**	15.750	31.500	22.750	4.125	6.375	90.201	20.250	42.000	34.750
Total catch	**891**	721	1511	442	2301	2017	1700	661	1586	1543	1109	**1359**	2310	827	1077	1498	568	2024	978	459	609
Number of species	**17**	17	23	15	17	18	20	19	20	17	18	**18**	18	18	20	15	16	19	17	17	17
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8	8	8	8

TABLE 1.2.12. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Belleville** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																				
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sea Lamprey	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Longnose Gar	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.000	**0.600**	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000
Alewife	**92.034**	0.250	82.375	0.125	11.500	13.875	9.750	0.125	34.875	78.782	59.821	**29.148**	128.250	24.750	272.438	0.000	65.026	27.000	0.375	33.625	89.753
Gizzard Shad	**266.440**	99.204	234.375	46.029	581.893	50.571	88.327	73.318	326.992	321.441	500.849	**232.300**	920.843	708.151	1011.184	0.000	204.767	72.884	9.000	910.080	49.779
Rainbow Smelt	**0.111**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125
Northern Pike	**0.111**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mooneye	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
White Sucker	**2.648**	0.375	0.375	0.500	0.125	0.000	0.750	0.250	0.250	0.125	0.625	**0.338**	0.125	0.000	0.375	0.250	0.000	0.250	0.125	0.125	0.250
Common Carp	**0.319**	0.125	0.125	0.625	0.000	0.500	0.625	0.250	0.125	1.000	1.500	**0.488**	0.000	0.375	0.125	0.125	0.000	0.875	0.500	0.250	0.000
Spottail Shiner	**71.584**	10.625	21.500	4.750	3.875	13.250	23.875	3.750	17.375	33.375	8.125	**14.050**	26.750	2.750	13.500	9.250	6.125	76.557	11.625	29.875	6.750
Brown Bullhead	**17.824**	32.000	10.875	5.375	17.875	15.000	14.875	9.375	6.000	2.750	6.250	**12.038**	1.250	1.125	1.250	2.375	4.000	3.125	3.625	0.625	7.750
Channel Catfish	**0.069**	0.000	0.125	0.125	0.000	0.375	0.000	0.000	0.000	0.000	0.000	**0.063**	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.375	0.250
American Eel	**0.194**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
Burbot	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**78.532**	13.000	5.500	12.750	14.375	9.750	4.000	14.250	19.000	32.125	18.625	**14.338**	32.000	22.250	39.125	38.875	21.625	18.000	75.375	46.250	159.685
White Perch	**306.900**	6.625	154.625	165.015	1930.129	476.087	880.660	338.969	845.077	1601.655	104.285	**650.313**	394.588	50.125	2494.625	24.375	45.250	175.135	363.391	129.725	421.900
White Bass	**1.509**	0.125	3.000	1.625	3.625	2.000	6.000	0.250	1.000	13.375	3.875	**3.488**	13.750	0.750	2.000	1.875	29.750	9.125	0.500	2.375	2.250
Sunfish	**4.472**	48.125	0.000	14.625	0.000	0.000	14.500	0.000	42.125	0.000	0.000	**11.938**	0.000	0.000	0.000	0.000	0.000	0.000	1.125	0.000	0.000
Rock Bass	**0.236**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.125	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
Pumpkinseed	**26.422**	21.750	5.125	1.875	4.125	1.750	1.125	0.875	0.500	0.250	0.375	**3.775**	0.500	0.125	0.375	0.125	0.500	0.500	30.250	2.000	26.750
Bluegill	**13.431**	0.250	0.500	0.125	0.000	0.375	1.250	1.875	0.000	0.000	0.625	**0.500**	0.375	0.000	0.125	3.625	0.000	0.375	16.500	0.875	49.375
Smallmouth Bass	**0.296**	0.125	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.157**	0.125	0.375	0.250	0.625	0.375	0.000	0.125	0.625	0.000	1.500	**0.400**	0.375	0.375	3.875	0.000	0.000	0.875	0.250	0.375	0.000
Black Crappie	**3.389**	0.375	0.000	0.000	0.250	0.125	2.000	0.375	0.250	0.125	0.000	**0.350**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lepomis sp.	**0.014**	0.000	88.375	0.000	2.375	409.720	0.250	5.125	9.000	17.875	293.990	**82.671**	13.375	30.625	5.625	31.250	20.500	28.625	1.375	18.500	30.125
Yellow Perch	**116.494**	37.875	53.250	14.250	66.250	47.375	14.625	78.750	214.729	44.375	300.513	**87.199**	637.039	21.750	40.750	681.156	168.711	95.847	51.000	193.821	36.625
Walleye	**13.352**	5.375	0.750	8.500	2.625	2.000	2.750	8.625	18.125	3.500	10.375	**6.263**	8.750	3.500	0.750	18.625	6.375	7.875	2.000	7.875	3.375
Johnny Darter	**1.481**	12.500	2.125	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**1.475**	0.000	0.000	0.000	0.125	0.250	0.000	0.000	0.000	0.000
Logperch	**0.347**	0.250	0.500	0.125	0.125	0.125	0.000	0.750	1.000	1.000	0.250	**0.413**	0.125	0.000	0.000	1.500	0.625	0.250	0.500	0.000	0.125
Brook Silverside	**0.139**	0.000	0.500	0.000	0.000	0.000	1.250	0.000	0.000	0.000	8.500	**1.025**	0.125	2.000	0.000	0.000	0.000	4.125	0.000	0.000	0.000
Round Goby	**0.000**	0.000	1.625	67.000	47.250	60.250	7.125	53.875	8.625	30.500	5.875	**28.213**	1.250	6.500	1.250	7.000	39.375	7.000	1.500	2.125	3.750
Freshwater Drum	**23.412**	163.750	58.250	20.875	4.375	214.777	87.000	830.175	25.000	31.000	53.375	**148.858**	13.875	17.625	9.250	11.250	27.750	151.597	19.250	30.250	32.250
Sculpin sp.	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total catch	**1042**	453	724	365	2691	1318	1161	1421	1571	2213	1385	**1330**	2193	893	3897	832	641	680	588	1409	921
Number of species	**18**	19	21	19	16	18	17	18	17	16	19	**18**	18	16	16	15	16	19	17	17	18
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8	8	8	8

TABLE 1.2.13. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Trenton** (4 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

						Year															
	1992-2000											**2001-2010**									
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alewife	**66.911**	149.297	98.611	174.137	8.625	508.870	126.639	24.500	8.750	112.375	26.875	**123.868**	49.500	86.639	354.152	56.754	44.250	96.852	36.000	197.128	86.677
Gizzard Shad	**165.299**	4.125	6.375	22.250	0.000	30.375	23.375	1.375	38.500	5.750	84.234	**21.636**	25.625	70.000	4.125	0.000	55.366	8.625	0.125	192.386	15.250
Rainbow Smelt	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike	**0.069**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mooneye	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
White Sucker	**3.000**	0.500	1.625	0.625	1.125	1.875	2.125	2.125	0.375	0.500	0.750	**1.163**	0.625	1.625	0.000	0.125	8.875	0.250	0.250	0.375	0.125
Shorthead Redhorse	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.000
Minnow	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.278**	0.000	0.250	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.125	**0.063**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**88.467**	217.425	60.875	60.875	1.250	24.500	41.750	0.000	76.000	148.410	120.061	**75.115**	158.481	189.616	5.875	1.000	86.873	3.625	23.500	97.125	2.250
Brown Bullhead	**26.431**	10.625	3.500	4.250	1.125	8.750	3.750	4.500	1.375	0.875	1.500	**4.025**	2.375	3.875	0.125	1.125	3.500	1.375	0.250	6.500	1.250
Channel Catfish	**0.236**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.125	0.000	0.125	0.000	0.000	0.000	0.000	0.000
American Eel	**0.250**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Banded Killifish	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Burbot	**0.000**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**27.139**	0.500	0.500	0.000	0.000	0.125	0.125	0.000	0.250	1.625	1.500	**0.463**	3.250	1.750	0.000	2.750	1.250	0.500	1.875	20.375	12.000
White Perch	**321.116**	54.250	19.875	240.032	80.777	279.018	388.312	29.875	33.750	669.313	16.250	**181.145**	261.900	361.891	27.125	0.250	11.125	72.244	62.875	385.768	144.820
White Bass	**0.403**	0.000	0.125	0.000	0.000	0.000	1.250	0.125	0.000	0.875	0.125	**0.250**	1.625	0.250	0.000	0.000	5.125	0.375	0.000	1.625	1.750
Sunfish	**13.764**	33.250	0.000	22.375	0.000	0.000	11.500	0.000	0.875	0.000	0.000	**6.800**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.889**	0.625	0.625	0.125	0.000	0.500	2.250	0.000	1.250	2.875	2.250	**1.050**	4.000	0.375	0.500	1.750	1.875	0.000	0.875	3.500	1.375
Pumpkinseed	**86.353**	84.750	32.250	88.887	56.794	46.750	20.000	77.522	143.790	66.250	62.250	**67.924**	67.062	40.125	118.617	20.000	63.875	2.625	91.750	22.375	19.500
Bluegill	**0.750**	1.125	0.500	1.500	0.875	0.375	3.875	5.250	2.625	0.625	5.125	**2.188**	11.875	1.000	3.875	2.500	1.625	0.000	29.625	21.125	22.500
Smallmouth Bass	**0.556**	0.375	0.250	0.500	0.500	0.125	0.000	0.000	0.125	0.250	0.000	**0.213**	0.125	0.000	0.250	0.000	0.000	0.000	0.125	0.000	0.250
Largemouth Bass	**2.236**	2.375	2.875	4.625	0.125	6.625	4.250	0.125	6.375	2.750	6.875	**3.700**	14.125	11.250	5.500	0.125	5.500	10.750	0.250	12.250	7.000
Black Crappie	**1.681**	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lepomis sp.	**0.764**	0.000	64.796	0.000	0.000	59.750	10.250	0.000	17.000	0.625	7.125	**15.955**	24.875	6.500	3.125	5.000	10.250	15.625	0.000	10.375	13.250
Yellow Perch	**317.772**	200.638	239.014	544.694	186.465	340.868	130.139	584.825	769.635	1095.367	335.295	**442.694**	1169.504	278.565	892.895	525.098	1009.464	140.827	194.013	653.821	185.591
Walleye	**9.764**	9.625	3.625	10.500	1.500	1.875	0.750	4.750	7.375	6.125	2.125	**4.825**	8.000	9.000	0.000	16.000	24.750	2.250	2.000	9.125	2.000
Johnny Darter	**5.458**	2.500	7.250	7.625	0.375	0.000	0.000	0.000	0.000	0.000	0.000	**1.775**	0.250	0.250	0.000	0.125	0.000	0.125	0.000	0.875	0.000
Logperch	**3.097**	2.000	0.000	15.250	4.250	52.750	0.625	5.625	23.375	32.375	6.875	**14.313**	24.375	4.750	2.625	48.750	12.250	1.000	0.750	15.500	3.500
Tessellated Darter	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000
Brook Silverside	**0.000**	0.000	0.000	0.250	0.000	0.000	0.000	0.125	0.000	0.000	0.125	**0.050**	0.125	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	2.875	8.500	13.125	5.250	0.750	12.375	34.125	7.375	**8.438**	18.750	12.125	1.875	19.750	32.625	7.000	1.250	14.875	6.125
Freshwater Drum	**11.931**	6.750	3.625	2.000	0.375	4.125	4.875	9.500	1.500	4.875	1.375	**3.900**	2.125	1.125	0.000	1.500	3.000	1.250	8.750	7.625	6.625
Total catch	**1155**	781	547	1203	353	1381	781	751	1145	2186	688	**982**	1849	1081	1421	703	1382	366	454	1673	532
Number of species	**20**	20	18	19	15	18	19	15	18	18	20	**18**	21	19	13	17	18	17	17	19	18
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8	8	8	8

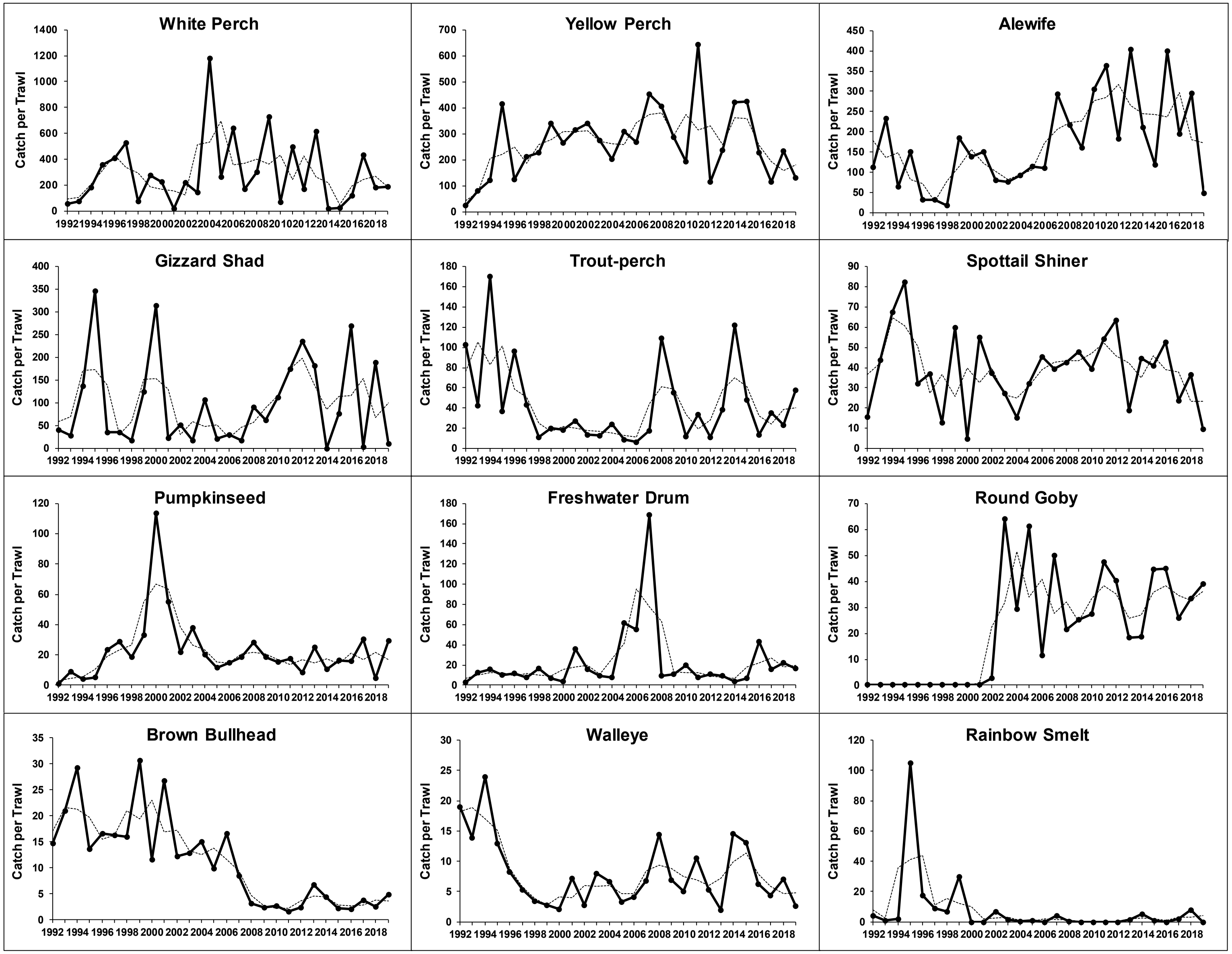


FIG. 1.2.3. Abundance trends (annual means) for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.2.1). Values shown here are 3-yr running averages (two years for first and last years graphed).

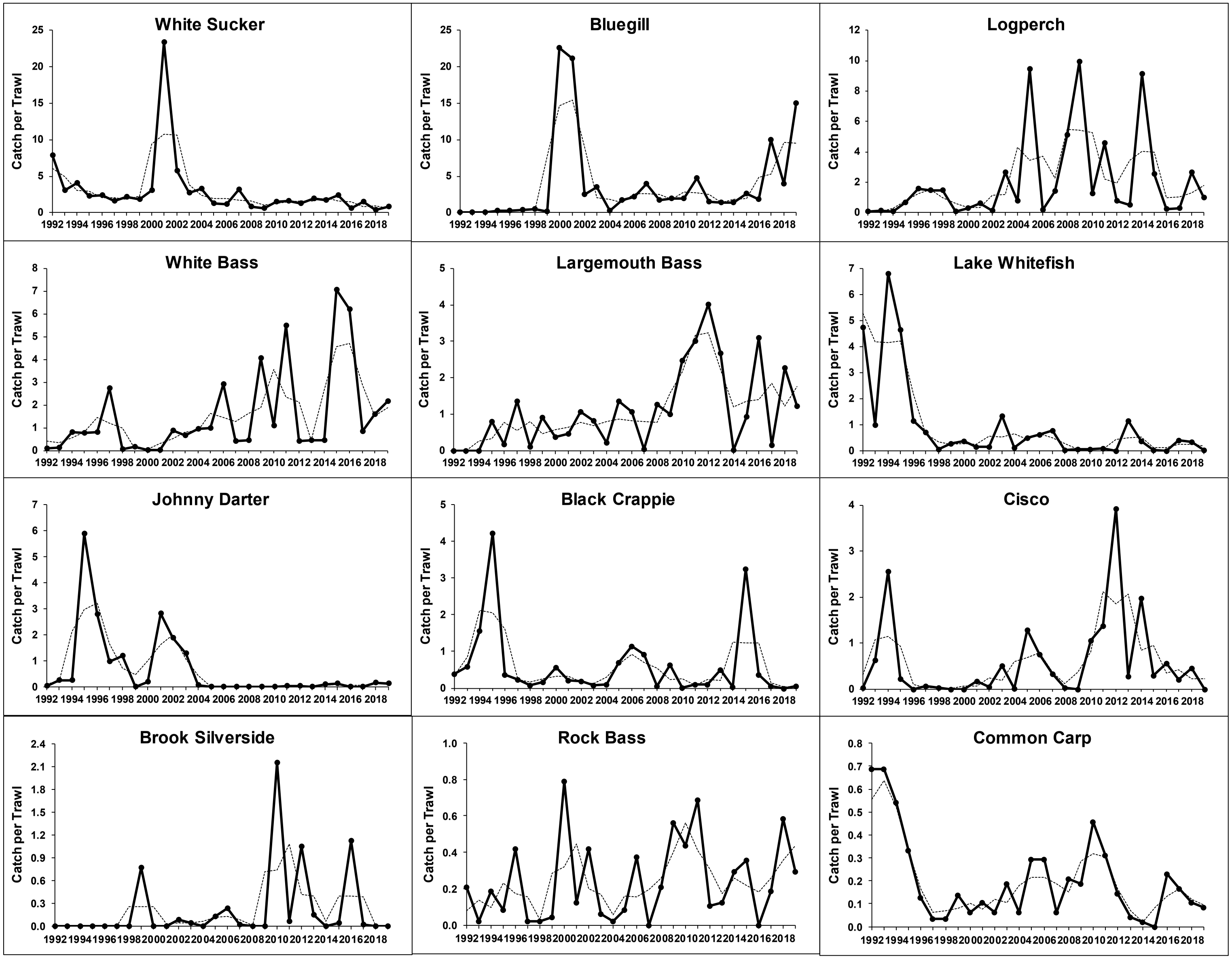


FIG. 1.2.3 (continued). Abundance trends for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.2.1). Values shown here are 3-yr running averages (two years for first and last years graphed).

TABLE 1.2.14. Mean catch-per-trawl of **age-0 Lake Whitefish** at two sites, Conway in the lower Bay of Quinte and EB03 near Timber Island in eastern Lake Ontario, 1992-2018. Four replicate trawls on each of two to four visits during August and early September were made at each site. Distances of each trawl drag were 1/4 mile for Conway and 1/2 mile for EB03.

Year	Conway	N	EB03	N
1992	23.4	8	0.9	12
1993	3.1	8	4.7	12
1994	40.5	8	79.7	8
1995	27.1	8	17.1	8
1996	2.6	8	0.8	8
1997	5.1	8	6.0	8
1998	0.4	8	0.0	8
1999	0.0	8	0.0	8
2000	0.4	8	0.0	8
2001	0.1	8	0.0	8
2002	0.1	8	0.0	8
2003	8.1	12	44.9	16
2004	0.0	12	2.1	12
2005	2.8	12	49.8	12
2006	2.4	12	3.6	8
2007	0.8	12	0.3	12
2008	0.1	12	0.0	8
2009	0.3	12	0.1	12
2010	0.3	12	4.7	12
2011	0.1	8	0.0	8
2012	0.0	8	0.0	8
2013	7.0	8	0.0	8
2014	2.3	8	0.0	8
2015	0.1	8	0.4	8
2016	0.0	8	0.0	6
2017	2.4	8	0.0	5
2018	1.5	8	0.0	5
2019	0.0	8	0.0	4

TABLE 1.2.15. Mean catch-per-trawl of **age-0 Cisco** at Conway in the lower Bay of Quinte, 1992-2019. Four replicate trawls on each of two to four visits during August and early September were made at the Conway site. Distances of each trawl drag was 1/4 mile.

Year	Conway	N
1992	0.00	8
1993	1.50	8
1994	7.69	8
1995	1.25	8
1996	0.00	8
1997	0.00	8
1998	0.14	8
1999	0.00	8
2000	0.00	8
2001	0.00	8
2002	0.13	8
2003	2.83	12
2004	0.08	12
2005	7.17	12
2006	4.50	12
2007	2.00	12
2008	0.17	12
2009	0.00	12
2010	6.33	12
2011	8.25	8
2012	23.25	8
2013	1.50	8
2014	11.63	8
2015	1.75	8
2016	3.00	8
2017	1.13	8
2018	2.63	8
2019	0.00	8

TABLE 1.2.16. Mean catch-per-trawl of **age-0 Yellow Perch** at six Bay of Quinte sites, 1992-2019. Four replicate trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile.

	Trenton	Belleville	Big Bay	Deseronto	Hay Bay	Conway	Mean	Number of trawls
1992	3.1	1.3	0.4	0.1	0.5	0.0	0.9	48
1993	203.7	14.0	0.4	36.3	1.6	0.3	42.7	48
1994	526.6	50.6	10.3	101.5	29.3	6.9	120.8	48
1995	730.4	101.1	9.5	764.5	268.9	0.0	312.4	48
1996	2.6	2.9	4.3	2.5	8.5	0.1	3.5	48
1997	302.0	4.0	36.0	135.0	526.0	0.0	167.2	48
1998	13.1	14.0	11.5	0.1	2.9	0.0	7.0	48
1999	24.5	7.0	4.9	638.7	900.3	0.0	262.6	48
2000	0.0	5.8	5.4	0.8	6.0	0.3	3.0	48
2001	158.0	27.6	16.8	71.8	127.0	0.0	66.9	48
2002	0.0	0.3	9.2	141.8	241.1	0.0	65.4	48
2003	228.5	3.8	0.9	9.2	1.6	0.5	40.8	52
2004	0.0	0.9	4.5	8.4	18.0	0.0	5.3	52
2005	202.8	37.5	24.8	444.7	61.9	0.0	128.6	52
2006	3.8	3.5	51.7	532.8	306.0	0.2	149.7	52
2007	284.3	70.9	29.6	883.5	776.0	0.1	340.7	52
2008	123.8	153.4	114.5	263.6	12.4	0.0	111.3	52
2009	101.3	29.8	130.2	81.1	14.3	0.0	59.4	52
2010	216.8	280.3	167.0	34.6	148.8	0.0	141.2	52
2011	729.7	582.4	382.3	1216.8	4.8	1.7	486.3	53
2012	72.5	16.8	103.6	31.5	38.1	0.1	43.8	48
2013	6.1	8.6	49.5	22.8	9.7	0.0	16.1	48
2014	330.1	223.2	449.3	98.7	48.1	0.0	191.6	48
2015	171.6	83.4	124.3	670.0	224.3	0.0	212.3	48
2016	54.4	92.3	296.4	378.6	36.0	0.0	142.9	48
2017	0.1	5.4	11.3	3.9	3.0	0.0	4.0	48
2018	447.4	189.8	49.1	370.5	47.4	0.1	184.1	48
2019	37.5	10.4	3.6	37.5	4.7	0.1	15.6	48

TABLE 1.2.17 Mean catch-per-trawl of **age-0 Walleye** at six Bay of Quinte sites, 1992-2019. Four replicate trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile.

Year	Trenton	Belleville	Big Bay	Deseronto	Hay Bay	Conway	Mean	Number of trawls
1992	6.8	12.4	14.0	37.9	6.1	0.8	13.0	48
1993	8.8	16.0	5.0	11.3	1.1	11.9	9.0	48
1994	17.0	21.0	15.0	23.8	11.5	12.5	16.8	48
1995	14.1	8.3	2.6	8.3	5.5	0.9	6.6	48
1996	4.3	7.6	4.9	1.1	0.0	1.1	3.2	48
1997	2.8	7.6	6.1	0.3	0.1	0.0	2.8	48
1998	0.1	0.4	0.6	0.1	0.0	0.0	0.2	48
1999	1.1	0.4	0.4	1.4	9.1	0.1	2.1	48
2000	0.0	3.8	1.0	0.0	0.1	0.0	0.8	48
2001	9.5	4.5	4.8	6.8	3.3	0.1	4.8	48
2002	0.0	0.0	1.1	0.1	0.0	0.0	0.2	48
2003	10.3	8.3	16.8	1.9	0.4	0.0	6.3	52
2004	0.0	0.6	11.4	1.4	0.9	0.0	2.4	52
2005	0.8	1.4	3.8	1.8	1.1	0.0	1.5	52
2006	0.0	1.0	3.0	2.8	5.9	0.3	2.1	52
2007	4.1	6.1	5.4	5.6	5.6	0.2	4.5	52
2008	5.5	17.6	20.5	14.6	12.4	0.0	11.8	52
2009	2.5	2.3	7.6	1.0	2.9	0.0	2.7	52
2010	1.4	4.6	4.5	1.0	3.6	0.0	2.5	52
2011	6.1	8.6	24.5	8.0	4.0	0.1	8.6	52
2012	6.4	2.5	7.1	0.3	0.1	0.0	2.7	48
2013	0.0	0.0	1.0	0.3	0.6	0.0	0.3	48
2014	15.4	18.5	21.0	20.4	6.4	0.0	13.6	44
2015	21.1	5.6	16.6	13.5	7.0	0.0	10.6	48
2016	0.9	5.5	4.9	2.4	0.1	0.0	2.3	48
2017	0.0	0.0	0.3	4.1	5.4	0.0	1.6	48
2018	8.3	7.8	6.1	11.1	2.6	0.0	6.0	48
2019	0.4	1.9	3.4	0.8	0.4	0.0	1.1	48

TABLE 1.2.18. Age distribution of **127 Walleye** sampled from summer bottom trawls, Bay of Quinte, 2019. Also shown are mean fork length and mean weight. Fish of less than 140 mm fork length were assigned an age of 0, fish over 140 mm were aged using scales (ages were not able to be assigned to two fish)

Age (years)	0	1	2	3	4	5
Year-class	2019	2018	2017	2016	2015	2014
Number of fish	52	56	10	1	3	3
Mean fork length (mm)	113	225	321	424	450	469
Mean weght (g)	14	113	373	884	1052	1197

1.3 Lake Ontario Nearshore Community Index Netting

E. Brown, Lake Ontario Management Unit

In 2019, Nearshore Community Index Netting (NSCIN) projects were completed at four nearshore areas: Hamilton Harbour, Toronto Harbour, Lower / Middle Bay of Quinte, and the Upper Bay of Quinte (Fig. 1.3.1). NSCIN was first initiated on the upper Bay of Quinte (Trenton to Deseronto), West Lake and Weller's Bay in 2001, and was expanded to include the middle and lower reaches of the Bay of Quinte (Deseronto to Lake Ontario) in 2002. In 2006, the NSCIN program was conducted on Hamilton and the Toronto Harbour areas thanks to partnerships developed with Fisheries and Oceans Canada and the Toronto and Region Conservation Authority. NSCIN was further expanded to other Lake Ontario nearshore areas in subsequent years (Table 1.3.1).

The NSCIN protocol is a provincial standard methodology which uses 6-foot trap nets and is designed to evaluate the relative abundance and other biological attributes of fish species that inhabit the littoral area. Suitable trap net sites are chosen from randomly selected UTM grids that contain shoreline in the nearshore area. Ecosystem (i.e., Index of Biotic Integrity or IBI) and fish community (e.g., proportion of piscivore biomass or PPB) level measures have been developed to assess relative health of Lake Ontario's nearshore areas. These assessments are particularly useful to monitor the on-going status of impaired fish communities in Lake Ontario Areas of Concern (AOCs) such as Hamilton and Toronto Harbours.

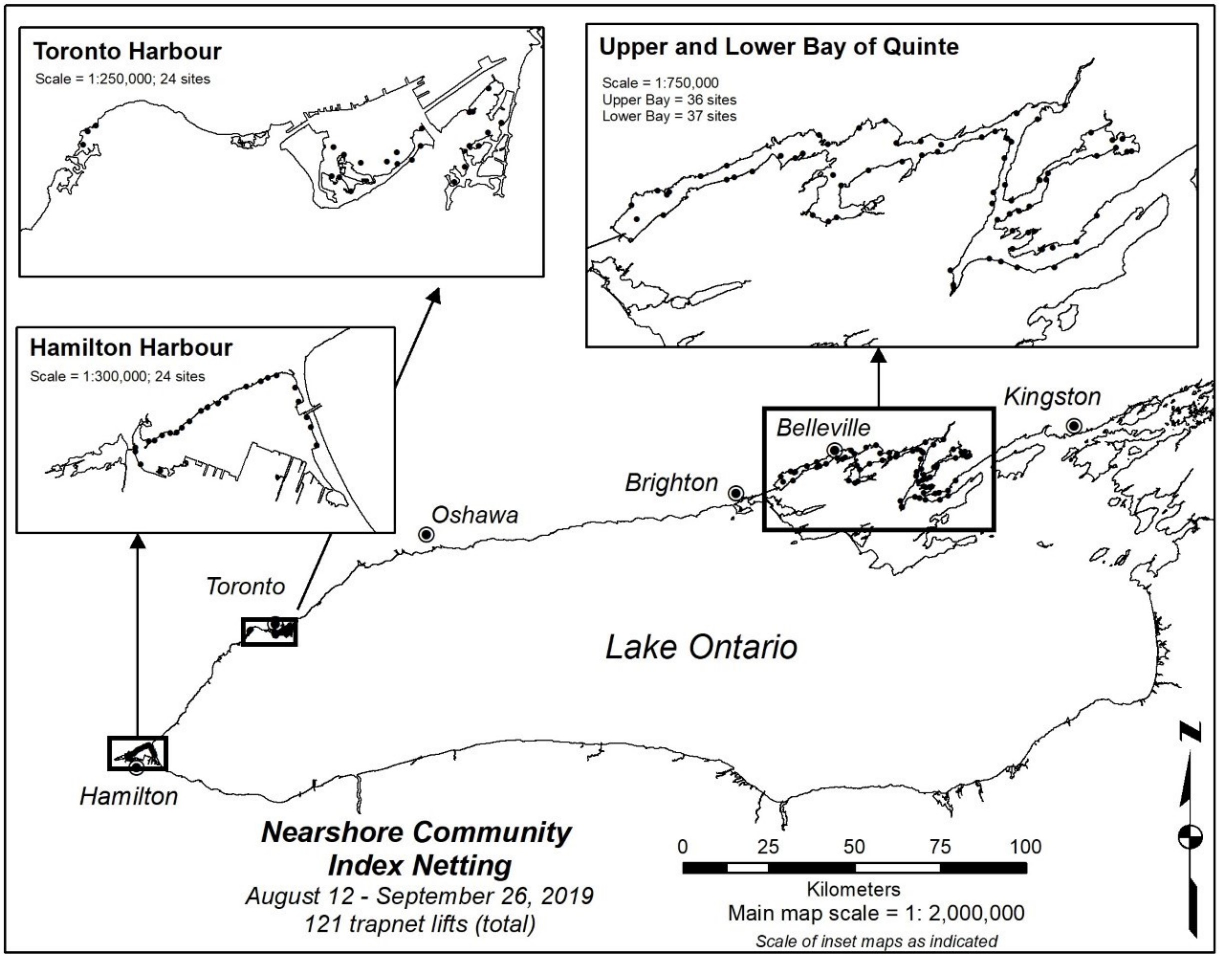


FIG. 1.3.1. Map of Lake Ontario indicating NSCIN trap net locations on Hamilton Harbour, Toronto Harbour, Middle / Lower Bay of Quinte, and the Upper Bay of Quinte, 2019.

Survey information and basic catch statistics for the three nearshore areas sampled in 2019 are given in Tables 1.3.2 and 1.3.3, respectively. Age distribution and length-at-age information is given in Tables 1.3.4 and 1.3.5. Abundance trends for all species are presented in Table 1.3.6 and graphically for selected species in Fig 1.3.2.

Hamilton Harbour

Partnership project with Fisheries and Oceans Canada

Twenty-four trap net sites were sampled on Hamilton Harbour from Aug 12 - 23, 2019 with water temperatures ranging from 19.5 - 23.4°C (Table 1.3.2). Just over 11,000 fish comprising 24 species were captured (Table 1.3.3). The most abundant species by number were Brown Bullhead (6,988), White Perch (3,150), Rudd (324), Walleye (167), Bluegill (134), and Channel Catfish (106). Goldfish (116), and Common Carp (97). Of note, Forty-seven Common Carp - Goldfish hybrids and two American Eel were captured.

Walleye have been stocked into Hamilton Harbour in an effort to establish a native predatory fish and an urban fishery (see Section 8.6). Of particular note was the strong showing of age-7 and age-3 Walleye from the 2012 and 2016 stocking event, respectively.

TABLE. 1.3.1. Annual NSCIN trap net schedule for Lake Ontario nearshore areas, 2006-2019. The numbers of trap net samples at each area in each year are indicated.

Year	Hamilton Harbour	Toronto Islands	Presqu'ile Bay	Weller's Bay	West Lake	East Lake	Prince Edward Bay	Upper Bay of Quinte	Middle Bay of Quinte	Lower Bay of Quinte	North Channel Kingston
2019	24	24						36	29	7	
2018	24	24						36			
2017					24	16	24	36			
2016	24	24						36			
2015	24		16	24				36			
2014	24	23						36			
2013					24	16	24	36			
2012	24	24						36			
2011								36	29	7	
2010	24	24						36			
2009							27	36	30	18	25
2008	24		12	24				36			
2007		24			18	18		36			
2006	19	24									

TABLE 1.3.2. Survey information for the 2019 NSCIN trap net program on Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte, 2019. Shown for each embayment are the survey dates, the range of observed surface water temperatures, the total number of trap net lifts, and the number of trap net lifts broken down by target sampling depth, and observed substrate and cover types.

		Hamilton Harbour	Toronto Harbour	Upper Bay of Quinte	Middle/Lower Bay of Quinte
Survey dates		Aug 12-22	Aug 26-Sep 5	Sep 3-20	Sep 9-27
Water temperature range (°C)		19.5-23.4	17.1-20.9	18.3-21.1	17.3-20.1
No. of trap net lifts		24	24	36	36
No. of lifts by depth:					
	Target (2-2.5 m)	5	8	12	16
	> Target	16	13	14	9
	< Target	3	3	10	11
No. of lifts by substrate type:					
	Hard	9	6	8	12
	Soft	15	18	28	24
No. of lifts by degree of cover:					
	None	9	1	0	0
	1-25%	11	15	8	1
	26-75%	4	6	22	25
	76-100%	0	2	6	10

Toronto Harbour

Partnership project with Toronto and Region Conservation Authority

Twenty-four trap net sites were sampled on Toronto Harbour from August 26 – September 6, 2019, with water temperatures ranging from 17.1 - 20.9°C (Table 1.3.2). Nearly 1,800 fish comprising 24 species were captured (Table 1.3.3). The most abundant species by number were Brown Bullhead (1,156), Alewife (204), Pumpkinseed (177), Rock Bass (46) and Common Carp (30). Four American Eel were caught.

Walleye have been stocked into Toronto Harbour in an effort to establish a native predatory fish and create an urban fishery (see Section 8.6). Of note was the detection of 5 age-2 Walleye, presumably from the 2017 stocking event.

Middle / Lower Bay of Quinte

Thirty-six trap net sites were sampled on the Middle and Lower Bay of Quite from September 9 - 27, 2019 with water temps ranging from 17.3 - 20.1°C. Nearly 5,000 fish comprising 24 species were captured (Table 1.3.3). The most abundant species by number were Bluegill (1,607), Pumpkinseed (1,454), Largemouth Bass (369), Rock Bass (223), Black Crappie (209), Yellow Perch (144), and Walleye (124). Seventeen American Eel were caught

Upper Bay of Quinte

Thirty-six trap net sites were sampled on the Upper Bay of Quinte from September 3 - 20, 2019 with water temperatures ranging from 18.3-21.1°C (Table 1.3.2). Just over 6,000 fish comprising 26 species were captured (Table 1.3.3). The most abundant species by number were Bluegill (3,670), Pumpkinseed (885), Brown Bullhead (393), Largemouth Bass (316), Rock Bass (166), Black Crappie (137), and White Perch (110). Thirty-two American Eel were caught.

Ecosystem Health Indices

Indices have been developed based on the NSCIN trap netting to evaluate ecosystem health in Lake Ontario nearshore areas. The indices vary among nearshore areas with the degree of exposure of the nearshore area sampled to Lake Ontario, and therefore are presented separately for sheltered and exposed embayments.

Piscivore Biomass

A proportion of the fish community biomass comprised of piscivores (PPB) greater than 0.20 reflects a healthy trophic structure. The PPBs in 2019 were 0.21, 0.38, and 0.39 in Hamilton Harbour, Upper Bay of Quinte and Middle Bay of Quinte (i.e.sheltered embayments), respectively. The PPB was 0.22 in Toronto Harbour (i.e. exposed embayment) and 0.59 in Lower Bay of Quinte (i.e. transitional area)

The average PPB at Hamilton Harbour remained below both 0.2 and that of other sheltered Lake Ontario embayments such as the Upper Bay of Quinte (Fig. 1.3.3). The average PPB at Toronto Harbour was just below the target value and that of other exposed Lake Ontario embayments (Fig. 1.3.4).

Index of Biotic Integrity

The index of biotic integrity (IBI) is a measure of ecosystem health. IBI classes can be described as follows: 0-20 very poor, 20-40 poor, 40-60 fair, 60-80 good, and 80-100 excellent ecosystem health. The IBIs in 2019 were 53 (fair), 72 (good) and 70 (good) for Hamilton Harbour, Upper Bay of Quinte and Middle Bay of Quinte (i.e. sheltered embayments), respectively. The IBI was 46 (fair) in Toronto Harbour (i.e. exposed embayment) and 59 (fair) in Lower Bay of Quinte (i.e. transitional area)

The average IBI at Hamilton Harbour remained below those of other sheltered Lake Ontario embayment's, while the average IBI at the upper Bay of Quinte was similar to values at other Lake Ontario sheltered nearshore areas (Fig. 1.3.5). Toronto Harbour IBI was lower than other exposed embayments (Fig 1.3.6).

TABLE 1.3.3. Species-specific catch in the 2019 NSCIN trap net program on Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte. Statistics shown include arithmetic and geometric mean catch-per-trap net (CUE), percent relative standard error of mean log10(catch+1), %RSE = 100*SE/mean, and mean fork or total length (mm).

	Hamilton Harbour				Toronto Harbour				Upper Bay of Quinte				Middle / Lower Bay of Quinte			
Species	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)
Longnose gar	0.500	0.293	39	806	0.083	0.059	69	730	2.083	0.535	33	809	0.167	0.114	43	706
Bowfin	1.167	0.847	19	583	0.792	0.523	26	582	2.306	1.144	19	521	1.556	0.875	19	578
Alewife	-	-	-	-	8.500	2.598	21	138	-	-	-	-	-	-	-	-
Gizzard shad	0.583	0.361	34	368	0.417	0.288	34	385	0.389	0.230	35	187	0.306	0.207	33	194
Rainbow trout	-	-	-	-	0.042	0.029	100	420	-	-	-	-	-	-	-	-
Brown trout	-	-	-	-	0.042	0.029	100	670	-	-	-	-	-	-	-	-
Northern pike	0.708	0.513	24	724	0.750	0.434	33	615	0.389	0.299	23	592	0.500	0.381	21	593
Quillback	0.083	0.059	69	480	-	-	-	-	-	-	-	-	-	-	-	-
White sucker	0.042	0.029	100	460	0.792	0.513	27	404	0.083	0.059	56	417	0.500	0.339	26	419
Silver redhorse	-	-	-	-	-	-	-	-	0.444	0.262	33	451	0.167	0.092	58	498
Shorthead redhorse	-	-	-	-	-	-	-	-	0.750	0.485	23	399	0.028	0.019	100	440
Greater redhorse	0.042	0.029	100	450	-	-	-	-	0.917	0.495	26	532	0.056	0.039	70	595
River redhorse	-	-	-	-	-	-	-	-	0.111	0.071	58	563	-	-	-	-
Goldfish	1.500	1.002	20	302	-	-	-	-	-	-	-	-	-	-	-	-
Common carp	3.167	2.035	15	532	1.250	0.811	23	608	0.500	0.354	24	419	0.806	0.572	19	632
Golden shiner	-	-	-	-	-	-	-	-	0.028	0.019	100	130	0.250	0.170	35	149
Rudd	13.500	4.331	17	247	-	-	-	-	-	-	-	-	-	-	-	-
Brown bullhead	291.167	107.569	7	258	48.167	7.686	17	246	10.917	3.841	13	277	3.056	1.577	17	287
Channel catfish	4.417	2.124	18	583	0.125	0.091	55	563	0.611	0.265	39	488	1.028	0.560	24	456
American eel	0.083	0.059	69	875	0.167	0.109	57	913	0.889	0.509	25	832	0.472	0.311	27	889
White perch	129.375	37.894	9	203	0.292	0.195	42	236	3.056	1.563	16	205	3.139	1.211	21	212
White bass	1.917	1.203	19	250	0.042	0.029	100	350	0.111	0.080	48	198	0.028	0.019	100	130
Rock bass	1.083	0.566	31	180	1.917	0.781	28	163	4.611	2.109	15	167	6.194	2.162	17	169
Pumpkinseed	0.083	0.059	69	130	7.375	2.072	23	132	24.583	12.381	8	149	40.389	11.562	11	143
Bluegill	5.583	3.007	16	149	0.833	0.421	37	107	101.944	41.923	7	137	44.639	17.990	9	143
Smallmouth bass	-	-	-	-	0.125	0.091	55	373	0.194	0.144	34	293	0.028	0.019	100	170
Largemouth bass	0.083	0.059	69	445	0.417	0.245	41	213	8.778	5.488	9	222	10.250	4.627	12	210
Black crappie	0.500	0.300	38	181	0.750	0.546	23	147	3.806	2.275	12	225	5.806	2.862	13	221
Lepomis sp.	-	-	-	-	-	-	-	-	0.056	0.039	70	180	-	-	-	-
Yellow perch	0.042	0.029	100	190	0.375	0.230	42	183	2.611	1.283	18	207	4.000	1.400	19	195
Walleye	6.958	4.269	11	579	0.375	0.245	38	476	1.444	1.084	13	489	3.444	1.892	14	524
Freshwater drum	1.750	0.928	24	381	0.417	0.319	28	667	0.889	0.474	28	457	1.028	0.613	22	427
Carassius auratus x Cyprinus carpio	1.958	1.161	21	402	0.125	0.091	55	420	-	-	-	-	-	-	-	-
Total catch per net				466				74				173				128
Number of species				24				24				26				24
Number of nets				24				24				36				36
Total catch				11,191				1,780				6,210				4,602

Table 1.3.4. Age distribution of selected species caught in Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte, 2019.

		Age (years) / Year-class													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Location	Species	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Hamilton Harbour															
	Northern Pike	-	1	3	5	4	1	2	-	-	-	-	-	-	-
	White Perch	-	3	6	10	5	1	3	2	-	-	-	-	-	-
	White Bass	-	18	3	4	1	2	1	-	-	-	-	-	-	-
	Rock Bass			6	12	3	1			1					
	Pumpkinseed	-	-	-	1	1	-	-	-	-	-	-	-	-	-
	Bluegill	-	-	-	1	2	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	-	-	-	-	-	-	-	1	-	1	-	-	-
	Black Crappie	-	5	5	-	1	-	-	-	-	-	-	-	-	-
	Walleye	-	1	-	15	4	-	-	10	-	-	-	-	-	1
Toronto Harbour															
	Northern Pike	1	1	4	7	3	1	1	-	-	-	-	-	-	-
	Rock Bass	-	-	4	17	2	4	-	-	-	-	-	-	-	-
	Pumpkinseed	-	6	6	12	4	1	-	-	-	-	-	-	-	-
	Bluegill	-	19	-	1	-	-	-	-	-	-	-	-	-	-
	Smallmouth Bass	-	-	-	-	1	2	-	-	-	-	-	-	-	-
	Largemouth Bass	-	8	-	-	1	-	1	-	-	-	-	-	-	-
	Black Crappie	-	16	1	1	-	-	-	-	-	-	-	-	-	-
	Yellow Perch	-	3	6	-	-	-	-	-	-	-	-	-	-	-
	Walleye	-	-	5	1	1	-	-	2	-	-	-	-	-	-
Upper Bay of Quinte															
	Northern Pike	-	2	7	1	3	1	-	-	-	-	-	-	-	-
	Pumpkinseed	-	-	2	15	8	3	2	-	-	-	-	-	-	-
	Bluegill	-	1	2	11	9	2	2	-	1	-	-	-	-	-
	Smallmouth Bass	-	2	1	4	-	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	15	8	5	1	1	-	-	-	-	-	-	-	-
	Black Crappie	1	15	3	1	7	1	-	1	-	1	-	-	-	-
	Yellow Perch	-	-	1	12	8	5	3	1	-	-	-	-	-	-
	Walleye	-	1	-	10	10	7	1	-	-	1	-	-	-	-
Middle/Lower Bay of Quinte															
	Northern Pike	1	5	6	3	2	-	1	2	-	1	-	-	-	-
	Rock Bass	-	-	3	14	6	3	4	-	-	-	-	-	-	-
	Pumpkinseed	-	-	5	11	12	1	1	-	-	-	-	-	-	-
	Bluegill	-	4	1	14	7	-	1	2	1	-	-	-	-	-
	Smallmouth Bass	-	1	-	-	-	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	17	6	5	-	-	1	-	1	-	-	-	-	-
	Black Crappie	-	8	5	2	10	3	2	-	-	-	-	-	-	-
	Yellow Perch	-	-	-	7	9	6	7	1	-	-	-	-	-	-
	Walleye	-	1	1	1	7	10	1	4	1	2	-	1	-	-

Table 1.3.5. Mean fork length (mm) of selected species caught in Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte, 2019.

		Age (years) / Year-class													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Location	Species	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Hamilton Harbour															
	Northern Pike	-	490	593	718	809	630	866	-	-	-	-	-	-	-
	White Perch	-	158	189	190	213	237	258	255	-	-	-	-	-	-
	White Bass	-	190	184	313	332	317	361	-	-	-	-	-	-	-
	Rock Bass	-	-	137	176	204	225	-	-	251	-	-	-	-	-
	Pumpkinseed	-	-	-	120	148	-	-	-	-	-	-	-	-	-
	Bluegill	-	-	-	148	153	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	-	-	-	-	-	-	-	450	-	444	-	-	-
	Black Crappie	-	140	212	-	242	-	-	-	-	-	-	-	-	-
	Walleye	-	256	-	483	551	-	-	615	-	-	-	-	-	610
Toronto Harbour															
	Northern Pike	211	571	544	626	655	713	726	-	-	-	-	-	-	-
	Rock Bass	-	-	148	164	195	176	-	-	-	-	-	-	-	-
	Pumpkinseed	-	98	120	129	148	130	-	-	-	-	-	-	-	-
	Bluegill	-	104	-	158	-	-	-	-	-	-	-	-	-	-
	Smallmouth Bass	-	-	-	-	328	384	-	-	-	-	-	-	-	-
	Largemouth Bass	-	180	-	-	292	-	365	-	-	-	-	-	-	-
	Black Crappie	-	142	164	186	-	-	-	-	-	-	-	-	-	-
	Yellow Perch	-	167	202	-	-	-	-	-	-	-	-	-	-	-
	Walleye	-	-	402	381	434	-	-	673	-	-	-	-	-	-
Upper Bay of Quinte															
	Northern Pike	-	474	551	670	643	745	-	-	-	-	-	-	-	-
	Pumpkinseed	-	-	113	141	160	151	153	-	-	-	-	-	-	-
	Bluegill	-	108	121	151	158	148	156	-	170	-	-	-	-	-
	Smallmouth Bass	-	182	284	333	-	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	197	256	327	296	383	-	-	-	-	-	-	-	-
	Black Crappie	118	162	236	254	277	283	-	327	-	345	-	-	-	-
	Yellow Perch	-	-	143	179	209	226	254	153	-	-	-	-	-	-
	Walleye	-	291	-	437	465	502	549	-	-	624	-	-	-	-
Middle/Lower Bay of Quinte															
	Northern Pike	248	426	562	699	603	-	724	717	-	728	-	-	-	-
	Rock Bass	-	-	119	161	187	201	206	-	-	-	-	-	-	-
	Pumpkinseed	-	-	122	146	167	155	170	-	-	-	-	-	-	-
	Bluegill	-	97	124	149	174	-	202	198	181	-	-	-	-	-
	Smallmouth Bass	-	167	-	-	-	-	-	-	-	-	-	-	-	-
	Largemouth Bass	-	193	272	308	-	-	345	-	419	-	-	-	-	-
	Black Crappie	-	167	229	228	282	302	299	-	-	-	-	-	-	-
	Yellow Perch	-	-	-	159	176	210	237	270	-	-	-	-	-	-
	Walleye	-	253	355	393	466	525	533	542	526	579	-	597	-	-

TABLE 1.3.6. Species-specific abundance trends (mean catch per trap net) in Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte. Annual total catch per net lift, number of net sets, and number of species are also indicated.

	Hamilton Harbour									Toronto Harbour							
Species	2006	2008	2010	2012	2014	2015	2016	2018	2019	2006	2007	2010	2012	2014	2016	2018	2019
Longnose gar	0.47	0.71	0.28	0.67	0.17	0.54	0.75	0.50	0.50	0.17	-	-	0.04	0.17	0.08	0.04	0.08
Spotted gar	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bowfin	0.58	1.17	2.42	1.17	1.54	0.83	1.33	0.88	1.17	0.33	0.08	0.46	0.42	0.13	0.54	0.25	0.79
Alewife	-	-	-	0.04	0.71	13.75	-	-	-	3.79	4.58	0.42	9.50	17.91	0.54	3.21	8.50
Gizzard shad	3.42	0.50	2.38	2.13	1.21	0.33	1.71	2.08	0.58	2.71	0.42	0.04	1.08	0.35	4.04	0.83	0.42
Chinook salmon	-	-	-	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-
Rainbow trout	0.05	0.04	-	-	-	-	-	-	-	-	-	0.04	-	-	0.08	0.04	0.04
Atlantic salmon	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-	-	-
Brown trout	-	-	-	-	0.04	-	-	-	-	0.04	-	-	0.08	0.13	-	-	0.04
Lake trout	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake whitefish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coregonus sp.	-	-	-	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern pike	1.11	1.08	1.08	0.29	0.25	0.54	0.54	0.33	0.71	1.17	0.83	1.38	1.25	1.00	1.50	0.88	0.75
Muskellunge	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mooneye	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Suckers	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quillback	-	0.04	-	-	0.08	-	-	-	0.08	-	-	-	-	-	0.04	-	-
White sucker	0.11	0.21	0.46	0.29	2.17	0.63	0.04	0.08	0.04	4.17	3.83	2.29	1.13	1.17	2.58	0.46	0.79
Bigmouth buffalo	0.05	-	-	-	0.04	0.04	-	0.04	-	-	-	-	-	-	-	-	-
Silver redhorse	-	0.04	-	-	-	-	-	-	-	-	-	-	-	0.04	-	-	-
Shorthead redhorse	0.11	0.04	0.25	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
Greater redhorse	-	-	-	-	0.08	0.04	-	-	0.04	-	-	-	-	-	-	-	-
River redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Black buffalo	-	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-
Moxostoma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minnow	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goldfish	0.32	0.92	2.71	0.88	0.58	1.08	3.46	4.83	1.50	0.04	-	0.04	-	-	0.25	-	-
Common carp	4.47	3.92	2.20	1.21	2.25	2.38	4.33	4.04	3.17	1.58	2.50	4.75	3.67	2.00	4.79	1.58	1.25
Golden shiner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fallfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rudd	-	-	-	0.04	-	0.38	3.96	14.75	13.50	-	-	-	-	-	-	-	-
Black bullhead	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brown bullhead	380.79	189.33	482.67	76.25	251.71	753.79	339.54	355.63	291.17	32.63	14.79	8.42	198.00	71.65	160.38	29.79	48.17
Channel catfish	34.84	15.92	8.00	14.17	49.58	11.25	12.96	3.92	4.42	0.04	-	0.17	0.08	0.04	0.13	0.13	0.13
American eel	-	-	-	-	0.08	0.13	0.04	0.13	0.08	-	-	-	-	0.09	0.04	-	0.17
White perch	48.42	34.88	84.38	69.92	169.29	132.04	110.88	210.63	129.38	0.04	-	0.25	0.92	0.04	0.04	0.21	0.29
White bass	2.00	1.75	1.46	0.29	0.75	0.58	0.50	0.50	1.92	0.33	-	0.04	0.04	0.22	-	0.04	0.04
Rock bass	0.58	1.08	1.48	1.17	2.00	1.04	3.33	2.50	1.08	0.33	1.13	2.58	4.75	1.78	8.71	2.46	1.92
Green sunfish	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumpkinseed	0.68	1.13	3.33	2.04	1.00	-	0.67	1.00	0.08	7.29	16.29	7.67	12.75	2.48	15.92	10.75	7.38
Bluegill	4.05	3.21	9.08	14.42	14.96	3.42	17.33	17.25	5.58	0.54	3.96	1.13	2.04	0.87	1.46	0.83	0.83
Smallmouth bass	0.11	-	0.13	-	-	-	0.08	0.04	-	0.04	0.04	0.08	0.08	0.09	0.17	0.08	0.13
Largemouth bass	0.26	0.17	0.33	0.25	0.13	0.08	0.17	0.38	0.08	1.08	1.25	1.38	5.00	0.61	0.54	0.58	0.42
Black crappie	2.32	0.17	0.42	0.58	0.08	-	0.58	0.58	0.50	0.83	0.42	0.13	1.13	0.70	0.17	0.08	0.75
Lepomis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow perch	0.11	0.63	4.16	0.25	1.08	0.71	0.58	0.46	0.04	1.08	5.96	2.63	20.63	2.17	3.83	0.71	0.38
Walleye (Yellow pickerel)	1.05	0.17	0.04	-	2.46	2.04	4.63	1.83	6.96	0.38	0.08	-	-	0.09	0.33	-	0.38
Round goby	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater drum	1.37	1.71	1.24	0.33	1.08	1.88	1.33	0.46	1.75	1.08	1.29	0.83	0.63	0.83	0.75	0.29	0.42
Carassius auratus x Cyprinus carpio	-	-	-	-	-	-	0.25	-	1.96	-	-	-	-	-	-	-	0.13
Notropis hybrids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-	-
Tilapia	-	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-	-	-
Iridescent Shark Catfish	-	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-
Total catch	488	259	609	187	503	928	509	623	466	60	57	35	263	105	207	53	74
Number of net lifts	19	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Number of species	28	25	22	21	25	23	23	25	24	24	16	20	20	24	24	20	24

TABLE 1.3.6. (continued) Species-specific abundance trends (mean catch per trap net) in Hamilton Harbour, Toronto Harbour, Upper Bay of Quinte, and Middle/Lower Bay of Quinte. Annual total catch per net lift, number of net sets, and number of species are also indicated.

	Upper Bay of Quinte																		Middle / Lower Bay of Quinte						
Species	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2002	2003	2004	2005	2009	2011	2019
Longnose gar	0.25	0.33	1.14	1.94	0.39	2.92	0.36	0.44	1.56	0.50	2.08	0.19	1.42	2.22	0.50	2.58	4.56	2.08	0.61	0.44	0.06	0.22	0.39	0.39	0.17
Spotted gar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bowfin	0.36	0.14	0.58	0.53	0.25	0.92	1.11	0.50	0.81	0.75	0.50	0.92	1.31	0.53	0.75	1.39	1.11	2.31	0.50	1.00	0.33	0.31	0.72	1.56	1.56
Alewife	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gizzard shad	1.11	1.44	2.00	0.06	20.42	0.39	1.00	0.06	0.64	0.14	0.33	0.06	0.25	0.58	1.50	0.67	0.81	0.39	0.28	0.53	0.19	8.42	0.28	0.75	0.31
Chinook salmon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow trout	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atlantic salmon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brown trout	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-
Lake trout	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake whitefish	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coregonus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern pike	1.03	0.58	0.86	0.69	0.64	0.44	0.33	0.28	0.83	0.78	0.53	0.28	0.28	0.28	0.53	0.61	0.56	0.39	0.83	1.00	0.78	0.97	1.31	0.69	0.50
Muskellunge	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Mooneye	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Suckers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quillback	-	-	-	-	-	-	-	0.03	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-
White sucker	1.03	1.47	1.72	1.25	1.11	0.44	0.92	0.64	0.44	0.42	0.72	0.86	0.72	0.25	0.61	0.31	0.64	0.08	3.56	3.92	2.56	2.25	1.83	1.47	0.50
Bigmouth buffalo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver redhorse	-	-	0.69	0.81	0.28	0.64	0.50	1.44	0.44	0.17	0.47	0.83	0.47	0.11	0.19	0.86	0.08	0.44	-	0.08	0.06	-	0.06	0.11	0.17
Shorthead redhorse	-	-	0.08	0.47	0.25	0.19	0.33	0.36	0.06	0.19	0.08	0.31	0.17	0.11	0.03	0.44	0.33	0.75	-	-	-	0.03	-	-	0.03
Greater redhorse	-	-	0.22	0.06	-	-	0.08	0.06	-	0.44	0.28	0.83	0.11	0.14	0.31	0.22	0.06	0.92	-	-	-	-	-	-	0.06
River redhorse	0.06	-	0.14	0.17	0.14	0.11	0.44	0.03	-	0.14	0.08	0.14	-	0.03	0.47	0.42	0.33	0.11	-	-	-	-	-	0.03	-
Black buffalo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moxostoma sp.	0.78	0.42	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-	-
Minnow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goldfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	-	-	-	-	-
Common carp	0.08	0.11	0.28	0.08	0.11	0.19	0.22	0.19	0.33	0.22	0.47	0.25	0.25	0.11	0.17	0.19	0.36	0.50	0.44	0.31	0.22	0.53	0.28	0.33	0.81
Golden shiner	0.03	-	0.03	-	0.03	-	0.22	-	0.06	0.14	0.03	0.06	-	-	0.11	0.03	0.33	0.03	0.17	0.03	0.08	0.14	0.28	0.33	0.25
Fallfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	-	-	-	-	-	-	0.06	-	-
Rudd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	-	-	-	-	-
Black bullhead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brown bullhead	167.67	95.83	37.33	20.83	17.89	7.25	6.42	2.56	10.56	13.69	7.11	15.28	6.08	5.75	3.94	3.67	7.72	10.92	71.72	79.00	34.83	21.47	21.89	4.25	3.06
Channel catfish	2.17	2.17	1.50	1.33	1.72	0.72	0.81	0.28	0.53	0.58	0.31	0.06	0.53	0.19	1.03	1.00	1.92	0.61	1.11	1.39	1.19	1.14	0.81	0.39	1.03
American eel	0.44	0.14	-	0.03	0.06	-	-	-	-	0.11	0.03	0.44	0.28	0.03	0.08	0.14	0.64	0.89	0.17	0.17	0.06	0.03	-	0.03	0.47
White perch	2.19	2.89	7.69	3.67	2.75	4.61	4.31	3.86	1.69	3.75	3.58	19.42	0.19	0.31	2.58	2.92	7.39	3.06	0.39	7.50	2.33	0.19	18.58	3.75	3.14
White bass	0.06	0.14	0.11	0.11	0.19	0.03	0.14	-	-	0.17	0.08	-	-	0.08	0.28	0.14	0.11	0.11	0.06	0.17	0.11	0.22	0.33	0.06	0.03
Rock bass	0.92	0.67	0.64	0.58	0.50	4.83	3.97	3.89	2.44	4.50	1.08	7.97	4.92	2.50	2.25	2.06	3.78	4.61	1.78	4.14	0.94	1.08	2.44	4.17	6.19
Green sunfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumpkinseed	89.39	73.08	26.94	15.33	15.97	18.61	18.14	23.42	29.08	37.53	28.11	14.72	15.25	50.33	25.06	9.61	43.72	24.58	54.83	20.69	18.33	20.89	25.86	25.94	40.39
Bluegill	169.58	142.64	66.25	75.19	44.44	63.92	159.11	71.75	61.50	136.03	74.92	53.56	75.81	62.89	57.53	72.83	118.36	101.94	8.00	7.03	8.31	6.44	57.44	46.81	44.64
Smallmouth bass	0.94	1.67	0.36	1.64	1.11	0.11	0.92	0.56	0.44	0.47	0.14	0.47	0.03	0.06	0.17	0.64	0.14	0.19	0.22	1.06	0.69	0.31	0.14	0.14	0.03
Largemouth bass	2.47	6.11	7.92	6.08	2.75	4.53	5.39	4.33	4.25	10.39	2.72	4.33	3.58	3.33	2.42	4.31	2.50	8.78	5.17	2.56	3.44	1.56	1.92	4.33	10.25
Black crappie	9.81	15.00	10.22	16.11	8.11	12.92	17.33	10.03	7.53	8.64	4.78	11.36	5.36	4.22	3.44	5.11	4.31	3.81	2.33	5.19	4.31	3.31	6.25	7.03	5.81
Lepomis sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.28	0.06	-	-	-	-	-	-	-
Yellow perch	3.75	3.42	1.94	0.83	1.00	4.72	7.00	2.64	6.11	6.25	1.31	2.69	4.94	3.75	3.86	2.53	4.64	2.61	2.72	1.39	1.67	1.03	3.36	3.67	4.00
Walleye (Yellow pickerel)	3.17	2.47	2.22	2.56	2.14	1.61	2.50	1.75	2.53	2.36	1.44	7.56	1.33	0.94	1.61	5.31	2.31	1.44	5.28	8.19	5.61	2.97	3.61	2.86	3.44
Round goby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater drum	6.36	3.31	3.81	2.14	4.36	1.25	1.17	1.89	1.97	1.67	2.19	0.94	0.94	0.97	0.72	1.19	1.50	0.89	6.50	7.00	5.28	5.42	6.81	1.50	1.03
Carassius auratus x Cyprinus carpio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Notropis hybrids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tilapia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iridescent Shark Catfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total catch	464	354	175	153	127	131	233	131	134	230	133	144	124	140	110	119	209	173	167	153	91	79	155	111	128
Number of net lifts	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Number of species	24	21	25	25	25	22	24	23	21	25	25	24	23	25	26	25	27	26	23	22	22	22	22	24	24

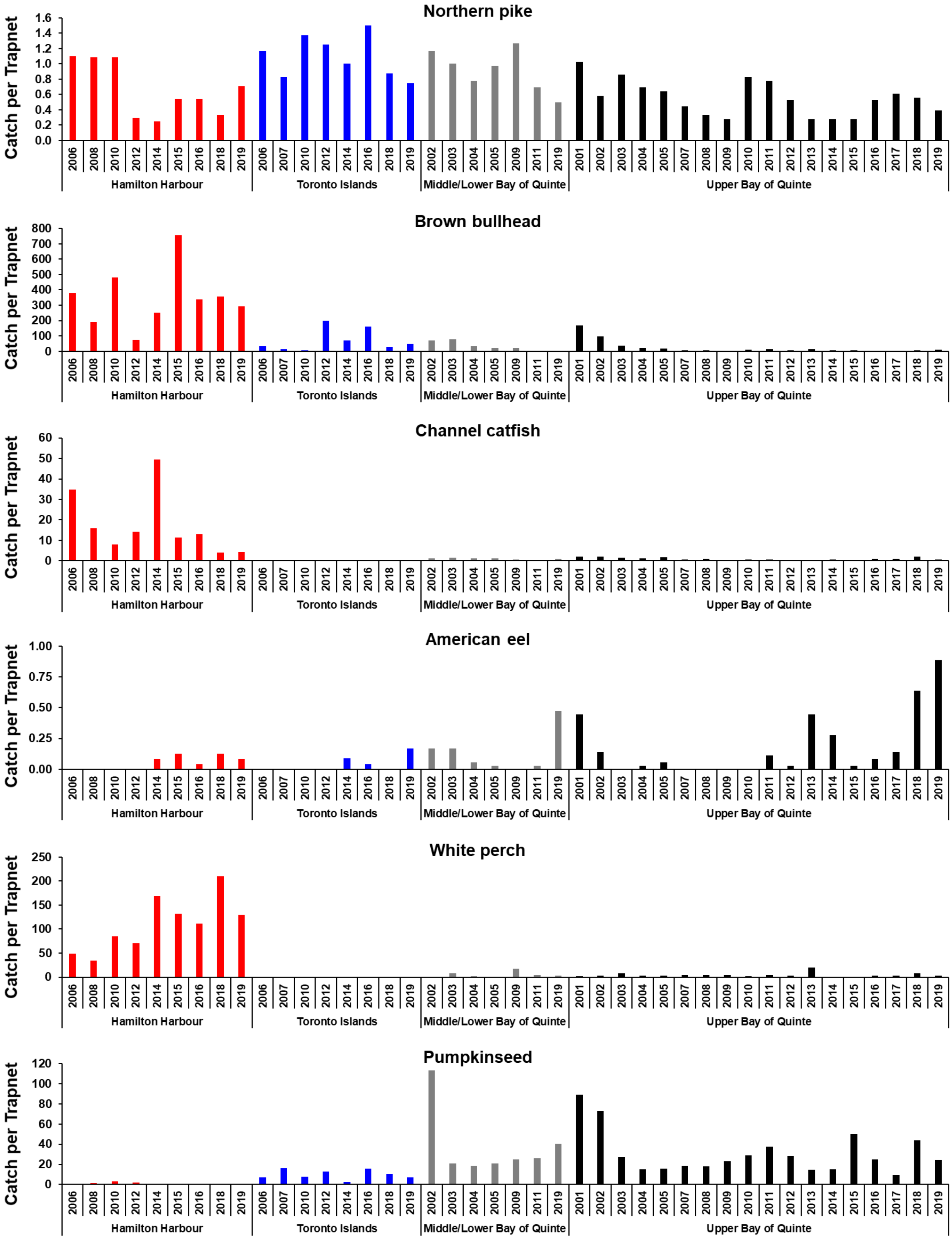


FIG. 1.3.2. Abundance trends for selected species caught in nearshore trap nets in Hamilton Harbour, Toronto Harbour, Middle / Lower Bay of Quinte, and the Upper Bay of Quinte. Values shown are annual arithmetic means.

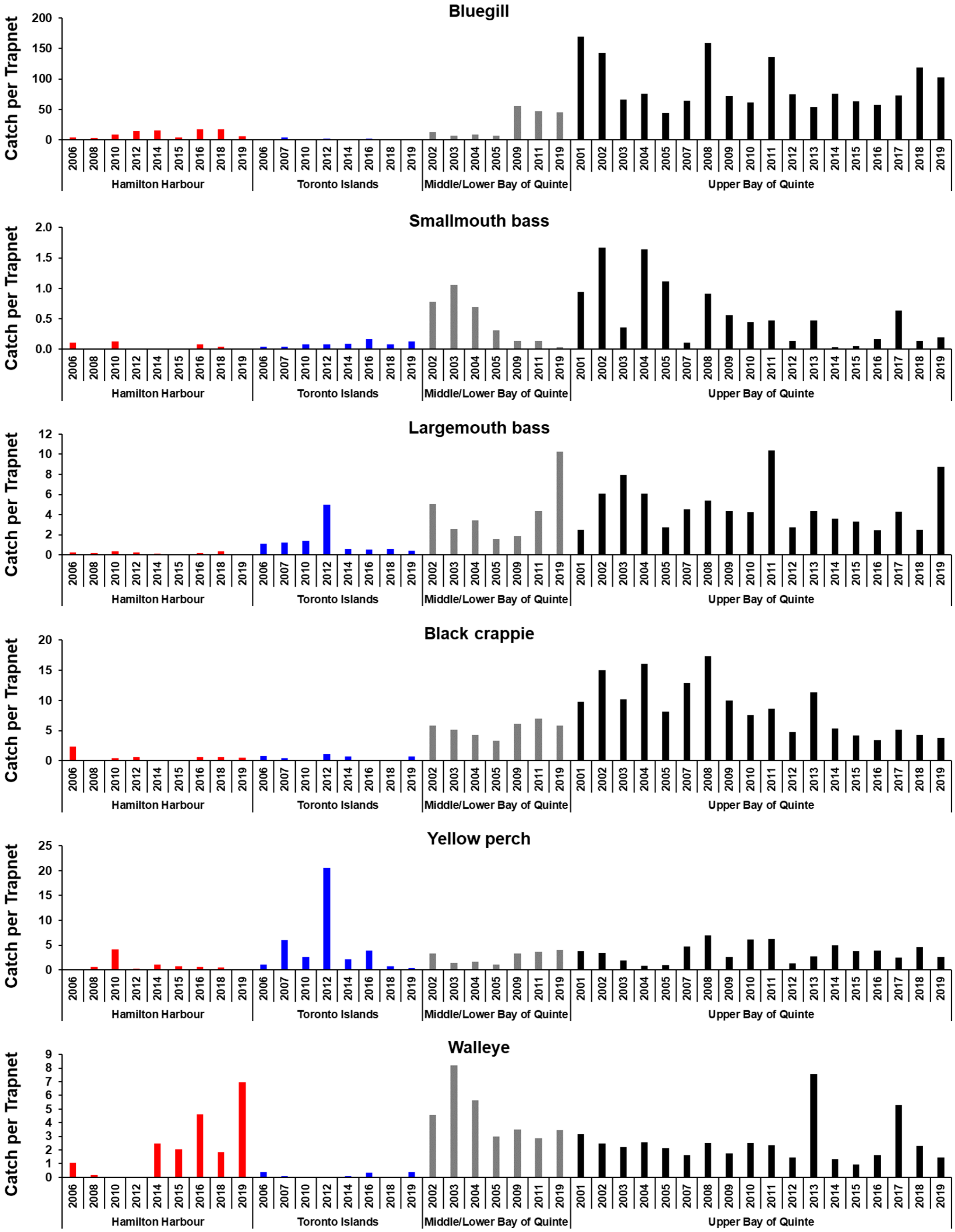


FIG. 1.3.2. (continued) Abundance trends for selected species caught in nearshore trap nets in Hamilton Harbour, Toronto Harbour, Middle /Lower Bay of Quinte, and the Upper Bay of Quinte. Values shown are annual arithmetic means.

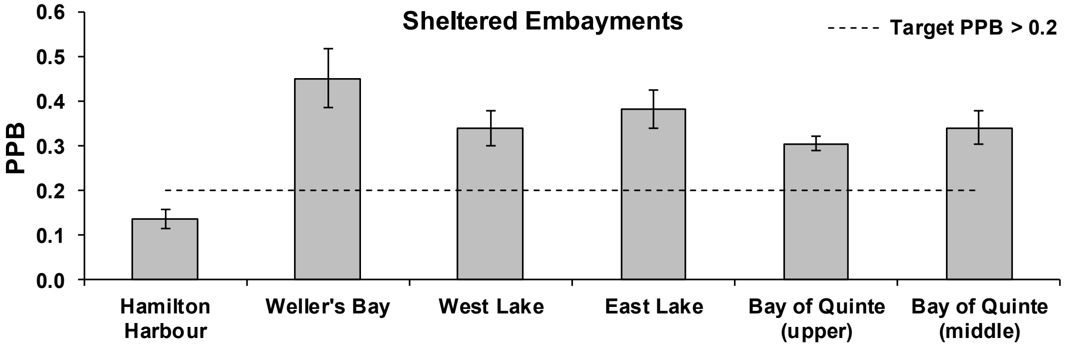


FIG. 1.3.3. Proportion of total fish community biomass represented by piscivore species (PPB) in the nearshore trap net surveys in six sheltered Lake Ontario embayments (2006-2019). A PPB>0.2 is indicative of a balanced trophic structure (depicted by a dashed line). Piscivore species included Longnose Gar, Bowfin, Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye. Error bars are ±2SE.

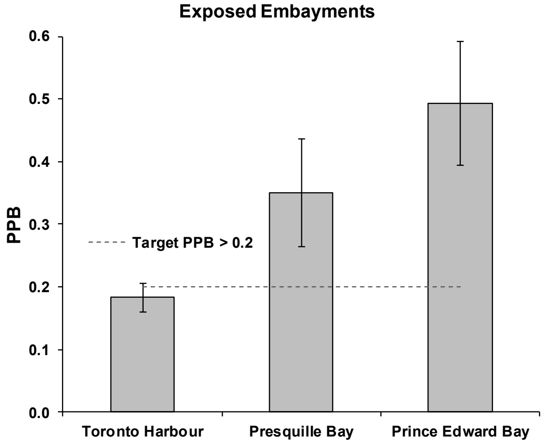


FIG. 1.3.4. Proportion of total fish community biomass represented by piscivore species (PPB) in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2019). A PPB>0.2 is indicative of a balanced trophic structure (depicted by a dashed line). Piscivore species included Longnose Gar, Bowfin, Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye. Error bars are ±2SE.

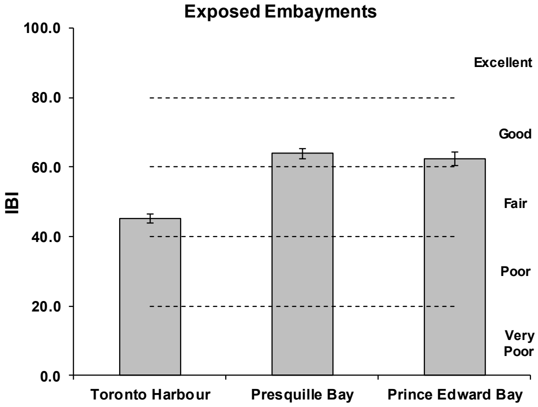


FIG. 1.3.5. Index of biotic integrity (IBI), as a measure of ecosystem health, in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2019). IBI classes can be described as follows: 0-20 very poor, 20-40 poor, 40-60 fair, 60-80 good, and 80-100 excellent ecosystem health. Error bars are ±2SE.

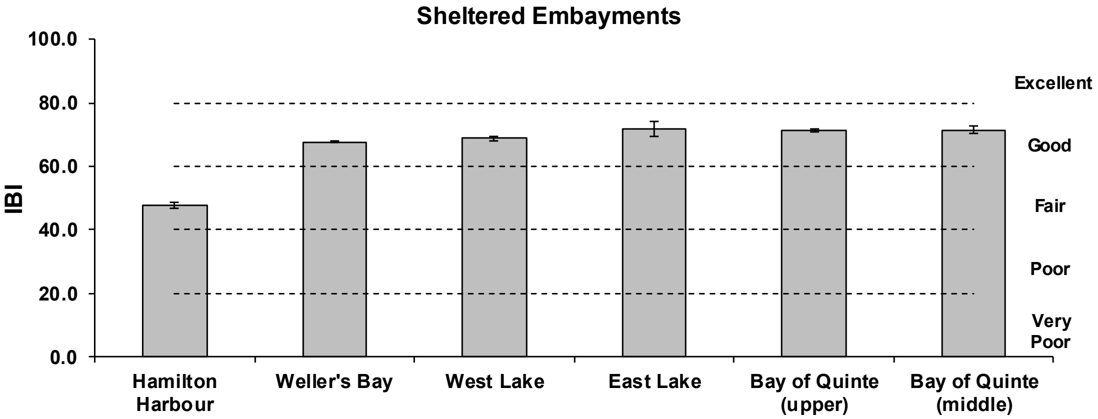


FIG. 1.3.6. Index of biotic integrity (IBI), as a measure of ecosystem health, in the nearshore trap net surveys in five sheltered Lake Ontario embayments (2006-2019). IBI classes can be described as follows: 0-20 very poor, 20-40 poor, 40-60 fair, 60-80 good, and 80-100 excellent ecosystem health. Error bars are ±2SE.

1.4 Ganaraska River Fishway Migratory Salmon and Trout Assessment

M. J. Yuille, Lake Ontario Management Unit

Lake Ontario is home to a multi-million-dollar recreational salmon and trout fishery and its tributaries provide spawning habitat to several migratory salmon and trout species, such as, Rainbow Trout, Brown Trout, Chinook Salmon and Coho Salmon. In the spring of 2016, the Lake Ontario Management Unit (LOMU) purchased new in-river fish counting technology to assess salmon and trout activity in the Ganaraska River fishway, Corbett Dam, Ganaraska River, Port Hope. Understanding migration timing and patterns of these species is critical to evaluate the success of restoration efforts and to determine potential overlap between species when using essential spawning and nursery areas. Monitoring and counting these fish during their spawning migration provides LOMU with an index of the species population status in Lake Ontario.

This fish counter technology (known as the Riverwatcher) automatically counts fish as they pass through the counting tunnel and records both a silhouette image and short, high resolution video for each individual fish. This section includes a summary of the Ganaraska River Riverwatcher data (available at: http://www.riverwatcherdaily.is/?I=133) as well as the Ganaraska River Chinook Salmon Spawning Index.

The Riverwatcher was installed in the Ganaraska Fishway on April 2nd, 2019 and continued to count fish through to November 18th, 2019. In this time, 1,841 (45% Rainbow Trout, 54% Chinook Salmon and 1% Coho Salmon) fish were manually passed over the Ganaraska fishway and 51,532 events were recorded (combined up and down events), with a total of 29,532 upstream counts through the fish counter (Figs. 1.4.1 and 1.4.2). The number of events recorded is a conservative estimate. During periods of heavy rainfall river flows increased, making the water cloudy. As the water became less clear, the light from the infrared counting sensors could not penetrate through the water, thus fish could not be counted. During these periods of high flow and turbid water, we did not have the capacity to count fish as they moved through the fishway. Additionally, there were

TABLE 1.4.1. Observed count and estimated run of Rainbow Trout moving upstream at the Ganaraska River fishway at Port Hope, Ontario during spring, 1974-2019. Estimates for 1980, 1982, 1984, 1986, 1992, and 2002 were interpolated from adjacent years with virtual population analysis. Estimate from 2017 to present utilized the Riverwatcher fish counting system.

Year	Observed	Estimated
1974	527	527
1975	591	591
1976	1,281	1,281
1977	2,237	2,237
1978	2,724	2,724
1979	4,004	4,004
1980	--	5,817
1981	7,306	7,306
1982	--	10,127
1983	7,907	7,907
1984	--	8,277
1985	14,188	14,188
1986	--	12,785
1987	10,603	13,144
1988	10,983	15,154
1989	13,121	18,169
1990	10,184	14,888
1991	9,366	13,804
1992	--	12,905
1993	7,233	8,860
1994	6,249	7,749
1995	7,859	9,262
1996	8,084	9,454
1997	7,696	8,768
1998	3,808	5,288
1999	5,706	6,442
2000	3,382	4,050
2001	5,365	6,527
2002	--	5,652
2003	3,897	4,494
2004	4,452	5,308
2005	4,417	5,055
2006	5,171	5,877
2007	3,641	4,057
2008	3,963	4,713
2009	3,290	4,502
2010	4,705	6,923
2011	6,313	9,058
2012	7,256	8,486
2013	8,761	12,021
2014	8,218	9,611
2015	5,890	6,669
2016	4,225	4,987
2017	6,952	--
2018	9,023	--
2019	6,051	--

occasions throughout the monitoring period where the volume of fish moving through the fish counter exceeded the system's ability to count them individually. Calibration of the system using manual hand counts was initiated in 2017 and is ongoing to provide estimates of fish missed during these periods of high turbidity and high fish volume.

April 18th, 2019 marked the most active spring day on the fishway with a total of 892 Rainbow Trout observed migrating upstream through the Riverwatcher. In the fall, September 15th, 2019 recorded the most upstream events through the Riverwatcher with 1,579 salmon and trout (Figs. 1.4.1 and 1.4.2). Throughout the monitoring period, data on Rainbow Trout, Chinook Salmon, Coho Salmon, Brown Trout and Atlantic Salmon were collected. The following paragraphs provide species specific observations.

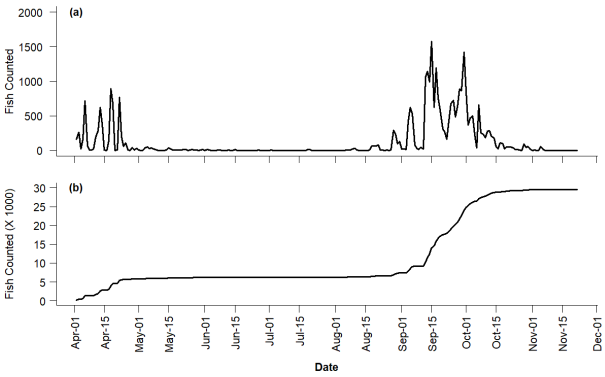


FIG. 1.4.1. (a) Daily and (b) cumulative observed fish counts at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

Rainbow Trout

The number of Rainbow Trout "running-up" the Ganaraska River during spring to spawn has been estimated at the fishway on Corbett Dam, Port Hope, ON since 1974. Prior to 1987, the Rainbow Trout counts at the fishway were based completely on hand lifts and visual counts. Between 1987 and 2016, fish counts were made with a Pulsar Model 550 electronic fish counter. Based on visual counts the Pulsar counter was about 85.5% efficient, and the complete size of the run was estimated accordingly. In years where no observations were made, the run was estimated with virtual population analysis. The counter is usually operated from mid to late March until early May. In 2019, the count of Rainbow Trout migrating upstream through the Corbett Dam was determined using the Riverwatcher fish counting system. The Riverwatcher actively counted and

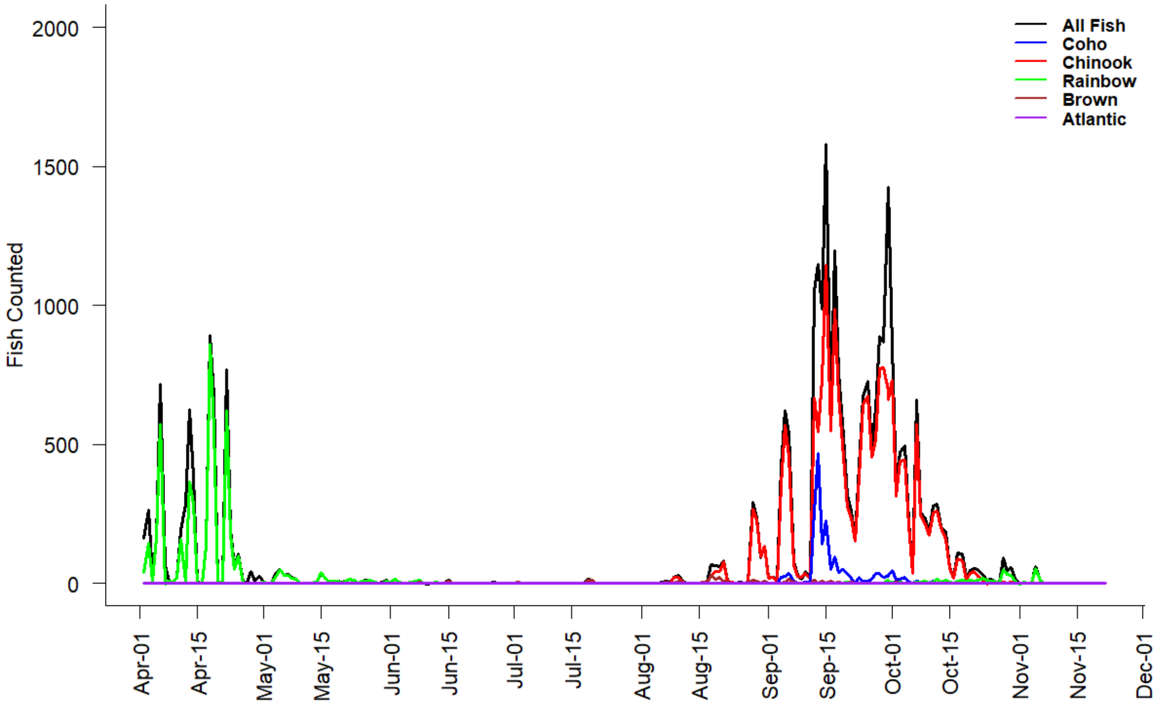


FIG. 1.4.2. Daily counts of each species of salmon and trout observed migrating through the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

recorded fish from April 2nd to May 18th, 2019 when the Rainbow Trout spawning run ended.

In the spring of 2019, 6,051 Rainbow Trout were observed passing through the Ganaraska Fishway (Table 1.4.1 and Figs. 1.4.3 and 1.4.4). This is below the average for the previous 10 years (6,463 fish average from 2009 to 2018). The total observed run size from 2019 decreased 33% from 2018 and is 50% below the peak estimated run in 2013 (Table 1.4.1 and Fig. 1.4.3). In the spring, the fishway was most active mid-April, which is comparable to previous runs (Fig. 1.4.4). In just five days (April 18th – April 22nd, 2019), 39% of the Rainbow Trout counted passed through the fish counter (Fig. 1.4.4). Rainbow Trout were observed utilising the fishway after the spring monitoring period. Another 530 Rainbow Trout migrated through the fishway after the primary spring run, making a total of 6,577

TABLE 1.4.2. Body condition (estimated weight at 635 mm total length) of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring, 1974-2019.

	Male		Female	
Year	Weight (g)	Sample Size	Weight (g)	Sample Size
1974	3,024	183	3,133	242
1975	2,826	202	3,018	292
1976	3,144	447	3,280	624
1977	2,906	698	3,128	1038
1978	3,053	275	3,271	538
1979	3,132	372	3,285	646
1981	3,131	282	3,304	493
1983	2,884	327	3,025	481
1985	3,118	446	3,274	760
1987	2,875	84	2,966	110
1990	2,851	261	3,043	198
1991	2,793	127	3,032	289
1992	2,946	142	3,072	167
1993	2,899	89	3,093	172
1994	3,088	116	3,274	181
1995	2,947	147	3,019	155
1997	3,107	157	3,109	148
1998	3,014	131	3,081	262
1999	2,990	182	3,149	293
2000	3,049	125	3,190	234
2001	2,865	308	3,022	299
2003	2,972	93	3,095	144
2004	3,008	143	3,155	248
2005	3,911	145	3,061	176
2006	2,936	102	3,099	217
2007	2,854	75	2,972	131
2008	2,846	125	2,996	148
2009	2,753	78	2,954	211
2010	2,989	74	3,102	156
2011	2,913	94	3,083	204
2013	3,044	163	3,178	217
2015	2,752	86	2,921	119
2016	2,801	105	2,942	132
2017	2,877	94	3,016	106
2018	2,785	249	2,930	407
2019	2,853	123	2,956	188
Average	2,970		3,090	

TABLE 1.4.3. Lamprey marks on Rainbow Trout in spring 1990-2019, at the Ganaraska River fishway, at Port Hope, Ontario. Since 1990, A1 and A2 marks were called wounds and the remainder of marks were called scars to fit with historical classification.

