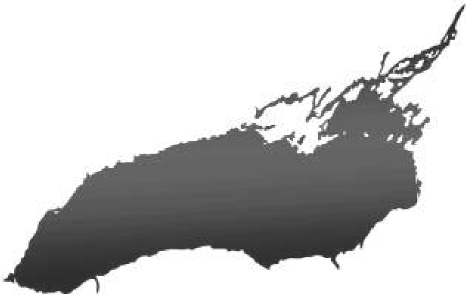

Lake Ontario Fish Communities and Fisheries:

2022 Annual Report of the Lake Ontario Management Unit

Ontario

Cover Photos:

(Top Left) LOMU field crew preparing on shore during St. Lawrence Index Netting. For more information, see Section 1.9.

(Top Right) MNRF's "Ontario Explorer" trawling as part of the Lake Ontario Spring Prey Fish Assessment. For more information, see Section 1.6.

(Bottom) LOMU field crew lifting a net containing a Walleye as part of the Lake Ontario and Bay of Quinte Community Index Gillnetting program. For more information, see Section 1.1.

LAKE ONTARIO FISH COMMUNITIES AND FISHERIES:

2022 ANNUAL REPORT OF THE LAKE ONTARIO MANAGEMENT UNIT

Prepared for the
Great Lakes Fishery Commission
Lake Committees Meetings
March 28-30, 2023

Printed in Picton, Ontario, Canada

December 2023

Report ISSN 1201-8449

Please cite this report as follows:
Ontario Ministry of Natural Resources and Forestry. 2023. Lake Ontario Fish Communities and Fisheries: 2022 Annual Report of the Lake Ontario Management Unit. Ontario Ministry of Natural Resources and Forestry, Picton, Ontario, Canada.

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

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Lake Ontario Fish Communities and Fisheries: 2022 Annual Report of the Lake Ontario Management Unit

Foreword

The Lake Ontario Management Unit (LOMU) and the Lake Ontario research staff from the Aquatic Research and Monitoring Section (ARMS) operating at the Glenora Fisheries Station, are pleased to provide the 2022 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 2022 including the comprehensive long-term base monitoring program that spans over five decades. In 2022, assessment of the Canadian waters from the Niagara River to Lake Saint Francis included 160 trap net sets, 133 gill net sets in over 169 sites and 122 trawls. Across all programs, 139,325 fish were captured (comprising more than 50 species) and 3,516 calcified structures were processed for age and growth assessment. Over 27,000 salmon and trout were observed migrating upstream using the Ganaraska River and Credit River video fish counter systems. MNRF Fish Culture Section and partners stocked 1.666 million fish (aprox. 40,000 kg).

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 2022.

Andy Todd
Lake Ontario Manager
613-476-3147

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This Annual Report is available online at: http://www.glfc.org/loc_mgmt_unit/

1. Index Fishing Projects

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

S. Beech, 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, and depth stratified random sites. In 2022, each site or area was visited once with one to three gill net gangs set during each visit.

The annual index gill netting field work occurs during the summer months 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 and in various geographic areas.

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 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

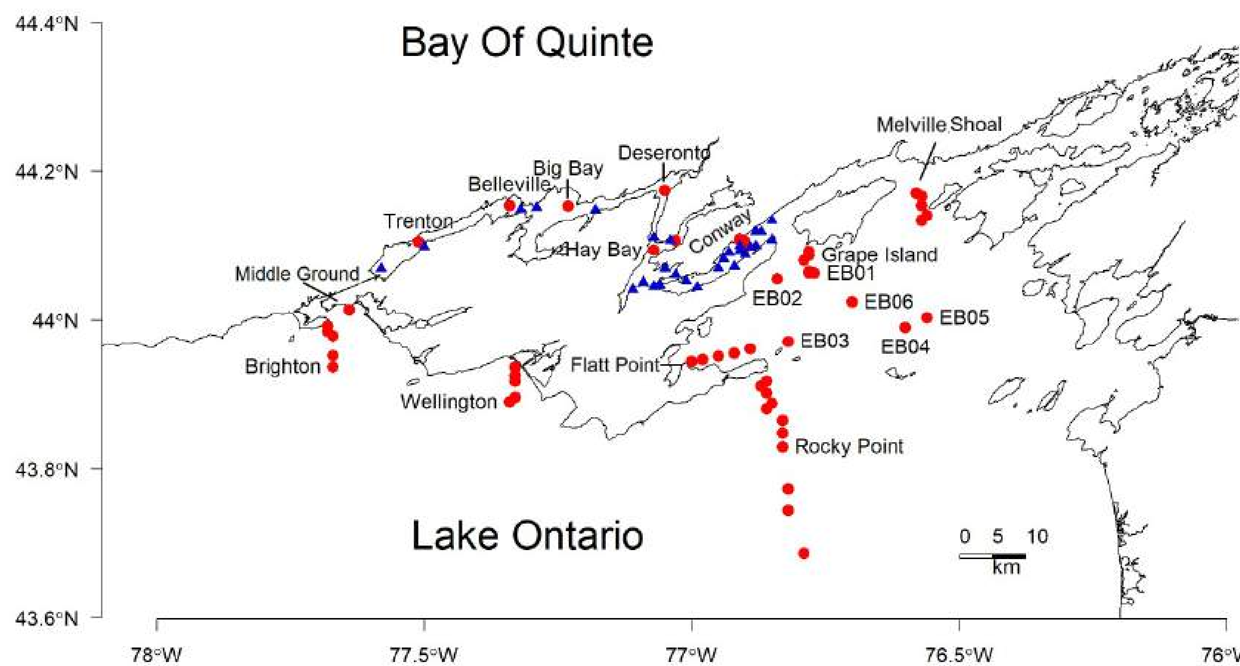


FIG. 1.1.1. Map of Lake Ontario showing fish community index gill netting fixed (red) and random (blue) sites in 2022. Fixed sites are labelled.

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]
Northeastern Lake Ontario	Brighton (BR)	Depth stratified area	BR08	7.5	1	2		435955	774058	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Brighton	Depth stratified area	BR13	12.5	1	2		435911	774071	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Brighton	Depth stratified area	BR18	17.5	1	2		435878	774053	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Brighton	Depth stratified area	BR23	22.5	1	2		435777	774034	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Brighton	Depth stratified area	BR28	27.5	1	2		435624	774004	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Middle Ground (MG)	Fixed site	MG05	5	1	2		440054	773906	2	mid July-Aug	1979	44
Northeastern Lake Ontario	Wellington (WE)	Depth stratified area	WE08	7.5	1	2		435622	772011	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Wellington	Depth stratified area	WE13	12.5	1	2		435544	772027	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Wellington	Depth stratified area	WE18	17.5	1	2		435515	772025	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Wellington	Depth stratified area	WE23	22.5	1	2		435378	772050	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Wellington	Depth stratified area	WE28	27.5	1	2		435348	772066	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point (RP)	Depth stratified area	RP08	7.5	1	2		435510	765220	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP13	12.5	1	2		435460	765230	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP18	17.5	1	2		435415	765222	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP23	22.5	1	2		435328	765150	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP28	27.5	1	2		435285	765135	2	mid July-Aug	1988	35
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP40	40	1		3	435190	765040	3	mid July-Aug	2016	7
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP50	50	1		3	435090	765030	3	mid July-Aug	2016	7
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP60	60	1		3	434950	765029	3	mid July-Aug	1997	26
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP80	80	1		3	434633	765006	3	mid July-Aug	1997	26
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP100	100	1		3	434477	764998	3	mid July-Aug	1997	26
Northeastern Lake Ontario	Rocky Point	Depth stratified area	RP140	140	1		3	434122	764808	3	mid July-Aug	1997	26
Kingston Basin (nearshore)	Flatt Point (FP)	Depth stratified area	FP08	7.5	1	2		435665	765993	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP13	12.5	1	2		435659	765927	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP18	17.5	1	2		435688	765751	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP23	22.5	1	2		435726	765541	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Flatt Point	Depth stratified area	FP28	27.5	1	2		435754	765314	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Grape Island (GI)	Depth stratified area	GI08	7.5	1	2		440537	764712	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI13	12.5	1	2		440523	764747	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI18	17.5	1	2		440476	764710	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI23	22.5	1	2		440405	764718	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Grape Island	Depth stratified area	GI28	27.5	1	2		440470	764796	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Melville Shoal (MS)	Depth stratified area	MS08	7.5	1	1		441030	763500	1	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS13	12.5	1	1		441004	763470	1	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS18	17.5	1	2		440940	763460	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS23	22.5	1	2		440835	763424	2	Jun 27-Jul 29	1986	37
Kingston Basin (nearshore)	Melville Shoal	Depth stratified area	MS28	27.5	1	2		440792	763424	2	Jun 27-Jul 29	1986	37

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. Starting in 2019, only one gang was used at each site in the Bay of Quinte. The reduction of fixed sites from one to two gangs allowed for the reallocation of effort to depth stratified random sites.

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.

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	1	3		440400	764650	3	Jul-Aug	2016	7
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB02	30	1	3		440330	765050	3	Jul-Aug	1968	55
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB03	25	1	3		435820	764950	3	Jul-Aug	2016	7
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB04	27	1	3		435940	763610	3	Jul-Aug	2016	7
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB05	29	1	3		440000	763400	3	Jul-Aug	2016	7
Kinston Basin (offshore)	Eastern Basin (EB)	Fixed site	EB06	30	1	3		440220	764210	3	Jul-Aug	1968	55
Bay of Quinte	Conway	Depth stratified area	CO08	7.5	1	1		440664	765463	1	Jul-Aug	1972	51
Bay of Quinte	Conway	Depth stratified area	CO13	12.5	1	1		440649	765452	1	Jul-Aug	1972	51
Bay of Quinte	Conway	Depth stratified area	CO20	20	1	1		440643	765453	1	Jul-Aug	1972	51
Bay of Quinte	Conway	Depth stratified area	CO30	30	1	1		440620	765440	1	Jul-Aug	1972	51
Bay of Quinte	Conway	Depth stratified area	CO45	45	1	1		440601	765402	1	Jul-Aug	1972	51
Bay of Quinte	Hay Bay (HB)[2]	Depth stratified area	HB08	7.5	1	1		440656	770156	1	Jul-Aug	1959	64
Bay of Quinte	Hay Bay	Depth stratified area	HB13	12.5	1	1		440575	770400	1	Jul-Aug	1959	64
Bay of Quinte	Deseronto (DE)	Fixed site	DE05	5	1	1		441035	770339	1	Jul-Aug	2016	7
Bay of Quinte	Big Bay (BB)	Fixed site	BB05	5	1	1		440920	771360	1	Jul-Aug	1972	51
Bay of Quinte	Belleville (BE)	Fixed site	BE05	5	1	1		440914	772048	1	Jul-Aug	2016	7
Bay of Quinte	Trenton (TR)	Fixed site	TR05	5	1	1		440636	773063	1	Jul-Aug	2016	7
Bay of Quinte	Upper Bay of Quinte	Random site	U006	1-3	1	1		4404.131	7733.946	1	Jul-Aug	2019	4
Bay of Quinte	Upper Bay of Quinte	Random site	U016	1-3	1	1		4405.227	7733.244	1	Jul-Aug	2019	4
Bay of Quinte	Upper Bay of Quinte	Random site	U057	3-6	1	1		4409.263	7721.414	1	Jul-Aug	2019	4
Bay of Quinte	Upper Bay of Quinte	Random site	U117	6-12	1	1		4408.859	7714.646	1	Jul-Aug	2019	4
Bay of Quinte	Upper Bay of Quinte	Random site	U067	6-12	1	1		4408.769	7719.143	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M072	12-20	1	1		4403.646	7704.71	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M070	12-20	1	1		4403.618	7706.207	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M030	1-3	1	1		4409.177	7657.401	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M028	1-3	1	1		4408.624	7658.133	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M054	3-6	1	1		4405.859	7701.789	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M002	3-6	1	1		4409.624	7702.669	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M077	6-12	1	1		4403.064	7706.937	1	Jul-Aug	2019	4
Bay of Quinte	Middle Bay of Quinte	Random site	M088	6-12	1	1		4402.579	7703.924	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L004	1-3	1	1		4403.159	7701.697	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L034	3-6	1	1		4405.963	7655.796	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L045	3-6	1	1		4406.528	7654.315	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L048	6-12	1	1		4404.908	7654.263	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L049	6-12	1	1		4407.08	7653.583	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L059	12-20	1	1		4407.645	7652.101	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L029	12-20	1	1		4405.41	7656.527	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L019	20-35	1	1		4403.212	7658.702	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L063	20-35	1	1		4408.197	7651.372	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L009	20-35	1	1		4402.633	7700.93	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L065	20-35	1	1		4407.117	7651.335	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L031	35+	1	1		4404.33	7656.492	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L054	35+	1	1		4407.093	7652.833	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L026	35+	1	1		4403.778	7657.223	1	Jul-Aug	2019	4
Bay of Quinte	Lower Bay of Quinte	Random site	L060	35+	1	1		4407.105	7652.084	1	Jul-Aug	2019	4

[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

[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

TABLE 1.1.2. Species-specific catch in 2022 gill net sets from June 20 to August 22. "Standard catch" and "Standard weight" is the observed catch and weight, respectively, 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.

Species	Observed Catch	Standard Catch	Observed Weight	Standard Weight
Lake sturgeon	1	1	-	-
Longnose gar	39	44	79	84
Bowfin	1	1	2	2
Alewife	3,973	12,875	148	479
Gizzard shad	34	48	36	36
Chinook salmon	6	6	22	22
Brown trout	12	12	27	27
Lake trout	224	231	833	835
Lake whitefish	53	53	58	58
Lake herring	82	82	46	46
Rainbow smelt	2	2	<0.1	<0.1
Northern pike	11	11	37	37
White sucker	77	77	50	50
Silver redhorse	2	2	4	4
Shorthead redhorse	2	2	2	2
Common carp	6	6	21	21
Golden shiner	2	7	<0.1	<0.1
Brown bullhead	24	26	7	7
Channel catfish	1	1	3	3
White perch	944	1,356	106	127
White bass	11	11	4	4
Rock bass	42	77	3	4
Pumpkinseed	104	118	6	7
Bluegill	52	112	2	3
Smallmouth bass	28	28	26	26
Largemouth bass	15	17	14	17
Black crappie	2	2	<0.1	<0.1
Lepomis sp.	1	1	<0.1	<0.1
Yellow perch	786	2,093	53	115
Walleye	283	297	448	449
Round goby	12	40	<0.1	1
Freshwater drum	123	125	121	121
Deepwater sculpin	1	1	<0.1	<0.1

In 2022, 135 gill net samples were conducted from June 20 to August 22. Thirty-three different species and 6956 individual fish were caught. Seventy-two percent of the observed catch (by number) was Alewife, followed by Yellow Perch (12%), White Perch (8%), Walleye (2%), and Lake Trout (1%) (Table 1.1.2). Species -specific catch across depth ranges is shown for the Bay of Quinte in Table 1.1.3 and for Lake Ontario in Table 1.1.4. Species-specific gill net catch by geographic area is shown in Fig. 1.1.2. Abundance trends for the most selected species caught in Lake Ontario and the Bay of Quinte are shown (Table 1.1.5-1.1.7 and Fig. 1.1.3-1.1.5). Length distributions are shown for selected species in Fig. 1.1.6. Other biological information is also presented below for Lake Whitefish, Cisco, Lake Trout, Yellow Perch, and Walleye (Table 1.1.8 and Figs. 1.1.7-1.1.8) and described for Northern Pike, Largemouth Bass, and Smallmouth Bass.

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 (Table 1.1.5, Fig. 1.1.3)

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. 1.1.3) 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-EB06) Offshore Areas (Table 1.1.6, Fig. 1.1.4)

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). Six single-depth sites (EB01-EB06) are used to monitor long-term trends in the deep-water fish community the Kingston Basin. Results were summarized in Table 1.1.6 and sites EB02 and EB06 are presented graphically (Fig. 1.1.4) to illustrate abundance trends of the most abundant species (Alewife, Lake Trout, Lake Whitefish, Yellow Perch, Rainbow Smelt, Cisco, Chinook Salmon and Round Goby).

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

Bay of Quinte, Lake Ontario

Bay of Quinte, Fixed Sites (Trenton, Belleville, Deseronto, Conway, Hay Bay and Big Bay; Table 1.1.7)

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. 1.1.5 to illustrate abundance trends of the most abundant species from 1992-2022. Catch per gillnet is provided for all 6 sites in the Bay of Quinte for 2022 and means for recent years (Table 1.1.)

Bay of Quinte, Depth Stratified (Upper, Middle and Lower Bay of Quinte; Table 1.1.3)

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 Quinte 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 1.1.3. In 2022, each site in the Bay of Quinte was visited once. 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

Fifty-three Lake Whitefish were caught and interpreted for age in the 2022 index gill nets (Table 1.1.8 and Fig. 1.1.7). Fish ranged in age from 3-27 years. Fourteen year-classes were represented. Thirty-two (60%) whitefish were from either the 2014, 2015 or 2017 year-classes.

Cisco

Eighty-two Cisco were caught and interpreted for age in 2022 index gill nets (Table 1.1.8 and Fig. 1.1.7). Fish ranged in age from 1-13 years. Twelve year-classes were represented. Forty-eight (56%) were from the 2014 and 2015 year-classes.

TABLE 1.1.3. Species-specific catch per depth strata across areas in the Bay of Quinte. All fixed and random sites were included. The total number of fish caught and number of gill nets set are indicated.

Species	1-3	3-6	6-12	12-20	20-35	>35
Longnose gar	3.26	2.7	0.38			
Bowfin	0.2					
Alewife	76	23.06	52.05	123.2	0.66	
Gizzard shad	3	3.43	0.25			
Lake trout				0.29	8.66	4.06
Lake whitefish					0.6	0.6
Lake herring			0.25	0.57		
Northern pike	0.8	0.33		0.14		
White sucker	0.8	2.11	1.5	5.57		
Silver redhorse	0.4					
Shorthead redhorse	0.4					
Common carp	1	0.11				
Golden shiner		0.73				
Brown bullhead	2.6	1.26	0.25			
Channel catfish		0.11				
White perch	7.3	86.53	52.67	17.11		
White bass	1	0.33		0.43		
Rock bass	2.06	2.79	0.54			
Pumpkinseed	1.6	10.54	1.88			
Bluegill	3.64	9.09	1.49			
Smallmouth bass	2.2	0.22				
Largemouth bass	3.46					
Black crappie		0.22				
Lepomis sp.	0.2					
Yellow perch	34.34	60.17	67.45	84.01	1.98	
Walleye	9	9.07	6.99	2.76		
Round goby				0.47		
Freshwater drum	8.2	5.48	3.5	0.86		
Total Catch	807	1,965	1,514	1,648	60	23
Nets Set	5	9	8	7	5	5

TABLE 1.1.4. Species-specific catch per depth strata across areas in Lake Ontario (Middle ground, Rocky Point, Wellington, Brighton, Flatt Point, Grape island, Melville shoal, and six Eastern basin fixed sites), 2022. The total number of fish caught and number of gill nets set are indicated.

Species	5	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140
Lake sturgeon				0.08								
Alewife		276.58	301.46	192.24	92.94	40.71	0.33				0.33	0.33
Chinook salmon				0.08	0.08	0.13						
Brown trout		0.09	0.27	0.08	0.33	0.1						
Lake trout					0.17	0.91	18	16.67	6.33	4	0.33	
Lake whitefish			0.09	0.17	0.08	1.4	0.33					
Lake herring		0.55		1.92	0.17	1.5						
Rainbow smelt					0.08	0.03						
Northern pike		0.27										
White sucker		0.18		0.08								
Rock bass	2.65	0.45	1.93	0.44								
Smallmouth bass		1.18	0.18									
Yellow perch	26.78	1.5	3.3	5.76	2.75	1.1						
Walleye	2	5.82	1.91	0.5								
Round goby		0.6	1.8	0.55	0.28							
Freshwater drum		0.09										
Deepwater sculpin												0.33
Total Catch	63	3,161	3,420	2,423	1,163	1,377	56	50	19	12	2	2
Nets set	2	11	11	12	12	30	3	3	3	3	3	3

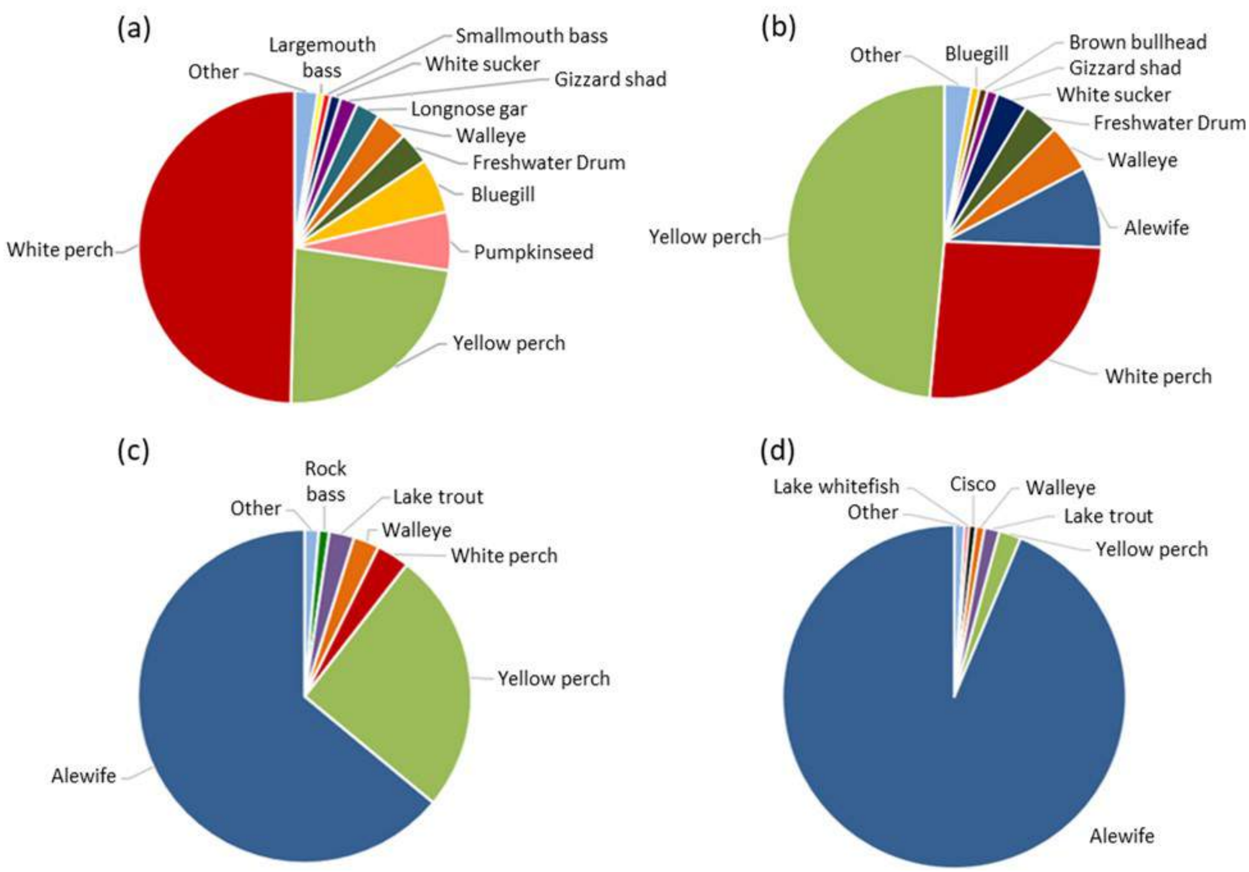


FIG. 1.1.2. Species-specific catch per region in the upper (a), middle (b) and lower (c) sections of the Bay of Quinte and Eastern Basin of Lake Ontario (d) displaying the most abundant species (less abundant species were grouped into “other”).