Year	Wounds /fish	Scars/ fish	Marks/ fish	% with wounds	% with scars	% with marks	Sample Size
1974	0.083	0.676	0.759	7.0	33.2	37	527
1975	0.095	0.725	0.820	8.0	37.2	40	599
1976	0.090	0.355	0.445	6.6	23.3	28	1280
1977	0.076	0.178	0.254	6.4	13.5	18	2242
1978	0.097	0.380	0.476	8.1	28.4	34	2722
1979	0.122	0.312	0.434	10.3	22.8	30	3926
1981	--	--	0.516	--	--	36	5489
1983	0.113	0.456	0.569	9.7	33.4	39	833
1985	0.040	0.154	0.193	3.7	11.5	14	1256
1990	0.030	0.071	0.101	2.8	5.8	8	466
1991	0.026	0.076	0.103	2.4	6.4	8	419
1992	0.079	0.117	0.197	6.3	11.1	17	315
1993	0.077	0.126	0.203	6.9	11.5	17	261
1994	0.044	0.141	0.185	4.0	12.4	15	298
1995	0.036	0.026	0.063	3.6	2.6	6	303
1996	0.028	0.025	0.053	2.8	2.5	5	396
1997	0.035	0.132	0.167	3.5	10.3	13	311
1998	0.075	0.092	0.168	6.8	8.5	13	400
1999	0.057	0.157	0.214	5.5	12.4	16	477
2000	0.091	0.191	0.283	8.0	16.9	24	361
2001	0.118	0.138	0.257	10.0	12.5	19	608
2003	0.063	0.134	0.197	5.9	10.9	16	238
2004	0.227	0.316	0.543	17.6	25.0	38	392
2005	0.231	0.433	0.664	17.1	33.6	41	321
2006	0.282	0.379	0.661	22.6	30.1	45	319
2007	0.199	0.534	0.733	15.5	39.3	49	206
2008	0.274	0.682	0.956	18.6	43.8	51	274
2009	0.256	0.377	0.633	20.4	29.8	42	289
2010	0.134	0.394	0.528	10.4	31.2	38	231
2011	0.124	0.235	0.359	10.7	21.8	30	298
2013	0.229	0.071	0.300	17.4	6.8	22	380
2015	0.058	0.238	0.296	4.9	16.5	20	206
2016	0.075	0.280	0.356	7.5	21.8	27	239
2017	0.109	0.183	0.292	10.9	16.8	27	202
2018	0.093	0.108	0.201	8.5	9.9	17	658
2019	0.103	0.186	0.289	8.7	16.4	23	311

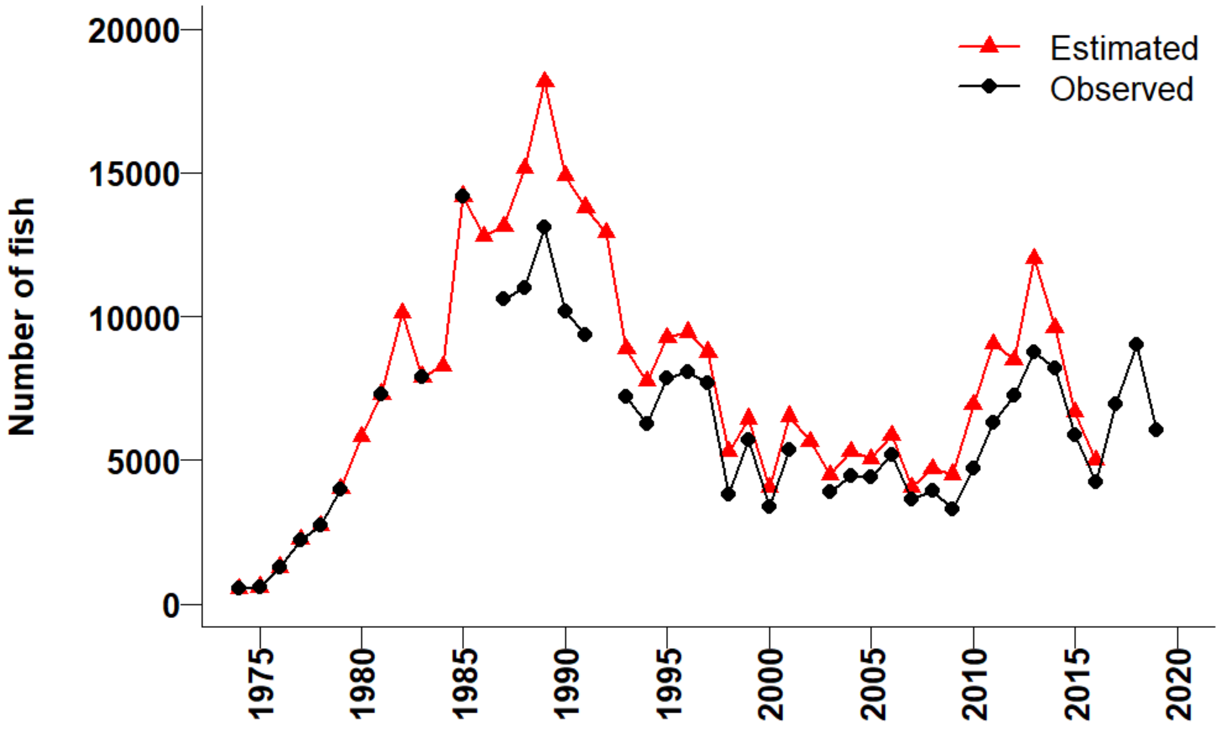


FIG. 1.4.3. Estimated and observed run of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2019.

Rainbow Trout identified migrating upstream through the Ganaraska Fishway in 2019

Rainbow Trout were measured and weighed during the spawning run in most years since 1974. Rainbow Trout body condition was determined as the estimated weight of a 635 mm (25 inch) fish (total length). In 2019, the condition of male (2,853 g) and female (2,956 g) Rainbow Trout were comparable to 2018 values and the previous 10-year average (Fig 1.4.5 and Table 1.4.2).

The proportion of Rainbow Trout with Lamprey marks in the Ganaraska River has been reported since 1974. In 2019, 23% of fish had Lamprey marks (wound or scar), which is 6% higher than 2018 (Fig. 1.4.6 and Table 1.4.3). Lamprey wounds on Ganaraska River Rainbow Trout in 2019 are 5% below the previous 10-year average (28%; Table 1.4.3).

Chinook Salmon

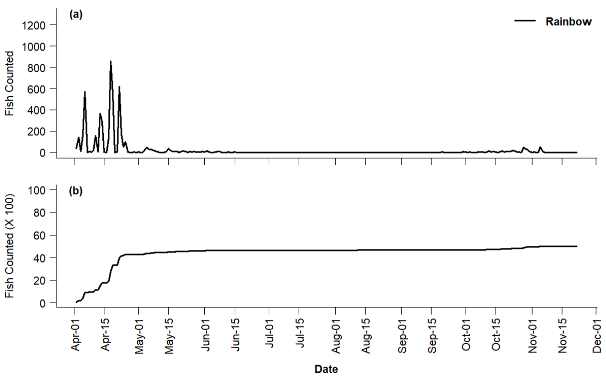


FIG. 1.4.4. (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

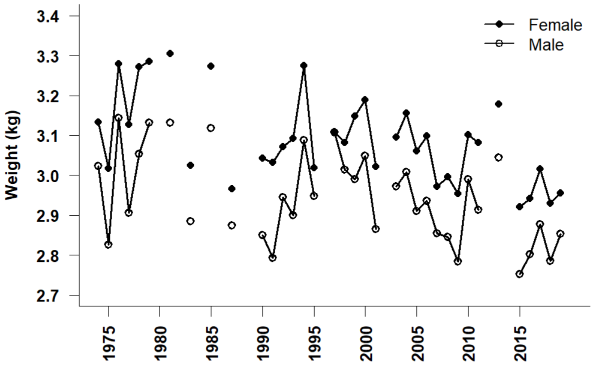


FIG. 1.4.5. Body condition (estimated weight at 635 mm total length) of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2019. Open and closed circles represent male and female Rainbow Trout (respectively).

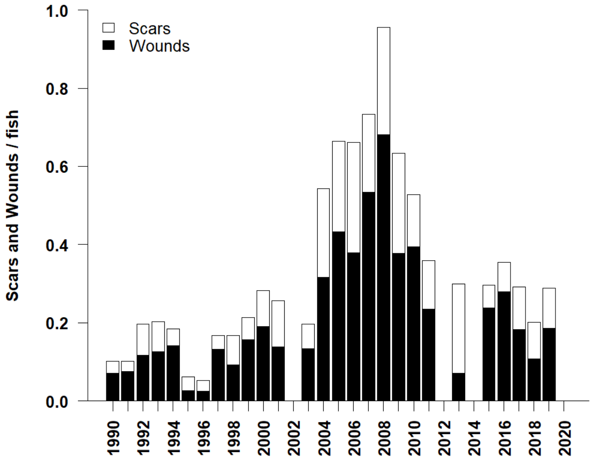


FIG. 1.4.6. Trend in lamprey marks on Rainbow Trout during the spring 1990-2019, at the Ganaraska River fishway at Port Hope, Ontario. Since 1990, A1 and A2 marks (King and Edsall 1979) were called wounds and the remainder of marks were called scars to fit with historical classification.

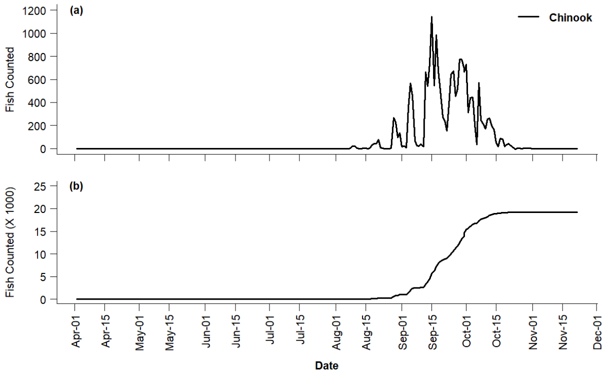


FIG. 1.4.7. (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

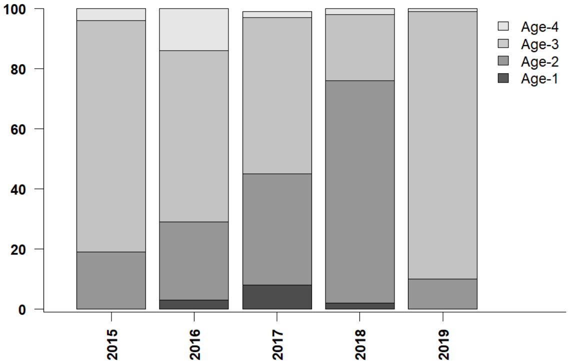


FIG. 1.4.8. Age proportions of spawning Chinook Salmon (males and females pooled) sampled during the fall Ganaraska River Chinook Salmon Spawning Index, Port Hope, Ontario from 2015 – 2019. The four grey colours correspond to each age where Age 1 is the darkest and Age 4 is the lightest.

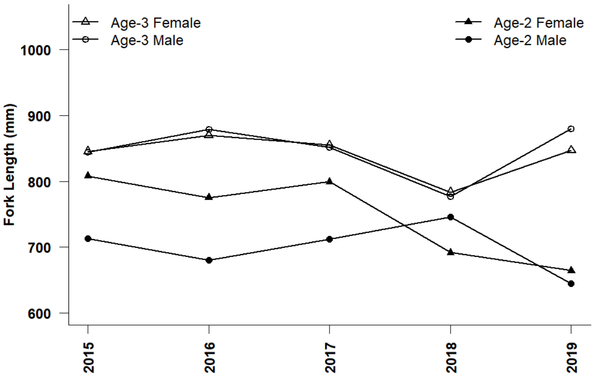


FIG. 1.4.9. Mean total length of age-2 and age-3 Chinook Salmon by sex, caught for spawn collection in the Ganaraska River during the fall spawning run (approximately first week of October), 2015-2019.

A total of 19,247 Chinook Salmon were identified migrating upstream through the Riverwatcher in the Ganaraska Fishway (Fig. 1.4.7). The first Chinook Salmon was observed July 26th, 2019; this is well ahead of the main Chinook Salmon spawning run (Fig. 1.4.7). Staff sampled a total of 999 Chinook Salmon from September 30th to October 10th, 2019. From the total, 189 fish were sampled in detail and the ages of 107 these Chinook Salmon were interpreted from otoliths. Using this information, an age-length-key was created to assign ages to the remaining 892 Chinook Salmon. Through this process it was determined that the 2019 fall Chinook run was comprised of less than 1% age-1 (all males) 10% age-2 (74% male and 26% female), 89% age 3 (65% male and 35% female) and 1% age-4 (all male; Fig. 1.4.8). In 2019, the length of age-2 males and females declined from 2018 values to 645 mm and 665 mm (respectively); the lowest value in the five-year time series (Fig. 1.4.9). The average length for age-3 males and females increased from 2018 values to 880 mm and 847 mm (respectively); the highest value in the five-year time series (Fig. 1.4.9). Condition measured as the mean weight of a 914 mm or 36-inch (total length) Chinook Salmon in the Ganaraska River has increased slightly for females and remained stable for males (Fig. 1.4.10). During the monitoring period, six Chinook Salmon with adipose clips were observed migrating upstream through the fishway. These fish are a product of stocking efforts in the Credit River and represent mature adults that have strayed to the Ganaraska River to spawning (see Section 1.5 for more information).

Coho Salmon

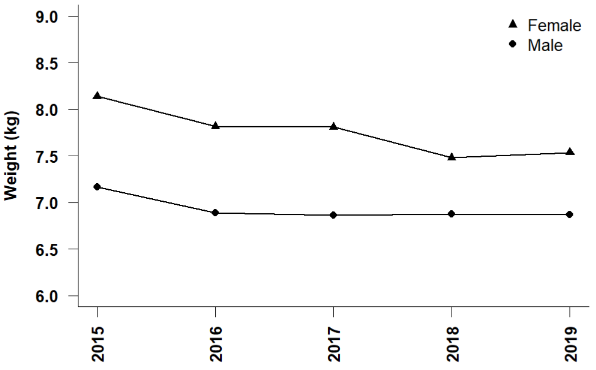


FIG. 1.4.10. Condition index as the mean weight of a 914 mm / 36-inch (total length) Chinook Salmon in the Ganaraska River during the spawning run (approximately first week of October), 2015- 2019.

The first Coho Salmon observed at the Ganaraska Fishway in 2019 was on August 28th. From that time, 1,834 Coho Salmon were identified moving upstream from the Corbett Dam (Fig. 1.4.11). During the monitoring period, two Coho Salmon with adipose clips were observed migrating upstream through the fishway and represent fish that were stocked in another location in Lake Ontario and strayed to the Ganaraska River to spawn.

Brown Trout

The first Brown Trout observed at the Ganaraska Fishway in 2019 was on May 7th. From that time until, 297 Brown Trout were identified moving upstream from the Corbett Dam (Fig. 1.4.12). Of the Brown Trout identified passing through the fishway, the majority were observed from mid-August to mid-September (Fig. 1.4.12).

Atlantic Salmon

The first Atlantic Salmon observed at the Ganaraska Fishway in 2019 was on August 14th. From that time, eight Atlantic Salmon were identified moving upstream from the Corbett Dam (Fig. 1.4.13). All returning fish were observed with an adipose clip represent fish from 2016, 2017 stocking events.

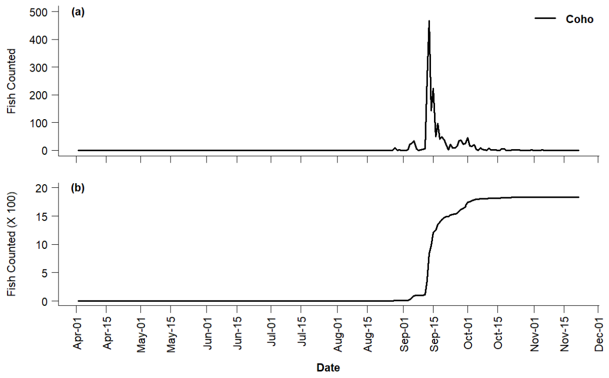


FIG. 1.4.11. (a) Daily and (b) cumulative observed counts of Coho Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

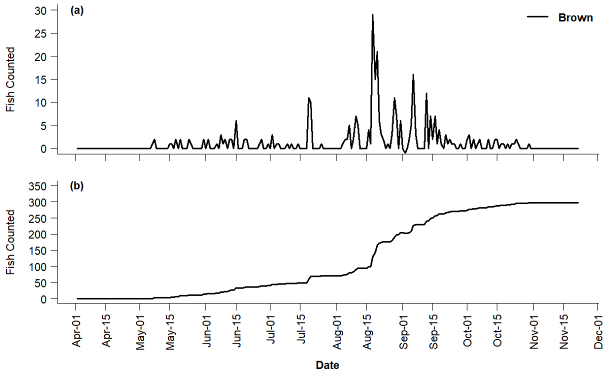


FIG. 1.4.12. (a) Daily and (b) cumulative observed counts of Brown Trout at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

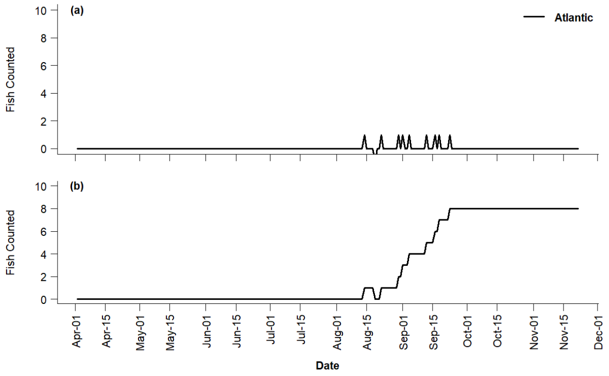


FIG. 1.4.13. (a) Daily and (b) cumulative observed counts of Atlantic Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

1.5 Credit River Trout and Salmon Assessment

M. J. Yuille, Lake Ontario Management Unit

The Credit River, below the Kraft Dam in Streetsville, has been the long-term sampling site for Chinook Salmon gamete collection. The Lake Ontario Management Unit completed infrastructure upgrades and construction on the Streetsville Fishway and installed the second Riverwatcher Fish Counting System in August 2018. The Credit River Riverwatcher was operational April 3, 2019 and continued to collect data through to November 8, 2019. This marks the first complete migratory salmon and trout spawning run survey on the Credit River and a key milestone for not only the Ministry that now owns and operates the only Riverwatcher systems in the province (see Section 1.4), but also for the Atlantic Salmon Restoration Program, where adult assessment is the focus of the current Five Year Implementation Strategy (see Section 8.2). This section includes a summary of the Credit River Riverwatcher data (available at: www.riverwatcherdaily.is?I=143) as well as the annual Credit River Chinook Salmon Spawning Index. Traditionally, Aurora District MNRF closes the Streetsville Fishway in the fall, effectively blocking all fish passage from mid-September to the end of Chinook Salmon Egg Collection (see below). For 2018, Aurora District implemented experimental selective passage trials using fishway jump height (cf LOMU 2018 Annual Report), whereby the fishway was left open, however jump heights were manipulated to facilitate passage of migratory salmonids with superior jumping abilities. In 2019, selective passage using jump height was abandoned and the district did not close the fishway allowing LOMU to monitor and quantify the migratory salmon and trout spawning run for an entire ice-free season. 2019 marks the first fisheries independent assessment of the migratory salmon and trout spawning runs on the Credit River. These data establish a baseline for run sizes and timings that will be critical in measuring the effect of management changes to the Credit River migratory fish community.

Credit River Riverwatcher

The Credit River Riverwatcher was installed at the exit of the Streetsville Fishway April 3rd, 2019. This fish counter technology (known as the Riverwatcher) automatically counts fish as they pass through the counting tunnel and records both a silhouette image and short, high resolution video for each individual fish (see Section 1.4). After installation, data were uploaded to the Riverwatcher Daily website every hour until the system was removed from the river on November 8th, 2019. In this time, a total of 5,282 mature salmon and trout were observed moving upstream through the Streetsville Fishway (Fig. 1.5.1). This number is conservative.

During periods of heavy rainfall river flows increased, making the water cloudy. As the water became less clear, the light from the infrared counting sensors could not penetrate through the water, thus fish could not be counted. During these periods of high flow and turbid water, we did not have the capacity to count fish as they moved through the fishway. Additionally, there were occasions throughout the monitoring period where the volume of fish moving through the fish counter exceeded the system's ability to count them individually. Calibration of each fish counting system is tailored to the specific installation site using manual hand counts. The

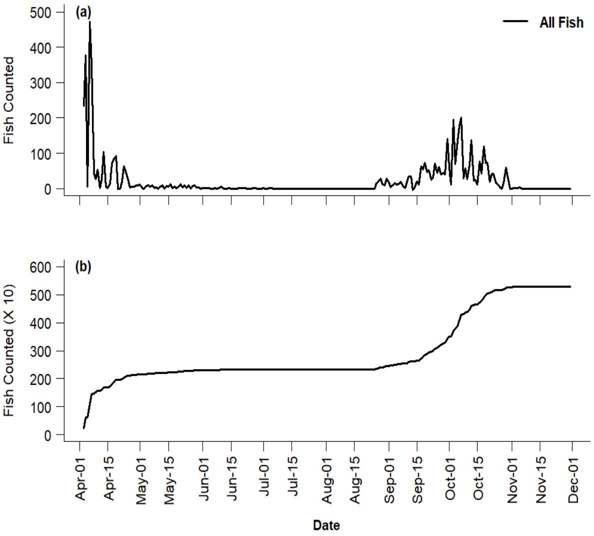


FIG. 1.5.1: (a) Daily and (b) cumulative observed fish counts at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

calibration of both the Credit River and Ganaraska River fish counters is ongoing and will aide in providing estimates of fish missed during periods of high turbidity and high fish volume.

April 6th, 2019 marked the most active day on the fishway with a total of 472 salmon and trout observed migrating upstream through the Riverwatcher (Fig. 1.5.2). Throughout the monitoring period, data on Rainbow Trout, Chinook Salmon, Coho Salmon, Brown Trout and Atlantic Salmon were collected. The following paragraphs provide species specific observations.

Rainbow Trout

A total of 2,007 Rainbow Trout were identified migrating upstream through the Streetsville Fishway from April 3rd to November 8th, 2019 (Fig. 1.5.3). 2019 marks the first enumeration of the spring Rainbow Trout spawning run on the Credit River, which occurred from April 3rd to May 1st, 2019. In this time, 1,776 Rainbow Trout (88% of observed Rainbow Trout in 2019) moved upstream through the Streetsville Fishway.

Chinook Salmon

A total of 2,291 Chinook Salmon were identified migrating upstream through the Riverwatcher in 2018. The first Chinook Salmon was observed April 4th, 2019 and the last observed on November 5th, 2019 (Fig. 1.5.4). Of the Chinook Salmon that passed through the Streetsville Fishway 312 fish were observed with an adipose clip 1,128 fish were unclipped and 851 were categorized as unknown because their adipose area were not clearly visible on camera. Chinook Salmon with the adipose clip represent Ganaraska River egg collections that were subsequently stocked in the Credit River in 2016, 2017 and 2018. Unclipped Chinook Salmon represent fish stocked in the Credit River that originated from the Credit River egg collections (stocked in 2016, 2017 and 2018) as well as fish that were naturally produced in the Credit River. Some straying from other river sources occurs, however their contribution to the total spawning population is minimal. For more detailed information on Chinook Salmon, please see Credit River Chinook Salmon Spawning Index (below).

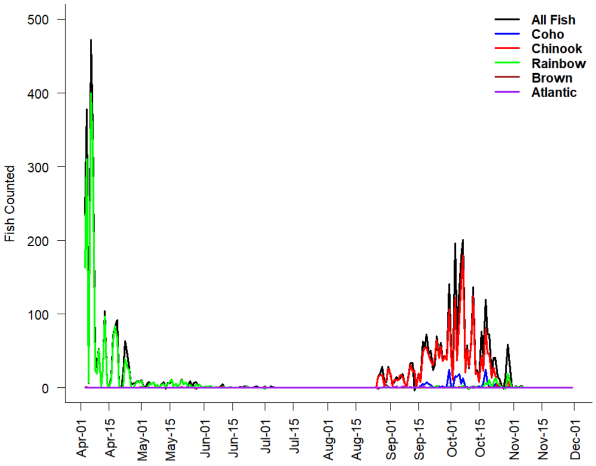


FIG. 1.5.2: Daily counts of each species of salmon and trout observed migrating through the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

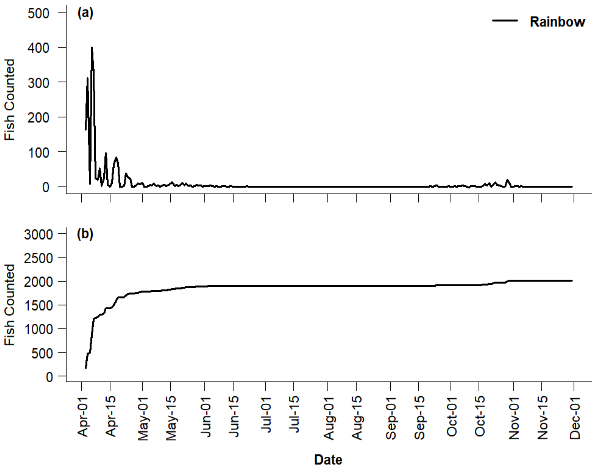


FIG. 1.5.3: (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

Coho Salmon

The first Coho Salmon observed at the Streetsville Fishway in 2019 was on September 16th. A total of 190 Coho Salmon were identified exiting the Streetsville Fishway (Fig. 1.5.5). The last Coho Salmon observed moving through Streetsville Fishway was on October 29th, 2019. There were two main pulses of Coho Salmon, occurring over a few days in the first and third weeks of October (Fig. 1.5.5). Of the Coho Salmon that passed through the Streetsville Fishway 94 fish were observed with an adipose clip, four fish were unclipped and 92 were categorized as unknown because their adipose area were not clearly visible on camera. Coho Salmon with the adipose clip represent fish stocked into the Credit River by Metro East Anglers and unclipped Coho Salmon represent fish naturally produced in the Credit River. Some straying from other river sources occurs, however their contribution to the total spawning population is minimal.

Brown Trout

The first Brown Trout observed at the Streetsville Fishway in 2019 was on May 21st. A total of 18 Brown Trout were identified exiting upstream the Streetsville Fishway (Fig. 1.5.6). The last Brown Trout observed was on October 23rd, 2019.

Atlantic Salmon

The first Atlantic Salmon observed at the Streetsville Fishway in 2019 was on May 24th. A total of 18 Atlantic Salmon were identified exiting the Streetsville Fishway (Fig. 1.5.7). The last Atlantic Salmon observed on the fish counter was on October 12th, 2019.

Credit River Chinook Salmon Spawning Index

Each year, Chinook Salmon are captured during the fall spawning run on the Credit River, below Streetsville Dam, at the beginning of October using electrofishing gear for gamete collections. LOMU staff have utilized the fish collections to index growth, condition and lamprey marking of Chinook Salmon.

Weight and otoliths are collected from fish used in the spawn collection, which has the

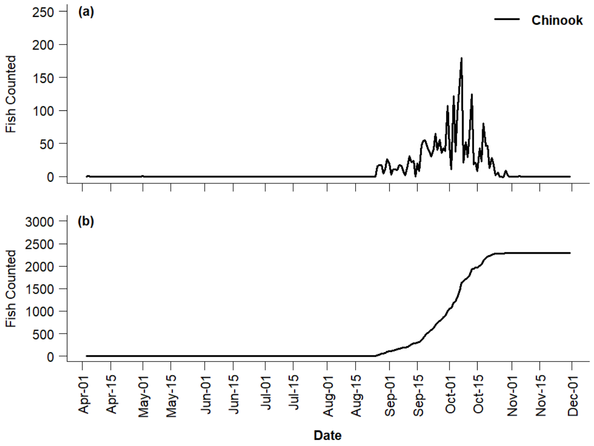


FIG. 1.5.4: (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

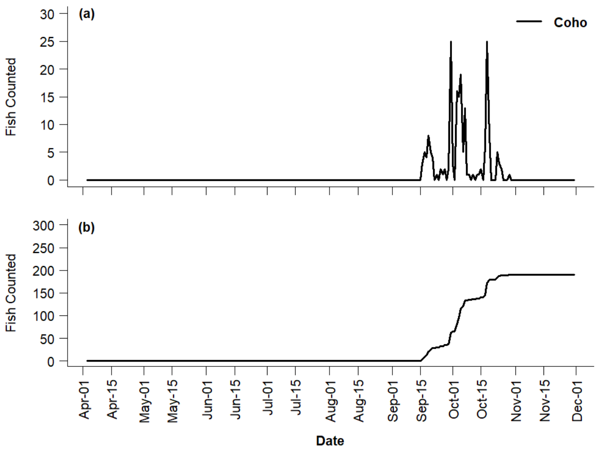


FIG. 1.5.5: (a) Daily and (b) cumulative observed counts of Coho Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

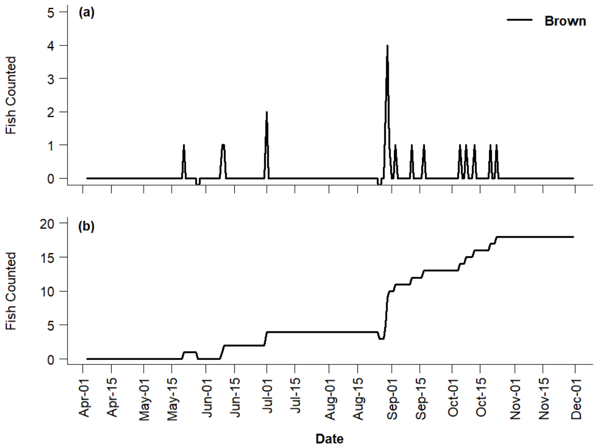


FIG. 1.5.6: (a) Daily and (b) cumulative observed counts of Brown Trout at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

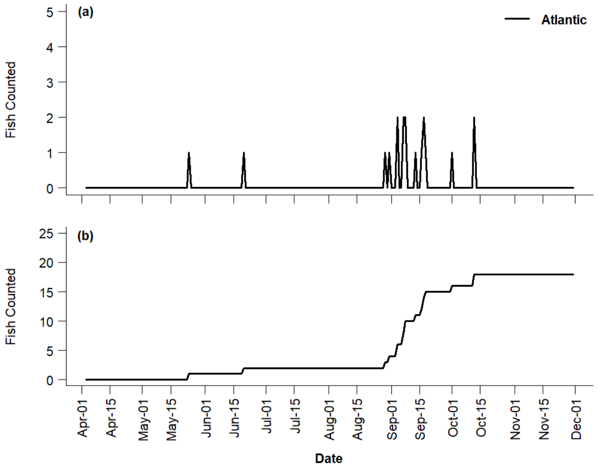


FIG. 1.5.7: (a) Daily and (b) cumulative observed counts of Atlantic Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

potential to be biased toward larger fish. To obtain a representative length sample of the spawning run, 50 fish per day were randomly selected, measured and check for clips prior to fish being sorted for spawn collection and detailed sampling. Detailed sampling included collecting data on length, weight, fin clips, coded-wire tag (CWT), lamprey marks and a subsample also had otoliths collected for age determination.

Samples for the 2019 Chinook Salmon index were taken between October 7th – 14th. Lengths were taken on a total of 819 Chinook Salmon 302 randomly selected fish (non-detailed sampling) and 517 fish where detailed sampling occurred. Of the randomly selected fish, 6% were observed with an adipose clip. To increase the diversity of the Chinook Salmon egg collection, LOMU began collecting Chinook Salmon eggs and milt from the Ganaraska River in addition to the Credit River. Fish that were stocked into the Credit River that were collected from the Ganaraska River had their adipose removed prior to stocking. This allows LOMU staff to identify the stock origin (Credit River/Wild = adipose fin intact; Ganaraska = adipose removed/clip) of the mature Chinook Salmon in the Credit River during the spawn/egg collection. Stocking of Ganaraska River Chinook Salmon into the Credit River began in 2016, so fish observed with an adipose clip would be from the 2016, 2017 and 2018 stocking events (see Section 6.1). Of the 17 fish observed with an adipose clip, 4 were male and 13 were female. In 2019, 80% of the spawning population (clipped and unclipped combined) were three years old, 19% were age 2 (Fig. 1.5.8).

In 2019, average fork length of Chinook Salmon at age-2 and age-3 decreased for both males and females (Fig. 1.5.9). The average fork length of age-3 males (870 mm) increased from 2018 and is about 2% below the the long-term average of 885 mm. Average length of age-3 females (850 mm) increased from 2018 and is 2% below the long-term mean (870 mm; Fig. 1.5.9). Length of age-2 females (830 mm) increased, while males (787 mm) were comparable to 2018 values and are 4% and 1% (respectively) below the long-term averages (Fig. 1.5.9).

The estimated weight (based on a log-log regression) of a 914 mm / 36" (total length) Chinook Salmon is used as an index of condition. In 2019, female and male condition measures

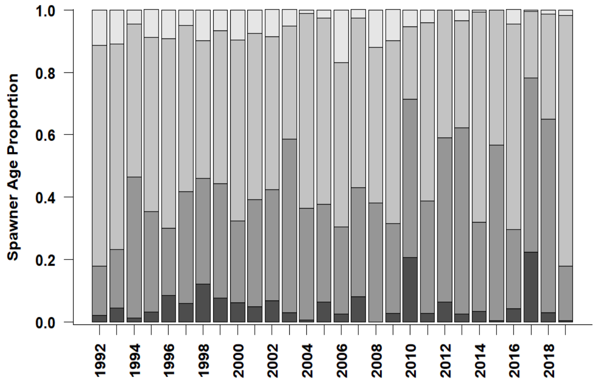


FIG. 1.5.8: Age proportions of spawning Chinook Salmon (males and females pooled) sampled during the fall Credit River Chinook Salmon Spawning Index, Credit River, Mississauga, Ontario from 1992 – 2019. The four grey colours correspond to each age where Age 1 is the darkest and Age 4 is the lightest.

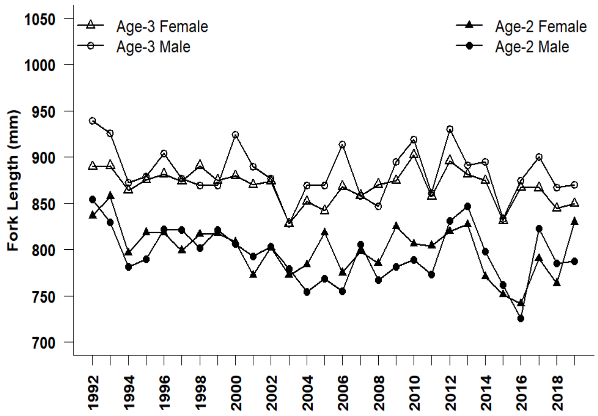


FIG. 1.5.9: Mean total length of age-2 and age-3 Chinook Salmon by sex, caught for spawn collection in the Credit River during the fall spawning run (approximately first week of October), 1989-2019.

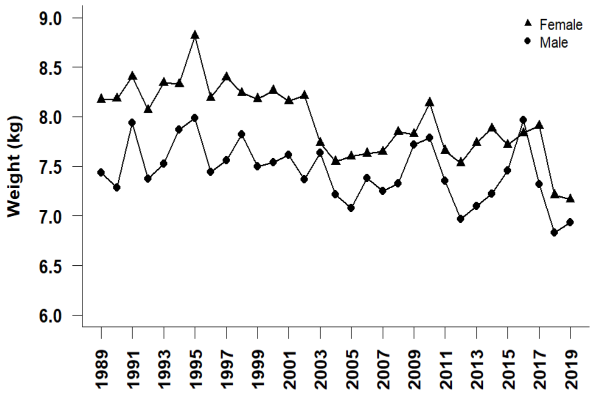


FIG. 1.5.10: Condition index as the mean weight of a 914 mm / 36 inch (total length) Chinook Salmon in the Credit River during the spawning run (approximately first week of October), 1989-2019.

were comparable to 2018 (Fig. 1.5.10). A sharp decline in male condition was observed in 2018 as well (Fig. 1.5.10). Female condition in 2019 (7,167 g) is the lowest in the 30 year time series; an 7% decline from the previous 10 year average (7,744 g). Male condition (6,937 g) in 2019 is 6% below the average condition over the past 10 years (7,371 g) and has declined 13% since its peak in 2016. It should be noted that the absolute difference between maximum and minimum condition for female (1995 and 2019) and male (1995 and 2018) Chinook Salmon in this time series is 1,647 g and 1,156 g (respectively).

1.6 Lake Ontario Spring Prey Fish Assessment

J. P. Holden, Lake Ontario Management Unit, OMNRF
B. C. Weidel, Lake Ontario Biological Station, USGS
M. J. Connerton, Cape Vincent Fisheries Station, NYSDEC

Since 1978 the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Geological Survey (USGS) have annually conducted 100-120 bottom trawl tows, primarily in US waters in April, to provide an index of Alewife abundance as well as biological attributes such as age distribution and body condition. As the dominant prey species in Lake Ontario, understanding Alewife abundance and age structure is important for assessing predator-prey balance and establishing stocking levels of predator species (i.e. Chinook Salmon, Lake Trout).

Since 2016, the survey has been expanded to Canadian waters with the Ontario Ministry of Natural Resources and Forestry (OMNRF) trawling a portion of the Canadian sites (Fig. 1.6.1). A total of 252 sites throughout the lake were sampled in 2019 spanning bottom depths from 5-224m between April 3rd and May 3rd.

The survey generally samples depths in proportion to the lake area however there are differences in how those samples are distributed between depths and jurisdictions. The south shore has well distributed coverage of depths between 8 -200m that can be surveyed at multiple transects. Bottom trawling along the north shore is less uniform due to a lack of suitable soft sediment trawl sites at shallower depths. Attempts to trawl at depths shallower than 80m in the main basin have consistently resulted in snags and torn trawls. During the day, in early spring, most Lake Ontario Alewife are found near the lake bottom in the warmer, deeper water (75m – 150m) thus trawl sites at depths greater than 80m provide suitable index sites for Alewife. Additionally, shallow tows (<40m) in Ontario waters occur disproportionately in the Kingston Basin. Efforts continue to identify suitable trawl locations along the north shore habitats of the main lake.

All vessels followed a standard trawl protocol that utilized a polypropylene mesh bottom trawl referred to as “3N1” (see Table 1.6.1 for trawl dimensions) equipped with rubber discs that elevate the footrope off bottom to minimize catches of Dreissenid mussels. NYSDEC and USGS vessels used USA Jet slotted, metal,

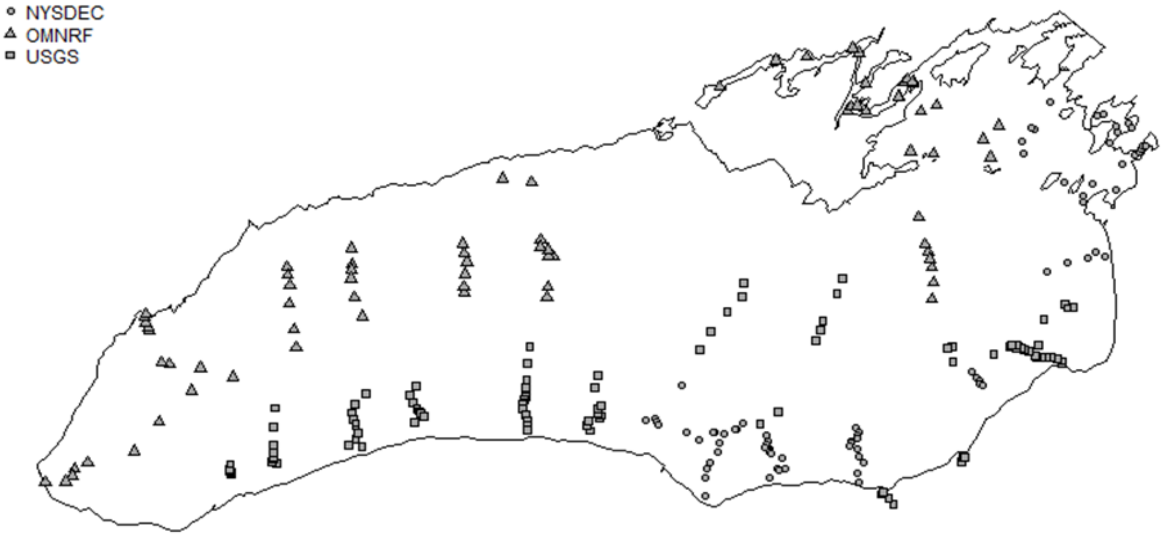
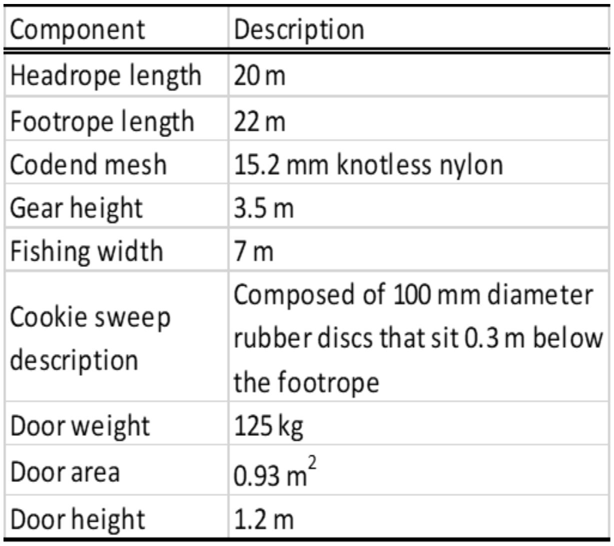


FIG. 1.6.1. Geographic distribution of trawl sites conducted by OMNRF, USGS and NYSDEC during the 2018 Lake Ontario Spring Prey Fish Assessment.

cambered trawl doors (1.22m x 0.75m) while OMNRF used comparable Thyborne doors to spread the trawl. Trawl mensuration gear was used to record door spread, bottom time and headrope depth. Sampling protocol seeks a target tow time of 5 minutes but actual bottom time is known to vary with depth.

Sites were further expanded in 2019 to include more embayments throughout the lake. Within Ontario waters, the majority of these sites were within the Bay of Quinte. The survey captured 215,429 individuals from 37 species. Alewife were 82% of the total catch by number and Round Goby, Deepwater Sculpin, and Rainbow Smelt comprised 3, 7, and 3% of the catch, respectively. Detailed results are provided in the Status of Preyfish (Appendix 1).

TABLE 1.6.1. Gear specifications for the polypropylene mesh bottom trawl referred to as “3N1” and equipped with rubber discs that elevate the footrope off bottom to minimize catches of Dreissenid mussels.



Component	Description
Headrope length	20 m
Footrope length	22 m
Codend mesh	15.2 mm knotless nylon
Gear height	3.5 m
Fishing width	7 m
Cookie sweep description	Composed of 100 mm diameter rubber discs that sit 0.3 m below the footrope
Door weight	125 kg
Door area	0.93 m^2
Door height	1.2 m

1.7 Lake Ontario Fall Benthic Prey Fish Assessment

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M.J. Connerton Cape Vincent Fisheries Station, NYSDEC
B. O'Malley Lake Ontario Biological Station, USGS
C. Osborne Lake Ontario Biological Station, USFWS

The Lake Ontario offshore prey fish community was once a diverse mix of pelagic and benthic fish but by the 1970s the only native fish species that remained abundant was Slimy Sculpin. Recent invasions of dressenid mussels and Round Goby have further changed the offshore fish community. The Lake Ontario Fall Benthic Prey Fish Survey provides an index of how prey fish abundance, distribution and species composition has adapted through time in response to environmental change and species invasions.

A benthic prey fish assessment in the main basin of Lake Ontario has historically only been conducted by the US Geological Survey (USGS). The survey assessed prey fish along six southern-shore, US transects in depths from 8 - 150m. However, the restricted geographic and depth coverage prevented this survey from adequately informing important benthic prey fish dynamics at a whole-lake scale, including monitoring the reappearance of Deepwater Sculpin. In 2015, this program was expanded to include additional trawl sites conducted by OMNRF and New York Department of Environmental Conservation (NYSDEC) with additional support provided from the US Fish and Wildlife Service (USFWS).

The 2019 survey consisted of 160 trawls conducted from September 23th through October 11th throughout the entire lake (Fig. 1.7.1). The survey generally samples depths in proportion to the lake area however there are differences in how those samples are distributed between depths and jurisdictions. Shallow tows (<40m) in Ontario waters are largely confined to the Kingston Basin due to limited suitable sites across the north shore. Efforts continue to find suitable, soft sediment trawl locations in shallow waters along the north shore portion of the main lake to improve the spatial coverage of this survey.

All vessels used a similar trawl (3/4 Yankee Standard, See Table 1.2.1 for specifications) however doors varied between vessels. Depth

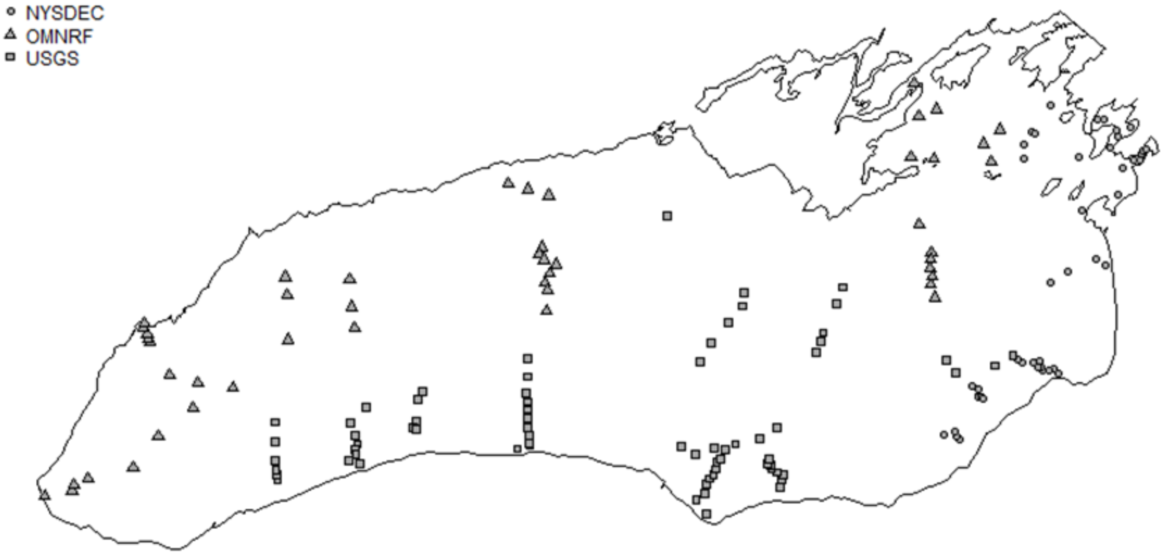


FIG. 1.7.1. Geographic distribution of trawl sites conducted by OMNRF, USGS and NYSDEC.

loggers and wing sensors were used on all trawls to provide estimates of true bottom time and net opening in order to standardize catches between vessels.

Round Goby were the most abundant species caught (N = 31,845; 47% numerically) followed by Deepwater Sculpin (N = 12,699; 19%); Alewife (N = 11,783; 17%) and Rainbow Smelt (N = 5526; 8%). Abundance trends and community indices are presented in detail in the Status Preyfish (Appendix 1).

1.8 Lake St. Francis Community Index Gill Netting

M. Yuille; Lake Ontario Management Unit

Traditionally, the Lake Ontario Management Unit (LOMU) conducts a Fish Community Index Gill Netting Survey in Lake St. Francis every other year in early fall. In 2019, the St. Lawrence River Fish Community Index Gill Netting Survey (Lake St. Francis and Thousand Islands) was redesigned and will be conducted annually. Netting effort is allocated to randomly selected sites within four depth zones based on their proportional representation in the study area. The catches are used to estimate fish abundance and measure biological attributes. Structures and tissues are collected for age determination, stomach content analyses, contaminant analyses and pathological examinations. The survey is part of a larger effort to monitor changes in the fish communities in four distinct sections of the St. Lawrence River: Thousand Islands, Middle Corridor, Lake St. Lawrence and Lake St. Francis. This survey is coordinated with New York Department of Environmental Conservation (NYSDEC) to provide comprehensive assessment of fisheries resources in the upper St. Lawrence River.

In 2019, the survey was conducted during the period of September 23rd to 25th. Fifteen nets were deployed, using standard multi-panel gillnets with monofilament meshes ranging from 1 ½ to 6 inches at half-inch increments. The nets were fished for approximately 24 hours. All catches prior to 2002 were adjusted by a factor of 1.58 to be comparable to the new netting standard initiated in 2002. In total, 216 fish were caught, which included nine different fish species (Table 1.8.1). The average number of fish per net was 14.4, up 27% from 2018. The number of fish per set increased in 2019, but remains below the 1984 – 2018 average for the survey (Fig. 1.8.1). The dominant species in the catch continues to be Yellow Perch (82% of catch, 29% of biomass; Fig. 1.8.2).

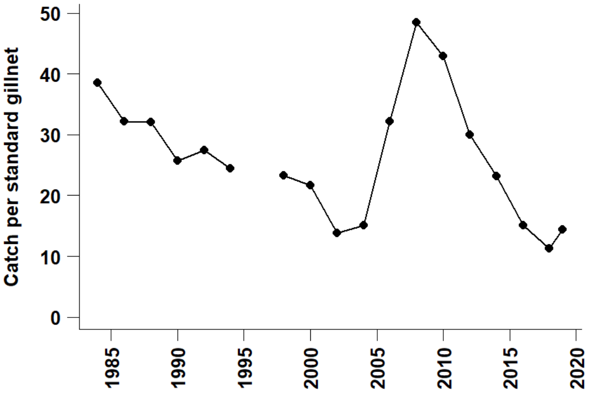


FIG 1.8.1. Average catch per standard gillnet set of all species combined, Lake St. Francis, 1984 – 2019. Survey was not conducted in 1996.

Species Highlights

Yellow Perch

Catches of Yellow Perch continued to decline from peak levels seen previously in 2008 and 2010 (Fig. 1.8.3). 2019 catches of Yellow Perch catch per net (11.8 fish per net) increased from 2016 and 2018 catches but remain below the 1984 – 2018 survey average (15.93 fish per net; Table 1.8.1). The increase in 2019 Yellow Perch catches was driven by an increase in the number of small fish (≤ 220 mm) caught (Fig. 1.8.3). The proportion of large fish (> 220 mm) observed in catches (1.0 fish per net) remains low (Fig. 1.8.3). Yellow Perch catches in 2019 contained fish from age-2 to age-8 with age-2 fish representing 42% of the total catch (Fig. 1.8.4).

Centrarchids

The centrarchids are represented by six species in Lake St. Francis: Rock Bass, Pumpkinseed, Bluegill, Smallmouth Bass, Largemouth Bass and Black Crappie (Fig. 1.8.5 and 1.8.6). While Rock Bass remain the most abundant of the centrarchids, catches in 2019 (0.67 fish per net) were 18% of the previous five surveys. Smallmouth Bass catches declined in 2019 relative to the 2018 catch and are currently 41% below the previous 10-year average (Fig. 1.8.5) with all fish caught being age-4. No pumpkinseed, Bluegill, Black Crappie or

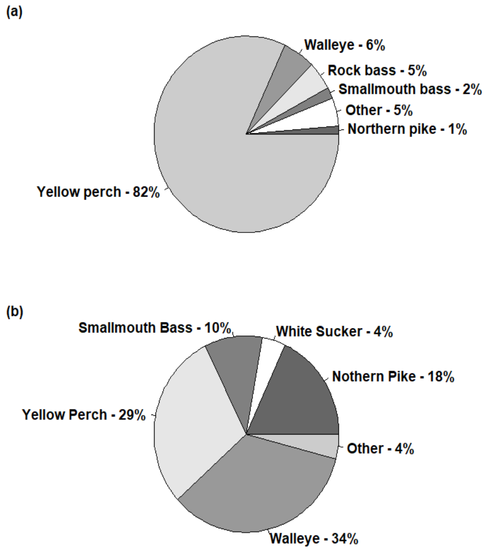


FIG. 1.8.2. Species composition by (a) catch and (b) biomass in the 2019 Lake St. Francis community index gill netting program.

Largemouth Bass were caught in the 2019 survey (Figs. 1.8.5 and 1.8.6).

Northern Pike

Northern Pike catches in 2019 remain low (0.2 fish per net; Fig. 1.8.7). Northern Pike abundances have been in decline since the early 1990s and are currently at the lowest levels observed in the 35-year time series (Table 1.8.1). A total of three Northern Pike were caught in 2019, which were age-3, age-6 and age-8. In 2019, there were no small (≤ 500 mm) Northern Pike caught (Fig. 1.8.7). No Muskellunge were caught in 2019.

Walleye

Walleye represented 6% of the total catch and 34% of total biomass caught in 2019 with 12 individuals caught. The average catch per net was 0.8; a decline from 2018 and roughly 17% below the previous 10-year average. Catches of small fish (≤ 500 mm) and large (>500 mm) continue to remain almost equal (Fig. 1.8.8). Walleye ages ranged from 1 to 11 years of age with the majority being ages 1 and 2 (Fig. 1.8.9).

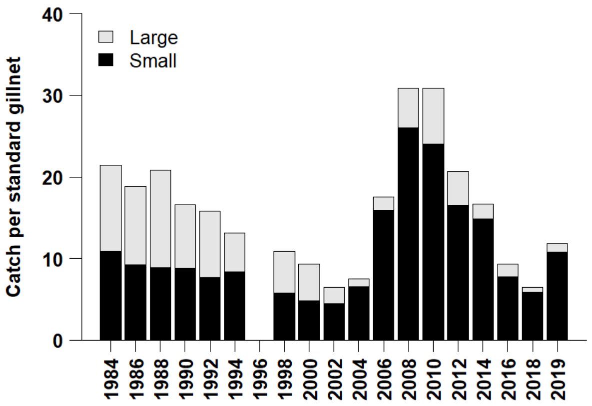


FIG. 1.8.3. Catches of small (≤ 220 mm total length) and large (> 220 mm total length) Yellow Perch in the Lake St. Francis community index netting program, 1984 – 2019. Survey was not conducted in 1996.

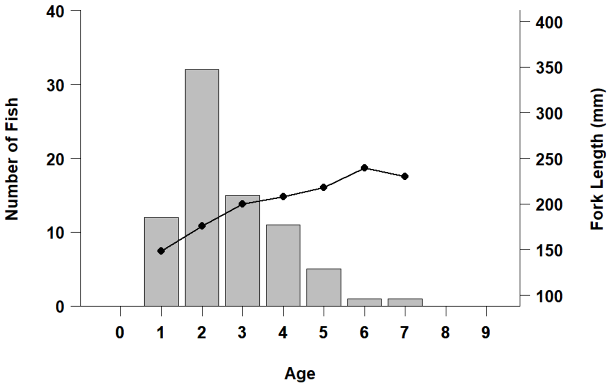


FIG. 1.8.4. Age distribution (bars) and mean fork length at age (mm) of Yellow Perch caught in Lake St. Francis, 2019.

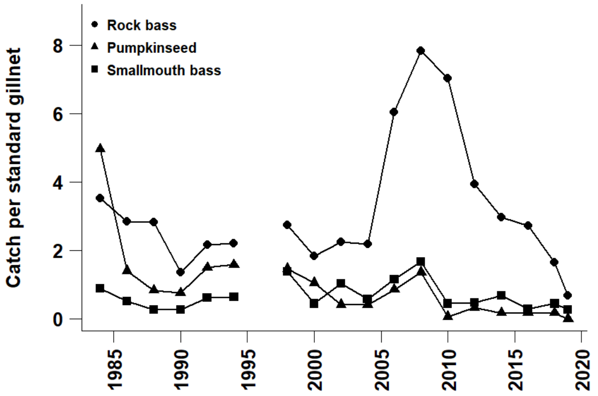


FIG. 1.8.5. Rock Bass (circle), Pumpkinseed (triangle) and Smallmouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 - 2019.

TABLE 1.8.1. Summary of catches per gillnet set in the Lake St. Francis Fish Community Index Gillnetting Program, 1984 - 2019. All catches prior to 2002 were adjusted by a factor of 1.58 to be comparable to the new netting

	1984 - 2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2019
Lake Sturgeon	0.01	--	0.03	--	0.03	--	0.03	--	0.03	--	--
Longnose Gar	0.19	0.4	--	0.06	--	--	0.22	--	0.28	--	0.07
Bowfin	0.01	--	--	--	--	--	--	--	--	--	--
Alewife	0.01	0.03	0.06	0.22	--	--	0.14	0.03	--	--	0.2
Gizzard Shad	0.00	--	--	--	--	--	--	--	0.06	--	--
Salvelinus sp.	0.01	--	--	--	--	--	--	--	--	--	--
Creek Chub	0.00	--	--	--	--	--	--	--	--	--	--
Northern Pike	3.92	1.23	1.45	1.67	1.08	0.31	0.19	0.31	0.14	0.14	0.2
Muskellunge	0.01	--	0.03	--	--	--	--	0.03	--	--	--
White Sucker	1.65	0.74	1.06	0.97	1.97	1.56	1.17	1.25	0.56	0.47	0.33
Silver Redhorse	0.00	--	--	0.11	0.14	0.08	0.06	0.03	0.06	0.11	--
Shorthead Redhorse	0.00	--	--	--	--	--	0.28	0.06	0.03	0.03	0.07
Greater Redhorse	0.01	--	--	--	--	--	--	--	--	--	--
River Redhorse	0.02	--	--	--	--	0.06	--	--	--	--	--
Moxostoma sp.	0.04	--	--	--	0.06	--	--	--	--	0.11	--
Common Carp	0.03	0.09	--	0.25	0.03	--	--	--	--	--	--
Golden Shiner	0.01	0.03	--	--	--	--	--	--	0.06	0.22	--
Creek Chub	0.01	--	--	--	--	--	--	--	--	--	--
Fallfish	0.01	--	--	--	--	--	--	--	0.03	0.14	--
Brown Bullhead	1.09	0.54	1.38	2.81	1.97	0.56	0.25	0.14	0.03	--	--
White Perch	0.00	--	--	--	--	--	--	--	0.03	--	--
Rock Bass	2.47	2.25	2.17	5.69	7.83	7.03	3.94	2.97	2.72	1.64	0.67
Pumpkinseed	1.76	0.41	0.41	0.89	1.36	0.06	0.33	0.17	0.17	0.17	--
Bluegill	0.01	0.1	--	--	--	0.06	--	--	0.03	--	--
Smallmouth Bass	0.63	1.02	0.58	1.17	1.67	0.44	0.47	0.67	0.28	0.44	0.27
Largemouth Bass	0.06	0.2	--	0.61	0.31	0.33	1.53	--	0.69	0.22	--
Black Crappie	0.07	0.07	--	--	--	--	--	--	0.08	0.03	--
Yellow Perch	15.69	6.48	7.49	16.36	30.89	30.83	20.64	16.67	9.36	6.5	11.8
Walleye	0.44	0.16	0.41	0.39	1.08	1.58	0.78	0.81	0.47	1.08	0.8
Freshwater Drum	0.00	0.04	--	--	0.03	--	--	--	0.03	--	--
All Species	28.14	13.79	15.07	31.2	48.45	42.9	30.03	23.14	15.14	11.3	14.41
Count of Species	12.63	16	11	13	14	12	14	12	20	14	9

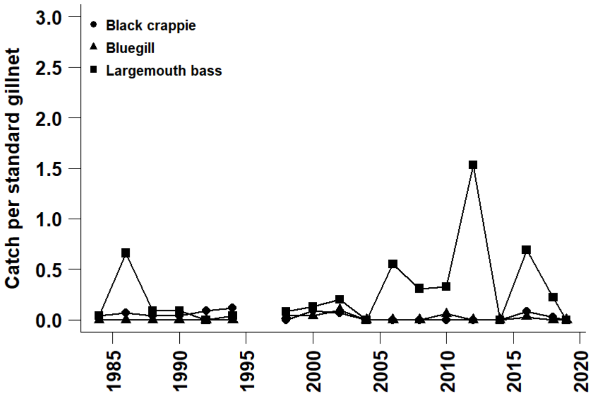


FIG. 1.8.6. Black Crappie (circle), Bluegill (triangle) and Largemouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 – 2019.

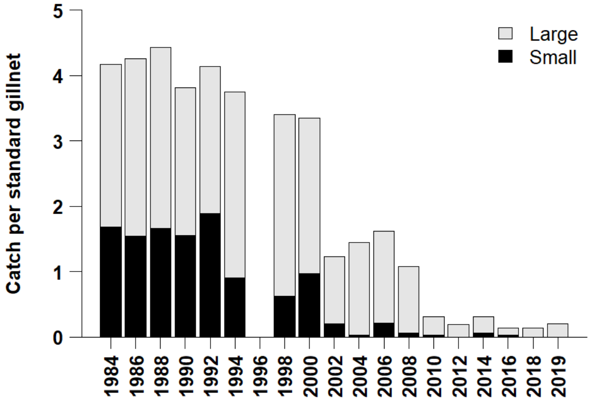


FIG. 1.8.7. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Northern Pike in the Lake St. Francis community index gill netting program, 1984 – 2019. Survey was not conducted in 1996.

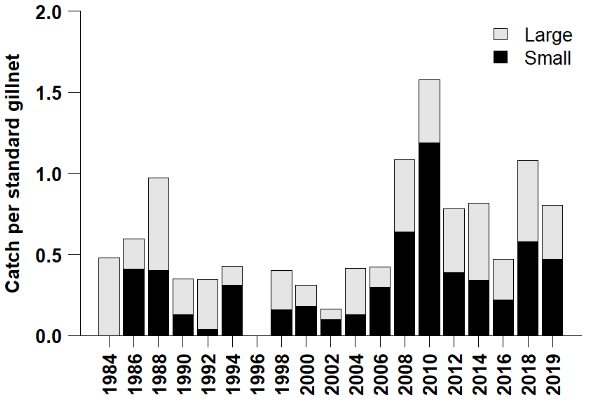


FIG. 1.8.8. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Walleye in the Lake St. Francis community index gill netting program, 1984 – 2019. Survey was not conducted in 1996.

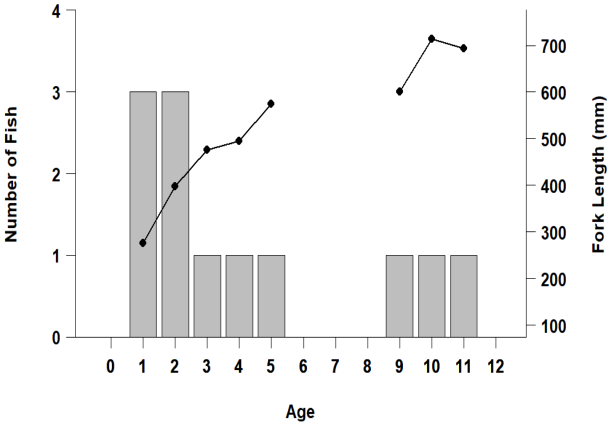


FIG. 1.8.9. Age distribution (bars) and mean fork length (circles) at age of Walleye caught in Lake St. Francis, 2019.

1.9 St. Lawrence River Fish Community Index Netting – Thousand Islands

M. Yuille; Lake Ontario Management Unit

Traditionally, the Lake Ontario Management Unit (LOMU) conducts a Fish Community Index Gill Netting Survey in the Thousand Islands every other year in early fall. In 2019, the St. Lawrence River Fish Community Index Gill Netting Survey (Thousand Islands and Lake St. Francis) was redesigned and will be conducted annually. Netting effort is allocated to randomly selected sites within four depth zones based on their proportional representation in the study area. The catches are used to estimate abundance, measure biological attributes, and collect materials for age determination, stomach contents and tissues for contaminant analysis and pathological examination. The survey is part of a larger effort to monitor changes in the fish communities in four sections of the St. Lawrence River (Thousand Islands, Middle Corridor, Lake St. Lawrence, and Lake St. Francis), and it is coordinated with the New York State Department of Environmental Conservation (NYSDEC) to provide comprehensive assessment of the river's fisheries resources.

In 2019, the survey was conducted between September 9th and September 18th. Twenty-five nets were deployed, using standard gillnets consisting of 25-foot panels of monofilament meshes ranging from 1.5 to 6 inches in half-inch increments. The nets were fished for approximately 24 hours. The overall catch was 883 fish comprising 22 species (summary in Table 1.9.1). The average number of fish per set was 35.3; comparable to the mean catch over the previous 10 years (38.5 fish per set; Fig. 1.9.1). Yellow Perch remained the dominate species caught in the nets followed by Smallmouth Bass and Rock Bass (Fig. 1.9.2).

Species Highlights

Yellow Perch

In 2019, Yellow Perch catches declined 26.0 to 18.4 fish per gillnet and represented 52% of the total catch by number and 18% by biomass (Table 1.9.1; Fig. 1.9.2 and 1.9.3). Catches of Yellow Perch in the 2019 Thousand Islands survey are below the average catch from the previous five netting surveys (average of 23.5 from 2009 to 2017). Age distributions and mean length at age for 2019 catches of Yellow Perch are summarized in Tables 1.9.2 and 1.9.3, respectively.

Centrarchids

The centrarchids are represented by six species in the upper St. Lawrence: Rock Bass, Pumpkinseed, Bluegill, Smallmouth Bass, Largemouth Bass and Black Crappie (Fig. 1.9.4 and 1.9.5). Smallmouth Bass were the most abundant centrarchid species in the 2019 survey, representing 17% of the total catch by number and 32% by biomass (Figs. 1.9.2 and 1.9.4). Length at age for Smallmouth Bass is comparable to the time series average for age-1 and exceeds the time series average for ages 3 and 5 (Table 1.9.3 and Fig. 1.9.6). Pumpkinseed continue to decline in 2019 and remain at the lowest level observed in this survey (Fig. 1.9.4). Bluegill, Largemouth Bass and Black Crappie were historically at much lower levels than the former three species, however, in 2019, Largemouth Bass catches increased to near record high levels for this survey (Fig. 1.9.5).

Northern Pike

Northern Pike remain at very low levels, reached after a slow steady decline spanning

FIG. 1.9.1: Total number of fish (all species) per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

almost the entire history of the Thousand Islands survey (Fig. 1.9.7). Currently, Northern Pike abundance is at the lowest observed in this survey; roughly 6% of its peak observed in 1989. In 2019, only large (> 500 mm) Northern Pike were caught. Condition as determined by mean lengths of age-4, age-5 and age-6 Northern Pike has increased from the 2017 survey and remains above the long-term average (Fig. 1.9.8 and Tables 1.9.2 and 1.9.3).

Walleye

Walleye represented 2% of the total catch and 15% of total biomass caught in 2019 with 19 individuals caught. The average catch per net was 0.76 (an increase from 2017), which is approximately 31% above the previous 10-year average (0.58 Walleye per gill net). Catches of small (≤ 500 mm) and large (>500 mm) fish remain stable with 36% and 64% of the catch representing small and large fish (respectively; Fig. 1.9.9). Walleye ages ranged from 1 to 16 years of age (Table 1.6.2).

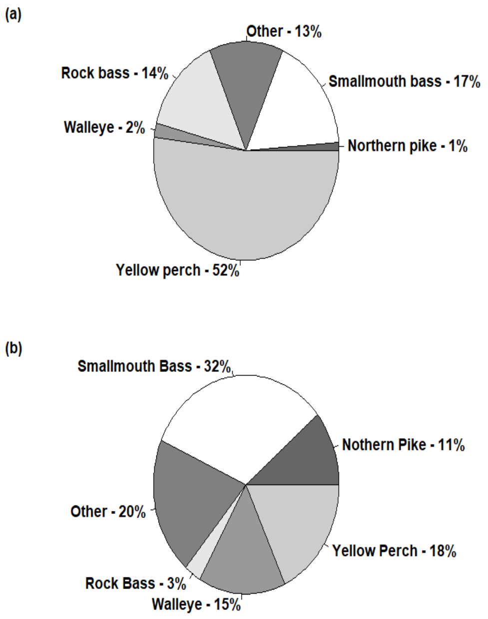


FIG. 1.9.2: Species composition by (a) catch and (b) biomass in the 2019 gillnet survey in the Thousand Island area of the St. Lawrence River.

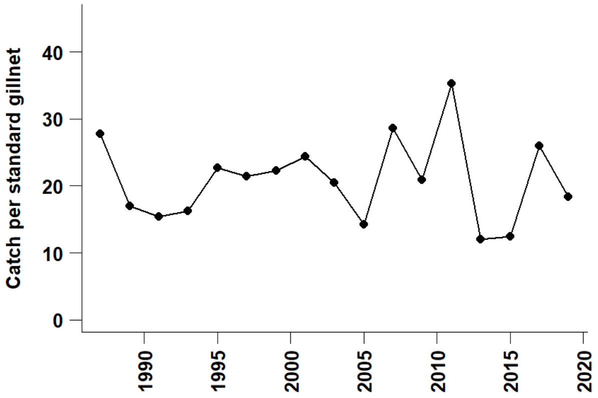


FIG. 1.9.3: Yellow Perch catch per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

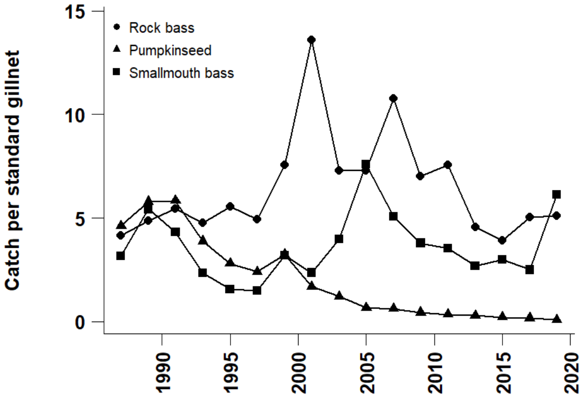


FIG. 1.9.4: Rock Bass (circle), Pumpkinseed (triangle) and Smallmouth Bass (square) catches per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

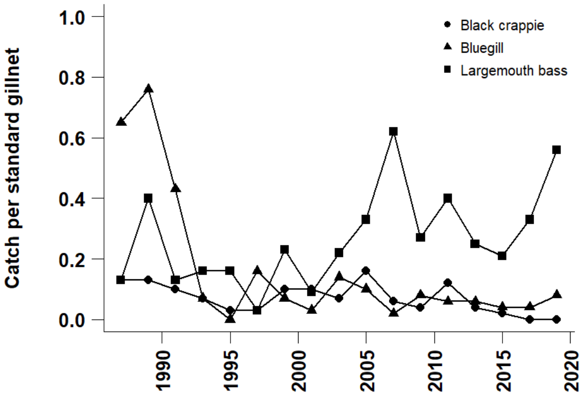


FIG. 1.9.5: Black Crappie (circle) Bluegill (triangle) and Largemouth Bass (square) catches per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

TABLE 1.9.1: Catches per standard gill net set in the Thousand Islands area of the St. Lawrence River, 1987-2019. Catches from multifilament nets (all catches prior to 2001, and a portion of catches from 2001-2005) were increased by a factor of 1.58 to adjust to the modern monofilament netting standards initiated in 2001.

	1987 - 1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
Lake sturgeon	0.01	--	0.02	0.02	0.02	0.05	0.05	--	--	--	0.12
Longnose gar	0.01	--	0.08	0.05	--	0.04	0.05	--	--	--	0.08
Bowfin	0.05	0.02	0.08	0.06	0.09	0.07	0.13	0.02	0.02	0.02	0.04
Alewife	0.10	--	--	0.02	0.14	0.07	--	0.12	0.27	0.46	1.32
Gizzard shad	0.13	0.11	--	0.05	0.02	--	0.09	0.14	0.12	0.08	--
Chinook salmon	0.01	0.04	--	--	--	--	0.03	--	--	--	--
Rainbow trout	0.01	--	--	--	--	--	--	--	--	--	--
Brown trout	0.01	--	--	--	--	--	0.04	0.02	--	--	--
Lake trout	0.10	--	--	--	--	--	--	--	--	0.02	--
Lake herring	0.02	--	--	--	--	--	--	--	--	--	--
Chub	0.01	--	--	--	--	--	--	--	--	--	--
Northern pike	4.06	2.00	2.26	1.97	1.42	0.97	1.29	1.10	0.43	0.35	0.44
Muskellunge	0.01	0.02	0.04	--	--	--	--	--	--	--	--
Chain pickerel	--	--	--	--	--	0.02	--	--	--	--	--
White sucker	1.64	1.06	1.05	0.70	0.43	0.27	0.66	0.30	0.22	0.33	0.4
Silver redhorse	0.04	0.05	--	0.07	0.07	0.02	0.13	0.07	0.03	--	0.04
Shorthead redhorse	0.00	--	--	0.04	--	--	--	--	--	--	--
Greater redhorse	0.00	0.05	0.12	--	--	--	--	--	--	--	--
Moxostoma sp.	0.11	--	--	--	--	--	--	--	--	--	--
Common carp	0.14	0.13	0.13	0.04	0.02	--	0.05	--	--	--	0.04
Golden shiner	0.05	--	--	0.05	0.07	0.36	0.13	0.09	0.24	0.42	0.12
Brown bullhead	2.28	4.64	2.97	5.16	1.27	4.09	1.86	0.66	0.52	0.17	1.24
Channel catfish	0.44	0.35	0.39	0.22	0.74	0.61	0.69	0.29	0.22	--	0.08
White perch	0.10	0.18	0.02	0.16	--	--	--	0.12	--	--	0.04
White bass	0.24	--	--	--	--	--	0.32	--	0.03	--	0.04
Rock bass	5.91	14.94	8.26	7.99	12.16	7.88	8.49	5.24	4.50	5.04	5.12
Pumpkinseed	4.51	1.86	1.33	0.74	0.70	0.47	0.38	0.33	0.23	0.17	0.08
Bluegill	0.34	0.04	0.14	0.10	0.02	0.09	0.07	0.07	0.05	0.04	0.08
Smallmouth bass	3.37	2.58	4.59	8.38	5.72	4.30	3.97	3.07	3.42	2.5	6.12
Largemouth bass	0.20	0.10	0.23	0.36	0.71	0.30	0.41	0.28	0.23	0.33	0.56
Black crappie	0.09	0.11	0.08	0.17	0.07	0.05	0.13	0.05	0.02	--	--
Yellow perch	22.27	27.29	22.80	15.81	32.28	23.83	39.65	13.72	14.42	25.96	18.36
Walleye	0.37	0.30	0.27	0.25	0.69	0.67	0.88	0.52	0.45	0.38	0.76
Round goby	--	--	--	0.86	0.22	0.21	0.02	0.02	0.05	0.02	0.12
Freshwater drum	0.04	0.12	0.05	0.33	0.04	0.24	0.13	0.10	0.22	0.02	0.12
Total Catch	46.64	55.99	44.91	43.60	56.90	44.61	59.65	26.33	25.69	36.31	35.32

TABLE 1.9.2: Age distribution of selected species caught in the 2019 Thousand Islands Community Index Gill Netting program.

	Year-class/Age																
	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Species	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yellow Perch	--	1	13	21	21	12	8	6	6	3	--	--	--	--	--	--	--
Walleye	--	6	--	1	1	--	--	2	1	1	--	--	3	--	2	1	1
Northern Pike	--	--	--	2	3	2	2	1	1	--	--	--	--	--	--	--	--
Smallmouth Bass	--	17	13	29	9	9	12	7	--	6	2	--	1	1	--	--	--

TABLE 1.9.3: Mean fork length (mm) of selected species caught in the 2019 Thousand Islands Community Index Gill Netting program.

	Year-class/Age																
	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Species	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yellow Perch	--	130	138	173	185	211	262	272	290	262	--	--	--	--	--	--	--
Walleye	--	272	--	443	494	--	--	559	630	635	--	--	662	--	697	709	635
Northern Pike	--	--	--	661	662	698	752	668	776	--	--	--	--	--	--	--	--
Smallmouth Bass	--	154	219	293	326	365	404	429	--	451	476	--	464	489	--	--	--

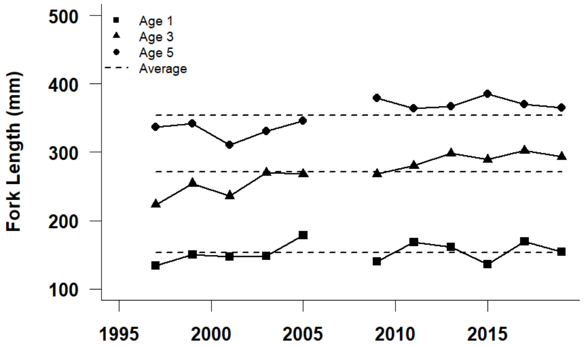


FIG. 1.9.6: Mean fork length (mm) of age-1 (square), age-3 (triangle) and age-5 (circle) Smallmouth Bass from 1997 to 2019. Dashed lines represent the average fork length from 1997 to 2019 for the aforementioned ages.

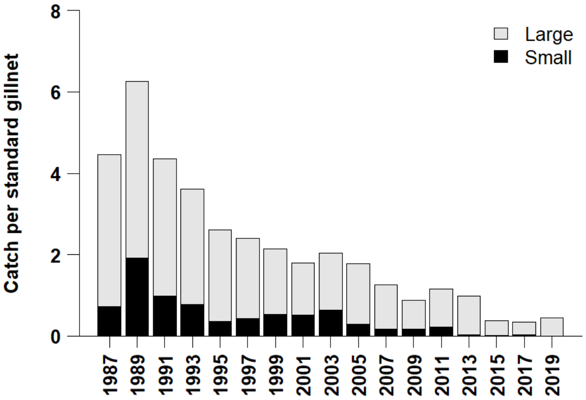


FIG. 1.9.7: Catches of small (≤ 500 mm fork length) and large (> 500 mm fork length) of Northern Pike per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

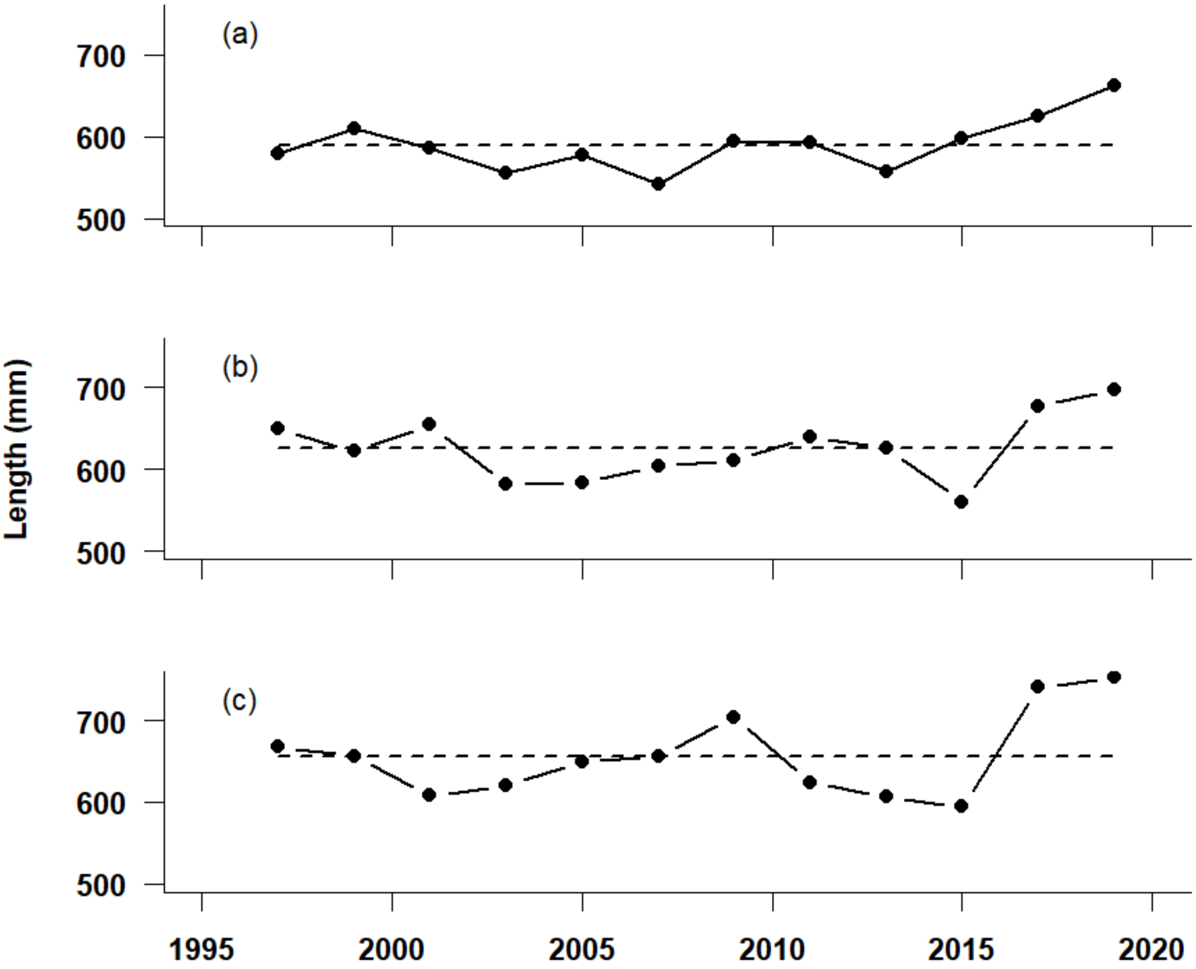


FIG. 1.9.8: Mean fork length (mm) of (a) age-4, (b) age-5 and (c) age-6 Northern Pike from 1997 to 2019. Dashed lines represent the average fork length from 1997 to 2019 for the aforementioned ages.

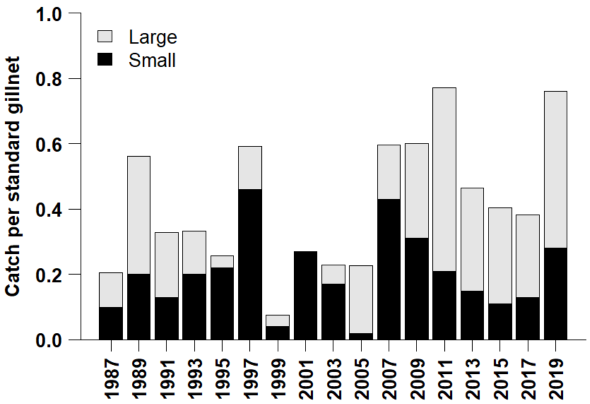


FIG. 1.9.9: Catches of small (≤ 500 mm fork length) and large (> 500 mm fork length) of Walleye per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2019.

2. Recreational Fishery

2.1 Fisheries Management Zone 20 Council (FMZ20) / Volunteer Angling Clubs

C. Lake, Lake Ontario Management Unit

Fisheries Management Zone 20 (FMZ20) Council provides advice to the Lake Ontario Management Unit regarding the management of Lake Ontario recreational fisheries. The FMZ20 Council, established in 2008, has been instrumental in shaping the future of the Lake Ontario recreational fishery. The FMZ20 Council has been involved in renewing the Fish Community Objectives, developing a stocking plan, assisting with angler diaries, changing regulations to support sustainable harvest, growing the stocking net pen program, identifying issues and concerns and acting as liaison to improve broader pubic awareness about the fishery.

FMZ20 Council members represents a broad spectrum of interests across the zone including Muskies Canada, competitive bass anglers, Bay of Quinte and Upper St. Lawrence River Guides, Central Lake Ontario Sport Anglers, Metro East Anglers, Port Credit Salmon and Trout Association, Halton Region Salmon and Trout Association, St. Catharines Game and Fish Association, Ontario Sportfishing Guides Association, Ontario Commercial Fish Association, Ontario Federation of Anglers and Hunters, tributary anglers, academia, environmental interests and several unaffiliated anglers.

Over the past year, the FMZ20 Council continued to be engaged in binational fish stocking decisions to address concerns about prey fish declines. The Council also worked very hard to develop new angling regulation options for Largemouth and Smallmouth Bass angling seasons in Lake Ontario and the St. Lawrence River.

Many of our volunteer clubs (council-affiliated and others) also help with the physical delivery of several management programs. Multiple clubs help with planning and implementation of Lake Ontario’s net pen rearing initiatives for Chinook Salmon (Section 6.2). Others help with the annual delivery of our stocking program through the operation of community-based hatcheries. The Napanee Rod and Gun Club helps MNRF meet its stocking targets by rearing Brown Trout. The Credit River Anglers stock Rainbow Trout and Coho Salmon. The Metro East Anglers, through their operation of the Ringwood hatchery, help the province meet its Rainbow Trout, Brown Trout, Atlantic Salmon, and Coho Salmon targets. Volunteers at the Ganaraska River-Corbett Dam Fishway assist MNRF staff install, maintain and operate the new fish counter. Numerous anglers and clubs also participate regularly by supplying catch and harvest information in our volunteer angler diary programs.

2.2 Bay of Quinte - Eastern Lake Ontario Open-Water Angler Survey

E. Brown and J. A. Hoyle, Lake Ontario Management Unit

The Bay of Quinte open-water recreational angling fishery was monitored from May 4 (Walleye angling "opening-weekend") until December 28, 2019 The last sampling day was November 30, 2019 but volunteer angler diaries (see Section 2.3) indicated that most angling continued until December 28, 2019.

A roving survey design was employed from Trenton to Lake Ontario and the St. Lawrence River (Fig. 2.2.1). Angling effort was measured using on-water fishing boat activity counts. Boat angler interviews provided information on catch/harvest rates and biological characteristics of the harvest. The survey consisted of sampling four days per week (two weekdays and both weekend days). Sampling was stratified by geographic area (21 areas; Fig. 2.2.1), season (five seasons: (1) May 4 - 5, (2) May 6 - Jun 14, (3) Jun 15 - Aug 9, (4) Aug 10 - Oct 11 and (5) Oct 12 - Dec 28 and day-type (weekdays and weekend days).

A total of 3,528 anglers in 1,589 boats were interviewed by field crews during the survey (Table 2.2.1). Forty-seven percent of anglers interviewed were local (Brighton to Gananoque, south of HWY 401), 45% were from Ontario (outside the local area), 3% were from elsewhere in Canada, 5% were from USA, and 1% were international (other than USA). Total angling effort was estimated to be 258,019 angler hours for all anglers.

Anglers caught 26 different species (Table 2.2.2). Seventy-four percent of anglers indicated that they were targeting Walleye, 20% were targeting Largemouth Bass, 10% were targeting Northern Pike, 6% were targeting Smallmouth Bass, and 4% were targeting Yellow Perch. Fishing effort was 191,519 hours for anglers targeting Walleye, 25,663 hours for anglers targeting Northern Pike, 50,641 hours for anglers targeting Largemouth Bass, 16,023 hours for anglers targeting Smallmouth Bass, and 10,369 for anglers targeting Yellow Perch (Table 2.2.2 and Table 2.2.3).

Numbers of Walleye caught and harvested were 44,877 and 29,191 respectively. Numbers of Walleye caught and harvested per hour by anglers targeting Walleye were 0.230 and 0.153, respectively. 24,718 and 9,042 for Largemouth Bass were caught and harvested, respectively. Largemouth Bass caught and harvested per hour

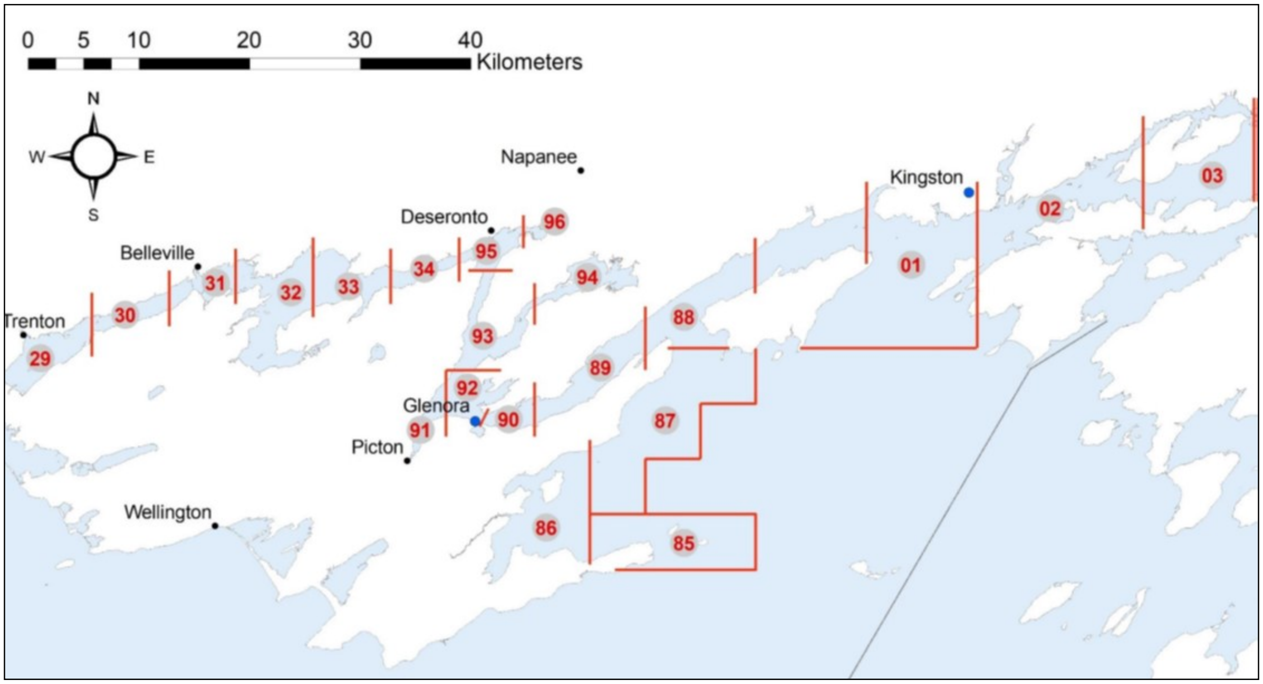


FIG. 2.2.1. Map of the Bay of Quinte - Eastern Lake Ontario showing angling survey areas.

by anglers targeting Largemouth Bass were 0.456 and 0.177, respectively. Anglers also caught and harvested 10,817 and 1,612 Northern Pike, respectively (Table 2.2.2 and 2.2.3). Open-water angling fishery trend statistics from 1988-2019 are shown graphically in Fig. 2.2.2 and from 1957 -2019 in Table 2.2.4.

The seasonal and regional patterns of Walleye, Largemouth Bass, and Northern Pike angling effort are depicted in Fig. 2.2.3 and Fig. 2.2.4. Targeted Walleye angling is highest in May and June. Most Walleye angling effort occurs in the upper region of the Bay of Quinte but a spike in effort also occurs in Lake Ontario and the lower Bay from mid-October through December (Fig. 2.2.3). Targeted Northern Pike angling is highest mid-August through mid-October in eastern Lake Ontario, including parts of the St. Lawrence River. Targeted Largemouth Bass angling is highest from June through August in the upper Bay of Quinte (Fig. 2.2.4).

The size distributions of Walleye, Largemouth Bass, Northern Pike and Yellow perch harvested by anglers and sampled by field crews are shown in Fig. 2.2.5 and 2.2.6. The size distribution (three categories: less than 19 inches total length, 19 to 25 inches and greater than 25 inches) reported to be released by anglers is shown in Fig. 2.2.7. The age distributions of Walleye, Largemouth Bass, and Northern Pike sampled are shown in Fig. 2.2.8. Age-3 and 4 year -old Walleye (2016 and 2015 year-classes respectively) dominated the harvest.

TABLE 2.2.1. Total estimated angler effort (angler hours), number of boats checked and anglers interviewed, number of anglers per boat, and number of rods per angler for the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019.

Total angling effort (hours)	258,019
Number of boats checked	1,589
Number of anglers interviewed	3,528
Anglers per boat	2.22
Rods per angler	1.09

TABLE 2.2.2. Species-specific statistics for the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019. Statistics shown are: estimated targeted angling effort (angler hours), proportion of anglers targeting each species, catch and harvest (number of fish) by all anglers, proportion of catch caught by anglers targeting that species, proportion of fish kept, and the number of fish caught per angler hour (CUE) by anglers targeting that species.

Species	Estimated Effort	Prop. Targeted	Estimated Catch	Prop. Targeted	Estimated Harvest	Prop. Kept	CUE
Longnose Gar	49	<0.01	107	0.34	0	0	0.760
Bowfin	17	<0.01	421	<0.01	0	0	0.001
Gizzard Shad	-	-	14	-	-	-	-
Lake Trout	165	<0.01	65	0.50	14	0.22	0.197
Northern Pike	25,663	0.10	10,817	0.60	1,612	0.15	0.255
Muskellunge	4,549	0.02	52	0.81	0	<0.01	0.009
White Sucker	-	-	20	-	-	-	-
Common Carp	32	<0.01	8	<0.01	0	<0.01	0.001
Brown Bullhead	-	-	119	-	-	-	-
Channel Catfish	239	<0.01	597	0.21	111	0.19	0.534
American Eel	-	-	116	-	-	-	-
Burbot	-	-	30	-	-	-	-
White Perch	-	-	22,413	-	491	0.02	-
White Bass	-	-	1035	-	508	0.49	-
Morone Species	3,661	0.01	17,242	0.27	3,027	0.18	1.267
Rock Bass	657	<0.01	2,019	0.06	154	0.08	0.177
Pumpkinseed	471	<0.01	4,183	0.05	220	0.05	0.481
Bluegill	285	<0.01	2,260	0.05	41	0.02	0.428
Sunfish Species	884	<0.01	1,534	0.14	183	0.12	0.243
Smallmouth Bass	16,023	0.06	4,810	0.89	418	0.09	0.266
Largemouth Bass	50,641	0.20	24,718	0.93	9,042	0.37	0.456
Black Crappie	330	<0.01	607	<0.01	232	0.38	0.001
Yellow Perch	10,369	0.04	102,603	0.07	5,615	0.05	0.685
Walleye	191,519	0.74	44,877	0.98	29,191	0.65	0.23
Round Goby	-	-	237	-	-	-	-
Freshwater Drum	1,617	0.01	10,282	0.1	133	0.01	0.611

TABLE 2.2.3. Angling statistics for Walleye, Largemouth Bass, and Northern Pike by season surveyed during the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019. “Targeted” statistic refers to the anglers targeting the indicated species.

Angling Statistics	Season					Total
	(1) May 4-5	(2) May6-Jun14	(3) Jun15-Aug9	(4) Aug10-Oct11	(5) Oct12-Dec28	
Walleye:						
Catch by All Anglers	2,781	23,399	11,484	3,798	3,415	44,877
Catch by Targeted Anglers	2,781	23,283	10,909	3,717	3,415	44,106
Harvest by All Anglers	2,023	15,256	7,853	2,526	1,533	29,191
Harvest by Targeted Anglers	2,023	15,256	7,850	2,526	1,533	29,188
Targeted Effort (angler hours)	25,421	75,429	33,926	27,554	29,190	191,519
Targeted Effort (rod hours)	25,545	75,603	33,972	30,650	48,073	213,842
All Effort (angler hours)	26,346	76,969	59,747	59,787	35,170	258,019
Targeted CUE	0.109	0.309	0.322	0.135	0.117	0.230
All Anglers CUE	0.106	0.304	0.192	0.064	0.097	0.174
Targeted HUE	0.080	0.202	0.231	0.092	0.053	0.152
All Anglers HUE	0.077	0.198	0.131	0.042	0.044	0.113
Northern Pike:						
Catch by All Anglers	580	2,748	1,546	4,768	1,174	10,817
Catch by Targeted Anglers	357	801	220	4,249	916	6,543
Harvest by All Anglers	144	323	316	479	350	1,612
Harvest by Targeted Anglers	61	183	18	479	350	1,090
Targeted Effort (angler hours)	5,796	5,327	2,628	9,789	2,124	25,663
Targeted Effort (rod hours)	5,809	5,327	2,628	10,178	2,124	26,066
All Effort (angler hours)	26,346	76,969	59,747	59,787	35,170	258,019
Targeted CUE	0.062	0.150	0.084	0.434	0.432	0.255
All Anglers CUE	0.022	0.036	0.026	0.080	0.033	0.042
Targeted HUE	0.011	0.034	0.007	0.049	0.165	0.042
All Anglers HUE	0.005	0.004	0.005	0.008	0.010	0.006
Largemouth Bass:						
Catch by All Anglers	204	803	15,090	8,350	271	24,718
Catch by Targeted Anglers	-	-	14,604	8,215	271	23,090
Harvest by All Anglers	0	0	5,925	2,860	257	9,042
Harvest by Targeted Anglers	-	-	5,840	2,847	257	8,943
Targeted Effort (angler hours)	-	-	27,689	19,900	3,052	50,641
Targeted Effort (rod hours)	-	-	27,687	19,888	3,052	50,628
All Effort (angler hours)	26,346	76,969	59,747	59,787	35,170	258,019
Targeted CUE	-	-	0.527	0.413	0.089	0.456
All Anglers CUE	0.008	0.010	0.253	0.140	0.008	0.096
Targeted HUE	-	-	0.211	0.143	0.084	0.177
All Anglers HUE	0.000	0.000	0.099	0.048	0.007	0.035

TABLE 2.2.4. Bay of Quinte - Eastern Lake Ontario, 1957-2019, open-water recreational fishery statistics including angling effort (angler hours), both for all anglers and targeted Walleye anglers, Walleye catch and harvest rates (number of fish per hour), Walleye catch and harvest (number of fish), and the mean weight (kg) of harvested Walleye.

	All Anglers, Total Effort	Walleye Anglers					
		Effort	Catch Rate (CUE)	Harvest Rate (HUE)	Catch	Harvest	Mean Weight (kg)
1957		128,040		0.299		38,318	0.638
1958		105,219		0.155		16,274	0.818
1959		67,000		0.254		17,037	0.963
1960						10,467	0.939
1961						22,117	0.596
1962						9,767	0.795
1963						2,466	1.422
1976		64,096		0.064		4,089	
1979		114,637		0.132		15,133	0.631
1980		321,388		0.598		192,305	0.464
1981		319,401		0.508		162,140	0.741
1982		382,306		0.236		90,182	1.030
1984		451,581		0.227		102,379	0.912
1985		442,717		0.263		116,415	0.859
1986		554,213		0.232		128,341	0.933
1987		589,163		0.172		101,092	0.756
1988		518,404	0.411	0.231	213,144	119,608	0.785
1989		466,008	0.512	0.290	238,549	135,151	0.760
1990		385,656	0.497	0.263	191,496	101,422	0.710
1991		634,101	0.543	0.302	344,156	191,785	0.789
1992		571,079	0.407	0.236	232,179	135,040	0.952
1993	644,477	637,401	0.417	0.227	265,551	144,476	0.912
1994	693,731	689,543	0.378	0.209	260,805	144,449	0.763
1995	519,276	512,054	0.320	0.189	163,875	96,631	0.710
1996	665,436	660,005	0.317	0.179	209,303	117,999	0.781
1997	544,476	539,276	0.250	0.154	134,672	82,821	0.747
1998	481,553	475,678	0.148	0.111	70,489	52,810	0.670
1999	379,012	374,128	0.127	0.090	47,562	33,575	0.958
2000	309,259	296,841	0.094	0.077	28,004	22,791	0.939
2001	247,537	222,052	0.182	0.126	40,512	28,037	0.916
2002	177,092	154,570	0.186	0.113	28,813	17,480	0.915
2003	219,684	194,169	0.344	0.178	66,706	34,543	0.637
2004	241,700	203,082	0.193	0.119	39,155	24,260	0.870
2005	225,385	205,933	0.204	0.125	42,031	25,757	0.693
2006	180,907	161,190	0.372	0.225	59,966	36,329	0.700
2008	209,153	201,669	0.187	0.124	37,710	24,929	1.069
2012	235,937	209,040	0.173	0.130	36,208	27,222	1.012
2015	186,081	171,337	0.142	0.091	24,370	15,632	1.399
2017	279,006	219,731	0.461	0.239	101,211	52,460	0.726
2019	258,019	191,519	0.234	0.152	44,793	29,169	0.883

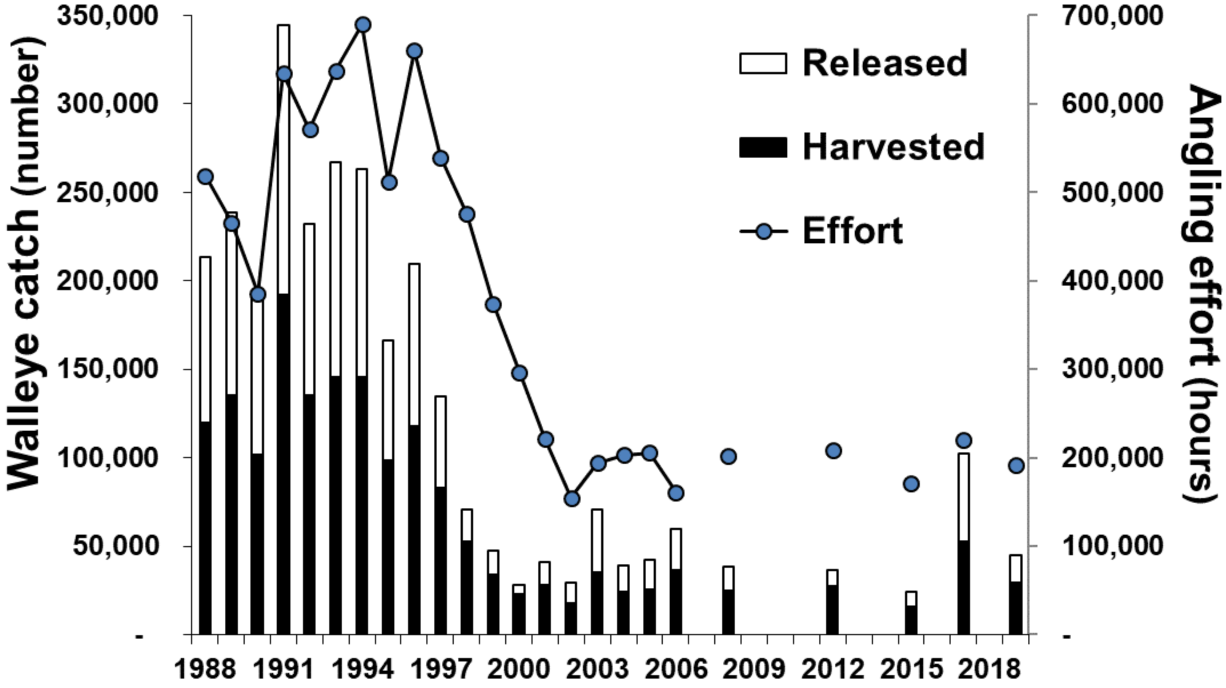


FIG. 2.2.2. Trends in Walleye angling effort and catch (release and harvested), 1988 - 2019 for the open-water recreational fishery on the Bay of Quinte (note 2017 and 2019 include the eastern Lake Ontario region and season 5).

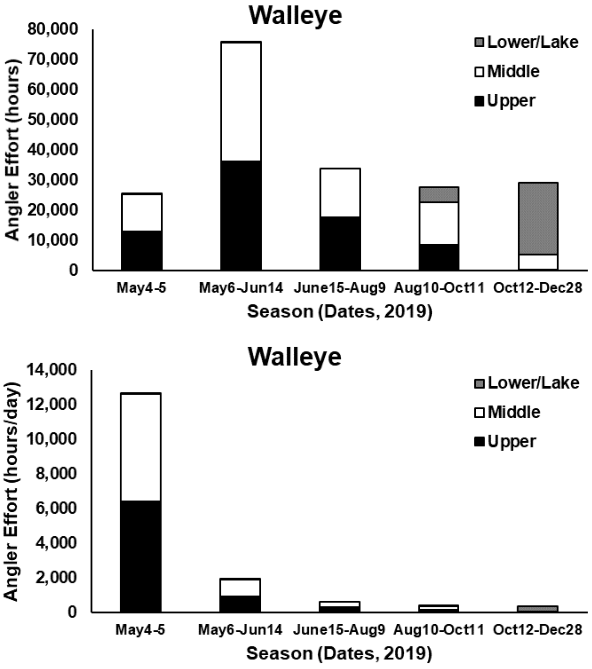


FIG. 2.2.3. Targeted Walleye angling effort (hours, upper panel; hours per day, lower panel) by season and region surveyed in the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019 (regions include the survey areas indicated in Fig. 2.2.1 as follows: Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91; Lower = 88, 89, 90 and Lake = 86, 85, 01, 02, 03; note that Lake areas were only sampled in Season 4).

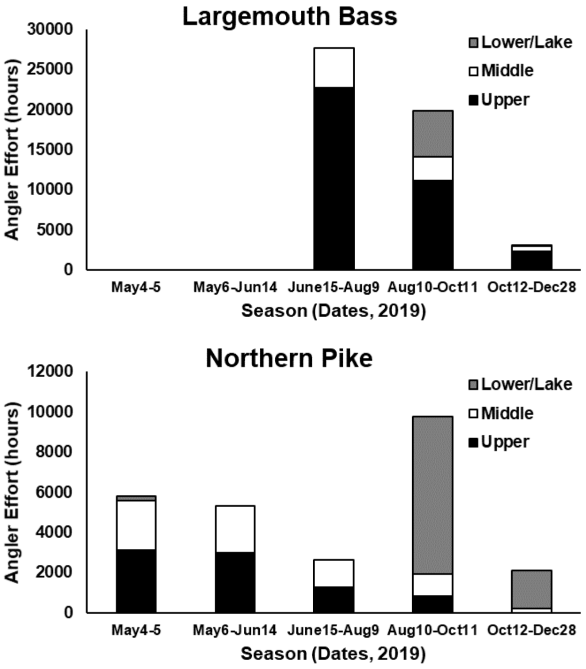


FIG. 2.2.4. Targeted Largemouth Bass (upper panel) and Northern Pike (lower panel) angling effort (hours) by season and region surveyed in the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019 (regions include the survey areas indicated in Fig. 2.2.1 as follows: Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91; Lower = 88, 89, 90 and Lake = 86, 85, 01, 02, 03; note that Lake areas were only sampled in Season 4).

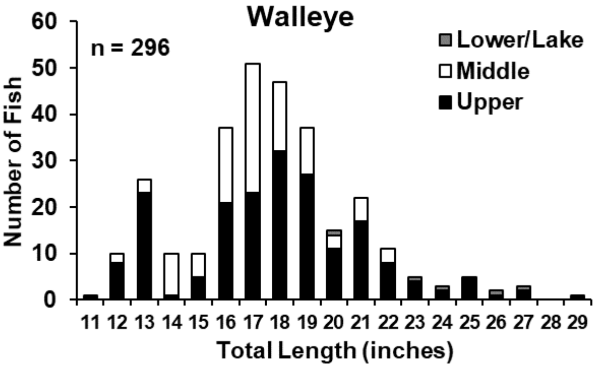


FIG. 2.2.5. Size distribution of Walleye sampled and reported harvested during the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019. Also depicted is the survey areas where the Walleye were sampled. As illustrated in Fig 2.1.1.: Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91; Lower/Lake = 90, 89, 88, 86, 85, 01, 02, 03

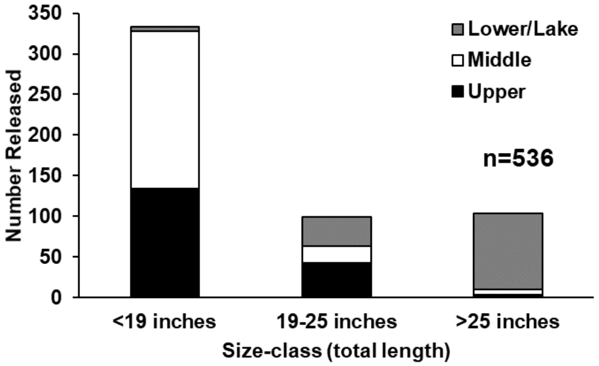


FIG. 2.2.7. Size distribution of Walleye reported to be released by anglers during the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019. Also depicted is the survey areas where the Walleye were sampled. As illustrated in Fig 2.1.1.: Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91; Lower/Lake = 90, 89, 88, 86, 85, 01, 02, 03

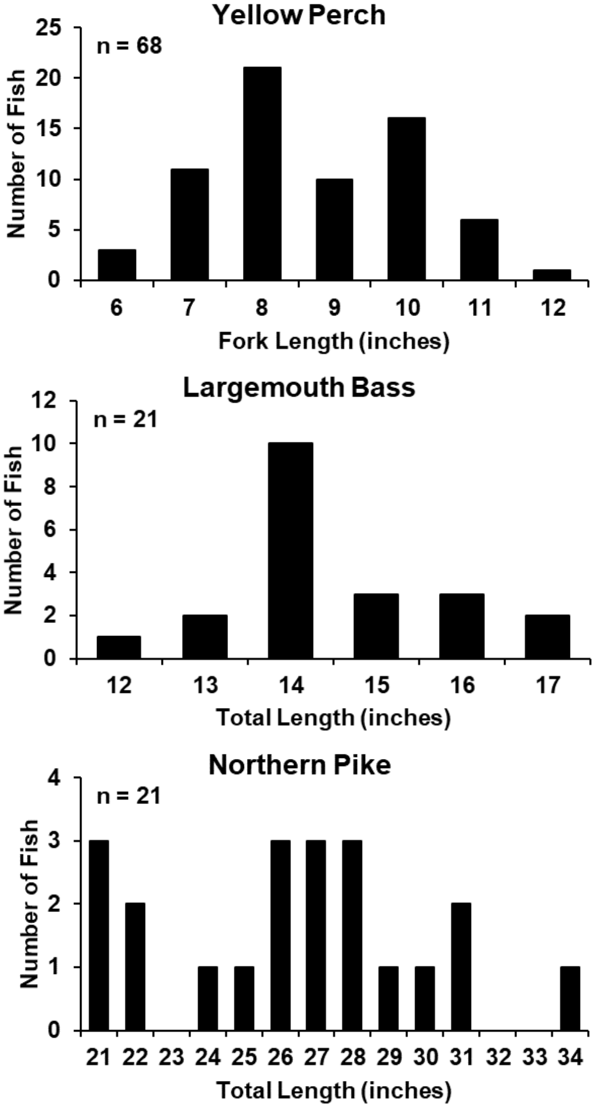


FIG. 2.2.6. Size distribution of Yellow Perch, Largemouth Bass, and Northern Pike sampled during the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019.

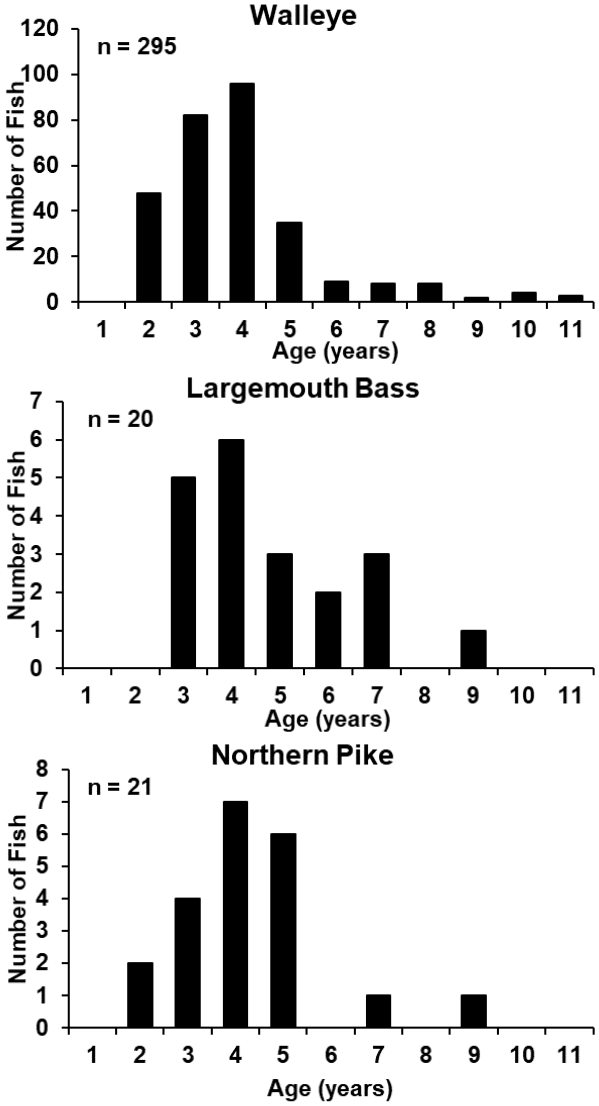


FIG. 2.2.8. Age distribution of Walleye, Largemouth Bass, and Northern Pike sampled during the open-water recreational fishery on the Bay of Quinte - Eastern Lake Ontario, 2019.

2.3 Eastern Lake Ontario Volunteer Walleye Angler Diary Program

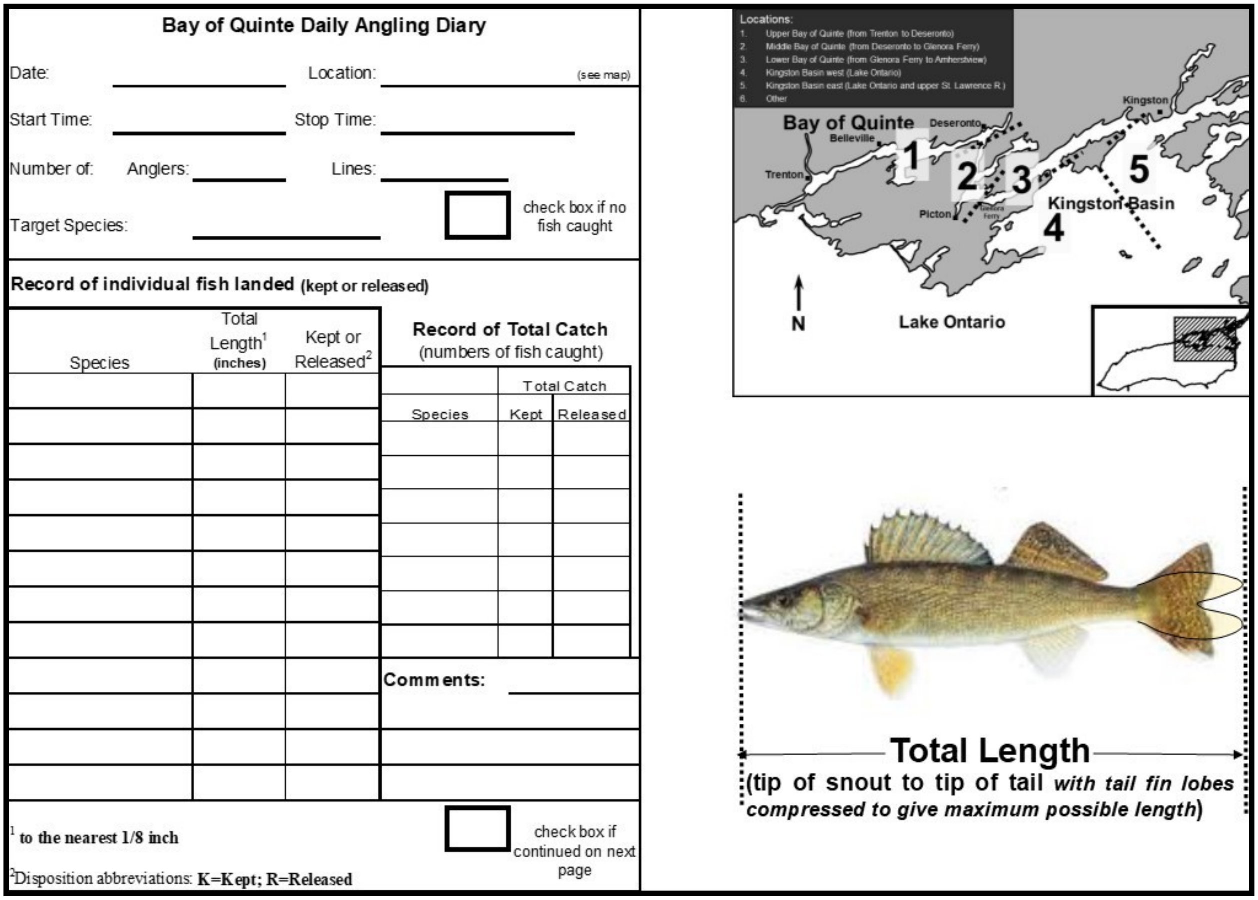
E. Brown, Lake Ontario Management Unit

A volunteer angler diary program was conducted during late-summer and fall 2019 on the Bay of Quinte and Kingston Basin, eastern Lake Ontario. The diary program focused on the popular late-summer and fall recreational fishery for "trophy" Walleye, primarily on the middle and lower reaches of Bay of Quinte. Increasingly in recent years, a late summer fishery for large migratory Walleye occurs in the Kingston Basin of eastern Lake Ontario; this component of the fishery was also targeted for volunteer anglers. This was the eighth year of the diary program. Anglers that volunteered to participate were given a personal diary and asked to record information about their daily fishing trips and catch (see Fig. 2.3.1). A total of 21 completed diaries were returned as of February 2019. We thank all volunteer anglers for participating in the program.

Objectives of the diary program included:

- engage and encourage angler involvement in monitoring the fishery;
- characterize late summer/fall Walleye angling effort, catch, and harvest (including geographic distribution);
- characterize the size distribution of Walleye caught (kept and released);
- characterize species catch composition.

Only fishing trips targeting walleye were examined. The number of fishing trips reported in each of the 21 diaries ranged from one to 23 trips. Fishing trips were reported for 83 out of a possible 147 calendar days from Aug 3 to Dec 28, 2019. One fishing trip occurred in Jan 2, 2020. There were from one to eight volunteer angler



Bay of Quinte Daily Angling Diary

Date: ____________ Location: ____________ (see map)

Start Time: ____________ Stop Time: ____________

Number of: Anglers: ________ Lines: ________

Target Species: ____________

☐ check box if no fish caught

Record of individual fish landed (kept or released)

Species	Total Length[1] (inches)	Kept or Released[2]

Record of Total Catch
(numbers of fish caught)

	Total Catch	
Species	Kept	Released

Comments: ____________

[1] to the nearest 1/8 inch

[2] Disposition abbreviations: **K=Kept; R=Released**

☐ check box if continued on next page

Locations:
1. Upper Bay of Quinte (from Trenton to Deseronto)
2. Middle Bay of Quinte (from Deseronto to Glenora Ferry)
3. Lower Bay of Quinte (from Glenora Ferry to Amherstview)
4. Kingston Basin west (Lake Ontario)
5. Kingston Basin east (Lake Ontario and upper St. Lawrence R.)
6. Other

FIG. 2.3.1. Volunteer angler diary used to record information about daily fishing trips and catch.

boats fishing on each of the 83 days, and a total of 162 trip reports targeted at Walleye; 8 charter boat trips and 154 non-charter boat trips (Table 2.3.1). Of the 162 trips, 123 (76%) were made on Locations 2 and 3 (middle and lower reaches of the Bay of Quinte), and 30 trips (19%) were made in Locations 4 and 5 (Kingston Basin, eastern Lake Ontario; see Fig. 2.3.1). The overall average fishing trip duration was 7.1 hours for charter boats and 5.7 hours for non-charter boats, and the average numbers of anglers per boat trip were 5.6 and 2.3 for charter and non-charter boats, respectively (Table 2.3.1). In Locations 3, 4 and 5, where two lines are permitted, most anglers used two lines.

Fishing Effort

A total of 2,383 angler hours of fishing effort was reported by volunteer anglers (Table 2.3.2). The seasonal pattern of fishing effort is shown in Fig. 2.3.2. Highest fishing effort occurred in November. Most fishing effort occurred in Location 3 (46%; lower Bay) (Fig. 2.3.3). Locations 4 and 5 (Kingston Basin, eastern Lake Ontario) accounted for 19% of the total fishing effort.

Catch

Thirteen species and a total of 727 fish were reported caught by volunteer anglers. The number of Walleye caught was 489; 199 (41%) kept and 290 (59%) released (Table 2.3.3). The next most abundant species caught was Freshwater Drum (74) followed by Yellow Perch (72), White Bass (49), Northern Pike (12), Smallmouth Bass (11), and White Perch (9).

Fishing Success

The overall fishing success for Walleye in fall 2019 was 3.0 Walleye per boat trip or 0.240 fish per angler hour of fishing (Table 2.3.2). Seventy-three percent of all boat trips reported catching at least one Walleye ("skunk rate" 27%). Seasonal fishing success, for geographic Locations 2, 3 and 4 combined, is shown in Fig. 2.3.4. Success was high in the first part of August and in late November and December. Success was low in the first part of October, but higher than normal in late October.

TABLE 2.3.1. Reported total number of boat trips, average trip duration, and average number of anglers per trip for charter and non-charter Walleye fishing trips during late summer and fall 2012-2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario.

Year	Trip type	Total number of boat trips	Average trip duration (hours)	Average number of anglers per trip
2012	Charter	121	7.7	4.4
	Non-charter	137	5.6	2.3
2013	Charter	72	7.4	4.0
	Non-charter	83	4.9	2.1
2014	Charter	123	7.4	4.4
	Non-charter	87	5.3	2.3
2015	Charter	118	7.5	4.3
	Non-charter	115	5.2	1.9
2106	Charter	33	7.2	4.7
	Non-charter	62	4.5	1.8
2017	Charter	77	6.2	4.0
	Non-charter	87	6.0	2.0
2018	Charter	25	7.2	4.8
	Non-charter	101	5.3	2.2
2019	Charter	8	7.1	5.6
	Non-charter	154	5.7	2.3

TABLE 2.3.2. Reported total number of diaries (with at least one reported fishing trip), boat trips and effort, total angler effort, total number of Walleye caught, harvested, and released, average number of Walleye caught per boat fishing trip, average number of Walleye caught per boat hour, average number of Walleye caught per angler hour, and the "skunk" rate (percentage of trips with no Walleye catch) for Walleye fishing trips during late summer and fall 2012-2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario.

	Year							
Statistic	2012	2013	2014	2015	2016	2017	2018	2019
Number of diaries	22	19	20	22	11	20	16	21
Number of boat trips	258	155	210	235	93	164	126	162
Boat effort (hours)	1,694	941	1,375	1,506	498	1,001	719	297
Angler effort (hours)	5,915	3,093	5,164	5,266	1,602	3,262	2,143	2,383
Catch	542	574	682	436	184	604	387	489
Harvest	291	307	336	285	112	350	186	199
Released	251	267	346	151	72	254	201	290
Fish per boat trip	2.1	3.7	3.2	1.9	2.0	3.7	3.1	3.0
Fish per boat hour	0.305	0.557	0.463	0.307	0.289	0.601	0.615	0.530
Fish per angler hour	0.102	0.193	0.137	0.138	0.122	0.210	0.279	0.240
"Skunk rate"	36%	19%	27%	34%	44%	24%	25%	27%

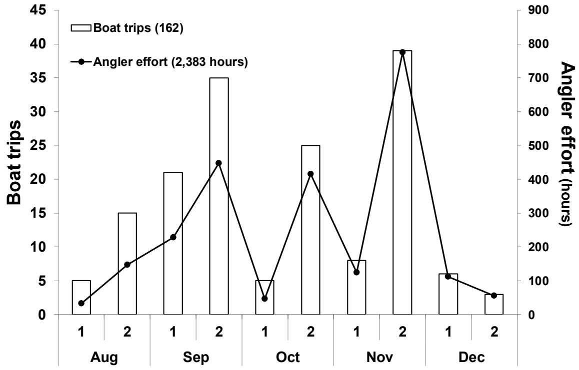


FIG. 2.3.2. Seasonal breakdown (summarized by first and second half of each month from the first half of Jul to the end of Dec) of fishing effort (boat trips and angler hours) reported by volunteer Walleye anglers during 2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario.

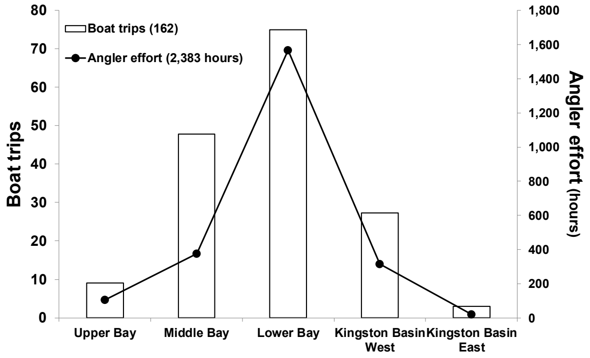


FIG. 2.3.3. Geographic breakdown of fishing effort (boat trips and angler hours) reported by volunteer Walleye anglers during late summer and fall 2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario.

Length Distribution of Walleye Caught

Ninety-six percent of Walleye caught by volunteer anglers were between 16 and 30 inches total length (Fig. 2.3.5). Over the seven years of the volunteer angler diary program 3,279 Walleye lengths have been reported (Fig. 2.3.6). The proportion of Walleye released was highest for smallest and largest fish and lowest for fish of intermediate size. Only 24% of fish caught that were between 16 and 25 inches were released. In contrast, 59% of fish less than 16 inches and 67% of fish greater than 25 inches were released.

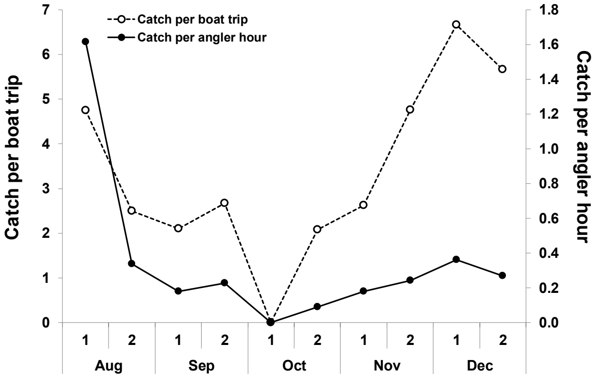


FIG. 2.3.4. Walleye fishing success (catch per boat trip and per angler hour) reported by volunteer Walleye anglers in areas 2, 3 and 4 during late summer and fall 2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario (summarized by first and second half of each month from August to December).

TABLE 2.3.3. Number of fish, by species, reported caught (kept and released) by volunteer anglers during late summer and fall 2012-2019 on the Bay of Quinte - Eastern Lake Ontario.

	2012		2013		2014		2015		2016		2017		2018		2109	
Species	Kept	Released	Kept	Released	Kept	Released	Kept	Released	Kept	Released	Kept	Released	Kept	Released	Kept	Released
Black crappie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Brown trout	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1
Chinook salmon	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Freshwater drum	1	43	0	25	1	53	8	81	0	38	0	58	0	37	0	74
Lake trout	0	1	0	0	0	4	3	10	0	1	1	6	0	0	0	2
Lake whitefish	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Longnose gar	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Morone sp.	1	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tiger Muskellunge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Northern pike	1	47	4	20	2	36	2	14	1	18	1	9	0	19	1	11
Rainbow trout	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Smallmouth bass	0	0	0	3	1	2	0	1	1	1	0	8	0	6	1	10
Sunfish	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0
Walleye	292	252	307	267	338	350	285	151	112	72	350	254	186	201	199	290
White bass	0	0	0	3	0	7	9	5	0	5	6	8	5	6	5	44
White perch	0	0	0	12	0	0	1	0	0	11	0	0	0	2	0	9
Yellow perch	4	32	2	6	0	0	1	0	0	0	0	0	0	1	8	64

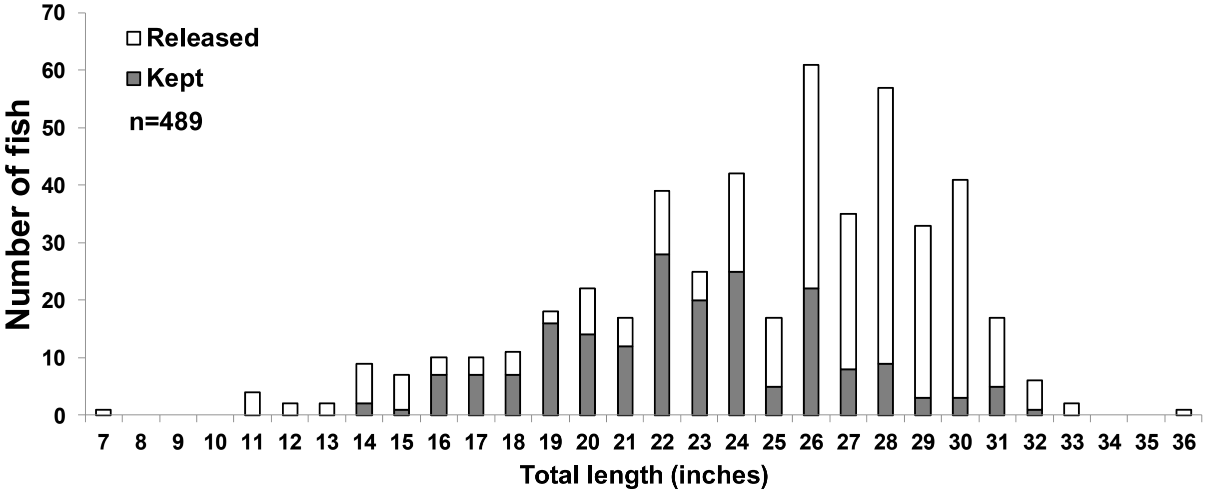


FIG. 2.3.5. Length distribution of 489 Walleye caught (kept and released) by volunteer Walleye anglers during late summer and fall 2018 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario.

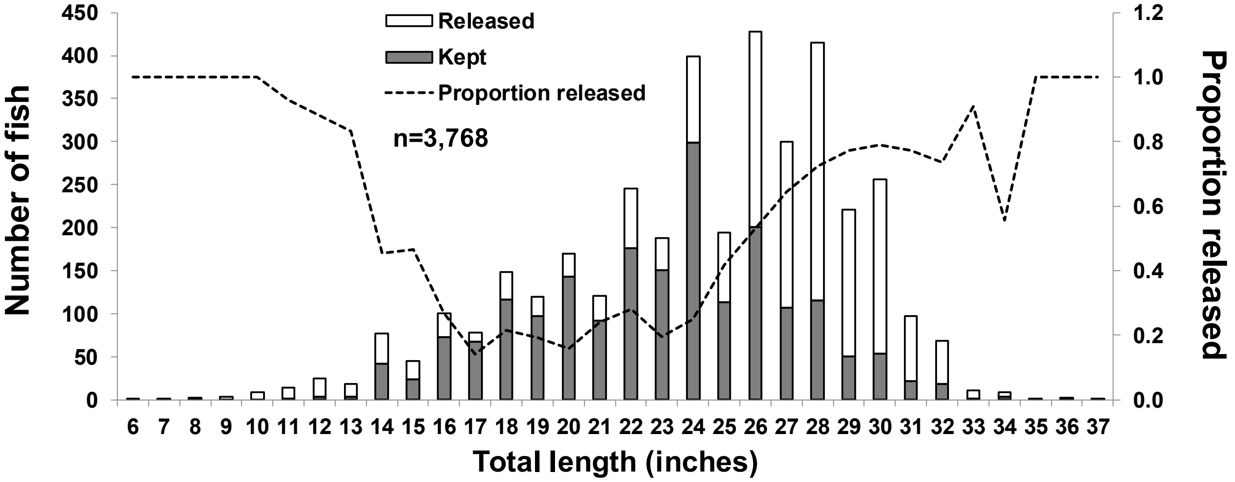


FIG. 2.3.6. Length distribution of 3,768 Walleye caught (kept and released) by volunteer Walleye anglers during late summer and fall 2012-2019 on the Bay of Quinte and the Kingston Basin, eastern Lake Ontario. Also shown is the proportion of fish released (dotted line)

2.4 Western Lake Ontario Boat Angling Fishery

M. J. Yuille, Lake Ontario Management Unit

Stocking of Coho Salmon and Chinook Salmon by New York State and Ontario in the lake 1960s created an angling fishery for salmon and trout in Lake Ontario. Rainbow Trout, Atlantic Salmon, Brown Trout and Lake Trout were lake stocked (see Section 6 and 7) creating a world-class fishery. Significant natural reproduction of Rainbow Trout and Chinook Salmon has further added to the quality of angling in Lake Ontario. OMNRF has surveyed this fishery in most years since 1977. This survey provides the only statistics for this fishery in Ontario waters and is the primary source for biological monitoring of salmon and trout in the Ontario waters of Lake Ontario. We have relied on catch rates to index the abundance of these salmon and trout populations. Moreover, this survey has provided a broad geographic and seasonal array of biological samples.

This fishery was monitored at boat launch ramps during April to the end of August from the Niagara River to Wellington (Fig. 2.4.1). The survey was temporally and spatially stratified by month and sectors (respectively, Fig. 2.4.1). Catch, harvest and effort information were obtained through angler interviews at selected high-effort ramps (one in each sector) after fishing trips were completed. Fishing effort was monitored by counting boat trailers at all ramps on a weekly basis. We limited interviews to the Niagara and Hamilton sectors in April and May, as past surveys indicated effort was sparse elsewhere during these months. Anglers were surveyed in all sectors from June through to the end of August. Fishery statistics for marina-based anglers were estimated based on the 2011 marina-based fishery scaled to the 2019 ramp-based fishery.

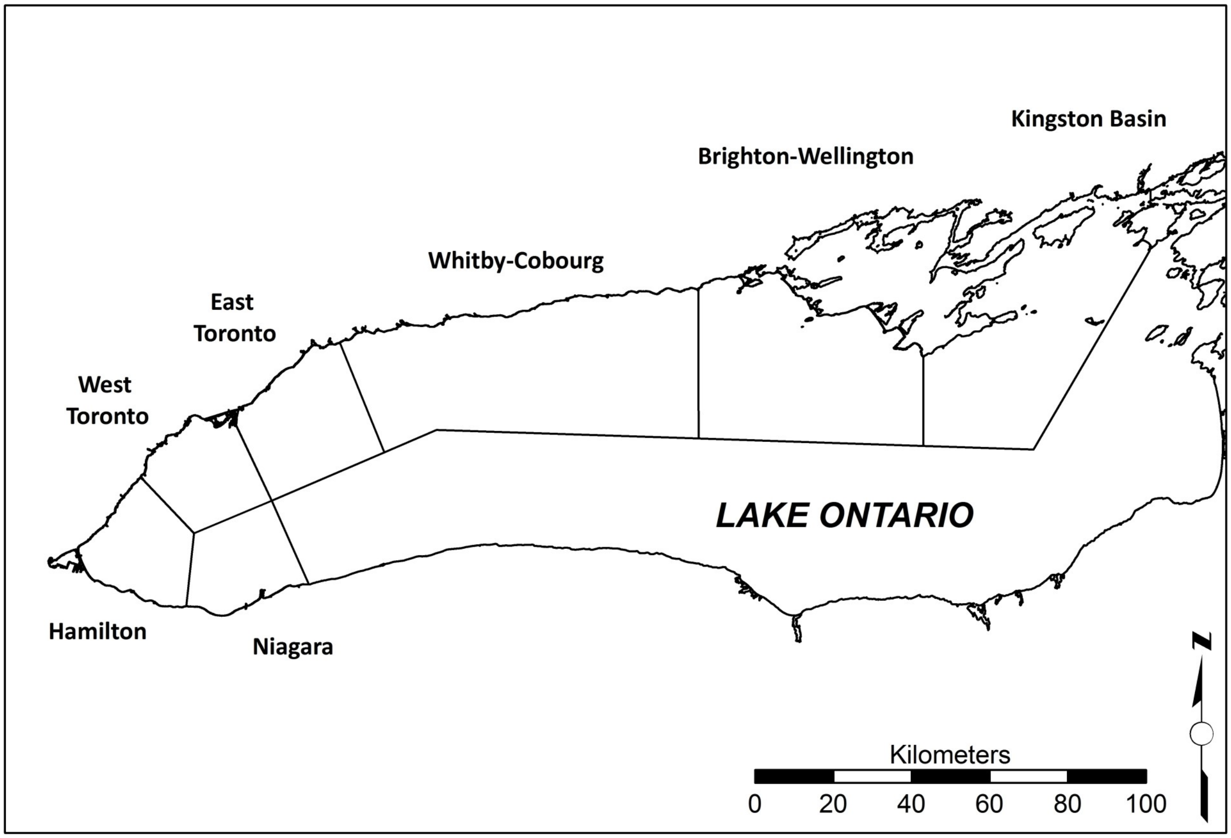


FIG. 2.4.1. Spatial stratification of OMNRF Western Lake Ontario Angler Survey. Kingston Basin was not surveyed in 2019.

Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario for 1977 to 2019 are provided in Table 2.4.1. Angling effort in 2019 (265, 235 angler-hrs; Fig. 2.4.2) a decrease of approximately 100,000 angler-hrs in 2016 (Fig. 2.4.2). Catches of Chinook Salmon in 2019 were comparable to 2016, while catches of the other salmon and trout species increased (Table 2.4.1). Chinook Salmon represented the highest total catch (43,187), followed by Rainbow Trout (21,674) and Coho Salmon (15,183). Together they represented about 88% of the total catch of all salmon and trout species. In 2019, 98% of interviewed anglers were targeting salmon and trout. Of those anglers, anglers primarily targeted Chinook Salmon (69%), followed by Rainbow Trout (26%) and Coho Salmon (18%; Fig. 2.4.4). Catch rates for the time series from 1977-2019 show major shifts in salmon and trout populations and the quality of angling in Lake Ontario (Fig. 2.4.4). In 2019, catch rates for salmon and trout (in total) in Lake Ontario were higher than the previous survey in 2016 (Fig. 2.4.4). Both Chinook Salmon and Rainbow Trout catch rates were higher than the previous survey in 2016 (Fig. 2.4.4).

Of the Chinook Salmon harvested in 2019, 66% were age-3 and age-4 (61% and 5% respectively; Fig. 2.4.5). Since 1995, the average age composition of Chinook harvested has been 22% age-1, 36% age-2, 38% age-3 and 3% age-4.

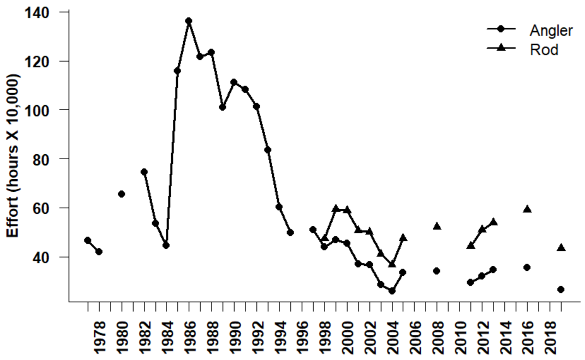


FIG. 2.4.2. Fishing effort (angler hours and rod hours) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2019. Anglers were only allowed to fish with one rod prior to 1998.

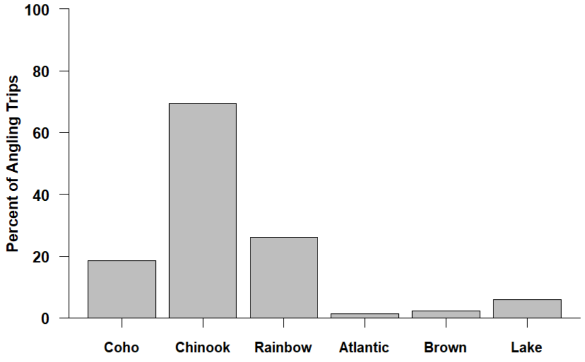


FIG. 2.4.3. The proportion of angling effort (angler hours) for specific salmon and trout species relative to the total estimated angling effort in 2019.

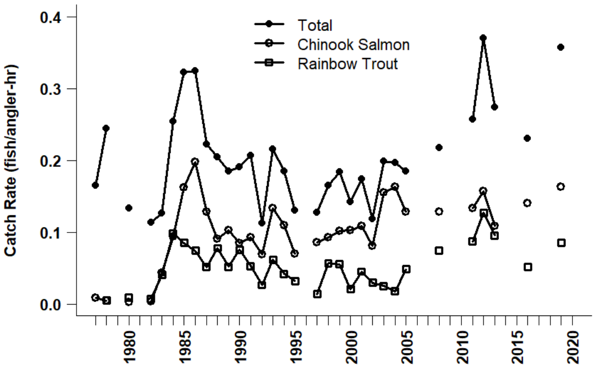


FIG. 2.4.4: The catch rate (number of fish per angler hour) of Chinook Salmon (open circle), Rainbow Trout (open square) and all salmon and trout in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2019.

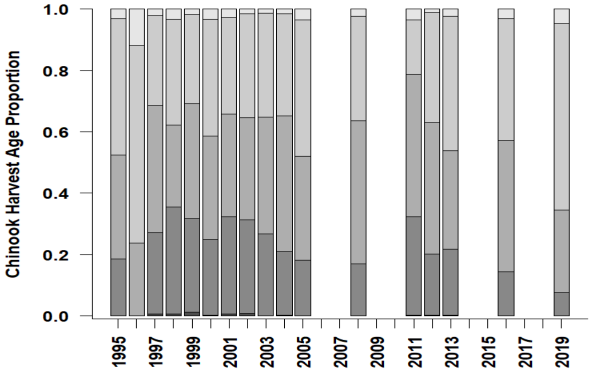


FIG. 2.4.5. Age proportions of harvested Chinook Salmon in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1995 to 2019.

TABLE 2.4.1. Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2019. Anglers were only allowed to fish with one rod prior to 1998.

Year	Catch						Harvest						Effort	
	Chinook Salmon	Rainbow Trout	Coho Salmon	Atlantic Salmon	Brown Trout	Lake Trout	Chinook Salmon	Rainbow Trout	Coho Salmon	Atlantic Salmon	Brown Trout	Lake Trout	Rod-hr	Angler-hr
1977	4,047	NA	72,718	--	NA	NA	3,972	NA	72,586	--	NA	NA	465,137	465,137
1978	1,928	2,109	97,924	--	450	72	1,892	2,096	97,746	--	450	72	418,895	418,895
1980	1,774	5,769	79,326	--	86	317	1,774	5,756	79,129	--	86	273	656,086	656,086
1982	2,730	5,435	74,854	--	129	1,512	2,447	4,126	66,998	--	129	1,172	744,802	744,802
1983	23,303	21,774	16,049	--	1,566	4,627	17,083	17,190	13,546	--	1,190	3,537	534,473	534,473
1984	41,764	43,774	12,867	--	5,224	9,259	32,906	35,627	10,458	--	3,991	6,242	444,448	444,448
1985	187,686	98,471	34,203	3,432	7,032	42,147	125,322	83,530	22,239	569	4,108	25,305	1,157,073	1,157,073
1986	268,877	100,824	43,294	1,843	2,831	24,775	157,675	73,377	29,200	187	1,471	9,013	1,363,082	1,363,082
1987	155,796	62,565	27,380	455	2,905	21,225	108,024	44,977	12,262	124	1,399	8,391	1,215,219	1,215,219
1988	112,289	96,008	27,983	1,382	5,542	9,307	74,606	73,561	16,180	140	3,100	3,012	1,233,013	1,233,013
1989	103,796	52,545	15,082	721	3,029	11,868	71,025	35,230	11,315	491	1,548	3,856	1,010,516	1,010,516
1990	94,786	84,229	15,906	1,628	2,817	12,201	60,701	67,529	10,516	162	1,040	2,832	1,112,047	1,112,047
1991	99,841	57,281	17,643	471	7,151	41,277	66,079	38,712	14,574	68	3,119	6,843	1,082,287	1,082,287
1992	69,959	26,742	3,222	2,516	4,010	7,891	50,182	18,381	1,826	413	1,761	2,997	1,012,822	1,012,822
1993	111,852	51,733	6,845	1,238	2,174	6,332	64,444	28,738	4,643	288	1,208	3,434	836,572	836,572
1994	66,031	25,227	2,254	203	3,983	13,623	38,170	14,382	1,517	129	2,251	5,443	601,325	601,325
1995	34,791	15,998	1,525	168	1,929	10,603	20,387	9,743	765	139	1,068	3,937	498,743	498,743
1997	43,566	7,077	2,777	35	1,003	10,427	23,890	3,979	1,453	19	619	2,113	508,297	508,297
1998	40,723	25,075	3,541	480	1,204	1,831	25,841	16,766	2,257	316	508	540	473,105	440,653
1999	47,899	26,080	3,669	120	953	7,331	27,542	18,616	3,529	30	387	1,114	593,233	469,117
2000	46,612	9,405	2,095	20	1,502	4,638	27,352	5,284	1,228	12	527	857	588,006	453,065
2001	40,140	16,683	2,689	60	1,508	3,008	18,525	10,828	1,596	0	787	387	505,616	369,407
2002	29,699	10,876	1,702	0	555	445	15,054	7,341	1,442	0	247	94	500,372	366,549
2003	44,500	7,176	2,145	24	914	2,216	15,843	4,437	1,763	12	240	528	411,011	286,384
2004	42,298	4,583	1,288	29	570	2,290	17,263	3,570	1,177	5	135	364	366,349	259,584
2005	42,711	16,154	1,254	83	221	1,214	18,601	15,667	694	83	66	75	474,114	333,952
2008	43,584	25,169	2,310	114	1,522	1,397	11,880	20,730	1,843	14	957	38	521,586	340,255
2011	39,172	25,588	7,128	456	1,392	1,756	17,820	16,185	5,078	254	1,159	642	443,548	293,952
2012	50,063	40,603	18,110	340	926	8,004	19,032	26,616	12,419	48	626	585	509,060	319,576
2013	37,413	33,027	8,424	103	1,121	14,477	16,024	23,115	8,773	12	431	532	539,185	345,568
2016	49,779	18,109	5,746	670	388	6,814	24,434	12,271	3,920	457	77	805	591,014	353,945
2019	43,187	21,674	15,183	344	462	9,893	22,810	14,390	11,292	97	89	1,374	432,867	265,235

3. Commercial Fishery

3.1 Lake Ontario and St. Lawrence River Commercial Fishing Liaison Committee

A. Todd, Lake Ontario Management Unit

The Lake Ontario and St. Lawrence River Commercial Fishery Liaison Committee (LOLC) consists of Ontario Commercial Fishing License holders that are appointed to represent each of the quota zones, as well as representatives of the Ontario Commercial Fisheries' Association, and MNRF. This committee provides advice to the Lake Ontario Manager on issues related to management of the commercial fishery and provides a forum for dialogue between the MNRF and the commercial industry.

The Lake Ontario Commercial Fishery Annual General Meeting (CFAGM) was held April 4 in Picton. The CFAGM agenda included a report on the status of commercial fish stocks, updates on administrative procedures, new licenses condition for 2019 to reduce turtle bycatch mortality and an overview of the American Eel trap and transfer program for 2019. The LOLC met twice during 2019 (February 21 and December 9). Topics of discussion at these LOLC meetings included commercial harvest summaries, status of fish stocks (including Yellow Perch, Lake Whitefish, Sunfish, Walleye, and Black Crappie), quotas and "pools", eel status and trap and transfer program and turtle bycatch mitigation.

3.2 Quota and Harvest Summary

E. Brown, Lake Ontario Management Unit

Lake Ontario supports a commercial fish industry; the commercial harvest comes from the Canadian waters of Lake Ontario east of Brighton (including the Bay of Quinte, East and West Lakes) and the St. Lawrence River (Fig. 3.2.1). The waters west of Brighton (quota zone 1-8) currently have no commercial licences. Commercial harvest statistics for 2019 were obtained from the commercial fish harvest information system (CFHIS) which is managed, by MNRF. Commercial quota, harvest and landed value statistics for Lake Ontario, the St. Lawrence River and East and West Lakes, for 2019, are shown in Tables 3.2.1 (base quota), 3.2.2 (issued quota), 3.2.3 (harvest) and 3.2.4 (landed value).

The total harvest (landed value) of all species was 378,272 lb ($528,298) in 2019, up 42,779 lb (13%) from 2018. The harvest (landed value) for Lake Ontario, the St. Lawrence River, and East and West Lakes was 305,824 lb ($438,821), 48,300 lb ($65,458), and 24,148 lb ($24,019), respectively (Fig. 3.2.2 and Fig. 3.2.3). Lake Whitefish, Yellow Perch, Walleye and Freshwater Drum were the dominant species in the harvest for Lake Ontario. Yellow Perch was dominant in the St. Lawrence River. Sunfish was the dominant fish in East and West Lakes.

Major Fishery Trends

Harvest and landed value trends for Lake Ontario (Embayments included) and the St. Lawrence River are shown in Fig. 3.2.4 and Fig. 3.2.5. Having declined in the early 2000s, commercial harvest appeared to have stabilized over the 2003-2013 time-period at about 400,000 lb and 150,000 lb for Lake Ontario (Fig. 3.2.4) and the St. Lawrence River (Fig. 3.2.5) respectively. In 2014, harvest declined again in both major geographic areas. In 2015, harvest

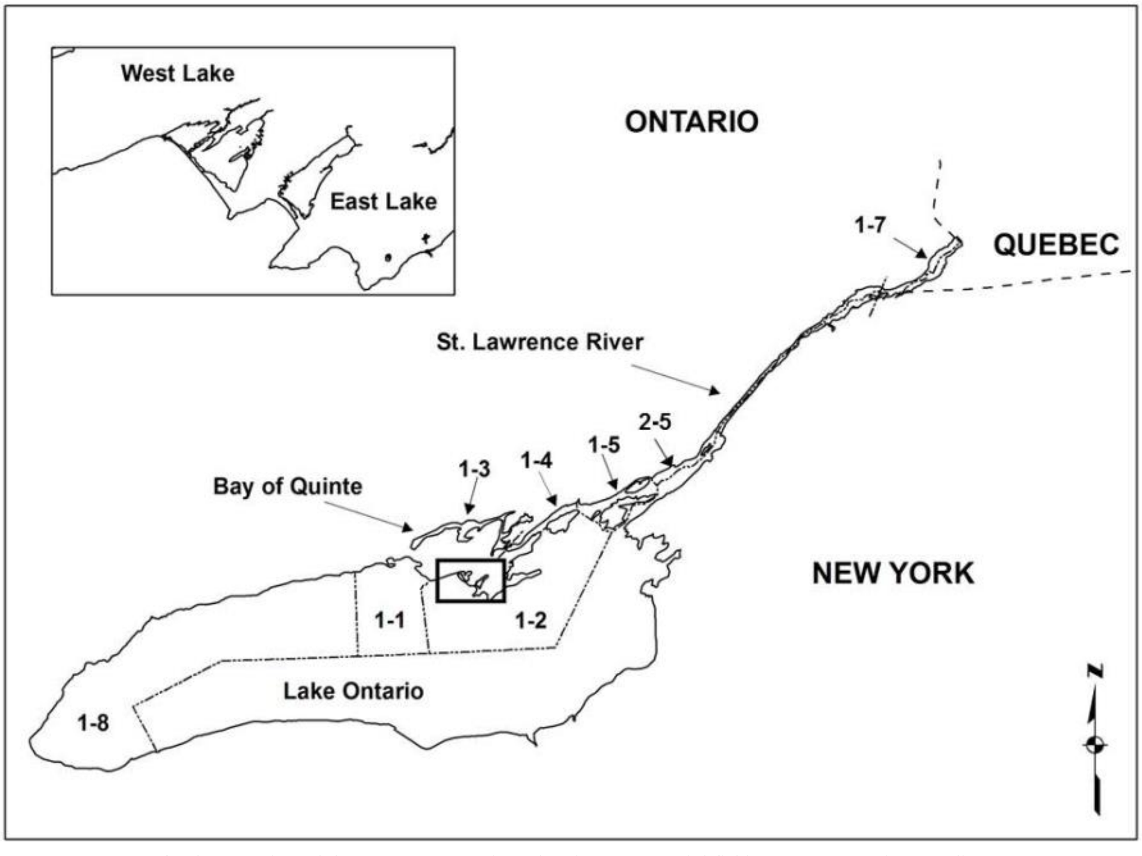


FIG. 3.2.1. Map of Lake Ontario and the St. Lawrence River showing commercial fishing quota zones in Canadian waters.

TABLE 3.2.1. Commercial fish **base quota** (lb), by quota zone, in the Canadian waters of Lake Ontario and the St. Lawrence River, East and West Lakes (two Lake Ontario embayments), 2019.

	Lake Ontario				St. Lawrence River			East Lake	West Lake	Base Quota by Waterbody		
Species	1-1	1-2	1-3	1-4	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	Total
Black Crappie	4,540	3,000	14,823	1,100	14,170	17,590	4,840	3,100	9,850	23,463	36,600	73,013
Lake Whitefish	6,548	97,742	12,307	18,282	0	0	0	0	0	134,879	0	134,879
Sunfish	28,130	0	0	0	0	0	0	14,600	18,080	28,130	0	60,810
Walleye	4,209	32,930	0	10,953	0	0	0	0	0	48,092	0	48,092
Yellow Perch	18,222	73,458	88,816	88,824	51,789	53,001	14,438	896	2,829	269,320	119,228	392,273
Total	61,649	207,130	115,946	119,158	65,959	70,591	19,278	18,596	30,759	503,883	155,828	709,066

TABLE 3.2.2. Commercial fish **issued quota** (lb), by quota zone, in the Canadian waters of Lake Ontario and the St. Lawrence River, East and West Lakes (two Lake Ontario embayments), 2019.

	Lake Ontario				St. Lawrence River			East Lake	West Lake	Issued Quota by Waterbody		
Species	1-1	1-2	1-3	1-4	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	Total
Black Crappie	2,270	1,500	9,406	550	7,085	8,795	4,840	3,100	9,850	13,726	20,720	47,396
Lake Whitefish	2,067	149,234	8,581	8,594	0	0	0	0	0	168,476	0	168,476
Sunfish	28,130	0	0	0	0	0	0	14,600	18,080	28,130	0	60,810
Walleye	1,523	15,864	0	33,703	0	0	0	0	0	51,090	0	51,090
Yellow Perch	11,339	38,266	73,934	57,302	33,740	26,500	14,438	896	2,829	180,840	74,679	259,244
Total	45,329	204,863	91,920	100,150	40,825	35,295	19,278	18,596	30,759	442,261	95,399	587,015

TABLE 3.2.3. Commercial **harvest** (lb), by quota zone, for fish species harvested from the Canadian waters of Lake Ontario and the St. Lawrence River, East and West Lakes (two Lake Ontario embayments), 2019.

	Lake Ontario				St. Lawrence River			East Lake	West Lake	Totals		
Species	1-1	1-2	1-3	1-4	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	All Waterbodies
Black Crappie	27	0	3,516	21	2,261	896	114	13	1,118	3,564	3,271	7,966
Bowfin	0	0	3,456	31	1,552	1,631	334	571	208	3,487	3,517	7,783
Brown Bullhead	19	268	4,611	33	1,689	1,530	9,448	0	179	4,931	12,667	17,777
Common Carp	46	81	1,738	2,080	0	0	0	206	379	3,945	0	4,530
Freshwater Drum	35	499	8,045	15,663	0	0	0	0	0	24,242	0	24,242
Cisco	5	1,079	1,307	965	0	0	0	0	36	3,356	0	3,392
Lake Whitefish	0	100,078	2,500	849	0	0	0	0	0	103,427	0	103,427
Northern Pike	1,148	427	3,421	1,994	421	0	0	652	715	6,990	421	8,778
Rock Bass	1,513	1,020	4,892	804	332	421	144	681	998	8,229	897	10,805
Sunfish	1,600	0	15,206	32	1,191	404	579	3,891	11,094	16,838	2,174	33,997
Walleye	543	3,014	0	23,763	0	0	0	0	0	27,320	0	27,320
White Bass	0	178	92	2,997	0	0	0	0	0	3,267	0	3,267
White Perch	36	306	15,242	6,437	13	0	0	78	2,273	22,021	13	24,385
White Sucker	124	282	9,515	2,244	6	2	0	0	14	12,165	8	12,187
Yellow Perch	1,923	2,868	39,413	17,838	11,036	5,831	8,465	138	904	62,042	25,332	88,416
Total	7,019	110,100	112,954	75,751	18,501	10,715	19,084	6,230	17,918	305,824	48,300	378,272

TABLE 3.2.4. Commercial **harvest (lb), price per lb, and landed value** for fish species harvested from the Canadian waters of Lake Ontario and the St. Lawrence River, and the total for all waterbodies including East and West Lakes, 2019.

	Lake Ontario			St. Lawrence River			All Waterbodies		
Species	Harvest	Price per lb	Landed value	Harvest	Price per lb	Landed value	Harvest	Price per lb	Landed value
Black Crappie	3,564	$3.51	$12,516	3,271	$2.69	$8,799	7,966	$3.21	$25,563
Bowfin	3,487	$0.32	$1,121	3,517	$0.64	$2,249	7,783	$0.51	$3,952
Brown Bullhead	4,931	$0.27	$1,316	12,667	$0.41	$5,236	17,777	$0.37	$6,617
Common Carp	3,945	$0.15	$599	0	$0.00	$0	4,530	$0.15	$687
Freshwater Drum	24,242	$0.10	$2,368	0		$0	24,242	$0.10	$2,368
Cisco	3,356	$0.32	$1,084	0		$0	3,392	$0.32	$1,075
Lake Whitefish	103,427	$1.64	$169,844	0		$0	103,427	$1.64	$169,844
Northern Pike	6,990	$0.35	$2,475	421	$0.40	$168	8,778	$0.34	$3,001
Rock Bass	8,229	$0.64	$5,231	897	$0.64	$570	10,805	$0.63	$6,831
Sunfish	16,838	$1.26	$21,254	2,174	$1.05	$2,289	33,997	$1.21	$41,189
Walleye	27,320	$2.51	$68,684	0		$0	27,320	$2.51	$68,684
White Bass	3,267	$0.61	$1,997	0		$0	3,267	$0.61	$1,997
White Perch	22,021	$0.46	$10,127	13	$0.47	$6	24,385	$0.48	$11,584
White Sucker	12,165	$0.14	$1,678	8	$0.15	$1	12,187	$0.14	$1,680
Yellow Perch	62,042	$2.23	$138,526	25,332	$1.82	$46,139	88,416	$2.07	$183,225
Total	305,824		$438,821	48,300		$65,458	378,272		$528,298

declined in the St. Lawrence River and increased slightly in Lake Ontario. Harvest increased significantly in both areas in 2016 and again in 2017. In 2018, harvest declined in both geographic areas. In 2019, harvest increased in Lake Ontario and decreased in St. Lawrence River.

Major Species

For major species, commercial harvest relative to issued and base quota information, including annual trends, is shown in Fig. 3.2.6 to Fig. 3.2.19. Price-per-lb trends are also shown. Species-specific price-per-lb values are means across quota zones within a major waterbody (i.e., Lake Ontario and the St. Lawrence River).

Yellow Perch

Yellow Perch 2019 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.6. Overall, 23% (88,416 lb) of the Yellow Perch base quota (392,273 lb) was harvested in 2019, down 11% from the previous year. The highest Yellow Perch harvest came from quota zones 1-3 and 1-4. All but one quota zone (1-7) harvested less than 50% of base quota.

Trends in Yellow Perch quota (base), harvest and price-per-lb are shown Fig. 3.2.7. In 2019, quota was reduced 20% in quota zone 1-7 and left unchanged in all other quota zones. Harvest decreased in 2019 in quota zones 1-1, 1-2, 1-4, 1-5, 2-5 and 1-7. Harvest increased in 2019 in quota zones 1-3, East Lake and West Lake (Fig. 3.2.7).

Lake Whitefish

Lake Whitefish 2019 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.8. Overall, 77% (103,427 lb) of the Lake Whitefish base quota was harvested in 2019. Most of the Lake Whitefish harvest came from quota zone 1-2. Lake Whitefish is managed as one population across quota zones. Therefore, quota can be transferred among quota zones. Issued quota and harvest was higher than base quota in quota zone 1-2 (Fig. 3.2.8). Relatively small proportions of base quota were harvested in quota zones 1-1, 1-3 and 1-4.

Trends in Lake Whitefish quota (base), harvest and price-per-lb are shown in Fig. 3.2.9. Base quota remained unchanged in 2019 compared to 2018.

Seasonal whitefish harvest and biological attributes (e.g., size and age structure) information

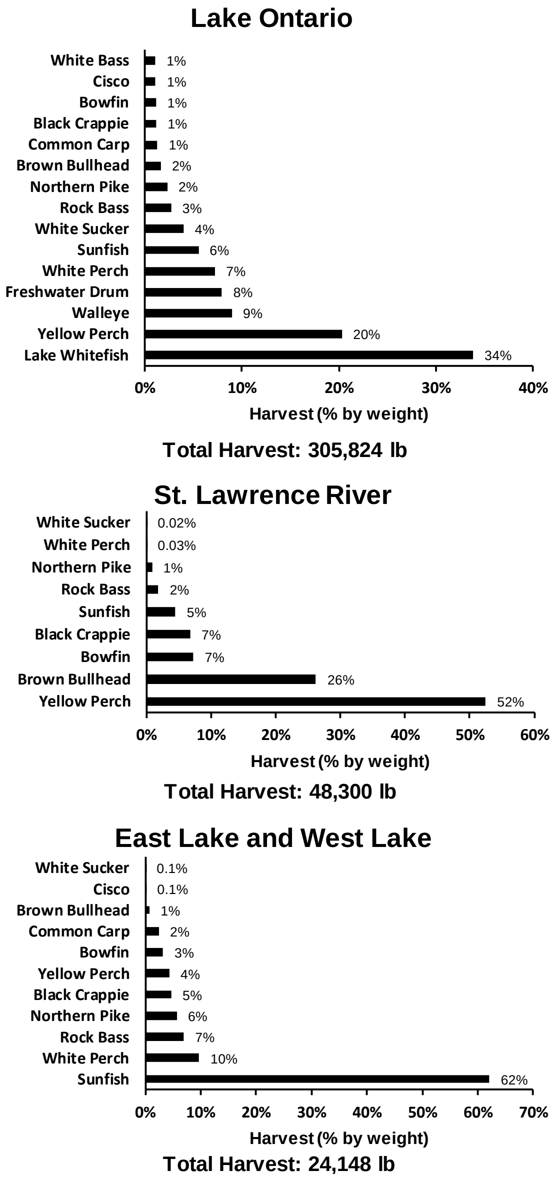


FIG. 3.2.2. Breakdown of 2019 commercial harvest by species (**% by weight**) for Lake Ontario (quota zones 1-1, 1-2, 1-3, 1-4 and 1-8), the St. Lawrence River (quota zones 1-5, 2-5 and 1-7), and for East and West Lakes combined.

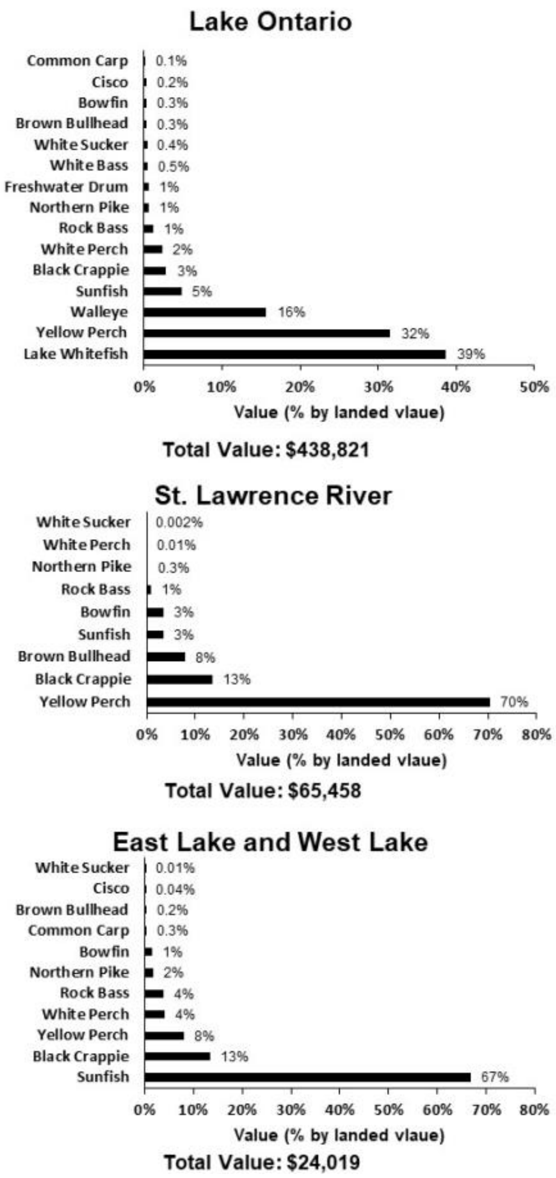


FIG. 3.2.3. Breakdown of 2019 commercial harvest by species (**% by landed value**) for Lake Ontario (quota zones 1-1, 1-2, 1-3, 1-4 and 1-8), the St. Lawrence River (quota zones 1-5, 2-5 and 1-7), and for East and West Lakes combined.

are reported in Section 3.3. Lake Whitefish price-per-lb has been trending up since 2016 with a slight decrease in 2019.

Walleye

Walleye 2019 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.10. Walleye harvest increased slightly in 2019. Overall, 57% (27,320 lb) of the Walleye base quota (48,092 lb) was harvested. The highest Walleye harvest came from quota zone 1-4. Very small proportions of base quota were harvested in quota zones 1-1 and 1-2. Walleye (like Lake Whitefish) is managed as one fish population across quota zones. Therefore, quota can be transferred among quota zones 1-1, 1-2 and 1-4. In 2019, this resulted in issued quota and harvest being considerably higher than base quota in quota zone 1-4 (Fig. 3.2.10).

Trends in Walleye quota (base), harvest and price-per-lb are shown in Fig. 3.2.11. Quota has remained constant since the early 2000s (just under 50,000 lb for all quota zones combined).

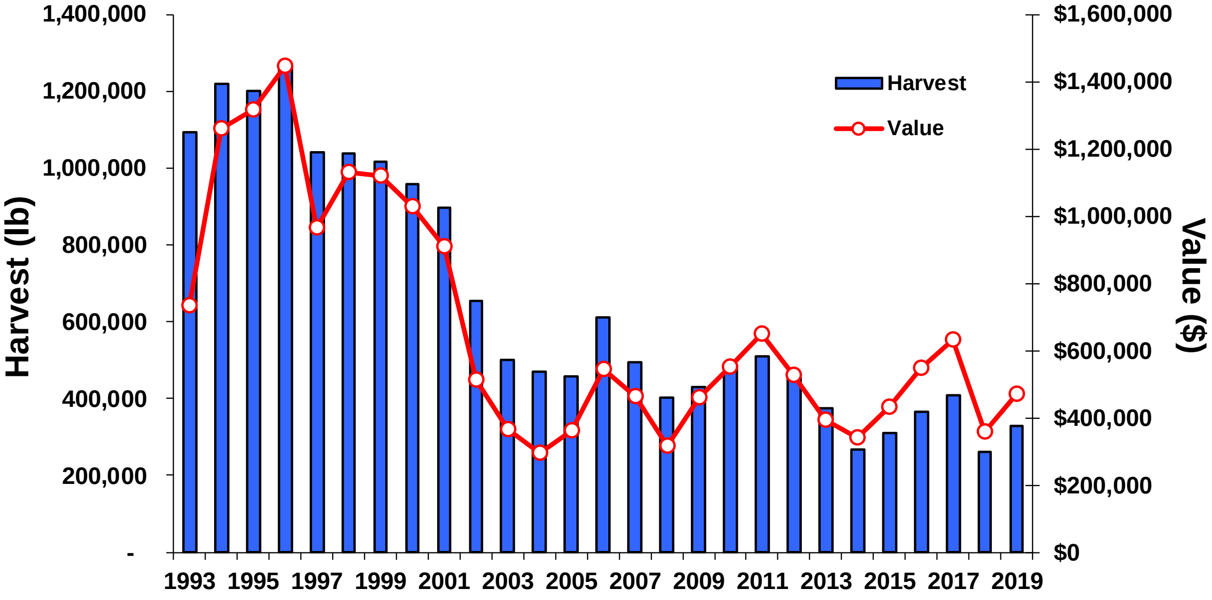


FIG. 3.2.4. Total commercial fishery harvest and value for **Lake Ontario** (Quota Zones 1-1, 1-2, 1-3 ,1-4 and 1-8) and **Embayments** (Quota Zones East Lake and West Lake), 1993-2019 .

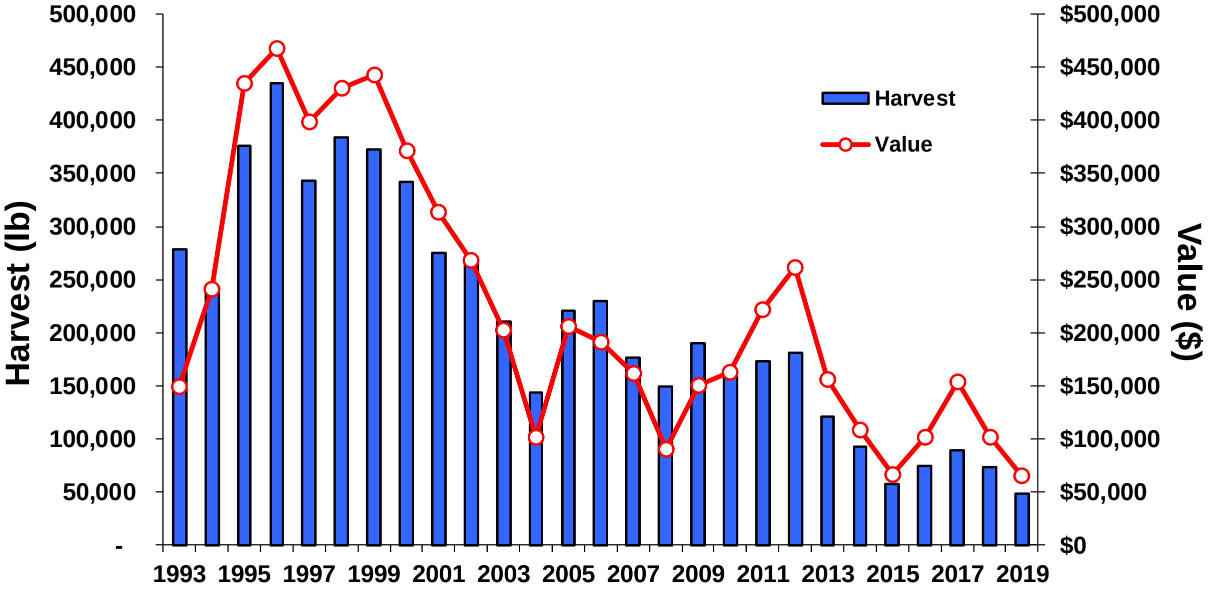


FIG. 3.2.5. Total commercial fishery harvest and value for the **St. Lawrence River** (Quota Zones 1-5, 2-5 and 1-7), 1993-2019.

Walleye price-per-lb has been trending higher for the last number of years.

Black Crappie

Black Crappie 2019 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.12. Overall, only 11% (7,966 lb) of the Black Crappie base quota (73,013) was harvested in 2019. The highest Black Crappie harvest came from quota zones 1-3, 1-5, West Lake and 1-7. Only a very small proportion of base quota was harvested in other quota zones.

Trends in Black Crappie quota (base), harvest and price-per-lb are shown in Fig. 3.2.13. Black Crappie harvest has been trending down in

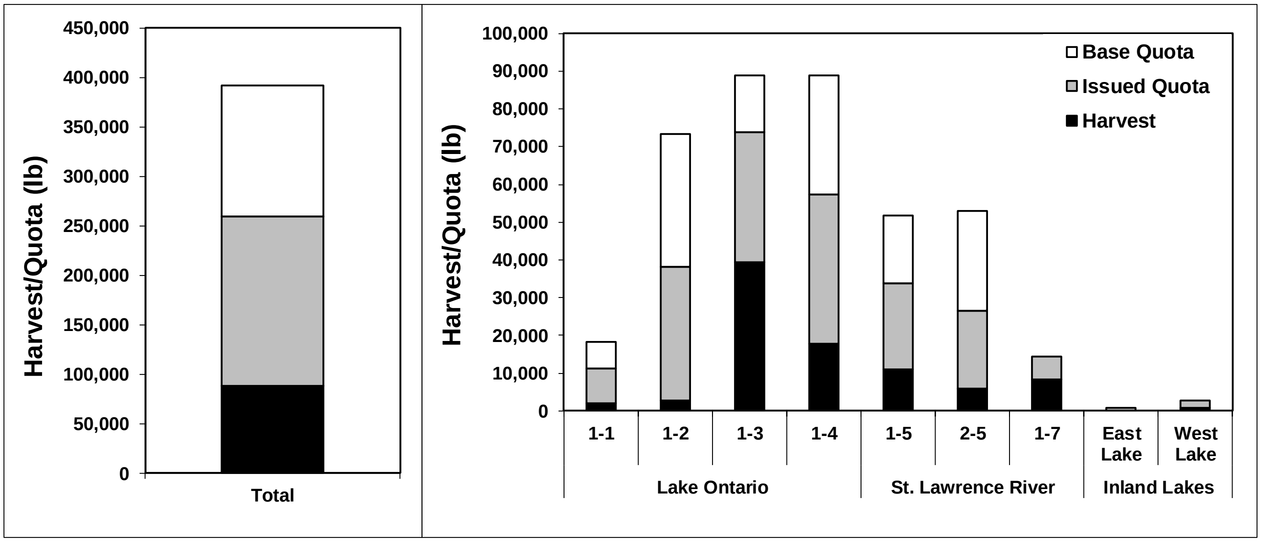


FIG. 3.2.6. **Yellow Perch** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2019.