TABLE 1.1.5. Species-specific catch per gillnet set at **site in Lake Ontario and Eastern Basin nearshore sites**. Values include the 2022 catch per gillnet and the 2011-2020 mean. 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.

	Middle Ground		Brighton		Wellington		Rocky Point Shallow		Rocky Point Deep		Flat Point		Grape Island		Melville Shoal	
Species	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean
Sea lamprey	-	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-
Lake sturgeon	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	0.005
Bowfin	-	-	-	0.017	-	-	-	-	-	-	-	-	-	-	-	-
Alewife	-	48.151	15.7	184.759	4.726	200.237	1.091	223.043	0.167	25.449	219.348	477.128	375.461	653.083	473.935	436.38
Gizzard shad	-	0.312	-	0.194	-	0.006	-	-	-	-	-	0.015	-	-	-	-
Chinook salmon	-	-	0.2	0.255	0.1	0.229	0.2	0.198	-	-	-	0.045	-	0.01	-	0.03
Rainbow trout	-	-	-	0.017	-	-	-	0.006	-	-	-	0.015	-	-	-	-
Atlantic salmon	-	-	-	0.006	-	-	-	-	-	-	-	-	-	-	-	-
Brown trout	-	0.062	0.3	0.239	-	0.344	0.4	0.544	-	-	0.2	0.165	0.1	0.105	0.125	0.025
Lake trout	-	0.156	0.3	0.676	0.1	0.428	-	1.314	7.556	3.989	0.3	1.057	0.6	0.961	0.375	0.452
Lake whitefish	-	-	-	0.006	-	0.072	-	0.072	0.056	0.238	0.1	0.268	0.3	0.195	-	-
Cisco	-	-	0.4	0.196	0.1	0.089	0.1	0.044	-	0.015	2	0.06	0.6	0.172	0.25	0.19
Coregonous sp.	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-
Rainbow smelt	-	-	0.2	0.059	-	0.098	-	-	-	0.032	-	0.033	-	-	-	-
Northern pike	-	1.031	-	0.067	-	0.011	-	0.006	-	-	0.3	0.135	-	-	-	0.01
White sucker	-	1.238	0.2	0.072	-	0.006	-	0.011	-	-	-	0.07	0.1	0.12		0.005
Silver redhorse	-	0.028	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common carp	-	0.188	-	0.006	-	0.006	-	0.006	-	-	-	-	-	-	-	-
Brown bullhead	-	0.094	-	0.018	-	-	-	-	-	-	-	-	-	-	-	-
Burbot	-	-	-	0.044	-	0.061	-	0.011	-	-	-	-	-	-	-	-
White perch	-	0.094	-	-	-	-	-	0.017	-	0.006	-	-		-	-	-
Rock bass	2.652	0.538	-	0.537	-	0.063	1.391	0.453	-	-	0.3	0.479	0.6	0.196	1.076	1.032
Bluegill	-	0.031	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smallmouth bass	-	-	-	-	-	0.006	0.7	0.578	-	-	-	0.025	0.4	0.638	0.5	0.593
Yellow perch	26.783	49.341	-	0.672	4.957	13.731	0.661	0.176	-	-	1.091	1.963	0.761	1.968	10.462	7.574
Walleye	2	1.55	0.1	0.187	0.5	0.083	0.1	0.909	-	-	0.1	0.075	0.5	0.94	9.75	8.735
Round goby	-	-	0.661	1.86	1.322	2.6	-	6.572	-	0.039	0.991	1.305	0.33	0.978	0.413	0.555
Freshwater drum	-	0.219	-	0.006	0.1	0.011	-	0.011	-	-	-	0.02	-	-	-	0.01
Deepwater sculpin	-	-	-	-	-	-	-	-	0.056	0.035	-	-	-	-	-	-

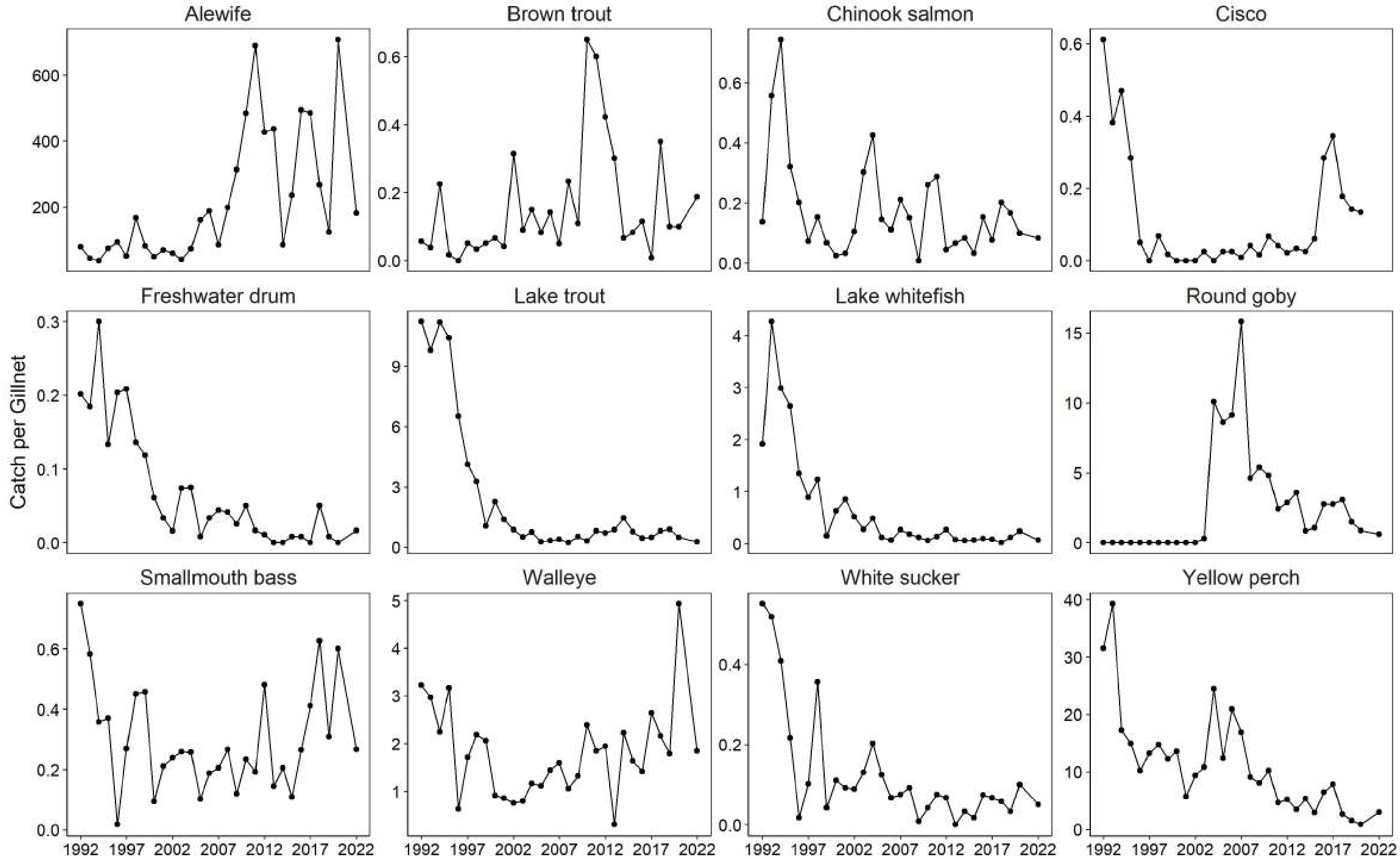


FIG. 1.1.3. Abundance trends for the most common species caught in gill nets at six depth-stratified transects (nearshore out to 30 m) in northeastern Lake Ontario (Melville Shoal, Grape Island, Flatt Point, Rocky Point, Wellington and Brighton; see Fig. 1.1.1). Annual catch per gill net values are unweighted means.

TABLE 1.1.6. Species-specific catch per gillnet set at **Eastern Basin sites.** Values include the 2022 catch per gillnet and either the 2016-2019 or 2011-2020 mean when data was available. Annual catches are averages for 1-3 gillnet gangs set at during each of 1-3 visits during summer.

	EB01		EB02		EB03		EB04		EB05		EB06	
Species	2022	2016-2019 mean	2022	2011-2020 mean	2022	2016-2019 mean	2022	2016-2019 mean	2022	2016-2019 mean	2022	2011-2020 mean
Alewife	2.87	136.02	296.986	64.389	7.275	44.78	11.681	96.67	5.507	64.81	24.696	41.634
Brown trout	-	-	-	0.044	0.333	0.06	-	0.03	-	0.03	-	0.019
Chinook salmon	-	0.14	-	0.186	-	0.17	-	0.29	-	0.29	0.333	0.052
Freshwater drum	-	0.22	-	-	-	-	-	-	-	-	-	-
Lake herring	-	1.31	-	0.41	2.667	0.64	2.667	2.36	-	1.28	8.667	0.799
Lake sturgeon	-	-	-	-	-	0.06	-	-	-	-	-	-
Lake trout	0.667	4.36	0.333	2.889	0.333	4.92	2	3.38	-	0.69	1.101	3.393
Lake whitefish	-	0.67	0.333	0.107	-	0.06	3.333	0.86	0.333	0.03	10	0.335
Rainbow smelt	-	0.03	-	0.025	-	-	-	0.21	-	0.09	-	0.016
Rainbow trout	-	-	-	0.004	-	-	-	-	-	-	-	0.005
Rock bass	-	0.03	-	0.004	-	-	-	-	-	0.03	-	-
Round goby	-	-	-	0.013	-	-	-	0.55		0.76	-	0.059
Smallmouth bass	-	0.28	-	0.004	-	-	-	-	-	-	-	0.012
Walleye	-	0.22	-	0.011	-	0.06	-	-	-	0.03	-	0.005
White bass	-	0.03	-	-	-	-	-	-	-	-	-	-
Yellow perch	-	0.9	-	0.072	-	-	-	0.79	9.913	0.15	-	-

Lake Trout

224 Lake Trout were caught and interpreted for age (CWT and age structures combined) in the 2022 index gill nets (Table 1.1.8 and Fig. 1.1.7). Fish ranged in age from 1-22 years. Twenty-one year-classes were represented. Sixty-three (28%) Lake Trout were from either the 2020, 2019, or 2017 year-classes.

Walleye

Two hundred and eighty-three Walleye were caught and interpreted for age in the 2022 summer index gill nets (Table 1.1.8 and Fig. 1.17). Fish ranged from age 1-21 and one hundred nineteen Walleye (42%) were age-2 or age-4 (2020 or 2018 year-class). In the Kingston Basin nearshore gill nets, 86% of Walleye were age-6 or greater, and in the Bay of Quinte gill nets, 81% were age-4 or less. Gonadal somatic index indicated females were mature at age 4 (Fig. 1.1.8).

Northern Pike

Eleven Northern Pike were caught and interpreted for age in the 2022 index gillnets. All fish were mature, ranging in age from 3-11 years (mean of 6.6 years). Of these fish, 73% were female.

Largemouth Bass

Fifteen Largemouth Bass were caught and interpreted for age in the 2022 index gillnets. Ages ranged from 2-8 with a mean of 4.1 years. Of these fish, 87% were mature and 67% were female.

Smallmouth Bass

Twenty-eight Smallmouth Bass were caught and interpreted for age in the 2022 index gillnets. Ages ranged from 2-10 with a mean of 4.2 years. Of these fish, 64% were mature and 57% were female.

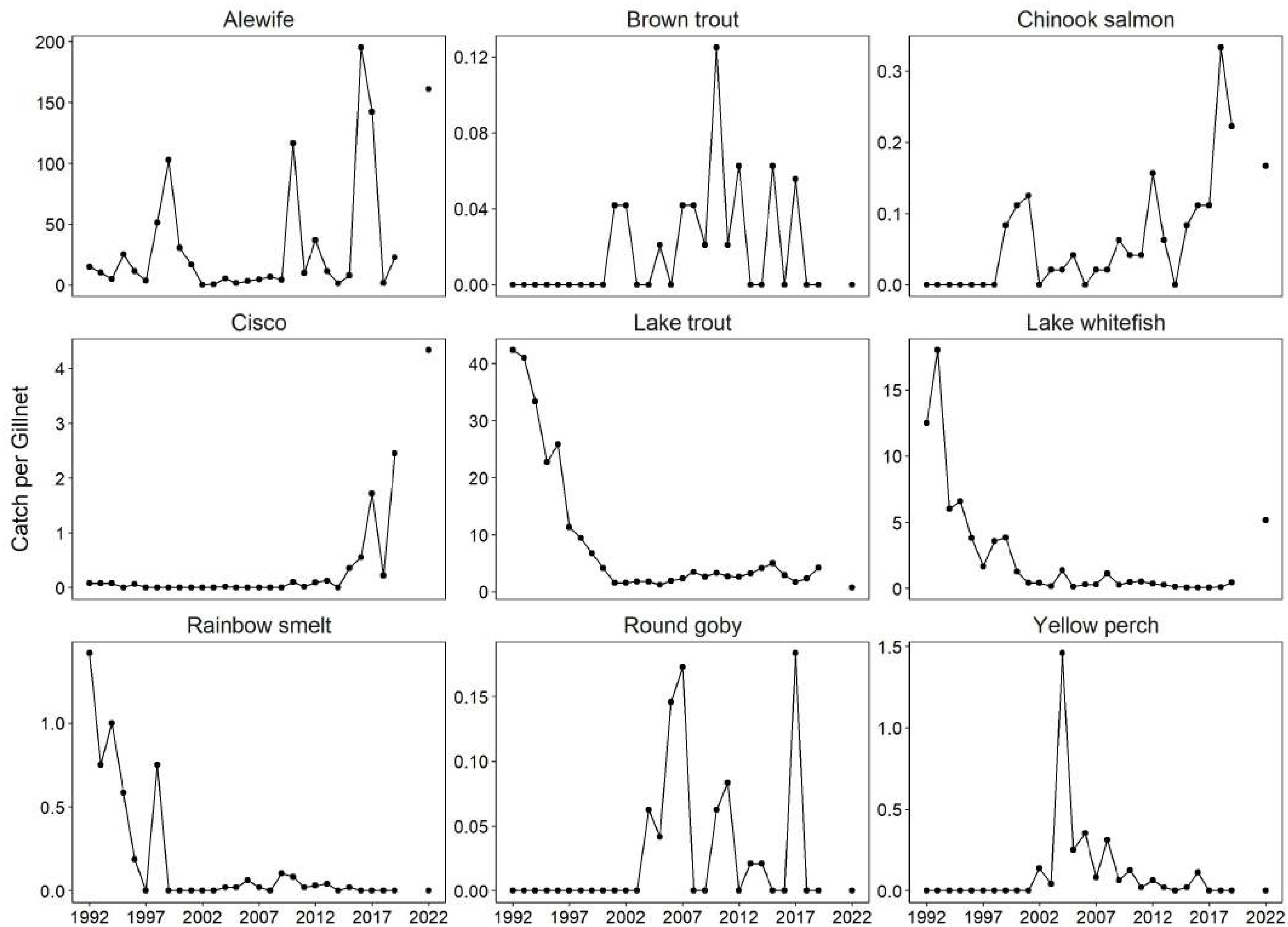


FIG. 1.1.4. Abundance trends (annual means) for the most common species caught in gill nets at the Kingston Basin deep sites, in eastern Lake Ontario (EB02 and EB06; see Fig. 1.1.1).

TABLE 1.1.7. Species-specific catch per gillnet set at fixed sites in the Bay of Quinte. Values include 2022 catch per gillnet and the 2016-2020 or 2011-2020 mean when data was available. Annual catches are averages for 1-3 gillnet gangs set during each of 1-3 visits during summer.

	Trenton		Belleville		Deseronto		Big Bay		Hay Bay		Conway	
Species	2022	2016-2020 mean	2022	2016-2020 mean	2022	2016-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean
Alewife	3.304	17.1		4.78	3.304	60.33		1.261	8.109	15.603	101.774	113.093
Black crappie						0.15	1			0.021		
Bluegill		14.11	38.348	2.83	7.304	0.6	9	6.973		0.013		
Bowfin		0.22				0.05						
Brown bullhead		0.45	2	0.45		1.14	2	0.969		0.038		0.005
Brown trout												0.05
Channel catfish		0.1		0.35				0.185				
Chinook salmon		0.05				0.05				0.025		0.134
Common carp					1	0.1				0.013		
Coregonus sp.												0.005
Freshwater drum	4.304	5.83	2	13.22	14	6.54	2	10.421	3	1.74	0.4	0.855
Gizzard shad	23.826	28.78	3	18.35	2	3.67		12.344	0.5	0.817		0.015
Golden shiner										0.229		
Lake herring		0.1		0.2		2				0.379	0.2	0.193
Lake sturgeon								0.017				0.005
Lake trout										0.042	3.4	1.85
Lake whitefish		0.2		0.35		0.25		0.019		0.017	0.2	0.281
Largemouth bass		0.53				0.37						
Longnose gar	9.304	10.5	3	7.64		0.05	8	4.7				
Morone sp.												0.005
Northern pike		0.65		0.15		0.5		0.065	0.5	0.473		0.03
Pumpkinseed		5.19	20.609	1.43	45.304	2.67	2	0.963		0.624		
Rainbow smelt										0.062		0.103
Rainbow trout										0.008		
Rock bass		1.28		0.57	3.304	0.3		0.117				0.486
Round goby												0.005
Sea lamprey												0.005
Shorthead redhorse		0.05		0.1				0.014				
Silver redhorse		0.25		0.05				0.019				
Smallmouth bass	1		1									0.04
Walleye	6	8.05	4	10.73	16	22.11	4	7.602	3	2.347	2.261	2.15
White bass		0.65		1.13	2	1.35	1	0.954		0.196		0.02
White perch	148.13	38.68	51.826	30.36	145.565	46.16	178.174	103.64	66.565	14.619	3.643	1.524
White sucker	1	0.65	3	2.17	1	4.1	4	7.329	1.5	4.254	0.2	0.205
Yellow perch	19.826	40.63	29.739	34.08	171.913	136.78	16.522	50.297	77.196	68.087	40.13	25.317

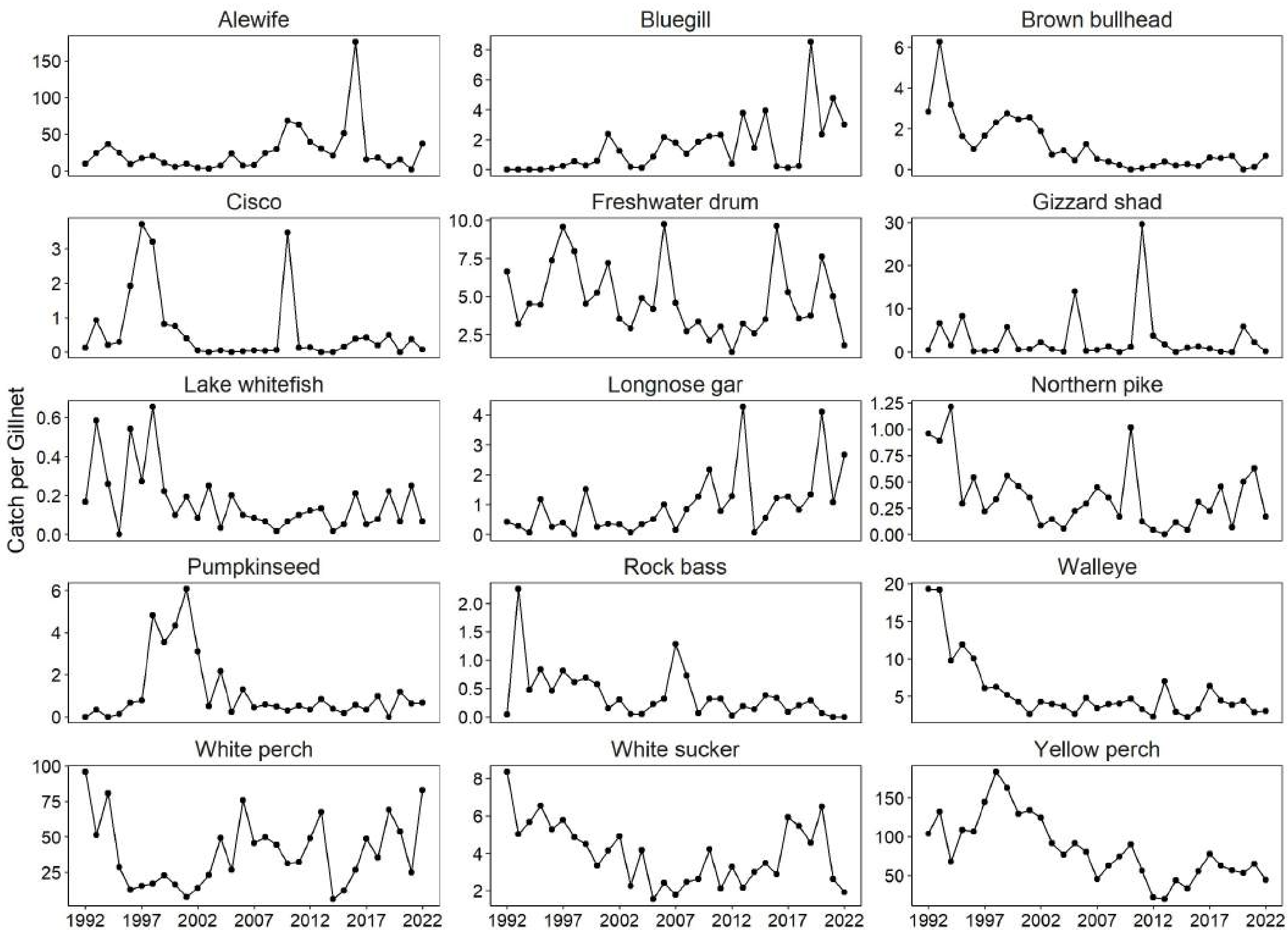


FIG. 1.1.5. Abundance trends (annual means) for the most common species caught in gill nets at three areas in the Bay of Quinte (Conway, Hay Bay and Big Bay; see Fig. 1.1.1).

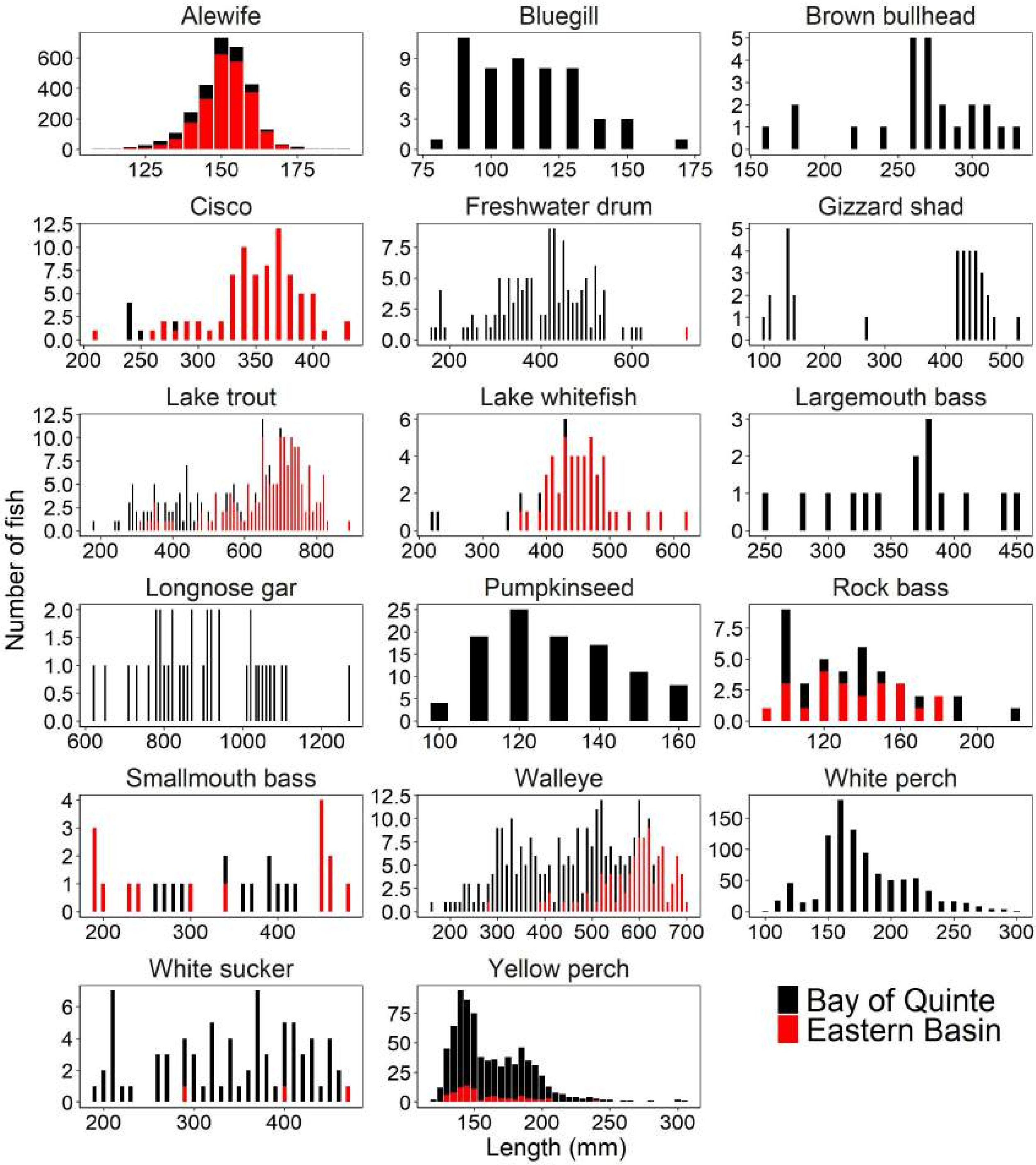


FIG. 1.1.6. Length distributions for commonly caught species in the 2022 gillnet sets in the Bay of Quinte (black) and Eastern Basin (red). Length values are grouped into 10mm bins for all species except Yellow perch and Alewife that are grouped into 5mm bins.

TABLE 1.1.8. Biological attributes across ages for five species **(Walleye, Yellow Perch, Cisco, Lake trout and Lake Whitefish)** sampled from index gill nets, by region (Bay of Quinte and Eastern Basin), 2022. Attributes include mean fork length (mm), mean round weight (g) and proportion of mature vs. immature fish.

Age		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	27
Year class		2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1995
Lake Trout																								
	Mean Fork Length	369	367	409	462	531	607	661	661	704	714	722	722	739	735	757	744	812	755	820	816		822	
	Mean Weight	806	828	1,053	1,470	2,306	3,381	4,240	4,256	5,536	5,666	5,668	5,478	5,930	5,756	6,378	6,008	7,772	6,708	7,536	8,222		8,871	
	Proportion Mature	0.13	0.16	0.4	0.5	0.73	1	1	0.86	0.93	1	1	1	1	1	1	1	1	1	1	1		1	
Lake Whitefish																								
	Mean Fork Length			298	355	434	440	439	430	451	477	463	473	441		505				569				581
	Mean Weight			350	466	955	1,036	1,013	954	1,205	1,404	1,177	1,376	1,342		1,358				2,406				2,754
	Proportion Mature			0.25	0	1	1	1	1	1	1	1	1	1		1				1				1
Cisco																								
	Mean Fork Length	286	276	309	338	368	315	363	367	340	383	379		387										
	Mean Weight	286	271	393	451	606	359	601	599	470	753	603		703										
	Proportion Mature	0.67	0.75	1	1	1	1	1	1	1	1	1		1										
Yellow Perch																								
	Mean Fork Length	139	143	154	168	194	242	235	296															
	Mean Weight	42	44	53	70	116	236	207	374															
	Proportion Mature	0	0.38	0.56	0.68	0.88	1	1	1															
Walleye																								
	Mean Fork Length	236	331	414	481	539	542	553	592	656	616	650	631		635	631	599	601	594	618	686	655		
	Mean Weight	138	383	832	1,298	2,128	2,074	2,230	2,733	3,775	3,034	3,788	3,405		3,470	3,177	2,865	2,900	2,794	3,214	4,211	2,992		
	Proportion Mature	0	0.12	0.32	0.89	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1		

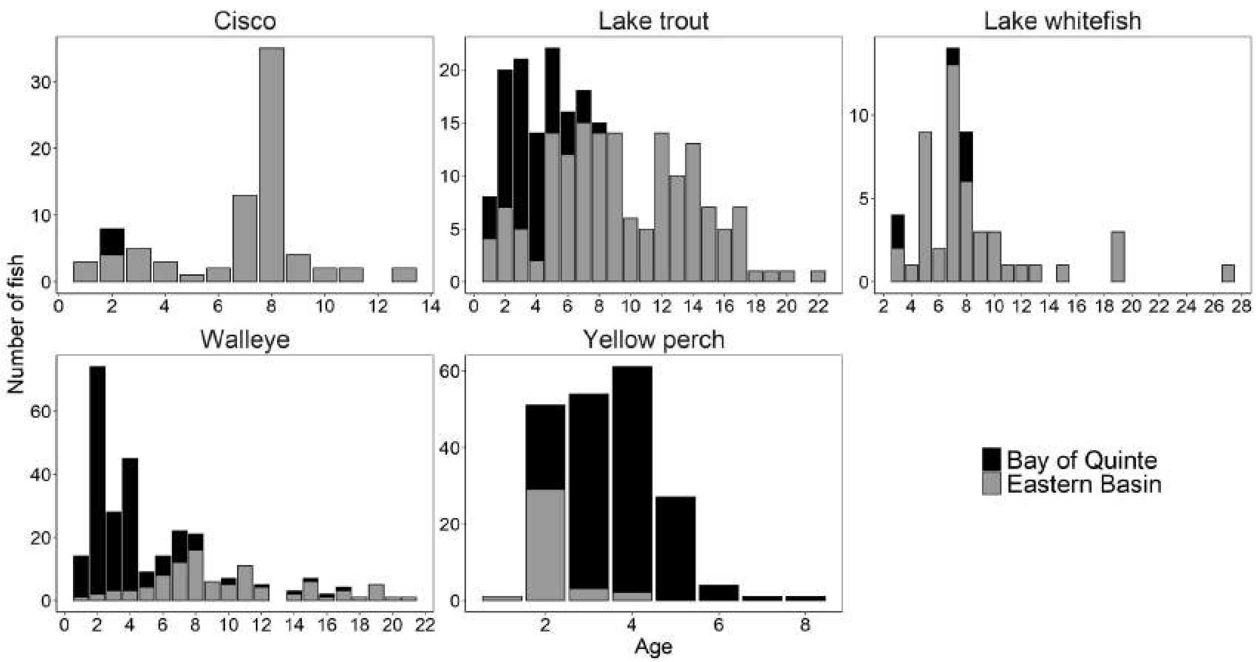


FIG 1.1.7. Age distribution of five species **(Walleye, Yellow Perch, Cisco, Lake trout and Lake Whitefish)** sampled from index gill nets by region (Bay of Quinte and Eastern Basin), 2022.

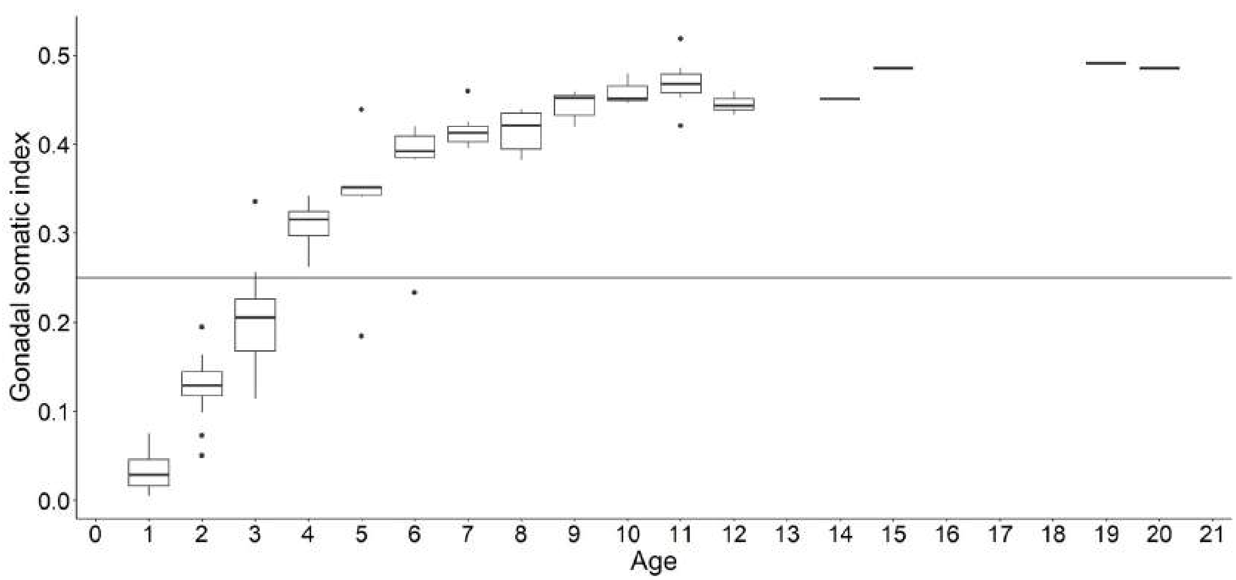


FIG 1.1.8 Mean GSI across ages of female **Walleye** sampled from 2022 gillnets. GSI = gonadal somatic index calculated for females only as log10 (gonad weight + 1)/log10(weight). Note that a GSI greater than approximately 0.25 indicates a mature female.

1.2 Lake Ontario and Bay of Quinte Fish Community Index Trawling

S. Beech, 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. Starting in 2016, 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; see Sections 1.6 and 1.7). Since 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; see Sections 1.6 and 1.7).

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. One to four replicate ¼ mile trawls are made during each visit to each site. The 2022 trawl sampling design is shown in Table 1.2.2.

Twenty species and nearly 26,000 fish were caught in 21 trawls in 2022 (Table 1.2.3). Alewife (42%), Rainbow Smelt (31%) and Yellow Perch (9%) collectively made up 82% of the catch by number. Species-specific catches in during 2022 trawling are shown in Table 1.2.3.

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	2" knotted nylon
	1.5" knotted black nylon	(chafing gear)
	1" knotted black nylon	
Codend Mesh Size	0.5" knotted white nylon	0.5" knotless white nylon
Remarks:	Fishing height 2.0 m	Fishing height 1.9 m
	FISHNET gear dimensions	FISHNET gear dimensions
	as per Casselman 92/06/08	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

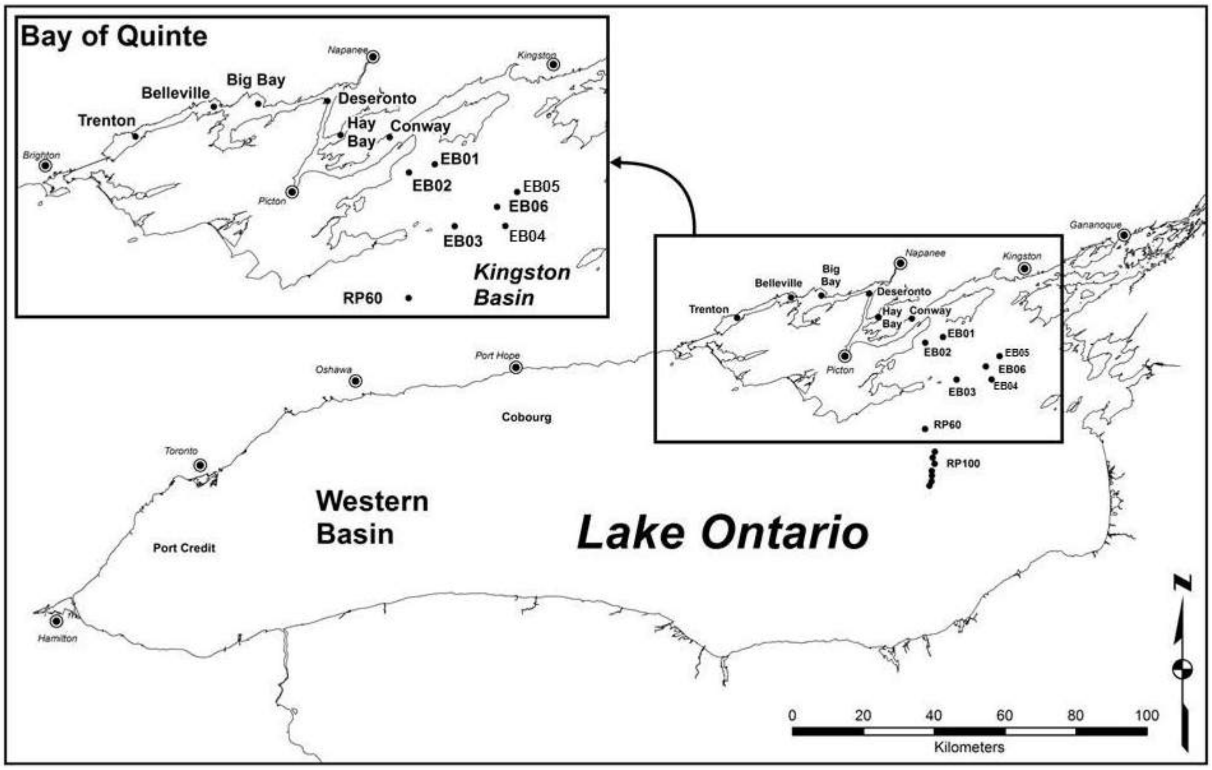


FIG. 1.2.1. Map of north eastern Lake Ontario. Shown are eastern Lake Ontario and Bay of Quinte fish community index bottom trawling site locations.

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 202 only, 1 replicate trawl was conducted except 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	7
Kingston Basin	Eastern Basin (EB)	EB02	30	1	1 x 5 minute	440280	765120	1	Aug 1-Sep 9	1972	51
Kingston Basin	Eastern Basin (EB)	EB03	21	1	4 x 5 minute	435780	764810	4	Aug 1-Sep 9	1972	51
Kingston Basin	Eastern Basin (EB)	EB04	35	1	1 x 5 minute	435680	763700	1	Aug 1-Sep 9	2016	7
Kingston Basin	Eastern Basin (EB)	EB05	33	1	1 x 5 minute	440110	763540	1	Aug 1-Sep 9	2016	7
Kingston Basin	Eastern Basin (EB)	EB06	35	1	1 x 5 minute	435940	763910	1	Aug 1-Sep 9	1972	51
Bay of Quinte	Conway (LB)	BQ17	21	2	1 x 6 minutes	440650	765420	2	Aug 1-Sep 9	1972	51
Bay of Quinte	Hay Bay (MB)	BQ15	5	2	1 x 6 minutes	440650	770175	2	Aug 1-Sep 9	1972	51
Bay of Quinte	Deseronto (UB)	BQ14	5	2	1 x 6 minutes	441000	770360	2	Aug 1-Sep 9	1972	51
Bay of Quinte	Big Bay (UB)	BQ13	5	2	1 x 6 minutes	440975	771360	2	Aug 1-Sep 9	1972	51
Bay of Quinte	Belleville (UB)	BQ12	5	2	1 x 6 minutes	440920	772010	2	Aug 1-Sep 9	1972	51
Bay of Quinte	Trenton (UB)	BQ11	4	2	1 x 6 minutes	440600	773120	2	Aug 1-Sep 9	1972	51

Lake Ontario

Kingston Basin (Table 1.2.4)

Bottom trawls were conducted at six sites in Kingston Basin in August 2022. 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 Table 1.2.4 (EB02, EB03, and EB06 prior to 2016 and EB01-EB06 after 2015). Trend through time catches for the most commonly caught species are shown in Fig. 1.2.2.

Bay of Quinte

Conway, Hay Bay, Deseronto, Big Bay, Belleville, and Trenton (Table 1.2.5)

Bottom trawls were conducted six sites in the Bay of Quinte in August 2022. Species-specific catch per trawl at each site is shown in Table 1.2.5. 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 and Fig. 1.2.4. All species show significant abundance changes over the long-term.

Species Highlights

Length distributions for the most abundant species caught in bottom trawls in 2022 are shown in Fig. 1.2.5. Catches of age-0 fish for selected species and locations are shown in Figs. 1.2.6-1.2.9. Additional age information is provided for all Walleye captured in 2022 in Table 1.2.6.

Cisco and Lake Whitefish

Only two Cisco (age-7 and age-8) and one Lake Whitefish (age-1) were caught during summer bottom trawling. No age-0 Cisco or Lake Whitefish were captured at the EB03 or BQ17 (Conway) sites including the second site visits conducted during the fall trawling program (Figs. 1.2.6 and 1.2.7).

Yellow Perch

Seventy-five age-0 Yellow Perch were caught at five of six trawl sites in the Bay of Quinte. Catch per trawl was low compared to previous years (Fig. 1.2.8).

TABLE 1.2.3. Species-specific total bottom trawl catch and biomass in summer 2022. Standard biomass is calculated by standardizing trawls to 6 minutes (¼ mile) in the Bay of Quinte and 12 minutes (½ mile) in the Lake Ontario. Frequency of occurrence (FO) is the number of trawls, out of a possible 21, in which each species was caught. Mean weight of each species is also provided.