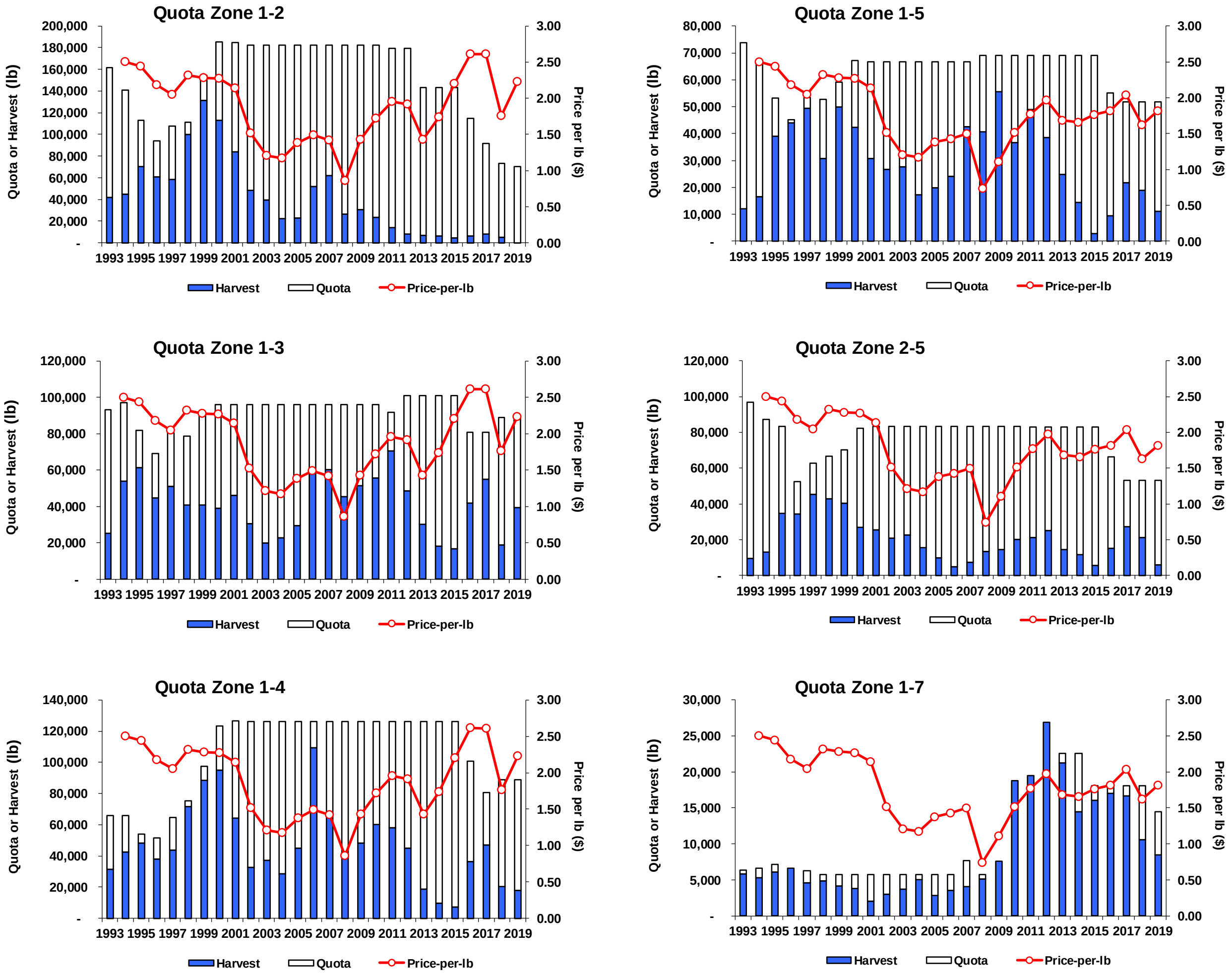


FIG. 3.2.7. Commercial base quota, harvest and price-per-lb for **Yellow Perch** in Quota Zones 1-2, 1-3, 1-4, 1-5, 2-5 and 1-7, 1993-2019.

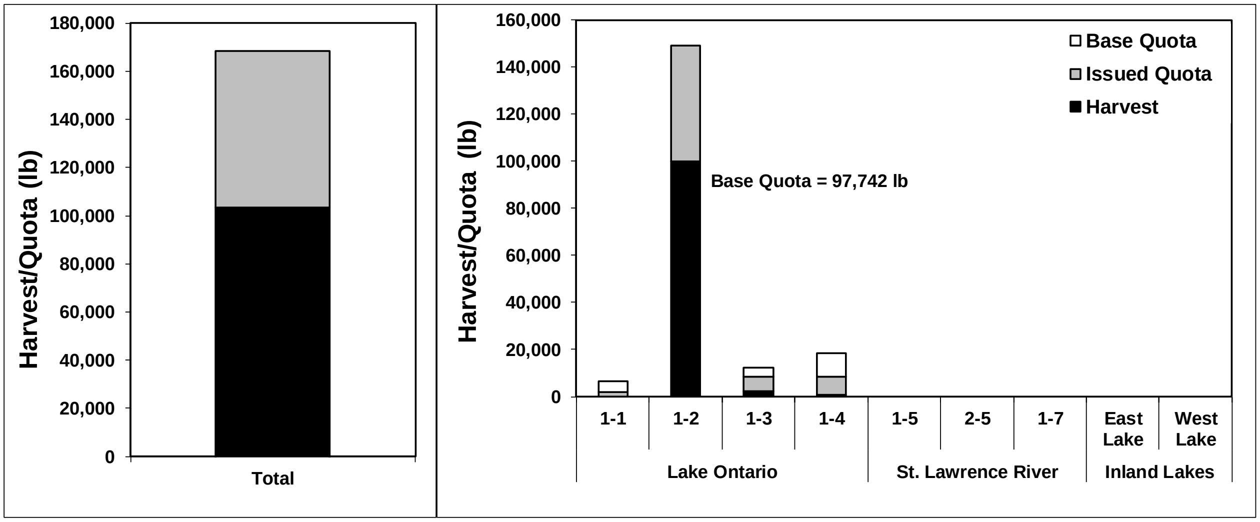


FIG. 3.2.8. **Lake Whitefish** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2019.

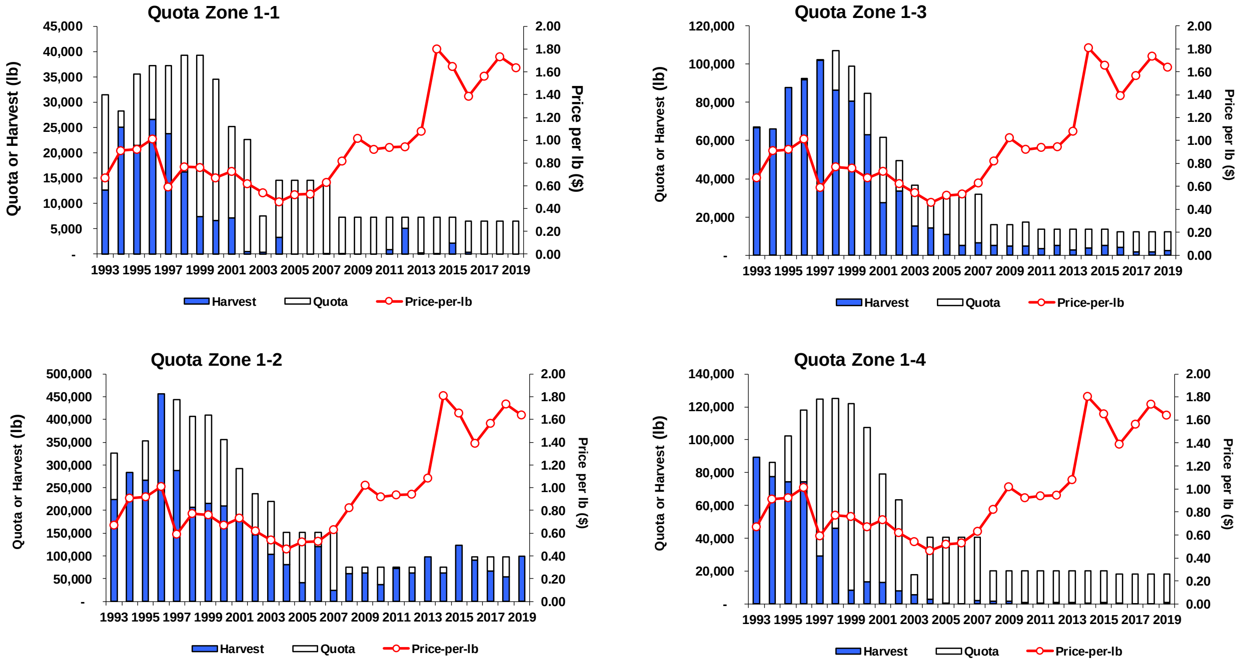


FIG. 3.2.9. Commercial base quota, harvest and price-per-lb for **Lake Whitefish** in Quota Zones 1-1, 1-2, 1-3 and 1-4, 1993-2019.

quota zone 1-3 and West Lake. Price-per-lb is currently high.

Sunfish

Sunfish 2019 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.14. Only quota zones 1-1 (embayment areas only), East Lake and West Lake have quotas for Sunfish; quota is unlimited in the other zones. Most Sunfish harvest comes from quota zone 1-3, East Lake and West Lake.

Trends in Sunfish quota (base), harvest and price-per-lb are shown in Fig. 3.2.15. In 2019, harvest decreased in quota zone 1-3, East Lake and West Lake. Sunfish price-per-lb is currently high and stable.

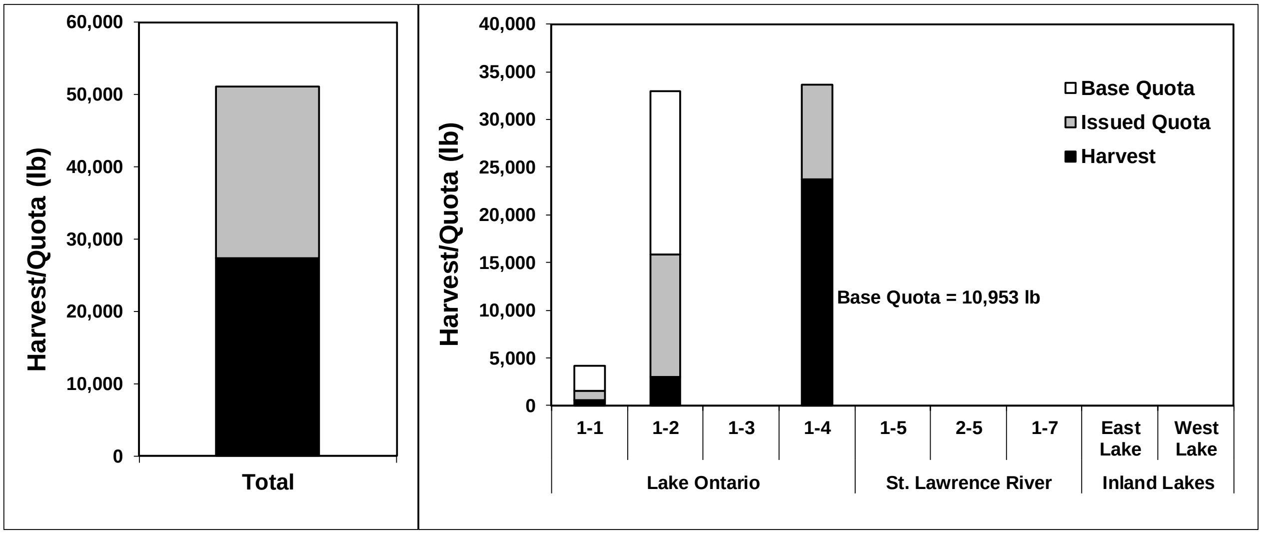


FIG. 3.2.10. **Walleye** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2019.

Brown Bullhead

Brown Bullhead 2019 commercial harvest by quota zone and total for all quota zones combined is shown in Fig. 3.2.16. Quota was removed in quota zones 1-1, East Lake and West Lake in 2016 and is now unlimited in all zones. Highest Brown Bullhead harvest came from quota zones 1-3 and 1-7.

Trends in Brown Bullhead quota (base), harvest and price-per-lb are shown in Fig. 3.2.17. Current harvest levels are extremely low relative to past levels.

Northern Pike

Northern Pike 2019 commercial harvest by quota zone is shown in Fig. 3.2.18. Highest pike harvest came from quota zone 1-3.

Trends in Northern Pike harvest and price-per-lb are shown in Fig. 3.2.19. Harvest remains low as compared to previous years.

Norther Pike is managed as an incidental harvest fishery. In 2018 and 2019, the harvest season was closed from April 1st to the first Saturday in May. Historically, this time period accounted for a significant amount of the annual harvest.

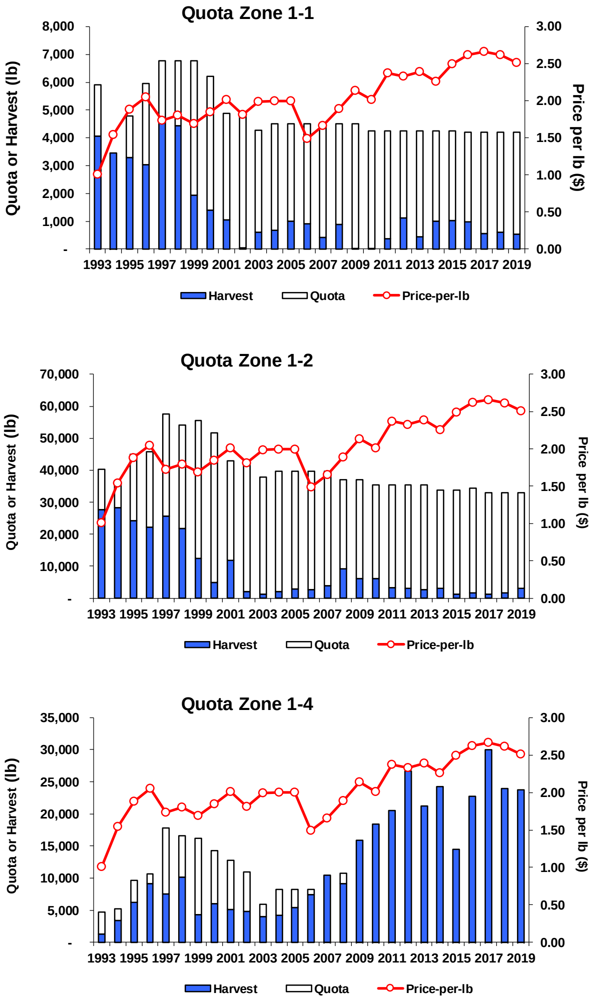


FIG. 3.2.11. Commercial base quota, harvest and price-per-lb for **Walleye** in Quota Zones 1-1, 1-2 and 1-4, 1993-2019.

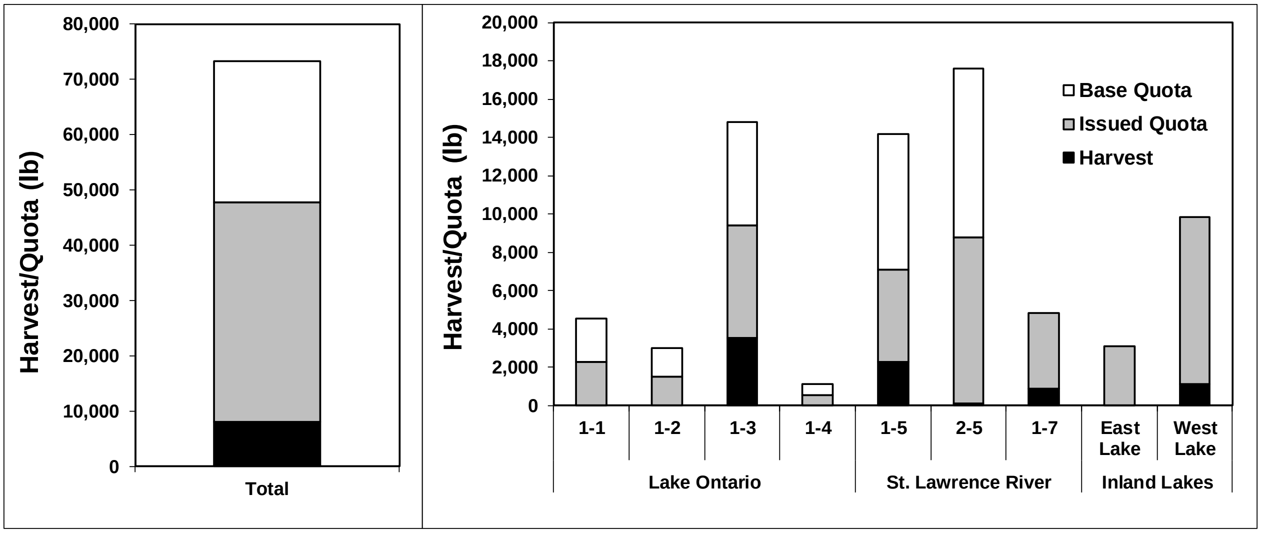


FIG. 3.2.12. **Black Crappie** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2019.

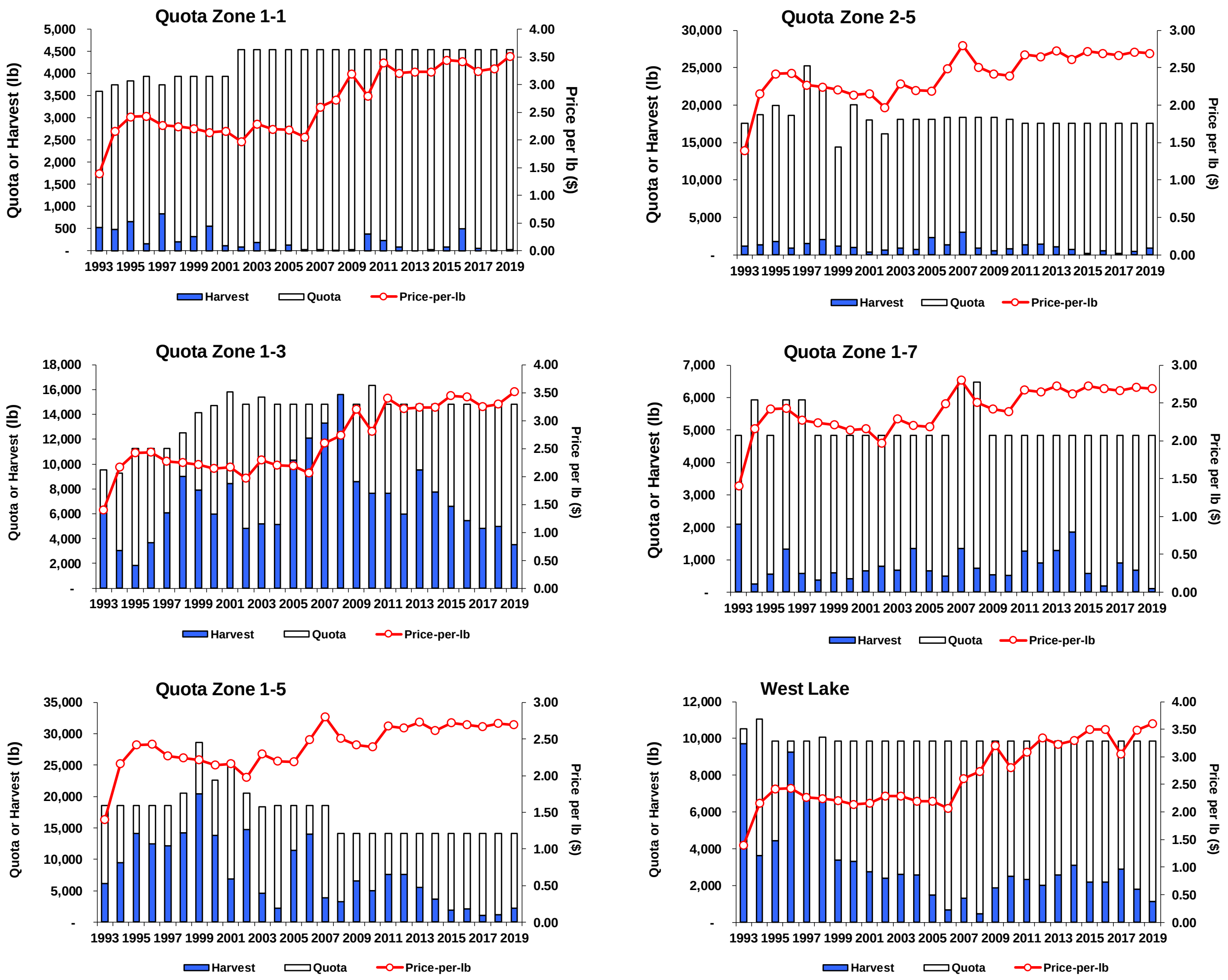


FIG. 3.2.13. Commercial base quota, harvest and price-per-lb for **Black Crappie** in Quota Zones 1-1, 1-3, 1-5, 2-5, 1-7 and West Lake, 1993-2019.

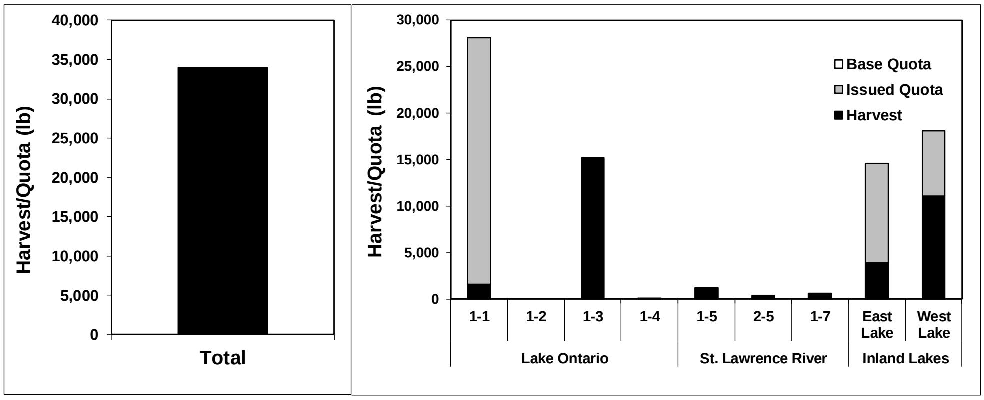


FIG. 3.2.14. **Sunfish** commercial harvest relative to issued and base quota for quota zones 1-1, East Lake and West Lake, 2019. The remaining quota zones have unlimited quota.

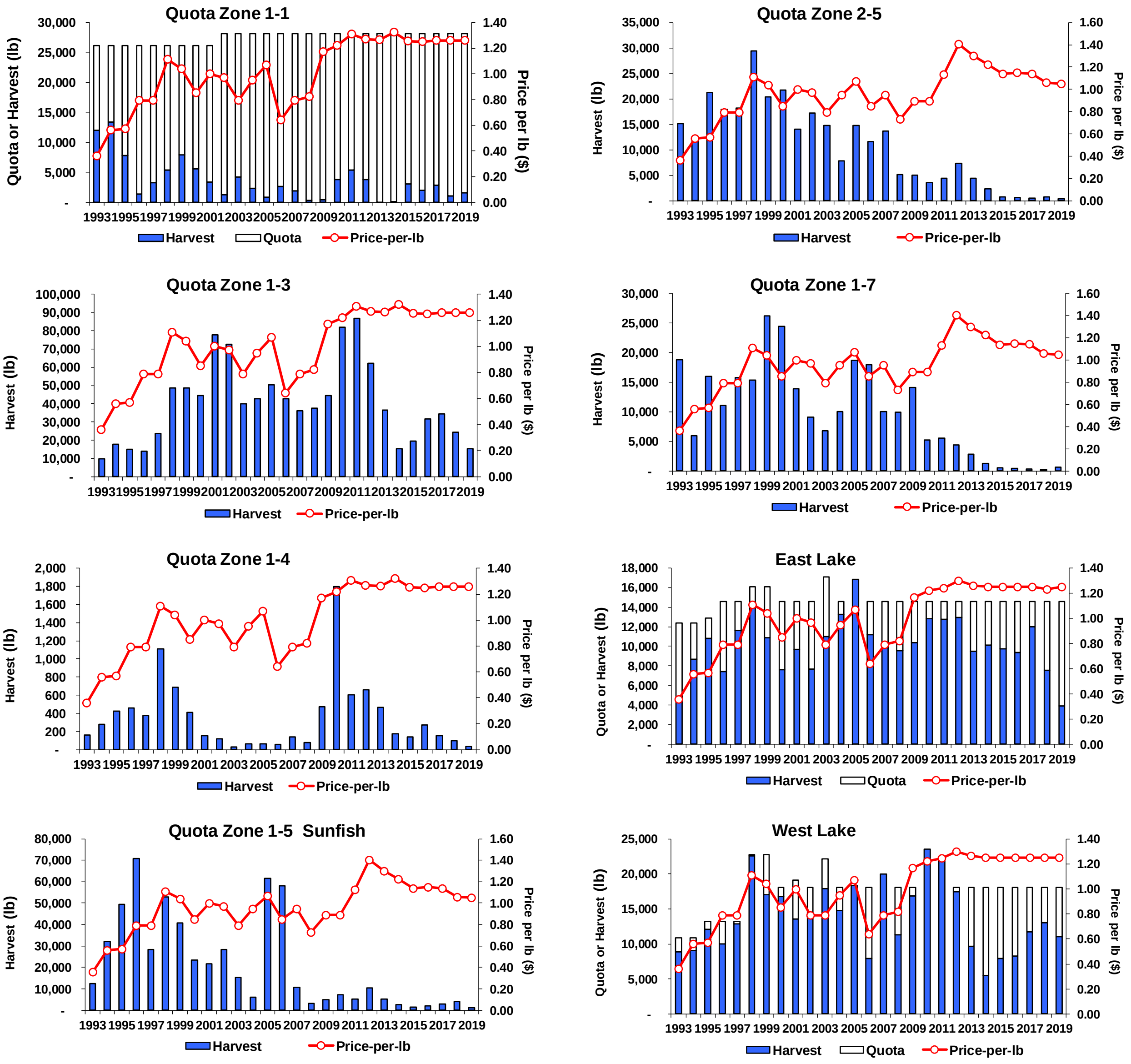


FIG. 3.2.15. Commercial base quota, harvest and price-per-lb for **Sunfish** in Quota Zones 1-1, 1-3, 1-4, 1-5, 2-5 and 1-7, East Lake and West Lake, 1993-2019.

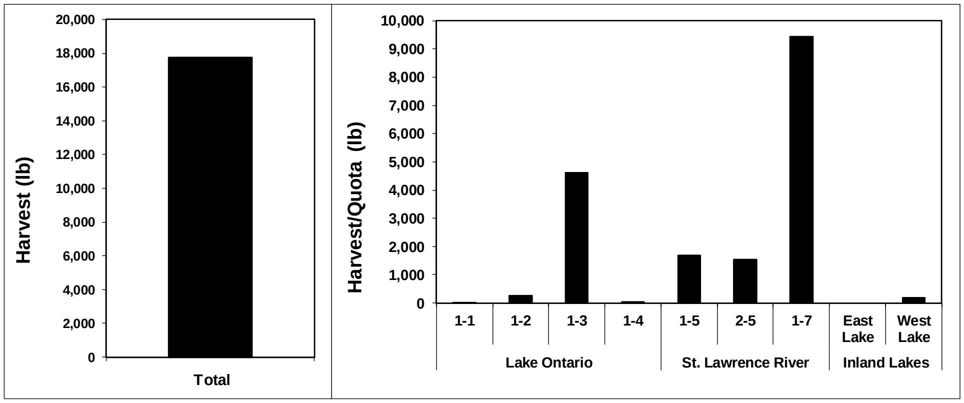


FIG. 3.2.16. **Brown Bullhead** commercial harvest by quota zone, 2019.

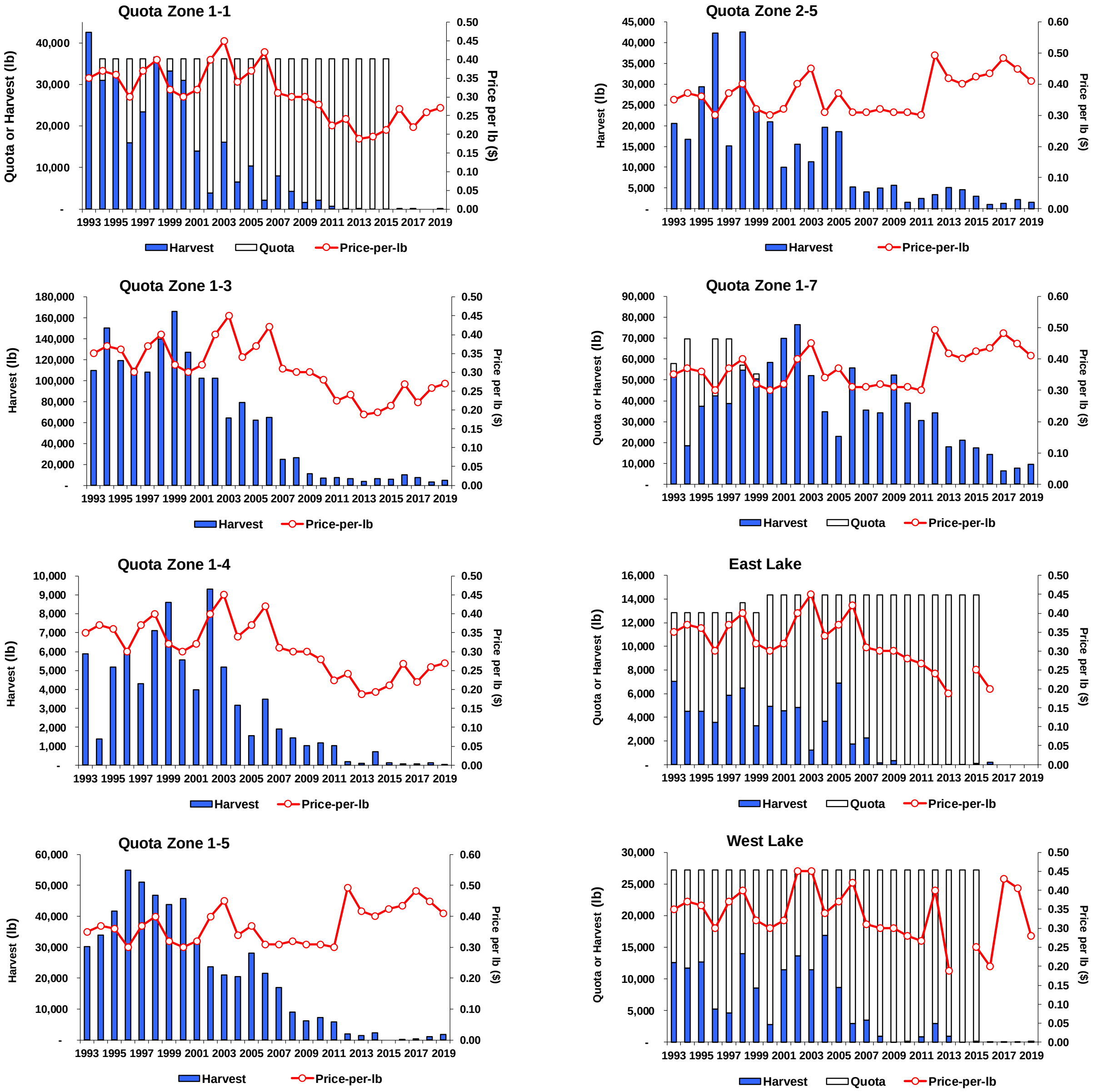


FIG. 3.2.17. Commercial base quota, harvest and price-per-lb for **Brown Bullhead** in Quota Zones 1-1, 1-3, 1-4, 1-5, 2-5 and 1-7, East Lake and West Lake, 1993-2019.

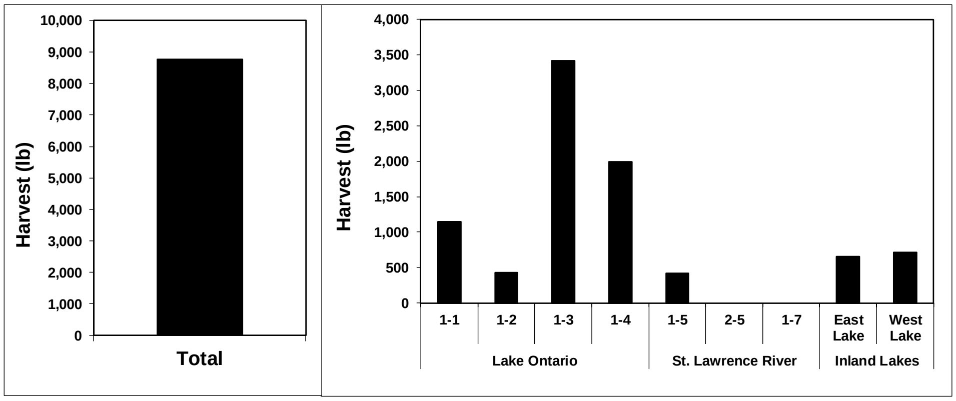


FIG. 3.2.18. **Northern Pike** commercial harvest by quota zone, 2019. In quota zones 2-5 and 1-7 no harvest is permitted; all other zones have unlimited quota.

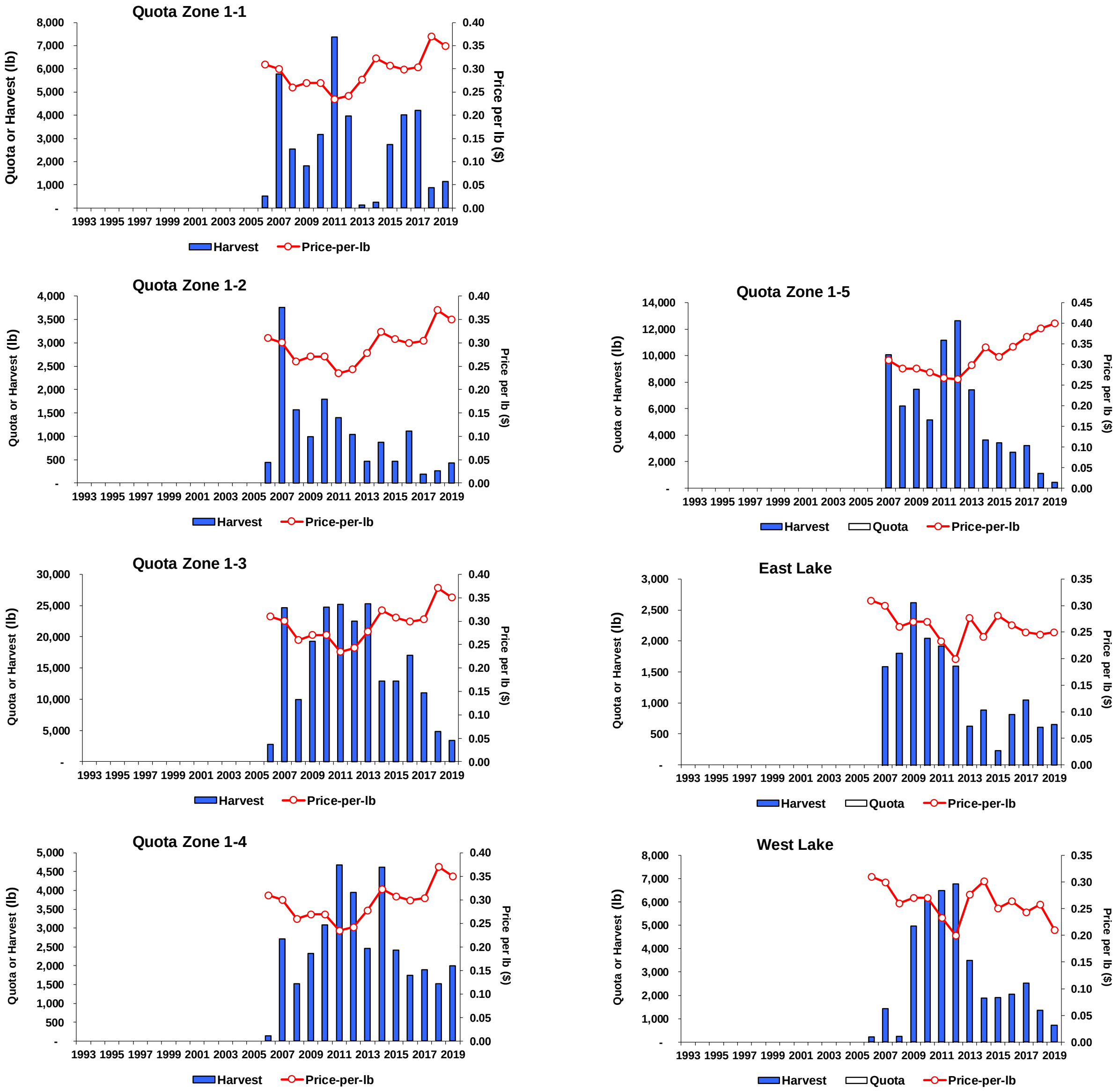


FIG. 3.2.19. Commercial base quota, harvest and price-per-lb for **Northern Pike** in Quota Zones 1-1, 1-2, 1-3, 1-4, and 1-5, East Lake and West Lake, 1993-2019.

3.3 Lake Whitefish Commercial Catch Sampling

E. Brown, Lake Ontario Management Unit

Sampling of commercially harvested Lake Whitefish for biological information occurs annually. While total Lake Whitefish harvest can be determined from commercial fish Daily Catch Reports (DCRs; see Section 3.2), biological sampling of the catch is necessary to breakdown total harvest into size and age-specific harvest.

Commercial Lake Whitefish harvest and fishing effort by gear type, month and quota zone for 2019 is reported in Table 3.3.1. Cumulative daily commercial Lake Whitefish harvest relative to quota 'milestones' is shown in Fig. 3.3.1. Total Lake Whitefish harvest for 2019 was 103,427 lbs; 61% of the issued quota.

Most of the harvest was taken in gill nets, 98% by weight; 2% of the harvest was taken in impoundment gear. Ninety-nine percent of the gill net harvest occurred in quota zone 1-2. Fifty-four percent of the gill net harvest in quota zone 1-2 was taken in November. In quota zone 1-3 most impoundment gear harvest and effort occurred in October and November (Table 3.3.1). About 47,000 lbs were harvested before November 1, the date on which an additional 20% of base quota was issued to the "pool" (Fig 3.3.1).

Biological sampling focused on the November spawning-time gill net fishery on the south shore of Prince Edward County (quota zone 1-2), and the October/November spawning-time impoundment gear fishery in the Bay of Quinte (quota zone 1-3). The Lake Whitefish sampling design involves obtaining large numbers of length tally measurements and a smaller length-stratified sub-sample for more detailed biological sampling for the lake (quota zone 1-2) and bay (quota zone 1-3) spawning stocks. Whitefish length and age distribution information is presented in Fig. 3.3.2 and Fig. 3.3.3. In total, fork length was measured for 3,328 fish and age was interpreted using otoliths for 281 fish (Table 3.3.2, Fig. 3.3.2 and 3.3.3).

Lake Ontario Gill Net Fishery (quota zone 1-2)

The mean fork length and age of Lake Whitefish harvested during the gill net fishery in quota zone 1-2 were 487 mm and 11.7 years respectively (Fig. 3.3.2). Fish ranged from ages 4-29 years. The most abundant age-classes in the fishery were aged 6-16 years which together comprised 84% of the harvest by number (76% by weight).

TABLE 3.3.1. Lake Whitefish harvest (lbs) and fishing effort (yards of gill net or number of impoundment nets) by gear type, month and quota zone. Harvest and effort value in ***bold italic*** represent months and quota zones where whitefish biological samples were collected.

		Harvest (lbs)			Effort (number of yards or nets)		
Gear type	Month	1-2	1-3	1-4	1-2	1-3	1-4
Gill net	Jan						
	Feb			53			320
	Mar			7			80
	Apr	100			720		
	May	3,976			26,040		
	Jun	5,073			25,300		
	Jul	11,014			43,250		
	Aug	9,121			33,700		
	Sep	12,798			24,800		
	Oct	3,797		290	7,340		1,200
	Nov	***54,174***		357	***52,100***		2,440
	Dec	23		119	240		760
Impoundment	Apr		63			55	
	May		9	3		10	6
	Jun			11			18
	Oct		***1,091***	9		***154***	6
	Nov		***1,340***			***71***	

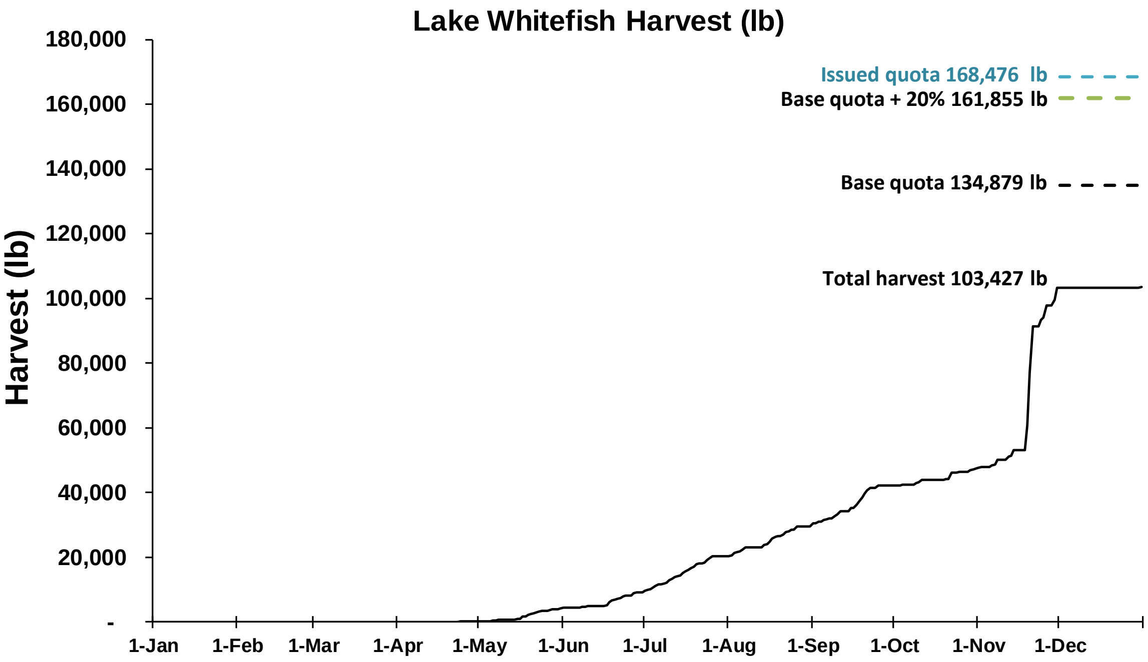


FIG. 3.3.1. Cumulative daily commercial Lake Whitefish harvest (2019) relative to quota ‘milestones’.

TABLE 3.3.2. Age-specific vital statistics of Lake Whitefish sampled and harvested including number aged, number measured for length, and proportion by number of fish sampled, harvest by number and weight (kg), and mean weight (kg) and fork length (mm) of the harvest for quota zones 1-2 and 1-3, 2019.

	Quota zone 1-2 (Lake stock)								Quota zone 1-3 (Bay stock)						
	Sampled			Harvested					Sampled			Harvested			
Age (years)	Number aged	Number lengthed	Proportion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)	Age (years)	Number aged	Number lengthed	Proportion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)
1	-	-	0.000	-	-			1	-	-	0.000	-	-		
2	-	-	0.000	-	-			2	-	-	0.000	-	-		
3	-	-	0.000	-	-			3	-	-	0.000	-	-		
4	3	59	0.022	684	663	0.970	431	4	2	10	0.017	14	13	0.908	423
5	2	40	0.015	458	380	0.829	424	5	19	131	0.224	183	176	0.965	438
6	16	280	0.103	3,227	3,037	0.941	434	6	19	107	0.184	150	139	0.931	434
7	17	357	0.131	4,115	4,445	1.080	455	7	14	89	0.153	124	132	1.059	451
8	10	216	0.079	2,491	2,821	1.132	467	8	5	21	0.036	30	38	1.299	485
9	17	404	0.148	4,650	5,337	1.148	471	9	4	20	0.034	28	37	1.319	470
10	5	103	0.038	1,182	1,520	1.286	484	10	5	19	0.033	27	37	1.384	487
11	1	19	0.007	219	289	1.322	504	11	24	71	0.122	99	147	1.487	498
12	4	66	0.024	761	1,309	1.721	523	12	5	22	0.038	31	42	1.335	475
13	15	264	0.097	3,045	5,303	1.742	525	13	7	35	0.061	49	81	1.629	501
14	12	238	0.087	2,743	4,240	1.546	515	14	2	6	0.011	9	19	2.176	559
15	10	203	0.075	2,345	3,440	1.467	501	15	4	6	0.010	8	18	2.140	554
16	8	141	0.052	1,625	2,747	1.691	533	16	12	24	0.041	34	63	1.880	538
17	3	45	0.016	518	941	1.815	541	17	1	0	0.001	1	1	2.543	574
18	-	-	0.000	-	-			18	-	-	0.000	-	-		
19	2	33	0.012	384	762	1.983	550	19	-	-	0.000	-	-		
20	-	-	0.000	-	-	0.000		20	1	1	0.002	1	3	2.274	589
21	1	19	0.007	216	248	1.149	461	21	2	8	0.013	11	14	1.354	487
22	-	-	0.000	-	-			22	-	-	0.000	-	-		
23	3	16	0.006	179	423	2.371	577	23	-	-	0.000	-	-		
24	2	16	0.006	185	365	1.968	571	24	-	-	0.000	-	-		
25	6	115	0.042	1,325	2,742	2.070	562	25	4	5	0.009	7	14	2.065	562
26	4	49	0.018	569	1,106	1.942	549.8	26	1	2	0.003	3	5	1.723	522
27	3	33	0.012	375	862	2.296	576	27	1	1	0.002	1	3	2.356	551
28	1	4	0.002	49	144	2.942	601	28	1	2	0.003	3	6	2.264	559
29	1	9	0.003	104	289	2.790	605	29	2	1	0.002	2	5	2.589	598
30	-	-	0.000	-	-			30	-	-	0.000	-	-		
31	-	-	0.000	-	-			31	-	-	0.000	-	-		
Total	146	2,729	1	31,448	45,395			Total	135	583	1	815	1,134		
Weighted mean						**1.444**		Weighted mean						**1.392**	

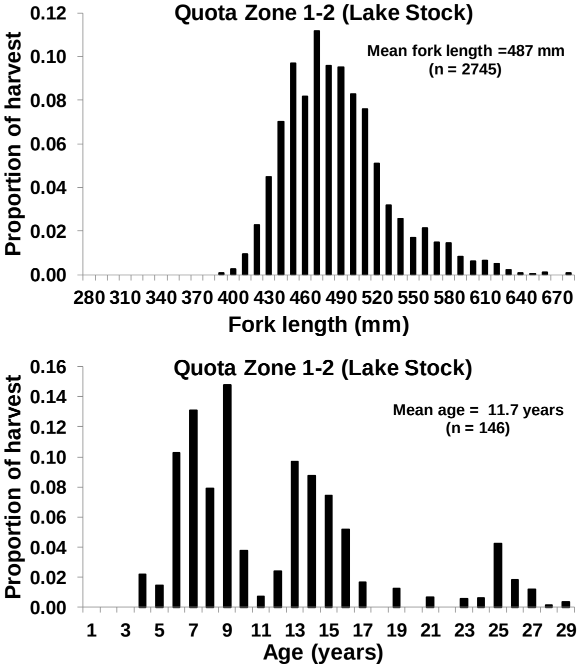


FIG. 3.3.2. Size and age distribution (by number) of Lake Whitefish sampled in quota zone 1-2 during the 2019 commercial catch sampling program.

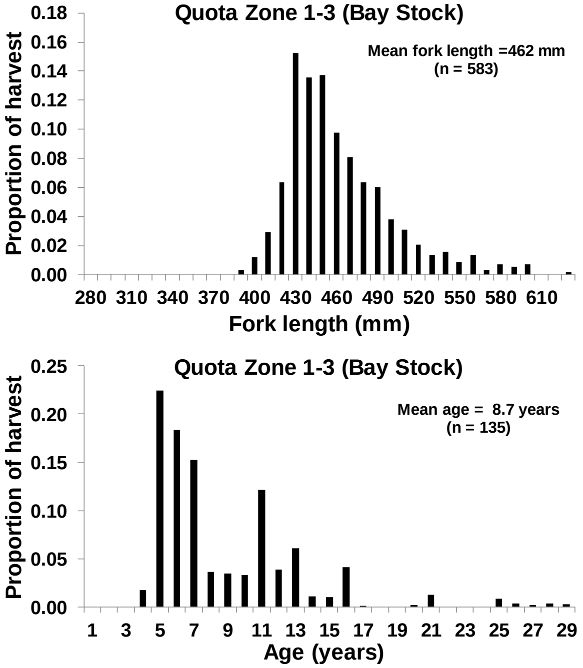


FIG. 3.3.3. Size and age distribution (by number) of Lake Whitefish sampled in quota zone 1-3 during the 2019 commercial catch sampling program.

Bay of Quinte November Impoundment Gear Fishery (quota zone 1-3)

Mean fork length and age were 462 mm and 8.7 years, respectively (Fig. 3.3.3). Fish ranged from ages 4-29 years. The most abundant age-classes in the fishery were aged 5-16 years which together comprised 95% of the harvest by number (82% by weight).

Condition

Lake Whitefish (Bay of Quinte and Lake Ontario spawning stocks; sexes combined) relative weight (see Rennie et al. 2008[1]) is shown in Fig. 3.3.4. Condition declined markedly in 1994 and remained low but stable.

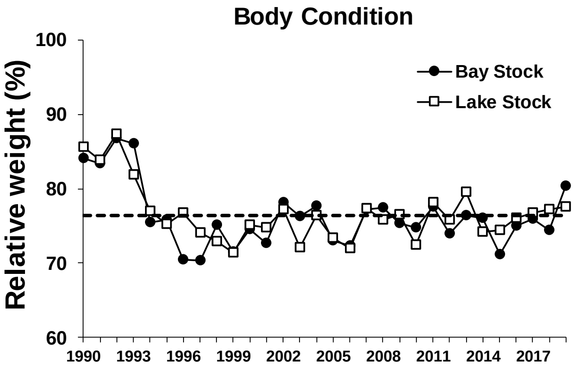


FIG. 3.3.4. Lake Whitefish (Lake Ontario and Bay of Quinte spawning stocks and sexes combined) relative weight (see [1]Rennie et al. 2008), 1990-2019.

[1] *Rennie, M.D. and R. Verdon. 2008. Development and evaluation of condition indices for the Lake Whitefish. N. Amer. J. Fish. Manage. 28:1270-1293.*

3.4 Cisco Commercial Catch Sampling

E. Brown, Lake Ontario Management Unit

Cisco appear to have increased in abundance in recent years (see Section 1.1 and 1.2). A small incidental commercial harvest of Cisco occurs in quota zone 1-3 where the species is taken in the fall Lake Whitefish targeted fishery. A sample of Cisco was taken in this fishery to examine age-class composition.

In total, fork length was measured for 644 fish and age was interpreted using otoliths for 99 fish (Fig. 3.4.1).

The mean fork length and age of Cisco harvested during the impoundment gear fishery in quota zone 1-3 were 350 mm and 5.6 years respectively (Fig. 3.4.1). Fish ranged from ages 2 -16 years. The most abundant age-classes in the fishery were aged 5 and 6 years which together comprised 76% of the harvest by number. Age-5 fish from the 2014 year-class were very numerous.

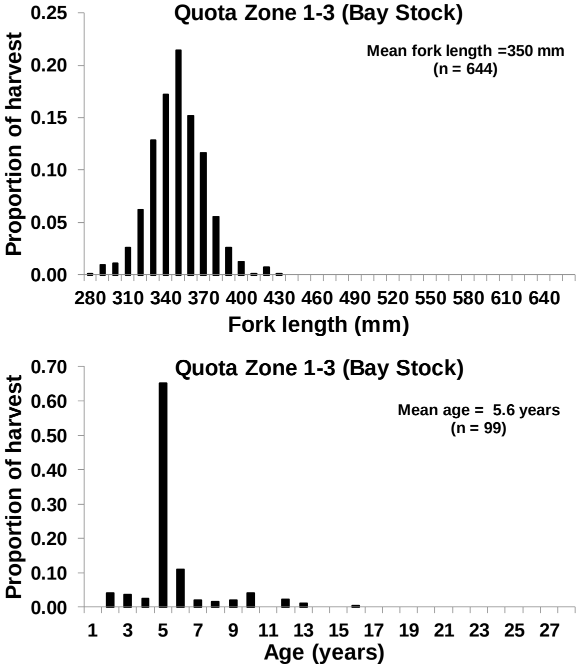


FIG. 3.4.1. Size and age distribution (by number) of Cisco sampled in quota zone 1-3 during the 2019 commercial catch sampling program.

3.5 Turtle Bycatch Audit

C. Lake, Lake Ontario Management Unit

New licence conditions were added to certain commercial fishing licences in 2019 to address concerns regarding the bycatch of turtles. Turtles can be inadvertently captured in commercial fishing gear (hoop nets and trapnets), and the likelihood of capture appears to vary by time of year, gear location, species of turtle and water temperature. The new conditions direct fishers to place a flotation device inside their gear so that captured turtles can reach the surface to breathe and be released alive the next time the fish gear is lifted. This condition applies to hoop and trap nets from May 1 to September 30 for shallow sets. An impoundment net is considered 'shallow' where any part of the terminal end is one metre or less from the surface (measured from surface of the water to the last hoop in the net or the closest point of the net structure). If a float cannot be added to the net for some reason, the fisher has the option of checking the net more frequently (every 24 hours) instead.

To assess how the new licence condition was being implemented in the field, MNRF technicians and biologists visited many commercial fishing sets and measured gear depth, overall water depth, number of turtle floats (if any) in the gear, and if an air pocket was available to turtles. In addition, underwater video and underwater still photos were taken for later analysis, as water clarity was often limiting. The video and photos were checked to see if any turtles were present in the nets that could not be seen from the surface.

The field work ran from May 7 to June 17, with 70 net location visited and a total of 93 nets inspected (some locations had multiple nets set). No turtles were observed by MNRF staff in commercial nets.

Thirty-three nets were found at a depth (1m or less) that required a float. Of these 33 nets, 28 had floats (85%). Of the 33 nets meeting the standard for the use of turtle floats, ten did not have air spaces. Of these ten, seven had floats that were ineffective (did not float the net high enough to reach the surface).

Higher than average water levels during the spring of 2019 created challenges in determining set depths and may have influenced the fishing power of the gear as well as turtle distribution and behaviour. Further collaboration with the commercial fishing industry is needed to fine-tune the implementation of this new licence condition. MNRF will continue to discuss options with the commercial to mitigate turtle bycatch.

4. Age and Growth Summary

S. Kranzl and E. Brown, Lake Ontario Management Unit

Biological sampling of fish from Lake Ontario Management Unit field projects routinely involves collecting and archiving structures used for such purposes as age interpretation and validation, origin determination (e.g. stocked versus wild), life history characteristics and other features of fish growth. Coded wire tags, embedded in the nose of fish prior to stocking, are sometimes employed to uniquely identify individual fish (e.g., to determine stocking location and year, when recovered). In 2019, a total of 4249 structures were processed from 14 different field projects (Table 4.1).

TABLE 4.1. Project-specific summary of age and growth structures interpreted for age (n=4249) in support of 14 different Lake Ontario Management Unit field projects, 2019 (CWT, Code Wire Tags).

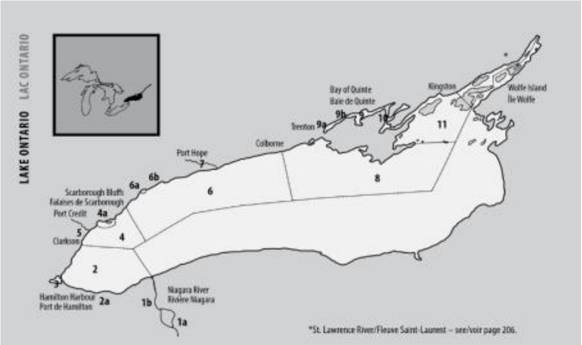
Project	Species	Structure	n
Ganaraska Rainbow Trout Assessment			
	Rainbow Trout	Scales	191
Lake Ontario and Bay of Quinte Community Index Gillnetting			
	Chinook Salmon	Otoliths	31
	Brown Trout	Otoliths	38
	Lake Trout	Otoliths	472
	Lake Whitefish	Otoliths	48
	Cisco	Otoliths	135
	Walleye	Otoliths	690
	Lake Trout	CWT	288
Lake Ontario and Bay of Quinte Community Index Trawling			
	Walleye	Otoliths	7
	Walleye	Scales	69
Hamilton Harbour Nearshore Community Index Netting			
	Northern Pike	Cleithra	16
	White Bass	Scales	29
	White Perch	Scales	30
	Rock Bass	Scales	23
	Pumpkinseed	Scales	2
	Bluegill	Scales	3
	Largemouth Bass	Scales	2
	Black Crappie	Scales	11
	Yellow Perch	Scales	1
	Walleye	Otoliths	29
	Walleye	Scales	2
Upper Bay of Quinte Nearshore Community Index Netting			
	Northern Pike	Cleithra	14
	Pumpkinseed	Scales	30
	Bluegill	Scales	28
	Smallmouth Bass	Scales	7
	Largemouth Bass	Scales	30
	Black Crappie	Scales	30
	Yellow Perch	Scales	30
	Walleye	Otoliths	30
Lower Bay of Quinte Nearshore Community Index Netting			
	Northern Pike	Cleithra	21
	Pumpkinseed	Scales	30
	Bluegill	Scales	30
	Rock Bass	Scales	30
	Smallmouth Bass	Scales	1
	Largemouth Bass	Scales	32
	Black Crappie	Scales	30
	Yellow Perch	Scales	30
	Walleye	Otoliths	29
Toronto Waterfront Nearshore Community Index Netting			
	Northern Pike	Cleithra	18
	Rock Bass	Scales	27
	Pumpkinseed	Scales	29
	Bluegill	Scales	20
	Smallmouth Bass	Scales	3
	Largemouth Bass	Scales	10
	Black Crappie	Scales	18
	Yellow Perch	Scales	9
	Walleye	Otoliths	9
Lake St. Francis Community Index Netting			
	Northern Pike	Cleithra	3
	Smallmouth Bass	Scales	4
	Yellow Perch	Scales	77
	Walleye	Otoliths	12
Thousand Island Community Index Netting			
	Northern Pike	Scales	11
	Smallmouth Bass	Scales	106
	Largemouth Bass	Scales	14
	Yellow Perch	Scales	91
	Walleye	Scales	19
Credit River Chinook Assessment and Egg Collection			
	Chinook Salmon	Otoliths	136
Ganaraska Chinook Assessment and Egg Collection			
	Chinook Salmon	Otoliths	107
Commercial Catch Sampling			
	Lake Whitefish	Otoliths	281
	Cisco	Otoliths	99
Lake Ontario Western Basin Creel			
	Chinook Salmon	Otoliths	185
Lake Ontario Spring Prey Fish Assessment			
	Alewife	Otoliths	412
Total			4249

5. Contaminant Monitoring

S. Kranzl and E. Brown, Lake Ontario Management Unit

Lake Ontario Management Unit (LOMU) cooperates annually with several agencies to collect fish samples for contaminant testing. In 2019, 496 contaminant samples were collected for Ontario's Ministry of the Environment, Conservation and Parks (MECP) Sport Fish Monitoring program (Table 5.1). Samples were primarily collected using existing fisheries assessment programs on Lake Ontario, Bay of Quinte and the St. Lawrence. Fig 5.1 is a map showing locations ("Blocks") for contaminant sample collections.

A summary of the number of fish samples collected by species, for contaminant analysis by the MECP from 2000 to 2019 is shown in Table 5.2.



3. Hamilton Harbour – harbour area

4a. Toronto Waterfront Area – nearshore area from the west side of Humber Bay Park to the east side of Ashbridges Bay Park (including Toronto Islands)

7. Ganaraska River – from the river mouth to the Port Hope fish ladder

9. Upper Bay of Quinte – open water from Trenton to County Road 49 Bridge

10. Middle Bay of Quinte – from County Road 49 Bridge to Glenora

11. Lower Bay of Quinte/Eastern Lake Ontario – from east of Glenora to Kingston as well as the open water from north of Main Duck Island to Wolfe Island and from across the Main Duck sill to Point Traverse

12. Thousand Islands area – St. Lawrence River from east of Kingston to Brockville

15. Lake St. Francis- St. Lawrence River from downstream of the Moses Saunders Dam to Quebec border

FIG. 5.1. Map showing locations ("Blocks") for contaminant sample collections.

TABLE 5.1. Number of fish samples provided to MECP for contaminant analysis, by region and species, 2019.

Region	Block	Species	Total
Hamilton Harbour	3	White Sucker	1
		Common Carp	7
		Brown Bullhead	10
		Channel Catfish	9
		White Perch	10
		White Bass	10
		Rock Bass	10
		Pumpkinseed	2
		Black Crappie	8
		Yellow Perch	1
		Walleye	10
		Freshwater Drum	10
Toronto Waterfront Area	4a	Rainbow Trout	1
		Brown Trout	1
		White Perch	7
		White Bass	1
		Rock Bass	10
		Pumpkinseed	10
		Bluegill	10
		Smallmouth Bass	3
		Largemouth Bass	7
		Walleye	9
Ganaraska River	7	Rainbow Trout	10
Upper Bay of Quinte	9	Lake Whitefish	9
		Cisco	10
		Brown Bullhead	10
		White Perch	10
		Rock Bass	9
		Largemouth Bass	10
		Walleye	10
Middle Bay of Quinte	10	Lake Whitefish	2
		Cisco	10
		Brown Bullhead	10
		White Perch	10
		Rock Bass	10
		Largemouth Bass	10
		Walleye	10
Lower Bay of Quinte	11	Chinook Salmon	10
		Brown Trout	5
		Lake Trout	10
		Lake Whitefish	11
		Rainbow Smelt	5
		Brown Bullhead	10
		White Perch	5
		Walleye	10

TABLE 5.1. *continued.*

Region	Block	Species	Total
Thousand Islands	12	Northern Pike	10
		White Sucker	8
		Silver Redhorse	1
		Brown Bullhead	10
		White Perch	1
		Rock Bass	10
		Smallmouth Bass	15
		Largemouth Bass	10
		Yellow Perch	15
		Walleye	13
Lake St. Francis	15	Northern Pike	3
		White Sucker	5
		Shorthead Redhorse	5
		Rock Bass	8
		Smallmouth Bass	4
		Yellow Perch	15
		Walleye	10
Total			496

TABLE 5.2. Summary of the number of fish samples collected, by species, for contaminant analysis by the MECP, 2000 - 2019.

	Year																			
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Black Crappie			20	20	3	20		20		20	29			35	2	14				8
Bluegill		26		20	10	23			102	88		40	40	3		10			10	10
Brown Bullhead		40	44	40	25	30	33	40	68	63	56	81	34	78	53	52			9	50
Brown Trout	40	3	20		31		22	6	29	34	34	12	20	6	10	1			20	6
Channel Catfish	20	20	7	23		17				8		15	20	4	10			10		9
Chinook Salmon	40	3	16		48		29	1	36		39	1	21	6	19	2			21	10
Cisco																18		20		20
Coho Salmon		1	3																10	
Common Carp				7													14	8		7
Freshwater Drum			43		16		13	2	32	20	37			42	2		12	18		10
Gizzard Shad																	7	10		
Lake Trout			42		54		38	17	46	20	33	13	18	20	49	10	28	10	29	10
Lake Whitefish	20													20	17	19	8	11	10	22
Largemouth Bass		4	25	28	20	9	8	89	26	40	28	55	20	11	7	18	20	4	10	37
Northern Pike		53	39	60	22	40	22	94	35	28	31	20	34	47	16	18	24	35	5	13
Pumpkinseed		60	25	57	8	11	23	78	92	105	19	43	31	14			15	20		12
Rainbow Smelt																3			4	5
Rainbow Trout	40	37	28	20	37	20	29	20	21	20	33		1	22		20			2	11
Rock Bass		36	30	38	11	21	27	30	20	40	42	80	5	24			20	20	17	57
Shorthead Redhorse																				5
Silver Redhorse							1												9	1
Smallmouth Bass		20	87	22	21	28	35	23	39	40	31	58	15	19	20	20	25	37	16	22
Walleye		42	51	40	61	30	62	98	61	40	70	71	24	73	59	67	56	29	53	72
White Bass											20									11
White Perch		40		40	40	14	21	20	35	20	7			40	8	11	4		4	43
White Sucker							1								25	7	21	30	16	14
Yellow Perch	20	60	66	58	75	40	86	90	60	91	80	20	44	81	22	20	39	50	20	31
Total	180	445	546	473	482	303	450	628	702	677	589	509	327	545	319	310	293	312	265	496

6. Stocking Program

6.1 Stocking Summary

C. Lake , Lake Ontario Management Unit

In 2019, OMNRF stocked over 2 million fish into Lake Ontario, equalling over 46,000 kilograms of biomass (Fig. 6.1.1; Table 6.1.1). Fish are allocated to one of seven sub-zones (Fig. 6.1.2) based on several factors, including: natural reproduction within the zone, size of local fisheries and suitable available habitat. More detail on the stocking zones and fish allocation can be found in the Stocking Strategy for the Canadian Waters of Lake Ontario (2015). The St. Lawrence River is not stocked. Table 6.1.2 shows the 2019 stocking levels compared to the targets outlined in the 2015 strategy.

Figure 6.1.3 shows salmon and trout stocking trends in the Ontario waters of Lake Ontario for the most recent five years, broken down by species and stocking zone. Table 6.1.3 provides detailed information on fish stocking by species, location and life stage for 2019.

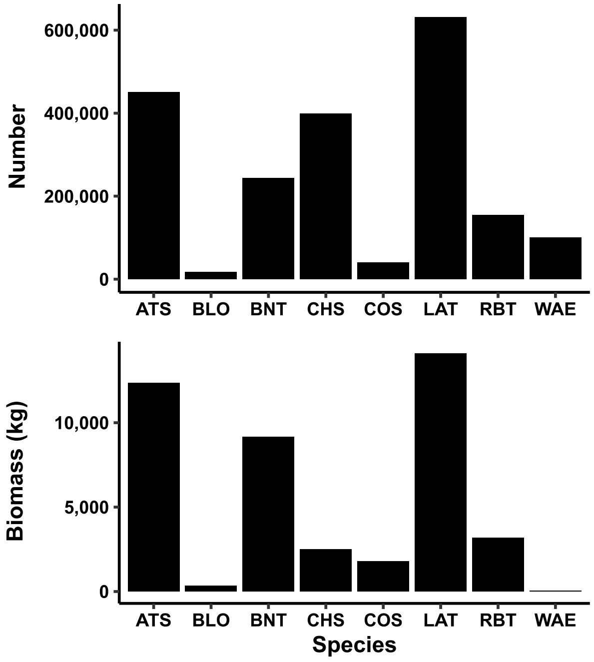


FIG. 6.1.1. **TOP:** Number of fish stocked into the Ontario waters of Lake Ontario in 2019 (total = 2,048,718). **BOTTOM:** Biomass of fish stocked into the Ontario waters of Lake Ontario in 2019 (total = 46,688 kg.). Adult, egg and Non-feeding fry life stages not included in totals. ATS = Atlantic Salmon, BLO = Bloater, BNT = Brown Trout, CHS = Chinook Salmon, COS = Coho Salmon, LAT = Lake Trout, RBT = Rainbow Trout, WAE = Walleye.

TABLE 6.1.1. Fish stocked into the Ontario waters of Lake Ontario in 2019. Numbers reflect both MNRF-produced fish and those raised by community groups. Details can be found in Table 6.1.2.

Species	Lifestage	Number	Biomass (kg)
Atlantic Salmon	Egg[1]	54,701	5.5
	Spring Fingerling	277,956	1,272
	Fall Fingerling	49,959	2,382
	Spring Yearling	123,040	8,698
	Adult	1,506	2,628
		452,461	**14,980**
Bloater	Fall Yearling	17,733	338
	Adult	9,703	638
		27,436	**976**
Brown Trout	Spring Fingerling	35,000	175
	Fall Fingerling	30,000	750
	Spring Yearling	178,721	8219
		243,721	**9,144**
Chinook Salmon	Spring Fingerling	**399,271**	**2,493**
Coho Salmon	Fall Fingerling	**40,000**	**1,800**
Lake Trout	Fall Fingerling	168,427	1,886
	Spring Yearling	463,139	12,202
		631,566	**14,088**
Rainbow Trout	Spring Yearling	**154,263**	**3,172**
Walleye	Non-feeding Fry[1]	1,000,000	10
	Summer Fingerling	100,000	35
		100,000	**45**
Totals		**2,048,718**	**46,688**

[1] Egg and Non-feeding fry lifestages not included in totals.

TABLE 6.1.2. Fish stocked into the Ontario waters of Lake Ontario in 2019. Numbers reflect both MNRF-produced fish and those raised by community groups. Details can be found in Table 6.1.3.

Species	2019 Number	Strategy Target	Difference ±	% of Target
Atlantic Salmon	452,461	750,000	- 297,539	60%
Bloater	27,436	250,000	- 222,564	11%
Brown Trout	243,721	165,000	+ 78,721	148%
Chinook Salmon	399,271	393,000	+ 6,271	102%
Coho Salmon	40,000	80,000	- 40,000	50%
Lake Trout	631,566	352,000	+ 279,566	179%
Rainbow Trout	154,263	140,000	+ 14,263	110%
Walleye	100,000	100,000	0	100%
Totals	**2,048,718**	**2,230,000**	**- 181,282**	**95%**

A total of 399,271 (2,493 kg.) Chinook Salmon spring fingerlings were stocked to provide put-grow-and-take fishing opportunities. This was 102% of our new interim target of 393,000. All Chinook Salmon for the Lake Ontario program were produced at Normandale Fish Culture Station. A total of 196,231 (49% of 2019 total) Chinook Salmon were held in stocking net pens for a short period of time prior to stocking (see section 6.2 for a detailed report of the 2019 stocking net pen program).

Atlantic Salmon were stocked in support of an ongoing program to restore self-sustaining populations of this native species to the Lake Ontario basin (Section 8.2). Atlantic Salmon (452,461; 14,980 kg.) of several life stages were stocked in 2019 into tributaries including: Credit River, Duffins Creek and Cobourg Brook. Beginning in 2016, the Ganaraska River has been stocked with advanced life stages (spring yearlings), with the goal of establishing a fishery. Atlantic Salmon are produced at MNRF hatcheries, with some eggs being delivered to partner facilities for rearing. Stocking numbers for 2019 (all life stages combined) were 60% of target, however biomass (size of fish stocked) increased substantially.

Lake Trout spring yearlings (631,566; 14,088 kg.) were stocked in 2019 as part of an established, long-term rehabilitation program, supporting of the Lake Trout Stocking Plan (Section 8.5). The 2019 target was held at a 20% reduction in response to poor Alewife year classes. A large number (168,427) of Lake Trout were stocked late in 2019 as fall fingerlings so that subsequent targets in 2020 could be met. As a result, the stocking level for 2019 was 179% of our stocking strategy target by number, with a smaller increase in biomass.

Bloater (27,436; 976 kg.) were stocked in 2019. This small relative of the Lake Whitefish was an important prey item for Lake Trout until the late 1950’s when both species were extirpated. A coordinated program involving staff from the US and Canada resulted in the initial stocking of approximately 15,000 Bloater in 2013. MNRF Fish Culture Section staff continue to work with our partner agencies to advance our understanding of the complicated process of rearing Bloater. See section 8.4 for a detailed description of this restoration effort.

Rainbow Trout (154,263; 3,172 kg.) and Brown Trout (243,721; 9,144 kg.) were stocked at various locations to support shore and boat fisheries. Community hatcheries contribute to the stocking of both species – see Table 6.1.3 for details. Coho Salmon were produced by stocking partner Metro East Anglers (approximately 40,000 fall fingerlings; 1,800 kg.).

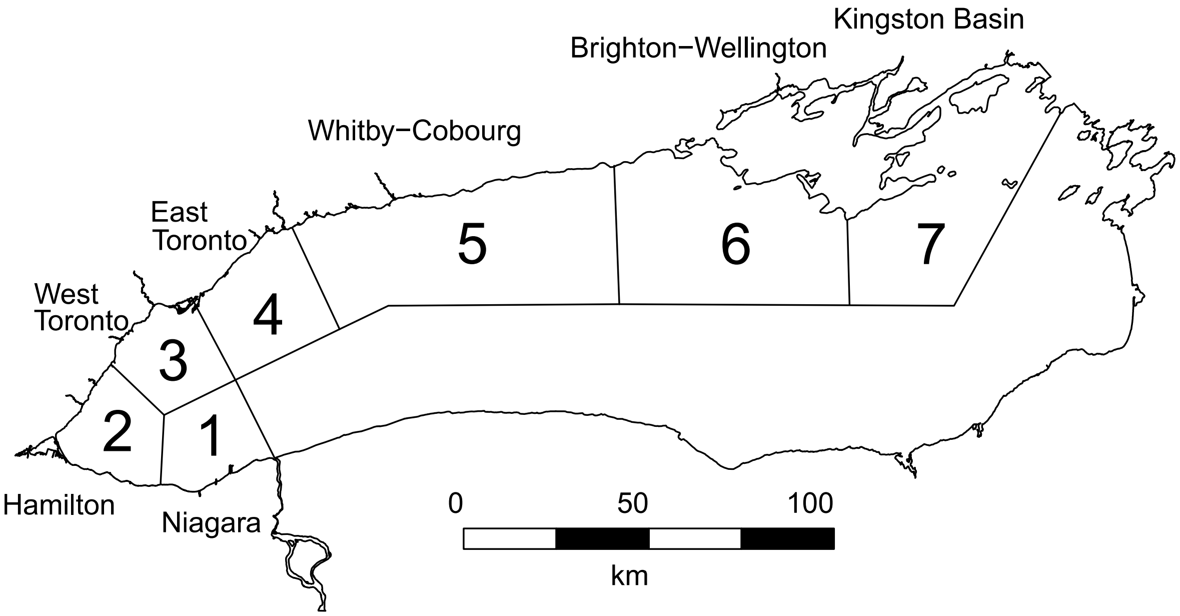


FIG. 6.1.2. Stocking zones for the Ontario waters of Lake Ontario.

Walleye were stocked into Toronto Harbour in 2019, continuing an effort to re-establish this native, predatory fish to the fish community and to promote urban, near-shore angling (see section 8.6 of this report for more detail). Walleye stocking alternates annually between Toronto Harbour and Hamilton Harbour (even years in Hamilton). In 2019 Toronto Harbour received approximately 1,000,000 Walleye non-feeding fry in the spring, followed by 100,000 fingerlings stocked in July.

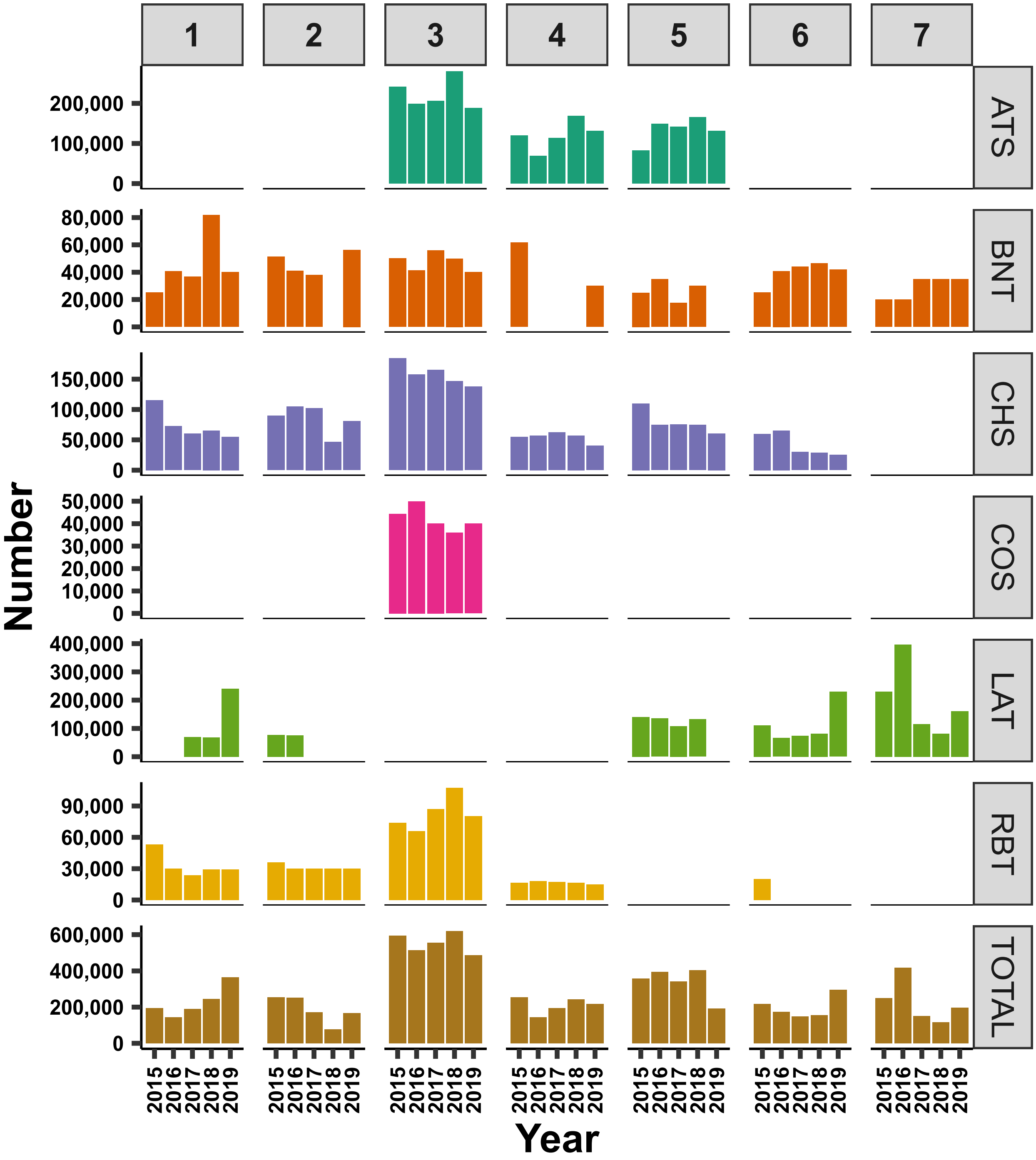


FIG. 6.1.3. Numbers of salmon and trout stocked in the Ontario waters of Lake Ontario for the most recent five years (2015-2019). Data are presented by species (rows) and by stocking zone (columns). The bottom panel ("Total") shows the total for all six species for the same time frame. Note that the y-axes are variable.
ATS = Atlantic Salmon, BNT = Brown Trout, CHS = Chinook Salmon, COS = Coho Salmon, LAT = Lake Trout, RBT = Rainbow Trout.

TABLE 6.1.3. Fish stocked into the Ontario waters of Lake Ontario and its tributaries in 2019. Abbreviations defined at the bottom of the table.

Waterbody	Site	Hatchery	Strain	Marks	Month	Age	Weight (g)	Biomass (kg)	Number
Atlantic Salmon - Egg									
Bronte Cr.	Kilbride Cr. - Cedarsprings Rd	MNRF-NM	Sebago	NONE	12	0	0.1	6	54,701
Atlantic Salmon - Spring Fingerling									
Cobourg Br.	Ball's Mill	MNRF-NM	LaHave	NONE	5	6	6.9	69	10,001
Cobourg Br.	Dale Rd.	MNRF-NM	LaHave	NONE	5	6	9.4	204	21,640
Cobourg Br.	Dale Rd.	SSFC	LaHave	NONE	5	6	0.5	17	33,559
Credit R.	Black Cr. - 15th Side Rd.	MNRF-NM	LaHave	NONE	5	6	4.5	45	10,002
Credit R.	Black Cr. - 6th Line	MNRF-NM	LaHave	NONE	5	6	4.9	62	12,501
Credit R.	Ellie's Ice Cream Parlour	MNRF-NM	Sebago	NONE	5	5	4.2	73	17,497
Credit R.	Forks	MNRF-NM	Sebago	NONE	5	5	4	70	17,499
Credit R.	Forks - Meadow	MNRF-NM	LaHave	NONE	5	6	5.4	68	12,502
Credit R.	Forks - Stuck Truck	MNRF-NM	LaHave	NONE	5	6	4.9	61	12,500
Credit R.	Terra Cotta	MNRF-NM	LaHave	NONE	5	6	4.5	45	10,003
Credit R.	W. Credit - Belfountain	MNRF-NM	LaHave	NONE	5	6	4.9	62	12,506
Duffins Cr.	E. Duffins Cr. - Claremont Field Centre	MNRF-NM	LaHave	NONE	5	6	7.3	92	12,507
Duffins Cr.	E. Duffins Cr. - Durham Outdoor Centre	MNRF-NM	LaHave	NONE	5	6	7.8	98	12,504
Duffins Cr.	E. Duffins Cr. - Pickering Museum	MNRF-NM	LaHave	NONE	5	6	9.1	91	9,999
Duffins Cr.	Reesor Cr. - Sideline 34	SSFC	LaHave	NONE	6	6	0.5	13	26,882
Duffins Cr.	W. Duffins - Whitevale Seton Trail	MNRF-NM	LaHave	NONE	5	6	6.3	79	12,505
Duffins Cr.	W. Duffins Cr. - Sideline 28 - Wixon Cr.	MNRF-NM	LaHave	NONE	5	6	5.6	70	12,507
Duffins Cr.	W. Duffins Cr. - Sideline 32	MNRF-NM	Sebago	NONE	5	5	3.4	53	15,905
Humber R.	Coffey Cr. - Finnerty Road	Humber R.	LaHave	NONE	5	4	0.2	0	430
Humber R.	Highway 9	Humber R.	LaHave	NONE	5	4	0.2	0	66
Humber R.	St. Francis Centre	Humber R.	LaHave	NONE	5	4	0.2	0	159
Humber R.	YMCA Cedar Glen	Islington	LaHave	NONE	4	2	0.1	0	4,282
Atlantic Salmon - Fall Fingerling									
Credit R.	Eldorado Park	MNRF-NM	LaHave	NONE	10	9	43.5	467	10,685
Credit R.	McLaughlin Rd. Bridge	MNRF-NM	LaHave	NONE	10	9	44.9	494	10,380
Credit R.	Terra Cotta	MNRF-NM	LaHave	NONE	10	9	50.1	761	15,254
Duffins Cr.	E. Duffins Cr. - Greenwood C.A.	MNRF-NM	LaHave	NONE	10	9	40.2	57	1,420
Duffins Cr.	E. Duffins Cr. - Greenwood North	MNRF-NM	LaHave	NONE	10	9	40.2	60	1,489
Duffins Cr.	Reesor Cr. - Hwy 7	MNRF-NM	LaHave	NONE	11	10	46.6	31	659
Duffins Cr.	W. Duffins - 7th Conc.	MNRF-NM	LaHave	NONE	11	10	44.1	24	554
Duffins Cr.	W. Duffins - 8th Conc.	MNRF-NM	LaHave	NONE	11	10	46.6	31	657
Duffins Cr.	W. Duffins - 9th Conc.	MNRF-NM	LaHave	NONE	11	10	44.2	26	578
Duffins Cr.	W. Duffins - Clarkes Hollow	MNRF-NM	LaHave	NONE	11	10	46.6	30	653
Duffins Cr.	W. Duffins - Whitevale Bridge	MNRF-NM	LaHave	NONE	11	10	44.1	24	550
Duffins Cr.	W. Duffins Cr. - Sideline 28 - Wixon Cr.	MNRF-NM	LaHave	NONE	11	10	46.6	31	659
Duffins Cr.	W. Duffins Cr. - Sideline 32	MNRF-NM	LaHave	NONE	11	10	44.1	24	554
Ganaraska R.	Carscadden Rd.	MNRF-NM	LaHave	AD	11	10	52.5	39	739
Ganaraska R.	Hwy 9	MNRF-NM	LaHave	AD	11	10	60.6	45	742
Ganaraska R.	Kendal - MNR Property	MNRF-NM	LaHave	AD	11	10	53	42	797
Ganaraska R.	Newtonville Rd.	MNRF-NM	LaHave	AD	11	10	66	45	683
Ganaraska R.	Quays Branch - 4th Line	MNRF-NM	LaHave	AD	11	10	50.5	37	724
Ganaraska R.	Quays Branch - 5th Line	MNRF-NM	LaHave	AD	11	10	52.9	38	728
Ganaraska R.	Shiloh Rd.	MNRF-NM	LaHave	AD	11	10	55.5	40	728
Ganaraska R.	Soper Rd.	MNRF-NM	LaHave	AD	11	10	47.7	35	726
Atlantic Salmon - Spring Yearling									
Cobourg Br.	Elgin Street West	MNRF-NM	Sebago	NONE	4	16	70.3	725	10,364
Cobourg Br.	W. Branch - Telephone Rd.	MNRF-NM	Sebago	NONE	4	16	66.3	398	5,999
Credit R.	Grange Sideroad	MNRF-NM	Sebago	NONE	4	16	74.3	894	12,192
Credit R.	Inglewood	MNRF-NM	Sebago	NONE	3	15	70.2	800	11,397
Credit R.	Norval	MNRF-NM	Sebago	NONE	4	16	79	812	9,981
Credit R.	Terra Cotta	MNRF-NM	Sebago	NONE	4	16	89.9	779	9,064
Duffins Cr.	E. Duffins Cr. - Greenwood C.A.	MNRF-NM	Sebago	NONE	4	16	61.2	601	9,921
Duffins Cr.	E. Duffins Cr. - Paulynn Park	MNRF-NM	Sebago	NONE	4	16	59.5	597	9,969
Duffins Cr.	E. Duffins Cr. - Paulynn Park	UWO	LaHave	NONE	5	14	9	4	396
Ganaraska R.	Newtonville Rd.	MEA-RW	Sebago	AD	4	16	70	1,073	15,334
Ganaraska R.	Shiloh Rd.	MNRF-NM	Sebago	AD	4	16	71.5	2,015	28,423
Atlantic Salmon - Adult									
Lk. Ontario	Cobourg Hrbr. West	MNRF-HW	LaHave	FLOY	4	50	968	582	601
Lk. Ontario	Grimsby - Forty Mile Cr. Park	MNRF-NM	Sebago	FLOY	11	39	2551.7	713	300
Lk. Ontario	Newcastle	MNRF-HW	LaHave	FLOY	4	50	968	252	260
Lk. Ontario	Port Dalhousie East	MNRF-NM	Sebago	FLOY	12	48	3421	561	164
Lk. Ontario	Port Hope - Mill St. boat ramp	MNRF-HW	LaHave	FLOY	11	83	3500	150	43
Lk. Ontario	Port Hope - Mill St. boat ramp	MNRF-HW	LaHave	FLOY	12	84	4050	202	50
Lk. Ontario	Pt. Credit Hrbr.	MNRF-HW	LaHave	NONE	5	50	1450	167	88

MNRF Fish Culture Stations: CH = Chatsworth, HW = Harwood, NM = Normandale, NB = North Bay, WL = White Lake.
Volunteer and other hatcheries: Belfountain = Belfountain Hatchery, Islington = Islington Sportsman Club, MEA-RW= Metro East Anglers—Ringwood, SSFC = Sir Sandford Fleming College Hatchery, Springside = Springside Park Hatchery, UWO = Western University.

TABLE 6.1.3. Fish stocked into the Ontario waters of Lake Ontario and its tributaries in 2019. Abbreviations defined at the bottom of the table.