Species	FO	Catch	Biomass (kg)	Standard Biomass (kg)	Mean Weight (g)
Alewife	17	12,448	72.8	136	10
Gizzard shad	7	2,241	9.5	9	9
Lake trout	1	1	5.1	13	5110
Lake whitefish	1	1	0.1	0	69
Lake herring	1	2	0.9	2	471
Rainbow smelt	10	4,453	22.9	57	4
White sucker	4	8	5.5	5	543
Emerald shiner	1	4	0.0	0	4
Spottail shiner	10	273	1.8	2	6
Brown bullhead	6	85	10.3	10	300
Channel catfish	-	1	- -	-	
Trout-perch	7	184	62.2	62	198
White perch	10	1,752	24.3	24	16
White bass	2	4	0.4	0	94
Rock bass	2	15	0.1	0	4
Pumpkinseed	8	275	10.4	10	43
Bluegill	7	133	3.3	3	28
Largemouth bass	4	24	0.2	0	10
Lepomis sp.	6	251	0.1	0	0
Yellow perch	12	3,264	18.7	19	8
Walleye	10	88	10.5	11	140
Logperch	2	8	0.0	0	1
Brook silverside	2	7	0.0	0	1
Round goby	14	686	2.1	4	3
Freshwater drum	9	108	8.9	9	231

Walleye

Fifty-six age-0 Walleye were caught in five of six trawl sites in the Bay of Quinte (Table 1.2.6). Overall, age-0 catch per trawl was considered “good” and exceed 2021 catches (Fig. 1.2.9). Additional age information is provided in Table 1.2.6.

TABLE 1.2.4. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at six sites in the Eastern Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls (one for all sites except EB03 which was sampled four times).

	EB01		EB02		EB03		EB04		EB05		EB06	
Species	2022	2016-2020 mean	2022	2011-2021 mean	2022	2011-2021 mean	2022	2016-2020 mean	2022	2016-2020 mean	2022	2011-2021 mean
Alewife	156	1.10	832	58.37	195.25	21.46		2.16		42.15		0.72
Chinook salmon						0.01						
Cisco				0.01		0.26						
Deepwater sculpin				0.07								0.20
Freshwater drum						0.09						
Lake trout		0.03		0.26		0.01				0.02	1.00	0.04
Lake whitefish		0.12		0.01		0.17						0.01
Rainbow smelt	3.00	0.22	46	9.14	1088	582.07	2.00	0.38	1.00	1.30		15.51
Round goby	342	20.79	77	244	7.50	2764.22		16.82		24.95		158.32
Sculpin sp.												0.08
Slimy sculpin												0.03
Spottail shiner						0.05						
Trout-perch						0.01						
Walleye						0.08						
White perch		0.04										
Yellow perch				0.10		0.01				0.04		

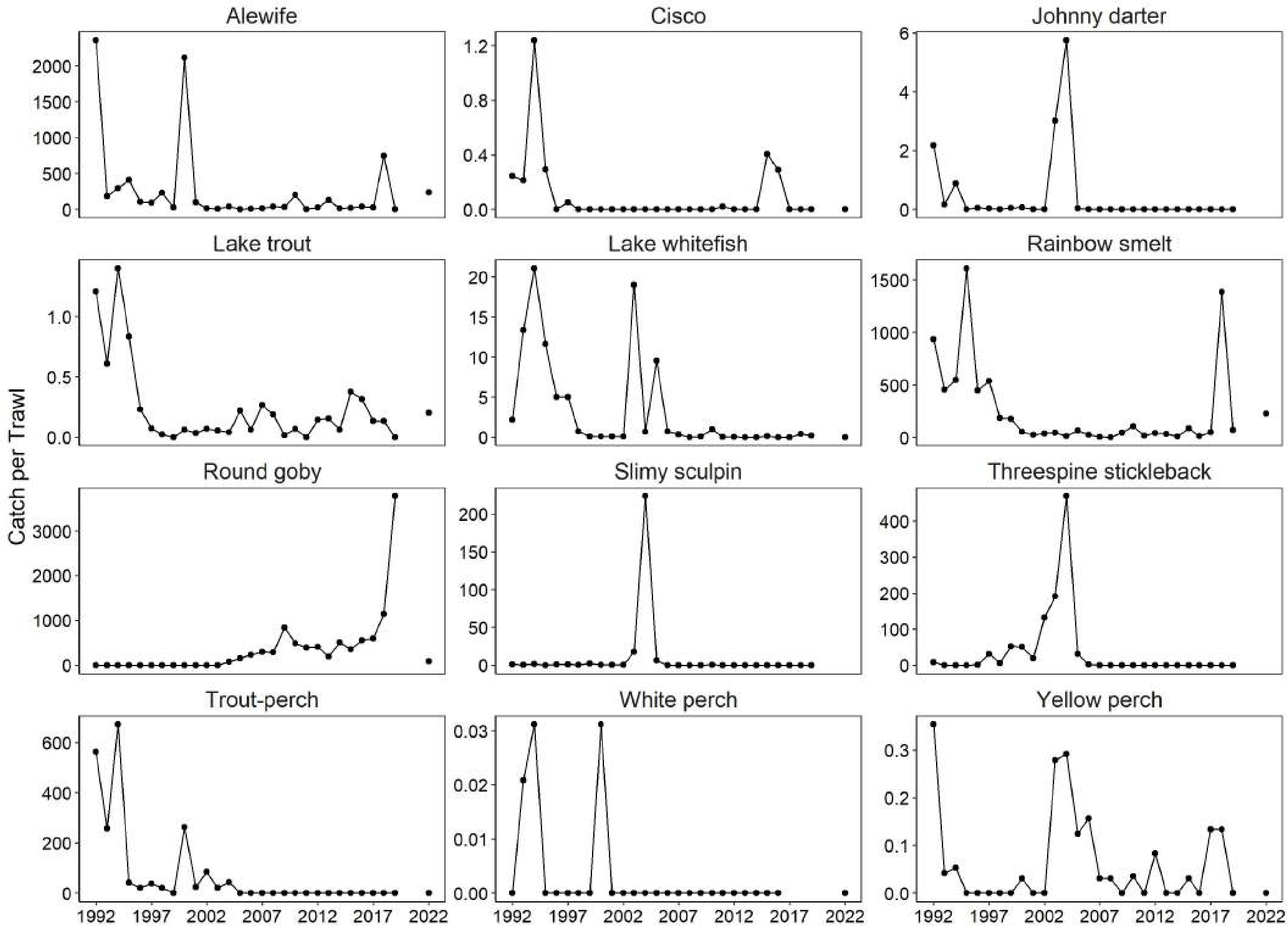


FIG. 1.2.2. Abundance trends (annual means) for the most common species caught in bottom trawls at three to six sites in the Kingston Basin, eastern Lake Ontario (EB01, EB02, EB03, EB04, EB05, EB06); see Fig. 1.2.1).

TABLE 1.2.5. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at 6 sites in the Bay of Quinte . Catches are the mean number of fish observed for the two trawls visits.

	Trenton		Belleville		Big Bay		Deseronto		Hay Bay		Conway	
Species	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean	2022	2011-2020 mean
Alewife	138.50	90.44	263.5	3.30	112			0.11	4748.	0.01		0.01
American eel		1.45		0.01		16.65						12.73
Banded killifish		32.62										
Black crappie		39.05		0.11		0.86		2.14		1.90		
Bluegill	37.00					5.51		11.16		5.18		4.54
Brook silverside		185.01		197.44		1.98		1.61		10.05		
Brown bullhead	5.50		5.00	21.21		1.45				0.03		
Brown trout												0.20
Burbot		0.35								0.09		0.01
Channel catfish				0.31				0.01		5.98		
Chinook salmon												76.77
Common carp		27.76		0.08				2.63		0.03		
Common shiner										0.55		
Emerald shiner								1.51				
Fathead minnow										0.05		
Freshwater drum	1.50	0.01	12.50	0.01	5.50	9.52		0.03		2.53		533.77
Gizzard shad	0.00	0.05	979			0.01		12.86		0.05		3.65
Ictalurus sp.								40.86				
Johnny darter		1.30		415.66		0.23		1.61				135.11
Lake herring										0.01		11.88
Lake trout												8.31
Lake whitefish												12.51
Largemouth bass	11.00			19.46		0.13		324.52		88.06		
Lepomis sp.	7.00		43.50	46.96	75.00	0.94		533.13		115.65		
Logperch	0.00	405.53		0.18		1.20		0.21				
Longnose gar				0.74				0.10				
Mooneye		0.36		32.93								
Morone sp.				0.01								
Moxostoma sp.						0.08						46.31
Northern pike		11.58		0.25		0.01				26.54		
Pumpkinseed	46.50	0.03	11.00					56.16		8.96		
Rainbow smelt		0.08		0.09		5.78		109.79		9.59	24.50	
Rock bass	7.50	9.20		9.16		0.01						0.03
Round goby	5.00	65.60	13.50	59.62		0.46				0.06	96.00	1.24
Sculpins				0.01								
Sea lamprey				7.31								
Shorthead redhorse		0.33										
Silver lamprey												0.03
Silver redhorse		0.16										
Smallmouth bass		0.76				0.20		3.55		2.84		
Spottail shiner	55.00	139.16	8.00	1.43	6.00	0.38		0.96	52.50	0.28		1.48
Sunfishes				0.03				54.22		50.05		
Tessellated darter		1.31						0.05				
Threespine stickle-back												0.01
Trout-perch		0.03	36.50	4.96	14.50			0.15		1.61		0.08
Walleye		11.39	5.00	6.34	10.50	530.13		0.00	6.50			1.16
White bass				7.93				0.01				0.01
White perch	64.00	1.75	162.5		106	172.90		4.95	155.5			57.25
White sucker	1.00	3.50		436.27		0.71		0.21		0.66		
Yellow perch	724.50	111.88	242	6.78	100	46.32		563.13	177.0	123.05	34.50	8.18

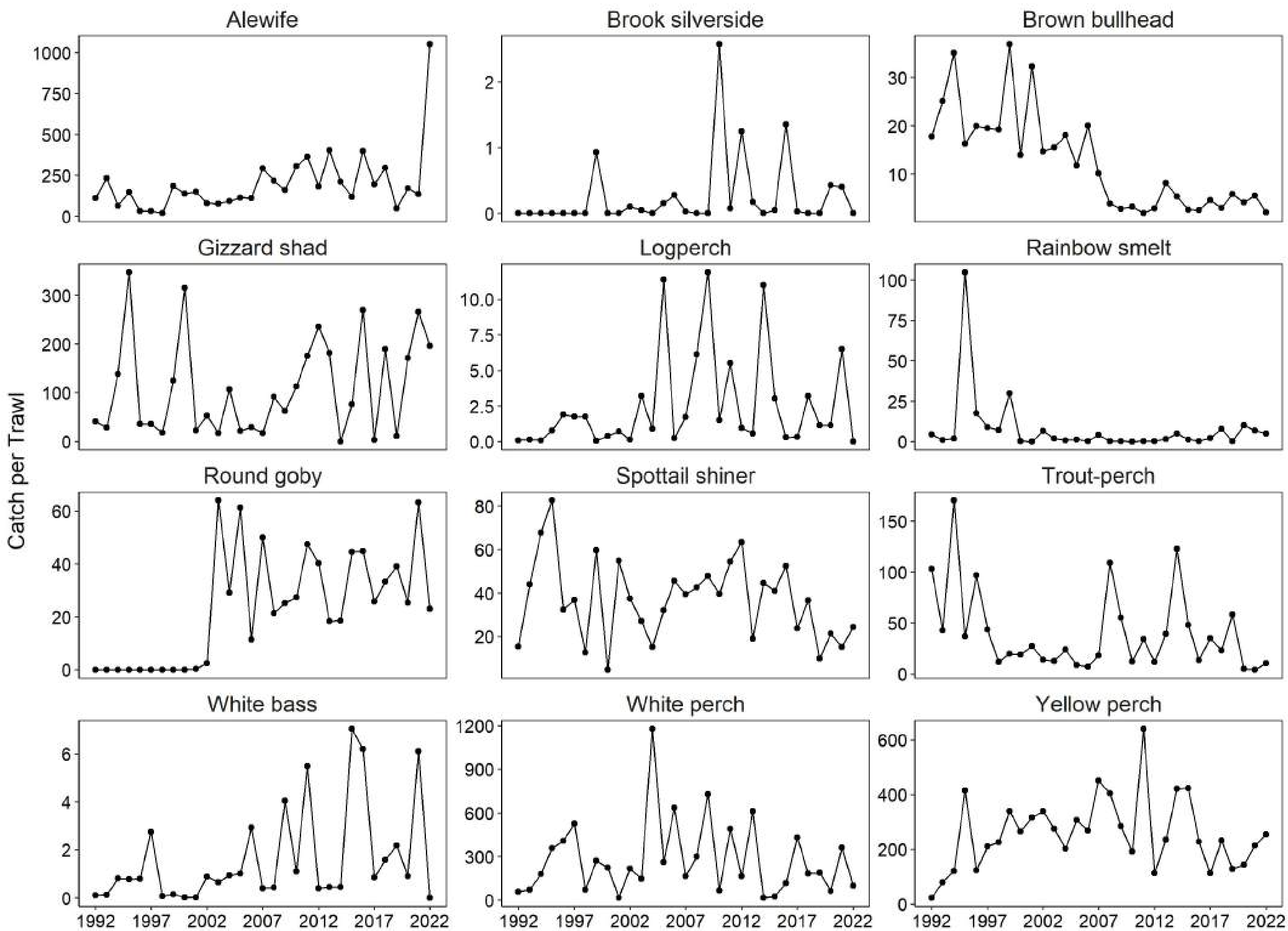


FIG. 1.2.3. Abundance trends (annual means) for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.2.1).

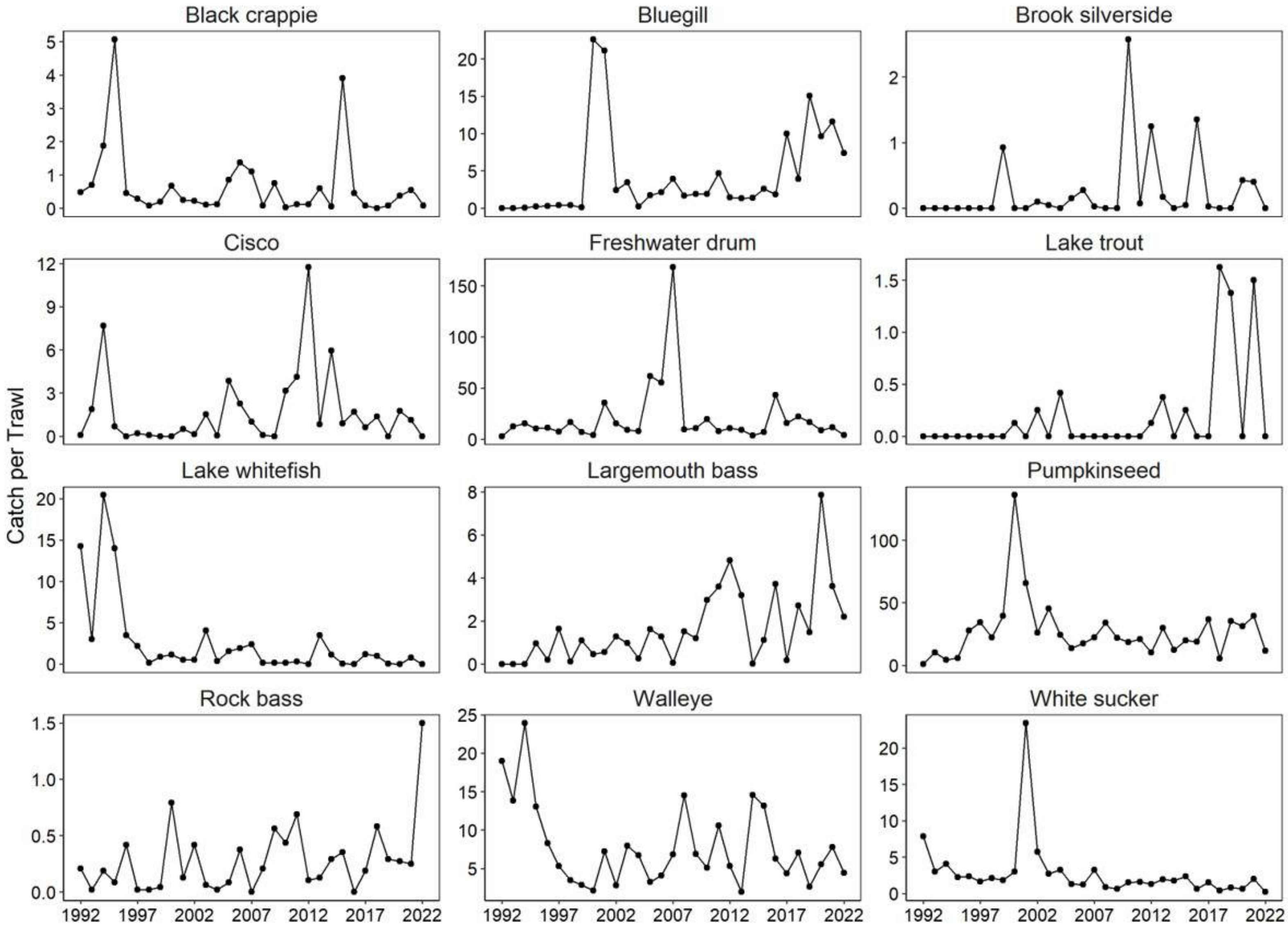


FIG. 1.2.4. Abundance trends for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.2.1).

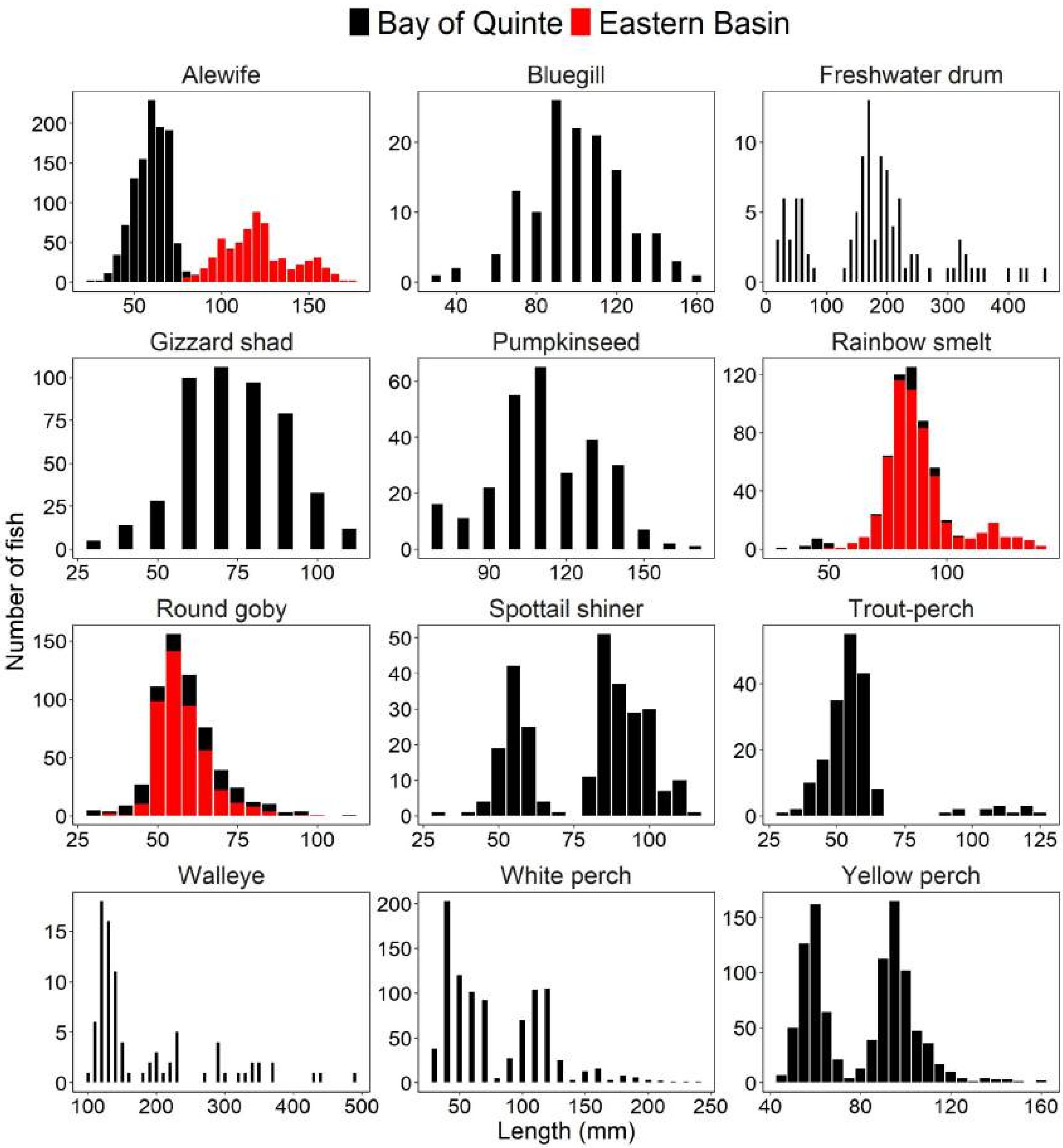


FIG. 1.2.5. Length distributions for the most abundant species caught in trawls in the Eastern Basin (red) and Bay of Quinte (black) in 2022. Length values were grouped into 10mm bins for all species except Yellow perch, Spottail shiner, Rainbow smelt, Round goby, Trout perch and Alewife that were grouped into 5mm bins.

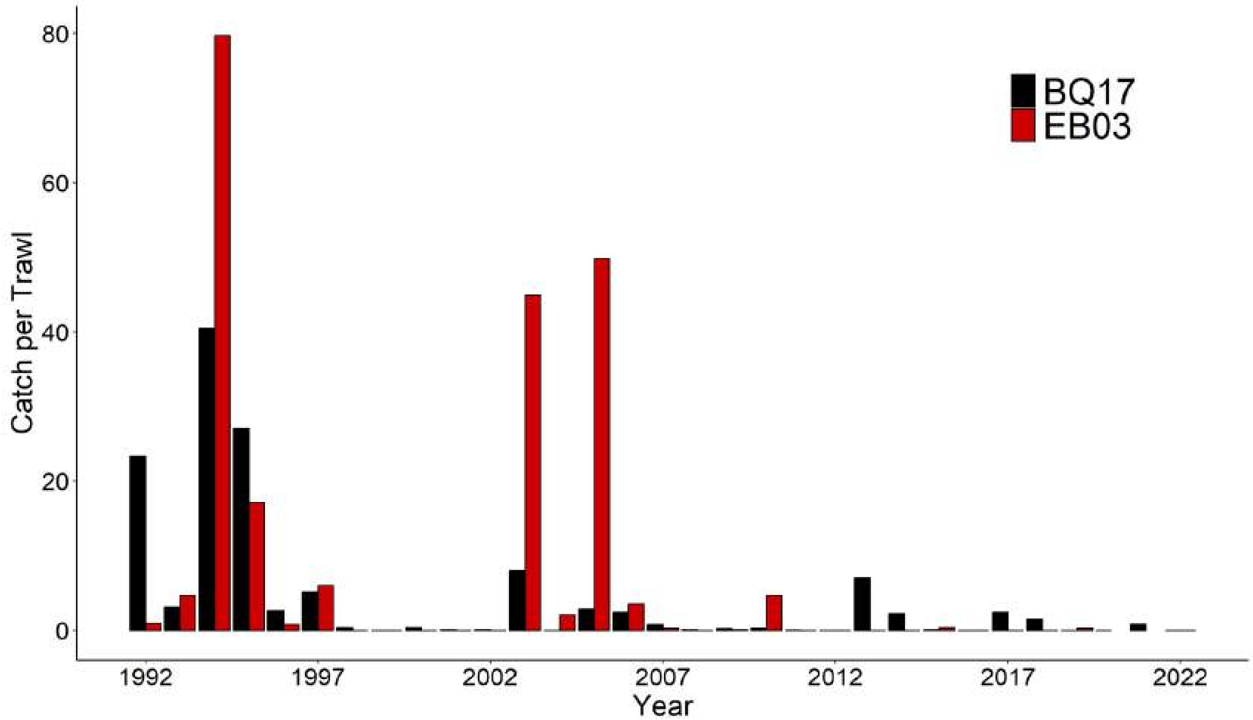


FIG. 1.2.6. Mean catch-per-trawl of **age-0 Lake Whitefish** at two sites, Conway in the lower Bay of Quinte and EB03 near Timber Island in eastern Lake Ontario, 1992-2022. Four replicate trawls on each of two to four visits were made at EB03. Only one replicate per visit to BQ17 was completed starting in 2022. Distances of each trawl drag were 1/4 mile for Conway and 1/2 mile for EB03. No trawls were conducted at EB03 in 2020 or 2021.

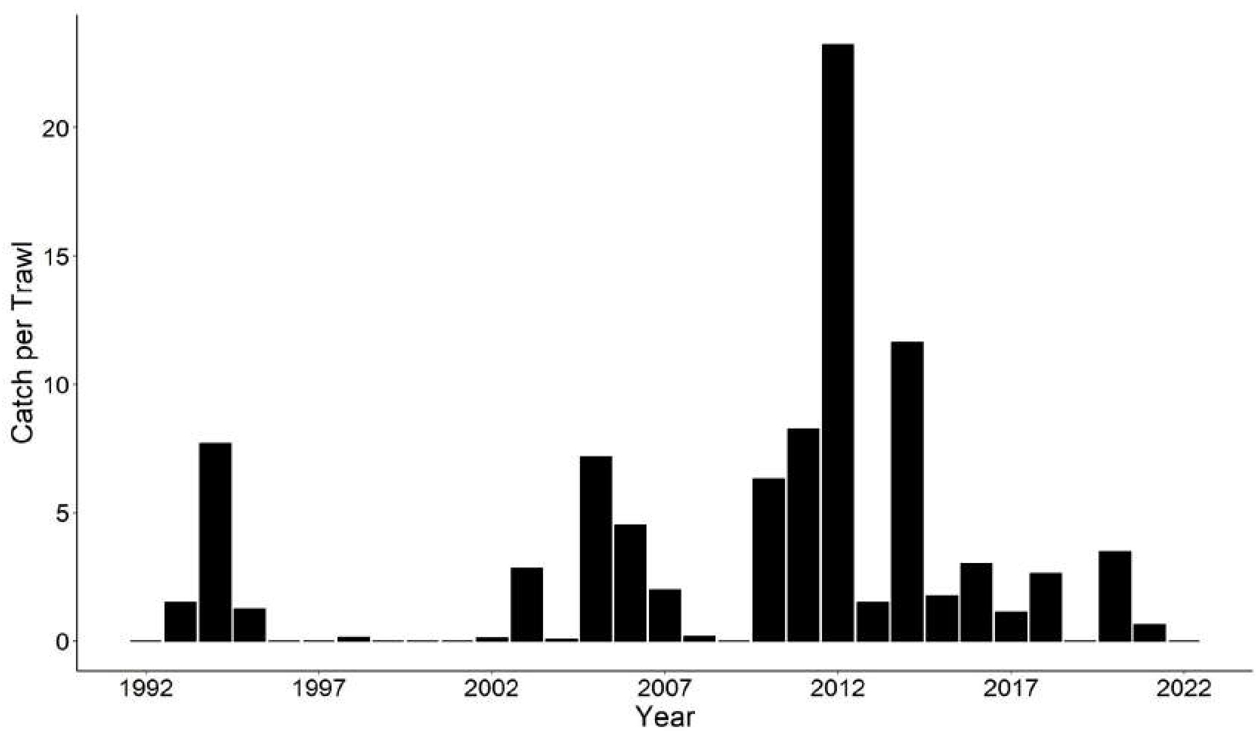


FIG 1.2.7. Mean catch-per-trawl of **age-0 Cisco** at Conway in the lower Bay of Quinte, 1992-2022. In pervious years, four replicate trawls on each of two to four visits during August and early September were made at the Conway site totalling 8-12 trawls per year. This was reduced to one replicate per visit in 2022. Distance of each trawl drag was 1/4 mile.

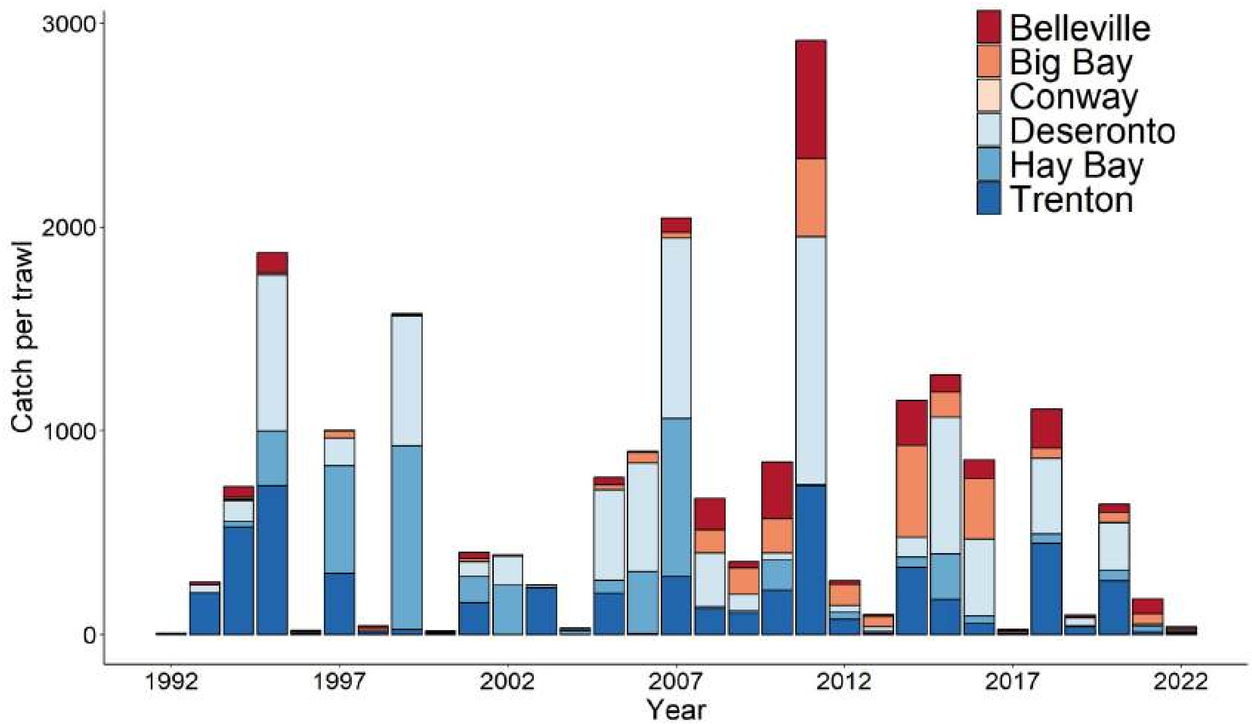


FIG. 1.2.8. Mean catch-per-trawl of **age-0 Yellow Perch** at six Bay of Quinte sites, 1992-2022. One-four trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile. In previous years 48-52 trawls were conducted per year but in 2022 this was reduced to 12 trawls due to the adjustment from 4 to 1 replicate trawls per visit.

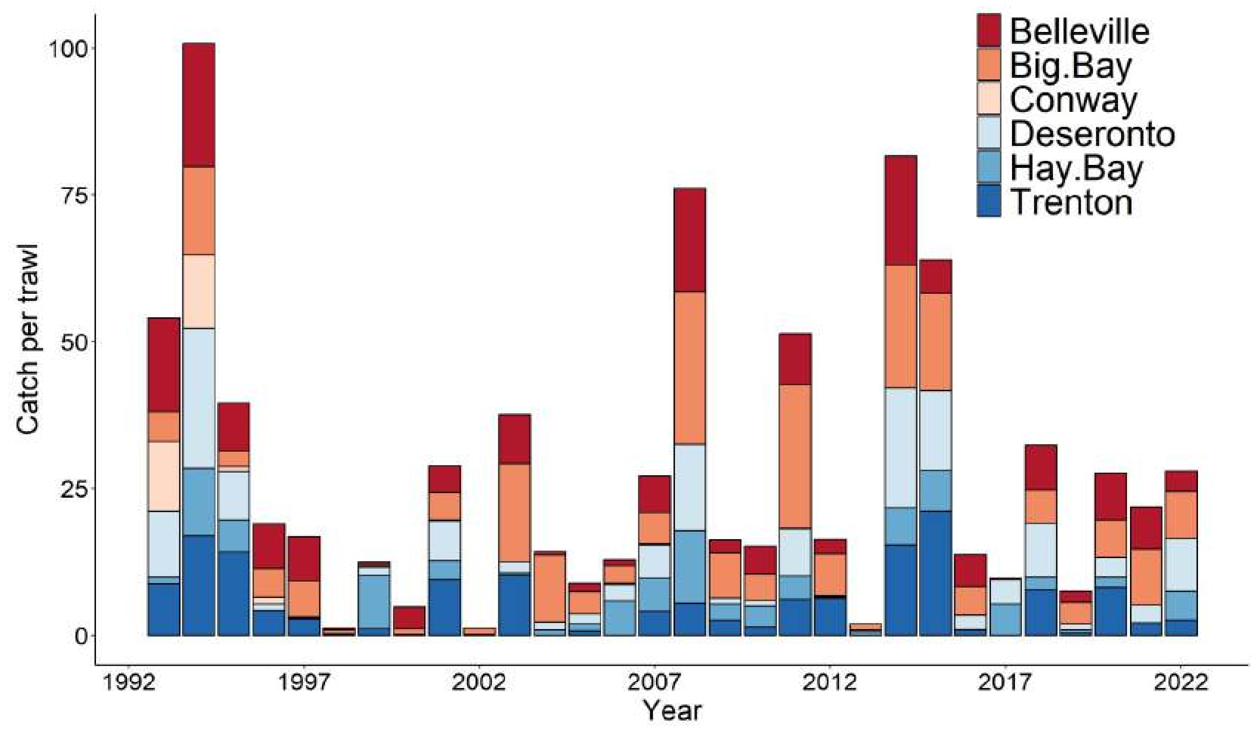


FIG. 1.2.9 Mean catch-per-trawl of **age-0 Walleye** at six Bay of Quinte sites, 1992-2022. One-four replicate trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile. n previous years 48-52 trawls were conducted per year but in 2022 this was reduced to 12 trawls due to the adjustment from 4 to 1 replicate trawls per visit.

TABLE 1.2.6. Age distribution of 87 **Walleye** sampled from summer bottom trawls, Bay of Quinte, 2022. Also shown are mean fork length, mean weight, mean GSI (females), proportion female (of fish in which sex could be determined) and proportion mature. Fish that were not aged and had a fork length of less than 154 mm fork length were assigned an age of 0.

Age	0	1	2	3	4
Year class	2022	2021	2020	2019	2018
Number	56	14	13	3	1
Mean weight (g)	20.04	90.49	316.51	766.06	1276.27
Mean length (mm)	128	210	314	407	493
Proportion female	0.3	0.36	0.46	0.67	1
Proportion mature	0	0	0	0.33	1
Mean GSI (females)	0.01	0.04	0.12	0.20	0.30

1.3 Lake Ontario Nearshore Community Index Netting

S. Beech, Lake Ontario Management Unit

In 2022, Nearshore Community Index Netting (NSCIN) was completed at the Upper Bay of Quinte, Toronto Harbour, and Weller's Bay (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 Bay of Quinte (Deseronto to Lake Ontario) in 2002. In 2006, the NSCIN program was conducted on Hamilton and Toronto Harbours thanks to partnerships developed with Fisheries and Oceans Canada and the Toronto and Region Conservation Authority. NSCIN was further expanded to other Lake Ontario 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 (e.g. Index of Biotic Integrity or IBI) and fish community (e.g. proportion of piscivore biomass or PPB) 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.

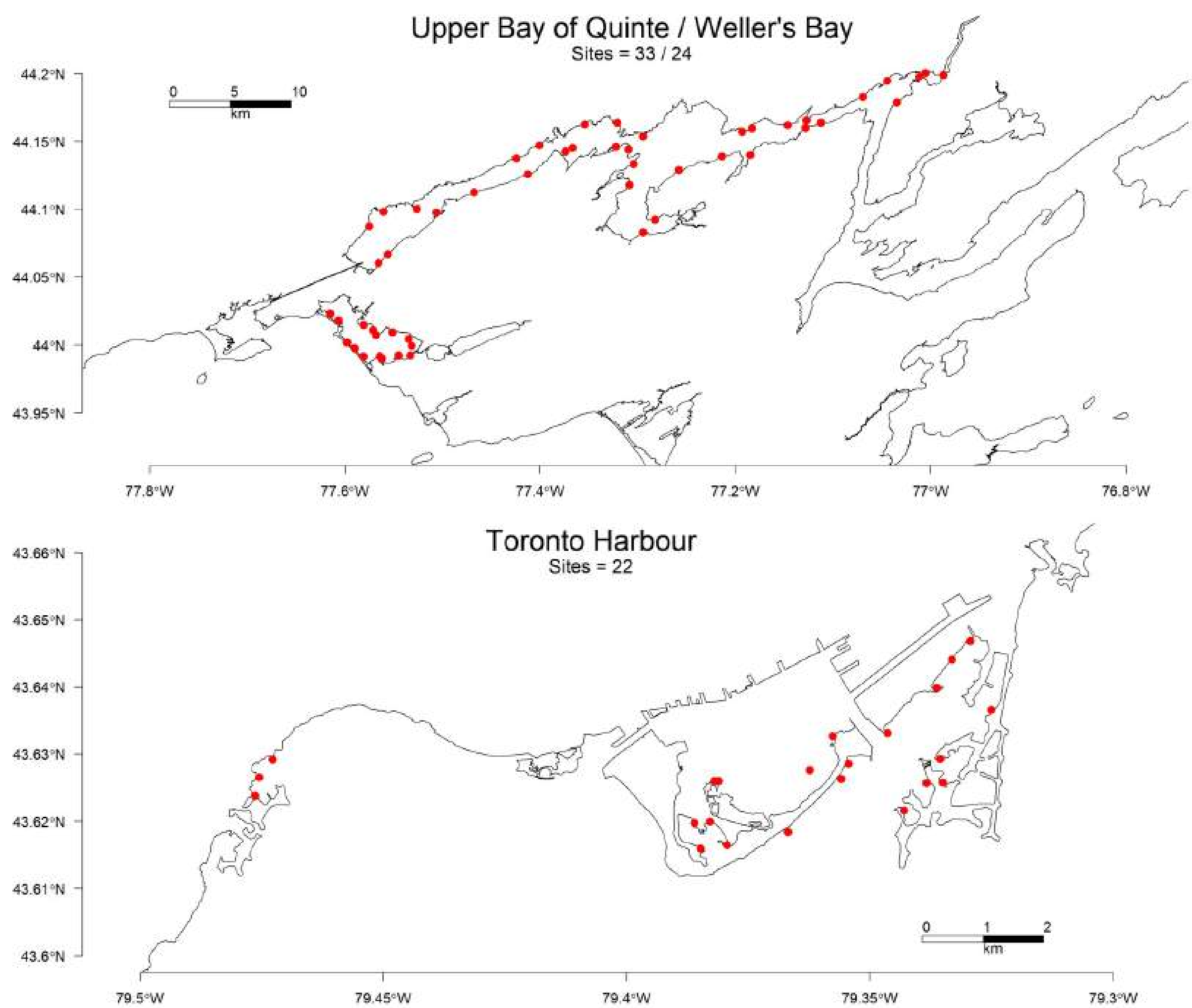


FIG. 1.3.1. Map of NSCIN trap net locations on Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte, 2022.

Survey information and basic catch statistics for the three nearshore areas sampled in 2022 are given in Tables 1.3.2 and 1.3.3. Age and length distribution is displayed in Figs. 1.3.4 and 1.3.5. Abundance trends for selected species are presented in Fig. 1.3.2.

Weller's Bay

Twenty-four trap net sites were sampled on Weller's Bay from Aug 30—Sept 9, 2022 (Table 1.3.2). Just over 1500 fish comprising 21 species were captured (Table 1.3.3). The most abundant species by number were Bluegill (975), Rock Bass (130), and Pumpkinseed (107). Six American Eel were captured.

Toronto Harbour

Partnership project with Toronto and Region Conservation Authority

Twenty-four trap net sites were sampled on Toronto Harbour from Sept 13 – Sept 21, 2022, (Table 1.3.2). Two nets were compromised and excluded from the data summary and analysis. Just over 4000 fish comprising 21 species were captured (Table 1.3.3). The most abundant species by number were Brown Bullhead (2676), Bluegill (453), Pumpkinseed (275), Yellow Perch (201) and Rock Bass (106). One American Eel was caught.

Walleye have been stocked into Toronto Harbour in 2017 and 2019 in an effort to establish a native predatory fish. Evidence of survival of stocked Walleye was minimal in the 2019 and

TABLE 1.3.1. Annual NSCIN trap net schedule for Lake Ontario nearshore areas, 2006-2022. The numbers of trap net samples at each area in each year are indicated.

Year	Hamilton Harbour	Toronto Harbour	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
2022		24		24				36			
2021	24										
2020											
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 2022 NSCIN trap net program on Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte. Shown for each embayment are the survey dates, the range of observed surface water temperatures, the total number of trap net lifts, mean depth, and the number of trap net lifts broken down by observed substrate and cover types for nets included in the analysis.

		Upper Bay of Quinte	Weller's Bay	Toronto Harbour
Survey dates		Sep 7-30	Aug 30-Sep 9	Sep 13-21
Water temp (°C)		14.5-23.3	20.1-23.9	19.6-21.3
Number of lifts		36	24	24
Average depth		2.3	2.0	2.6
Lifts by substrate type	Hard	27	23	13
	Soft	6	0	9
Lifts by degree cover	None	1	4	10
	Low (1-25%)	7	10	2
	Med (26-75%)	14	9	9
	High (76-100%)	1	4	10

2022 trap net survey but will continue to be monitored.

Upper Bay of Quinte

Thirty-six trap net sites were sampled on the Upper Bay of Quinte from September 7 - 30, 2022 (Table 1.3.2), however, three net sets were compromised and were excluded from the data summary and analysis. Just under 8,000 fish comprising 26 species were captured (Table 1.3.3). The most abundant species by number were Bluegill (4,759), Pumpkinseed (1,639), Brown Bullhead (308), White Perch (243), Black Crappie (200), and Largemouth Bass (197). Forty -five 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 2022 were 0.27, 0.32, and 0.64 in Toronto Harbour, Upper Bay of Quinte and Weller's Bay, respectively.

TABLE 1.3.3. Species-specific catch in the 2022 NSCIN trap net program on Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte. Statistics shown include arithmetic 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).