Waterbody	Site	Hatchery	Strain	Marks	Month	Age	Weight (g)	Biomass (kg)	Number
Bloater - Fall Yearling									
Lk. Ontario	Cobourg - 100	MNRF-CH	Lk.Mich.	NONE	11	18	19	338	17,733
Bloater - Adult									
Lk. Ontario	Cobourg Hrbr. Pier	MNRF-HW	Lk.Mich.	NONE	11	31	66.1	638	9,703
Brown Trout - Spring Fingerling									
Lk. Ontario	Finkle's Shore Ramp	Springside	Wild	NONE	6	6	5	175	35,000
Brown Trout - Fall Fingerling									
Lk. Ontario	Frenchman's Bay	MEA-RW	Ganaraska	NONE	11	11	25	750	30,000
Brown Trout - Spring Yearling									
Lk. Ontario	Athol Bay	MNRF-CH	Ganaraska	NONE	4	15	45.1	1,880	41,838
Lk. Ontario	Bronte Hrbr.	MNRF-CH	Ganaraska	NONE	3	14	46.2	2,600	56,451
Lk. Ontario	Humber Bay Park	MNRF-CH	Ganaraska	NONE	4	15	48.1	970	20,179
Lk. Ontario	Lakefront Promenade	MNRF-CH	Ganaraska	NONE	4	15	48.2	965	20,012
Lk. Ontario	Port Dalhousie East	MNRF-CH	Ganaraska	NONE	3	14	44.8	1,804	40,241
Chinook Salmon - Spring Fingerling									
Bronte Cr.	2nd Side Rd. Bridge	MNRF-NM	Wild	NONE	4	5	5.6	168	30,086
Bronte Cr.	4th Side Rd. Bridge	MNRF-NM	Wild	NONE	4	5	5.8	185	31,874
Credit R.	Eldorado Park	MNRF-NM	Wild	AD	4	6	6.5	228	34,744
Credit R.	Eldorado Park	MNRF-NM	Wild	NONE	4	6	6.8	222	32,932
Credit R.	Norval	MNRF-NM	Wild	AD	4	5	6.6	213	32,438
Credit R.	Norval	MNRF-NM	Wild	NONE	4	5	5.9	193	32,470
Hamilton Hrbr.	Grindstone Cr. - Hidden Valley	MNRF-NM	Wild	NONE	5	6	6.2	52	8,496
Lk. Ontario	Bluffer's Park - Netpen	MNRF-NM	Wild	NONE	5	6	6.1	245	40,156
Lk. Ontario	Bronte Hrbr. - Netpen	MNRF-NM	Wild	NONE	5	6	7	72	10,271
Lk. Ontario	Oshawa Hrbr. - Netpen	MNRF-NM	Wild	NONE	5	6	5.8	116	20,084
Lk. Ontario	Port Credit - Outer Hrbr. Netpen	MNRF-NM	Wild	NONE	5	6	5	26	5,168
Lk. Ontario	Port Dalhousie Hrbr. - Netpen	MNRF-NM	Wild	NONE	5	6	6	333	55,078
Lk. Ontario	Port Darlington - Netpen	MNRF-NM	Wild	NONE	5	6	8.5	172	20,201
Lk. Ontario	Wellington - Netpen	MNRF-NM	Wild	NONE	5	6	5.2	132	25,193
Lk. Ontario	Whitby Hrbr. - Netpen	MNRF-NM	Wild	NONE	5	6	6.8	136	20,080
Coho Salmon - Fall Fingerling									
Credit R.	Norval	MEA-RW	Wild	AD	11	12	45	1,800	40,000
Lake Trout - Fall Fingerling									
Lk. Ontario	Athol Bay	MNRF-HW	Seneca	LPAD	12	11	22.6	483	21,289
Lk. Ontario	Athol Bay	MNRF-WL	Slate	LPAD	11	11	16.5	272	16,484
Lk. Ontario	Glenora	MNRF-NB	Seneca	LPAD	12	11	6	180	30,000
Lk. Ontario	Glenora	MNRF-NB	Slate	LPAD	12	10	6.6	98	14,855
Lk. Ontario	Glenora	MNRF-WL	Slate	LPAD	11	11	15.6	528	33,836
Lk. Ontario	Jordan Hrbr.	MNRF-NB	Seneca	LPAD	12	11	6	186	31,000
Lk. Ontario	Jordan Hrbr.	MNRF-NB	Slate	LPAD	11	10	6.6	138	20,963
Lake Trout - Spring Yearling									
Lk. Ontario	Athol Bay	MNRF-WL	Slate	RVAD	4	16	24.2	2,112	87,271
Lk. Ontario	Finkle's Shore Ramp	MNRF-WL	Seneca	RVAD	4	15	33	1,916	58,059
Lk. Ontario	Glenora	MNRF-WL	Slate	RVAD	4	16	24.2	590	24,380
Lk. Ontario	Jordan Hrbr.	MNRF-NB	Seneca	RVAD	4	14	25.6	2,039	79,786
Lk. Ontario	Jordan Hrbr.	MNRF-NB	Slate	RVAD	5	15	23.2	2,544	109,350
Lk. Ontario	Ogden Point	MNRF-HW	Seneca	RVAD	4	16	35.3	1,418	40,168
Lk. Ontario	Ogden Point	MNRF-NB	Seneca	RVAD	4	14	24.8	1,170	47,621
Lk. Ontario	Ogden Point	MNRF-NB	Slate	RVAD	4	14	25	413	16,504
Rainbow Trout - Spring Yearling									
Bronte Cr.	2nd Side Rd. Bridge	MNRF-HW	Ganaraska	NONE	5	14	21.5	323	15,028
Bronte Cr.	4th Side Rd. Bridge	MNRF-HW	Ganaraska	NONE	5	14	18	270	15,002
Credit R.	Eldorado Park	MNRF-HW	Ganaraska	NONE	6	15	19	475	24,996
Credit R.	Norval	MNRF-HW	Ganaraska	NONE	6	15	17	425	24,991
Humber R.	E. Branch Islington	MNRF-HW	Ganaraska	NONE	5	14	21.1	316	14,998
Humber R.	King Vaughan Line	MNRF-HW	Ganaraska	NONE	5	14	21.9	330	15,088
Lk. Ontario	Port Dalhousie East	MNRF-HW	Ganaraska	NONE	6	15	20	583	29,160
Rouge R.	Little Rouge R. - Steeles Ave.	MEA-RW	Wild	NONE	5	12	30	450	15,000
Walleye - Non-feeding Fry									
Lk. Ontario	Toronto Hrbr. - Unwin Ave.	MNRF-WL	Wild	NONE	5	1	0	10	1,000,000
Walleye - Summer Fingerling									
Lk. Ontario	Toronto Hrbr. - Polson St.	MNRF-WL	Wild	NONE	7	1	0.4	35	100,000

MNRF Fish Culture Stations: CH = Chatsworth, HW = Harwood, NM = Normandale, NB = North Bay, WL = White Lake.
Volunteer and other hatcheries: Belfountain = Belfountain Hatchery, Islington = Islington Sportsman Club, MEA-RW= Metro East Anglers—Ringwood, SSFC = Sir Sandford Fleming College Hatchery, Springside = Springside Park Hatchery, UWO = Western University.

6.2 Chinook Salmon Stocking Net Pen Program

C. Lake, Lake Ontario Management Unit

The stocking net pen is a floating enclosure that is tied to a pier or other nearshore structure and is used to temporarily house and acclimatize young Chinook Salmon prior to their release into Lake Ontario. The fish are held in the net pen for approximately 4-5 weeks, and the sites are managed by local angler groups who monitor the health of the fish and ensure that the fish are fed, and the pens are cleaned regularly. Several of the clubs also use the net pens as an outreach tool, involving their local community during delivery and/or release of the fish.

Compared to fish released directly from the hatchery, net pen fish are larger, survive better and may have a greater degree of site fidelity, or imprinting, to the stocking site based on marking experiments conducted by the New York Department of Environmental Conservation (NYSDEC). Because of their time in the net pens as young fish, it is expected that sexually mature fish will return to the area and provide a quality near shore fall fishery for anglers. A thorough review of the history of the program was described in the 2014 Annual Report.

2019 Net Pen Program

A total of 196,231 Chinook Salmon were released from 8 sites (18 net pens) in 2019. This represents 49% of the total number (399,271) of Chinook Salmon stocked in the Ontario waters of Lake Ontario in 2019 (Fig. 6.2.1). Site-specific data for the 2019 season is shown in Table 6.2.1.

In 2019 survival was good at all eight sites, but growth was slow due to a cold spring. As a result, fish were held slightly longer than average (35.5 days for 2019; long-term average is 30.6 days; see Fig. 6.2.2). Fish were delivered to the pens at 2.8g and weighed 6.5g when released (Fig. 6.2.3).

The smaller size of fish in 2019 kept overall density in each pen low. A maximum of 15,000 fish are placed in each net pen, keeping the overall density under the guideline of 32g of fish per liter of water (net pens have a volume of approximately 4,000 litres). Figure 6.2.4 shows the average density of fish (at time of release) in the net pens.

TABLE. 6.2.1. Summary data of the 2019 Chinook Salmon stocking net pen program. * CLOSA (Central Lake Ontario Salmon Anglers); HRSTA (Halton Region Salmon and Trout Assoc.); MEA (Metro East Anglers); PCSTA (Port Credit Salmon & Trout Assoc.); SCFGC (St. Catharines Fish & Game Club)

Site	Club*	Number Stocked	# Net Pens	Stocking Date	Stocking Size (g)	Release Date	# Days	Release Size (g)	Mort	Samples	Number Released
Bluffers	MEA	40,176	3	Apr-07	2.6	May-14	38	6.1	0	20	40,156
Bronte	HRSTA	10,291	2	Apr-06	2.6	May-11	36	7.05	0	20	10,271
Credit	PCSTA	5,188	1	Apr-06	2.6	May-11	36	-	0	20	5,168
Dalhousie	SCFGC	55,098	4	Apr-09	3.5	May-11	33	6.05	0	20	55,078
Darlington	MEA	20,221	2	Apr-07	3.4	May-11	35	8.5	0	20	20,201
Oshawa	MEA	20,104	2	Apr-05	2.5	May-10	36	5.76	0	20	20,084
Wellington	CLOSA	25,314	2	Apr-04	2.5	May-06	33	5.25	41	80	25,193
Whitby	MEA	20,100	2	Apr-05	2.5	May-11	37	6.75	0	20	20,080
Average		24,561	2.3		2.8		35.5	6.5			24,529
Total		196,491	18						41	220	196,231

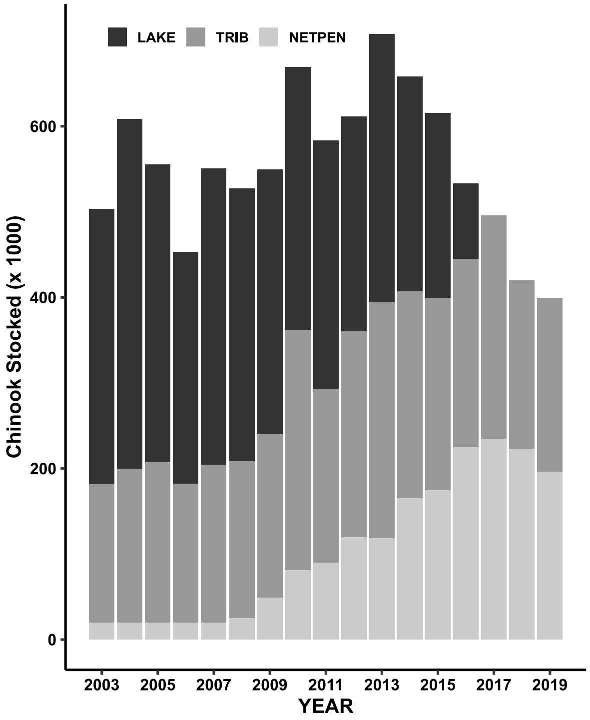


FIG. 6.2.1. Number of Chinook Salmon released (2003-2019) from Ontario net pens versus those stocked directly into tributaries or Lake Ontario.

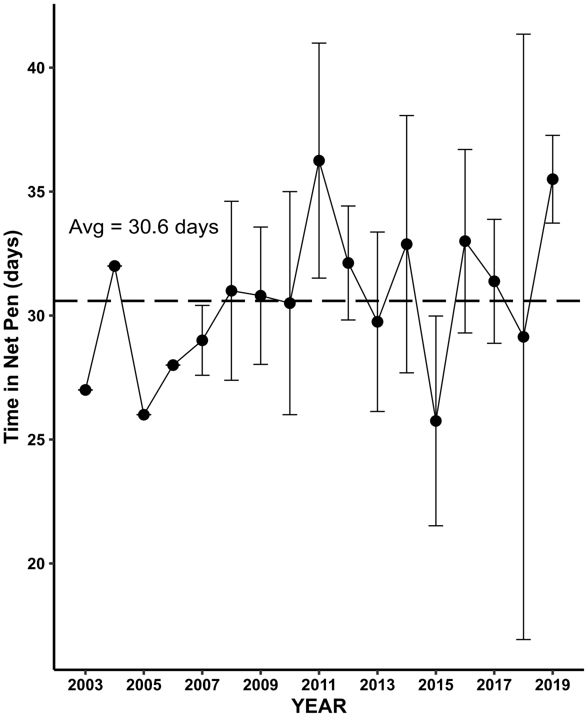


FIG. 6.2.2. Average duration of the stocking net pen program, 2003-2019.

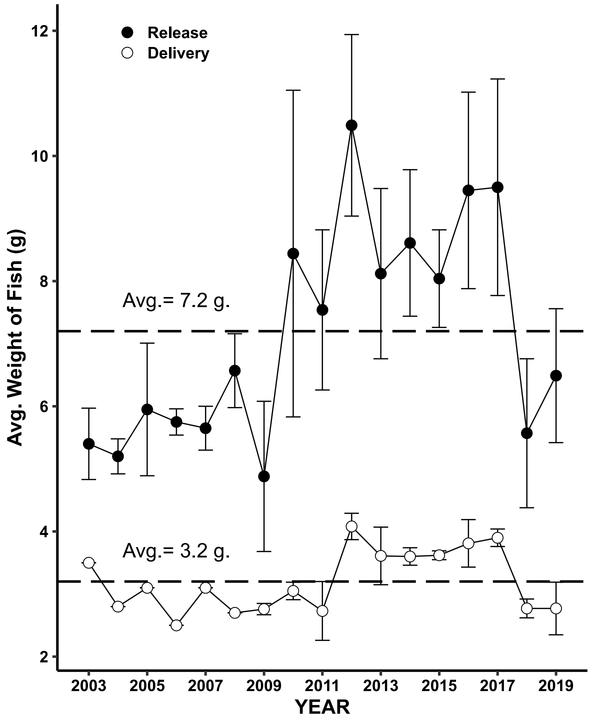


FIG. 6.2.3. Average weight (g) of fish when delivered to the net pens and at time of release. Long– term averages represented by the dashed lines.

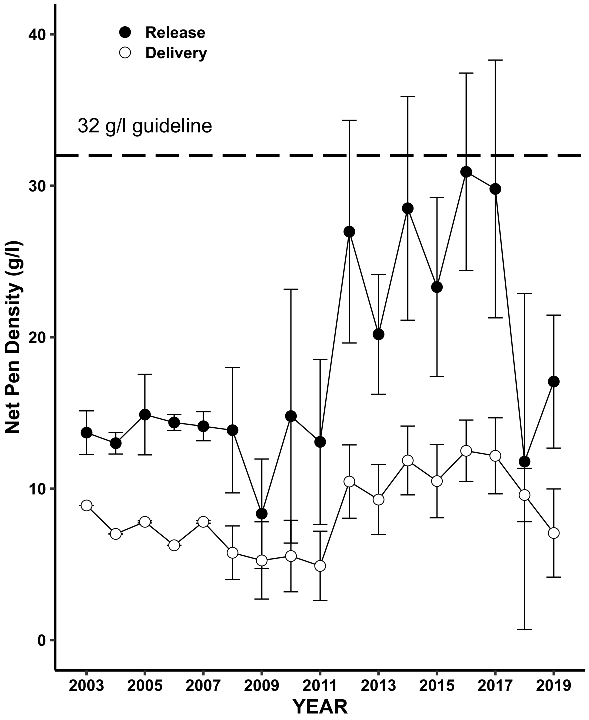


FIG. 6.2.4. Average density (g/l) of Chinook Salmon held per stocking net pen. The guideline is represented by the dashed line.

6.3 Atlantic Salmon Brood Stock Tagging Project

C. Lake, Lake Ontario Management Unit

The Ministry of Natural Resources and Forestry maintains Atlantic Salmon ‘brood stock’ in several provincial fish culture stations to support ongoing stocking efforts. Brood stock are adult (sexually mature) fish that are kept in the hatchery so that their offspring can be raised and eventually stocked into Lake Ontario and its tributaries.

Once the brood stock fish near the end of their lifespan, the quality of their gametes declines, and egg quality can suffer. Keeping these large fish in a hatchery environment right up to the end of their lives is costly in terms of space and food – it’s more efficient to ‘retire’ these fish a bit early in favour of younger, more productive individuals.

It was decided to stock these retired brood stock in various locations around Lake Ontario so that anglers could enjoy these fish. The fish were all tagged near the dorsal fin with a coloured streamer tag with a unique identifying number and phone number printed on it. When anglers caught one of these tagged fish and reported it, basic information on movement and survival was determined, and their observation was added to an online map that is provided to the angler. This project is possible only through the enthusiasm of the participating anglers.

To date, 1,872 tagged adults have been released, and 70 recaptures have been reported (overall recapture rate = 3.74%). Of these reports, 66 had enough detail to determine time and place of capture. This information is detailed in Table 6.3.1.

TABLE 6.3.1. Summary data of tagged Atlantic Salmon (adult brood stock) captured and reported by anglers (n = 66). Recaptured fish are added to an online tracking site (https://www.sdc.gov.on.ca/sites/MNRF-PublicDocs/EN/ProvincialServices/TaggedAtlanticSalmonRecaptures.html).

Release Site	Date	Fish Stocked	Strain	Age (mo)	Age (yr)	Weight (g)	Number Caught	Recap. Rate	Dist. Swam (km)			Days Swimming		
									min	avg	max	min	avg	max
Bronte Harbour	28-Nov-18	199	Sebago	35	2.9	2,050	5	2.5%	1.1	39.2	118.6	14	123	329
Port Dalhousie	29-Nov-18	96	Sebago	35	2.9	2,050	5	5.2%	0.1	57.7	233.8	2	137	312
Cobourg Marina	30-Apr-19	556	LaHave	50	4.2	968	19	3.4%	6	75.6	149.2	19	101	343
Port of Newcastle	30-Apr-19	249	LaHave	50	4.2	968	12	4.8%	6.7	68.1	130.5	32	101	124
Grimsby	21-Nov-19	208	Sebago	35	2.9	1,860	6	2.9%	0.1	0.5	2.1	17	41	138
Port Hope	22-Nov-19	43	LaHave	83	6.9	3,500	0							
Grimsby	27-Nov-19	92	Sebago	35	2.9	1,964	3	3.3%	0.1	38.4	112.6	12	89	137
Port Dalhousie	11-Dec-19	164	Sebago	48	4.0	3,421	10	6.1%	0.5	61.6	274.1	2	79	137
Port Hope	12-Dec-19	50	LaHave	84	7.0	4,050	2	4.0%	0.4	36.3	72.2	81	86	90
Port Hope	09-Jan-20	215	LaHave	83	6.9	3,500	4	1.9%	9.8	94.0	180.2	65	77	91

7. Stock Status

7.1 Chinook Salmon

M. J. Yuille, Lake Ontario Management Unit

Chinook Salmon were stocked in Lake Ontario beginning in 1968 to suppress an over-abundant Alewife population, provide a recreational fishery and restore predator-prey balance to the fish community. At present Chinook Salmon are the most sought-after species in the main basin recreational fishery, which is supported by a mix of New York State and Ontario stocked as well as naturalized fish. Salmon returning to rivers to spawn also support important shore and tributary fisheries. Data presented in the following paragraphs represent programs led by the Lake Ontario Management Unit (LOMU). Future Chinook Salmon stock status summaries will synthesize data and analyses from both LOMU and New York State Department of Environment and Conservation (NYSDEC) to provide a holistic evaluation of the Lake Ontario Chinook Salmon population.

Ontario's Chinook Salmon stocking levels have remained relatively constant since 1985 (approximately 500,000 to 600,000 per year; Fig. 7.1.1). Ontario's current base stocking target is 600k Chinook Salmon annually. New York State Chinook Salmon stocking peaked in the early 1980s at over 3.5 million fish; their target was reduced in 1996 to the current base target of approximately 1.76 million fish. In 2017, lake-wide Chinook stocking targets were reduced 20% and remained at the reduced level for 2018. In 2019, stocking targets were reduced an additional 20%, resulting in a new reduced target for Ontario of 360,000 Chinook Salmon. Despite recent changes to stocking, Chinook Salmon CUE in the Fish Community Index Gill Netting has been variable. Catches in 2019 (0.12 fish per net) decreased from 2018 (0.18 fish per net) and are comparable to the previous 10-year average (0.17 fish per net from 2009 to 2018; Fig. 7.1.2).

Chinook Salmon mark and tag monitoring data were reported from five LOMU surveys: i) Lake Ontario Salmon and Trout Angler Survey (Section 2.4), ii) Chinook Salmon Angling Tournament and Derby Sampling, iii) Lake Ontario Volunteer Angler Diary Program, iv) Eastern Lake Ontario and Bay of Quinte Fish Community Index Gill Netting (Section 1.1) and v) Credit River Chinook Salmon Spawning Index (Section 1.5). Community Index Gill Netting (Section 1.1) catches small Chinook Salmon and complements the angler-based programs that catch larger fish (Fig. 7.1.3).

2016 marked the end of the Chinook Salmon coded wire tag (CWT) study. In general, the maximum age of a Lake Ontario Chinook Salmon is 4 years old (5-year-old fish have been observed but are rare). The last stocking event related to the Mark and Tag program was in 2011, thus all fish associated with this program left the

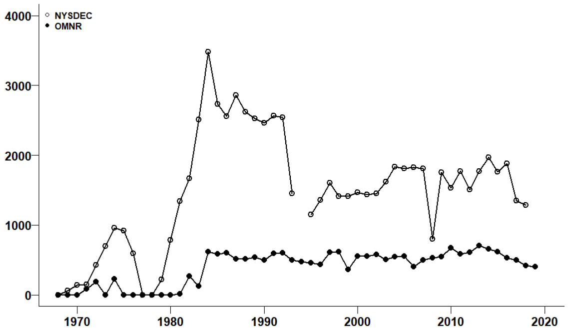


FIG. 7.1.1 Number of Chinook Salmon stocked by New York State Department of Environmental Conservation (NYSDEC) and MNRF from 1968 – 2019 (Section 6.1).

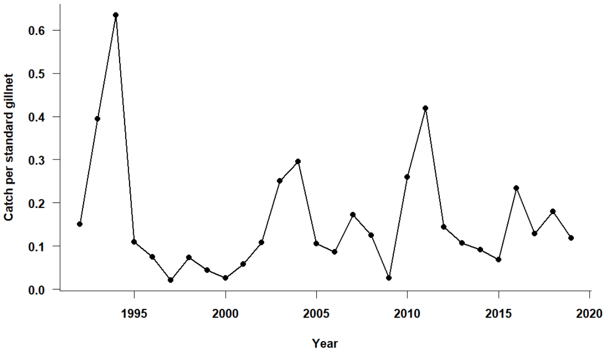


FIG. 7.1.2. Number of Chinook Salmon caught per gill net (CUE) from the Fish Community Index Gill Netting Program (see Section 1.2) from 1992 – 2019.

Lake Ontario ecosystem in the fall of 2015. CWTs were collected from the Chinook Salmon Mark and Tag program from 2009 to 2015 and have shown a mixed population of Chinook Salmon (natural reproduced, stocked by New York and stocked by Ontario) originating from geographically widespread stocking locations. The mark and tag monitoring program has confirmed that during the summer (July and August), Chinook Salmon move throughout Lake Ontario and returns to the Credit River tend to originate from fish stocked in the Credit River with a few strays from Bronte Creek stocking locations.

The Lake Ontario Management Unit continued to collect Chinook Salmon on the Ganaraska River in 2019 with the goal of diversifying Chinook Salmon gamete sources. In contrast to the Credit River, where adult returns are predominantly stocked fish, adult Chinook Salmon returning to the Ganaraska River to spawn are naturalized. Chinook Salmon stocked by LOMU into the Credit River that originated from the Ganaraska River Egg Collection (Sections 1.4, 1.5 and 6.1) received an adipose clip prior to stocking. LOMU started collecting Chinook Salmon gametes on the Ganaraska River in 2015 and the first stocking event on the Credit River using these fish was in the spring of 2016 (Section 6.1). Over the next few years, LOMU will be using data collected from both the Credit River Riverwatcher fish counter and the annual Chinook Salmon Spawning Index (Section 1.5) to evaluate the performance of both egg sources (e.g., return percentage, run timing, age and size at maturity, etc).

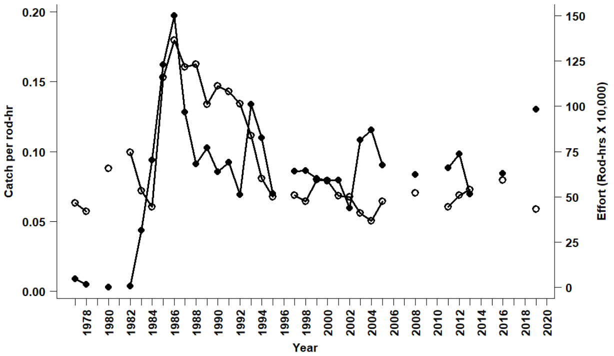


FIG. 7.1.4. Catch rate (CUE) of Chinook Salmon (closed circle) and annual total effort (rod-hrs; open circle) in the Ontario waters of Lake Ontario (excluding the Eastern Basin), 1977 to 2019.

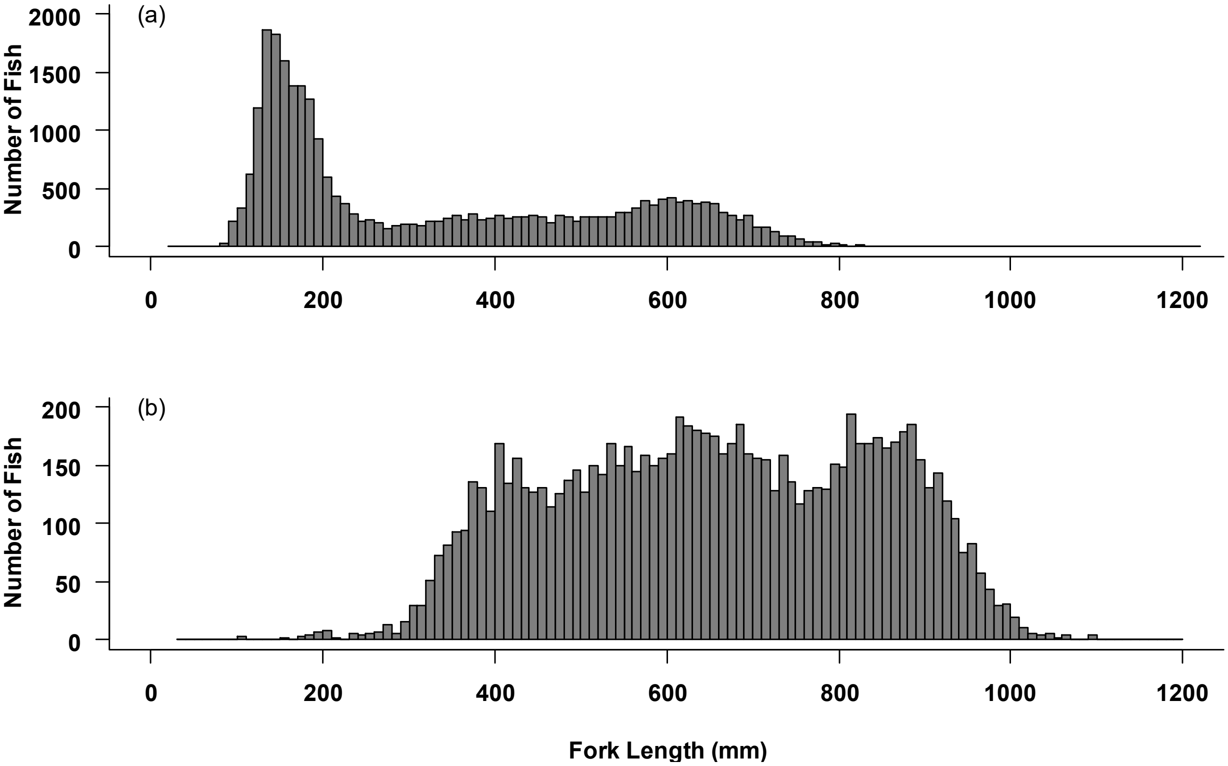


FIG. 7.1.3. Size distribution (fork length in mm) of Chinook Salmon caught (a) in the Fish Community Index Gill Netting Program from 1992 – 2016 (Section 1.1) and (b) by anglers in the Western Lake Ontario Angler Survey from 1995 to 2016.

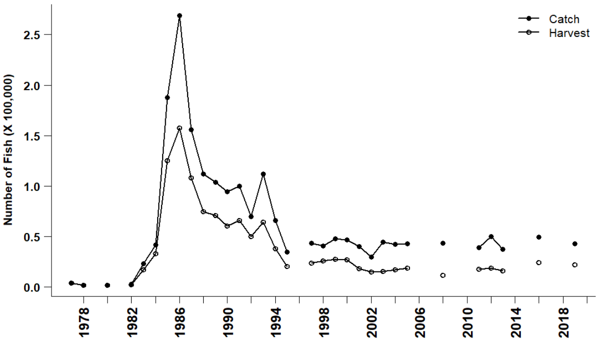


FIG. 7.1.5. Number of Chinook Salmon caught (circle) and harvested (triangle) annually in the Ontario waters of Lake Ontario (excluding he Eastern Basin), 1977 to 2019. Dashed line represents the mean catch and harvest from 1997 to 2019.

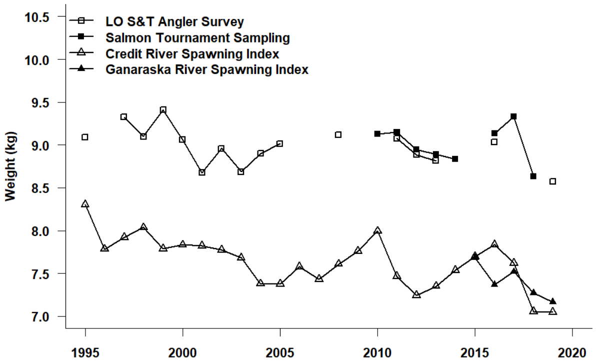


FIG. 7.1.6. Condition index of Chinook Salmon from Credit River Spawning Index (open triangle), Ganaraska River Spawning Index (closed triangle), Lake Ontario Salmon and Trout Angler Survey (open square) and the Salmon Tournament Sampling (closed square) from 1989 – 2019. Condition index is the predicted weight (based on a log-log regression) of a 914 mm (36”) total length Chinook Salmon.

Catch per unit effort (CUE), total catch and total harvest is assessed by the Lake Ontario Salmon and Trout Angler Survey. This program is on a three-year rotation schedule and was conducted in 2019 (Section 2.4). In 2019, total effort declined from 2016, while catch rates were the highest since the mid-1990s (Fig. 7.1.4). Total catch and harvest were 2% below and 12% above the mean through 2011 to 2019 (Fig. 7.1.5). Release rates in both the Lake Ontario Salmon and Trout Angler Survey and the Lake Ontario Volunteer Angler Program have generally increased through time. In 2019, the release rates in the Lake Ontario Salmon and Trout Angler Survey increased to 54% from to 50% in 2016.

The condition of Lake Ontario Chinook Salmon has been evaluated through four separate LOMU programs: i) Ganaraska River Trout and Salmon Assessment (Section 1.4), ii) Credit River Trout and Salmon Assessment (Section 1.5), iii) Chinook Salmon Tournament Sampling (Section 2.4) and iv) Lake Ontario Salmon and Trout Angler Survey. Chinook Salmon in the Credit River and Ganaraska River index have lower conditions relative to fish sampled in the lake during mid-summer when condition should be at a maximum. Overall, Chinook Salmon condition, evaluated using data from the Credit River Chinook Spawning Index (Section 1.5), has declined since 1989 (Fig. 7.1.6). In 2012, Credit River Chinook Salmon condition hit a low point in the time series. Since this time, condition in the Credit River increased to a peak 2016, followed by three years of decline. In 2019, the condition of Chinook Salmon in the Credit River is comparable to 2018 and remains at the lowest value recorded in the time series (Fig. 7.1.6). The condition of Chinook Salmon on the Ganaraska River has been measured over the past five years (2015 to 2019). On average, the condition of the Ganaraska River Chinook Salmon is comparable to the Credit River (Fig. 7.1.6). Condition of Ganaraska River Chinook Salmon declined further in 2019 (Fig. 7.1.6). 2018 marked a sharp decline in condition of Chinook Salmon harvested during summer tournaments. The condition of Chinook Salmon sampled in tournaments and the Lake Ontario Salmon and Trout Angler Survey have been comparable and follow similar trends. Chinook Salmon condition in 2019, as measured in the Lake Ontario Salmon and Trout Angler Survey, reached the lowest value since in the 1995 – 2019 time series (Fig. 7.1.6). In 2019, Chinook Salmon condition indices from each program monitoring Chinook Salmon exhibited estimated declines in condition and are at the lowest values observed in the 1995-2019 time series (Fig. 7.1.6).

In 2019, LOMU operated the Riverwatcher fish counting system in the Ganaraska River Fishway from April 2nd to November 18th. The Credit River Riverwatcher system was April 3rd to November 8th, 2019. The first Chinook Salmon to migrate upstream through the Ganaraska Fishway was observed on July 26th, 2019. Since this time, a total of 19,247 Chinook Salmon were identified migrating upstream through the Riverwatcher in the Ganaraska Fishway (Fig. 7.1.7; Section 1.4).

In 2019, a total of 2,291 Chinook Salmon were observed passing through the Riverwatcher fish counter on the Streetsville Fishway during the monitoring period. On the Credit River, the first Chinook Salmon was observed April 4th, 2019 and the last on November 5th, 2019 (Fig. 7.1.8; Section 1.5). The Ganaraska and Credit River Trout and Salmon Assessment will continue in 2019 allowing for the development of new indices on this important species. These fish counting systems augment current Lake Ontario salmon and trout assessment, providing more information on spawning populations of migratory trout and salmon from early-spring to late-fall.

In 2019, average fork length of Chinook Salmon at age-2 and age-3 males was consistent with values from 2018. For females, average fork length for age-2 Chinook Salmon increased, while average length for age-3 females was consistent with 2018 values (Section 1.5; Fig. 1.5.9). Average fork length of age-2 females is above the previous 10-year average and age-3 females as well as age-2 and age-3 males were slightly below the previous 10-year average. In 2019, female condition was lower than 2018; marking a two-year decline (Section 1.5; Fig. 1.5.10). After a sharp decline in 2018, male condition increased slightly in 2019 (Section 1.5; Fig. 1.5.10). Female condition in 2019 is the lowest in the 30-year time series; male condition in 2019 is below the previous 10-year average.

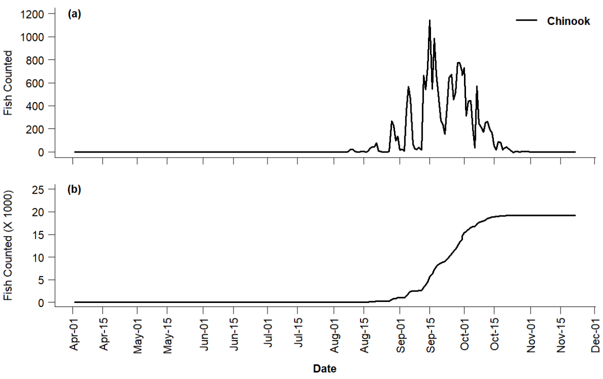


FIG. 7.1.7. (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

Body condition of Chinook Salmon collected on the Credit River and Ganaraska River during the egg collection was comparable in 2019 (Fig. 7.1.6). Monitoring and assessment of both Credit River and Ganaraska River salmon and trout provide comparisons between fish populations that are predominantly of stocked origin (Credit River) and naturalized (Ganaraska River). Continued monitoring and assessment of these populations on the Credit and Ganaraska Rivers is critical in understanding the dynamic between stocked and naturalized fish populations as well as the success of the Lake Ontario Management Unit's diverse egg collection strategy with Chinook Salmon.

Mean summer temperatures for Lake Ontario were above the long-term average in 2019 (Section 11.1); a sharp contrast to the 2014 and 2015 seasons, which marked the coldest mean summer water temperatures recorded since 2002 (Section 11.1). The winter severity index for 2018 -2019 was comparable to the long term average (Section 11.1). While, these two factors may not be the only ones behind the observed declines in Chinook Salmon size, they likely have a significant contribution, as cooler temperatures are associated with lower metabolic activity and growth and severe winters negatively affect prey fish populations (i.e., Alewife).

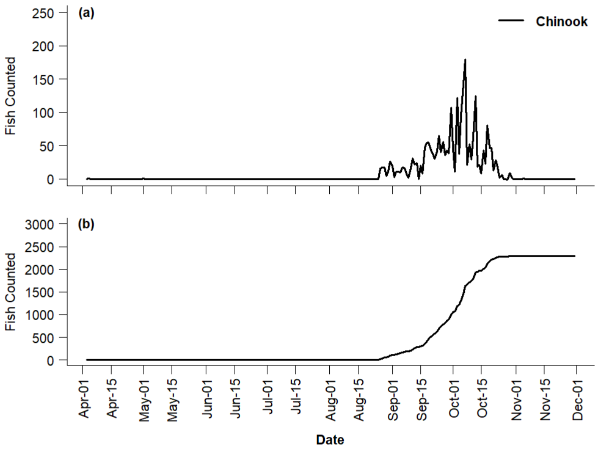


FIG. 7.1.8. (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

7.2 Rainbow Trout

M. J. Yuille, Lake Ontario Management Unit

The Lake Ontario fish community is a mix of non-native and remaining native species. Rainbow Trout, a non-native species, was intentionally introduced to Lake Ontario in 1968 and has since become naturalized (naturally reproducing fish). Rainbow Trout are the primary target for tributary anglers, who take advantage of the seasonal staging and spawning runs of this species and Rainbow Trout are the second most sought-after species in the Ontario waters of the Lake Ontario offshore salmon and trout fishery. In addition, the spring and fall spawning runs attract high numbers of tourists to local tributaries to watch these fish jump at fishways and barriers along their spawning migration. For these reasons, Rainbow Trout are not only ecologically important but recreationally and economically important as well.

The OMNRF stocks only *Ganaraska River* strain Rainbow Trout into Lake Ontario. A total of 154,263 Rainbow Trout were stocked in 2019, below the 2009 to 2018 average of 167,890 (Fig. 7.2.1; see Section 6.1).

The spring spawning run of Rainbow Trout in the Ganaraska River has been estimated at the fishway at Port Hope since 1974 (Section 1.4). In 2019, the Lake Ontario Management Unit (LOMU) operated the new Riverwatcher fish counting system in the Ganaraska River Fishway from April 2nd to November 18th, 2019. In 2019, the spring Rainbow Trout run in the Ganaraska River declined to 6,051 fish from 9,014 fish observed in 2018 and is below the previous 10-year average (6,463 fish from 2009 – 2018; Fig. 7.2.2). Rainbow Trout were observed utilising the fishway after the spring monitoring period. Another 530 Rainbow Trout migrated through the fishway after the primary spring run, making a total of 6,577 Rainbow Trout identified migrating upstream through the Ganaraska Fishway in 2019 (Fig. 7.2.3).

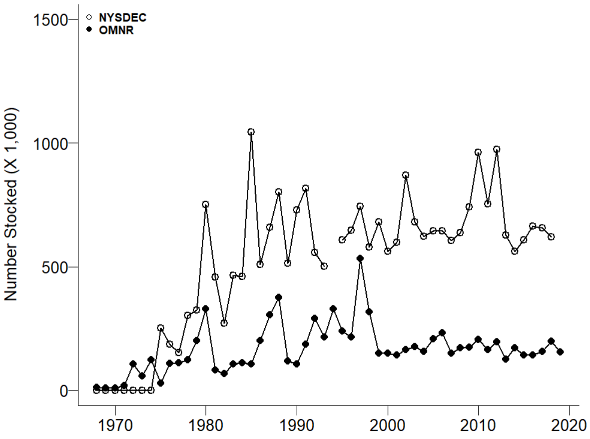


FIG. 7.2.1. Number of Rainbow Trout stocked by New York State Department of Environmental Conservation (NYSDEC) and OMNRF from 1968 – 2019 (see Section 6.1).

2019 marked the first fishery independent assessment of the spring Rainbow Trout run in the Credit River (Section 1.5). In 2019, the Lake Ontario Management Unit (LOMU) operated the new Riverwatcher fish counting system in the

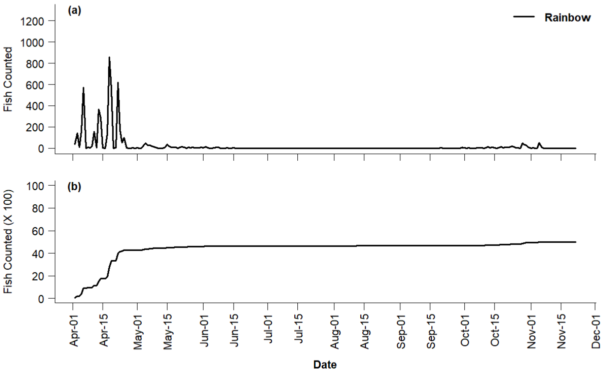


FIG. 7.2.3. (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Ganaraska River Fshway at Port Hope, Ontario from April 2nd to November 18th, 2019.

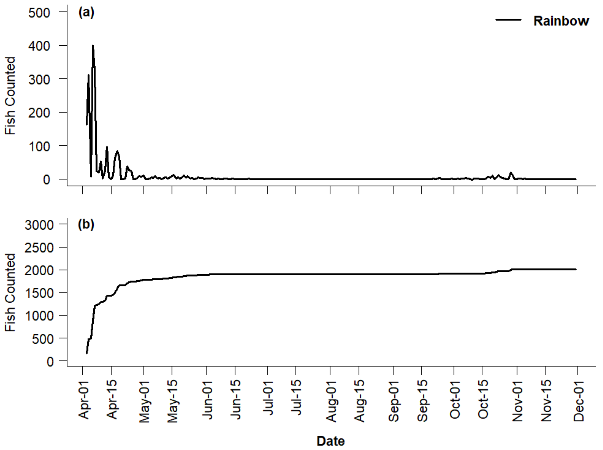


FIG. 7.2.4. (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Streetsville Fishway on the Credit River, Mississuaga, Ontario from April 3rd to November 8th, 2019.

Streetsville Fishway from April 3rd to November 8th, 2019. In 2019, the spring Rainbow Trout run through the Streetsville Fishway was estimated at 1,776 (Fig. 7.2.4). Additionally, Rainbow Trout were observed utilising the fishway after the spring monitoring period. From April 3rd to November 8th, 2019 a total of 2,007 Rainbow Trout were identified migrating upstream through the Streetsville Fishway (Fig. 7.2.4).

The Lake Ontario ecosystem has changed dramatically during this time series (e.g., phosphorus abatement, dreissenid mussel invasion, round goby invasion). During this time period (1974 to 2019), Rainbow Trout condition has declined (Fig. 7.2.5a). With the exceptions of 1994 and 1996, the highest condition values occurred in the 1970's, prior to invasion of Zebra Mussels, Quagga Mussels and Round Goby. Fish body condition declined through the 1980's to a low point in 1987. From 1990 to 2019, the long-term trend shows slight decline in relative condition. Data on Rainbow Trout condition over the past 10 years are the most informative for the current population (Fig. 7.2.5b). Rainbow Trout condition declined to a low in 2008 then increased up to 2013 (the highest in the whole time series since 1997). In 2015, Rainbow Trout condition declined significantly, to the lowest point since 1986. This sharp decline was likely due to low tiamine levels in Rainbow Trout, resulting in declines in the Lake Ontario population as well as low condition. Since 2015, Rainbow Trout condition has remained low but stable (94 – 96%; Fig. 7.2.5b).

After a sharp increase in catch per unit effort (CUE) from 1979 to 1984 (the highest in the 34-year time series), Rainbow Trout CUE declined until 2004 in the Lake Ontario Salmon and Trout Angler Survey (Fig. 7.2.6; Section 2.4). After 2004 (the lowest CUE since1982), the CUE steadily increased to 2013. The Lake Ontario Management Unit, did not conduct the Lake Ontario Salmon and Trout Angler Survey in 2014 or 2015, but Rainbow Trout CUE in 2016 showed a significant decline, falling below the average CUE for both the time series (1977-2016). Anglers experienced an increase in Rainbow Trout CUE in 2019 where catch rates are 7% bleow the previous 10-year average (2008 to 2016 average; Fig. 7.2.6). Effort in this fishery declined in 2019 and is the lowest estimate since 2004 (Fig. 7.2.6). Total numbers of Rainbow Trout caught and harvested in the Lake Ontario Salmon and Trout Angler Survey have been stable since 2008 and are just below the previous 10-year average (Fig. 7.2.7).

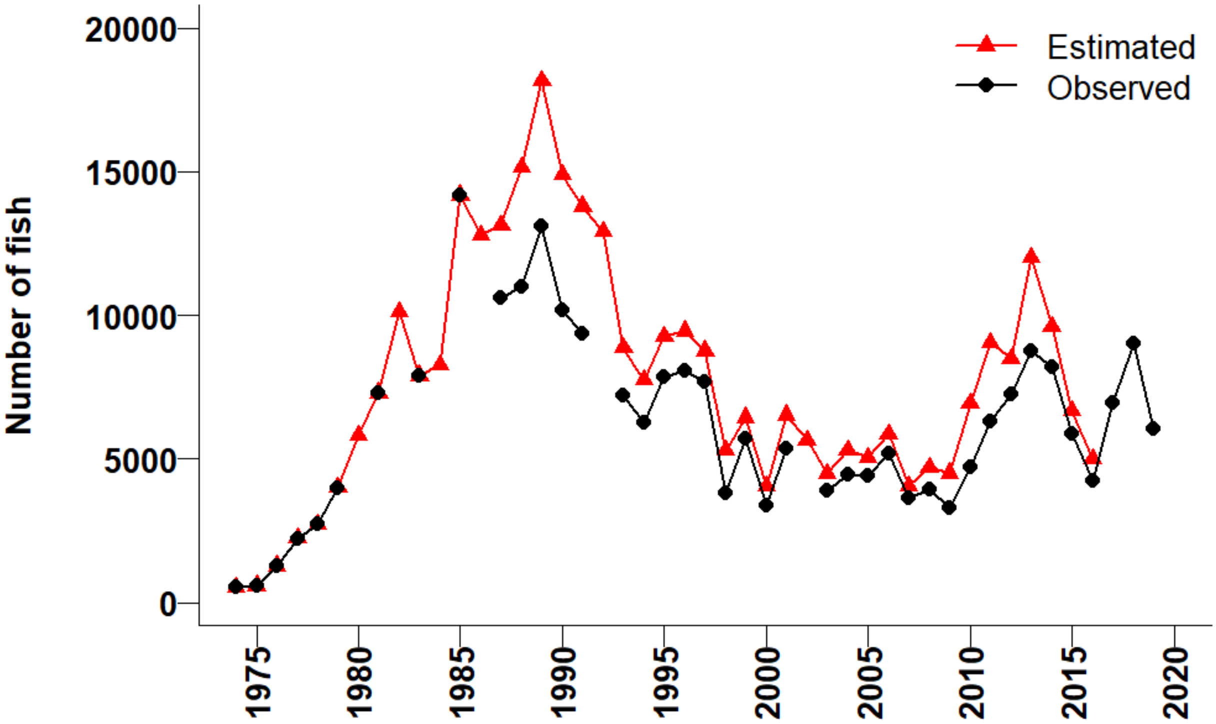


FIG. 7.2.2. Estimated and observed spring run of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario from 1974 – 2019.

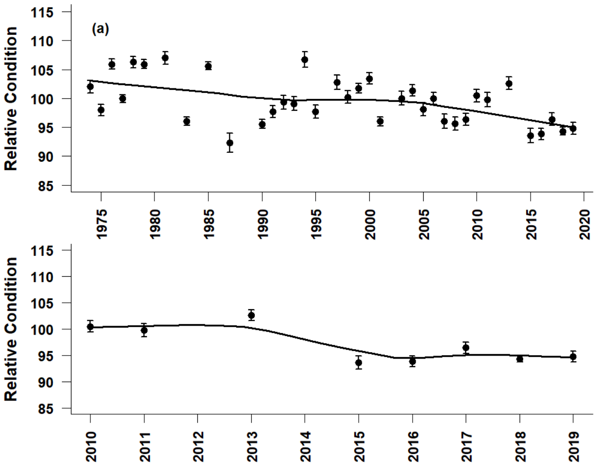


FIG. 7.2.5. Relative condition of Rainbow Trout sampled at the Ganaraska River fishway at Port Hope, Ontario for (a) the whole time series 1974 – 2019 and (b) from 2010 – 2019; see Section 1.4).

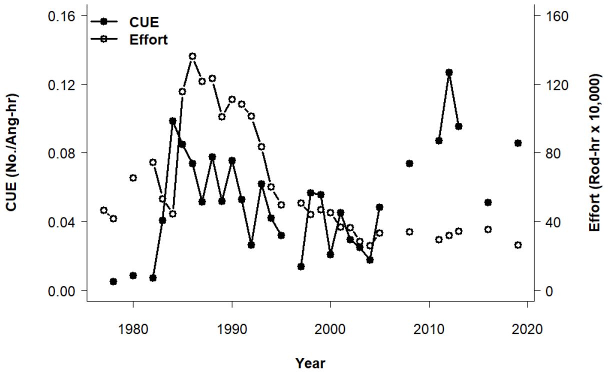


FIG. 7.2.6. Catch rate (CUE) of Rainbow Trout and total effort (ang -hrs) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 – 2019.

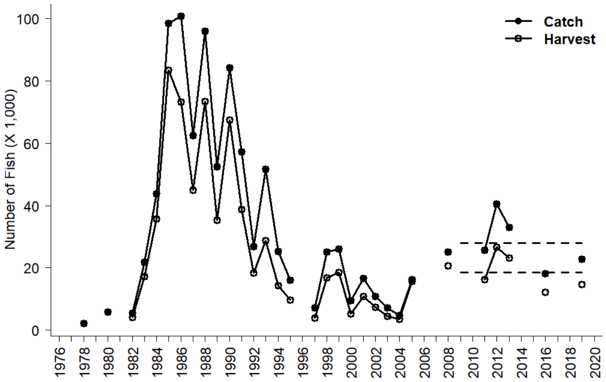


FIG 7.2.7. Number of Rainbow Trout caught (closed circle) and harvested (open circle) annually by the boat fishery in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1978 – 2019. The dashed line represents the mean catch and harvest from 2008 to 2019.

7.3 Brown Trout

M. J. Yuille, Lake Ontario Management Unit

Brown Trout, in conjunction with several other stocked and naturalized trout and salmon species support a Lake Ontario main basin recreational fishery. Salmon and trout returning to rivers to spawn also support an important shore and tributary fisheries. Ontario's Brown Trout stocking levels have increased slightly from 2000 to 2019, while New York stocking rates have remained stable (Fig. 7.3.1). Stocking numbers in 2019 were comparable to 2018 and are approaching the highest levels since the early 1990s (Fig. 7.3.1; Section 6.1). The 2019 average catch per standard net (0.04 fish per net) in the Community Index Gill Netting showed a sharp decline from the 2018 values and is more comparable to 2014-2017 catches (Fig. 7.3.2). Brown Trout that were caught during Fish Community Index Gill Netting were biologically sampled, recording length and weight information as well as age structures for age interpretation (Section 1.1). Ontario stocks Brown Trout as yearlings and they will reach a maximum age of five. In 2019, most of the Brown Trout caught in Fish Community Index Netting (58%) were age-3 (Table 7.3.1).

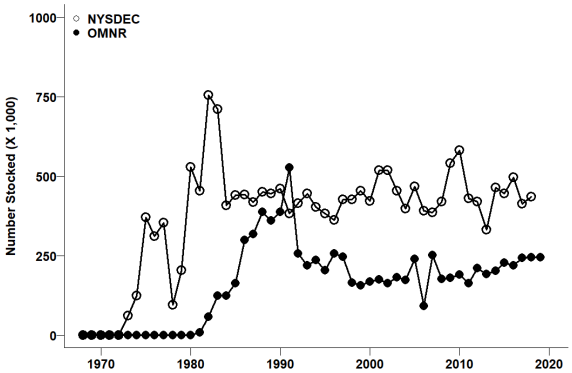


FIG. 7.3.1. Number of Brown Trout stocked by New York State Department of Environmental Conservation (NYSDEC) and MNRF from 1968 – 2019 (Section 6.1).

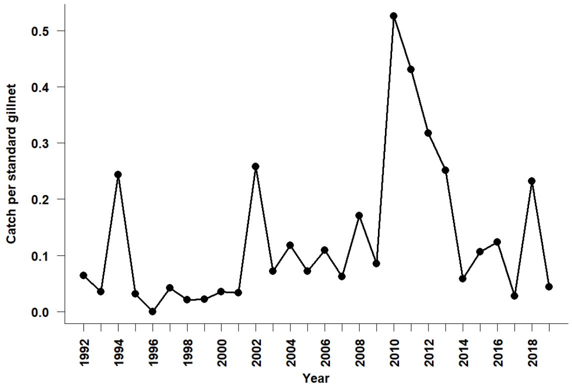


FIG. 7.3.2. Number of Brown Trout caught per gill net (CUE) from the Fish Community Index Gill Netting Program (see Section 1.1) from 1992 – 2019.

Based on stakeholder and public consultation, Ontario's stocking strategy for Lake Ontario Brown Trout changed in 2015 to include: increased size of stocked Brown Trout, an increase to Ontario's total stocking target for Brown Trout, and the stocking of fewer locations with more fish. This strategy increases fish density at stocking location to increase angler success and create high quality destination fisheries for Brown Trout. In 2018, the Lake Ontario Management Unit expanded their Community Index Gill Netting Program (Section 1.1) to include two areas that sampled in the vicinity of the aforementioned Brown Trout stocking locations (Athol Bay and Port Dalhousie). Preliminary results have Port Dalhousie to have significantly higher Brown Trout catches compared to other locations included in the study (Athol Bay, Port Credit, Cobourg, Brighton, Wellington and Rocky Point; Fig 7.3.3). Some catches may have been affected by weather and lake currents (e.g., Athol Bay). Analyses and interpretation of the 2018 and 2019 data are ongoing to fully understand the effects of the changes to the Brown Trout stocking strategy. Brown Trout are one of the least targeted salmon and trout species in the Lake Ontario open-water fishery (Fig. 7.3.4a). Anglers target this species primarily in the early spring (e.g., April; Fig. 7.3.4b) and then switch to other species as the lake warms through the spring into the summer months (Fig. 7.3.4a). Catch per angler hour of

TABLE 7.3.1. Age distribution of 86 Brown Trout sampled from Fish Community Index Gill Nets, by region, during 2019 (Section 1.1). Also shown are mean fork length (mm) and mean weight (g).

	Age (years)/year-class					
	1	2	3	4	5	
Region	2018	2017	2016	2015	2014	Total
Southwestern	1	5	13	3	2	24
Northwestern		1				1
Northcentral						0
Northeastern		1	6			7
Kingston Basin			3	1	1	5
Bay of Quinte		1				1
Total aged	1	8	22	4	3	38
Mean fork length (mm)	254	513	592	644	650	
Mean weight (g)	205	1783	3407	4445	4357	

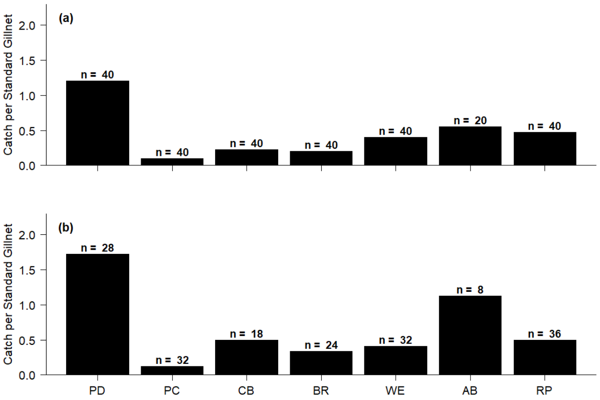


FIG. 7.3.3. Number of Brown Trout caught per gill net (CUE) from specific areas fished during the Fish Community Index Gill Netting Program (2018 and 2019) to evaluate the effects of new Brown Trout stocking strategy. Areas include: Port Dalhouise (PD), Port Credit (PC), Cobourg (CB), Brighton (BR), Wellington (WE), Athol Bay (AB) and Rocky Point (Section 1.1). Areas marked with "*" indicate Brown Trout stocking locations (Section 6.1).

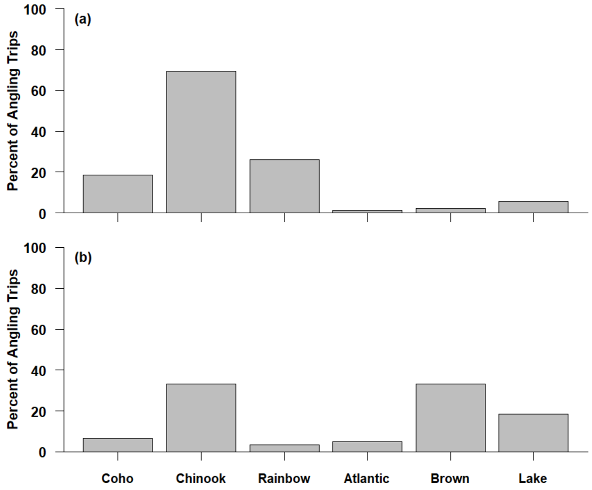


FIG. 7.3.4. The proportion of targeted (a) total angling effort and (b) angling effort in April (angler hours) for specific salmon and trout species relative to the total estimated targeted angling effort in 2019.

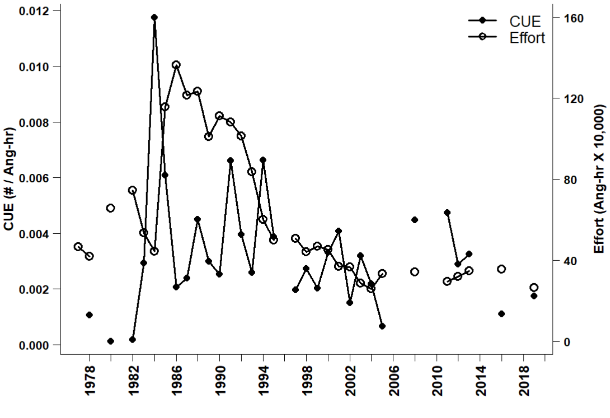


FIG. 7.3.5. Catch rate (CUE) of Brown Trout and annual total effort (ang-hrs) in the Ontario waters of Lake Ontario (excluding the Eastern Basin), 1977 to 2016.

Brown Trout in the 2019 recreational fishery (0.002 fish per ang-hr) doubled from estimates in 2016 (0.001 fish per ang-hr), but remain low compared to other species in the Lake Ontario salmon and trout recreational fishery (Fig. 7.3.6; Section 2.4). Despite an increase in catch per angler hour, the total estimated catch and harvest in the 2019 Lake Ontario Salmon and Trout Angler Survey was comparable to 2016 (Fig. 7.3.6; Section 2.4). Unlike other salmon and trout species (e.g., Chinook Salmon, Section 7.1) length distributions of Brown Trout harvested in the Lake Ontario recreational fishery and caught in Community Index Gill Netting (Fig. 7.3.7) were similar.

The condition of Lake Ontario Brown Trout has been evaluated through two separate LOMU programs: i) Fish Community Index Gill Netting (Section 1.1) and ii) the Western Lake Ontario Angler Survey. Body condition is represented by relative condition of Brown Trout

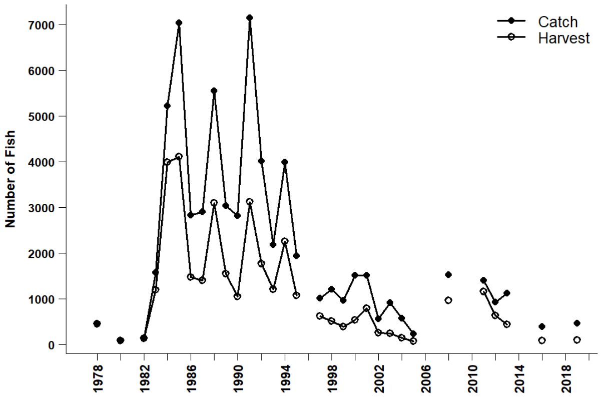


FIG. 7.3.6. Number of Brown Trout caught (closed circle) and harvested (open circle) annually in the Ontario waters of Lake Ontario (excluding the Eastern Basin), 1977 to 2016.

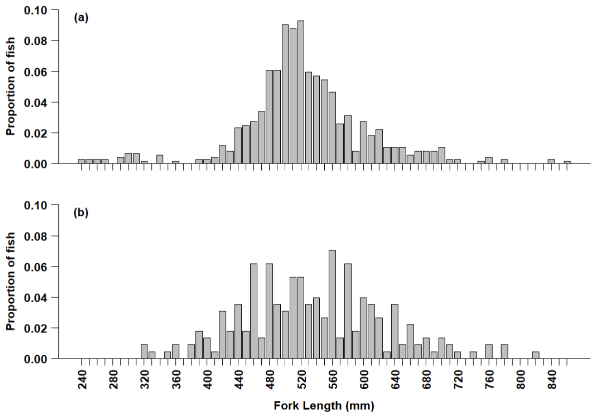


FIG. 7.3.7. Size distribution (fork length in mm) of Brown Trout caught (a) in the Fish Community Index Gill Netting Program from 1992 – 2018 (Section 1.1) and (b) by anglers in the Western Lake Ontario Angler Survey from 1995 to 2016.

smaller than 625 mm fork length (“Small”) and greater than or equal to 625 mm fork length (“Large”). The fish were grouped into these two size classes to reduce bias associated with non-linear growth. Relative condition small of Brown Trout caught in Fish Community Index Netting increased from a low point in 1998 to one of the highest in 2002 (Fig. 7.3.8a). This coincides with the invasion of Round Goby into Lake Ontario. Brown Trout are known to eat Round Goby to supplement their diets; the increase in Brown Trout body condition observed may be due to the incorporation of Round Goby in their diet. Body condition of large Brown Trout has been variable but stable throughout the time series (Fig. 7.3.8b). Relative condition measured in the Lake Ontario Salmon and Trout Angler Survey is generally lower than that of the Fish Community Index Gill Netting but follows the same trends (Fig. 7.3.8). In 2019, none of the harvest Brown Trout sampled by LOMU staff measure 625 mm or above, so the condition of “Large” Brown Trout caught in the recreational fishery could not be evaluated (Fig. 7.3.8). In the Lake Ontario Salmon and Trout Angler Survey, Brown Trout are primarily targeted and caught early in the season (Fig. 7.3.4; Section 2.4). As a result, we would expect that their condition would be lower relative to Fish Community Index Gill Netting (July and August) as they have not had the same amount of time to recover from the winter and growth throughout the summer.

The Lake Ontario Management Unit installed and operated two Riverwatcher fish counters in the Ganaraska River (April 2nd to November 15th, 2019) and the Credit River (April 3rd to November 8th, 2019). In 2019, 297 Brown Trout were identified passing through the Ganaraska Fishway (Fig. 7.3.9, Section 1.4). Brown Trout continue to be the most active salmon and trout species utilising the fishway from June to early August, however in 2019, the majority of Brown Trout were observed from mid-August to mid-September (Fig. 7.3.9). On the Credit River, a total of 18 Brown Trout were identified passing through the fish counter during the monitoring period (Fig. 7.3.10, Section 1.5). On the Credit River, the majority Brown Trout activity through the fishway/fish counting system occurred from September 1st to November 1st, 2019 (Fig. 7.3.10). The 2019 field season marks the first fishery independent evaluation of the Credit River migratory salmon and trout spawning runs (Section 1.5). Data collected via the Credit River and Ganaraska River fish counting systems augments current Lake Ontario salmon and trout assessment, providing more information on spawning populations of migratory trout and salmon from early-spring to late-fall.

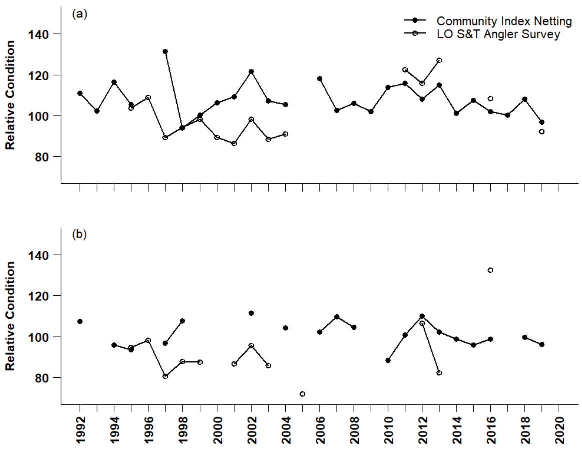


FIG. 7.3.8. Relative condition of (a) small and (b) large Brown Trout from Fish Community Index Gill Netting (closed circle) and Western Basin Angling Survey (open circle) 1992 – 2019. The data point for small Brown Trout in 2005 Western Basin Creel was removed as an outlier.

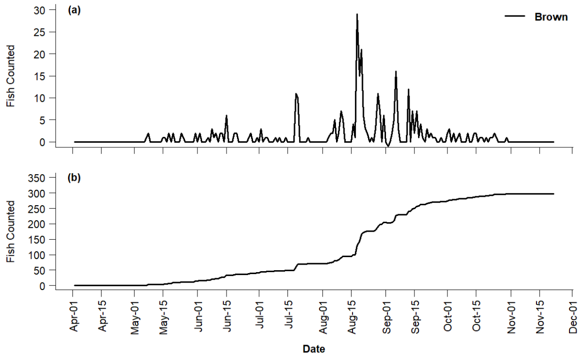


FIG 7.3.9. (a) Daily and (b) cumulative observed counts of Brown Trout at the Ganaraska River fishway at Port Hope, Ontario from April 2nd to November 18th, 2019.

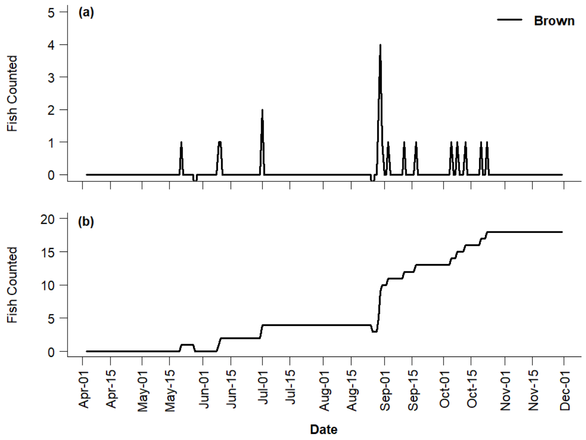


FIG. 7.3.10. (a) Daily and (b) cumulative observed counts of Brown Trout at the Streetsville Fishway, Credit River, Mississauga, Ontario from April 3rd to November 8th, 2019.

7.4 Walleye

E. Brown, Lake Ontario Management Unit

Walleye is the Bay of Quinte fish community's primary top piscivore and of major interest to both commercial (Section 3.2) and recreational fisheries (Section 2.3 & 2.4). The Walleye population in the Bay of Quinte and eastern Lake Ontario is managed as a single large stock. The Walleye's life history-specific movement and migration patterns between the bay and the lake determines the seasonal distribution patterns of the fisheries. Understanding Walleye distribution is also crucial to interpret summer assessment netting results (Sections 1.1 and 1.2). After spawning in April, mature Walleye migrate from the Bay of Quinte toward eastern Lake Ontario to spend the summer months. These mature fish return back "up" the bay in the fall to over-winter. Immature Walleye generally remain in the bay year-round. In 2017 a multi-year acoustic telemetry project was initiated to describe Bay of Quinte-eastern Lake Ontario Walleye movement at a finer scale than currently exists (Section 9.10).

Recreational Fishery

The recreational fishery consists of a winter ice-fishery and a three season (spring/summer/fall) open-water fishery. Most Walleye harvest by the recreational fishery occurs in the upper and middle reaches of the Bay of Quinte during the winter ice-fishery (Fig. 7.4.1) and the spring/early summer open-water fishery. All sizes of fish are caught during winter while mostly juvenile fish (age-2 and age-3) are caught during spring and summer. A popular "trophy" Walleye fishery occurs each fall based on the large, migrating fish in the middle and lower reaches of the Bay of Quinte at that time (see Section 2.3). Increasingly in recent years, there is also a late-summer fishery in eastern Ontario targeted at these large Walleye prior to their return to the Bay of Quinte. Trends in the open-water fishery are shown in Fig. 7.4.2. Annual Walleye angling effort and catch (ice and open-water fisheries combined) has been relatively stable averaging 333,665 hours and 64,206 fish caught during the last decade. Walleye catch and harvest spiked in the 2017 open-water fishery (102,351 and 52,651 fish, respectively) as two very strong year-classes (age-2 and 3) recruited to the fishery.

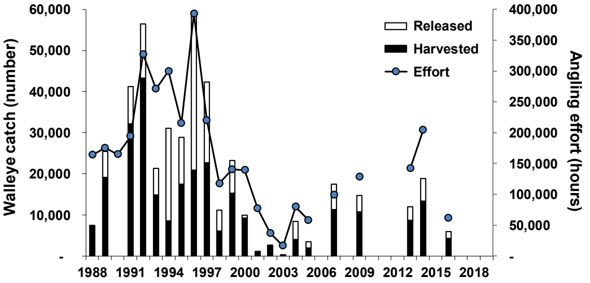


FIG. 7.4.1. Bay of Quinte recreational angling effort and walleye catch (released and harvested) during the winter ice-fishery, 1988-2017. No data for 2006, 2008, 2010-2012, 2015, 2017-2019.

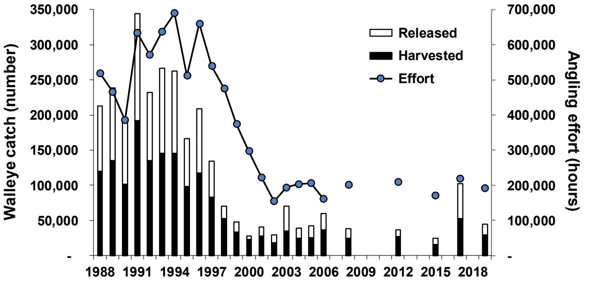


FIG. 7.4.2. Bay of Quinte recreational angling effort and walleye catch (released and harvested) during the open-water fishery, 1988-2017. No data for 2007, 2009-2011, 2013-2014, 2016 or 2018.

Commercial Fishery

Walleye harvest by the commercial fishery is highly regulated and restricted. No commercial Walleye harvest is permitted in the upper and middle reaches of the bay (Trenton to Glenora). A relatively modest Walleye commercial quota (51,090 lbs; Fig. 7.4.3) is allocated in the lower Bay of Quinte and Lake Ontario with additional seasonal, gear, and fish-size restrictions. The commercial harvest of Walleye was 27,320 lbs in 2019 (see Section 3.2). Commercial Walleye harvest has shifted location from quota zone 1-2 to 1-4 over the last decade (Fig. 7.4.4). This shift has likely resulted in smaller, younger Walleye being harvested but this has not been measured.

Annual Harvest

Total annual Walleye harvest in the recreational and commercial fisheries (by number and weight) over the last decade (20010-2019) is given in Table 7.4.1. The recreational fishery takes about 80% of the annual harvest with the open-water component of the recreational fishery

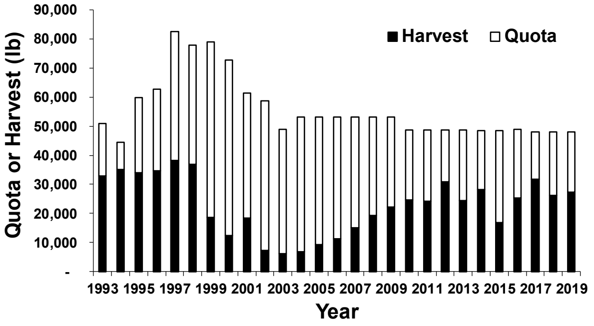


FIG. 7.4.3. Walleye commercial quota and harvest, 1993-2019.

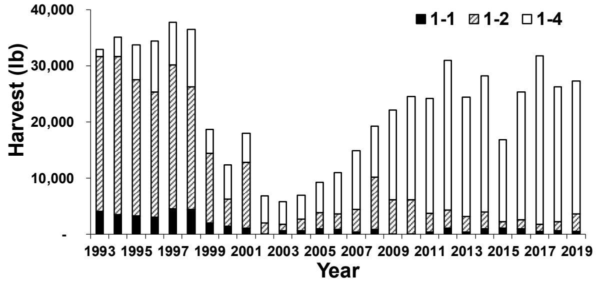


FIG. 7.4.4. Walleye commercial harvest by quota zone, 1993-2019.

making up 62% (by number) of total annual harvest.

Abundance

Walleye abundance is assessed in a number of programs. Summer gill net sampling (Section 1.1) is used to assess relative abundance of juvenile (Bay of Quinte) and adult (eastern Lake Ontario) fish (Fig. 7.4.5). Fig. 7.4.6 shows the 2019 Walleye age distribution in these two geographic areas. Young-of-the-year (YOY) abundance is assessed in Bay of Quinte bottom trawls (Fig. 7.4.7; Section 1.2).

Except for an unusually high catch in 2013, juvenile abundance in the Bay of Quinte has been very stable since 2001 (Fig. 7.4.5). The 2019 catch was average with a large contribution of age -3, 4 and 5 fish. In eastern Lake Ontario index gill nets, after an unusually low catch in 2013, Walleye abundance in eastern Lake Ontario increased to a level similar to that observed in the previous few years. The 2019 catch was above the FMP target (Fig. 7.4.5). The 2014 catch of YOY Walleye in bottom trawls was the highest since 1994 (Fig. 7.4.7) and the 2015 year-class was also very large. Although 2019 was a poor year-class, recent year-classes (i.e. 2014, 2015 and 2018) foreshadow continued stability in the Walleye population and fisheries.

TABLE 7.4.1. Mean annual Walleye harvest by major fishery over the last decade (2010-2019).

	Walleye harvest			
	Number of fish	lbs	% by number	% by weight
Recreational				
ice-fishery	8,762	28,170	17.5%	24.8%
open-water fishery	31,185	59,585	62.2%	52.4%
Commercial	10,178	25,968	20.3%	22.8%
Total	50,125	113,723	100%	100%

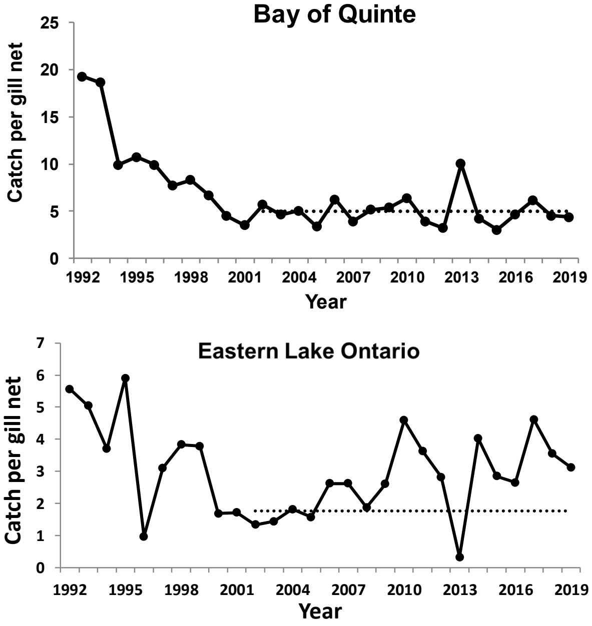


FIG. 7.4.5. Walleye abundance in summer gill nets in the Bay of Quinte, 1992-2019 (upper panel) and eastern Lake Ontario, 1992-2019 (lower panel). Also shown (dotted line) is the Bay of Quinte FMP (Fisheries Management Plan) "target" for these two components of the Walleye population.

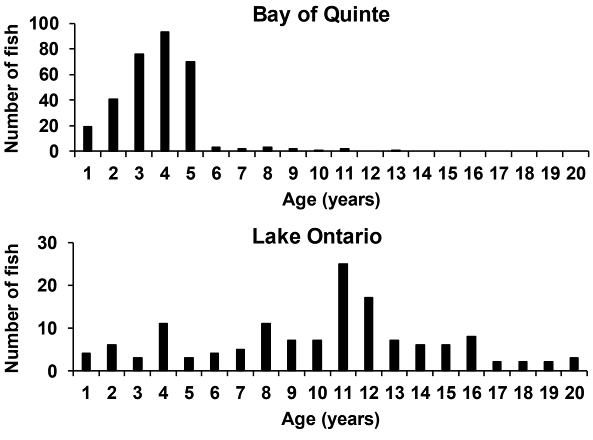


FIG. 7.4.6. Walleye age distribution in 2018 summer gill nets in the Bay of Quinte (upper panel) and Lake Ontario (lower panel).

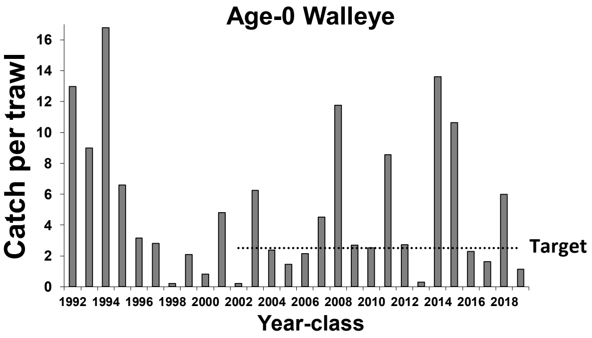


FIG. 7.4.7. Young-of-the-year (Age-0) Walleye catch per trawl in the Bay of Quinte, 1992-2019. Also shown (dotted line) is the Bay of Quinte FMP (Fisheries Management Plan) "target" catch per trawl.

Growth

Walleye length-at-age for age-2 and age-3 juvenile fish and age-10 mature fish (males and females separated) is shown in Fig. 7.4.8. Length -at-age increased for juvenile (age-2 and 3) fish in 2000 and remained stable since. For mature fish (age-10), length-at-age has been stable, with females being larger than males, however in 2019, female condition decreased and was lower than males.

Condition

Walleye condition (relative weight) is shown in Fig. 7.4.9. Condition has remained stable in Bay of Quinte fish (immature), with an increasing trend since 2015. An increasing trend in Lake Ontario (mature fish) was observed until 2014 when condition declined sharply; condition in the lake has since increased and declined slightly.

Other Walleye Populations

The Bay of Quinte/eastern Lake Ontario Walleye population is the largest on Lake Ontario; smaller populations exist in other nearshore areas of the Lake Ontario. Walleye in these other areas are regularly assessed with a standard trap net program (Nearshore Community Index Netting; see Section 1.3). Mean Walleye trap net catches (2006-2012 compared to 2013-2019 time-periods) in 12 geographic nearshore areas are shown in Fig. 7.4.10. Highest Walleye abundance occurs in Hamilton Harbour, Bay of Quinte, East Lake, West Lake and Weller's Bay. Walleye abundance increased in Hamilton Harbour after stocking efforts began in 2012.

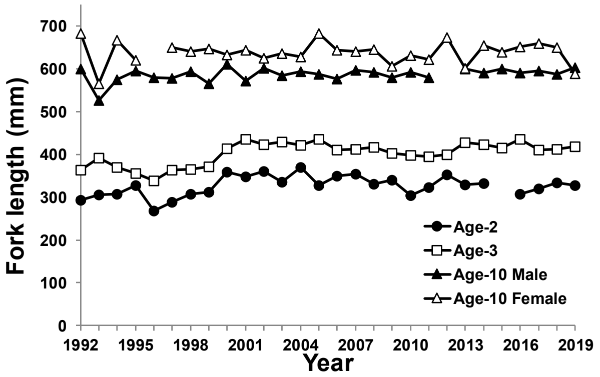


FIG. 7.4.8. Trends in Walleye fork length-at-age for age-2, age-3, age-10 males and females, caught in summer assessment gill nets, 1992-2019.

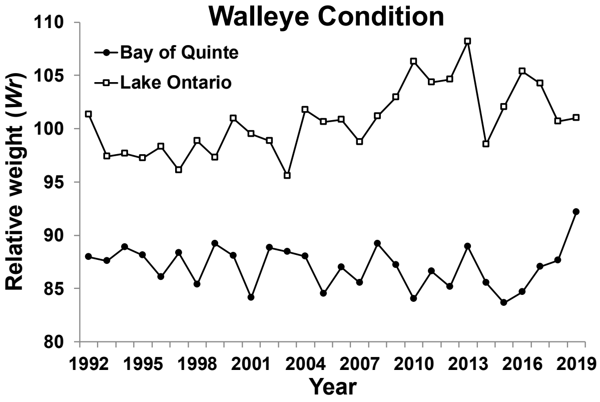


FIG. 7.4.9. Trends in Walleye condition (relative weight), caught in summer assessment gill nets in the Bay of Quinte (fish <500 mm fork length) and Lake Ontario (fish >500 mm fork length), 1992-2019.

Walleye Stocking

Walleye stocking alternates annually between Hamilton Harbour and Toronto Harbour in an effort to re-establish this native, predatory fish and to promote urban, near-shore angling. In 2019, 1 million swim-up fry and 100,000 summer fingerlings were stocked in May and July respectively into Toronto Harbour (see Sections 6.1 and 8.6).

Overall Status

The overall status of Lake Ontario Walleye is good. The Bay of Quinte/eastern Lake Ontario population did decline during the 1990s but stabilized at levels that supports a high quality fishery including for trophy fish (see Section 2.3). Recent recruitment levels forecast a healthy population over the next several years.

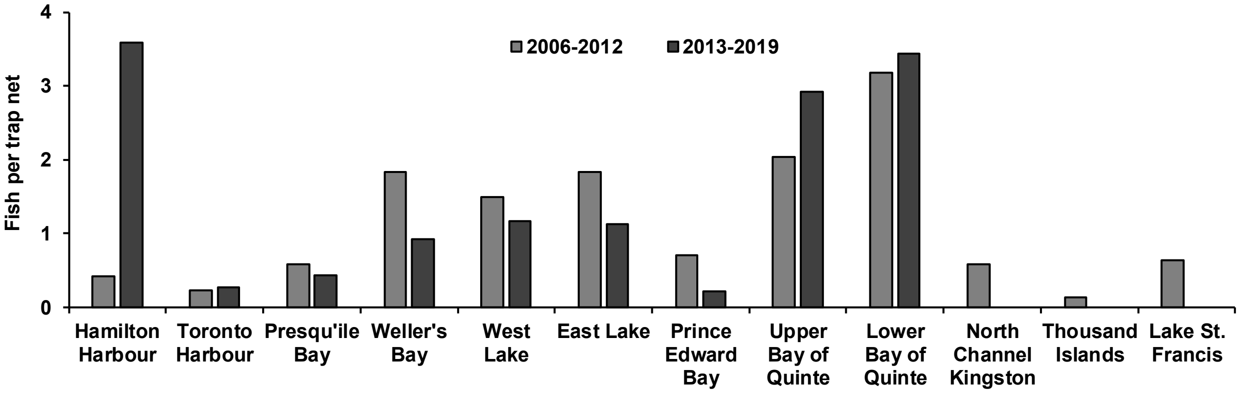


FIG. 7.4.10. Walleye abundance (mean annual number of fish per trap net) in 12 geographic nearshore areas of Lake Ontario and the St. Lawrence River arranged from west (Hamilton Harbour) to east (Lake St. Francis). Catches are annual means for all sampling from 2006-2012 and 2013-2019 time-periods with individual areas having been sampled from one to seven years within a time-period. No sampling in the later time-period for North Channel/Kingston, Thousand Islands and Lake St. Francis.

7.5 Lake Whitefish

E. Brown, Lake Ontario Management Unit

Lake Whitefish is a prominent member of the eastern Lake Ontario cold-water fish community and an important component of the local commercial fishery. Two major spawning stocks are recognized in Canadian waters: one spawning in the Bay of Quinte and the other in Lake Ontario proper along the south shore of Prince Edward County. A third spawning area is Chaumont Bay in New York State waters of eastern Lake Ontario.

Commercial Fishery

Lake Whitefish commercial quota and harvest increased from the mid-1980s through the mid-1990s, declined through to the mid-2000s then stabilized at a relatively low level (Fig. 7.5.1). Quota and harvest averaged 123,906 lb and 78,788 lb respectively, over the 2008-2019 time-period. In 2019, base quota was 134,879 lb and the harvest was 103,427 lb (Section 3.2). In recent years, most of the harvest occurs in quota zone 1-2, eastern Lake Ontario (Fig. 7.5.2). Here, most of the harvest occurs at spawning time in November and early December (Fig. 7.5.3). Although harvest at other times of the year is less than at spawning time, considerable gill net fishing effort does occur. Highest harvest rates (HUE) occur at spawning time.

The age distribution of Lake Whitefish harvested is comprised of many age-classes (Fig. 7.5.4). Most fish are age-5 to age-16.

Abundance

Lake Whitefish abundance is assessed in a number of programs. Summer gill net sampling is used to assess relative abundance of juvenile and adult fish in eastern Lake Ontario (Fig. 7.5.5, and see Section 1.1). Young-of-the-year (YOY) abundance is assessed in bottom trawls (Section 1.2) at Conway (lower Bay of Quinte) and Timber Island (EB03 in eastern Lake Ontario) (Fig. 7.5.5). Lake Whitefish abundance, like commercial harvest, has been stable at a relatively

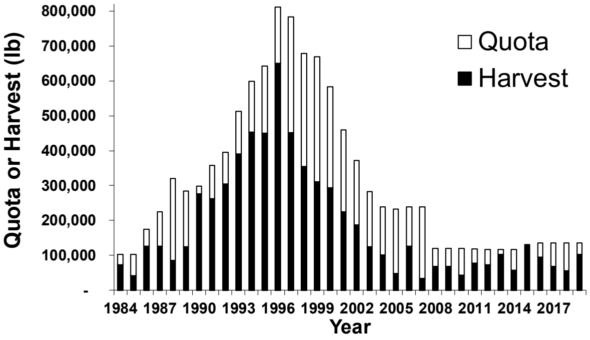


FIG. 7.5.1. Lake Whitefish commercial quota and harvest, 1984-2019.

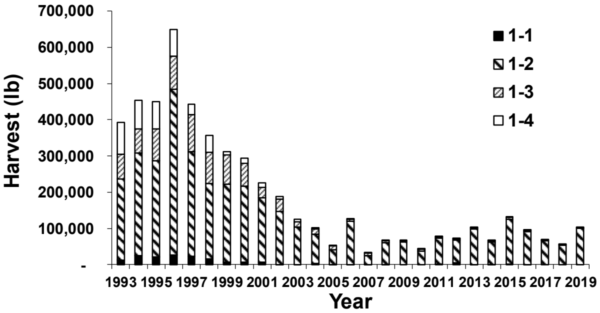


FIG. 7.5.2. Lake Whitefish commercial harvest by quota zone, 1993-2019.