	Toronto Islands			Upper Bay of Quinte			Weller's Bay		
	Arithmetic mean	% RSE	Mean Length	Arithmetic mean	% RSE	Mean Length	Arithmetic mean	% RSE	Mean Length
Alewife	2.23	24	139	0.03	100	160	0.13	72	150
American eel	0.05	111		1.36	23		0.25	56	
Black crappie	3.09	31	165	6.06	18	210	0.04	95	170
Bluegill	20.59	55	125	144.21	16	133	40.63	27	129
Bowfin	1.59	27	610	1.55	23	600	1.29	25	612
Brown bullhead	121.64	47	253	9.33	21	272	2.13	29	289
Carps and minnows	0.05	111							
Centrarchidae hybrids							0.08	72	190
Channel catfish	0.05	111	620	1.12	45	525			
Common carp	1.73	44	528	0.49	25	490	0.33	48	626
Freshwater drum	0.14	51	607	1.61	27	487	0.04	95	600
Gizzard shad	0.86	29	354	1.58	88	140	0.04	95	480
Golden shiner				0.36	38	141			
Goldfish	0.18	44	295						
Greater redhorse				0.03	100	420			
Largemouth bass	2.82	34	222	5.97	23	246	2.00	26	255
Longnose gar	0.09	66	625	0.58	36	805	2.54	42	769
Northern pike	1.36	29	609	0.27	33	687	0.58	26	655
Pumpkinseed	12.50	25	118	49.67	25	142	4.46	27	148
Rainbow trout							0.04	95	310
River redhorse				0.27	40	651			
Rock bass	4.82	35	157	2.67	42	172	5.42	26	156
Shorthead redhorse				0.36	33	475			
Silver redhorse				0.39	48	501			
Smallmouth bass				0.46	35	348	1.79	31	299
Walleye	0.23	84	496	2.12	20	451	0.88	30	504
White bass				0.15	66	278			
White perch	0.14	74	198	7.36	68	186	0.08	72	245
White sucker	0.32	75	261	0.61	33	435	0.21	38	416
Yellow perch	9.14	33	172	3.12	33	191	0.54	44	183

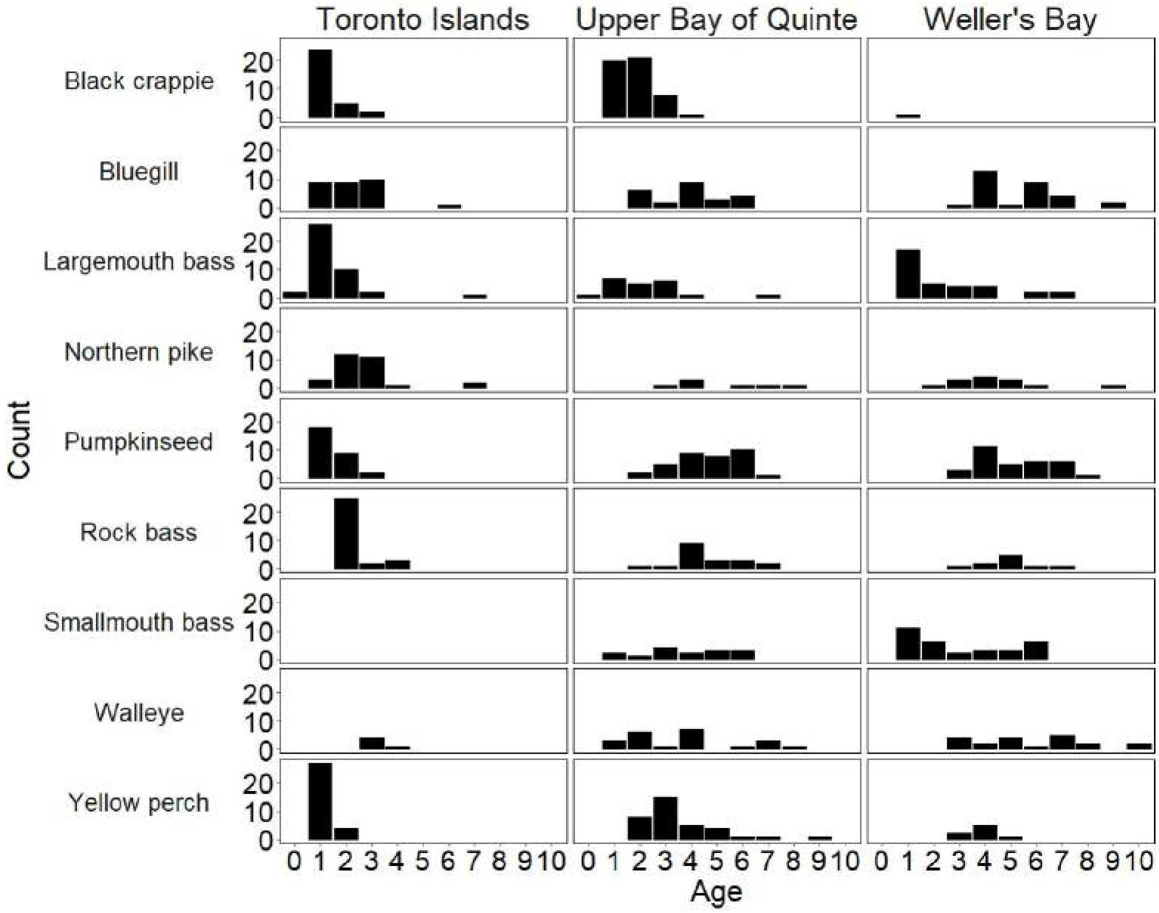


FIG. 1.3.4. Age distribution (years) of selected species caught in Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte, 2022.

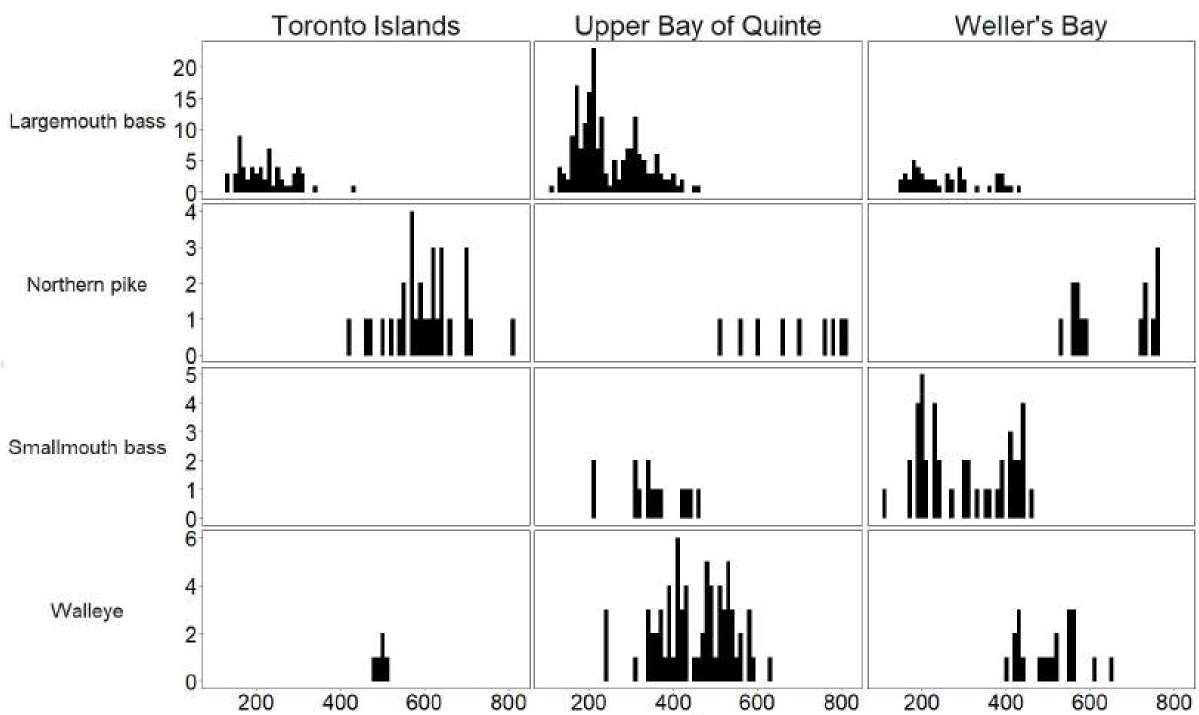


FIG. 1.3.5. Length distribution (mm) of selected species caught in Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte, 2022.

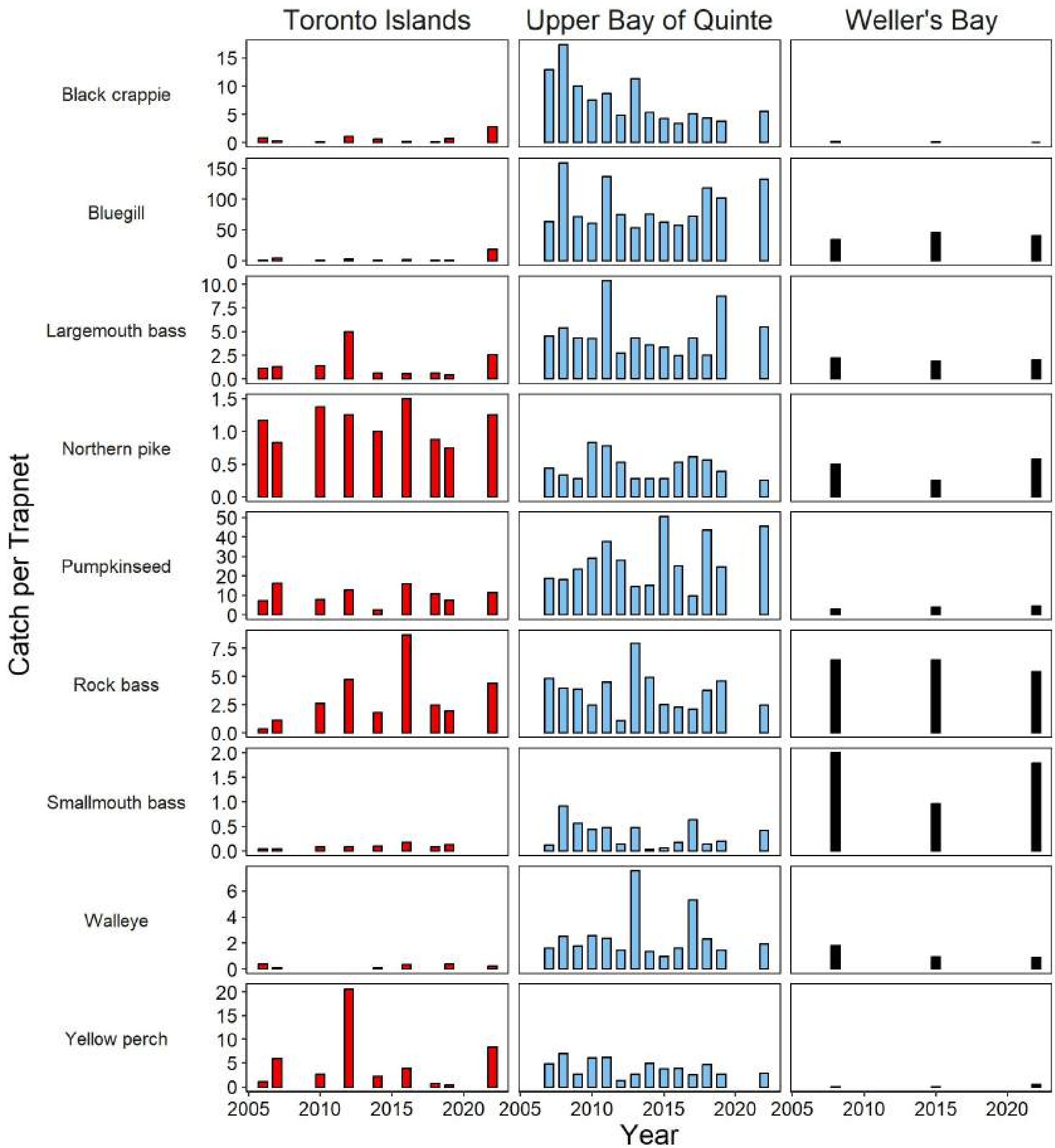


FIG. 1.3.6. Abundance trends for selected species caught in nearshore trap nets in Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte. Values shown are annual arithmetic means.

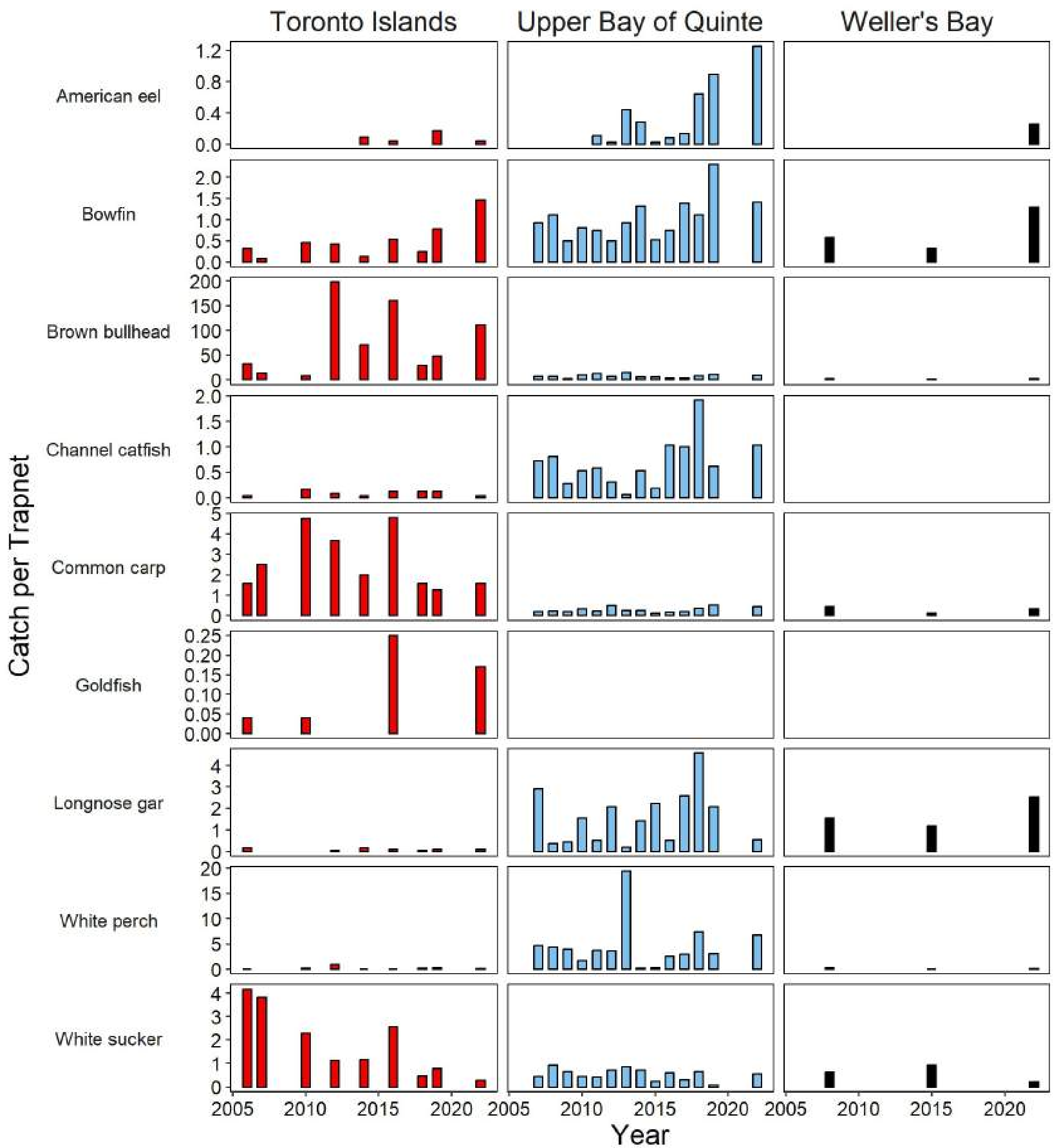


FIG. 1.3.6. (continued) Abundance trends for selected species caught in nearshore trap nets in Weller's Bay, Toronto Harbour, and the Upper Bay of Quinte. Values shown are annual arithmetic means.

The average PPB at Toronto Harbour remained below both 0.2 and that of other exposed Lake Ontario embayments (Fig. 1.3.8).

Percent Specialist Biomass

A proportion of the fish community biomass comprised of specialists (PSPE) greater than 0.40 generally indicates a healthy trophic structure. The PSPEs in 2022 were 0.25, 0.53, and 0.26 in Toronto Harbour, Upper Bay of Quinte and Weller's Bay, respectively. Toronto Harbour PSPE was similar to other exposed embayments (Fig. 1.3.9).

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 2022 were 61 (good), 72 (good) and 72 (good) for Toronto Harbour, Upper Bay of Quinte and Weller's Bay, respectively. In Toronto Harbour, the IBI increased from 45 in 2019 (fair) to 61 in 2022 (good).

The average IBI between 2006-2022 at Toronto Harbour remained below those of other exposed Lake Ontario embayments, while the average IBI scores at the upper Bay of Quinte and Weller's Bay were similar to values at other Lake Ontario sheltered nearshore areas (Fig. 1.3.7).

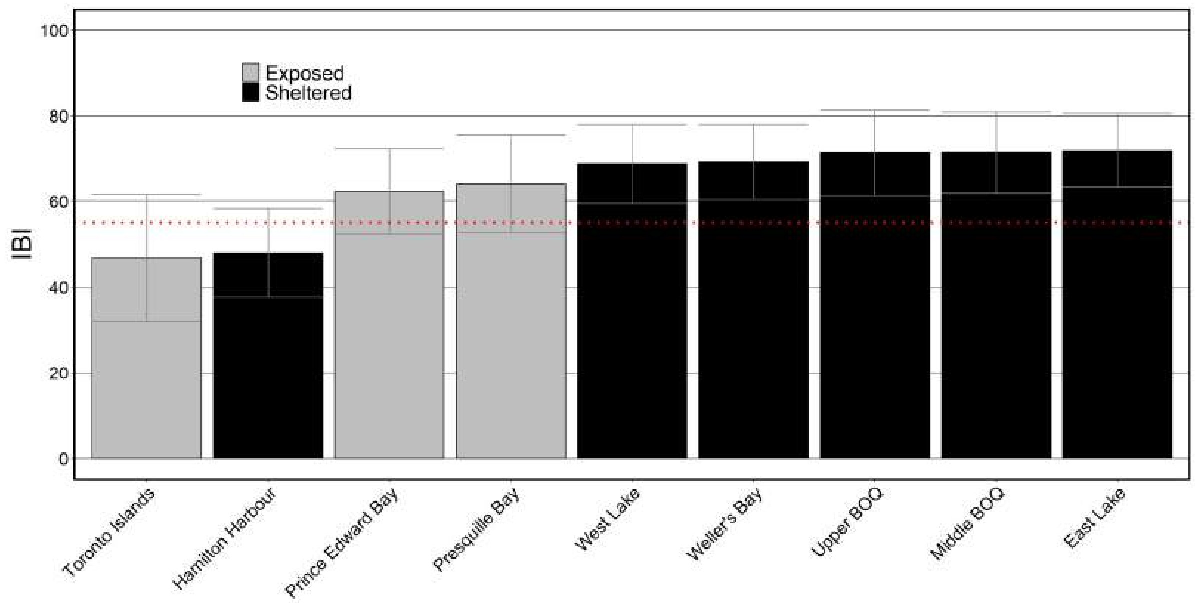


FIG. 1.3.7 Index of biotic integrity (IBI), as a measure of ecosystem health, in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2022). IBI target for Toronto Harbour is 55 (red dotted line). Error bars are ± 2SD.

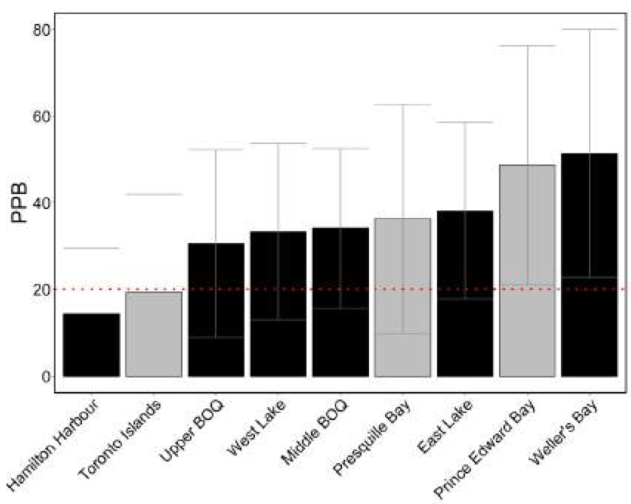


FIG. 1.3.8. Proportion of total fish community biomass represented by piscivore species (PPB) in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2022). A PPB>0.2 is depicted by a dashed line. Piscivore species included Longnose Gar, Bowfin, Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye. Error bars are ± SD.

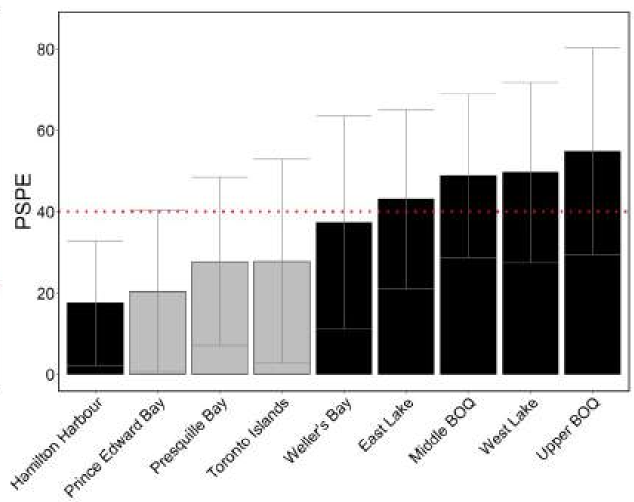


FIG. 1.3.9. Proportion of total fish community biomass represented by specialist species (PSPE) in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2022). Specialist species included Alewife, Gizzard Shad, White Sucker, Redhorses, White Perch, White Bass, Rock Bass, Bluegill, Pumpkinseed, Black Crappie, Yellow Perch and Freshwater Drum. Error bars are ± SD.

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: 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 1st, 2022 and continued to count fish through to November 21st, 2022. In this time, 35,696 events were recorded (combined up and down events), with a total of 22,032 fish observed migrating upstream through the fishway (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 occasions throughout the monitoring period where the volume of fish moving through the fish counter exceeded the system's ability to count them individually.

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, 1974-2022. Estimates for 1980, 1982, 1984, 1986, 1992, and 2002 were interpolated from adjacent years with virtual population analysis.

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	--
2020	--	--
2021	6,985	--
2022	8,929	--

April 12th, 2022 marked the most active day during the monitoring period on the fishway with a total of 1,495 salmon and trout observed migrating upstream through the Riverwatcher (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.

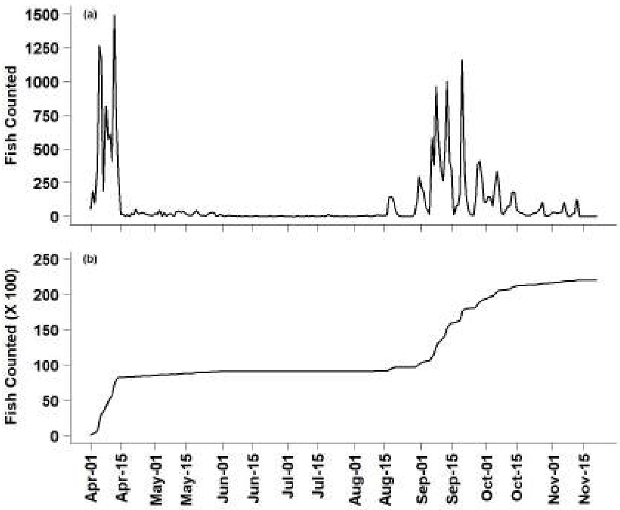


FIG. 1.4.1. (a) Daily and (b) cumulative observed fish counts at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

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 2018, the count of Rainbow Trout migrating upstream through the Corbett Dam was determined using the Riverwatcher fish counting system. The Riverwatcher actively counted and recorded fish from April 1st to May 21st, 2022 when the Rainbow Trout spawning run ended.

In the spring of 2022, 8,929 Rainbow Trout were observed passing through the Ganaraska Fishway (Table 1.4.1 and Figs. 1.4.3 and 1.4.4). This is comparable to the previous 10-year average (7,040 fish average from 2012 to 2021).

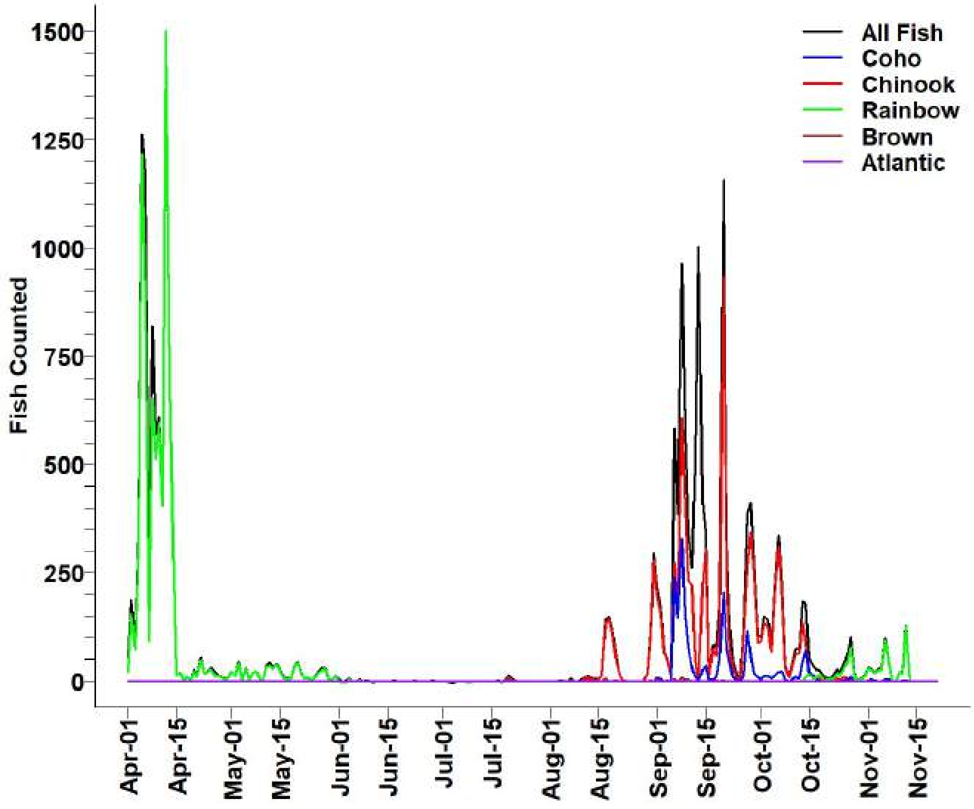


FIG. 1.4.2. Daily counts of each species of salmon and trout observed migrating through the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

The total observed run size from 2022 increased 28% from the previous survey in 2021, is the second highest observed run in the time series and is 26% below the peak estimated run in 2013 (Table 1.4.1 and Fig. 1.4.3). In the spring, the fishway was most active early April (Fig. 1.4.4). In just 10 days (April 4th – April 14th, 2022), 88% of the Rainbow Trout counted passed through the fish counter (Fig. 1.4.4). Rainbow Trout were observed utilizing the fishway after the spring monitoring period. Another 822 Rainbow Trout migrated through the fishway after the primary spring run, making a total of 9,751 Rainbow Trout identified migrating upstream through the Ganaraska Fishway in 2022.

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, 1974-2022.

Year	Male		Female	
	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	1,038
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
2021	3,091	56	3,404	113
2022	2,394	126	2,558	221
Average	2,958		3,084	

TABLE 1.4.3. Lamprey marks on Rainbow Trout in spring 1974-2022, 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	1,280
1977	0.076	0.178	0.254	6.4	13.5	18	2,242
1978	0.097	0.380	0.476	8.1	28.4	34	2,722
1979	0.122	0.312	0.434	10.3	22.8	30	3,926
1981	--	--	0.516	--	--	36	5,489
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	1,256
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
2021	0.083	0.065	0.148	8.3	6.5	15	169
2022	0.264	0.106	0.370	5.2	1.4	28	349

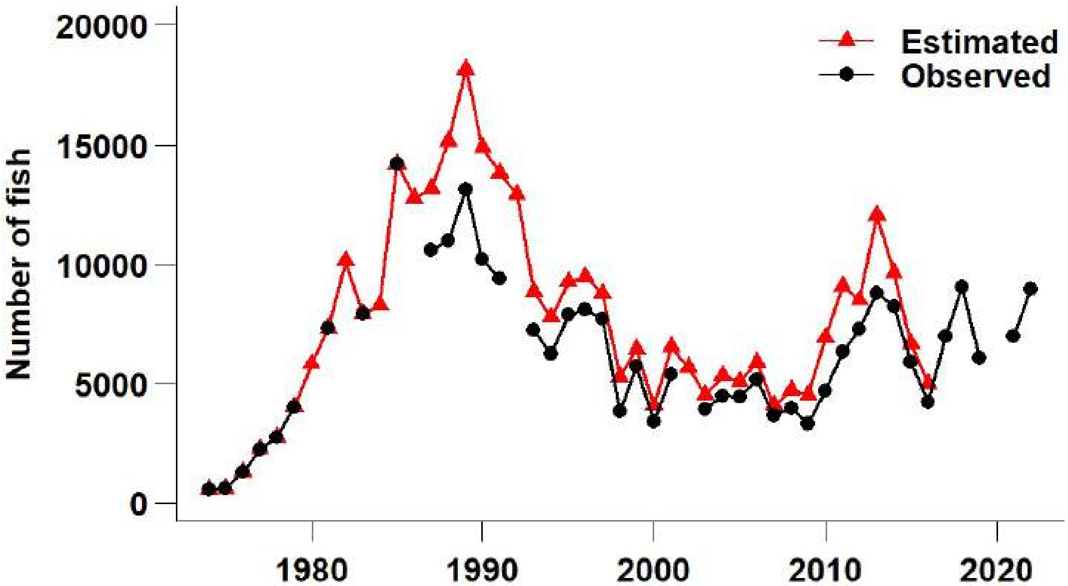


FIG. 1.4.3. Estimated and observed run of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2022.

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 2022, the condition of male (2,295 g) and female (2,558 g) Rainbow Trout declined from the previous 2021 survey and were 17% and 16% (respectively) below the previous 10-year average (Fig. 1.4.5 and Table 1.4.2).

The proportion of Rainbow Trout with Sea Lamprey marks in the Ganaraska River has been reported since 1974. In 2022, 7% of fish had Lamprey marks (wound or scar), which is 8% lower than the previous survey in 2021 (Fig. 1.4.6 and Table 1.4.3). Lamprey wounds on Ganaraska River Rainbow Trout in 2022 are 32% below the previous 10-year average (Table 1.4.3).

Chinook Salmon

A total of 8,060 Chinook Salmon were identified migrating upstream through the Riverwatcher in the Ganaraska Fishway during the 2022 monitoring period (Fig. 1.4.7). The first Chinook Salmon was observed June 12th, 2022; this is well ahead of the main Chinook Salmon spawning run (Fig. 1.4.7). The last Chinook Salmon migrating upstream through the fishway was observed November 6th, 2022. During the monitoring period, one Chinook Salmon with an adipose clip was observed migrating upstream through the fishway. These fish are a product of stocking efforts in the Credit River and represent

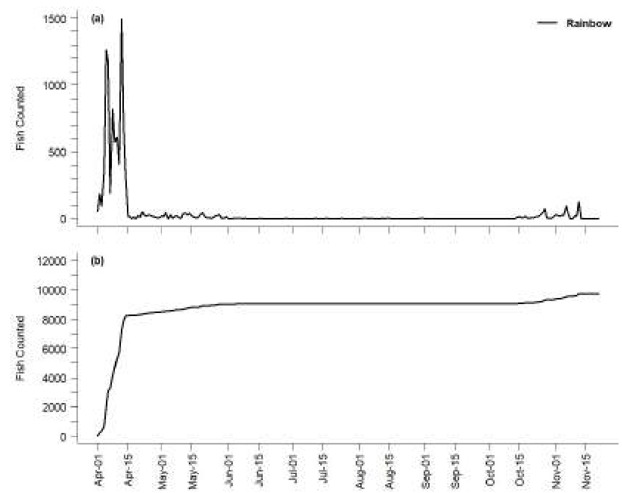


FIG. 1.4.4. (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

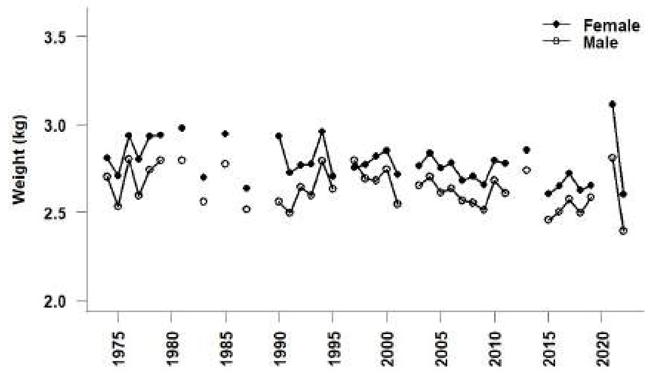


FIG. 1.4.5. Body condition (estimated weight at 635 mm total length) of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2022. Open and closed circles represent male and female Rainbow Trout (respectively).

mature adults that have strayed to the Ganaraska River to spawn (see Section 1.5 for more information). Detailed sampling of the Ganaraska River Chinook Salmon spawning population did not occur in 2022 as the Chinook Egg Collection program was conducted on the Credit River only (see Section 1.5).

Coho Salmon

The first Coho Salmon observed at the Ganaraska Fishway in 2022 was on August 31st. From that time, 1,991 Coho Salmon were identified moving upstream from the Corbett Dam (Fig. 1.4.8). During the monitoring period, one Coho Salmon with an adipose clip was observed migrating upstream through the fishway and represents fish that were stocked in another location in Lake Ontario (e.g., Credit River or the along the south shore of Lake Ontario) and strayed to the Ganaraska River to spawn.

Brown Trout

The first Brown Trout observed at the Ganaraska Fishway in 2022 was on May 31st. From that time, 76 Brown Trout were identified moving upstream from the Corbett Dam (Fig. 1.4.9). Of the Brown Trout identified passing through the fishway, the majority were observed through the summer months (July to the beginning of September; Fig. 1.4.6).

Atlantic Salmon

The first Atlantic Salmon observed at the Ganaraska Fishway in 2022 was on August 17th. A total of eight Atlantic Salmon successfully navigated upstream from the Corbett Dam (Fig. 1.4.10). Six of the eight fish observed were adipose clipped, representing fish from 2017, 2018, 2019 and 2020 stocking events.

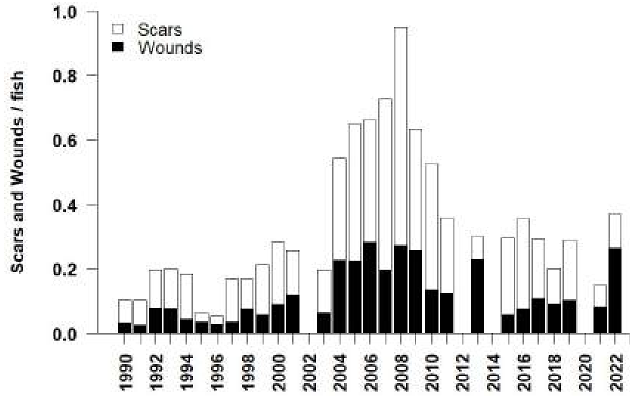


FIG. 1.4.6. Trend in lamprey marks on Rainbow Trout during the spring 1990-2022, at the Ganaraska River fishway at Port Hope, Ontario. Since 1990, A1 and A2 marks (King and Edsall 1979) were called wounds and the remainder of marks were called scars to fit with historical classification.

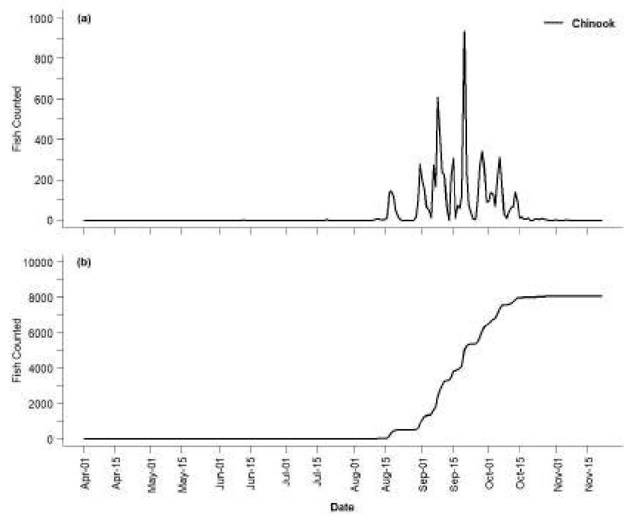


FIG. 1.4.7. (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

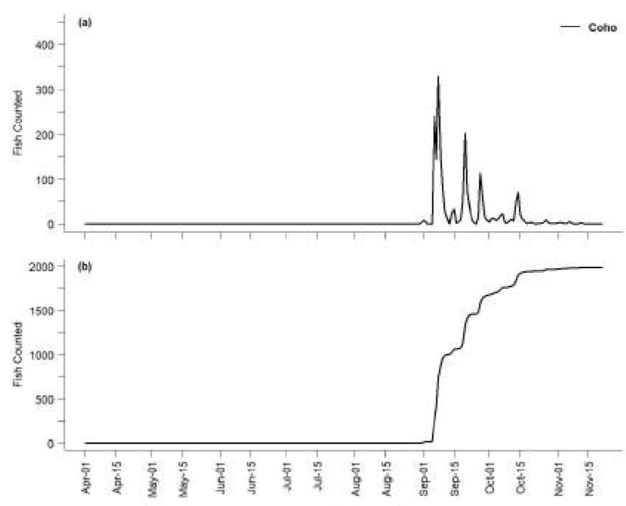


FIG. 1.4.8. (a) Daily and (b) cumulative observed counts of Coho Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

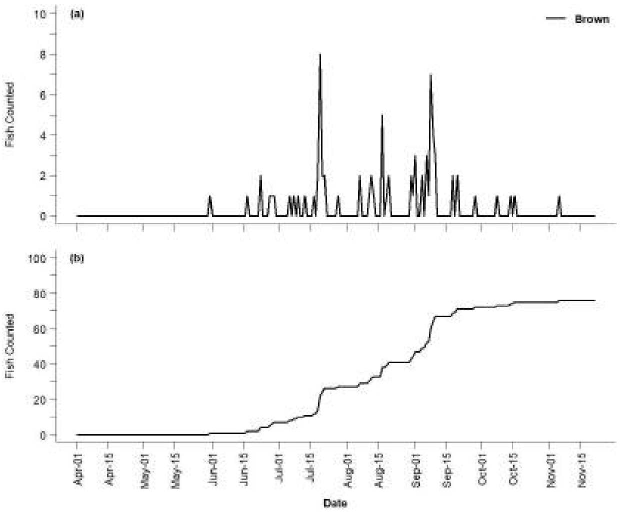


FIG. 1.4.9. (a) Daily and (b) cumulative observed counts of Brown Trout at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

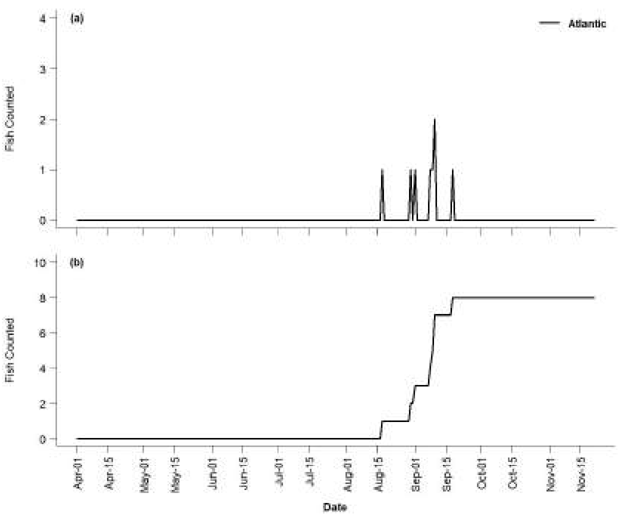


FIG. 1.4.10. (a) Daily and (b) cumulative observed counts of Atlantic Salmon at the Ganaraska River fishway at Port Hope, Ontario from April 1st to November 21st, 2022.

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 March 31st, 2022 and continued to collect data through to November 9th, 2022. 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, the Streetsville Fishway was closed in the fall, effectively blocking all fish passage from mid-September to the end of Chinook Salmon Egg Collection (see below). In 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. Streetsville fishway was open for free fish passage throughout the ice-free season in 2022.

Credit River Riverwatcher

The Credit River Riverwatcher was installed at the exit of the Streetsville Fishway March 31st, 2022. 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. After installation, data were uploaded to the Riverwatcher Daily website every hour until the system was removed from the river on November 9th, 2022. In this time, a total of 5,105 mature salmon and trout were observed moving upstream through the Streetsville Fishway (Fig. 1.5.1).

During periods of heavy rainfall river flows increased, making the water cloudy. As the water becomes less clear, the light from the infrared counting sensors cannot 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.

September 27th, 2022 marked the most active day on the fishway with a total of 403 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 621 Rainbow Trout were identified migrating upstream through the Streetsville Fishway from March 31st to November 9th, 2022 (Fig. 1.5.3). During the spring migration (March 31st to May 21st, 2021), 578 Rainbow Trout (93% of observed Rainbow Trout in 2022) moved upstream through the Streetsville Fishway.

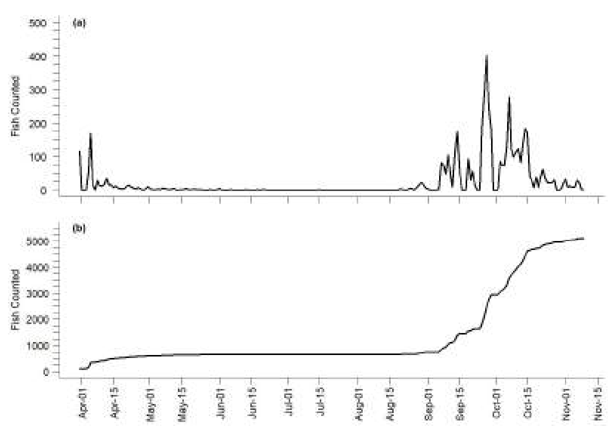


FIG. 1.5.1. (a) Daily and (b) cumulative observed fish counts at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

Chinook Salmon

A total of 3,541 Chinook Salmon were identified migrating upstream through the Riverwatcher in 2022. The first Chinook Salmon was observed August 20th, 2022 and the last observed on November 7th, 2022 (Fig. 1.5.4). Of the Chinook Salmon that passed through the Streetsville Fishway 136 fish were observed with an adipose clip. Chinook Salmon with the adipose clip represent Ganaraska River egg collections that were subsequently stocked in the Credit River in 2018 and 2019. Unclipped Chinook Salmon represent fish stocked in the Credit River that originated from the Credit River egg collections (stocked in 2018, 2019, 2020 and 2021) 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 (following page).