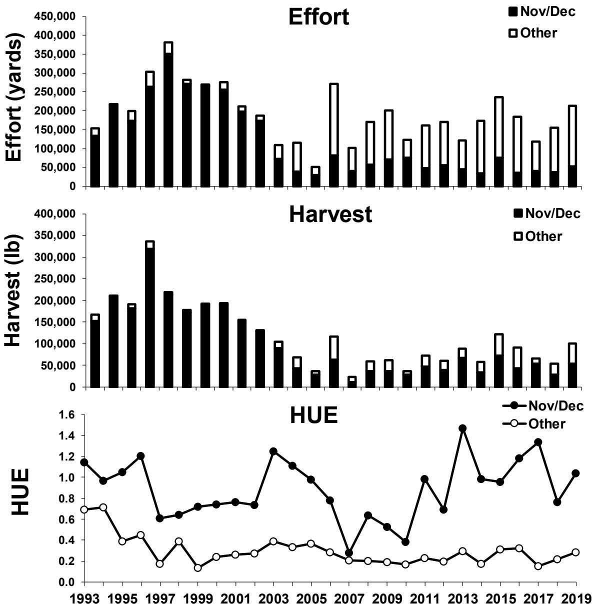


FIG. 7.5.3. Commercial Lake Whitefish gill net fishing effort (top panel), harvest (middle panel), and harvest-per-unit-effort (HUE; bottom panel) in quota zone 1-2, 1993-2019. November/December statistics are reported separately from other times of year.

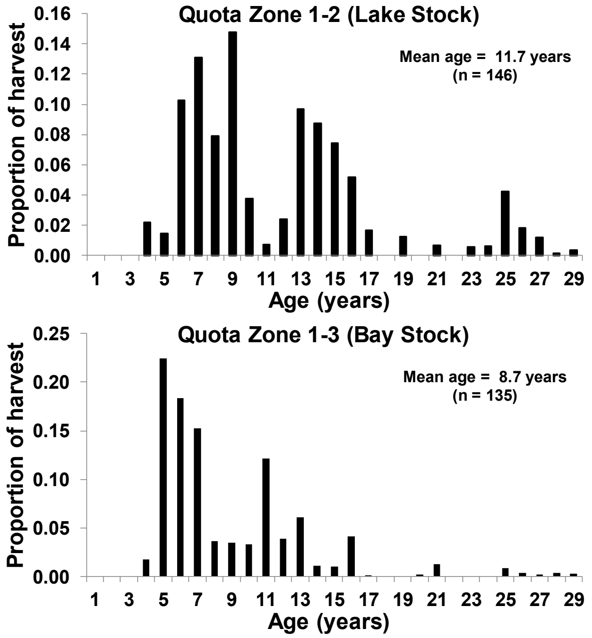


FIG. 7.5.4. Lake Whitefish age distributions (by number) in the 2019 quota zones 1-2 (upper panel) and 1-3 (lower panel) fall commercial fisheries.

low level for the last decade. Young-of-the-year catches have been highly variable.

Condition

Trends in Lake Whitefish condition during summer and fall are shown in Fig. 7.5.6. Condition was high from 1990-1994, declined through 1996. Condition then increased to intermediate levels for Lake Whitefish sampled during summer but condition remained low for fish sampled during fall.

Overall Status

Following severe decline in abundance, commercial harvest, growth and condition, during the 1990s, the eastern Lake Ontario Lake Whitefish population appears to have reached a much reduced level of abundance and stable condition.

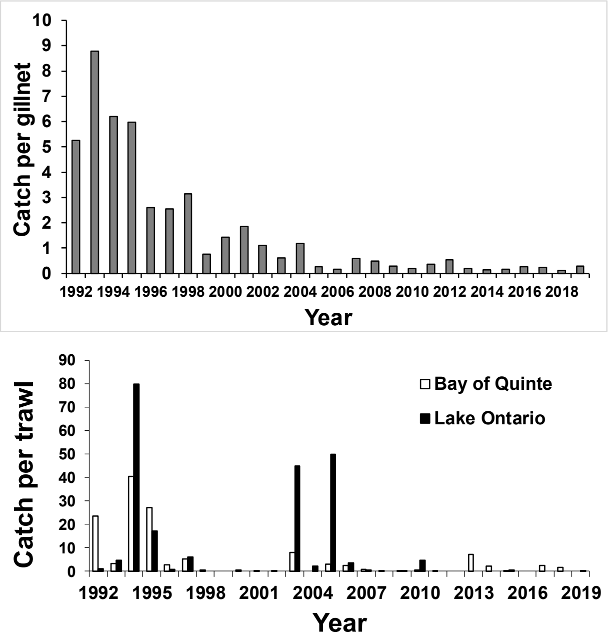


FIG. 7.5.5. Lake Whitefish abundance in eastern Lake Ontario assessment gill nets, 1992-2019 (sub-adult and adult; upper panel) and bottom trawls, 1992-2019 (young-of-the-year; lower panel).

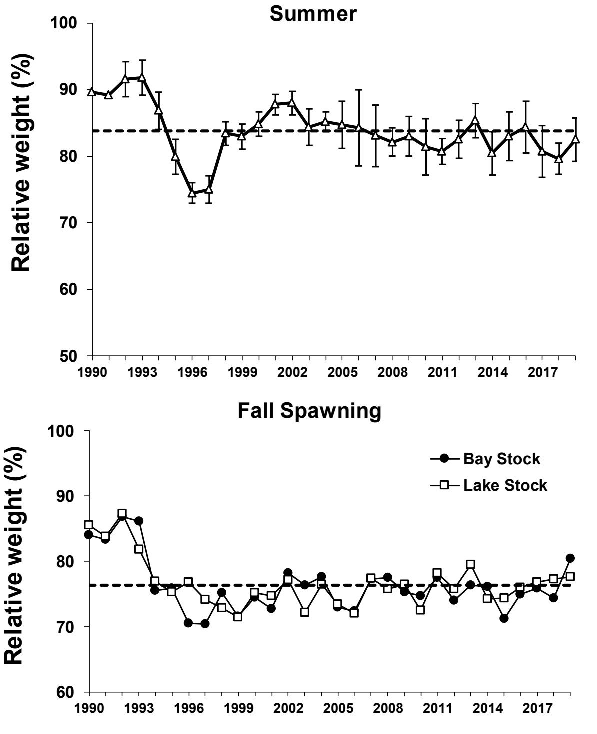


FIG. 7.5.6. Condition (relative weight) of Lake Whitefish sampled during summer assessment gill net surveys in eastern Lake Ontario (upper panel error bars ±2SE) and fall commercial catch sampling (lower panel) in the Bay of Quinte ("Bay Stock") and the south shore Prince Edward County ("Lake Stock"), 1990-2019.

8. Species Rehabilitation

8.1 Introduction

M. D. Desjardins and A. Todd, Lake Ontario Management Unit

Lake Ontario has a long history of fish community change caused by introduced species (intentional and unintentional), overfishing, habitat loss, industrial development and pollution. OMNRF works with many partners - government agencies, non-government organizations and interested individuals at local, provincial and national levels - to enhance Lake Ontario fish community fisheries through native species rehabilitation.

Actions to rehabilitate native species include fish stocking, habitat enhancement, fish passage, fish community monitoring and research and management to ensure sustainable harvest though regulations. Rehabilitation efforts are occurring across the Lake Ontario basin including the embayments, tributaries and the lower Niagara River and the St. Lawrence River downstream to the Quebec-Ontario boarder.

The sections below describe initiatives to restore Atlantic Salmon, American Eel, Bloater, Lake Trout and Walleye. Some of these species have been extirpated, while others were once common but are now considered rare, at least in some locations in the lake. Successful restoration of these native species will enhance the overall health of the fish community and support fisheries that provide economic and social benefits to Ontario. Native species restoration also contributes to improving Ontario's biodiversity and meeting Ontario's commitments under the GLFC's Fish Community Objectives and commitments identified in the Great Lakes Water Quality Agreement.

8.2 Atlantic Salmon Restoration

M. D. Desjardins, Lake Ontario Management Unit

Atlantic Salmon were extirpated from Lake Ontario by the late 1800s, primarily as a result of spawning and nursery habitat loss in streams. As a top predator, they played a key ecological role in the offshore fish community. They were also a valued food resource for indigenous communities and early Ontario settlers. As such, Atlantic Salmon are recognized as an important part Ontario's natural and cultural heritage.

The Lake Ontario Restoration Program for Atlantic Salmon was initiated in 2006 and has developed into a significant partnership combining the efforts of the Ontario Ministry of Natural Resources and Forestry (OMNRF), the Ontario Federation of Anglers and Hunters (OFAH), and many corporate and community partners. Significant progress has been made through enhancements in fish production, community involvement, research and assessment, and habitat enhancement. In 2014 a program science review resulted in a number of recommendations. In 2015, the program steering committee developed a revised five-year plan (2016-2020) designed to accelerate restoration with emphasis on improving adult returns.

Since then, many program adjustments have been implemented to improve numbers of returning Atlantic Salmon. Changes to hatchery rearing / stocking practices have resulted in larger fish of all life stages being stocked with more emphasis on stocking spring yearling aged Sebago Lake Strain Atlantic Salmon (Section 6.1). Regulation changes in 2016 allowed for catch and release angling of Atlantic Salmon in Lake Ontario tributaries and a significant stocking allocation was directed toward the Ganaraska River to establish a destination fishery.

To help monitor success a trial volunteer Atlantic Salmon angler survey was initiated during 2018 with a full angler survey delivered across multiple watersheds in 2019. While initial angler engagement was high with 24 anglers participating, only a few volunteers submitted information and tissue samples seeming to indicate low abundance of Atlantic Salmon. Interestingly, numerous independent angler reports from multiple tributaries during the same period imply that numbers of adult fish were higher than indicated by the volunteer survey.

Progress is also being tracked with the help of new "state of the art" fish counter / camera systems (known as the Riverwatcher fish counter) that has been installed in the fishway at Corbett's Dam on the Ganaraska River (Section 1.4) and in the fishway at the Reid Milling Dam (a.k.a. Streetsville Dam) on the Credit River (Section 1.5). This new technology provides better surveillance of the Atlantic Salmon spawning run and provides valuable information on the migratory patterns for other species ascending the Ganaraska and Credit Rivers.

The Ganaraska River fish counter monitored fish passage events from April 2nd to November 18th, 2019. The first Atlantic Salmon observed at the Ganaraska Fishway in 2019 was on August 14th. A total of eight Atlantic Salmon were detected moving through the camera in 2019. All fish possessed an adipose fin clip indicating that these individuals were returning to the stream in which they were stocked. Since 2016 all Atlantic Salmon stocked into the Ganaraska River received an adipose clip to facilitate stocking assessments. During this period, anglers noted many Atlantic salmon downstream of the fishway, however, these fish were not seen passing through the fishway camera. Coincidentally, migrating Chinook Salmon were in peak abundance in the Ganaraska River at that time and their run size was high relative to other years (see Sections 1.4 and 7.1). The effects of interspecific interference on migration in streams and particularly those with fishways is of research interest.

The Credit River Riverwatcher was installed at the exit of the Streetsville fishway April 3rd, 2019 and monitored fish passage to November 8th, 2019. The first Atlantic Salmon observed was on May 24th. A total of 20 Atlantic Salmon were identified exiting the Streetsville Fishway (Fig. 1.5.7). The last Atlantic Salmon observed on the fish counter was on October 12th, 2019.

In 2019, work also began summarizing program progress toward meeting the targets and objectives as set out in the 2015 five-year restoration plan. Once finished, this planning document will help frame the discussions going forward regarding direction of the next 5-year planning process.

8.3 American Eel Restoration

J. La Rose, Lake Ontario Management Unit

Background

The American Eel (Anguilla rostrata) was historically an important predator in the nearshore fish community of Lake Ontario and the upper St. Lawrence River (LO-SLR). They also functioned as an important component of the LO-SLR commercial fishery during the latter part of the 20th century and are highly valued by indigenous peoples. American Eel abundance declined in the LO-SLR system as a result of the cumulative effects from a variety of factors including: mortality during downstream migration due to hydro-electric turbines, reduced access to habitat imposed by man-made barriers to upstream migration, commercial harvesting, contaminants, and loss of habitat.

By 2004, American Eel abundance in Ontario had declined to levels that warranted closure of all commercial and recreational fisheries in the province. In 2007, American Eel was identified as Endangered under Ontario's Endangered Species Act (ESA). In 2012, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that American Eel be identified as Threatened under the Canadian Species at Risk Act. These events led to additional efforts to protect and restore the American Eel. This section describes the status of American Eel in LO-SLR as well as actions taken by the Lake Ontario Management Unit and its partners to reverse the decline of American Eel populations in Lake Ontario and the St. Lawrence River.

Indices of Eel Abundance

Eel Ladder

The largest barriers to both upstream and downstream migration of American Eels into the Lake Ontario system are power dams in the St. Lawrence River. One of these dams, the Moses Saunders Power Dam (MSPD), is located on the upper St. Lawrence River between Cornwall, Ontario and Massena, New York. In 1974, an eel ladder (Saunders Ladder) was put in place on the Ontario portion of the dam to aid in the upstream passage of American Eel. The maintenance and operation of the ladder was accomplished through collaborations between OMNRF and Ontario Power Generation (OPG) until 2007 when OPG took full responsibility for the structure.

In 2019, the Saunders eel ladder was in operation 24 hours a day from June 15 to October 15. Over the course of these four months an electronic fish counter was used to quantify the number of eels passing upstream. The counter operated uninterrupted throughout the season. In 2019, a total of 966 eels successfully passed through the OPG eel ladder (Figure 8.3.1). Most eels passed through the ladder from early July to late August and the majority of eels (98.6%) exited the ladder during hours of darkness from 22:00 to 06:00.

The number of eels passed through the Saunders ladder during 2019 was higher than the number of eels that passed through a second eel ladder (Moses Ladder) on the New York portion of the MSPD, where 29 eels successfully passed through the structure. The Moses Ladder is maintained by the New York Power Authority (NYPA) and since its operation began in 2006 it has often passed slightly more eel than the Saunders Ladder.

The passage of eel through the ladder has declined in recent years and the combined total which passed through both ladders in 2019 (995 eels) is the lowest observed over the past 13 years. In 2019, record high water levels and flows in the USLR-LO likely changed the extent to which eel used both ladders. The Long Sault Dam Spillway along the South channel of the St Lawrence passed additional water throughout the duration of the eel upward migration period in 2019. Attractive flow from the spillway is thought to reduce ladder use by migrating eel. A similar reduction in passage was also observed during high flows in 2017. In high flow years (e.g. 2017 and 2019) eel passage may be less representative of eel abundance in the system.

Though the number of eels ascending the ladders in 2019 is only 0.1% of the level of

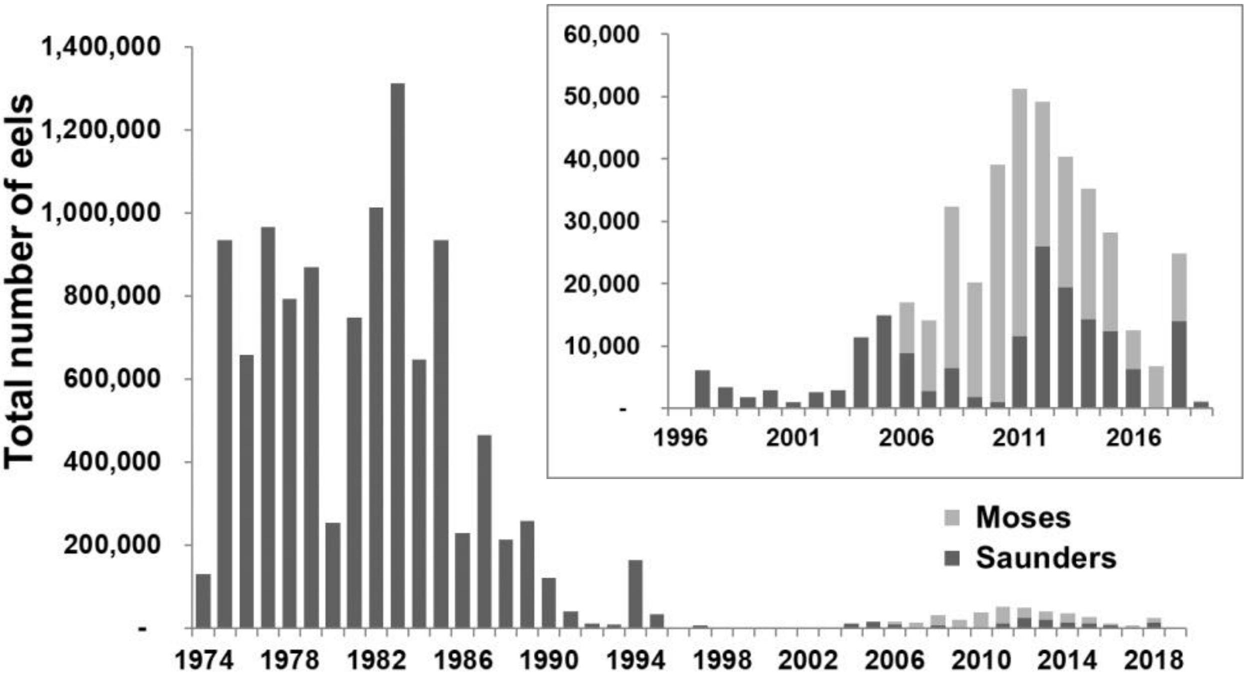


FIG. 8.3.1. Total number of eels ascending the eel ladder(s) at the Moses-Saunders Dam, Cornwall, Ontario from 1974-2019. During 1996, the ladder operated however no counts were made

recruitment identified as a long-term indicator in the Lake Ontario Fish Community Objectives for American Eel (FCO 1.3; at least one million eels ascending the ladders annually), it is thought that fewer eel used the ladders as a result of high flow conditions in the St Lawrence in 2019.

Lake Ontario and Upper St. Lawrence River Assessment programs

In 2019, the abundance of larger “yellow” eels in the LO-SLR was measured with several assessment programs. Bottom trawling in the Bay of Quinte has been conducted since 1972 as part of the fish community index program. The average catch of American Eel in 511 trawls conducted (June-September at sites upstream of Glenora) between 1972 and 1996 was 2.0 eels per trawl. No eels were captured in the 360 trawls conducted between 2003 and 2011. Catches of eels have been increasing slightly in recent years with six eels captured during the 48 bottom trawls conducted during 2019 (Section 1.2).

Nearshore trap netting was conducted using the NSCIN fish community index protocol (see Section 1.3). During 2019, two eels were captured in 24 nets set in Hamilton Harbour, four eels were captured in 24 nets set in Toronto Harbour, 32 eels were captured in 36 nets set in the Upper Bay of Quinte and 17 eels were captured in 36 nets set in the Middle/Lower Bay of Quinte. Eel catch rates in Toronto, Upper and Middle/Lower Bay of Quinte were the highest observed in the time series for each of these locations.

Tailwater Survey

In 2019, surveys were conducted by OPG to collect dead eels in the Canadian water from the tailwater of the MSPD. The surveys followed standardized routes which extended approximately 10 km downstream of the dam along the Canadian shoreline. Parallel surveys are conducted in US waters below the MSPD by New York Power Authority (NYPA). Tailwater surveys were conducted twice weekly from June 11 to September 27, 2019. Investigators working in a boat searched the specified area for dead and injured American Eels near the shoreline. In 2019, OPG observed a total of 61 eels during 31 surveys, an average of 1.9 eels per day while NYPA observed 0.7 eels per day during their survey of US waters below the MSPD (Figure 8.3.2). The average length of whole eels (n=14) collected by OPG was 992 ± 68 mm (mean ± SD) (Figure 8.3.3). These results are within the range observed in previous years, although it is possible that high St Lawrence River flows in 2019 changed the distribution of dead eel downstream.

Prompted by a report of dead American eels and a late fall survey in 2018, a tailwater survey was also conducted on November 2, 2019. Sixteen eels were collected during the survey and analysis of otoliths indicated that all were of stocked origin. This later timing of outmigration by stocked eels is corroborated by outmigration studies on stocked eels conducted in conjunction with the Eel Passage Research Center as well as from landings in the commercial silver eel fishery in Quebec.

Restoration Efforts

Trap and Transport

Safe downstream passage past hydro turbines during the eel's spawning migration is important to restoration of eel and is identified in the OPG Action Plan. "Trap and Transport" (T&T) of large yellow eels was initiated in 2008 as an OPG pilot project to investigate this alternative for mitigating mortality of eels in the turbines at the Saunders Hydroelectric Dam. Through this program, commercial fishers in the USLR-LO and LSF are permitted to retain large eel for transport and release below the furthest downstream dam near Beauharnois Quebec. During 2008-2014, only eels collected during the spring commercial fishery were included in T&T. Since 2014, eels collected during the fall commercial fishery were also included in the T&T project to increase the numbers of eels transported.

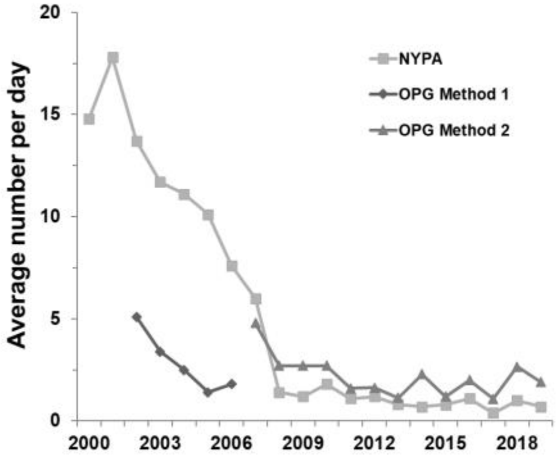


FIG. 8.3.2. Average number of eels observed per day in the tail-waters of the Moses-Saunders Dam 2000-2019. Note that the OPG sampling methodology and route changed in 2007.

In 2019 a total of 5,253 large yellow eels (393 and 91 from Lake St. Francis in the spring and fall respectively, and 1718 and 3,051 from above the Moses-Saunders Dam during the spring and fall respectively) were released alive into Lac St. Louis immediately downstream of the Beauharnois Hydroelectric Dam as part of the T&T program (Figure 8.3.4).

Eel Passage Research Center

Since 2013, the Eel Passage Research Center (EPRC) has conducted research to evaluate potential techniques to concentrate out-migrating eels for downstream transport around turbines at Moses-Saunders and Beauharnois Hydroelectric Dams to mitigate mortality in turbines. EPRC is coordinated by the Electric Power Research Institute and primary funders of

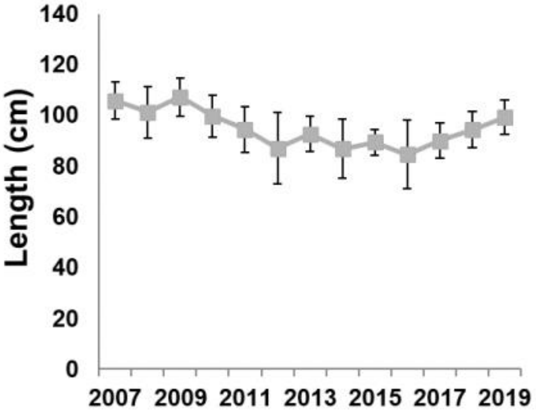


FIG 8.3.3 Mean length (± standard deviation) of eels collected in the tail-waters of the Moses-Saunders Dam 2007-2019.

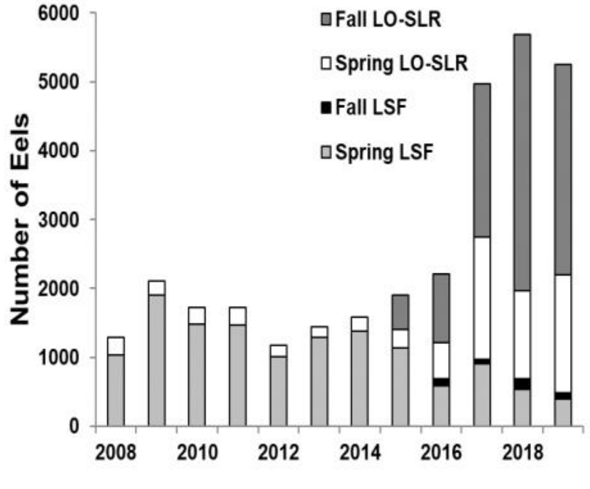


FIG 8.3.4 Total number of eels collected in the Trap and Transport program from 2008-2019. Each total is divided into the locations at which the eels were captured in commercial fishery nets and the season of collections.

the research include OPG, Hydro Quebec, and the United States Fish and Wildlife Service (through a funding arrangement from NYPA). In 2019, the EPRC focussed on applying knowledge of eel behavior and migration gained in recent years, to plan for a behavioral guidance experiment in the St Lawrence River.

Summary

Restoration of American Eel in Lake Ontario and the St. Lawrence River has been identified as a Fish Community Objective for Lake Ontario. The abundance of eels moving into the system via the ladders at the Moses-Saunders Dam and the number of mature eels leaving the system are much lower than the FCO long-term indicators. However, the mortality rate of eels migrating downstream towards the spawning grounds has decreased because of the Trap and Transport project. In addition, a collaborative effort to develop methods of reducing mortality of eels during their downstream migration has been initiated. Although the Fish Community Objective related to American Eels has not been achieved, the activities summarized in this report show that some progress has been made.

8.4 Bloater Restoration

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E. Brown, Lake Ontario Management Unit, MNRF
B.C. Weidel Lake Ontario Biological Station, USGS
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B. O'Malley Lake Ontario Biological Station, USGS
C. Osborne Lake Ontario Biological Station, USFWS

Prior to the mid-1950s, Lake Ontario was home to a diverse assemblage of deepwater ciscoes including Bloater (*Coregonus hoyi*), Kiyi (*C. kiyi*), and Shortnose Cisco (*C. reighardi*). Currently, only the Cisco (*C. artedi*) remains in Lake Ontario. The Lake Ontario Committee has set a goal to establish a self-sustaining population of Bloater in Lake Ontario requiring a cooperative, international effort between the Ontario Ministry of Natural Resources and Forestry (OMNRF), the New York State Department of Environmental Conservation (NYSDEC), the U.S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey (USGS) and the Great Lakes Fishery Commission (GLFC). The objectives and strategies for the establishment of Bloater are specified in a draft strategic plan. The plan addresses: sources of gametes, culture facilities, culture capacity, stocking, detection of wild fish, increasing our understanding of ecological consequences, research needs, and public education.

Potential long-term benefits of restoring Bloater include restoring historical food web structures and function in Lake Ontario; increasing the diversity of the prey fish community; increasing resistance of the food web to new species invasions; increasing wild production of salmon and trout by reducing thiaminase impacts of a diet based on Alewife and Rainbow Smelt; and, potentially supporting a commercial fishery. Potential risks associated with the reintroduction of Bloater relate to the unpredictability of food web interactions in an evolving Lake Ontario ecosystem. Accepting some risk and uncertainty, doing the necessary science to increase understanding and minimize risk, and adapting management strategies accordingly are prerequisites for successful restoration of Bloater in Lake Ontario.

In 2019, there were 17,733 fall yearling (age-1) and 9703 age-2 Bloater stocked by OMNRF on November 13th and 12th, respectively,

FIG. 8.4.1. Extent of fish community sampling conducted in 2019 by the Lake Ontario Management Unit, NYDEC, and USGS in areas where Bloater could expect to be found. Sampling occurred throughout the entire open water season using gill nets and bottom trawls (2 different styles).

south of Cobourg in deep water. Detailed stocking records are reported in Section 6.1.

Several of OMNRF programs sample depths considered Bloater habitat have the potential to capture and assess Bloater. The Fish Community Index Gill Net program (Section 1.1) sampled at three off-shore areas (Rocky Point, Cobourg and Port Credit) in depth from 50m to 140m. In total, 45 index gill nets (15 per area) resulted in no Bloater catches (Fig, 8.5.1). During the spring and fall bottom trawl surveys (Section 1.6 and 1.7) conducted in partnership with the USGS and NYSDEC, a total of 260 trawls (N = 157 spring, N = 103 fall) were conducted in depths greater than 50m. One Bloater was caught in US waters during the spring survey (further details provided in Appendix A).

8.5 Lake Trout Rehabilitation

J. P. Holden, M. Yuille, C. Lake and E. Brown, Lake Ontario Management Unit

Once a dominant offshore predator and important commercial fishery; a combination of harvest, habitat destruction and impacts of invasive species resulted in Lake Trout being deemed extirpated in Lake Ontario by the 1950s. Commercial harvest records of Lake Trout began in the 1830s with the peak of the fishery resulting in over a million pounds of landed catch during the 1920s. Early stocking efforts were unsuccessful at sustaining Lake Trout due to high Sea Lamprey predation of adult Lake Trout. The Sea Lamprey control program began on Lake Ontario in the 1970s and offered new optimism for Lake Trout restoration. The first joint Canada/ U.S. plan outlining the objectives and strategies for the rehabilitation efforts was formulated in 1983. The two objectives of the recovery strategy are: 1) increase abundance of stocked adult lake trout to a level allowing for significant natural reproduction and 2) improve production of wild offspring and their recruitment to adult stock.

Canadian waters of Lake Ontario have had gill net assessments since the 1950s. Sites within the Kingston Basin (also referred to as the East Basin; the portion of the lake bounded by Prince Edward Bay, Main Duck Island, Amherst Island and the Canada/US border) provide the most consistent long-term index of Lake Trout monitoring in Ontario waters dating back to the 1957. Index gill netting in the main basin of Lake Ontario began in the 1960s but has not been conducted with standard effort and sites throughout the entire period. Stocking throughout the 1980s was successful in restoring Lake Trout biomass throughout Lake Ontario (Figure 8.5.1). Ecosystem change, stocking cuts and a period of high Sea Lamprey mortality lead to declines in Lake Trout abundance throughout the 1990s to 2005 (2008 in the main basin). Since 2005 catches in the Ontario waters of the main basin have remained low relative to the peak in the 1990s but exhibit a moderate increasing trend. A summary of progress towards restoration targets is included in Table 8.5.1.

An increase in spatial coverage in gill net sites in recent years provides an opportunity to compare geographical differences in Lake Trout abundance (Fig. 8.5.2). Catches are highly variable at all sites with a five-year mean catch-per-unit-effort (CUE) of 2.4 fish per 24hr set of standardized index gill net (min. = 0.0, max. = 41.0). Port Dalhousie, added in 2018, is a notable outlier among the areas with a mean catch rate of 15.6 (median CUE = 9.7) (Fig. 8.5.3). Port Dalhousie also is unique in that the catch composition has a high proportion of US stocked fish (64%) relative to the other sites (15%).

Catch and harvest of Lake Trout in the recreational fishery is assessed through the Lake Ontario Salmon and Trout Angler Survey (Section 2.4). A recommended maximum harvest 5000 Lake Trout from Ontario waters is suggested as a harvest level to meet restoration objectives. In 2019, the Lake Ontario Salmon and Trout Angler Survey estimated that 1349 Lake Trout were harvested from the western portion of the Lake. In 1987 and 1992 creel surveys were conducted in both western Lake Ontario and in the Kingston Basin. It was found that the Kingston Basin harvest was 3.5x higher than the western portion of the lake. This relationship is used to estimate the harvest for the Kingston Basin (4706 fish for 2019). The whole lake estimate of harvest (6055 fish) is the sum of the western harvest and the estimated Kingston Basin harvest (Fig. 8.5.6).

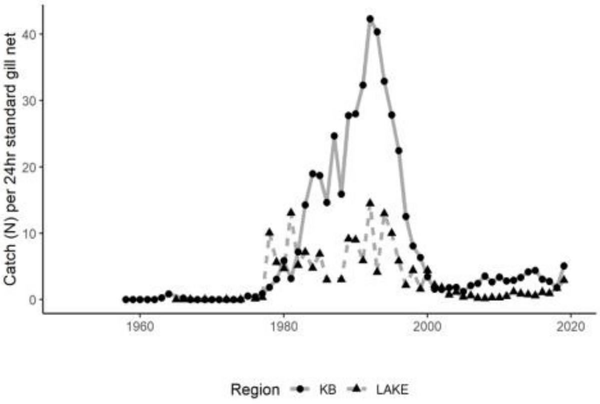

FIG. 8.5.1. Relative abundance of Lake Trout captured in the Ontario waters of Lake Ontario from Fish Community Index Gill Netting (Section 1.2) sites meeting the criteria identified within the plan tracked with the main basin of Lake Ontario ("LAKE"; indicated by triangles and dashed line) and with the Kingston Basin ("KB", indicated by circles and solid line).

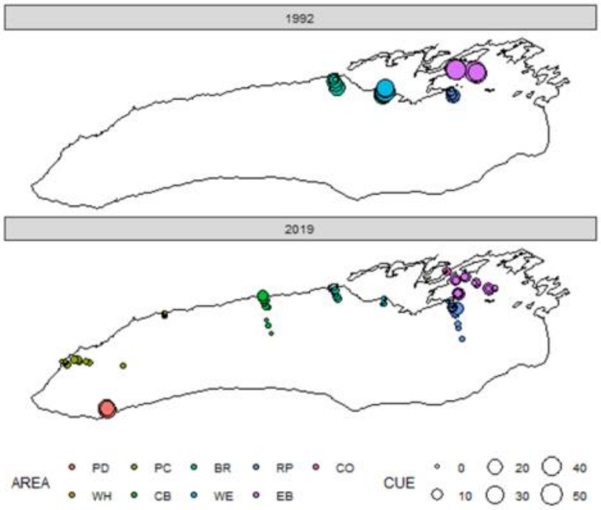

FIG. 8.5.2. Main lake gill netting in the Fish Community Index Gill Netting (Section 1.1) has increased in recent years covering a broader geographical area and range of depths. Points are scaled to Lake Trout catch (N) per 24-hour standard gill net set where the temperature at the net was 15°C or colder.

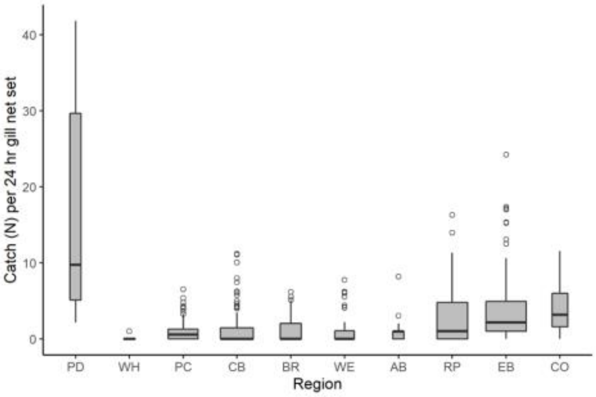

FIG. 8.5.3. Relative abundance of Lake Trout captured in the Ontario waters of Lake Ontario from 2015 to 2019 from Fish Community Index Gill Netting (Section 1.1) nets in the main basin fishing in water temperatures 15°C or colder by geographic region (geographic region indicated in Fig. 8.5.2). Box widths are scaled to the relative number of gill nets fished at a site as effort varied between sites. Boxes encompass 50% of the observations (25th to 75th percentile) with the median catch indicated by the solid line. Whiskers indicate 1.5 * the interquartile range and values beyond that range are plotted individually as open circles.

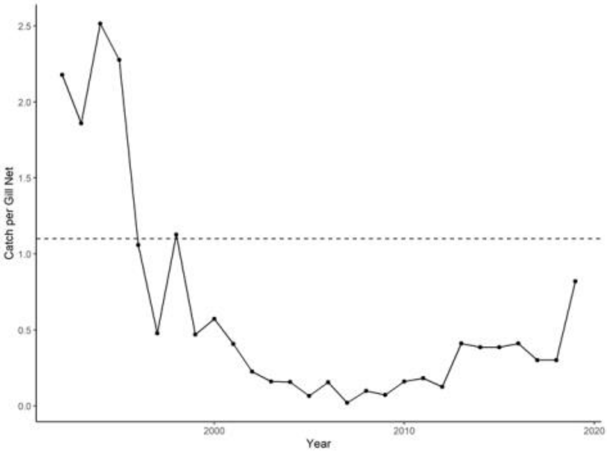

FIG. 8.5.4. Relative abundance of mature female Lake Trout greater than 4000 g captured in Fish Community Index Gill Netting (Section 1.1).

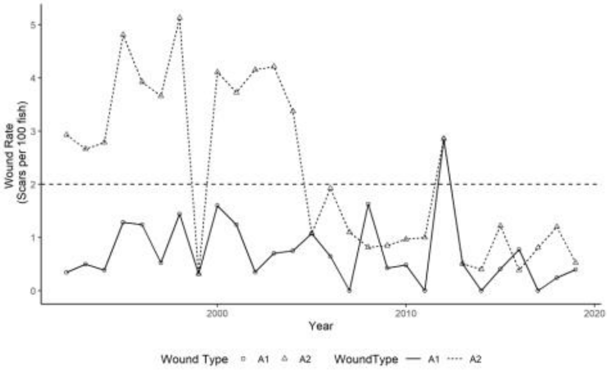

FIG. 8.5.5. Sea Lamprey scarring rate on Lake Trout captured in Fish Community Index Gill Netting (Section 1.1). Dotted line indicates the Lake Trout Management Strategy target of a maximum of two A1 wounds (fresh with no healing) per 100 Lake Trout.

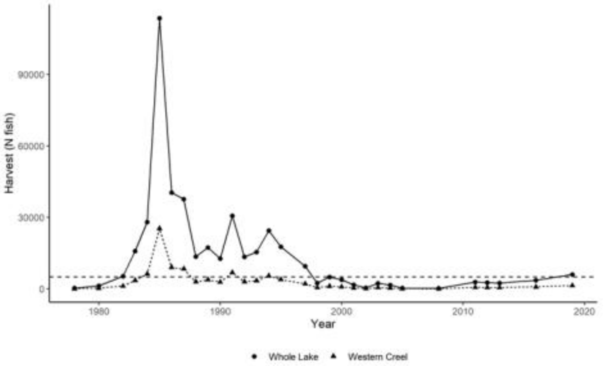

FIG. 8.5.6. Lake trout harvest estimates from the Lake Ontario Salmon and Trout Angler Survey (Section 2.4) for the western portion of Lake Ontario (triangles with dotted line). Whole lake harvest (circles, solid line) is the sum of the western harvest and the Kingston Basin harvest where the Kingston Basin harvest is estimated using as 3.489 x western harvest. The recommended maximum harvest of 5000 fish from Ontario waters is denoted with a dashed line.

TABLE 8.5.1. Status of Ontario targets identified in the Lake Trout Management Plan.

Management Strategy	Status	Details
Stock 440,000 spring yearlings per year in Canadian waters	Met	In 2019, 463,139 yearlings and 168,427 fall fingerlings were stocked. Fall fingerlings were stocked as part of interim target reductions in 2020.
Maintain an adjusted catch rate of age-3 fish per standard gill net per 500,000 stocked > 1.5 fish per standard gill net set	Below/Unclear	Historically below target but has shown an increasing trend since 2012 however changes in fish distribution, stocking practices and sampling program confound the interpretation of this index.
A relative abundance greater than a CUE of 1.1 female Lake Trout > 4000g per standardized gill net	Below	Increasing trend but still well below target (Figure 8.5.4)
Yearly survival of adult fish > 60%	Met	Survival of ages 5 to 15 has averaged 66% since 2016
Maintain the sea lamprey wounding rate in fall gill netting at <2 A1 wounds per 100 lake trout >433mm total length	Met	Target has been consistently met since 1996 although there was a period of high A2 wounding rates between 1995 to 2004 (Figure 8.5.5).
Maintain annual harvest to <5,000 fish in Canadian waters	Exceeded	Harvest in Lake Ontario Salmon and Trout Angler Survey estimated at 1,349 but does not account for harvest in the Kingston Basin. Kingston Basin has historically been 3.5x higher than reported in Western Lake Ontario suggesting 4703 harvested in the Kingston Basin. Lakewide Ontario harvest is 6055.
Emphasize strains that show the best combination of low post-stocking, juvenile, and adult mortality	Not assessed	In the absence of CWT in stocked lake trout, genetic analysis of all fish would be required in order to determine whether this target is being met. Currently only unclipped fish have tissue collect for genetic analysis.
Emphasize strains that are successfully producing a measurable level of wild recruits	Not reported	DNA samples from unclipped fish are routinely sent for analysis but are not reported here.
Protect naturally produced fish	Unclear	No special measures in place to meet this objective although harvest of all Lake Trout is generally low in Ontario

8.6 Walleye Spawn Collection and Urban Embayment Restoration Efforts

E. Brown, J. A. Hoyle and C. Lake, Lake Ontario Management Unit

Past and Current Walleye Restoration Efforts in Urban Embayments

Fish community assessments are done by OMNRF on a number of embayments across Lake Ontario to assess the health and composition of the fish community (see Section 1.3). Findings from these surveys have historically shown very low abundance of Walleye in Toronto Harbour and Hamilton Harbour relative to comparable embayments such as Presqui'ile Bay and Upper Bay of Quinte, respectively. Walleye are predatory fish, and a healthy fish community should have a percentage (20-25%) of predators to balance the fish community. Both Toronto Harbour and Hamilton Harbour have historically been below this target. Stocking Walleye in Toronto and Hamilton not only support efforts of the local Remedial Acton Plan objectives to restore a healthy fish community, but they may also provide angling opportunities for urban anglers.

Walleye declined in Hamilton Harbour in the early 1900s and were not observed in various fish surveys conducted during the mid-1900s. Walleye were reintroduced in Hamilton Harbour through adult transfer and spring fingerling stocking of Bay of Quinte strain in the 1990s (Table 8.6.1). All Walleye subsequently caught in trap net assessments during 2006 and 2008 had DNA showing Bay of Quinte origin, consistent with the 1990s stocking and adult transfer programs. Walleye abundance declined and disappeared from the trap net surveys between 2006 and 2012.

OMNRF reinitiated Walleye stocking in Hamilton Harbour in 2012 and initiated stocking in Toronto Harbour in 2017. Since 2017, stocking in Toronto and Hamilton is done every other year (Table 8.6.1). Results of the 2012 and 2016 Walleye stocking events in Hamilton Harbour continue to be very successful, while early signs of success have been observed in Toronto Harbour.

TABLE 8.6.1. Chronology of Walleye stocked into Hamilton Harbour and Toronto Harbour, 1993-2019.

Location	Year	Month	Life-Stage	Mean Weight (g)	Number of Fish	Source
Hamilton	1993	Oct	Adult	600	185	Transferred from Bay of Quinte
Hamilton	1994	Oct	Adult	1,500	129	Transferred from Bay of Quinte
Hamilton	1997	Oct	Adult	900	130	Transferred from Bay of Quinte
Hamilton	1998	Sept	Adult	1,364	120	Transferred from Bay of Quinte
Hamilton	1999	July	3-months	0.5	6,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2012	July	3-months	0.4	100,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2012	Nov	Adult	1,050	74	White Lake FCS (Bay of Quinte strain)
Hamilton	2013	July	3-months	0.5	10,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2014	June	Swim-up Fry	n/a	950,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2015	May	Swim-up Fry	n/a	1,017,625	White Lake FCS (Bay of Quinte strain)
Hamilton	2015	July	3-months	0.3	52,963	White Lake FCS (Bay of Quinte strain)
Hamilton	2016	May	Swim-up Fry	n/a	168,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2016	June	3-months	0.5	115,722	White Lake FCS (Bay of Quinte strain)
Toronto	2017	May	Swim-up Fry	n/a	1,080,000	White Lake FCS (Bay of Quinte strain)
Toronto	2017	July	3-months	0.5	100,059	White Lake FCS (Bay of Quinte strain)
Hamilton	2018	May	Swim-up Fry	n/a	1,000,000	White Lake FCS (Bay of Quinte strain)
Hamilton	2018	July	3-months	0.6	82,176	White Lake FCS (Bay of Quinte strain)
Toronto	2019	July	3-months	0.4	100,000	White Lake FCS (Bay of Quinte strain)

2019 Bay of Quinte Walleye Spawn Collection

In April 2019, the Lake Ontario Management Unit (LOMU) worked in conjunction with OMNRF's White Lake Fish Culture Station (FCS) to collect Bay of Quinte Walleye gametes. Similar projects were conducted in spring 2013 - 2018. In 2019, White Lake FCS had a target of eight million eggs and 40 families.

Walleye gamete collection occurred April 8 - 19, 2019 on Trent River below Lock #1 and at three presumed shoreline spawning locations: Highshore, east side of Long Reach (i.e. Sherman's Point), and Glenn Island. Boat electrofishing was used to target Walleye staging to spawn. Depths fished ranged from 0.5 - 2 m. During the time of gamete collection, temperature averaged 3.0 ^{o}C in the river and 6.6 ^{o}C at the shoreline spawning locations. Water temperature was also continuously recorded at a the Long Reach site near Sherman's Point. Water temperature steadily increased from late-March through the month of April, with water temperatures reaching 9^{o}C by late-April (Fig.8.6.1).

Walleye, in spawning condition, were brought to a holding and recovery pen prior to spawn collection. The average fork length of Walleye selected for spawn collection was 666 mm (490 - 760 mm) and 567 mm (398 - 670 mm) for females and males, respectively. Approximately 9.2 million eggs were collected from 32 families and transferred to White Lake FCS (7.2 million eggs / 26 families from Trent River and 2 million eggs / 6 families from shoreline spawning locations).

2019 Urban Embayment Stocking Efforts

On July 3, 2019 White Lake FCS and LOMU stocked 100,000 3-month old walleye into Toronto Harbour in the Portlands/Polson Pier area at Jennifer Kateryna Koval's'kyj Park. These Bay of Quinte strain summer fingerling walleye were reared at White Lake FCS and weighed approximately 0.37g each when they were released.

Monitoring and Assessment

Nearshore Fish Community Index Trap Netting (NSCIN)

NSCIN was conducted on Toronto Harbour and Hamilton Harbour in August 2019 (see Section 1.3).

In 2019, a mean catch of 7 Walleye per trap net was observed in Hamilton Harbour (Fig. 8.6.2), well above the restoration target of 2 fish per net established prior to commencement of the 2012 Walleye stocking initiative. Twenty-two of 24 trap net lifts in Hamilton Harbour caught at least one Walleye. The largest catch occurred at a trap net in the east end of the harbour (n=37). In 2019, Walleye were the fourth most abundant species.

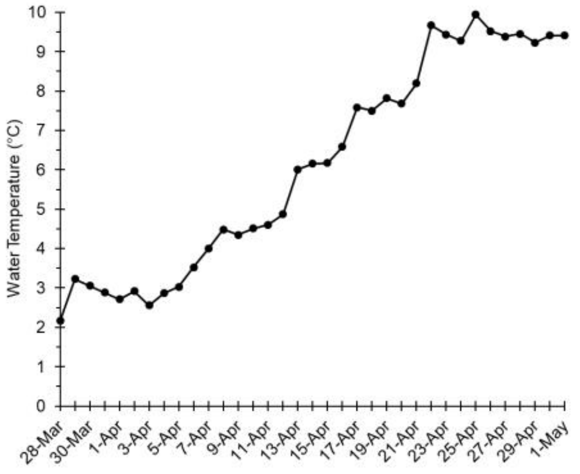

FIG. 8.6.1. Mean Daily water temperature (recorded at 1 hr. intervals) at 1 m depth, on the east shore of Long Reach, near Sherman's Point, March 28 - May 1, 2019.

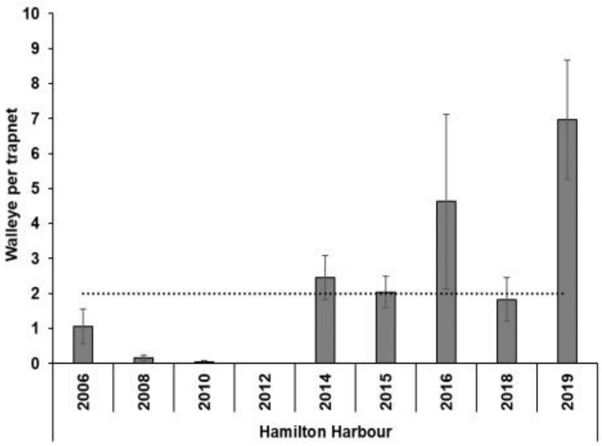

FIG. 8.6.2. Walleye catch (number of fish per trap net lift) on Hamilton Harbour, 2006-2019 (years indicated). Dotted line represents the restoration target of 2 Walleye per trap net.

Age was interpreted (otoliths) for a random sample of 31 of the 167 Walleye caught. These 31 fish ranged in length from 256 to 695 mm fork length. Ten were age-7 (mean fork length: 615 mm) and fifteen were age-3 (mean fork length: 483 mm). These fish were likely from the 2012 and 2016 stocking events, respectively. One Walleye was age-1 and four were age-4. Nineteen of 21 males and eight of the ten female Walleye sampled were judged to be mature and capable of spawning in spring of 2020.

A total of nine Walleye were detected in Toronto Harbour in 2019, five of which were age-2 (mean fork length: 402mm) and presumably from the 2017 stocking event.

Concluding Remarks

An adequate level of top fish predators, such as Walleye, helps to achieve a balanced trophic structure in the fish community, and also complements local remedial actions to improve water quality and restore fish habitat in Toronto and Hamilton Harbour.

All indications to date are that the 2012 and 2016 Walleye stocking effort in Hamilton Harbour was highly successful in terms of survival and growth rates. 2019 was the first year Walleye from 2017 Toronto Harbour stocking efforts were likely to recruit into the trap net gear. Though lower in abundance when compared to Hamilton Harbour in 2014 (i.e. the first 2012 year class detections), observations of the 2017 stocking event in Toronto suggests a positive outlook for this year class. These year classes will be continued to be monitored in future trap net surveys.

To help further evaluate stocking success, local anglers are encouraged to report of any Walleye caught in Hamilton Harbour to LOMU. Of particular interest, moving forward, are the distribution and migration patterns as well as any spawning behaviour exhibited by these stocked Walleye.

9. Research Activities

9.1 Station 81: Long-term monitoring at the base of Lake Ontario's food web

Project Leads: Project Leads: Adam Rupnik and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Heather Niblock and Kelly Bowen (Fisheries and Oceans Canada)

Limnological (e.g. water temperature, clarity, chemistry) and lower trophic level (e.g. phytoplankton and zooplankton) samples have been collected as part of a long-term monitoring program designed to identify and respond to physical, chemical, and biological changes within Lake Ontario. From 1981-1995, samples were collected by Fisheries and Oceans Canada (DFO), and in 2007 sampling resumed as a partnership between MNRF's Aquatic Research and Monitoring Section (ARMS), the Lake Ontario Management Unit and DFO. In 2017 two additional sampling sites were added – T4L and NYSDEC (Figure 9.1.1) – to understand spatial differences in lake conditions (to inform bloater restoration [see section 8.4]).

Station 81 is located near the centre of the Kingston basin in eastern Lake Ontario (44° 01.02'N, 76° 40.23'W) in approximately 34 m water depth. The other two sites are located farther offshore. T4L is located west of the Duck-Galloo Ridge in 57m of water, just outside of the eastern basin (43° 49.67'N, 76° 41.68'W). The NYSDEC site is located within the St. Lawrence Channel (43° 55.20'N, 76° 31.00'W) in 53 m of water depth and has been infrequently sampled as part of a U.S. biomonitoring program.

In 2019, samples were collected biweekly from April 29th to October 28th. Sample collections consisted of water profiles that measured temperature, dissolved oxygen, and chlorophyll-a (an index of the quantity of algae), turbidity and dissolved organic matter. Secchi depth (clarity) was also recorded, along with the collection of water samples for nutrient, phytoplankton, and zooplankton community analyses.

The mean surface water temperature ranged from 4.5℃ in late-April to 21.1℃ in late-July at Station 81. Peak temperatures were slightly warmer at T4L and NYSDEC with temperatures reaching 22.3℃ and 22.9℃ respectively. Stratification of the water column (when the warm upper layer of the water is distinguished from a cooler deep layer, and the lake resists mixing) was first observed on June 24th at all three sites and was last observed on October 10th. Average depth

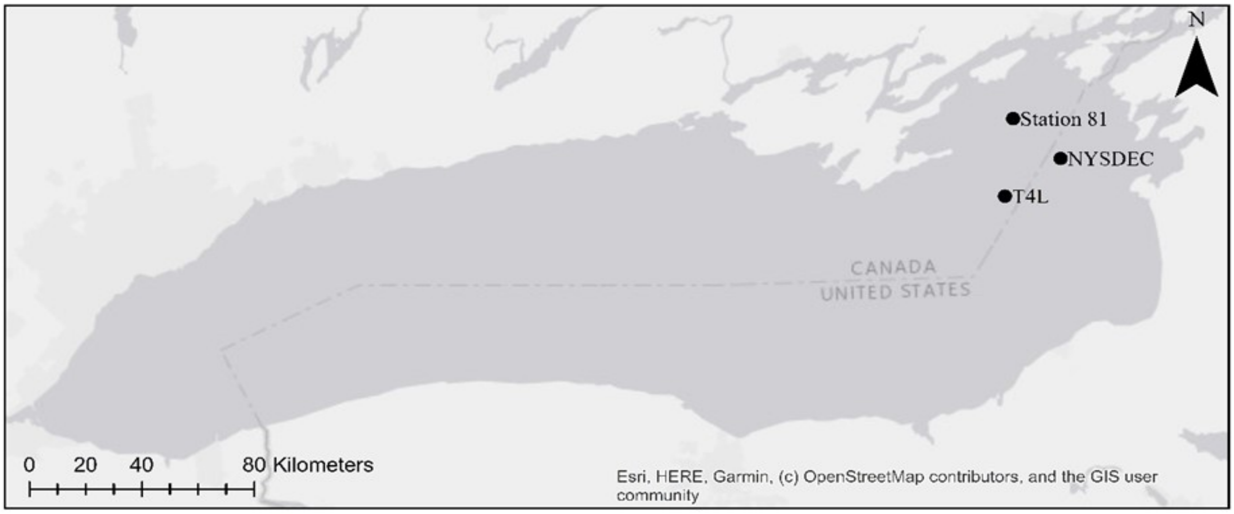

FIG. 9.1.1. Map of Lake Ontario showing the locations of all three sampling sites.

of the thermocline was similar for both Station 81 and NYSDEC but was slightly shallower in the water column at T4L (Table 9.1.1).

Water clarity was greatest at Station 81 in April (12.5 m) and declined as water warmed to a low of 4.5 m in June and again in August. T4L showed a similar trend. Chlorophyll and turbidity differed slightly between sites and years. Phytoplankton, zooplankton, and nutrient samples collected in 2019 are currently being analyzed and will aid in our understanding of changes in the composition and production of the plankton community (Table 9.1.2).

The epilimnetic zooplankton community has shown dramatic changes in density, biomass and production between the sampling periods (1981-1995 and 2007-2019), most notably sharp declines in cyclopoids and herbivorous cladocerans (Figure 9.1.2). May to October crustacean densities averaged 74.9 ± 6.6 animals L^{-1} in the early sampling period (1981-2007), compared to only 5.4 ± 0.3 animals L^{-1} in the recent period (2007-2019), a decline of 93%. Corresponding values for biomass were 77.1 ± 8.5 and 12.3 ± 1.4 mg m^{-3}, representing a decline of 84%. Smaller bodied crustaceans such as *Bosmina* and juvenile cyclopoid copepods were most impacted, whereas populations of larger taxa, including calanoids, large *Daphnia*, *Holopedium* and predatory cladocerans (e.g. *Bythotrephes*) have remained stable or increased. The reduction in crustacean zooplankton has been partially offset between 2007 and 2019 by large populations of veligers, planktonic larvae of the invasive quagga mussel *Dreissena bugensis*. Veliger density averaged 14.3 ± 3.3 animals L^{-1} in the recent sampling period, numerically comprising 67% of total zooplankton density. May to October veliger biomass during the recent period averaged 8.9 ± 2.4 mg m^{-3} (34.7%), with the highest levels occurring between 2010 and 2015.

TABLE 9.1.1. Average, maximum, and minimum thermocline depth (m) at all three sampling sites in Lake Ontario. All data was collected from April 29th to October 28th, 2019.

	STN 81	T4L	NYSDEC
Mean	16.7	12.8	15.5
Max	27.0	25.0	23.0
Min	8.0	7.0	7.0

There are many mechanisms potentially driving these changes in the Lake Ontario zooplankton community over the last forty years. These include bottom up drivers associated with oligotrophication (declining levels of

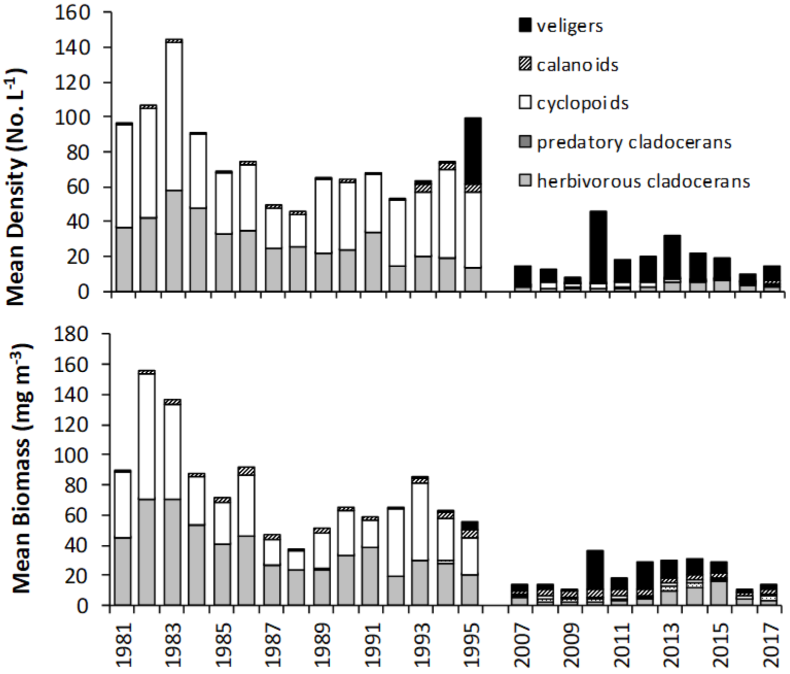

FIG. 9.1.2. Mean May to October density and biomass of zooplankton groups in the epilimnion of Station 81. Samples were collected from 1981 to 1995, and 2007 to 2017.

phosphorous, primary production and phytoplankton biomass), increased water clarity and competition for food resources by dreissenids, as well as top down forces such as alterations in alewife and invertebrate planktivory.

Long-term monitoring programs, such as Station 81, provide scientists and lake managers with information about the organisms that make up the base of the Lake Ontario food web. For example, we have seen a progressive increase in water temperatures in the past 30 years (averaging 0.03°C per year, or over 3.0° since sampling began in 1981), and a dramatic decline in zooplankton density following the establishment of dreissenid mussels. As we improve our understanding of the physical, chemical, and biological components of the Lake Ontario ecosystem, resource managers will be better equipped to respond to changes that may impact the fishery. The expanded spatial coverage will help us to determine if observed changes are localized or more wide-spread.

TABLE 9.1.2. Mean ± SD limnological conditions (April to October) for three habitat spaces in eastern Lake Ontario in 2018 and 2019. Chlorophyll-a and turbidity values reflect epilimnetic measurements only.

Parameter	Station 81		NYSDEC		T4L	
	2018	2019	2018	2019	2018	2019
Epilimnetic Temperature (°C)	18.7±3.3	18.0±3.2	19.4±3.1	18.8±3.8	18.0±4.6	19.6±3.9
Hypolimnetic Temperature (°C)	9.2±2.3	8.9±0.9	7.7±0.9	7.8±0.8	7.7±2.4	7.3±1.0
Thermocline Depth (m)	14.9±3.8	16.7±7.3	18.3±7.5	15.5±6.5	16.3±6.1	12.8±7.5
Secchi Depth (m)	8.0±3.7	7.2±2.7	NA	NA	7.7±2.9	6.8±2.1
Chlorophyll a (µg/L)	0.5±0.4	0.4±0.2	0.4±0.2	0.6±0.4	0.8±0.5	0.5±0.6
Turbidity (FNU)	0.1±0.1	0.2±0.2	1.5±1.6	0.6±0.7	0.2±0.3	0.5±0.3

9.2 Post-stocking behaviour, movement and survival of Bloater in Lake Ontario

Project Leads: Tim Johnson (OMNRF, Aquatic Research and Monitoring Section); Aaron Fisk and Natalie Klinard (University of Windsor, Great Lakes Institute for Environmental Research)
Collaborators: Eddie Halfyard (Centre for Marine Applied Research); Jordan Matley (University of Windsor, Great Lakes Institute for Environmental Research); Mike Connerton (New York State Department of Environmental Conservation); MNRF Fish Culture Section

Until the mid-1950's, a diverse assemblage of deepwater ciscoes including bloater (*Coregonus hoyi*) inhabited Lake Ontario. Currently, only the shallow-water form of Cisco (C. *artedi*) remains. The Lake Ontario Committee has initiated a plan to re-establish a self-sustaining deepwater cisco population within 25 years. The work is supported by the Lake Ontario Fish Community Objectives and guided by the Strategies for the Reestablishment of Native Deepwater Ciscoes in Lake Ontario, both co-developed by OMNRF. Initially fertilised bloater eggs from Lake Michigan were reared in hatcheries in Ontario and New York; more recently progress has been made in establishing a captive brood stock used to support the restoration stocking initiative [see Section 8.4]. However, as with most stocked fishes, we have little knowledge of their behaviour and survival following stocking. Questions include: Where do the fish go after they are released? What habitats do they use and how does that change over time? How many of the stocked fish survive after stocking? Do they school together and move in groups? These and other questions can be answered through the use of acoustic telemetry, which involves surgically implanting bloater with acoustic transmitters and releasing them as part of the normal stocking event. This report provides a summary of what we have learned since the first acoustically tagged bloater were released in fall 2015.

Following release, we observed bloater quickly descended to the lake bottom. This was not entirely unexpected as bloater are known to occupy deep regions of the Great Lakes, but also because hatchery fish instinctively head to the bottom of the "tank" for protection. Regrettably, we also learned there was high mortality with the Bloater shortly after release (~58% in first two weeks). Specialised tags that detect if and when the bloater are eaten by a predator revealed that predation was high – 40% of the bloater were predated within the first two weeks (average time to predation 5.5 d, range 2-23 d). For the remaining bloater that died, we speculate it may be related to rapid compression as the fish swim to the lake bottom – while all fish looked vigorous when visually examined in tanks just prior to release, some tagged fish failed to move (moribund, about to die) within a few hours of release. Future research will investigate the possibility of this compression related mortality as it could have implications for other fishes stocked in deep water such as Lake Trout. In addition, behaviour of all major predator fishes is also being investigated with acoustic telemetry, and analyses are underway to relate predator movement relative to bloater (or other prey fishes which could be tagged) which would better inform managers in understanding the capacity of prey fishes to support a certain level and mix of stocked predators.

Of the bloater that survived, telemetry suggests they disperse quickly with some individuals moving several kilometres from the release point within 24 hours of stocking. bloater showed a preference for deep (>40m) water, and despite overlap in space-use for some bloater, we found no evidence of schooling (Fig. 9.2.1). The lack of schooling behaviour was surprising given fisheries and hydroacoustic data suggest Bloater school elsewhere in the Great Lakes and may be related to the naivety of stocked fish to Lake Ontario, or could be an artifact of the low number of tagged fish relative to a much larger number of fish being stocked (<0.2% of the fish released with our loater were acoustically tagged). Acoustic tagging of bloater revealed an extensive diel vertical migration (up at night, down during the day) (Fig. 9.2.2) which has been inferred from previous surveys in the upper Great Lakes but never with the detail we were able to capture. MNRF stocks bloater in the fall, when the lake is isothermal (near constant cool temperatures from surface to lake bottom) and our observed vertical migrations showed bloater coming very near the surface, much higher than the summer observations when suitably cold-water temperature is restricted to depths below the thermocline. Unfortunately, with such high mortality and a currently limited distribution of acoustic receivers (moored devices that detect the acoustic tags implanted in fish), we have not obtained sufficient information to infer behaviour of Bloater during the summer months.

The combination of the behavioural and survival knowledge gleaned through the use of acoustic telemetry can be used to enhance the success of the bloater restoration initiative. High predation is a reflection of the high predator abundance and suggests stocking juvenile individuals will require high stocking numbers to ensure sufficient escapement to mature to adulthood. The immediate post-release behaviour of bloater (diving and dispersing) that may contribute to higher mortality could possibly be managed through stocking bloater in shallower water, or at different times of day or year that would allow the bloater to adjust to the lake before moving to deep habitat. Another consideration currently under preliminary investigation is conditioning the fish in the hatchery so they respond better to the novel lake environment.

Diversification of the prey fish community, including restoration of deepwater species is essential to provide a healthy and resilient fishery. Dominance by Alewife has seen rapid development of a recreational fishery, but managers are now concerned about declining Alewife numbers and their ability to support the many predatory fish that depend on them. Having a more diverse prey fish community would buffer against any one individual species decline and the negative consequences for the fishery as seen in the upper Great Lakes. Likewise, restoring deepwater ciscoes will alleviate some of the concerns around thiamine deficiency complex associated with Alewife that may be inhibiting recruitment of Lake Trout and other species. As such, efforts to understand potential impediments to bloater restoration are essential to achieving a healthy and productive fishery in Lake Ontario.

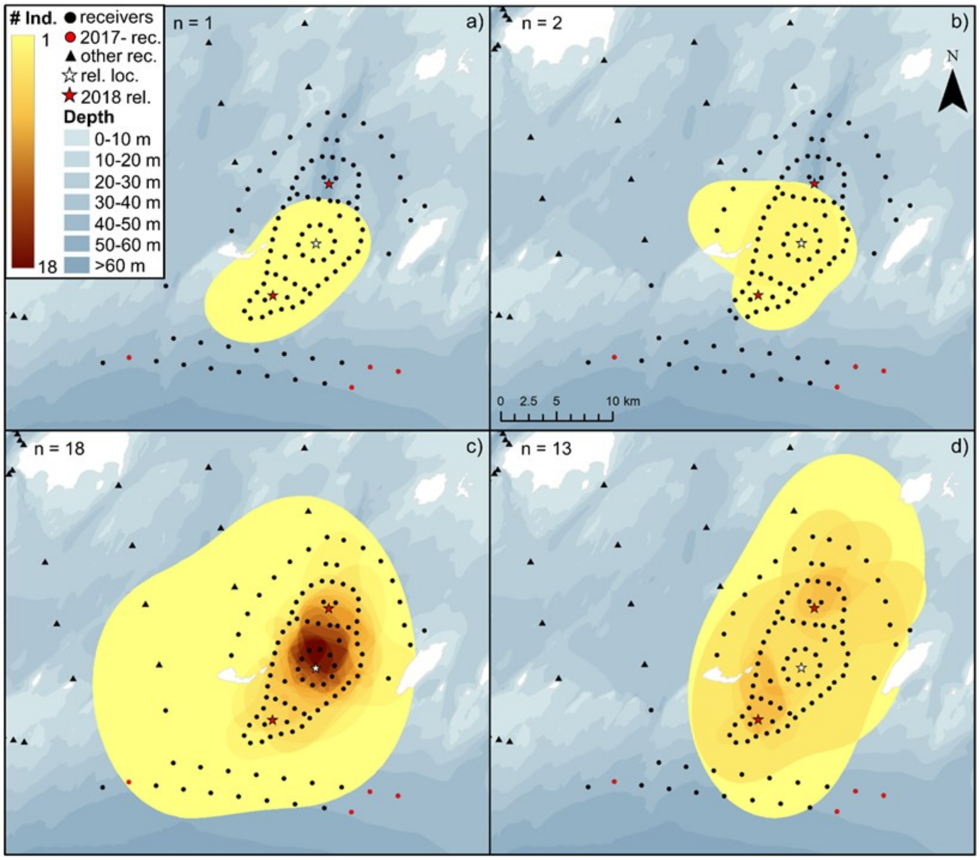

FIG. 9.2.1. Overlapping ellipses (95% autocorrelated kernel density estimates) representing habitat used by each tagged bloater. Colour gradient signifies the number of individuals with overlapping habitat-use in a location. Habitat-use estimates are shown by release group: (a) fall 2016 (*n* = 1); (b) spring 2017 (*n* = 2); (c) fall 2017 (*n* = 18); and (d) fall 2018 (*n* = 13). From Klinard et al. Freshwater Biol in press.

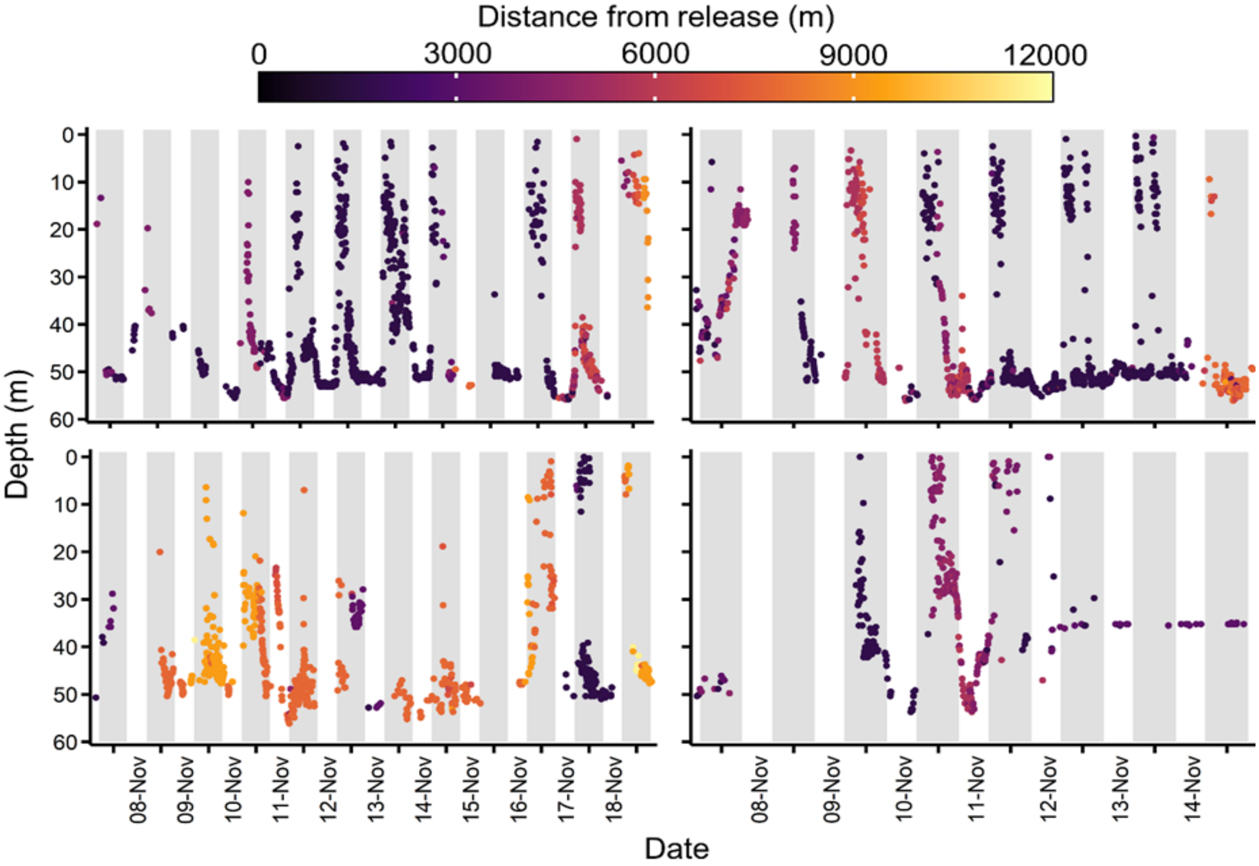

FIG. 9.2.2. Depth profiles of four Bloater displaying diel vertical migration (DVM). Each circle represents a single detection and the colour of the circle corresponds to the distance from the release site (m) at time of detection. Grey shaded areas indicate night periods based on daily sunrise and sunset times. From Klinard et al. Freshwater Biol in press.

9.3 Informing Lake Trout restoration in Lake Ontario based on interactions with other top predators in time and space

Project Leads: Silviya Ivanova and Aaron Fisk (University of Windsor, Great Lakes Institute for Environmental Research); Tim Johnson and Brent Metcalfe (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Chris Legard (New York State Department of Environmental Conservation)

Evidence from diets suggests trout and salmon show considerable overlap with respect to food preference. However, we do not know the degree to which spatial and temporal interactions are driving this dietary overlap. Knowing how much species interact, and potentially compete for shared resources, would better inform management planning with respect to restoration plans and stocking strategies. Lake Ontario is home to six salmonid species attracting recreational anglers from across North America. Currently, a number of different fish species, including Lake Trout (*Salvelinus namaycush*) and Chinook Salmon (*Oncorhynchus tshawytscha*) are being stocked in Lake Ontario in an effort to promote restoration of historically important species and support economically important recreational fisheries. The Lake Ontario Lake Trout population was decimated in the 1900s due to Sea Lamprey, habitat loss, and overfishing, and efforts to rehabilitate the population have been on-going for over 40 years. Chinook Salmon are the most sought–after salmonid species by anglers largely driving the open lake recreational and charter boat fishery. Understanding the spatial and temporal interactions of Lake Trout with other top predators such as Chinook Salmon is critical to understand the potential for restoration of Lake Trout in Lake Ontario and elsewhere.

Little is known of Lake Trout and Chinook Salmon seasonal movements and preferred depth and temperature in Lake Ontario. Acoustic telemetry provides a means to begin to understand these behaviours. We are using both a fixed-station receiver array in the east and west ends of Lake Ontario (Fig. 9.3.1), and an autonomous underwater vehicle (self-propelled mini-sub) to track the movements and behaviour of Lake Trout and Chinook Salmon that have been surgically implanted with acoustic tags. Both Lake Trout and Chinook Salmon have been tagged on a yearly basis since 2017.

As of May 2019, we collected 2.5 years of data to examine in detail Lake Trout movements in eastern Lake Ontario. Lake Trout are known to prefer deep, cold waters, and migrate to shallow areas in the fall to spawn. Yet, specific details on the timing of habitat switch and corridors for movement are not well known. Our results show that fall migrations occurred between October 10

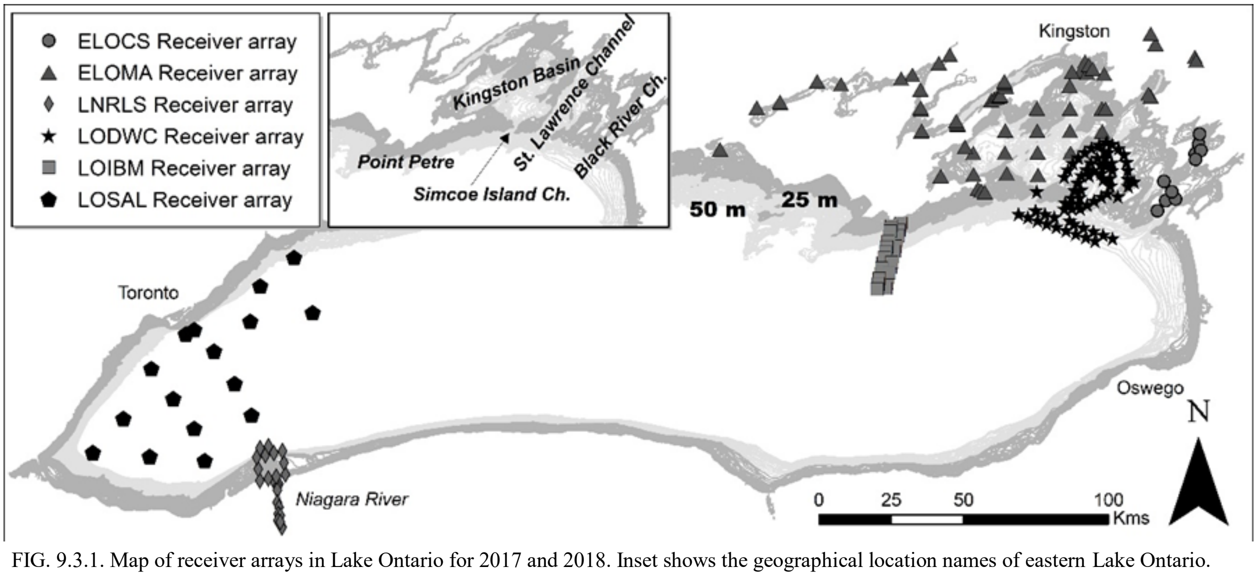

FIG. 9.3.1. Map of receiver arrays in Lake Ontario for 2017 and 2018. Inset shows the geographical location names of eastern Lake Ontario.

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and November 19, 2017, and October 10 and November 13, 2018 (Fig. 9.3.2). The most utilized route was the St. Lawrence Channel (Fig. 9.3.3 and 9.3.4), the deepest of three underwater channels connecting the lake proper to the shallower basin containing the spawning shoals. Migration convergence of individuals and synchrony between years were observed. Return migration to the open lake occurred sporadically during the winter, spring, and summer seasons, and this lack of coordinated movement was consistent between years (Fig. 9.3.2). Detailed examination of each individual's movement track revealed that some individuals return to deep water in December or January soon after spawning activities are over, others remained in the Kingston Basin until onset of stratification in the spring, and still others only went to deep water about a month prior to fall migration to spawning shoals. Irrespective of timing of movement to deep water, all Lake Trout moved from the deep main basin to the spawning shoals. While the majority (n=38) of the Lake Trout were only detected on receivers in the east half of the lake, four individuals were also detected in the west end receiver arrays (LNRLS and LOSAL; see Fig. 9.3.1), with one individual repeating the movement in both winters of 2018 and 2019. Similar seasonal movement analysis is underway for Chinook Salmon, and combining the results for the two species will help us understand the extent of spatial overlap between the two species and whether they utilize similar movement routes.

This work contributes directly to better understanding Lake Trout ecology in Lake Ontario, providing novel data to inform their restoration. On a broader scale, this research contributes new insights on the interactions of top predator fish in large lake ecosystems and will aid in the development of more adaptive stocking strategies and management plans.

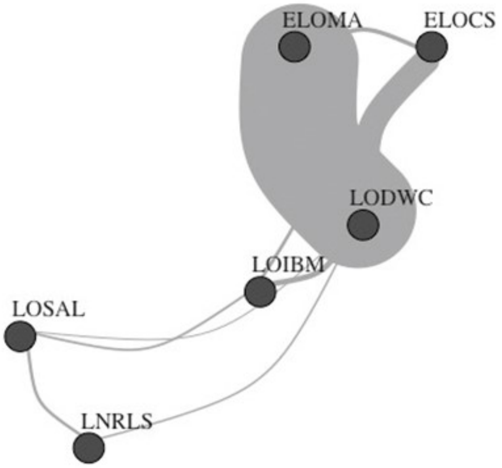

FIG. 9.3.3. Lake trout general movements (line thickness reflects the number of movements) among acoustic receiver arrays during the study period.

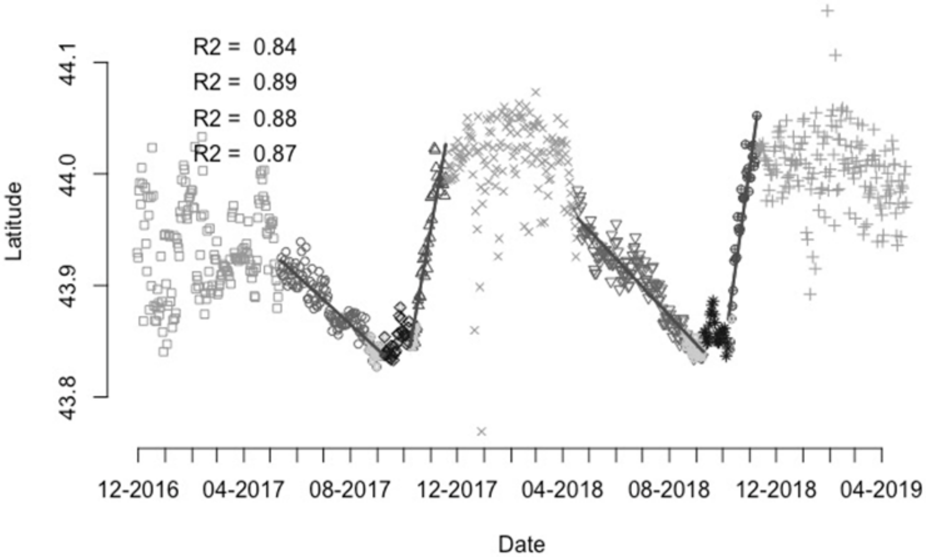

FIG. 9.3.2. Mean daily locations of Lake Trout for the period of December 1, 2016 to April 30, 2018 in eastern Lake Ontario. Regressions were fit to identify the timing of habitat switch. Southward migration began May 12, in 2017, and Apr 18 in 2018, and ended on Sept 8 and Sept 9, respectively. Northward migration started Oct. 10 in 2017 and 2018 and was completed by Nov. 18, 2017 and Nov. 13, 2018. Southward migration took longer to occur and seems more sporadic in comparison to northward fall migration.

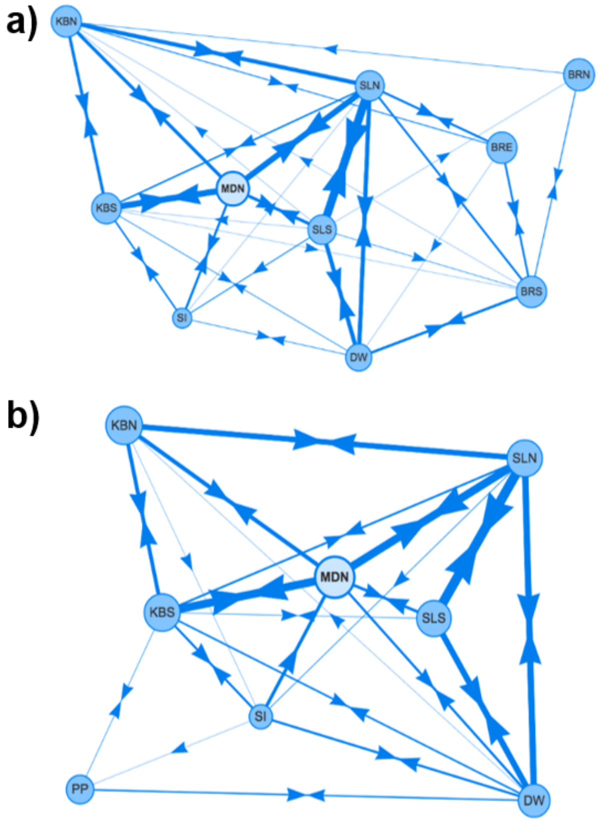

FIG. 9.3.4. Movement and migration routes used by Lake Trout in eastern Lake Ontario in a) fall 2017 and b) fall 2018. The major route used for migration from the deep water is the St. Lawrence Channel (StL channel N and StL channel S). Arrows show the directionality of the movements occurring with thickness showing the number of movements. The later is suggestive of not only migration to shoals, but also pre-spawning shoal exploration. An examination of each individual's tracks seems to confirm that. Geographic regions include: St. Lawrence Channel north and south (SLN, SLS), Simcoe Island Channel (SI), Kingston Basin north and south (KBN, KBS), Black River channel north and south (BRN, BRS), north of Main Duck Island (MDN), Point Petre (PP).

9.4 Citizen science helps determine stable isotopes and genetics of adult Atlantic Salmon in Lake Ontario

Project Leads: Sarah Larocque and Aaron Fisk (University of Windsor, Great Lakes Institute for Environmental Research); Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Chris Wilson (OMNRF, Aquatic Research and Monitoring Section)

Atlantic Salmon (*Salmo salar*) are stocked into Lake Ontario as part of the Lake Ontario Atlantic Salmon Restoration Program. While adult Atlantic Salmon returns are monitored on some rivers, encounters in the open lake are infrequent making it difficult to learn more about their in-lake ecology. To assist with collection of samples of adults from the open lake, we developed a citizen science project in 2018 in which 12 charter-boat captains from various regions of Lake Ontario collected non-lethal fin clips from angled Atlantic Salmon. These samples were combined with those collected by OMNRF, DFO, and NYSDEC to infer fish diets using stable isotopes (of carbon, nitrogen, and sulphur) and genetics. Results will help us better understand adult Atlantic Salmon ecology in Lake Ontario.

Collectively, 49 Atlantic Salmon fin clips from 14 different catch locations were analyzed for stable isotopes and genetics in 2018 (Fig. 9.4.1). Fin clips from Brown Trout (*Salmo trutta*), Chinook Salmon (*Oncorhynchus tshawytscha*), Coho Salmon (*Oncorhynchus kisutch*), Lake Trout (*Salvelinus namaycush*), and Rainbow Trout (*Oncorhynchus mykiss*) were also collected at fishing derbies to assess stable isotope signatures for the whole salmonid community. Stable isotopes identify the long-term (several months) diet of fish in contrast to stomach samples which reveal only the most recent meal. Three different stable isotopes were used: carbon ($\delta^{13}C$) indicates whether fish feed nearshore or in the open waters, nitrogen ($\delta^{15}N$) indicates the trophic position (how high up in the food web the fish is feeding), and more recently sulphur ($\delta^{34}S$) has been used to distinguish between feeding on bottom dwelling food versus that living higher up in the water column. We used all three isotopes to infer the diet of the salmonid community and to determine where Atlantic Salmon fit in. Based on biplots of the three isotopes and the 40% standard ellipses of each species, there was nearly identical overlap

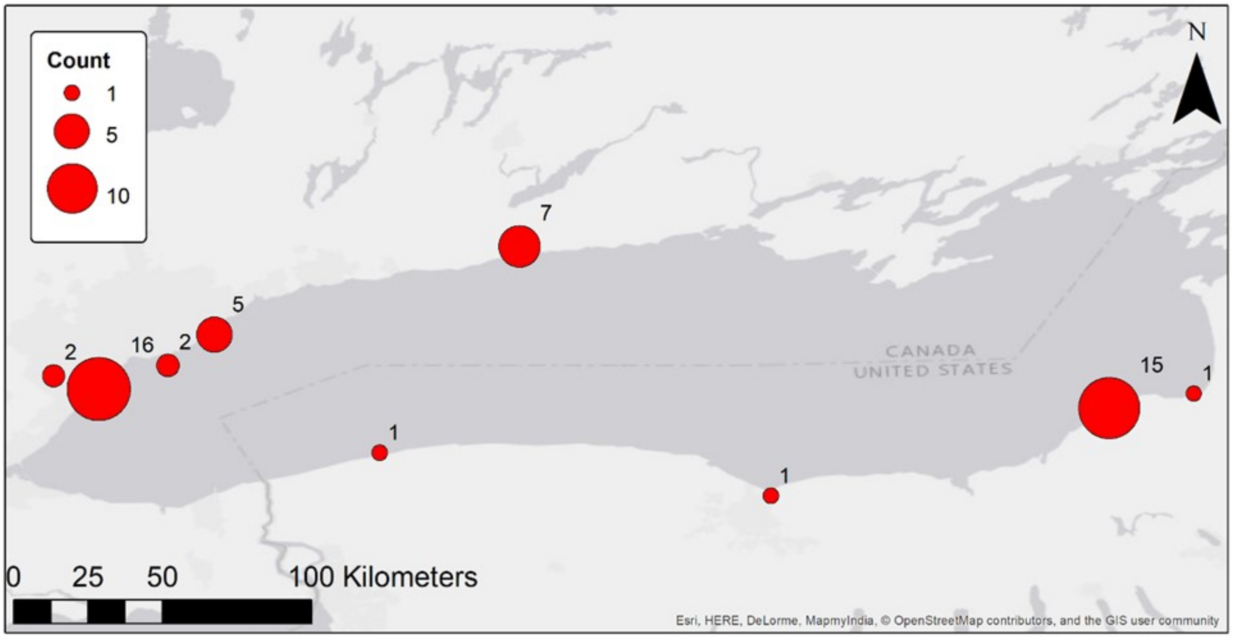

FIG. 9.4.1. Count (indicated by circle size and superscript number) and location of adult Atlantic Salmon fin clips collected from Lake Ontario in 2018.

between Atlantic Salmon, Chinook Salmon, and Coho Salmon suggesting they are feeding on similar items (Fig. 9.5.2A-C). Lake Trout had much higher $\delta^{15}N$ values suggesting they are feeding at a higher trophic level (Fig. 9.4.2A and 9.54.2C). Rainbow Trout and Brown Trout had much larger ellipses which showed both higher $\delta^{13}C$ and $\delta^{15}N$ compared to the salmon, suggesting they fed closer to shore and potentially at a higher trophic level or on nutrient enriched prey (that can occur when feeding nearshore; Fig. 9.4.2A-C).

The genetic analyses of the Atlantic Salmon fin clips determined each fish's genetic strain and their life stage when they were stocked (if from a Canadian stocking program). Historically, there have been three strains of Atlantic Salmon stocked into Lake Ontario tributaries – Lac St. Jean, Sebago, and LaHave – of which only Sebago and LaHave continue to be stocked. Of the 49 samples analyzed, the majority of the Atlantic Salmon in Lake Ontario were from the Sebago strain (n = 30; 61%), followed by LaHave (n = 14; 29%), and no fish were of the Lac St. Jean strain, while the remaining samples were data deficient (n = 3; 6%) or ambiguous (n = 2; 4%)(Fig. 9.4.3). Approximately 29% (n = 14) of the salmon could be traced back to the Canadian stocking program, in which eight fish were stocked as spring yearlings (three were LaHave strain, and five were Sebago strain), and six fish were stocked as spring fingerlings (all from LaHave strain). Most of the LaHave strain fish were identified to come from Canadian stocking programs (60%; origins of remaining LaHave fish uncertain) while only 20% of Sebago strain were from Canadian stocking programs. However, some of the unassigned Sebago fish could be from the American stocking programs (which do not stock LaHave or Lac St. Jean). Of the Canadian stocked fish, they were all three-year-old fish, except for one four-year-old.

The stable isotope and genetic analyses provided information on the relative feeding structure of Atlantic Salmon and how it compares to other salmonids over time, as well as important information on strain and stocking strategies that had the greatest survival to adulthood. This information is important to resource managers, but much of its generation was only possible with the help of volunteers from the angling community. Maintaining good relations and communication with stakeholders enabled us to obtain large sample sizes and develop a better understanding of what is occurring in our lakes.

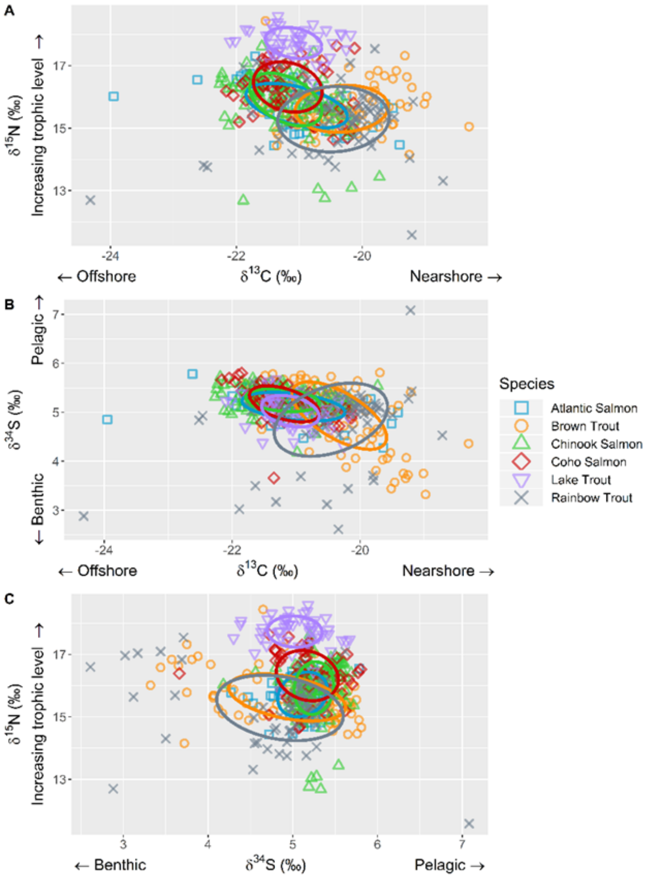

FIG. 9.4.2. Stable isotope bi-plots of fin clips from adult salmonid species collected from Lake Ontario, 2018. Panels indicate the different combination of isotopes. A) $\delta^{13}C$ vs $\delta^{15}N$; B) $\delta^{13}C$ vs $\delta^{34}S$; and C) $\delta^{34}S$ vs $\delta^{15}N$.

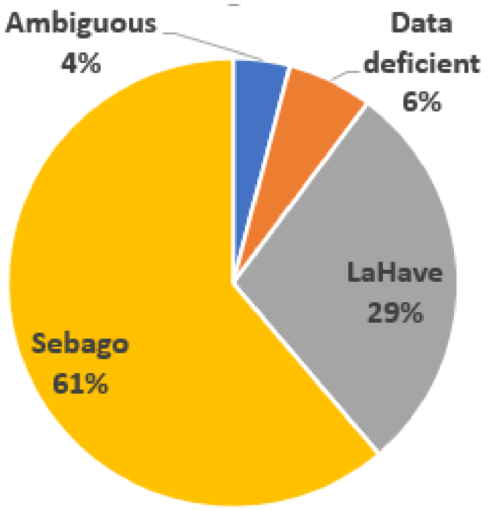

FIG. 9.4.3. The genetic strain of fin clips collected from adult Atlantic Salmon in Lake Ontario, 2018.

9.5 Stomach content analysis of predator fish species collected from Lake Ontario as part of the 2018 Cooperative Science and Monitoring Initiative

Project Leads: Brent Nawrocki and Brittany Payne (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: United States Geological Survey (USGS); New York Department of Environmental Conservation (NYSDEC)

To understand predator fish feeding habits and determine the degree of dietary overlap between co-occurring top predator fish species within Lake Ontario, predator stomachs were collected as a part of the 2018 Cooperative Science and Monitoring Initiative (CSMI) and analyzed at the Glenora Fisheries Station. Previous CSMI collection years (2008, 2013) yielded similar stomach content analyses with the purpose of establishing historical lake-wide diet profiles in order to understand predator diet variation amidst fluctuating prey assemblages.

In 2018, samples were collected between 15 April and 8 November by OMNRF, USGS, and NYSDEC from numerous locations spanning Lake Ontario. A variety of predator stomachs (n=469) were collected including Lake Trout (*Salvelinus namaycush*), Brown Trout (*Salmo trutta*), Chinook Salmon (*Oncorhynchus tshawytscha*), Walleye (*Sander vitreus*), and Smallmouth Bass (*Micropterus dolomieu*). Lengths and weights were measured for each fish, whole stomachs were removed, and contents were identified to the lowest possible taxonomic group using diagnostic visual features including cleithra, otoliths, and vertebral columns on highly digested prey. Diet proportions were calculated using wet weight of individual prey items. Ration (Σ g prey/g predator) was calculated by combining prey item contents per each individual and dividing by individual predator wet weight.

Our results showed an overwhelming reliance on Alewife (*Alosa pseudoharengus*) as diet items for Chinook Salmon (99%), Brown Trout (90%), and Lake Trout (94%; Fig. 9.5.1A-C). Walleye diet also consisted of 100% Alewife. Lake Trout had the greatest diversity of prey items consumed (4 prey groups), while Walleye had the lowest diet diversity (1 prey group). In contrast, Smallmouth Bass did not consume Alewife, and instead consumed a high proportion of Round Goby (*Neogobius melanostomus*; 79%) and various aquatic invertebrates (21%) such as snails (*Valvatidae* spp.) and Driessenid mussels (Fig. 9.5.1D). The only prey species present in all stomachs, except for Walleye, was Round Goby (proportion range: 1-79%) (Fig. 9.5.1A-D). Rations ranged from 0.2-3.1% with Lake Trout having the greatest ration and Smallmouth Bass having the smallest ration (Table 9.5.1).

Repeated broadscale diet analysis is an important tool that can be used in conjunction with stock assessments by management agencies to monitor the ecological response to changes in prey composition and abundance for economically and ecologically important fish species in Lake Ontario.

TABLE 9.5.1. Total number of stomachs (n), % stomachs containing food items (% food), total prey weight (Σ), and ration for Chinook Salmon (CHS), Brown Trout (BRT), Lake Trout (LAT), Smallmouth Bass (SMB), and Walleye (WAL) in Lake Ontario. All data were collected between 15 April and 8 November 2018.

	CHS	**BRT**	**LAT**	**SMB**	**WAL**
n	35	65	244	48	77
% food	71.4	69.2	84.0	66.7	55.8
Σ_{Prey} (g)	163.0	508.0	6031.0	17.5	641.2
Ration (%)	0.7	0.4	3.1	0.2	0.4

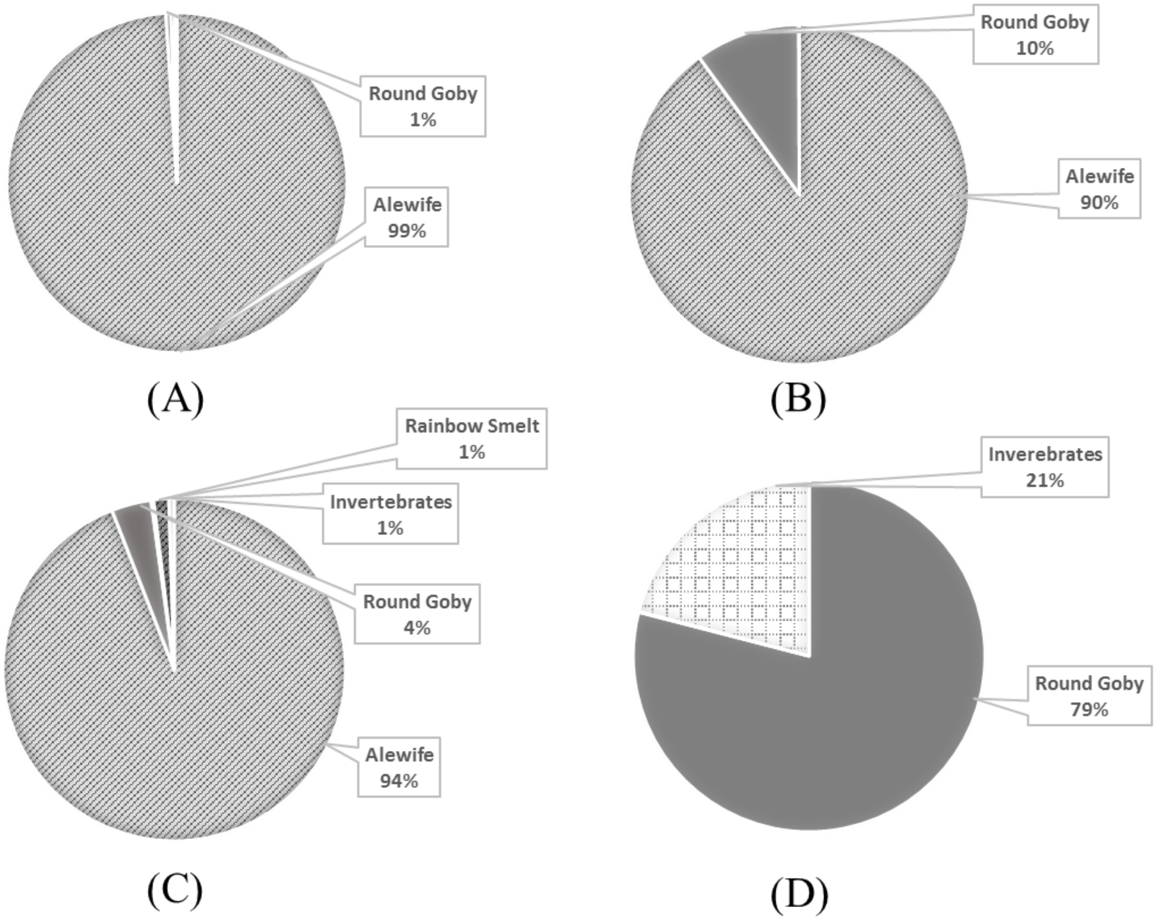

FIG. 9.5.1. Diet proportions of (A) Chinook Salmon, (B) Brown Trout, (C) Lake Trout, and (D) Smallmouth Bass in Lake Ontario. Walleye diet was 100% alewife (not shown). Samples were collected between 15 April and 8 November, 2018.

9.6 Assessing the efficacy of recreational watercraft decontamination methods to reduce the overland dispersal of aquatic invasive species

Project Leads: Shrisha Mohit and Shelley Arnott (Queen's University); Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Jeff Brinsmead (OMNRF, Natural Heritage Policy Section)

Recreational boating activities are known to facilitate the overland dispersal of aquatic invasive species (AIS) among lakes. To minimise the transport of AIS to new environments, the Invading Species Awareness Program recommends decontamination measures for watercraft and related equipment including pressure-washing, rinsing with hot water, or air-drying. We assessed the efficacy of these methods by conducting several experiments from May to October 2019 at Queen's University and its biological station. The species included in the experiments are already present in parts of Ontario, and the findings of this study will inform future best management practices for decontamination with regards to efficacy and ease of implementation.

Pressure washing experiments

Two types of experiments were performed to assess the efficacy of washing surfaces with pressures ranging from 50 psi to 1950 psi (Fig. 9.6.1). In the lake experiment, aluminium tiles were suspended in Lake Opinicon for three weeks to allow algae and other organisms to grow on or colonise the surfaces. After treatment, the mass of material remaining attached was compared to untreated controls. The artificial experiment consisted of a known amount of Eurasian watermilfoil leaflets randomly stuck on tiles with 15ml of extra-strong water-soluble gel. After pressure washing/handling, the number of whole leaves and leaf fragments remaining attached were counted. In both experiments, half the tiles in each treatment group were positioned at 90^{o} to the ground, and the remaining at 20^{o} to mimic the profile of a boat hull. Our preliminary results from both experiments indicated that increasing pressure outputs up to 900psi consistently decreased the amount of material remaining on surfaces

Laboratory experiments

Test organisms

Adult banded mystery snails (*Viviparus georgianus*), two sizes of zebra mussels (*Dreissena polymorpha*), and spiny water fleas (*Bythotrephes longimanus*) comprised the invertebrates used in the experiments. Ten healthy individuals were included in each treatment group for all experiments. Eurasian watermilfoil (*Myriophyllum spicatum*), Carolina fanwort (*Cabomba caroliniana*), and European frogbit (*Hydrocharis morsus-ranae*) were the aquatic plants used; each treatment group consisted of ten 10cm-long fragments of Eurasian watermilfoil and Carolina fanwort, or a single whole rosette of European frogbit.

Experiments

Following the three treatments (Fig. 9.6.2), all invertebrates were placed in tanks containing filtered lake water to recover, and the number of individuals surviving after 24h among banded mystery snails and zebra mussels were determined, and after 4h among spiny water fleas. Before subjecting the plants to each treatment, the number of leaflets and other structures present on the fragments or rosettes was counted, and the mass of all groups was recorded. The plants were also placed in compartment boxes and returned to

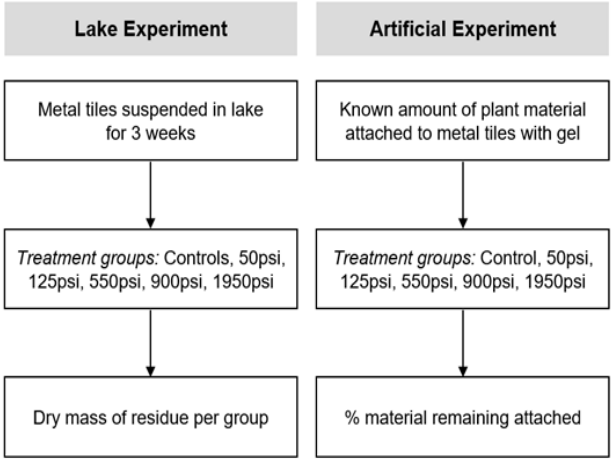

FIG. 9.6.1. Design of pressure-washing experiments.

filtered lake water after treatment; the groups were weighed (spun and blotted to remove excess water) and their structures (leaves, roots, and buds) counted every seven days for 28 days to monitor new growth or decay.

Hot water: Specimens for each species studied were placed inside mesh bags or tubes, and immersed in hot water for 2s, 5s, or 10s. Brief exposure durations were selected to best represent spray washing rather than soaking. After determining that all spiny water fleas died immediately at 60°C and above, only 25°C, 40°C, and 50°C were used in subsequent replicates.

Air-drying: All specimens were air-dried outside, away from direct sunlight and rain, inside a screen tent. Banded mystery snails had air-drying times of three and four days to determine when the highest mortality occurred since this species survived all air-drying durations tested.

Hot water and air-drying combination: In this experiment, all specimens were immersed in hot water for five seconds before immediately allowing them to air-dry. Survival for all invertebrates and plants were determined as above. This experiment determined if combining both treatments would be more beneficial than hot water immersion or air-drying alone. Preliminary results differed among species: the combination was more deadly than either method separately for zebra mussels, as a lower water temperature (40°C) combined with a shorter air-drying duration (36h) resulted in 100% mortality, compared to either 60°C or 60h separately. However, spiny water fleas reached 100% mortality with either 3h of air-drying alone or in the combined treatments, indicating that hot water immersion did not confer additional benefits over airdrying only. The opposite was noted for Eurasian watermilfoil where important degradation was found at temperatures of 60°C combined with at least 12h of air-drying, indicating air-drying was not more beneficial than hot water only.

Next steps include determining the magnitude of the effect resulting from the treatments on the viability of the AIS subjects. Additionally, for decontamination methods to effectively target the maximum number of AIS threatening the waterbodies of Ontario, it will be important to also identify the next best conditions that yield overall low survival while remaining feasible.

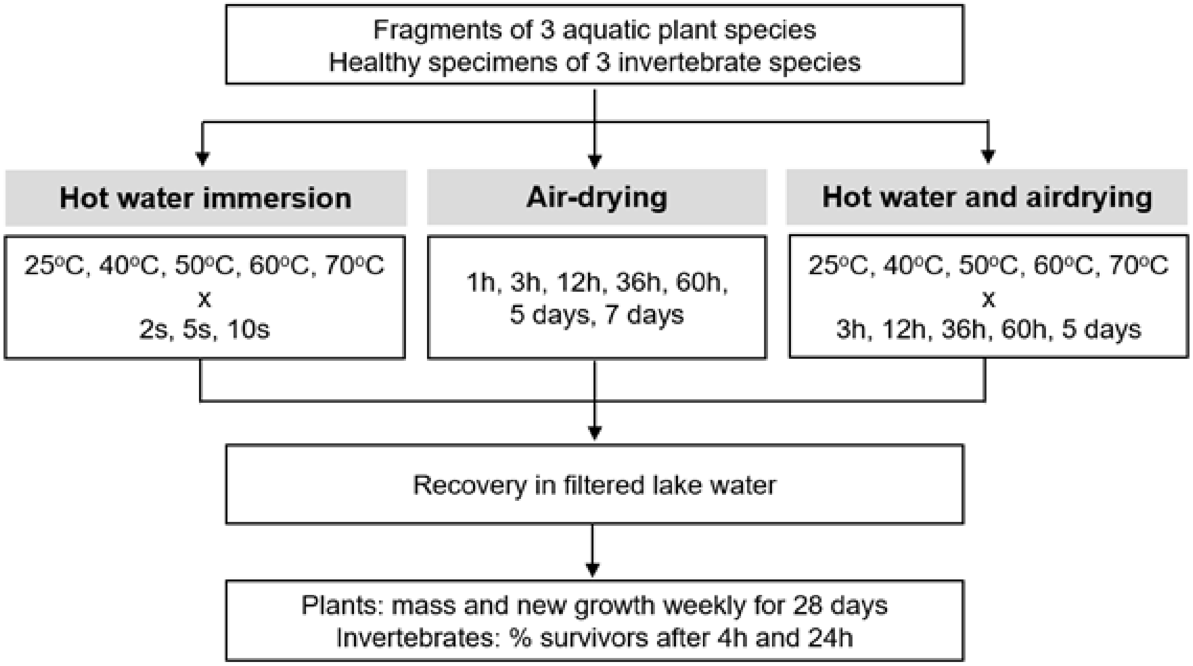

FIG. 9.6.2. Laboratory experiments, showing hot water temperatures and air-drying durations.

9.7 Application of a habitat suitability and natural dispersal model for invasive species in the Great Lakes.

Project Leads: Jeff Buckley and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Len Hunt (OMNRF, Centre for Northern Forest Ecosystem Research); Andrew Drake (Fisheries and Oceans Canada)

Invasive species pose a threat to the function and diversity of aquatic communities. In collaboration with partners at the Centre for Northern Forest Ecosystem Research and Fisheries and Oceans Canada, we have continued work on a vulnerability assessment of Ontario and the Great Lakes to the spread and establishment of aquatic invasive species (AIS). This year, we developed a method of predicting the suitability of Ontario's climate for AIS.

To model the suitability of climate, we first determined the native range of all known and potential AIS. This list of species was produced by Hatton *et al.* (2019) as a survey of AIS either currently invading, or on watch lists in Ontario, the Great Lakes, and all neighbouring jurisdictions. This survey included native ranges for each species. A total of 25 unique ranges were identified.

For each native range, a climate suitability model was developed. Temperature and precipitation-based variables from the WorldClim database were combined to create a single measure of climate within each native range. This measure was compared to Ontario's current measured 30-year climate average (1981-2010) as well as a predicted future climate scenario (2041-2071). Climate suitability was the degree to which Ontario's climate matched the climate in its native range.

An aggregate measure of climate suitability was produced combining all possible native ranges (Fig. 9.8.1A and 9.8.1B). Suitability maps were weighted by the proportion of AIS from each region such that regions from which a larger number of species are predicted (e.g. the Ponto-Caspian region) have a larger influence on the aggregate suitability. Climate suitability for AIS is likely to increase across the province (Fig. 9.8.1C), with the greatest increases predicted to occur in the Sault St. Marie area, as well eastern Lake Ontario, and eastern Georgian Bay. Increasing suitability suggests that AIS may more easily become established in the future and that there is the potential for new habitat to become available.

This climate suitability model is a part of a larger project investigating habitat suitability as well as natural and human mediated spread of AIS. Assessing climate suitability aids in

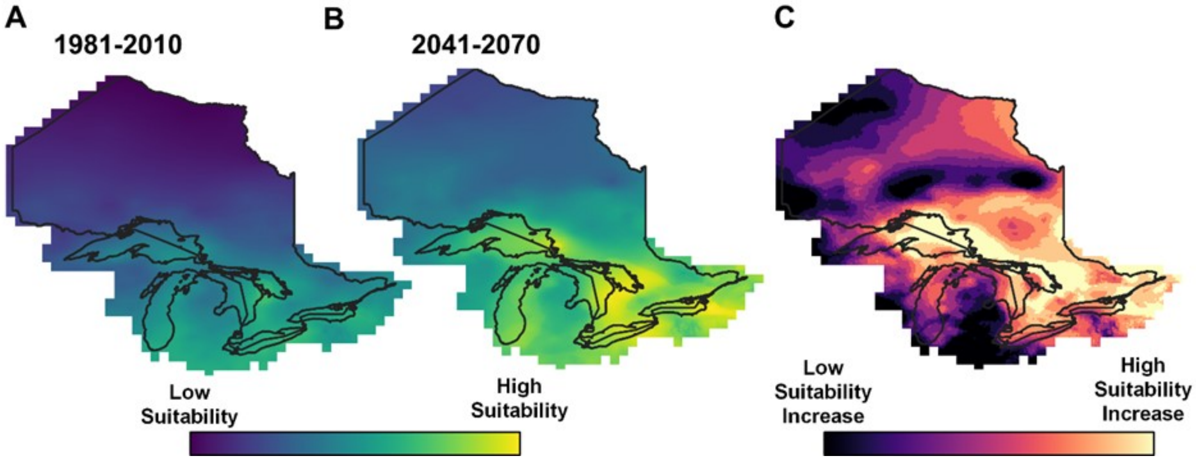

FIG. 9.7.1. Aggregate climate suitability for known and potential aquatic invasive species. Suitability is shown based on 30-year climate averages for 1981-2010 (A) and 2041-2070 (B). C shows the difference between these time periods and highlights increases in suitability.

identifying potential hotspots of invasion throughout the province, while dispersal models show how human activity will connect distant areas of the province and identify key pathways of spread. This combined analysis will allow for more efficient management of AIS in Ontario and the Great Lakes.

Hatton, E.C., J.D. Buckley, S.A. Fera, S. Henry, L.M. Hunt, D.A.R. Drake and T.B. Johnson. 2019. Current and potential aquatic invasive species in Ontario and the Great Lakes region: A compilation of ecological information. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Information Report IR-16. 23 p. + appendices

9.8 Chinook Salmon Otolith Microchemisty

L. Johnson and M. J. Yuille, Lake Ontario Management Unit

Understanding the sources of fish production (natural or hatchery) and geographic distribution of natural fish production within an ecosystem can have significant fisheries management implications (e.g., identifying priority areas for habitat restoration/protection, where to allocate stocking efforts, etc.) In Lake Ontario, the magnitude of natural reproduction of salmon and trout populations is vital in managing for sustainable fisheries as well as maintaining a healthy predator-prey balance in the lake. Based on a Lake Ontario Chinook Salmon (*Oncorhynnchus tashawystscha*) Mass Marking study, the contribution of natural Chinook Salmon to the lake population varies from 33-60% (see 2015 Lake Ontario Management Unit Annual Report, Section 2.2). Understanding this variability is critical to maintaining a healthy predator-prey balance, however contribution of natural reproduction requires the ability to determine natal origin of adult fish.

There are many ways in which fish natal origin can be identified. Clipping and/or implanting coded wire tags in stocked fish allows for an easy visual identification of stocked (clipped/tagged) and naturalized (no clip/tag) fish but is expensive and requires multi-year program commitments for data (mark and tag) recovery. An alternative approach that has been well documented as a reliable tool in determining the natal origin of fish is otolith microchemistry.

Otoliths are composed of a crystalline calcium carbonate structure that accumulates layers throughout the life of the fish. Within these layers, elements are deposited in trace amounts and reflect the physical and chemical characteristics of ambient water in which a fish resides. The concentration of trace elements within the layers of otolith create a temporal/geographical signature or “fingerprint” unique to the water in which the fish was born and lived early in its life. These elemental “fingerprints” in the fish otoliths can be matched to the “fingerprint” of their birthplace (e.g., hatchery or river) to determine the natal origin of a fish.

The objective of this study was to determine whether otolith microchemistry is a viable tool for determining natal origin of Lake Ontario Chinook Salmon. We assessed the otolith microchemistry from Chinook Salmon smolts collected in Lake Ontario tributaries in Ontario as well as direct from hatcheries and net pen sites from both Ontario and New York to determine the whether there were differences in elemental concentrations based on the known natal origin of the sample.

Fish for this study were collected from Lake Ontario tributaries (natural origin), hatchery facilities (hatchery origin-direct stocked) and net pen operations (hatchery origin-net pen) (Table 9.9.1). The selected tributaries included those known to support Chinook Salmon natural production and were chosen to maximize spatial representation of the Lake Ontario watershed as they are located on two different geological regions: the Niagara Escarpment and Oak Ridges Moraine. The hatcheries represented all those producing Chinook Salmon for release into Lake Ontario including fish for rearing in net-pen sites. Net pens included all net pen sites holding Chinook Salmon from the hatcheries to be reared for release in Lake Ontario.

Otolith microchemistry analysis on the core of otoliths was conducted at the Great Lakes Institute for Environmental Research (Element and Heavy Isotope Analytical Laboratories, University of Windsor). The core of the otolith corresponds to the earliest period of the fish’s life, thus the microchemistry of the core of the otolith was used as a means of inferring natal origin of fish.

Non-metric multidimensional scaling (NMDS) was used to characterize variability in multivariate elemental values between groups based on natal origin: 1. Natural vs. hatchery discrimination, 2. Further natural discrimination and 3. Further hatchery discrimination. We further investigated differences in clusters based on natal origin using analysis of similarities (ANOSIM), which compares mean ranked dissimilarities within and between groups. After testing for differences in multivariate elemental values between natal origin groups with ANOSIM, we employed a machine learning classification method called random forests (R-Package “randomForest”; hereafter RF) to build a classification model for discriminating natal origin based on otolith elemental values.

Smolt otolith microchemistry results showed that natural origin fish could be distinguished from hatchery origin fish with a maximum of 100% accuracy in the model (Fig. 9.8.1; Table 9.8.2). Examining natural origin fish specifically, showed some overlap in trace element concentrations and at a coarse level, fish grouped into two categories representing two geologic features in their respective headwaters in which they were collected (i.e., Niagara Escarpment and Oak Ridges Moraine; Fig. 9.9.2; Table 9.9.2). Analyses on hatchery origin fish only showed net-pen and direct stocked fish separated based on their elemental concentrations (Fig.9.8.3) and the model could assign the hatchery smolts into the correct group with a maximum accuracy of 88% (Table 9.8.2).

The long-term goal of this study is to develop a methodology for differentiating sources of Chinook Salmon production (e.g., natural or stocked) as well as and identifying key sources of Chinook Salmon natural production in Lake Ontario. This information is critical to successfully managing Lake Ontario’s salmon and trout populations and maintaining a healthy predator-prey balance. In 2020, further analysis will incorporate known origin adult Chinook Salmon from both Ontario and New York State.

TABLE 9.8.1. Collection sites of Chinook Salmon smolts from Lake Ontario tributaries, net pens and hatcheries collected by the Ontario Ministry of Natural Resources and Forestry (OMNRF) and New York State Department of Environmental Conservation (NYSDEC). Geological regions for natural smolts are separated into Niagara Escarpment (N) and Oak Ridges Moraine (O).

Collection Site	Agency	Natal Origin	Geological Region	Sample Size
Bronte Creek	OMNRF	Natural	N	13
Credit River	OMNRF	Natural	N	16
Duffins Creek	OMNRF	Natural	O	14
Ganaraska River	OMNRF	Natural	O	14
Oakville	OMNRF	Natural	N	5
Shelter Valley	OMNRF	Natural	O	20
Wilmot Creek	OMNRF	Natural	O	14
Salmon River Hatchery	NYSDEC	Hatchery	--	24
Normandale Hatchery	OMNRF	Hatchery	--	18
Genesee River	NYSDEC	Net Pen	--	10
Lower Niagara River	NYSDEC	Net Pen	--	9
Olcott	NYSDEC	Net Pen	--	5
Oak orchard	NYSDEC	Net Pen	--	5
Sodus	NYSDEC	Net Pen	--	10
Wilson	NYSDEC	Net Pen	--	8
Bronte Creek	OMNRF	Net Pen	--	8
Oshawa	OMNRF	Net Pen	--	8
Port Dalhousie	OMNRF	Net Pen	--	9
Wellington	OMNRF	Net Pen	--	9
Whitby	OMNRF	Net Pen	--	13

TABLE 9.8.2. Classification accuracy of random forest classification models developed using otolith microchemistry data. The parameter mtry describes the number of predictor variables (i.e., microchemical elements) considered at each tree split within the random forest algorithm. Model was run with all elements and important elements are elements with mean decrease accuracy >5.

Scale	Maximal Accuracy (%), mtry = 2	Maximal Accuracy (%), mtry = 3	Maximal Accuracy (%), mtry = 4	Important Elements
Natural vs. Hatchery	100	100	100	^{25}Mg, ^{55}Mn, ^{88}Sr, ^{118}Sn, ^{138}Ba
Natural - Geological region discrimination	79	83	76	^{25}Mg, ^{88}Sr, ^{138}Ba, Sn
Direct stocked vs. net pen	85	88	88	^{118}Sn, ^{60}Ni, ^{25}Mg, ^{208}Pb, ^{59}Co, ^{63}Cu, ^{88}Sr

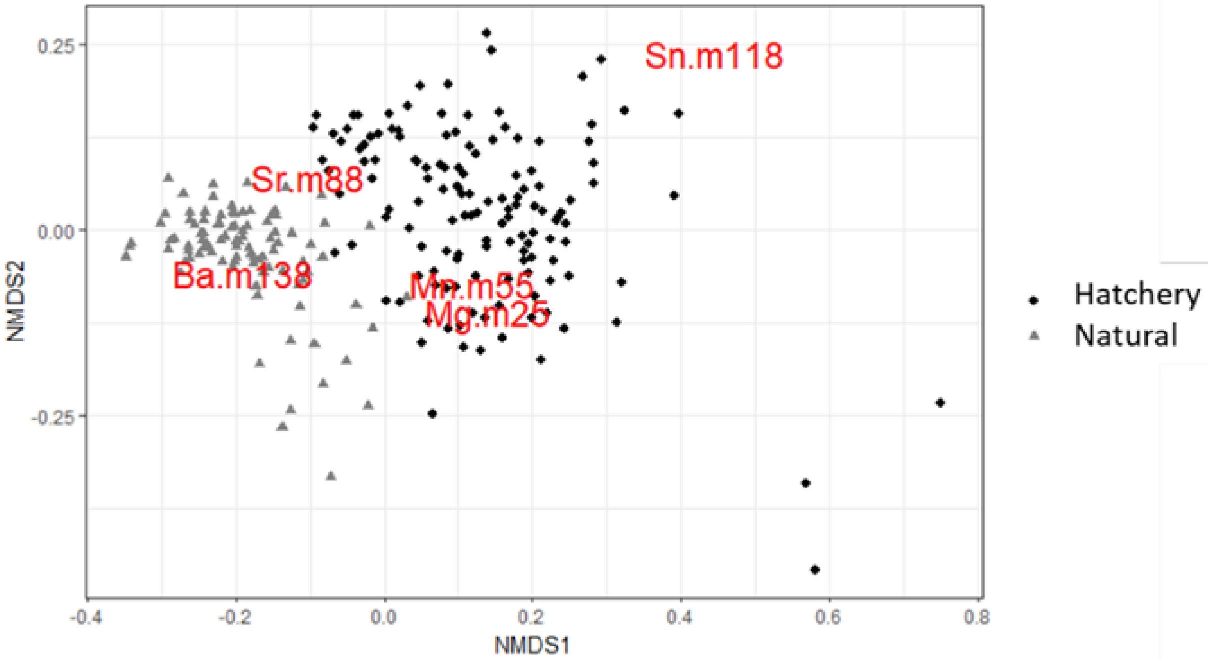

FIG. 9.8.1. Bray-Curtis based non-metric multidimensional scaling (NMDS) plot (stress 0.13) of Chinook Salmon otolith elemental fingerprints. The plot shows clustering of otolith samples distinct from each natal origin group. ANOSIM results were $R = 0.1601$, $p < 0.01$. Elements located near the clusters were more commonly observed in those groups.

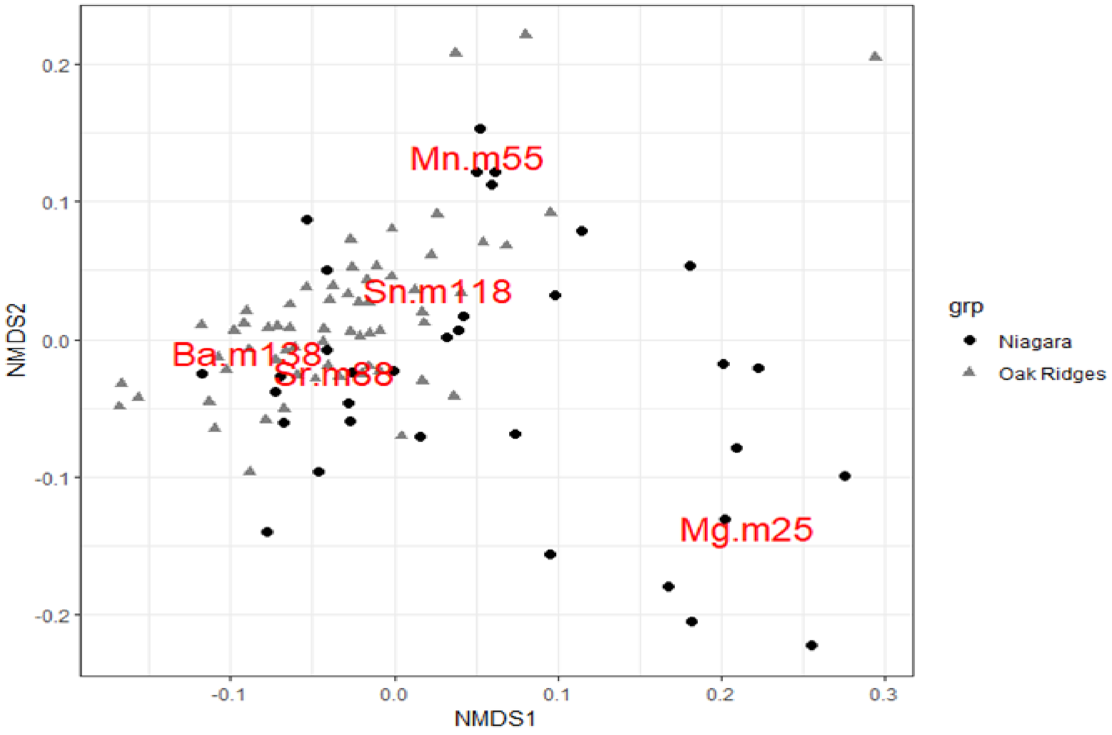

FIG. 9.8.2. Bray-Curtis based non-metric multidimensional scaling (NMDS) plots of natural Chinook Salmon smolts grouped by geological region. Stress value for the NMDS plot was 0.13 indicating good fit if the data. ANOSIM test of dissimilarity between groups results was R = 0.2463, p < 0.01.

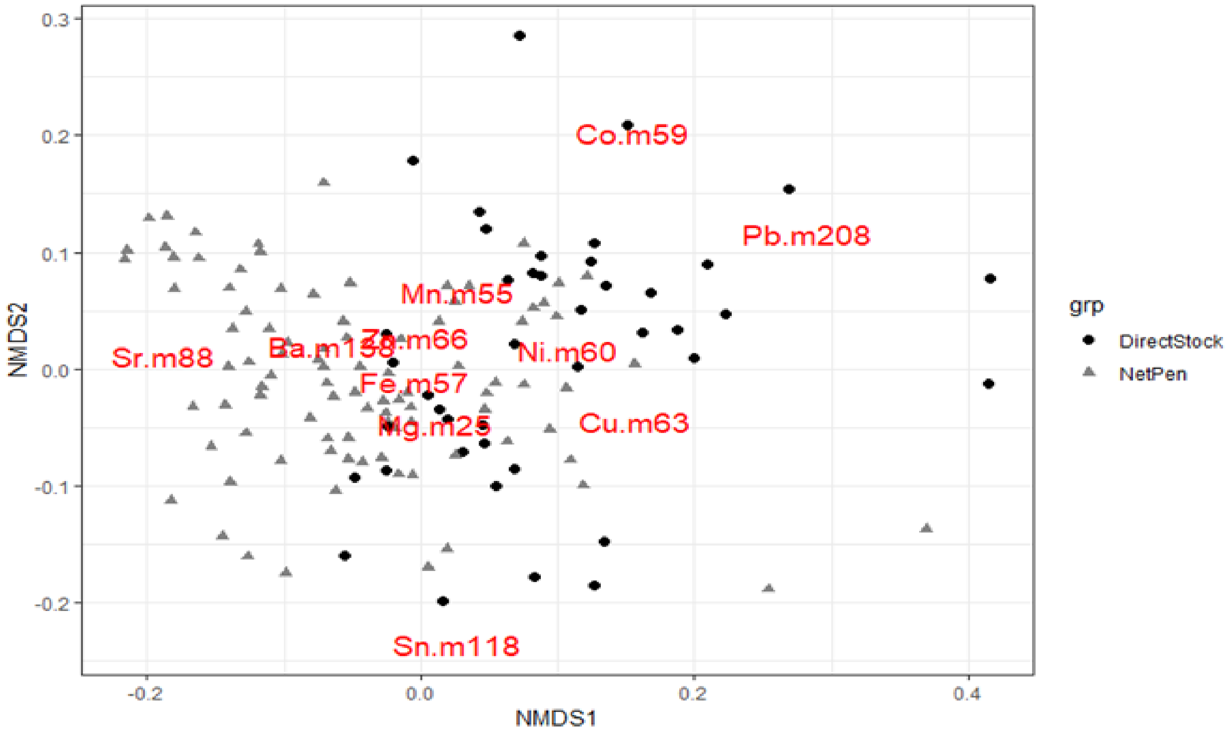

FIG. 9.8.3. Bray-Curtis based non-metric multidimensional scaling (NMDS) plots of hatchery origin Chinook Salmon smolts grouped by stocking method. Stress value for the NMDS plots with net pen data included was 0.19. ANOSIM test of dissimilarity between groups results was R = 0.39, p < 0.01.

9.9 Evaluation of Fishway Performance on the Ganaraska and Credit Rivers

L. Johnson, B. Maynard, M. Desjardins and M. Yuille, Lake Ontario Management Unit

Lake Ontario tributaries provide spawning/nursery habitat to several migratory salmon and trout species, from both stocked and natural sources. To restore the connectivity of fragmented river habitats, a variety of passage facilities (herein fishways) have been installed at river barriers in Lake Ontario tributaries. This study focuses on two fishways on Lake Ontario tributaries: 1) a pool-and-weir fishway located on the Ganaraska River at the Corbett Dam, Port Hope and 2) a pool-and-weir fishway located on the Credit River at the Streetsville Dam, Mississauga. The Lake Ontario Management Unit (LOMU) has monitored and assessed salmon and trout spawning runs on these rivers for over 30 years. These tributaries represent sentinel rivers providing insight into the condition, health and status of migratory salmon and trout in Lake Ontario.

It has been well documented that the presence of a fishway does not fully mitigate the fragmentation induced by a river barrier (e.g., dam). An evaluation of fishway performance at these barriers is necessary to provide an impact assessment on Lake Ontario migratory salmon and trout and facilitate estimates of run sizes. The objective of this study was to quantify fishway performance (combination of fishway attraction and passage efficiency) and other various attributes of fishway passage for migratory salmonid species at both the Streetsville and Ganaraska fishways.

Primary Objectives

1) What is the fishway attraction efficiency and attraction time?
2) What is the fishway passage efficiency and passage time?
3) What is the overall fishway performance and performance time?

Secondary Objectives

1) Are there biological effects (fish size, sex, condition, etc) on fish passage?
2) Of the fish that successfully migrate upstream of Streetsville Dam (river km 15), what proportion migrate upstream to Norval Dam (river km 40)*
3) How long does it take fish to migrate upstream to Norval Dam?*

*Secondary objectives 2 & 3 are specific to the Credit River.

All fish utilized in this study were captured using a combination of dip netting and backpack electrofishing. Rainbow trout were targeted during the spring spawning migration on the Ganaraska river while a mix of trout and salmon species were targeted on both the Ganaraska and Credit rivers during the fall spawn. Fish that were considered in good condition for tagging had a 23-mm HDX PIT tag implanted and an external FLOY tag applied below their dorsal fin on the left (Credit River) or right (Ganaraska River) side. For each fish

FIG. 9.9.1. Left: Ganaraska River tagging reach with red circles depicting where most fish tagging occurred. Right: Locations of antennas around and within the fishway.

included in this study several biological measurements were taken including: fork length (mm), depth (mm), round weight (g), sex, gonad condition, IJC lamprey markings and presence or absence of gill lice.

To detect the movement of migratory fish downstream of/within the fishway, stationary antennae were installed. Every time a tag was detected, the date, time, detection period, unique tag ID and antenna number were recorded and stored on the associated reader; these were manually downloaded during site visits. For simplicity, each antenna was labeled based on its position within the river and location within the fishways (Figs. 9.9.1, 9.10.2 and 9.9.3).

NOTE: On the Credit River, bypass 1 and bypass 2 antennae interfered with the entrance and exit antennae. Bypass 1 and bypass 2 were deactivated for the 2019 study and were removed from subsequent analyses. There was also an equipment error from October 9-21, 2019 and detections on the entrance and exit antennae were not assigned to a specific antenna. During this period, it is unknown whether fish detected on these antennae successfully passed through the fishway. As a result, two cases will be presented: Case 1) assume all fish detected in the fishway, entered and exited the fishway upstream and Case 2) assume all fish detected in the fishway, entered the fishway but did not exit upstream unless there was a distinct exit detection.

Fishway performance analyses were conducted separately for each species to account for inherent physiological and morphological differences that may affect results. Attraction, Passage and Performance efficiency calculations are listed in Table 9.9.1. Attraction, Passage and Performance times were calculated for each fish by subtracting the date/time stamp (T) associated with an antenna from the closest downstream antenna date/time stamp to get time elapsed between antennae (Table 9.9.1).

Ganaraska River Results- Spring 2019

Seventy-two rainbow trout were PIT-tagged and released over the course of spring sampling period (Table 9.9.2). A summary of detections and primary objective calculations for spring 2019 can be found in Table 9.9.3.

Differences in fork length, weight and

FIG. 9.9.2. Left: Credit river tagging reach with red circles depicting where most fish tagging occurred. Right: Locations of antennas around and within the fishway. Bypass antennae were decommissioned due to interference with the entrance and exit antennae.

FIG. 9.9.3. Antenna configuration downstream of Norval Dam (river km 40) on the Credit River.

Fulton's condition factor between fish that were detected in the fishway and those that were not were not statistically significant (Fig. 9.9.4).

Ganaraska River Results- Fall 2019

On the Ganaraska River, 111 Chinook salmon, four Coho salmon and nine rainbow trout were PIT-tagged and released over the course of fall sampling period (Table 9.10.4).

Twenty-four Chinook salmon, two Coho salmon and three rainbow trout were detected on the downstream antenna. Fish were first detected on the downstream antenna an average of one day (range = 4 hours - 9 days) post-release for Chinook salmon, average of nine days (range = 2-16 days) for Coho salmon and average of 14 hours (range = 3 hours - 1 day) for rainbow trout.

There were five Chinook salmon detected on the entrance antenna, however 12 Chinook salmon were detected on the exit antenna. Therefore, 12 Chinook salmon were considered to have passed the entrance antenna. Elapsed time calculations involving the entrance and exit arrays were based on the fish that were detected on each of those arrays (5 and 12 respectively; Table 9.9.5).

Welch two-sample t-tests showed significant differences were found between fishway detected and not detected groups based on fork length (t = -6.9667, df = 59.389, p-value = 2.988e-09) and weight (t = -5.8602, df = 26.852, p -value = 3.125e-06) but not on Fulton's condition factor (Fig. 9.10.5).

Credit River Results

On the Credit River, 107 Chinook salmon, nine Coho salmon and three brown trout were PIT -tagged and released over the course of fall sampling period (Table 9.9.6). In summary, thirty-six Chinook salmon, three Coho salmon and two brown trout were detected in the study (Table 9.9.7). Fish were first detected on the downstream antenna an average of six days post-release (range 1.5 hours – 32 days).

Differences in fork length, weight and Fulton's condition factor between fish that were detected in the fishway and those that were not were not statistically significant (Fig. 9.9.6).

Of the fish that successfully migrated upstream of Streetsville Dam (river km 15), one brown trout was detected on the Norval Dam antenna (river km 40). It was tagged and released below Streetsville Dam on Oct.15, 2019, passed the fishway on Oct. 20, 2019 and was detected on the Norval antenna on Oct. 25, 2019 (10 days from release to detection at Norval).

TABLE 9.9.1. Primary objectives, definitions and calculations.

Primary Objectives	Definition	Calculation
Attraction Efficiency (E_A)	Proportion of fish that pass the downstream array that enter the fishway	$E_A = N_{entrance} / N_{downstream}$
Attraction Time (T_A)	Time elapsed from detection on the downstream array and detection at fishway entrance	$T_A = T_{entrance} – T_{releasetime}$
Passage Efficiency (E_P)	Proportion of fish that exit the fishway after entering the fishway	$E_P = N_{exit} / N_{entrance}$
Passage Time (T_P)	Time elapsed from entering the fishway to exiting the fishway	$T_P = T_{exit} – T_{entrance}$
Fishway Performance (E_F)	Proportion of fish that pass the downstream array that exited the fishway	$E_F = N_{exit} / N_{downstream}$ or $E_A * E_P$
Fishway Performance time (T_F)	Time elapsed from detection on the downstream array (or release) and detection at fishway exit	$T_F = T_{exit} – T_{releasetime}$

TABLE 9.9.2. Summary of biological information collected on tagged fish from the spring in the Ganaraska River. One fish is not included in the sex ratio as its sex was unknown.

Species	n	Male:Female	Gill Lice	Lamprey Marks	Fork Length (mm ± SD)	Weight (g ± SD)	Condition (K ± SD)
Rainbow	72	25:46	19	13	603 ± 97	3111 ± 1343	1.35 ± 0.17

TABLE 9.9.3. Summary of detections and primary objective calculations for spring 2019 on the Ganaraska River. *One outlier took 7 hours to pass through the fishway. When this fish is removed from the time elapsed calculations, the average T_P is 1.4 hours.

	Total Fish Passed Antenna			Fishway Performance Metrics (% : hrs)		
Species	Downstream	Entrance	Exit	$E_A : T_A$	$E_P : T_P$	$E_F : T_F$
Rainbow	30	8	6	27 : 246	75 : 2	20 : 258

TABLE 9.9.4. Summary of biological information collected on tagged fish from the Ganaraska River in the fall. *Sex ratio for rainbow trout represents male:unknown.

Species	n	M:F	Gill Lice	Lamprey Marks	Fork Length (mm ± SD)	Weight (g ± SD)	Condition (K ± SD)
Coho	4	2:2	2	0	580 ± 66	2544 ± 676	1.29 ± 0.12
Chinook	111	46:65	89	8	870 ± 60	7919 ± 1554	1.19 ± 0.15
Rainbow	9	3:6*	7	0	611 ± 54	2723 ± 876	1.16 ± 0.09

TABLE 9.9.5. Summary of detections and primary objective calculations on the Ganaraska River in the fall. *There were two outlier fish that each took ~17 hours to pass through the fishway. When these are removed from the time elapsed calculations, the average T_P is 1.48 hours.

	Total Fish Passed Antenna			Fishway Performance Metrics (% : hrs)		
Species	Downstream	Entrance	Exit	$E_A : T_A$	$E_P : T_P$	$E_F : T_F$
Coho	2	0	0	0 : --	-- : --	-- : --
Chinook	32	12	12	38 : 32	100 : 8	38 : 34
Rainbow	3	0	0	0 : --	-- : --	-- : --

TABLE 9.9.6. Summary of biological information collected on tagged fish from fall 2019 on the Credit River.

Species	n	Male:Female	Gill Lice	Lamprey Marks	Fork Length (mm ± SD)	Weight (g ± SD)	Condition (K ± SD)
Coho	9	5:4	3	0	643 ± 44	2934 ± 681	1.09 ± 0.14
Chinook	107	37:70	74	9	841 ± 83	7524 ± 1737	1.37 ± 1.52
Brown	3	0:3	2	0	632 ± 95	3387 ± 1588	1.26 ± 0.21

TABLE 9.9.7. Summary of detections and primary objective calculations on the Credit River.

	Total Fish Passed Antenna			Fishway Performance Metrics (% : hrs)		
Species	Downstream	Entrance	Exit	$E_A : T_A$	$E_P : T_P$	$E_F : T_F$
Coho	3	0	0	0 : --	-- : --	-- : --
Case 1: Chinook	36	5	5	14 : 168	100 : 3**	14 : 149
Case 2: Chinook	36	5	2	14 : 168	40 : --	6 : 19
Brown	2	1	1	50 : --	100 : --	50 : 125

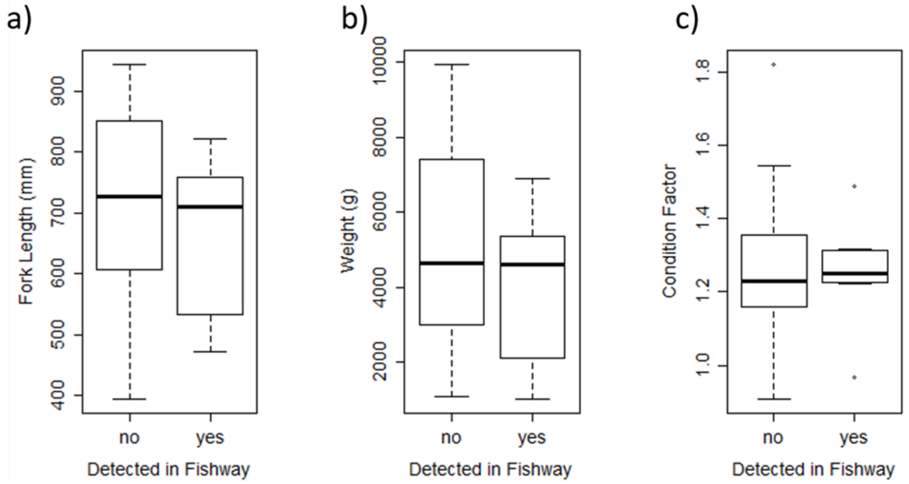

FIG. 9.9.4. Comparisons of fish (a) fork length, (b) weight, and (c) Fulton's condition factor between tagged Rainbow Trout that were detected in the Ganaraksa Fishway (n=8) and those that were detected downstream that did not use the fishway (n=22) in the spring. No significant differences were found between fishway detected and not detected groups on Welch two-sample t-tests.

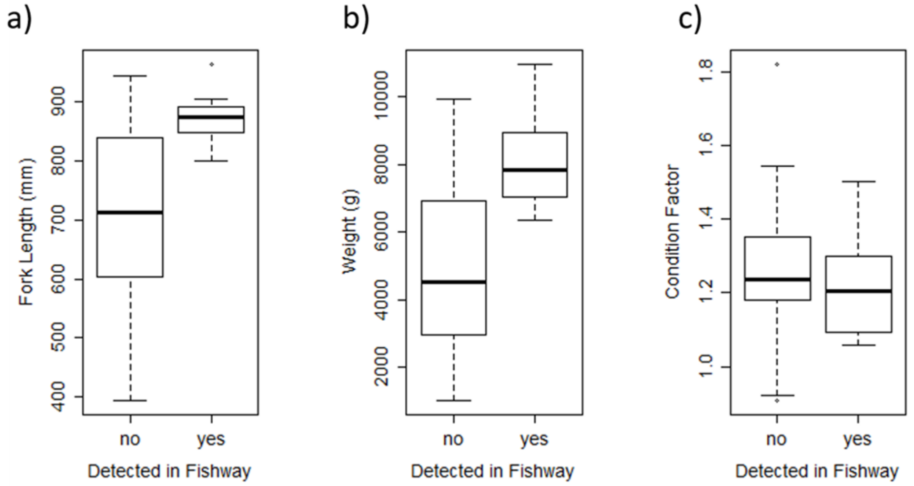

FIG. 9.9.5. Comparisons of fish (a) fork length, (b) weight, and (c) Fulton's condition factor between tagged Chinook Salmon that were detected in the Ganaraska Fishway (n=12) and those that were detected downstream that did not use the fishway (n=20). Significant differences were found between fishway detected and not detected groups based on fork length and weight but not on Fulton's condition factor.

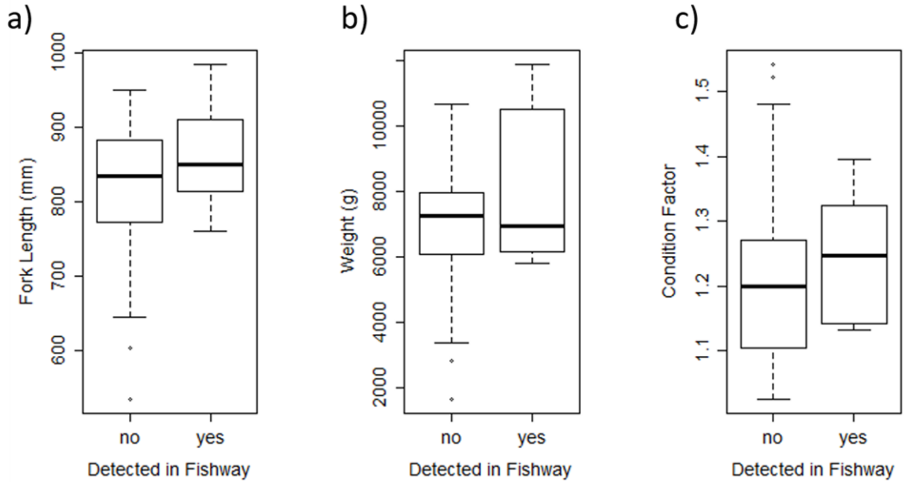

FIG. 9.9.6. Comparisons of fish (a) fork length, (b) weight, and (c) Fulton's condition factor between tagged Chinook salmon that were detected in the Streetsville Fishway (n=5) and those that were detected downstream that did not use the fishway (n=31). No significant differences were found between fishway detected and not detected groups on Welch two-sample t-tests.

9.10 Migration and Spatial Ecology of Bay of Quinte-Eastern Lake Ontario Walleye

C. W. Elliott[1], E. Brown[2], J. A. Hoyle[2] and B. L. Tufts[1]
Queen's University[1]; Lake Ontario Management Unit[2]

Walleye are the dominant piscivorous fish in the Bay of Quinte and nearshore waters of eastern Lake Ontario. As adults they are known to be highly migratory, utilizing both the Bay of Quinte and eastern Lake Ontario seasonally. Historically, their movements have been described using mark-recapture studies and assessment netting programs to infer age-specific geographical and seasonal distributions. In the spring, adults utilize the bay to spawn before migrating out to eastern Lake Ontario for the summer. Subadults (typically less than age-5) are thought to be resident to the Bay of Quinte, and they make use of different regions within the bay throughout the year. These seasonal and age-specific distributions are related to spawning site fidelity, thermal preferences, and foraging opportunities. This Walleye population supports important recreational, commercial, and First Nations fisheries.

The aim of this project is to collect more detailed insights into the seasonal movements and distribution of Walleye using acoustic telemetry in the Bay of Quinte and eastern Lake Ontario. With this technology it is possible to gain repeated observations of individual fish spanning multiple years. This makes it possible to describe behaviours for both subadult and adult Walleye, as well as describe the transition period between these two life stages. In April 2019, twenty adult Walleye were also tagged with external pop-off data storage tags (pDST) which record the depth and temperature of the fish for an entire year. The additional information provided from these tags may help to better understand some of the factors driving the Walleye movements in this region. This project is part of a Walleye acoustic telemetry partnership between Queen's University and the Lake Ontario Management Unit (LOMU).

One hundred and sixty-two adult Walleye (> 2.5 lbs) were surgically implanted with V16 69 kHz VEMCO internal acoustic transmitters between 2017 and 2019. A summary of capture and tagging events for adult Walleye can be found in Table 9.10.1. Forty-seven subadult Walleye (< 2.5 lbs) were surgically implanted with V13 69 kHz VEMCO internal acoustic transmitters between 2018 and 2019. A summary of capture and tagging events for subadult Walleye can be found in Table 9.10.2. Biological measurements were collected, external identification tags were applied, and fish were released near their capture location. Detection data was collected using a well-established array of acoustic receivers in Lake Ontario and the GLATOS network. Detection histories for 2019 are not reported at this time due to the timing of receiver maintenance and data downloads. For a summary of monthly acoustic telemetry detections prior to November 2018, please refer to the 2018 Annual Report of the Lake Ontario Management Unit, section 9.16 (adult) and 9.17 (subadult).

Twenty of the adults tagged from the Trent River in April 2019 also received external G5 pDSTs (Cefas Technology Limited). The pDSTs record depth and temperature every two seconds for an entire year before they release from the fish and float to the surface. In order to retrieve the data from the pDSTs this portion of the study relies on the public recovering and returning the tags for a $100 reward. The tags were programmed to pop-off one year after deployment (April 2020) when the Walleye had returned to the Trent River. As of December 2019, seven (35%) of the tags had been returned though angling events or failure of the pop-off mechanism. Early insights recovered from the data on these tags has provided interesting new details about daily and seasonal movements for Walleye in this region. If you recover an orange pDST, please visit TUFTSLAB.com for more information.

Queen's University and LOMU will continue acoustic tagging efforts and receiver retrievals in 2020. Continued tagging of subadult Walleye will enhance our understanding across different life stages and migration strategies. We also plan to include the tagging of an additional twenty pDSTs affixed to adult Walleye. Additional years of detection information paired with information from both the pDSTs and LOMU's ongoing assessment program is expected to provide a compressive understanding of Walleye spatial ecology in Lake Ontario and support the management of this important

TABLE 9.10.1: Summary of adult Walleye (> 2.5 lbs) acoustic telemetry tagging events (V16 69 kHz VEMCO internal acoustic transmitters) and biological data collection in eastern Lake Ontario, 2017-2019.

Capture Location	Date Tagged	Capture Method	Average Length (in)	Average Weight (lbs)	Number Tagged			*Total*
					M	F	U	
Big Bay, Bay of Quinte	2017-Apr	Trap Net	24.11	5.38	5	5	-	*10*
Trumpour Point, Bay of Quinte	2017-Apr	Trap Net	27.08	7.77	5	5	-	*10*
Trent River, Bay of Quinte	2017-May	Electrofishing	24.51	5.58	3	2	1	*6*
Timber Island, Kingston Basin	2017-Aug	Angling	27.57	8.44	-	-	10	*10*
Black River, New York	2018-Apr	Trap Net	27.90	9.80	1	9	-	*10*
Trent River, Bay of Quinte	2018-Apr	Electrofishing	26.28	7.22	11	11	-	*22*
Napanee River, Bay of Quinte	2018-Apr	Electrofishing	24.92	5.69	11	10	-	*21*
Melville Shoal, Kingston Basin	2018-Jun	Gill Net	26.17	8.04	-	-	20	*20*
Timber Island, Kingston Basin	2018-Aug	Gill Net	25.87	7.23	-	-	12	*12*
Trent River, Bay of Quinte	2019-Apr	Electrofishing	27.63	7.27	10	10	-	20
Black River, New York	2019-Apr	Trap Net	25.05	6.05	11	10	-	21
			Average		*Total*			
			26.10	*7.13*	*57*	*62*	*43*	***162***

TABLE 9.10.2: Summary of subadult Walleye (< 2.5 lbs) acoustic telemetry tagging events (V13 69 kHz VEMCO internal acoustic transmitters) and biological data collection in the Bay of Quinte 2018-2019

Capture Location	Date Tagged	Capture Method	Average Length (in)	Average Weight (lbs)	Number Tagged			*Total*
					M	F	U	
Napanee River, Bay of Quinte	2018-Apr	Electrofishing	16.73	1.46	6	-	-	6
Trent River, Bay of Quinte	2018-Apr	Electrofishing	16.14	1.46	6	-	-	6
Hay Bay, Bay of Quinte	2018-Jul	Angling	17.08	1.71	-	-	8	8
Upper Bay, Bay of Quinte	2018-Sep	Trap Net	18.93	2.28	-	-	7	7
Trent River, Bay of Quinte	2019-Apr	Electrofishing	17.24	1.82	20	-	-	20
			Average		*Total*			
			17.22	*1.75*	*32*	-	*15*	***47***

9.11 Bay of Quinte – Eastern Lake Ontario Coregonus Acoustic Telemetry

S. J. H. Beech[1], E. Brown[2], J. A. Hoyle[2] and B. L. Tufts[1]
Queen's University[1]; Lake Ontario Management Unit[2]

Lake Whitefish (*Coregonus clupeaformis*) were a historically abundant cold-water fish species in Lake Ontario. This commercially important population experienced declines due to overfishing, habitat degradation and invasive species introductions. Decreased body condition and reproductive success of since the late 1990's has emphasized the need to better understand the spatial ecology of the population. Using acoustic telemetry, this project is monitoring the movements of Lake Whitefish in the Bay of Quinte and Lake Ontario. The goal of this project is to better understand the geographic distribution of this population with a focus on spawning areas and seasonal migration patterns. In particular, this project will compare the distribution of Lake Whitefish tagged in two different spawning areas; the Bay of Quinte and the southern shore of Prince Edward County (PEC).

A total of 57 Lake Whitefish have been tagged with acoustic transmitters between 2016 and 2018. In April and November of 2016 and 2017, 29 Lake Whitefish were captured using trap netting at various locations in the Bay of Quinte (Trumpour's Point, Sherman's Point, Big Bay and Northeast Big Island). Individuals that were approximately greater than 400 mm in length were surgically implanted with Vemco V13 69 kHz acoustic transmitters that have a 2-year battery life. Larger individuals were implanted with larger V16 69 kHz acoustic transmitters with a 5-year battery life. An additional 28 Whitefish were captured in October and November of 2018 and were all tagged with Vemco V16 69 kHz acoustic transmitters. Eleven of these fish were captured around Northeast Big Island in the Bay of Quinte and the remaining 17 were tagged at the southern shore of Prince Edward County. A summary of Whitefish capture events and biological information can be found in Table 9.11.1. A network of acoustic receivers has been deployed by Queen's University, OMNRF and USFWS and other agencies throughout the Bay of Quinte and Lake Ontario. The detection data collected by these receivers is used to interpret fish movements over space and time.

Seasonal movements of tagged Whitefish were analyzed and the spatial distribution results are shown for fish tagged in the Bay of Quinte in Fig. 9.11.1 and fish tagged off of PEC in Fig. 9.11.2. During the summer seasons (June 21st-September 21st) tagged Whitefish from the Bay of Quinte primarily occupied the lower bay with some individuals using the eastern basin. In the

TABLE 9.11.1. Summary of Lake Whitefish acoustic telemetry tagging events (V13 and V16 69 kHz VEMCO internal acoustic transmitters) and biological data collection in eastern Lake Ontario.

Capture Location	Date Tagged	Capture Method	Average Length (in)	Average Weight (lbs)	Number Tagged			*Total*
					M	F	U	
Trumpour's Point, Bay of Quinte	2016-Apr	Trap Net	22.14	-	-	-	5	*5*
Sherman's Point, Bay of Quinte	2016-Apr	Trap Net	19.29	-	-	-	1	*1*
Northeast Big Island, Bay of Quinte	2016-Nov	Trap Net	21.44	-	2	2	-	*4*
Big Bay, Bay of Quinte	2017-Apr	Trap Net	20.94	2.86	-	-	2	*2*
Trumpour's Point, Bay of Quinte	2017-Apr	Trap Net	21.54	3.38	-	-	4	*4*
Northeast Big Island, Bay of Quinte	2017-Nov	Trap Net	20.02	2.46	-	-	13	*13*
Northeast Big Island, Bay of Quinte	2018-Oct	Trap Net	21.67	-	2	4	5	*11*
Big Sand Bay, Lake Ontario	2018-Nov	Gill Net	29.53	3.75	1	-	-	*1*
Gravelly Point, Lake Ontario	2018-Nov	Gill Net	20.55	2.62	12	4	-	*16*
			Average		*Total*			
			21.06	*2.69*	*17*	*10*	*30*	*57*

fall (September 22nd - December 20th) the tagged Whitefish migrated into the middle and upper parts of the bay to spawning areas. Many of these individuals quickly left later in the fall season while others remained in the Bay of Quinte. The tagged Whitefish occupied several different areas during the winter (December 21st - March 19th). Some remained in the middle and upper parts of the bay while others migrated into the lower bay and eastern basin. In the spring (March 21st - June20th) distribution also varied but the upper bay was less utilized. The Whitefish tagged at PEC only have 3 seasons of available data (fall 2018, winter 2018/2019 and spring 2019) but provide initial insights into movement patterns of this spawning group. After being tagged in the fall, the Whitefish occupied several areas in the eastern basin with many individuals moving towards the southeastern shore. Distribution in the winter was similar but a number of fish were not detected so observations are limited. In the spring there was also limited detection data but one individual was detected at the mouth of the Niagara River. When the receivers are downloaded in the spring of 2020 movements of the groups tagged in November 2018 and will be analyzed further.

This project will continue to monitor the movements and habitat use of Lake Whitefish in order to better understand the seasonal geographic distribution and movements of this population. As additional detection data from Whitefish tagged at PEC is collected spatial distributions will be compared to analyze if the two spawning groups mix during the non-spawning seasons.

A better understanding of the spatial ecology of depressed populations of Lake Whitefish is required to help conserve this species. This project uses acoustic telemetry to monitor movements and habitat use of Lake Whitefish in the BOQ and Lake Ontario. Seasonal distributions of tagged Lake Whitefish from two spawning areas are presented and analyzed. These two spawning groups show initial differences and overlap in geographic distribution.

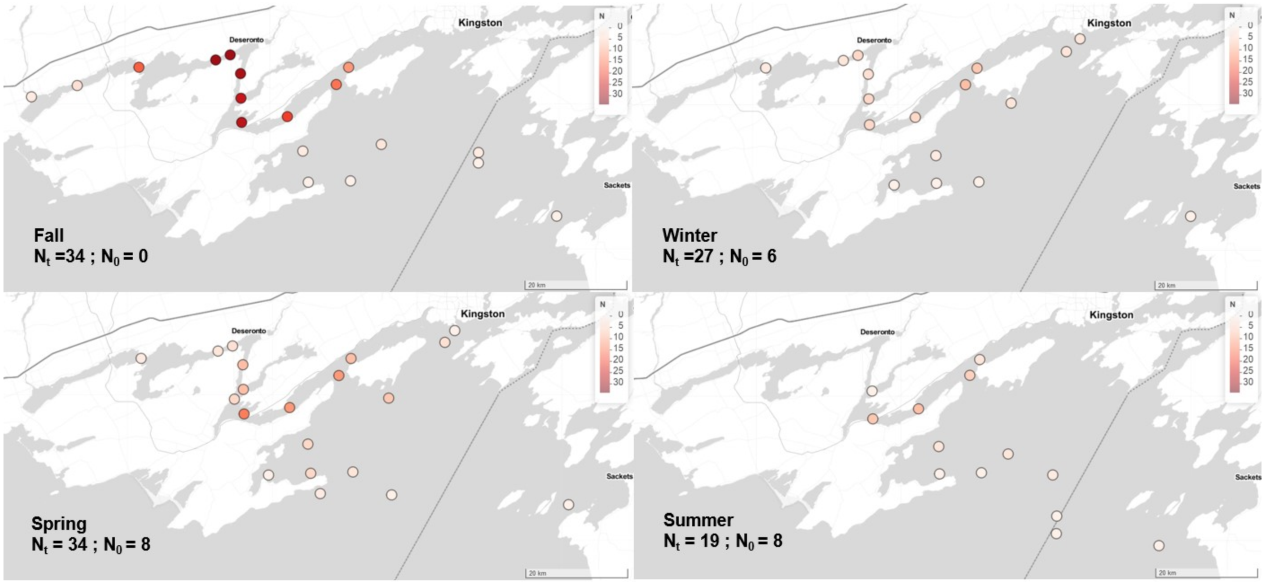

FIG. 9.11.1. Seasonal detections of Lake Whitefish tagged in the Bay of Quinte are shown from Spring 2016 through Spring 2019. Colour saturation at a station represents the number of unique Whitefish detected. Total number of Whitefish in the tagged population for each season is N_t and the number of tagged Whitefish that were not detected in that season is N_0. Data from most of the GLATOS array was not yet available after spring of 2019 at the time of this report.

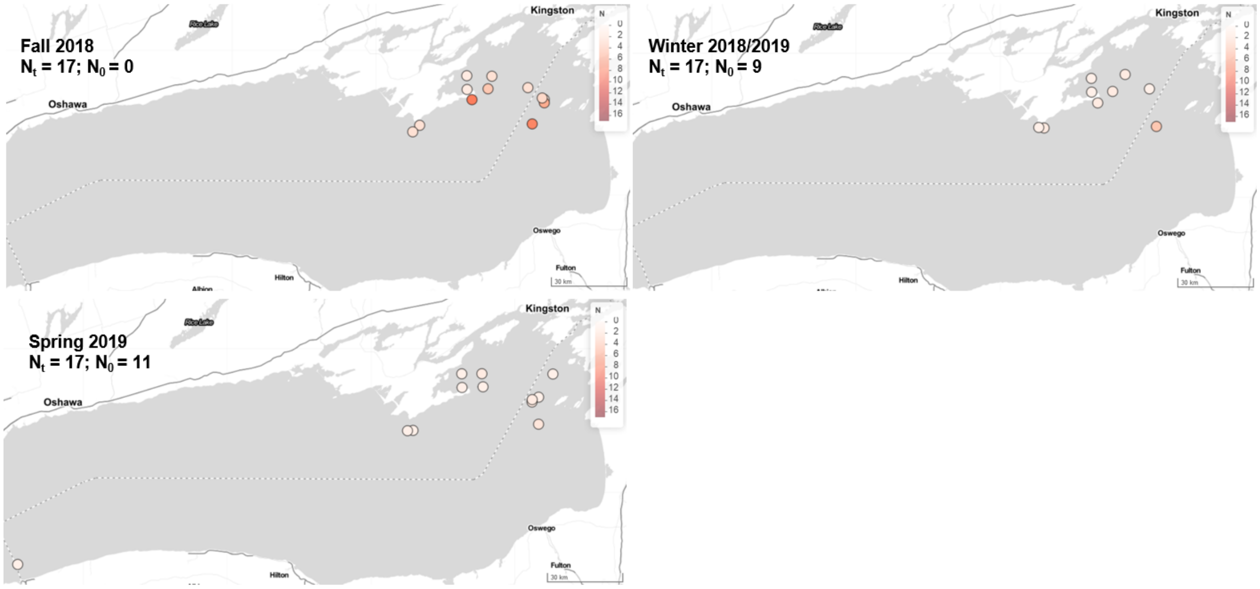

FIG. 9.11.2. Seasonal detections of Lake Whitefish tagged at PEC are shown from Fall 2018 through Spring 2019. Colour saturation at a station represents the number of unique Whitefish detected. Total number of Whitefish in the tagged population for each season is N_t and the number of tagged Whitefish that were not detected in that season is N_0. Data from most of the GLATOS array was not yet available after spring of 2019 at the time of this report.

10. Environmental Indicators

10.1 Water Temperature

J. P. Holden and E. Brown, Lake Ontario Management Unit

Winter Severity Index

Winter severity is often correlated with year-class strength in temperate fish species. A long-term (1944-2019) winter severity index is presented in Fig. 10.1.1. The winter of 2018/19 was more severe than the long-term average. Eight of the last 20 years have been more severe than the long-term average.

Mid-summer Water Temperature

Summer water temperatures can impact fish distribution and influence growth and survival of young of the year fish.

Bay of Quinte

A long-term (1944-2019) mid-summer water temperature index is presented in Fig. 10.1.2. Water temperature in the summer of 2019 were warmer than the long-term average. Fourteen of the last 20 years were above the long-term average.

Lake Ontario

Main lake surface water temperatures have been collected by the National Oceanic and Atmospheric Administration's National Data Buoy Center (www.ndbc.noaa.gov) at Station 45012 (East Lake Ontario – 20 nautical miles north of Rochester, NY) . Mean summer water temperatures in 2019 were above the average for the time series (2002 to 2019; Fig. 10.1.3).

Coldwater Habitat

Native coldwater species such as Lake Trout, Lake Whitefish and Lake Herring (Cisco) depend on access to suitable temperatures. Temperature profiles are collected at each Fish Community Index Gill Net and Trawl site (Section 1.1 and 1.2). Gill net site EB06 is an offshore site in the Kingston Basin (for a map, see map 1.1.1) that can provide a representative index of available thermal habitat in summer months within the Kingston Basin through time. Profiles collected in July, August and September at EB06

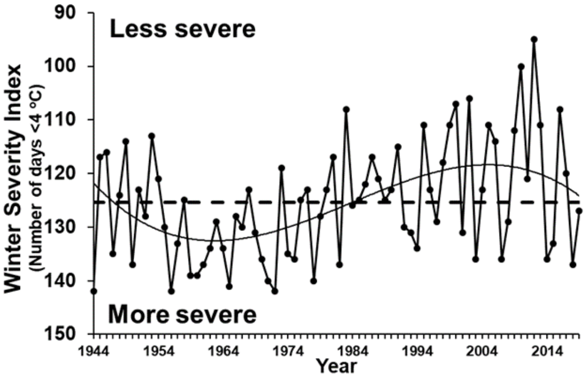

FIG. 10.1.1. Winter severity index, 1944-2019. Winter severity is measured as the number of days in December through April with a mean water temperature less than 4°C. By way of example, the 2019 data point includes the mean daily surface water temperature from Dec 1, 2018 to April 30, 2019. The long-term average index is depicted with a dashed line, and a third order polynomial fit to the data is shown as a thin solid line. Mean daily surface water temperature data was obtained from the Belleville (Upper Bay of Quinte) Water Treatment Facility. The temperature data comes from water drawn from the bottom at a depth of approximately 3.2 m. Water temperatures are homothermous in this section of the bay.

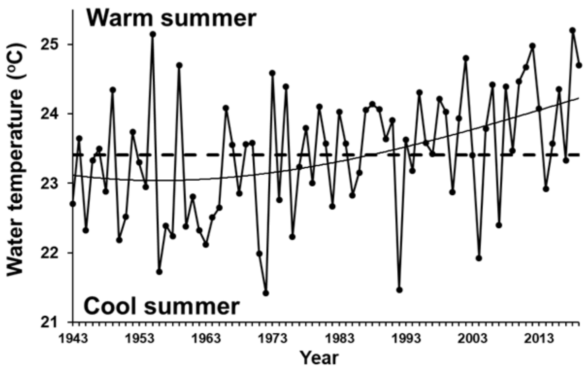

FIG. 10.1.2. Mean mid-summer water temperature (July and August; mean of 62 days) at the Belleville Water Treatment Facility, 1943-2019. The long-term average index is depicted with a dashed line, and a third order polynomial fit to the data is shown as a thin solid line. Mean daily surface water temperature data was obtained from the Belleville (Upper Bay of Quinte) Water Treatment Facility. The temperature data comes from water drawn from the bottom at a depth of approximately 3.2 m. Water temperatures are homothermous in this section of the bay.

(Fig. 10.1.4) show the seasonal warming (warmer water deeper) of the Kingston Basin but do not capture the daily variability influenced by thermal mixing due to wind events. The water depth at which water temperature is below 15°C provides an index of the amount of coldwater habitat available between years which may influence catches of coldwater species such as Lake Trout and Lake Whitefish. A shallower depth of 15°C would indicate more coldwater habitat available (Fig. 10.1.5).

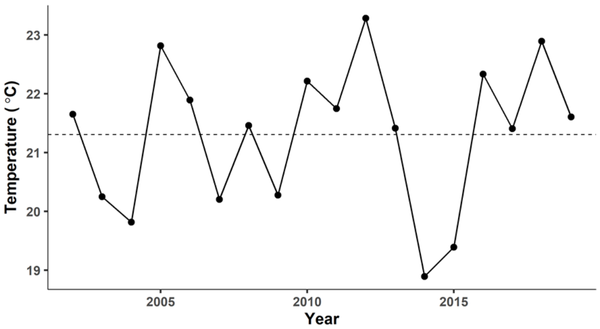

FIG. 10.1.3. Mean annual water temperatures in July and August collected at the National Oceanic and Atmospheric Administration's Station 45012 (East Lake Ontario – 20 nautical miles north of Rochester, NY). Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

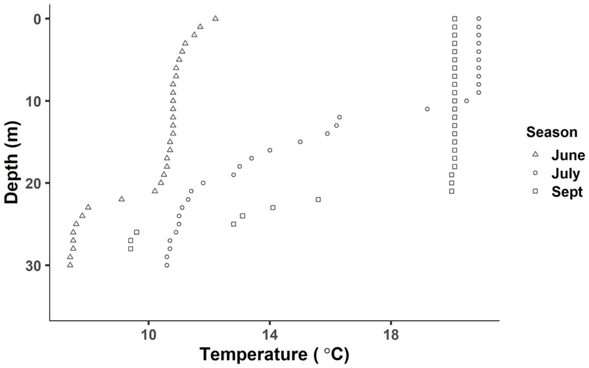

FIG. 10.1.4. Temperature profiles collected in June, July and September at Fish Community Index Gill Net (Section 1.2) site EB06.

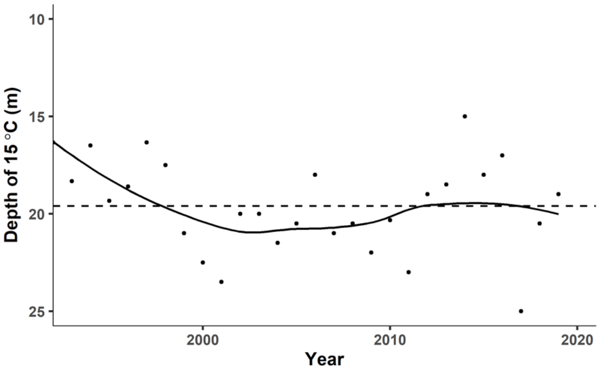

FIG 10.1.5. Index of coldwater habitat in the Kingston Basin determined by July and August temperature profiles collected at Fish Community Index Gill Net (Section 1.1) site EB06. The solid line is the trend through time (loess fit) and the dotted line is the average depth of 15°C throughout the timerseries (1992-2019).

10.2 Wind

M. J. Yuille, Lake Ontario Management Unit

National Oceanic and Atmospheric Administration (NOAA) records multiple weather variables using a variety of weather buoys deployed throughout Lake Ontario. Buoy data are available through the National Data Buoy Center webpage hosted by NOAA (http://www.ndbc.noaa.gov/). The Rochester weather buoy (Station ID# 45012; located 37 km offshore, north-northeast of Rochester) records several environmental variables, including wind direction and velocity ($m \cdot s^{-1}$). Wind direction and velocity can affect both the Lake Ontario ecosystem (e.g., thermal mixing, fish distribution) and the recreational fishery (e.g., total angler effort and the distribution of effort on Lake Ontario).

Two indices were developed to provide a wind index on Lake Ontario from 2002 – 2019 (Fig. 10.2.1). Small Craft Wind Warnings are issued for Lake Ontario by Environment Canada when wind velocities measure 20 – 33 knots (http://weather.gc.ca/marine/). The Small Craft Index represents the total number of hours from July 1st to August 31st each year, where the wind velocity was greater than or equal to 20 knots. This index shows that in the last 10 years, 2010, 2011, 2014, 2017 and 2019 had higher than average small craft warnings (Fig. 10.2.1a). In 2019, the number of small craft warning hours was significantly greater than 2018 and well above the average for the time series (Fig. 10.2.1a). A second index, the East Wind Index, was calculated to determine relative contribution of east winds to the July/August open water fishing season (Fig. 10.2.1b). This index shows a decrease from 2018 to 2019, where relative contribution of east winds was below the long -term average in 2019 (Fig. 10.2.1b).

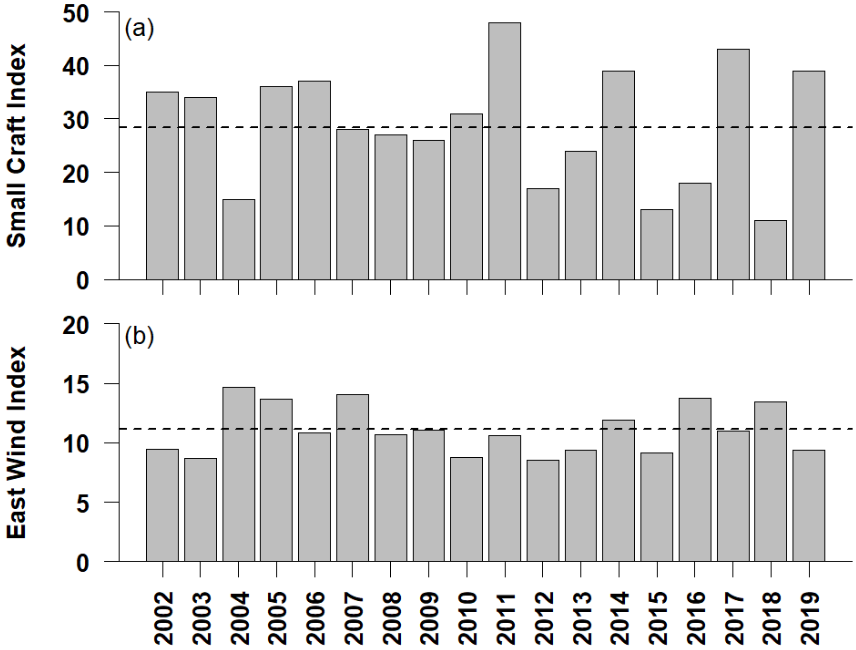

FIG 10.2.1. Lake Ontario wind as characterized by the Small Craft Index (a) and East Wind Index (b). The Small Craft Index represents the total number of hours from July 1st to August 31st each year (2002 – 2019), where the wind velocity was ≥ 20 knots. The East Wind Index represents the number of hours from July 1st to August 31st each year (2002 – 2019) that an eastern wind predominated. Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

10.3 Water Clarity

J. P. Holden, Lake Ontario Management Unit

Summary Water Transparency

Water clarity is measured using a Secchi disk at each Fish Community Index Gill Netting site (Section 1.1). The maximum depth the Secchi disk can be observed is an index of water clarity. Mean annual water clarity varies between the Bay of Quinte, Kingston Basin and the Eastern Portion of Lake Ontario (measured at Rocky Point gill net sites) (Fig. 10.3.1). Bay of Quinte Secchi depths are generally shallower (less clear) than main lake sites and have been decreasing (i.e. reduced clarity) through the time series. Similarly, Rocky Point is marginally clearer than the Kingston Basin but neither show a trend through time (1993 to present). Year to year variation in Kingston Basin and Rocky point are highly correlated throughout the time series

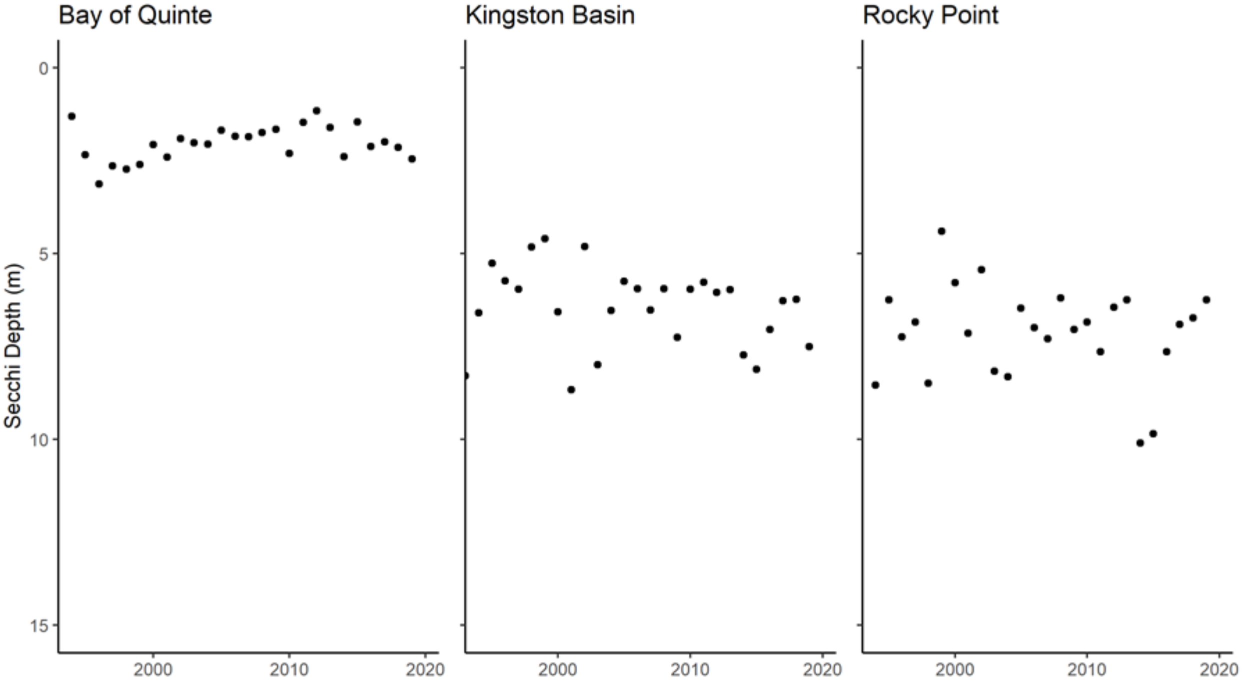

FIG 10.3.1. Mean annual water clarity determined by Secchi disk readings collected at Fish Community Index Gill Net sites in June, July and August.

10.4 Tributary Water Flow

E. Brown, Lake Ontario Management Unit

Tributary water flow regimes can impact fish species that use Lake Ontario's tributaries for spawning and rearing. For example, migratory salmonid species such as Rainbow Trout and Chinook Salmon rely on cold water tributaries during the spring and fall in areas where natural reproduction occurs. Native cool water species such as Walleye, Northern Pike, and Lake Sturgeon may also use tributary areas for spawning during the spring. Though flow regimes can be described using several metrics, in this report, annual discharge data ($m^3 \cdot s^{-1}$) and central flow timing (i.e. date at which half the annual discharge has been exceeded) are used. Average annual discharge is used to describe large-scale comparison in flow among years, whereas central flow timing is used to indicate whether the annual discharge occurred early or late in the season relative to the long-term average.

Water Surveys of Canada (WSC) collects hydrometric data from gauges across Canada, which are available through the Environment Canada webpage (http://wateroffice.ec.gc.ca/index_e.html). Discharge data from three stations (listed and described Table 11.4.1) were retrieved in February 2020 and summarised to characterise tributary water flow regimes. At the time of this report, 2019 daily discharge data are considered provisional by the Environment and Climate Change Canada and subject to change.

The Credit River drains into the western end of Lake Ontario and provides fishing opportunity for migratory salmonids within the river and lake basin. In 2019, the average annual discharge at the Credit River (Station ID: 02HB029) was 9.52 $m^3 \cdot s^{-1}$. This was above the long-term average (Fig. 10.4.1). The central flow Julian day date was 124, indicating that flows occurred earlier relative to the 5-year average (128).

The Ganaraska River receives annual runs of naturalized Chinook Salmon and Rainbow Trout and both of these species reproduce naturally within this river system. In 2019, the average annual discharge at the Ganaraska River (Station ID: 02HD012) was 4.05 $m^3 \cdot s^{-1}$. This was above the long-term average (Fig. 10.4.2). The central flow Julian day date was 130, indicating that flows occurred earlier relative to the 5-year average (138).

The Salmon River drains into the Bay of Quinte near Shannonville, Ontario. The lower reaches of this system provide spawning and rearing habitat for warm and coolwater species that inhabit the Bay of Quinte and Lake Ontario (e.g. Walleye). In 2019, the average annual discharge at the Salmon River (Station ID: 02HM003) was 15.49 $m^3 \cdot s^{-1}$. This was above the long-term average (Fig. 10.4.3). The central flow Julian day date was 115, indicating that flows occurred later relative to the 5-year average (112).

TABLE 10.4.1. Information of three Lake Ontario tributaries used in the stream flow analysis including river name, station ID, latitude and longitudes (Degrees Decimal Minutes), gross drainage area (km^2), and the Daily Discharge Time Series for each tributary.

River	Station ID	Latitude	Longitude	Gross Drainage Area (km^2)	Daily Discharge Time Series
Credit	02HB029	44° 34.933 N	79° 42.517 W	774.24	2005-2019
Ganaraska	02HD012	43° 59.450 N	78° 16.683 W	241.87	1976-2019
Salmon	02HM003	44° 12.433 N	77° 12.550 W	906.73	1958-2019

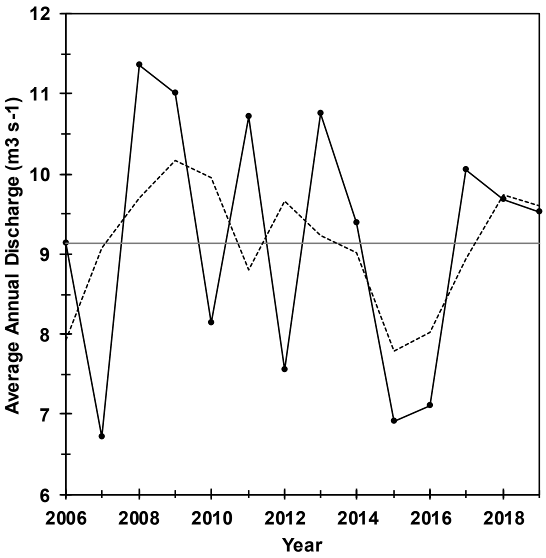

FIG. 10.4.1. Average annual discharge (m^3•s^{-1}) for the Credit River, Ontario (Station ID: 02HB029) from 2006 to 2019. The horizontal line is the historical average discharge and the dotted line represents the 3-year running mean. In 2019, the average annual discharge was 9.52 m^3•s^{-1}.

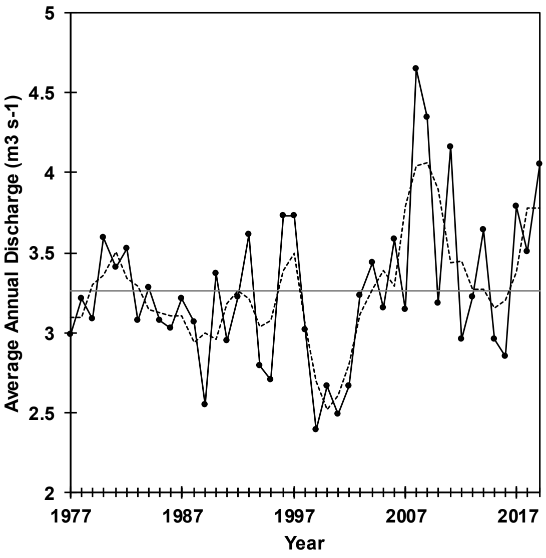

FIG. 10.4.2. Average annual discharge (m^3•s^{-1}) for the Ganaraska River, Ontario (Station ID: 02HD012) from 1977 to 2019. The horizontal line is the historical average discharge and the dotted line represents the 3-year running mean. In 2019, the average annual discharge was 4.05 m^3•s^{-1}.

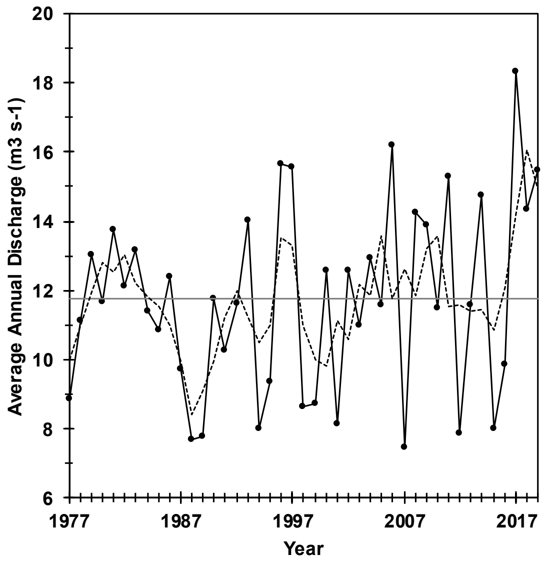

FIG. 10.4.3. Average annual discharge (m^3•s^{-1}) for the Salmon River, Ontario (Station ID: 02HM003) from 1977 to 2019. The horizontal line is the historical average discharge and the dotted line represents the 3-year running mean. In 2019, the average annual discharge was 15.49 m^3•s^{-1}.

11. Staff 2019

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Mary Hanley	Project Biologist (Food Webs)
Eloise Ashworth	Project Biologist (Habitat)
Brittany Payne	Student Research Technician

12. Operational Field and Lab Schedule, 2019

(SPA = Special Purpose Account; COA = Canada Ontario Agreement; CRF = Consolidated Revenue Fund; DFO = Department of Fisheries and Oceans; TRCA = Toronto and Region Conservation Authority; OFAH = Ontario Federation of Anglers and Hunters; OPG = Ontario Power Generation; GLFC = Great Lakes Fishery Commission; QU = Queen's University).

Field and Lab Projects	Dates	Species Assessed, Monitored	Project Lead	Operational Lead	Funding Source
Atlantic Salmon Marking Program	Feb	Atlantic Salmon	Lake	Chicoine	SPA
Chinook Salmon Marking Program	Mar	Chinook Salmon	Yuille	Kranzl	SPA
Public Outreach - Toronto Sportsmen's Show	Mar	Public Outreach/Education	Kranzl	Kranzl	SPA
Atlantic Salmon Classroom Hatchery Program	Jan-May	Atlantic Salmon	McNevin/Dr. Johnson	Wingrove/Dr. Johnson	OFAH
Ganaraska River Fish Counter Salmon and Trout Assessment	Mar-Nov	Migratory Trout & Salmon	Yuille	Maynard	COA/SPA/CRF
Ganaraska Fishway Rainbow Trout Assessment	Mar-Apr	Rainbow Trout	Yuille/Maynard	Brennan	SPA
Ganaraska River Evaluation of Fishway Performance	Apr-Nov	Migratory Trout & Salmon	Yuille	Maynard/L. Johnson	COA
Walleye Egg Collection	Mar-Apr	Walleye	Kranzl	Wingrove/Moore	SPA
Foodweb Dynamics in Lake Ontario	Apr-Nov	Fish Community	Dr. Johnson	Metcalfe/Rupnik	COA/SPA
Migration and Spatial Ecology of BOQ / ELO Walleye (Acoustic Tagging)	Apr	Walleye	E. Brown/Dr. Tufts	Wingrove/Elliott	SPA/QU
Asian Grass Carp Emergency Response	Apr-Nov	Grass Carp	McNevin	Kranzl/McNevin	SPA
Chinook Salmon Net Pens	Apr	Chinook Salmon	Lake	Jakobi	SPA
Lake Ontario Spring Prey Fish Trawling Survey	Apr	Alewife/Smelt	Holden	Chicoine/Scholz	SPA
Fish Contaminant Sampling	Apr-Dec	Sport Fish	E. Brown/Kranzl	Jakobi/Kranzl	SPA
Turtle Bycatch Assessment	Apr-May	Outreach/Compliance	Lake	S. Brown/Loiselle	SPA
Atlantic Salmon Brood-Stock Tagging	Apr-Nov	Atlantic Salmon	Lake	Kranzl	SPA
Lake Ontario Salmon and Trout Angling Survey	April-Sept	Salmon and Trout	Yuille	Murphy/Staton/Campbell	SPA
Bay of Quinte - Eastern Lake Ontario Open Water Angling Survey	May-Dec	Walleye, Perch, Bass and Pike	E. Brown	Peat	SPA
St 81- Offshore Benthos and Zooplankton Survey	May-Oct	Lower Food Web	Dr. Johnson	Metcalfe	SPA
Spring American Eel Trap and Transfer	Apr-Jun	American Eel	LaRose	Loiselle	OPG
Public Outreach - Belleville Cops for Kids Fishing Day	Jun	Public Outreach/Education	McNevin	Jakobi	SPA
Deepwater Cisco Acoustic Telemetry Program	Jun	Deepwater Cisco	Dr. Johnson	Chicoine/Dale	GLFC/COA
Queens University - Bay of Quinte/Eastern L.Ont Acoustic Receiver Program	Jun-Oct	Bass / Walleye	Dr. Tufts	Wingrove/Elliott	SPA/QU
Eastern Lake Ontario and Bay of Quinte Fish Community Index Netting	Jun-Nov	Fish Community	E. Brown	Kranzl	SPA
Western Lake Ontario Fish Community Index Netting	July	Fish Community	E. Brown	Kranzl	SPA
Eastern Lake Ontario and Bay of Quinte Fish Community Index Trawling	Jun-Sep	Fish Community	E. Brown	Kranzl	SPA
Public Outreach - Hamiton Harbour Kids Fishing Day	Aug	Public Outreach/Education	Todd	Jakobi	SPA
Point Petre Receiver Array	Aug	Multiple Species	Dr. Johnson	Chicoine/Dale	COA/SPA
Credit River Fish Counter Salmon and Trout Assessment	Aug-Nov	Migratory Trout & Salmon	Yuille	Maynard	COA/SPA/CRF
Credit River Evaluation of Fishway Performance	Aug-Nov	Migratory Trout & Salmon	Yuille	Maynard/L. Johnson	COA
Hamilton Harbour Nearshore Community Index Netting	Aug	Nearshore Fish Community	E. Brown	Wingrove	COA/DFO
Toronto Waterfront Nearshore Community Index Netting	Aug-Sept	Nearshore Fish Community	E. Brown	Perry	COA/TRCA
Upper Bay of Quinte Nearshore Community Index Netting	Sept	Nearshore Fish Community	E. Brown	Brennan	COA
Lower Bay of Quinte Nearshore Community Index Netting	Sept	Nearshore Fish Community	E. Brown	Moore	COA
St. Lawrence River Fish Community Index Netting	Sept	Fish Community	Yuille	Scholz	COA
Lake St. Francis Fish Community Index Netting	Sept	Fish Community	Yuille	Scholz	COA
Ganaraska Chinook Salmon Assessment and Egg Collection	Sept	Chinook Salmon	Yuille	Loiselle	SPA
Fall American Eel Trap and Transfer	Sept-Oct	American Eel	LaRose	T. Reed	OPG
Lake Ontario Fall Benthic Prey Fish Trawling Survey	Sept-Oct	Round Goby/Slimy and Deepwater	Holden	Chicoine/Dale	COA
Credit River Chinook Salmon Assessment and Egg Collection	Oct	Chinook Salmon	Yuille	Wingrove	SPA
Lake Whitefish Commercial Catch Sampling	Oct-Nov	Lake Whitefish	E. Brown	Jakobi	SPA
Cisco Commercial Catch Sampling	Oct-Nov	Cisco	E. Brown	Jakobi	SPA
Age and Growth (Lab)	Year-Round	Multiple Species	Kranzl	Operational Team	SPA/COA
Deepwater Cisco Restoration Stocking	Nov	Deepwater Cisco	Lake	Chicoine	SPA

13. Primary Publications 2019

Primary Publications of Glenora Fisheries Station Staff[1] in 2019

Brooke. T.C., Elliott, C.W., **Holden**, **J.P.**, Wang, Y., Hornsby, R.L., and Tufts, B.L. 2019. The importance of livewell transport in the physiological disturbance experienced by Smallmouth Bass in tournaments on large water bodies. North American Journal of Fisheries Management. 39 (6) pp. 1260-1268.

Darcy, A.P., Raby, G.D., **Johnson, T.B.**, Pitcher, T.E., and Fisk, A.T. 2019. Effects of intracoelomic transmitter implantation on metabolic rate, swimming performance, and survival in juveniles of two salmonids. J. Fish Biol. DOI: 10.1111/jfb.14102 .

Holda, T.J., Rudstam, L.G., Bowen, K.L., Weidel, B.C., Watkins, J.M., Sullivan, P.J., **Holden**, **J.P.,** and Connerton, M.J. 2019. Status of Mysis diluviana in Lake Ontario in 2013: Lower abundance but higher fecundity than in the 1990s. Journal of Great Lakes Research. Volume 45, Issue 2, Pages 307-316.

Hossain, M., Arhonditsis, G., **Hoyle, J.,** Randall, R., and Koops, M. 2019. Nutrient management and structural shifts in fish assemblages: Lessons learned from an Area of Concern in Lake Ontario. Freshwater Biology. 64: 967-982. 10.1111/fwb.13278.

Hunt, L.M., Morris, D.M., Drake, D.A.R., **Buckley, J.D.**, and **Johnson, T.B**. 2019. Predicting spatial patterns of recreational boating to understand potential impacts to fisheries and aquatic ecosystems. Fish. Res. 211: 111-120.

Hutchings, J.A., Ardren, W.R., Barlaup, B.T., Bergman, E., Clarke, K.D., Greenberg, L.A., **Lake, C.**, Piironen, J., Sirois, P., Sundt-Hansen, L.E. and Fraser, D.J., 2019. Life-history variability and conservation status of landlocked Atlantic salmon: An overview. Canadian Journal of Fisheries and Aquatic Sciences, 76(10), pp.1697-1708.

Ives, J.T., McMeans, B., McCann, K., Fisk, A.T., **Johnson, T.B.**, Bunnell, D.B., Frank, K.T., and Muir, A.M. 2019. Food-web structure and ecosystem function in the Laurentian Great Lakes – toward a conceptual model. Freshwat. Biol. 64: 1-23.

Klinard, N.V**.,** Halfyard, E.A., Matley, J.K., Fisk, A.T., and **Johnson, T.B**. 2019. The influence of dynamic environmental interactions on detection efficiency of acoustic transmitters in a large, deep, freshwater lake. Animal Biotelemetry, 7(17). doi:10.1186/s40317-019-0179-1

Klinard, N.V**.,** Matley, J.K., Fisk, A.T., and **Johnson, T.B.** 2019. Long-term retention of acoustic telemetry transmitters in temperate predators revealed by predation tags implanted in wild prey fish. *Journal of* Fish Biology, 95(6): 1512-1516. doi:10.1111/jfb.14156.

Mumby, J.A., Larocque, S.M., **Johnson, T.B.**, Stewart, T.J., Fitzsimons, J.D., Weidel, B.C., Walsh, M.G., Lantry, J.R., **Yuille**, **M.J.**, and Fisk, A.T.. 2019. Diet and trophic niche space and overlap of Lake Ontario salmonid species using stable isotopes and stomach contents. J. Great Lakes Res. 44: 1383-1392 doi.org/10.1016/j.jglr.2018.08.009.

Pratt, T.C., O'Connor, L.M., Stacey, J.A., Stanley, D.R., **Mathers, A**., **Johnson, L.E.**, Reid, S.M., Verreault, G., and Pearce, J. 2019. Pattern of *Anguillicoloides crassus* infestation in the St. Lawrence River watershed. Journal of Great Lakes Research, 45(5): 991-997.

Raby, G.D., **Johnson T.B.,** Kessel, S.T., Stewart, T.J., and Fisk, A.T. 2019. Pop-off data storage tags reveal niche partitioning between native and non-native predators in a novel ecosystem. J. Appl. Ecol. DOI: 10.1111/1365-2664.13522.

Weidel, B.C., Connerton, M.J., Walsh, M.G., **Holden**, **J.P.**, Holeck, K.T., and Lantry, B.F. 2019. Lake Ontario Deepwater Sculpin Recovery: An Unexpected Outcome of Ecosystem Change. Pages 467-482 *in* C.C. Krueger, W.W. Taylor, and S. Youn, editors. From catastrophe to recovery: stories of fishery management success. American Fisheries Society, Bethesda, Maryland.

Zhang, H., Rutherford, E.S., Mason, D.M., Wittmann, M.E., Lodge, D.M., Zhu, X., **Johnson**, **T.B**., and Tucker, A. 2019. Potential Impacts of Three Benthic Invasive Species on the Lake Erie Food Web. Biol. Invas. 21: 1697-1719.

[1] **Names of staff of the Glenora Fisheries Station are indicated in bold font.**

Appendix

A.1. Bottom trawl assessment of Lake Ontario prey fishes

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J. P. Holden, OMNRF, Lake Ontario Management Unit

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Bottom trawl assessment of Lake Ontario prey fishes

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Abstract

*Multi-agency, collaborative Lake Ontario bottom trawl surveys provide information for decision making related to Fish Community Objectives including predator-prey balance and understanding prey fish community diversity. In 2019, bottom trawl surveys in April (n = 252 tows) and October (n = 160 tows) sampled main lake and embayments at depths from 5–226 m. Combined, the surveys captured 283,383 fish from 39 species. Alewife were 67% of the total catch by number while round goby, deepwater sculpin, and rainbow smelt comprised 13, 10, and 4% of the catch, respectively. In 2019, the lake-wide adult alewife biomass index declined from 2018 and age-1 biomass, a measure of reproductive success the previous year, was low. Year-class catch curve models identified years where estimates from surveys conducted only in U.S. waters were biased, potentially due to a greater portion of the alewife population inhabiting unsampled Canadian waters. Accounting for spatial survey bias, these model estimates indicated the 2019 adult alewife biomass was the lowest value in the 42-year time series. Models also identified the extent to which age-1 alewife biomass was historically underestimated, however lake-wide results from 2016-2019 appear less biased. If below-average year-class estimates from 2017 and 2018 are accurate, adult alewife biomass will continue to decline in 2020. Abundance indices for other pelagic prey fishes such as rainbow smelt, threespine stickleback, emerald shiner, and cisco were low and similar to 2018 values. Pelagic prey fish diversity is low because a single species, alewife, dominates the community. Deepwater sculpin and round goby were the most abundant demersal (bottom-oriented) prey fishes in 2019. Despite declines in slimy sculpin and other nearshore prey fishes, demersal prey fish community diversity has increased as deepwater sculpin and round goby comprise more even portions of the community. New experimental trawl sites in embayment habitats generally captured more species, a higher proportion of native species, and higher densities relative to main lake habitats. In 2019, a western tubenose goby (*Proterorhinus semilunaris*) was captured for the first time in the trawl surveys.*

Introduction

Lake Ontario Fish Community Objectives (herein FCOs) call for maintaining predator-prey balance and for maintaining and restoring pelagic and benthic (bottom–oriented, demersal) prey fish diversity (Stewart et al., 2017). Collaboratively-conducted bottom trawl surveys have measured Lake Ontario prey fish community status and trends since 1978 to provide information for decision making relative to those objectives.

Alewife are the most abundant fish in Lake Ontario and, as prey, support most of the lake's piscivores (Mills et al., 2003; Stewart and Sprules, 2011; Weidel et al., 2018). Accordingly, their abundance and population abundance trajectories are critical to achieving FCOs and maintaining sport fishing quality. Recent bottom trawl prey fish surveys have documented lower-than-average alewife reproduction in 2013 and 2014 resulting in reduced adult abundances (Weidel et al., 2018). Concerns over maintaining alewife in balance with the lake's predators has resulted in management agencies reducing the number of Chinook salmon and lake trout stocked in 2016 – 2019 (Great Lakes Fishery Commission Lake Ontario Committee, 2016; New York State Department of Environmental Conservation, 2018; Ontario Ministry of Natural Resources and Forestry, 2018).

In addition to providing information for managing sport fisheries, prey fish surveys also quantify the status of native species and prey fish communities, providing information for other FCOs and basin-wide prey fish status assessments (Environment and Climate Change Canada and U.S. Environmental Protection Agency, 2017). These surveys documented the natural recovery of native deepwater sculpin, a bottom-oriented prey fish once thought to be extirpated from the lake (Weidel et al., 2017). Bottom trawl surveys also measure the progress of bloater restoration, a native species that historically inhabited deep Lake Ontario habitats. Trawl surveys also provide lake-wide surveillance for nonnative species and their effects, such as round goby and its apparent negative impact on native demersal fishes (Weidel et al., 2018). In addition to standardized sampling, surveys also conduct targeted research to better interpret historic bottom trawl data. For instance, video cameras attached to the bottom trawls determined the extent to which trawls were in contact with the lake bottom and found the area swept by deep trawls was, for some trawls, three times what had been previously estimated based on recorded tow times (Weidel and Walsh, 2013). The prey fish trawl survey design and timing has changed over time to reduce duplicative results, increase sampling efficiency, and expand the spatial extent of surveys (Weidel et al., 2015). Lake-wide surveys began in 2015 for the October survey and in 2016 for the April survey, and have provided critical new insights related to prey fish distribution. Whole lake surveys have demonstrated that alewife spatial distribution in April can vary substantially between U.S. and Canadian waters (Weidel et al., 2018). This new understanding of annual variability in spatial distribution has affected the interpretation of results from surveys conducted only in U.S. waters.

This report describes the status of Lake Ontario prey fishes with emphasis on information addressing the bi-national (OMNRF, NYSDEC) Lake Ontario Committee's FCOs (Stewart et al., 2017). This research is also guided by the U.S. Geological Survey (USGS) Ecosystems Mission Area science strategy that seeks to understand how ecosystems function and provide services, what drives ecosystems, and to develop science and tools that inform decision making related to ecosystem management, conservation and restoration (Williams et al., 2013).

Methods

Estimating trawl conversion factor

Prey fish bottom trawl surveys have primarily used two different bottom trawl and door designs over the past 42 years. The original Yankee trawl was nylon with an 11.8-m (39 ft) headrope and was spread with flat, rectangular, wooden trawl doors (2.1m x 1m). Large catches of dreissenid mussels in 1990s caused a change to a 3n1 polypropylene trawl. This trawl has an 18-m (59 ft) headrope and is spread with slotted, metal, cambered V-doors (1.2 m x 0.5m). The footrope of the 3n1 trawl includes a rubber cookie sweep and is raised to reduce lake bottom contact and reduce dreissenid mussel and shell catches. To determine a conversion factor for comparing data collected with the smaller Yankee trawl (1–2 m vertical opening) to the 3n1 trawl (3–4 m vertical opening), the Seth Green and Kaho conducted comparison trawling at the same sites and depths in 1995–1998 (O'Gorman et al., 1999). We calculated a conversion factor to apply to the data collected with the smaller Yankee trawl (1978–1997) in order to compare it to data collected with the larger 3n1 trawl (1997 – present). For all paired trawls, biomass values were calculated based on boat and trawl specific area swept estimates for both the Yankee and 3n1 trawls as described in Weidel and Walsh (2013). A single conversion value was based on the linear model relating Yankee biomasses (independent variable) to 3n1 biomasses (dependent variable). Linear models were fit using untransformed, paired data and the glm function in R (R Core Team, 2013).

April survey

The Lake Ontario April bottom trawl survey has been collaboratively conducted in April and early May since 1978. The survey targets alewife at a time when their winter behaviors place them on the lake bottom, which maximizes their susceptibility to bottom trawls (Wells, 1968). Daytime trawling is conducted at fixed sites located along transects extending from shallow (~6m) to deep (228m) habitats. While random sampling is preferable for trawl-based estimates, it is not practical because of varied substrates that can prohibitively damage trawls at randomly selected sites (MacNeill et al., 2005). A review of the Lake Ontario prey fish trawl program found the fixed-station sampling design generated a suitable estimate of relative abundance (ICES, 2004; MacNeill et al., 2005). The original survey design sampled from 8–150m (26–495 ft) in U.S. waters at 12 transects. Changes in fish depth distribution and the need for lake-wide information have resulted in survey expansion. For instance, the depth distributions of alewife and other prey fish have shifted deeper as water clarity increased and in 2004, trawling was expanded to 170m (557 ft) in U.S. waters (O’Gorman et al., 2000). In 2016, the survey was further expanded to a whole-lake extent and the OMNRF research vessel joined the survey. Since 2016, trawls have generally been collected from 6–225m (20–743 ft), with sites organized in 20–23 transects or regions distributed around the lake (Figure 1).

Bottom trawl catches are separated to species, counted, and weighed in aggregate. Subsamples of all species are also measured for individual length and weight. Stomach contents, muscle tissue, and various aging structures are sampled from representative subsets of the catch from species of key management priority.

Trawl effort was historically based on tow time and abundance indices were reported as number or weight per 10-minute trawl. Area-swept estimates calculated using trawl mensuration sensors and video cameras indicated trawl effort, expressed as area swept, differed substantially from effort based on tow time. Models were developed to estimate area swept based on fishing depth and were applied to all historic and current trawl catches (Weidel and Walsh, 2013). Currently, trawl catches are expressed in kilograms per hectare of trawl area swept based on trawl wing widths. Annual mean biomass estimates are lake area-weighted from thirteen 20 m (66 ft) strata depth intervals and the proportional area of those depth intervals within the U.S. and Canadian portions of the lake (Table 1). Mean and standard error calculations are from Cochrane (1977). Time series are still regarded as biomass indices because we lack estimates of trawl catchability (proportion of the true density within a surveyed area captured by the trawl). Reporting indices as biomass units provides data in a more readily useable form to address ecosystem-scale management questions and facilitates comparisons across lakes.

To estimate the mean stratified abundance from a consistent lake area, stratified means for all years are calculated using all 13 depth strata (0 – 244m). In years when trawling was not conducted in the deepest 3-4 strata (160 - 244m), we assumed prey fish catch was zero in those strata. Separate abundance indices are calculated for trawls collected in U.S. and Canadian waters. Statistics reported for trawl catches in Canadian waters follow a similar analysis, however the area within 20m strata in Canadian waters differ from U.S. waters (Table 1). We also report a lake-wide alewife biomass index expressed in kilograms per hectare combining biomass estimates from U.S. and Canadian portions of the lake, assuming 48% lake area is in U.S. and 52% is in Canada.

Log-linear catch curve models were created for each alewife year-class from 1972 – 2017 to identify years when biomass estimates from surveys in U.S. waters may have been biased. Natural log-transformed (log) abundance estimates of a given year-class for each year they were in the lake are plotted according to age. If sampling is unbiased and year-to-year survival is consistent, the log-transformed points should decline in a straight line. Often values at young ages (age-1 and age-2) are estimated to be less than age-3 values and represent either size or spatial bias in the sampling and when plotted, appear as curved sets of points. Model-predicted estimates of abundance were multiplied by the observed mean weight for each age in a year, and then weights were summed for all age-2 and older alewife. We compared this modeled-based biomass estimate to our observations from the survey conducted in U.S. waters. Catch curve models assume survival is constant, but their simplicity helps to identify patterns in sampling bias in any given year and provide estimates for us to understand how likely our observed survey values are relative to the modeled population estimates.

Adult alewife condition indices are estimated using linear models with length and weight observations from fish over a length range from 150 mm to 180 mm. Condition is illustrated as the predicted weight of a 165-mm (6.5 inch) alewife in the April and October surveys. Pelagic and demersal prey fish community diversity are quantified using the Shannon index, based on trawl catch by weight (Shannon and Weaver, 1949). New experimental trawl sites in Sodus Bay, and Little Sodus Bay were established and sampled during the 2019 April survey.

October survey

From 1978–2011, the October bottom trawl survey sampled six to ten transects along the southern shore of Lake Ontario, from Olcott to Oswego, NY, and targeted demersal prey fish. Daytime trawls were typically 10 minutes and sampled depths from 8–150 m (26–495 ft). The original survey gear was a Yankee bottom trawl using doors described above. Abundant dreissenid mussel catches led to the survey abandoning the standard trawl and experimenting with a variety of alternate polypropylene bottom trawls and metal trawl doors (2004–2010). Comparison towing indicated alternate trawls caught few demersal fishes and the alternative trawl doors influenced net morphometry (Weidel and Walsh, 2013). Since 2011, the survey has used the historical-standard Yankee trawl and doors but has reduced tow times to reduce mussel catches. Experimental sampling at new transects and in deeper habitats began in 2012. More notably, in 2015, the survey spatial extent was doubled to include Canadian waters. At that time the NYSDEC and OMNRF research vessels joined the survey, which greatly expanded the spatial extent and diversity of habitats surveyed. Demersal prey fish time series are illustrated in this report from 1978 to present and no adjustments are available for data when the alternative trawls were used. Trawl catch processing is the same as the April survey. Trawl results are expressed as biomass (kilograms of fish per hectare) and account for depth-based differences in the lake area swept by the trawl (Weidel and Walsh, 2013). Time series are still regarded as biomass indices because we lack estimates of trawl catchability (proportion of the true density within a surveyed area captured by the trawl).

Results and Discussion

In 2019, bottom trawl surveys in April (n = 252 tows) and October (n = 160 tows) sampled main lake and embayments at depths from 5–226 m. Combined, the surveys captured 283,383 fish from 39 species (Table 2). Alewife were 67% of the total catch by number while round goby, deepwater sculpin, and rainbow smelt comprised 13, 10, and 4% of the catch, respectively (Table 2).

Trawl conversion factors – The regression model slope coefficient for converting Yankee trawl biomass to 3n1 equivalents was 1.71 (N=104, S.E. = 0.06, *p-value* < 0.00001) for adult alewife and was 3.51 (N=104, S.E.= 0.13, *p-value* < 0.0001) for age-1 alewife (Figure 2). Greater catches in the 3n1 relative to the Yankee trawl can partially be explained by a difference in the vertical opening of the trawl. The vertical opening of the 3n1 is 3 – 4 m depending on the fishing depth while the Yankee trawl vertical opening ranges from 1 – 2 m. In addition, the Yankee trawl door arrangement ‘overspreads’ the Yankee trawl and could allow fish to avoid the wing sections relative to the 3n1 wings that are not overspread.

Previous conversion analyses ‘connected’ the alewife abundance time series collected with different trawls by reducing 3n1 trawl catches to match the Yankee trawl catches. The trawl conversion factor previously used reduced 3n1 catches from depths greater than 70m to approximately 30% of the observed catch. While statistically valid, this type of conversion did not account for alewife depth distribution changes. As the proportion of alewife caught at depths greater than 70m increased over time, the conversion factor had an increasingly large effect on the alewife abundance estimate. This resulted in the reported converted 3n1 catches appearing as though they were decreasing during the 2000s and early 2010s however more recent time series that did not use the historic conversion factor did not illustrate a decline over this time period (Weidel et al., 2019). The conversion factors we applied in this analysis are likely conservative (low) but they provide interpretative context for the current alewife biomass estimates. Future research should evaluate alternative conversion factor estimates and add additional comparison trawl data.

Alewife – The adult alewife (age-2 and older) biomass index for the lake-wide survey decreased in 2019 (27.7) relative to 2018 value (39.1) and was the lowest observed in the four years of lake-wide sampling (Figure 3). Similarly, the 2019 age-1 alewife biomass value declined slightly from 2018 (Figure 4, Table 3) and was also the lowest value observed in the four years of lake-wide sampling. Biomass values in U.S.

and Canadian waters were generally similar in 2019 (Table 3, Figure 5).

The age distribution of adult alewife in 2019 was dominated by age-3 fish from the 2016 year-class (Figure 6). Lower than average abundances of the 2017 and 2018 year-classes suggest the 2016 year-class comprised much of the spawning alewife population in 2019 and will also likely be the most abundant spawning year-class in 2020. The low age-1 alewife biomass estimated for 2019 suggests the adult biomass will decline further in 2020 (Figure 6).

In the previous three years of lake-wide surveys, U.S. and Canadian values differed substantially within a year (Table 3). The environmental factors driving this spatial variability in alewife distribution are unknown, but this variability would partly explain aberrant alewife biomass estimates in the U.S. time series. For instance, the alewife biomass value observed in 2010 was uncharacteristically below both the 2009 and 2011 values (Figure 3). Estimates from 2010 are likely an example where alewife biomass was higher in the unsampled Canadian waters than the U.S. waters where the survey was conducted. This bias in the 2010 U.S-only survey is also evident in the year-class catch curve plots from 2005 – 2007 where the single point representing the 2010 catches in each of these year-class plots (2005: age-5, 2006: age-4, 2007: age-3) are uncharacteristically low, and then abundance increases in the 2011 catches (Figure 7). Catch curves also indicate when U.S.-only survey results are likely higher than the actual lake-wide biomass such as the 2011 catch which appears higher-than-expected in the 2002–2004 year-class plots at ages 7–9 (Figure 7).

Identifying bias in survey results does not invalidate the survey, but rather it strengthens inference from the results and supports the need for lake-wide approaches. While 2019 biomass estimates appear to be generally similar to observations from 1978, 1979, and 2010, model estimates indicate estimates in those years were likely biased low (Figure 8). This further strengthens our conclusion that the 2019 adult alewife biomass values represent the lowest value yet observed in the 42-year Lake Ontario time series.

Lake-wide sampling has illustrated age-1 alewife spatial distribution can also vary between U.S. and Canadian portions of Lake Ontario. This may partly explain why historical observations from U.S.-only surveys often underestimated age-1 abundance (Figure 8). Lake-wide sampling with the larger 3n1 trawl has apparently improved our ability to assess age-1 abundance relative to historic procedures, however it is important to recognize the potential for underestimating the year class size with only a single year of observation.

Adult alewife condition in April 2019 was similar to 2018 and below the 10-year average while the October 2019 value was much higher than 2018 and well above the 10-year average (Figure 9).

Other Pelagic Fishes – Bottom trawl abundance indices for other pelagic species noted in the FCOs (threespine stickleback, rainbow smelt, emerald shiner, and cisco) either declined or remained at low levels in 2019 (Figure 10).

Bloater – Bloater are a pelagic species native to Lake Ontario that historically inhabited deep, offshore habitats. While records are sparse, commercial fishery catches suggest the species was historically abundant in Lake Ontario, but by the 1970s, was rare (Christie, 1973). Restoration in Lake Ontario began in 2012 by stocking bloater raised from eggs collected from Lake Michigan (Connerton, 2018). Catches have been sporadic since restoration stocking began but may be reasonable based on the survey's power to detect species at low abundance (Weidel et al., 2019). In 2019, a single bloater (87 mm) was captured during the spring survey and none were captured during the October survey. An additional two bloater were captured near Niagara on the Lake, Ontario (123 mm) and Southwicks Beach, NY (160mm) during the July-conducted juvenile lake trout bottom trawl survey.

Slimy Sculpin – Slimy sculpin biomass indices in 2019 were among the lowest observed for the entire time series (Figure 11). Once the dominant demersal prey fish in Lake Ontario, slimy sculpin declines in the 1990s were attributed to the collapse of their preferred prey, the amphipod *Diporeia* (Owens and Dittman, 2003). The declines of slimy sculpin that occurred in the mid-2000s appear to be related to round goby introduction. Since round goby numbers have increased, the proportion of juvenile slimy sculpin in the total catch of slimy sculpins dropped from ~10% to less than 0.5% (Weidel et al., 2018). These data suggest round goby may be limiting slimy sculpin by interfering with reproduction or consuming eggs and or juvenile life stages.

Deepwater Sculpin - In 2019, deepwater sculpin were among the most abundant demersal prey fishes in Lake Ontario, and their biomass estimates increased from 2018 (Figure 11). Reduced abundance of non-native planktivores, rainbow smelt and alewife, and shifts in the depth distributions of these species has been suggested as contributing to deepwater sculpin recolonization (Weidel et al., 2019). Lake-wide biomass estimates in Lake Ontario are similar or greater than estimates from Lakes Superior, Huron and Michigan (Weidel et al., 2019). Dead deepwater sculpin continue to be occasionally captured in both April and October surveys however the frequency of dead deepwater sculpin declined from 24% of October trawls in 2018 to 18% of trawls in 2019 (15 of 82 trawls).

Round Goby – Round goby biomass decreased in 2019, relative to 2018, for both the U.S. biomass index and the whole lake index based on data from the October survey (Figure 11). Estimating round goby abundance using bottom trawls can be complicated by this fish's preference for rocky substrate and seasonal changes in depth distribution (Ray and Corkum, 2001; Walsh et al., 2007). Biomass indices from trawl surveys are likely lower than actual biomass because of trawls can not sample in rock substrates although rock substrates comprise a relatively small portion of the Lake Ontario bottom (Thomas et al., 1972).

Prey fish diversity - Lake Ontario FCOs seek to increase prey fish diversity (Stewart et al., 2017). Based on bottom trawl catches, the pelagic prey fish community diversity remains low because a single species, alewife, dominates the catch (Figure 12). Current management efforts to improve pelagic prey fish community diversity include bloater restoration and cisco rehabilitation (Connerton, 2018). Despite slimy sculpin declines, demersal prey fish community diversity has generally increased during recent decades. In the 1970s – 1990s, a single species, slimy sculpin, dominated the catch, resulting in lower diversity values. More recently, deepwater sculpin and round goby comprise similar proportions of the trawl catch, increasing diversity relative to when only slimy sculpin dominated the catches (Figure 12).

Embayment Catches – Trawl catches at embayment sites (Quinte, Chaumont, Black River, Henderson, Little Sodus, Sodus) differed markedly from trawl catches in the main lake (Table 4). As in 2018, the 2019 embayment samples suggested these habitats had a higher species diversity and a higher proportion of native species relative to main lake habitats (Table 4). These habitats, especially Black River Bay and the Bay of Quinte, are the only sites where trawls routinely capture trout-perch and spottail shiner, native species that were ubiquitous in the main lake in the 1970s – 1990s. Alewife density in the embayments was either zero or low relative to the main lake (Table 3).

The lake-wide trawling program is also valuable for detection of new invasive species. For example, in 2019, a western tubenose goby (*Proterorhinus semilunaris*) was captured for the first time in the trawl surveys. Tubenose goby are a recent invader to Lake Ontario and have been detected previously in the eastern Lake Ontario- St. Lawrence River Basin (Goretzke, 2019). The addition of embayment trawl sites more thoroughly addresses Lake Ontario FCOs by providing consistent sampling methods across different lake habitats. Expanding the survey into these more diverse habitats serves to quantify the biomass of alewife or other prey fishes of interest and better provide a more holistic observation of the Lake Ontario prey fish community.

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(http://fisheries.org/docs/wp/Guidelines-for-Use-of-Fishes.pdf).

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Table 1. Lake Ontario area in square kilometers within different depth strata in U.S. and Canadian (CA) waters. The proportional area columns illustrate how the area-weighting of stratified abundance mean indices would vary if different depth ranges were considered in analyses.

Range	Area U.S	Area CA	Proportional Area U.S.			Proportional Area CA
(m)	(km^2)	(km^2)	0-160m	0-180m	0-244m	0-160m
0-20	1155	1749	0.19	0.15	0.12	0.18
20-40	905	1616	0.15	0.12	0.10	0.16
40-60	680	1248	0.11	0.09	0.08	0.13
60-80	514	1426	0.08	0.07	0.06	0.14
80-100	441	1198	0.07	0.06	0.05	0.12
100-120	527	1293	0.09	0.07	0.06	0.13
120-140	822	964	0.13	0.11	0.09	0.10
140-160	1112	353	0.18	0.14	0.12	0.04
160-180	1598	0		0.21	0.18	NA
180-200	737	0			0.09	NA
200-220	448	0			0.05	NA
220-240	79	0			0.01	NA
240-260	<1	0			<.01	NA

Table 2. Number of fish captured in Lake Ontario during the 2019 April and October prey fish bottom trawl surveys. The catch of dreissenid mussels is represented by weight in kilograms. The classification column denotes which species are used in pelagic and demersal prey fish community diversity calculations.

Species	Spring	Fall	Total	Percent	Classification
Alewife	177952	11783	189735	67	pelagic
Round goby	6542	31845	38387	14	demersal
Deepwater sculpin	16074	12699	28773	10	demersal
Rainbow smelt	6376	5526	11902	4	pelagic
Yellow perch	4853	1449	6302	2	demersal
Trout-perch	1543	1654	3197	1	demersal
White perch	333	1687	2020	1	pelagic
Spottail shiner	876	156	1032	0	demersal
Slimy sculpin	197	421	618	0	demersal
Pumpkinseed	146	254	400	0	
Brown bullhead	8	224	232	0	
Lake trout	119	76	195	0	
Freshwater drum	98	25	123	0	
Walleye	108	0	108	0	
Threespine stickleback	82	6	88	0	pelagic
Gizzard shad	0	51	51	0	pelagic
White sucker	13	37	50	0	
Lake whitefish	42	4	46	0	
Emerald shiner	12	15	27	0	pelagic
Bluntnose minnow	0	26	26	0	
Rock bass	9	4	13	0	
Logperch	3	7	10	0	demersal
Carp	5	4	9	0	
White bass	9	0	9	0	
Johnny darter	5	0	5	0	demersal
Lake sturgeon	4	1	5	0	
Cisco	4	0	4	0	pelagic
Northern pike	4	0	4	0	
Bluegill	2	0	2	0	
American eel	1	0	1	0	
Black crappie	1	0	1	0	
Bloater	1	0	1	0	pelagic
Brown trout	1	0	1	0	
Chain pickerel	1	0	1	0	
Largemouth bass	1	0	1	0	
Longnose sucker	1	0	1	0	
Sea lamprey	1	0	1	0	
Smallmouth bass	1	0	1	0	
Tubenose goby	1	0	1	0	demersal
dreissenid mussels (kg)	611	4848	5459		

Table 3. Lake Ontario alewife biomass estimates in kilograms per hectare based on the April bottom trawl survey (2016-2019). Lake-wide estimates assumed 52% of the lake area was represented by the estimate from Canadian waters and 48% was represented by the estimate from U.S. waters.

Year	Adult (Age-2+)			Age-1		
	Lake-wide	U.S.	Canada	Lake-wide	U.S.	Canada
2016	44.8	26.2	61.9	5.9	2.5	9.0
2017	28.6	47.5	11.1	11.9	20.3	4.2
2018	39.1	23.3	53.7	2.6	0.5	4.6
2019	27.7	26.3	29.0	2.2	1.1	3.2

Table 4. Mean fish density (number per hectare) based on bottom trawls from Lake Ontario embayment and main lake trawls during the 2019 April survey.

Species (# trawls)	Quinte (16)	Chaumont (5)	Black River (7)	Henderson (1)	Little Sodus (3)	Sodus (4)	Main Lake (204)
Yellow perch	386.5	414.4	225.9	98.7	1000.8	1097.2	0.7
Trout-perch	38.9	0	778.9	0	0	0	0.9
Spottail shiner	6.3	11	472.7	0	0	9	0
Rainbow smelt	3.1	17.5	121.1	9.2	10.4	2.2	61.8
White perch	55.1	0	1.7	0	0	9.1	3.7
Pumpkinseed	4.7	56.5	0	0	0	0	0
Round goby	25.3	1.7	2.9	0	0	0	61.3
Walleye	15.9	0.9	0.6	0	0	9	0.7
Freshwater drum	13.2	0.4	0	0	0	0	0.9
Alewife	0.3	0	8.2	0	0	0	1716.4
White sucker	1.1	0.5	1.4	0	2.9	2.3	0
Emerald shiner	0.2	0	6.6	0	0	0	0
Lake whitefish	5.8	0	0	0	0	0	0.5
Northern pike	0	0	0	0	4.5	1.1	0
Carp	0	0	0	0	0	4.5	0
Slimy sculpin	3.3	0	0	0	0	0	2
Johnny darter	0	0	2.9	0	0	0	0
Rock bass	1.3	0	1.1	0	0	0	0
White bass	1.5	0	0	0	0	0	0
Brown bullhead	1.3	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	1.2	0
Cisco	0.6	0.5	0	0	0	0	0
Unidentified coregonine	0	0	0	0	0	1.1	0
Logperch	0.7	0	0	0	0	0	0
Chain pickerel	0	0.5	0	0	0	0	0
Smallmouth bass	0	0	0.5	0	0	0	0
Lake trout	0.5	0	0	0	0	0	1.2
Bluegill	0.4	0	0	0	0	0	0
Black crappie	0.2	0	0	0	0	0	0
American eel	0.2	0	0	0	0	0	0
Common mudpuppy	0.2	0	0	0	0	0	0
Tubenose goby	0.2	0	0	0	0	0	0
Deepwater sculpin	0.1	0	0	0	0	0	148.4
Longnose sucker	0.1	0	0	0	0	0	0

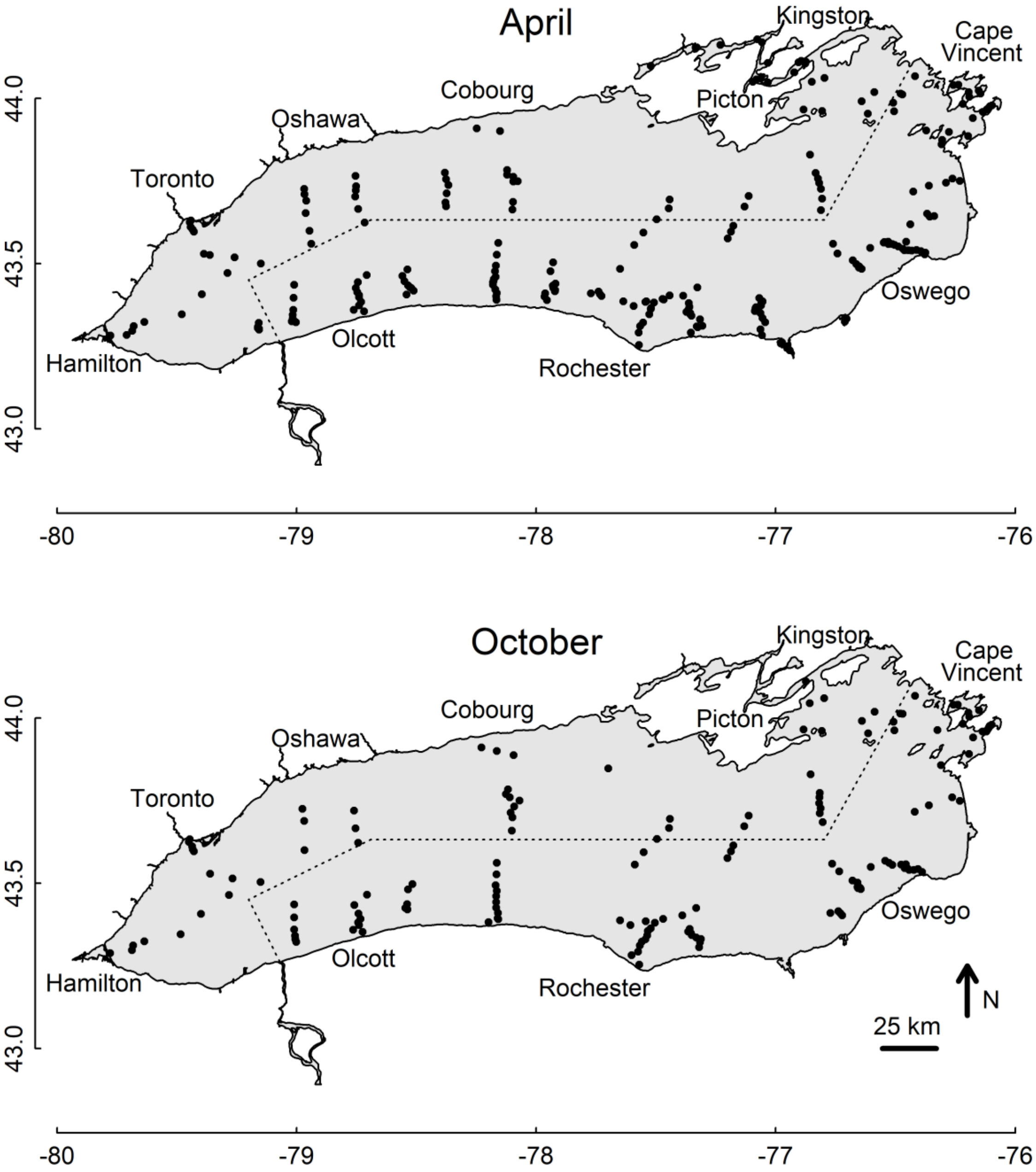

Figure 1. Lake Ontario bottom trawl sites from the 2019 collaborative (USGS, NYSDEC, OMNRF, USFWS) April and October surveys. The April survey targets alewife and other pelagic prey fishes that are found near bottom at this time of year and the October survey targets demersal or benthic prey fishes. A total of 252 trawls were conducted in April and 160 trawls were conducted in the October survey. Dashed line represents U.S. Canada border.

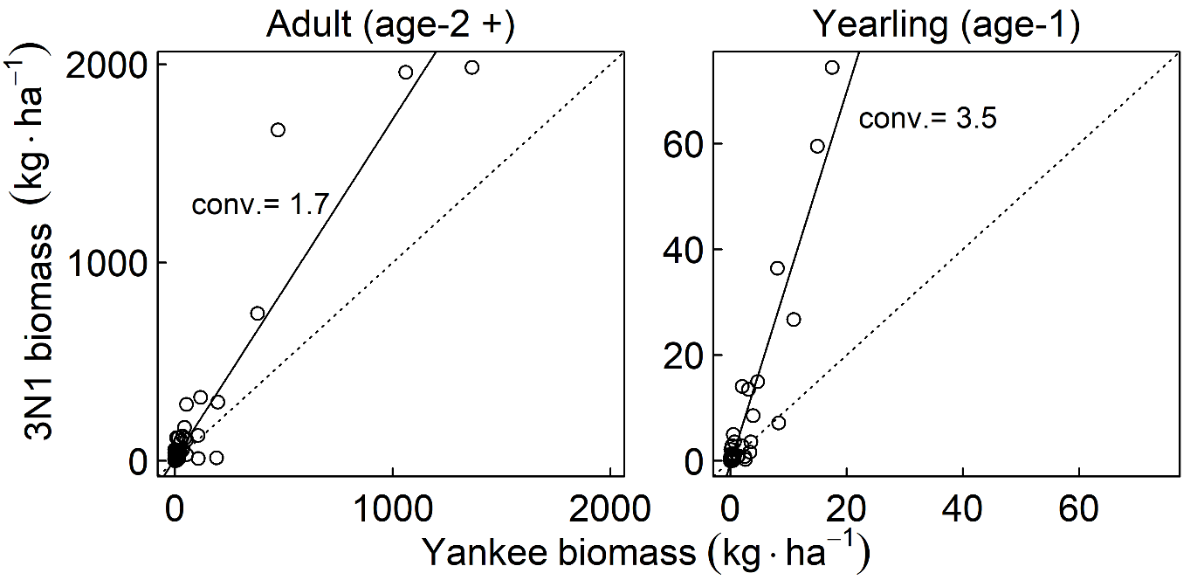

Figure 2. Paired trawl comparison results for the 11.8m headrope Yankee trawl (horizontal axis) and the 18m headrope 3n1 trawl used in Lake Ontario bottom trawl surveys. The open circles represent the alewife biomass estimates from the 104 paired trawls collected from 1995-1998 at the same depths. Trawl depths ranged from 8 to 157 m. The solid black line is a linear regression model and the slope of that model represents a conversion factor to be multiplied by Yankee trawl biomass values to convert them to 3n1 values. The dashed line represents unity, or the 1:1 line, if both trawls caught similar alewife biomasses.

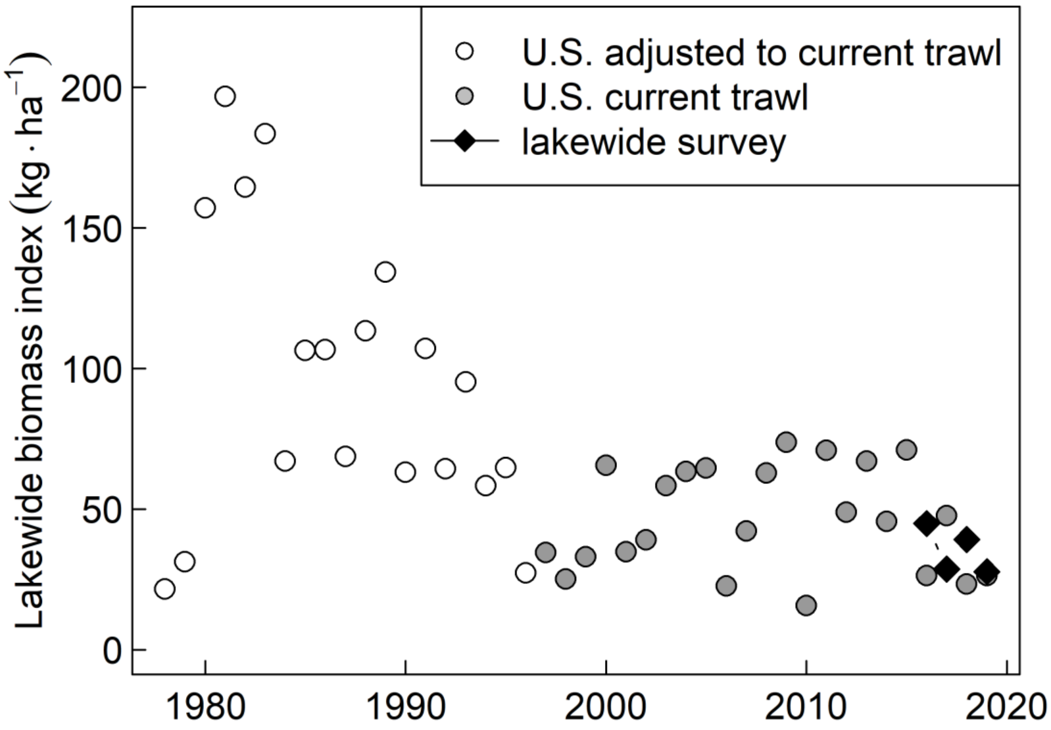

Figure 3. Lake Ontario April bottom trawl-based biomass index for adult alewife (age-2 and older) for trawl surveys in U.S. waters (circles, 1978-2019) and lake-wide (diamonds,2016-2019). Values represent a depth-stratified (20m strata), area-weighted mean biomass expressed as kilograms per hectare. Bottom trawl area swept is based on wing widths, biomass indices are not corrected for trawl catchability. Surveys from 1978-1996 were conducted with a smaller Yankee trawl. Open circles represent biomass values that were adjusted to be equivalent to the current trawl (gray circles) by multiplying them by 1.7.

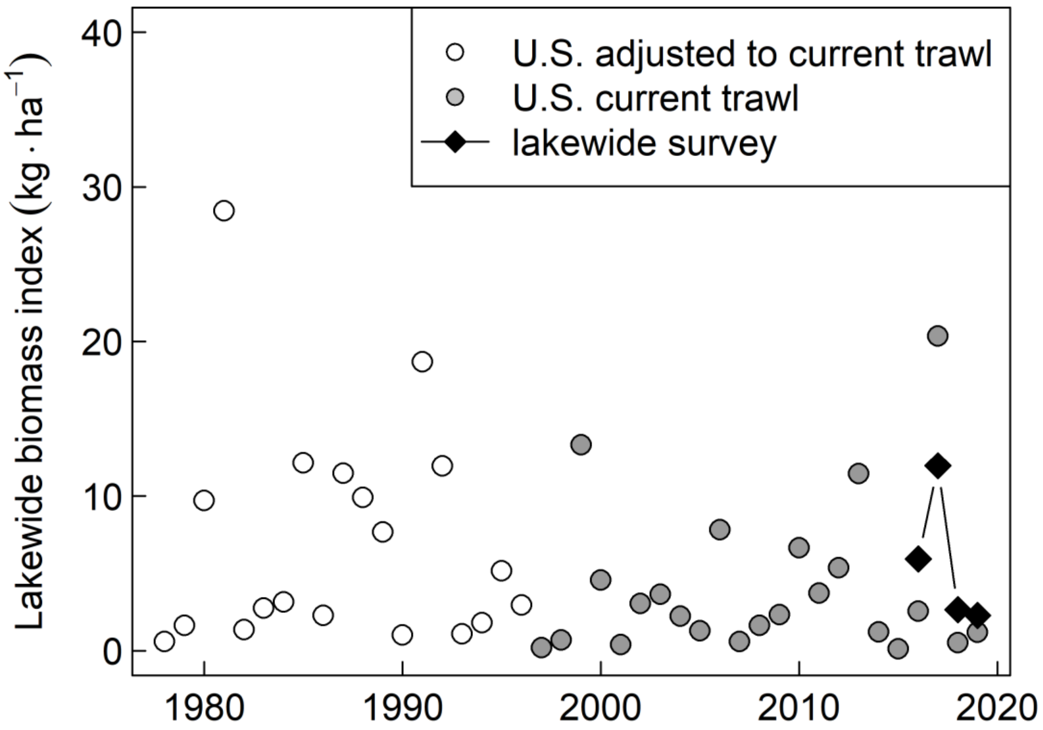

Figure 4. Lake Ontario April bottom trawl-based biomass index for age-1 alewife for trawl surveys in U.S. waters (circles, 1978-2019) and lake-wide (diamonds,2016-2019). Values represent a depth-stratified (20m strata), area-weighted mean biomass expressed as kilograms per hectare. Bottom trawl area swept is based on wing widths, biomass indices are not corrected for trawl catchability. Surveys from 1978-1996 were conducted with a smaller Yankee trawl. Open circles represent biomass values that were adjusted to be equivalent to the current trawl (gray circles) by multiplying them by 3.52.

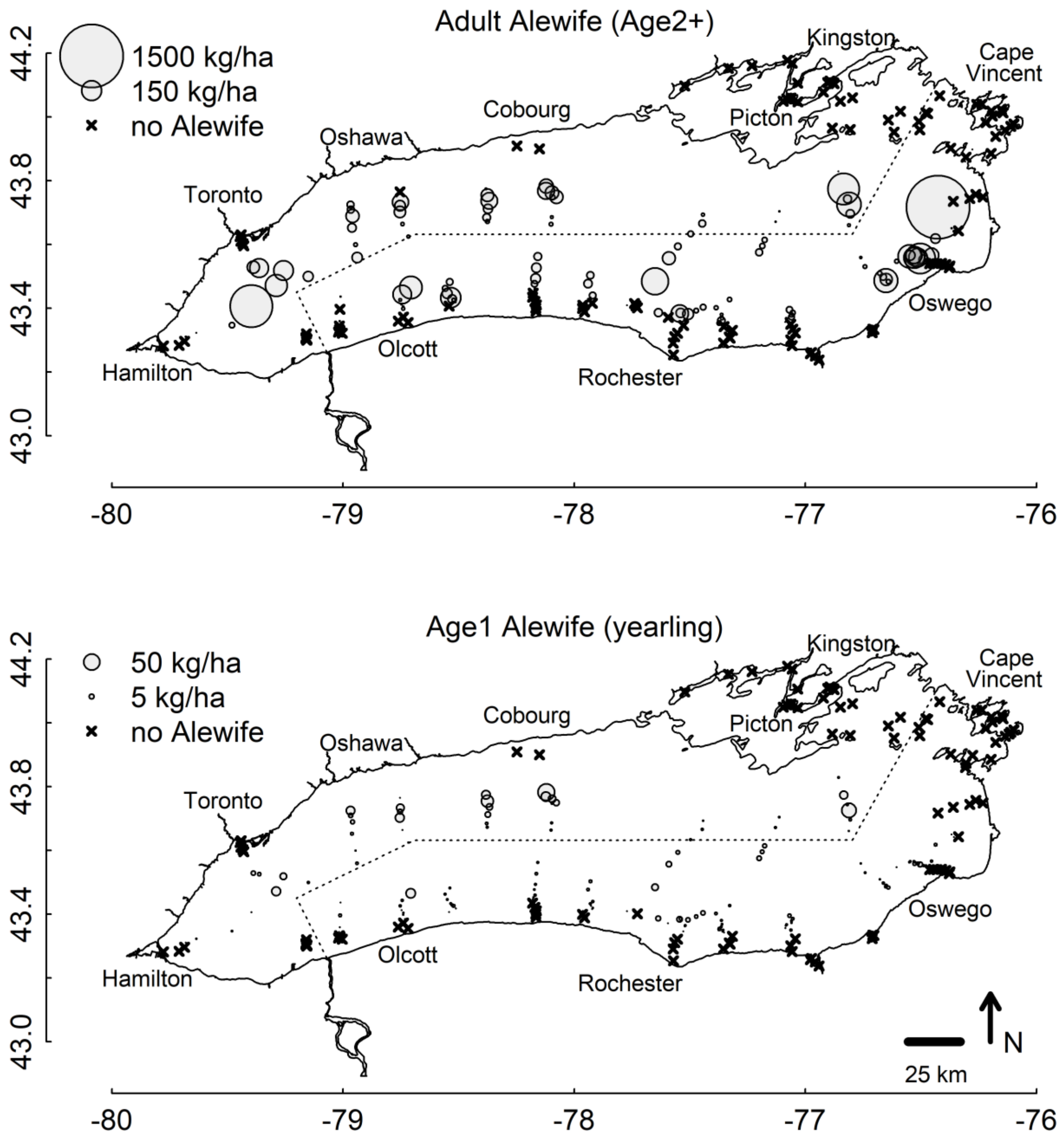

Figure 5. Spatial distribution of alewife biomass values from the 2019 collaborative Lake Ontario April bottom trawl survey. The size of the gray circles represents the biomass in kilograms per hectare of alewife captured, while an "x" signifies a location where no alewife were captured. Note the difference in age-1 alewife abundance between the Canadian and U.S. portions of the lake.

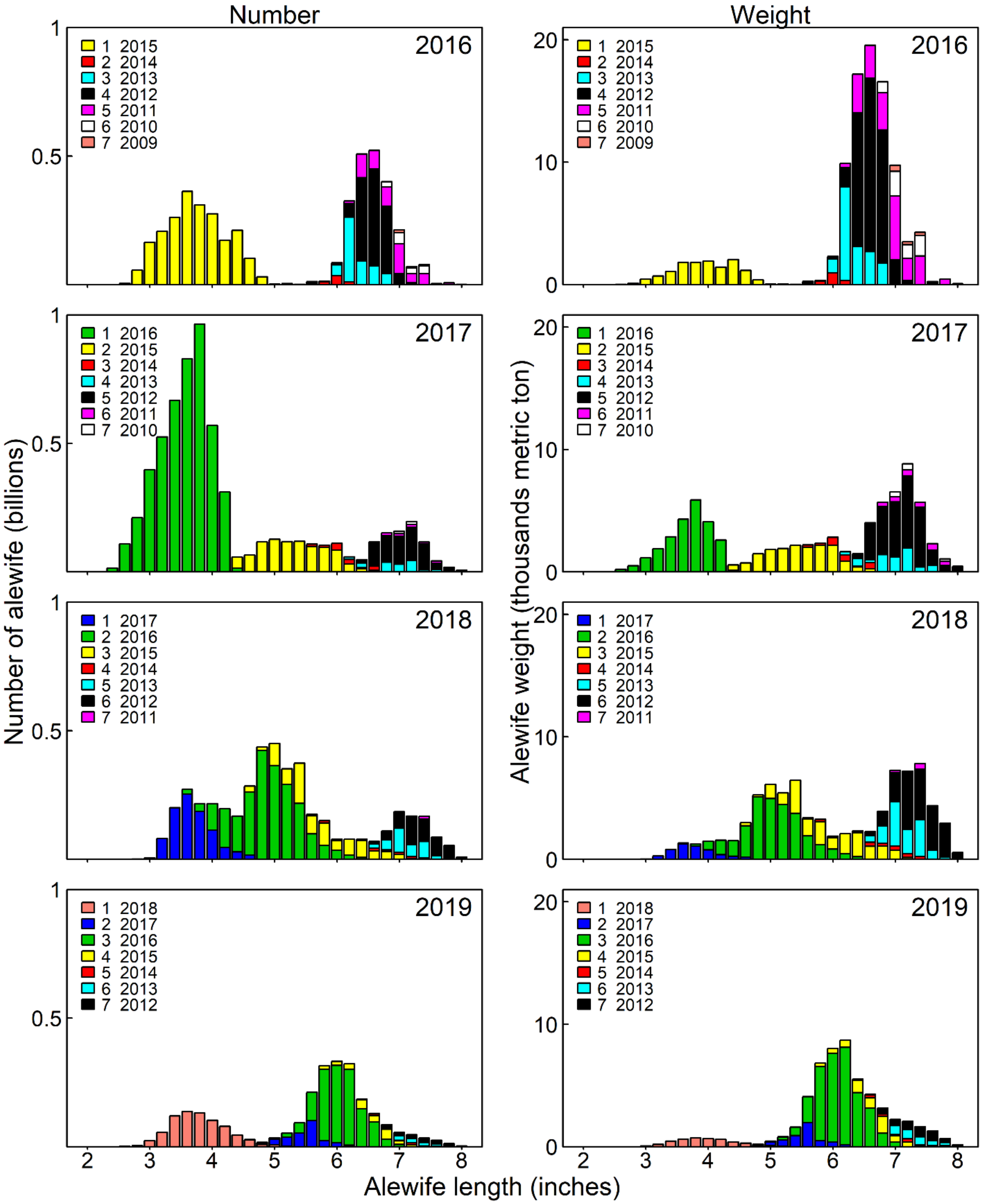

Figure 6. Lake Ontario alewife size and age distribution from April bottom trawl surveys, 2016-2019. Height of the bars represent number of alewife (in billions) or weight of alewife (thousands of metric tons) for each size bin (1/5th inch or 5mm). Colors represent a year-class and are consistent across the different years.

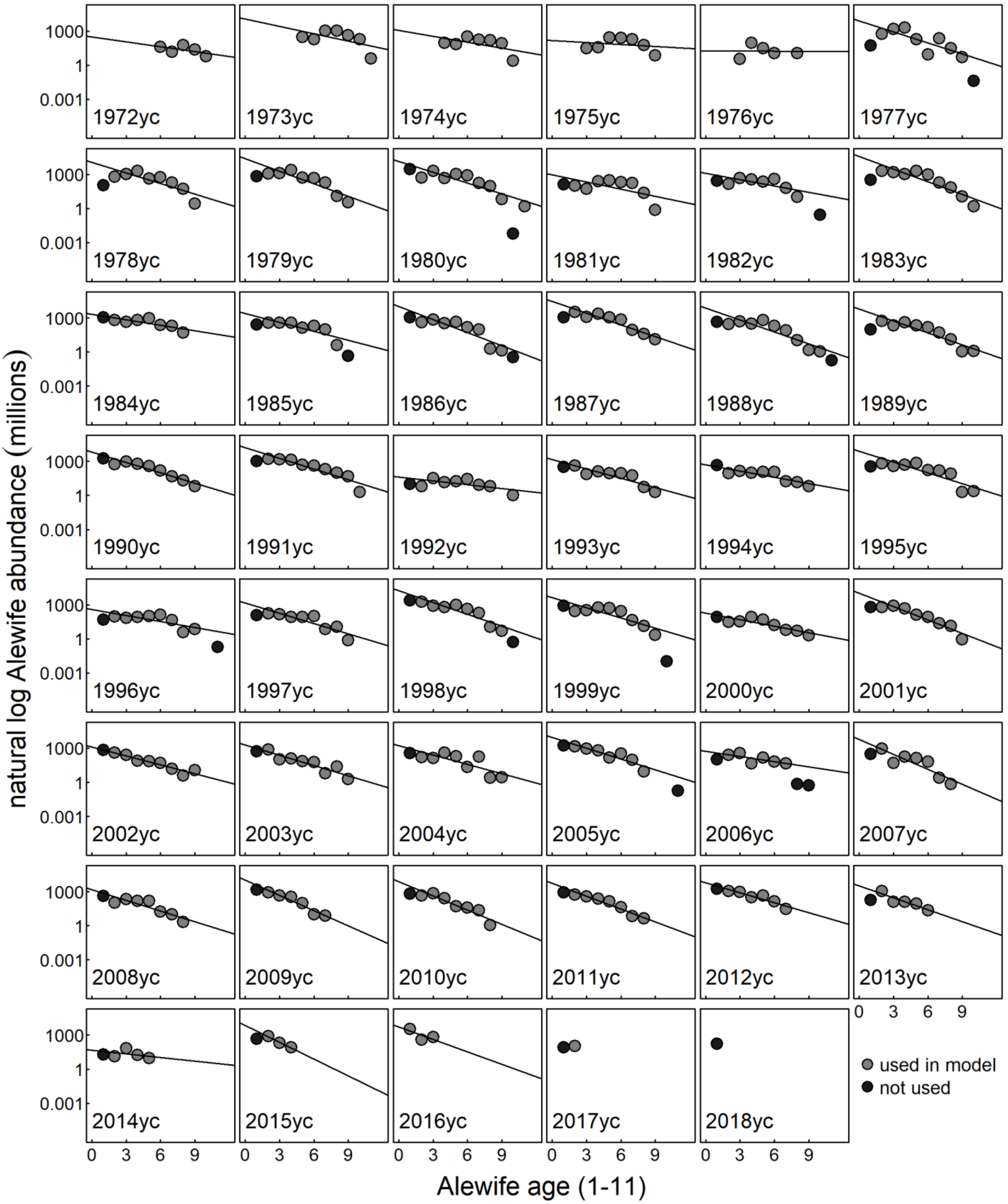

Figure 7. Alewife year-class catch curve observations (points) and models (lines) for Lake Ontario alewife year-classes (1972-2018). Values on the y-axis are natural log transformed. Black filled circles are points not used in

the model because either the mean length of the cohort was below 120mm or the total number estimated was below 700,000 fish (horizontal dotted line).

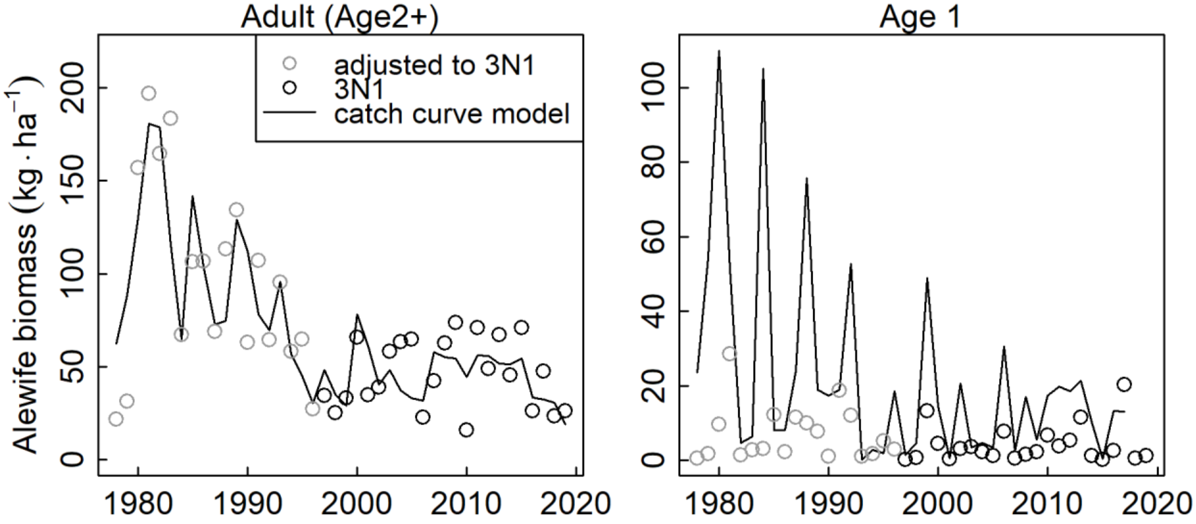

Figure 8. Alewife biomass estimates based on catch curve models (black line) and bottom trawl survey mean values in U.S. waters (circles) for adult (left panel) and age-1 (right panel) alewife in Lake Ontario, 1978-2019. Gray circles represent estimates collected with the smaller Yankee trawl (1978-1996) that have been converted to correspond with survey results from 1997-2019 collected with a larger 3n1 bottom trawl. Example years where there was evidence that survey results were biased low include 1978, 1979, 1990, and 2010. Example years where adult biomass values may have been biased high include 1983, 1995, 2004, and 2011. In contrast to the adults, model estimates for age-1 alewife are more frequently much larger than observed values. These differences are most evident from the observations collected with the smaller Yankee trawl (1978-1997) and less evident since the 3n1 trawl was adopted.

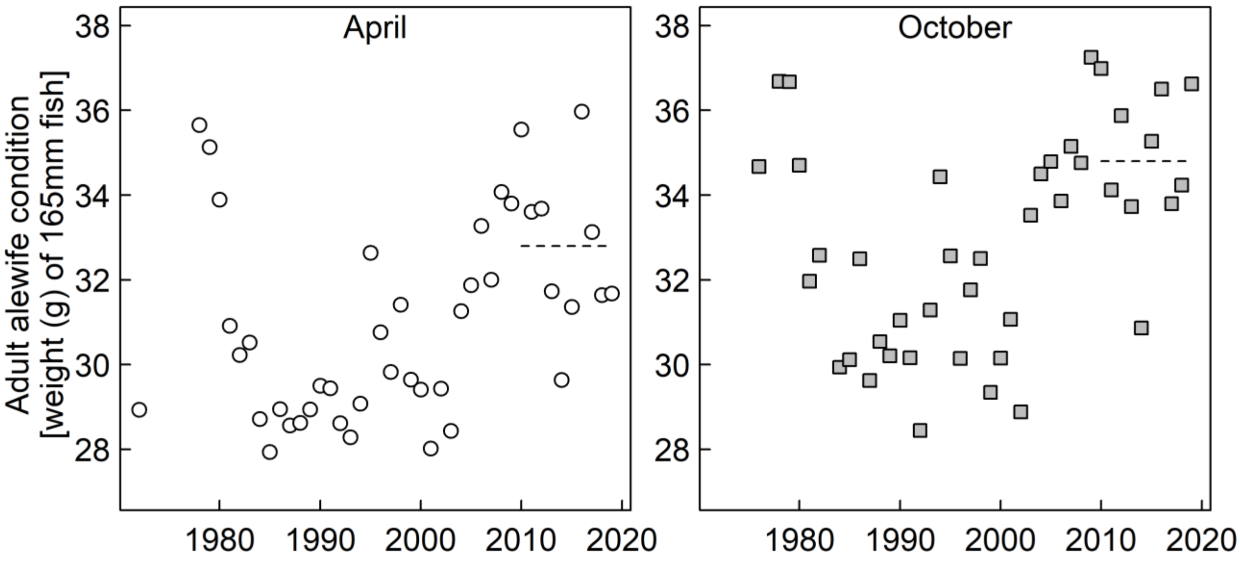

Figure 9. Lake Ontario alewife condition represented as the predicted weight of a 165mm (6.5 inch) fish from the April (left panel) and October (right panel) bottom trawl surveys. Linear models are based on observations from 150-180mm total length (5.9 to 7 inches). Dashed horizontal lines represent mean values from the past 10 years. Data from 1978-2015 represent trawls in U.S. waters while data from 2016-2019 also include observations from Canadian waters.

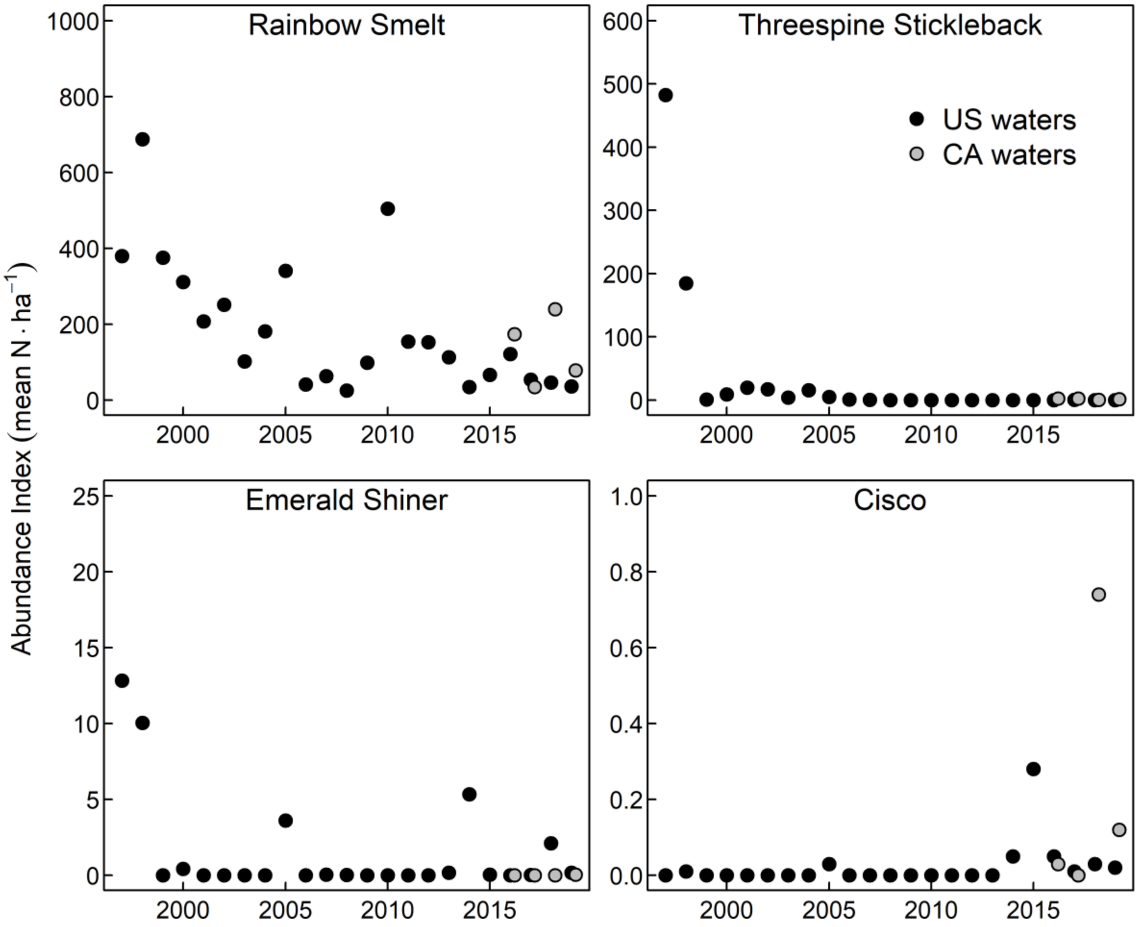

Figure 10. Abundance indices for Lake Ontario pelagic prey fishes based on bottom trawls in U.S. and Canadian waters, 1997-2019. These species are specifically mentioned in Fish Community Objectives related to diverse prey fish communities (Stewart et al., 2017).

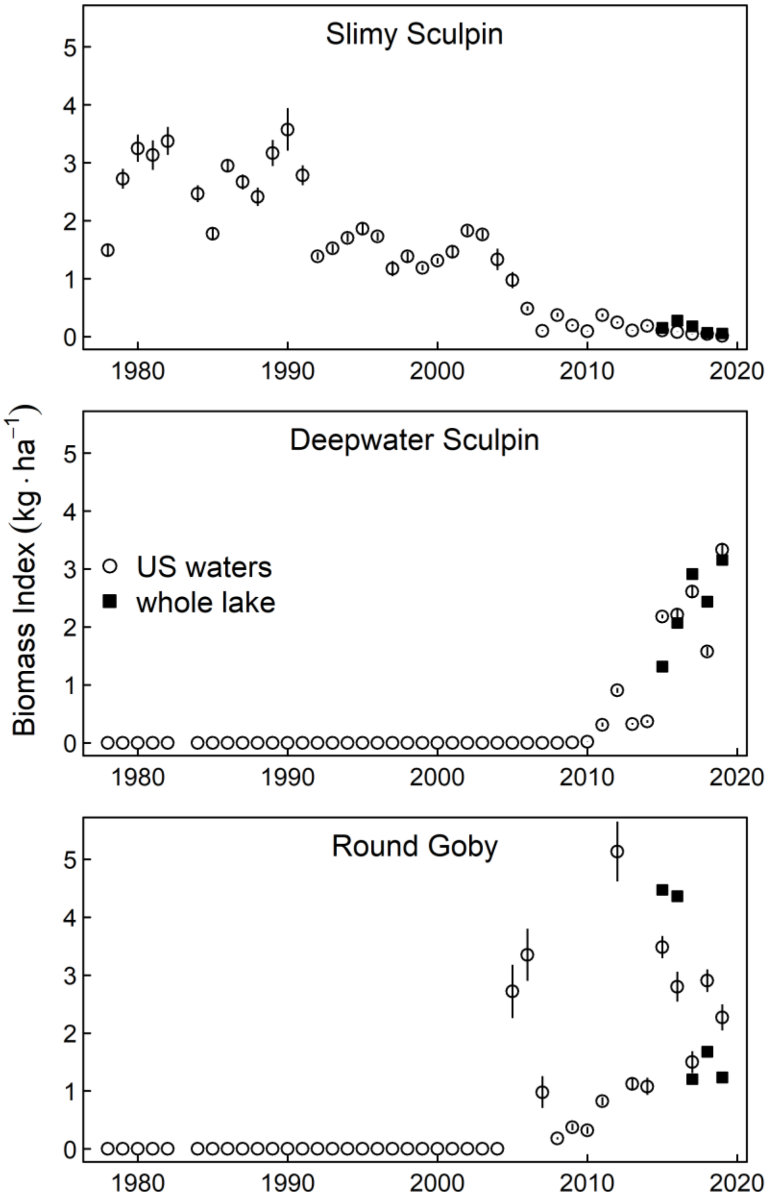

Figure 11. Lake Ontario biomass indices for demersal (bottom-oriented) prey fishes from the October bottom trawl survey, 1978-2019. Values represent a depth-stratified (20m strata), area-weighted mean biomass expressed as kilograms per hectare in either U.S. waters, open circles, or lake-wide surveys, filled squares. Bottom trawl area swept is based on wing widths, biomass indices are not corrected for trawl catchability.

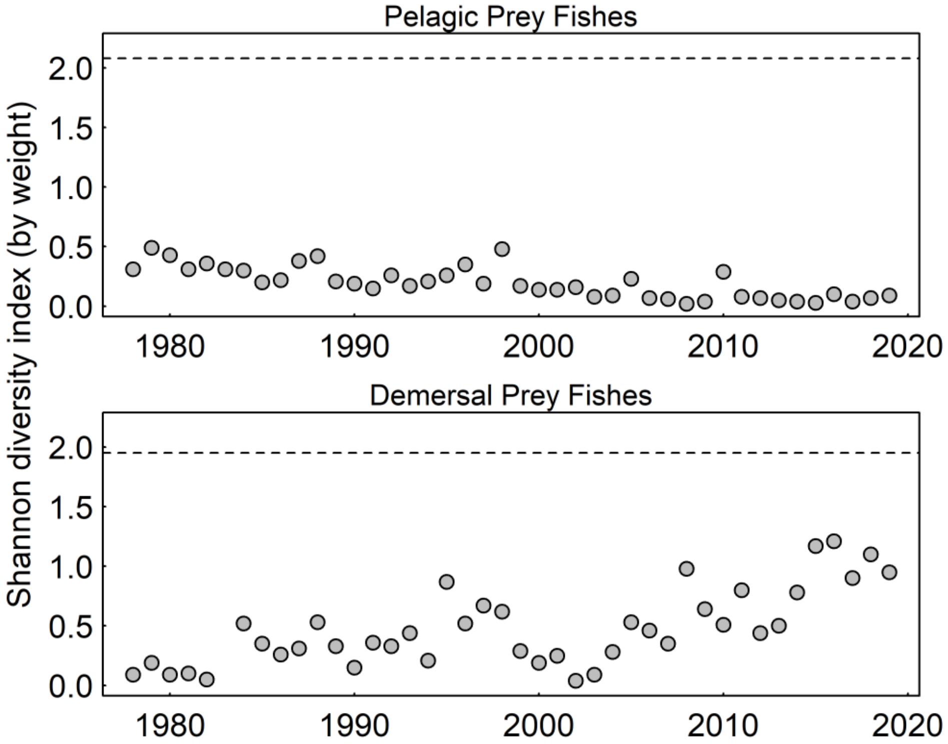

Figure 12. Lake Ontario prey fish diversity indices for pelagic and demersal prey fish communities, based on bottom trawl catch weights 1978-2019. Species used for calculations are identified in Table 2. Diversity is represented with the Shannon index (Shannon and Weaver, 1949), using commonly encountered species in the April (targets pelagic prey fishes) and October (targets demersal prey fish) surveys. The dashed lines represent the maximum diversity index value if all species made up equal proportions of the catch by weight. Lake Ontario Fish Community Objectives seek to improve pelagic and demersal prey fish diversity (Stewart et al., 2017).

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