Coho Salmon

The first Coho Salmon observed at the Streetsville Fishway in 2022 was on September 8th. A total of 431 Coho Salmon were identified exiting the Streetsville Fishway (Fig. 1.5.5). The last Coho Salmon observed moving through Streetsville Fishway was on November 7th, 2022. No Coho Salmon that passed through the Streetsville Fishway were recorded as having an adipose clip.

Brown Trout

The first Brown Trout observed at the Streetsville Fishway in 2022 was on May 15th and the last was observed on November 1st. A total of 15 Brown Trout were identified exiting upstream of the Streetsville Fishway (Fig. 1.5.6).

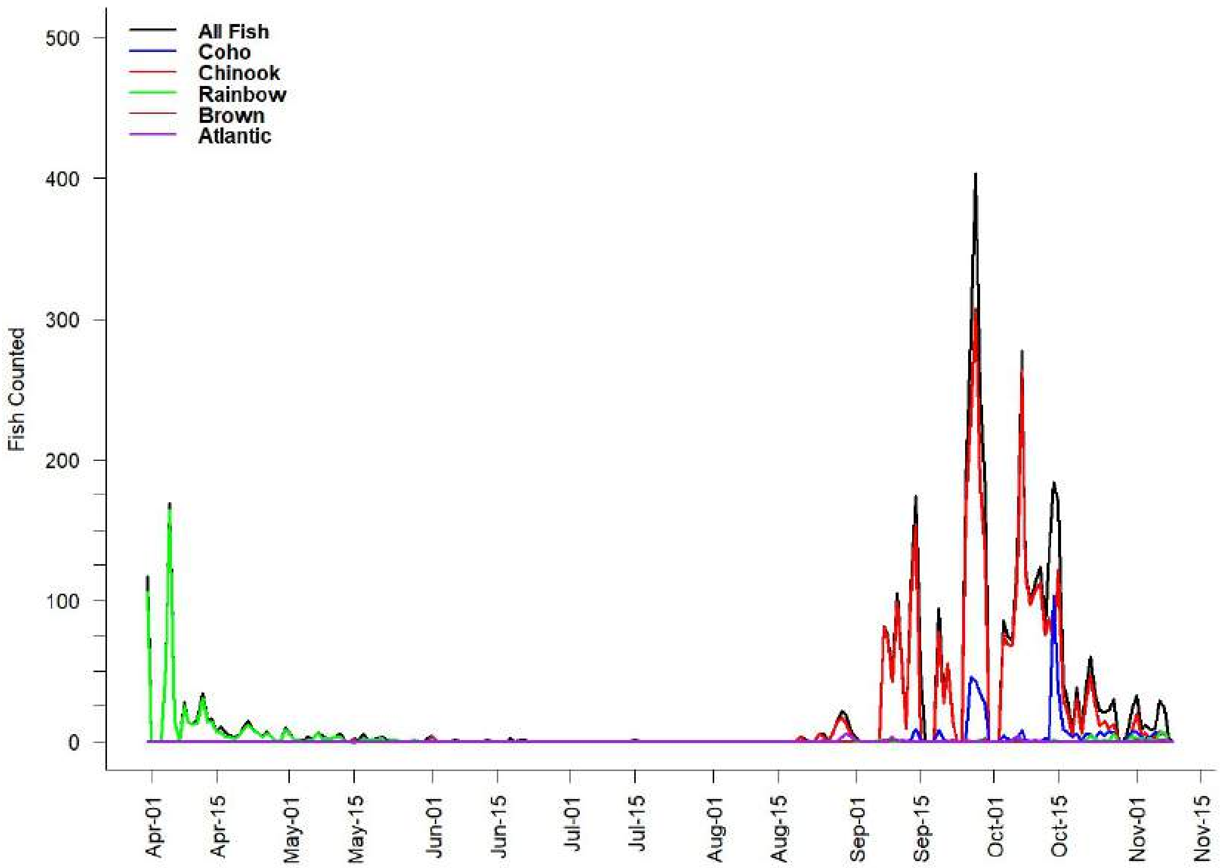


FIG. 1.5.2. Daily counts of each species of salmon and trout observed migrating through the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

Atlantic Salmon

The first Atlantic Salmon observed at the Streetsville Fishway in 2022 was on August 25th and the last was observed on November 7th. In total 26 Atlantic Salmon were identified exiting upstream of the Streetsville Fishway (Fig. 1.5.7).

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.

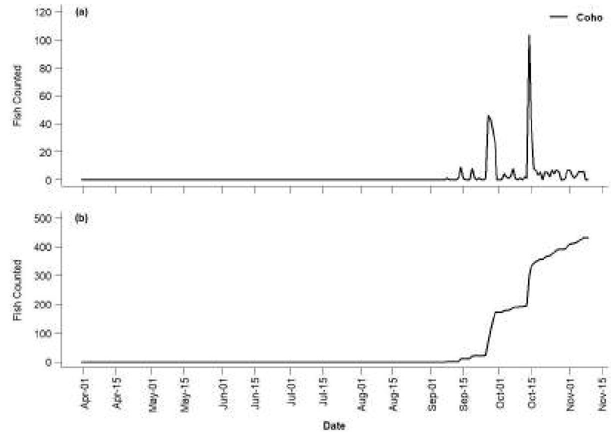


FIG. 1.5.5. (a) Daily and (b) cumulative observed counts of Coho Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

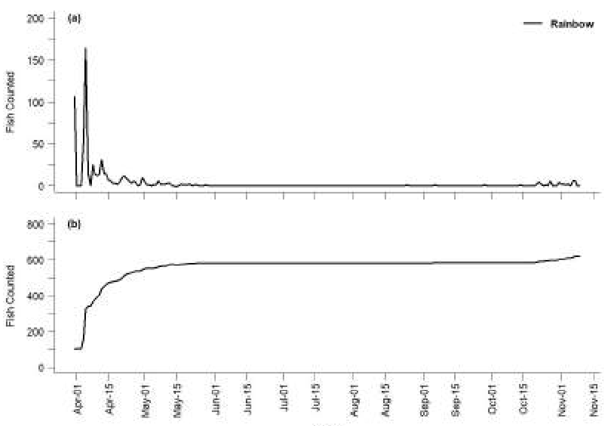


FIG. 1.5.3. (a) Daily and (b) cumulative observed counts of Rainbow Trout at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

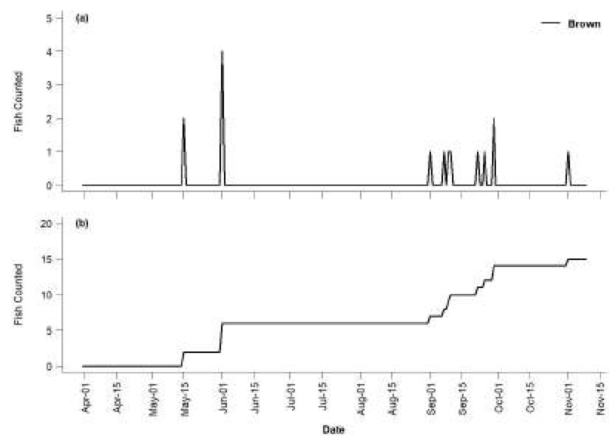


FIG. 1.5.6. (a) Daily and (b) cumulative observed counts of Brown Trout at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

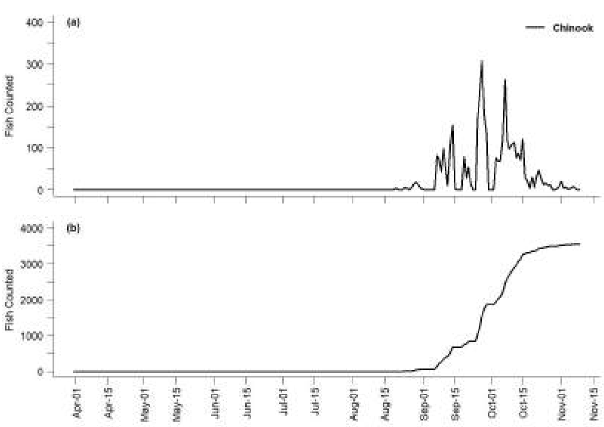


FIG. 1.5.4. (a) Daily and (b) cumulative observed counts of Chinook Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

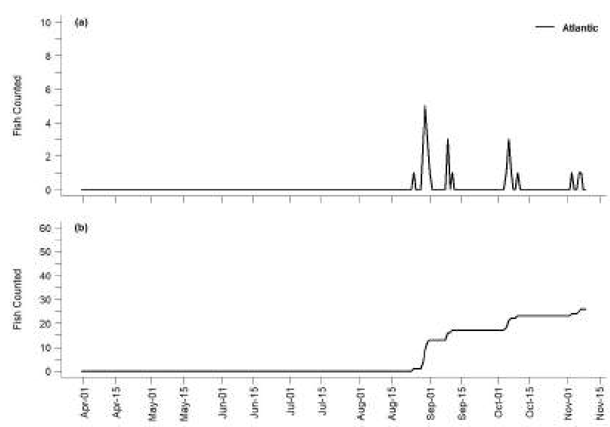


FIG. 1.5.7. (a) Daily and (b) cumulative observed counts of Atlantic Salmon at the Streetsville Fishway, Credit River, Mississauga, Ontario from March 31st to November 9th, 2022.

Weight and otoliths are collected from fish used in the spawn collection, which has the 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 2022 Chinook Salmon index were taken between October 4th and October 24th. Lengths were taken on a total of 825 Chinook Salmon 300 randomly selected fish (non-detailed sampling) and 525 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 River = 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 and it is rare to observe Chinook Salmon in Lake Ontario older than age-4 so fish observed with an adipose clip would be from the 2018, 2019 and 2020 stocking events (Chinook Salmon egg collections on the Ganaraska have not occurred since fall of 2019 see Section 6.1). To gain more information on adipose clipped fish, all clipped fish encountered were retained for detailed sampling. In total 35 fish with an adipose clip were biologically sampled; five were male and 30 were female. In 2022, 65% of the spawning population (clipped and unclipped combined) were three years old, 24% were two years old and 10% were one year olds (Fig. 1.5.8).

In 2022, average fork length of Chinook Salmon for age-2 males increased from values in 2021 (Fig. 1.5.9). The average fork length of age-3 and age-2 females (846 mm and 790 mm, respectively) declined from 2021 and is below the time series average. Average fork length for age-3 males in 2022 (884 mm) declined from 2021 and is comparable to the long-term average (Fig. 1.5.9).

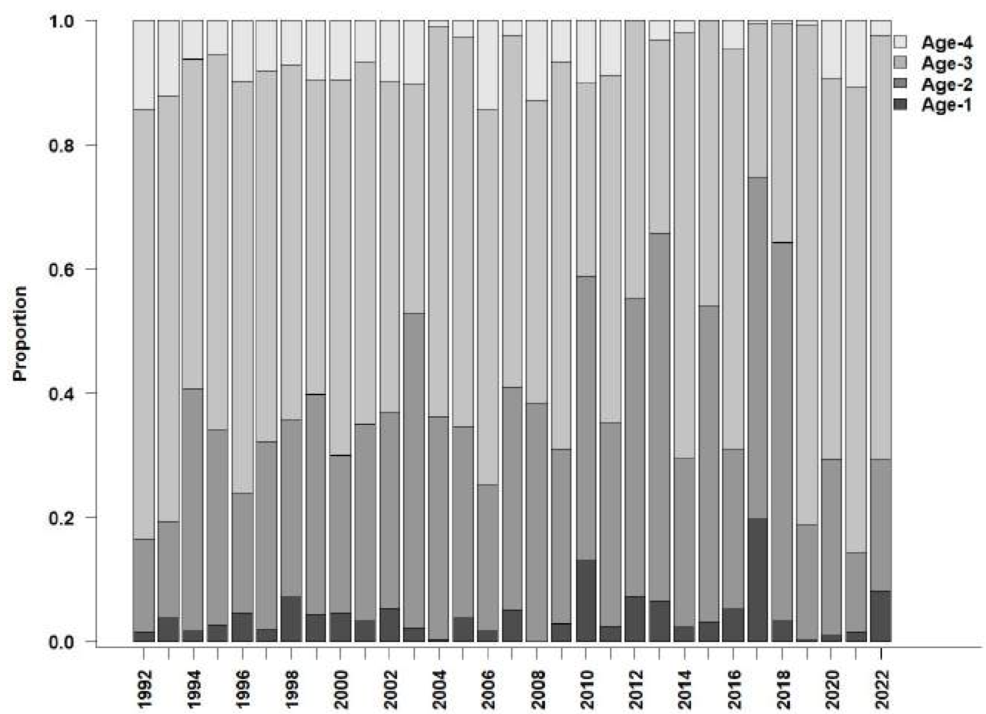


FIG. 1.5.8. Age proportions of spawning Chinook Salmon (males and females pooled) sampled during the fall Credit River Chinook Salmon Spawning Index, Credit River, Mississauga, Ontario from 1992 – 2022. The four grey colours correspond to each age where Age 1 is the darkest and Age 4 is the lightest.

The estimated weight (based on a log-log regression) of a 914 mm or 36” (total length) Chinook Salmon is used as an index of condition. In 2022, both male and female condition measures decreased from 2021 and are currently at the lowest value in the timeseries (Fig. 1.5.10). Female condition in 2022 (7,164 g) showed a significant decrease from 2021 and is below the previous 10-year average (7,657 g). Male condition in 2022 (6,797 g) declined from 2021 is below the previous 10-year average (7,255 g). It should be noted that the absolute difference between maximum and minimum condition (which occurred in 1995 and 2022, respectively) for female and male Chinook Salmon in this time series is 1,650 g and 1,192 g (respectively).

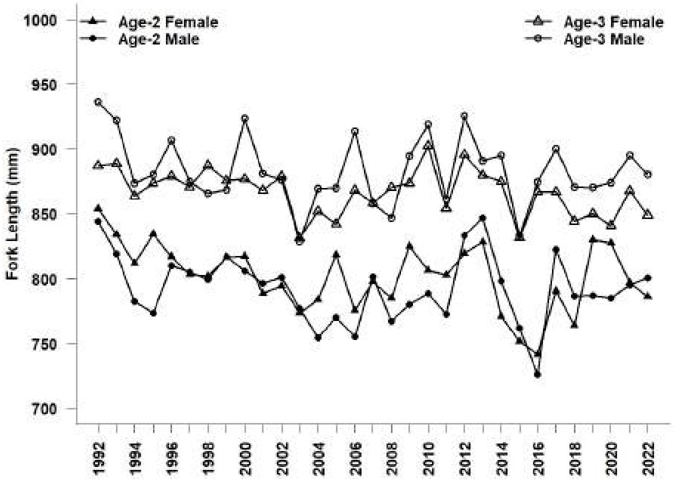


FIG. 1.5.9. Mean total length of age-2 and age-3 Chinook Salmon by sex, caught for spawn collection in the Credit River during the fall spawning run (approximately first week of October), 1989-2022.

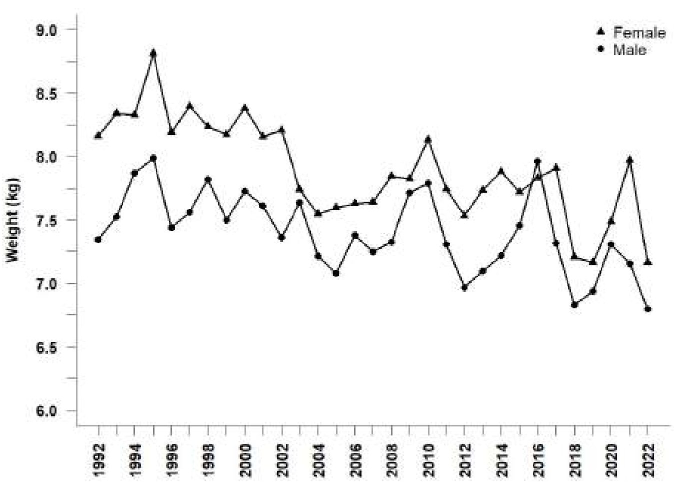


FIG. 1.5.10. Condition index as the mean weight of a 914 mm / 36 inch (total length) Chinook Salmon in the Credit River during the spawning run (approximately first two weeks of October), 1989-2022.

1.6 Lake Ontario Spring Prey Fish Assessment

J. P. Holden, Lake Ontario Management Unit

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 64 sites were sampled by the OMNRF vessel in 2022 spanning bottom depths from 4.8 - 161.7 m between April 1st and April 14th.

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, 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.

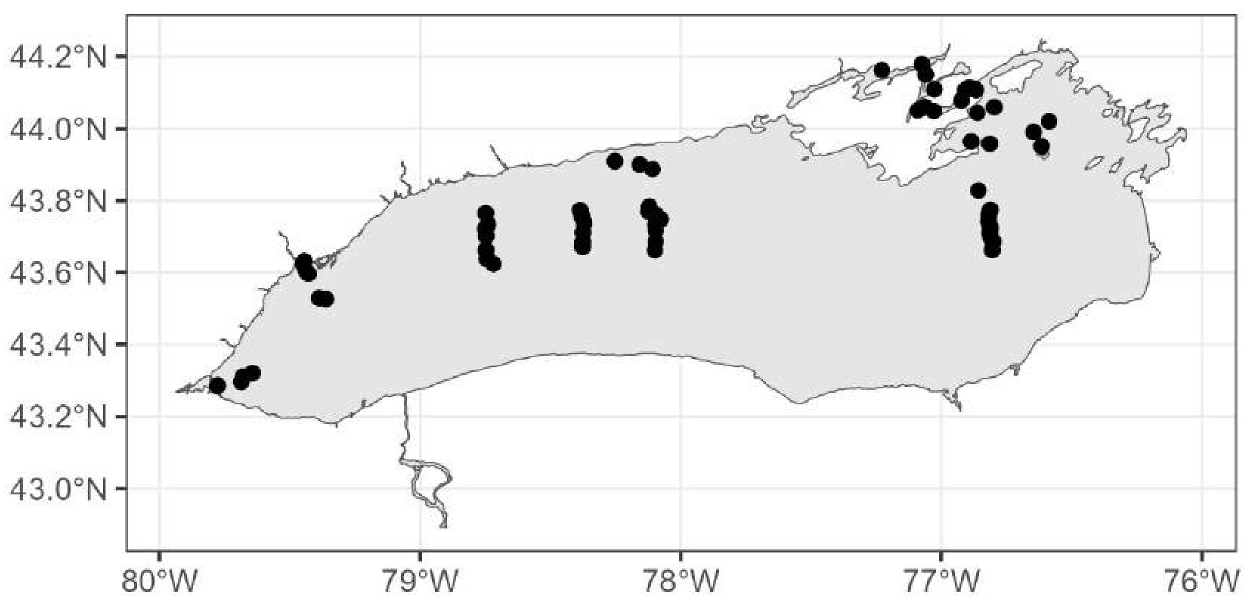


FIG. 1.6.1. Tow sites conducted in the Ontario waters of Lake Ontario by the MNRF vessel Ontario Explorer during the Spring Prey Fish Survey. Additional sites in the US and in Canada were conducted by USGS and NYSDEC.

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. Throughout the survey, Alewife were the most abundant species caught (N = 45,709) followed by Deepwater sculpin (N = 5,600); and Rainbow smelt (N = 2,266). Full catch data presented in Table 1.6.1.

The Lake Ontario Spring Prey Fish Survey is a subset of a binational prey fish assessment program. The complete data set is available through the Ontario Open Data Catalogue (https://data.ontario.ca/en/dataset/lake-ontario-prey-fish-trawl-data).

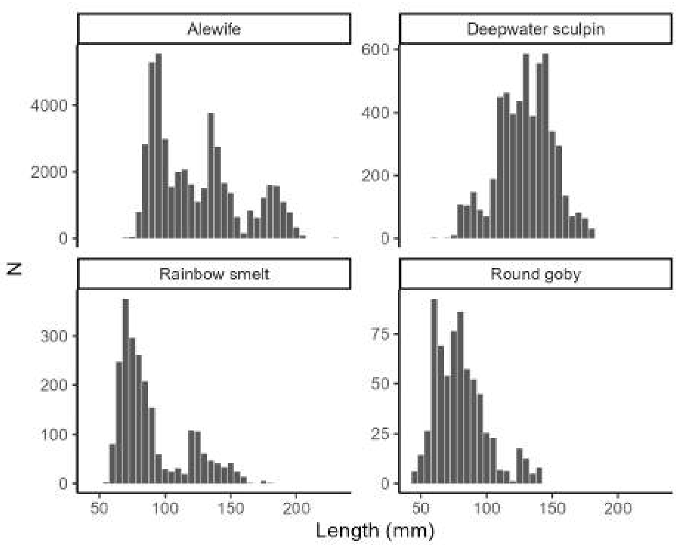


FIG. 1.6.2. Size distribution of Alewife, Deepwater Sculpin, Rainbow Smelt and Round Goby captured across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Spring Prey Fish Survey. Length is recorded as total length to the nearest millimeter.

TABLE 1.6.1. Species composition across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Spring Prey Fish Survey.

Species	Total Number	Total Weight (kg)	Number of tows that captured the species
Alewife	45,709	690.65	28
Deepwater sculpin	5,600	127.16	27
Rainbow smelt	2,266	9.84	49
Round goby	684	5.17	14
White perch	418	57.93	8
Trout-perch	347	5.08	5
Yellow perch	203	3.36	7
Threespine stickleback	80	0.15	20
Freshwater drum	75	44.60	3
Walleye	73	11.79	3
Slimy sculpin	25	0.10	10
Lake whitefish	15	1.87	3
Spottail shiner	13	0.16	4
Cisco (lake herring)	12	1.33	5
Brown bullhead	4	1.74	2
White sucker	4	1.65	1
Lake trout	2	0.39	2
White bass	1	0.97	1
Emerald shiner	1	0.01	1
Black crappie	1	0.06	1
Logperch	1	0.004	1

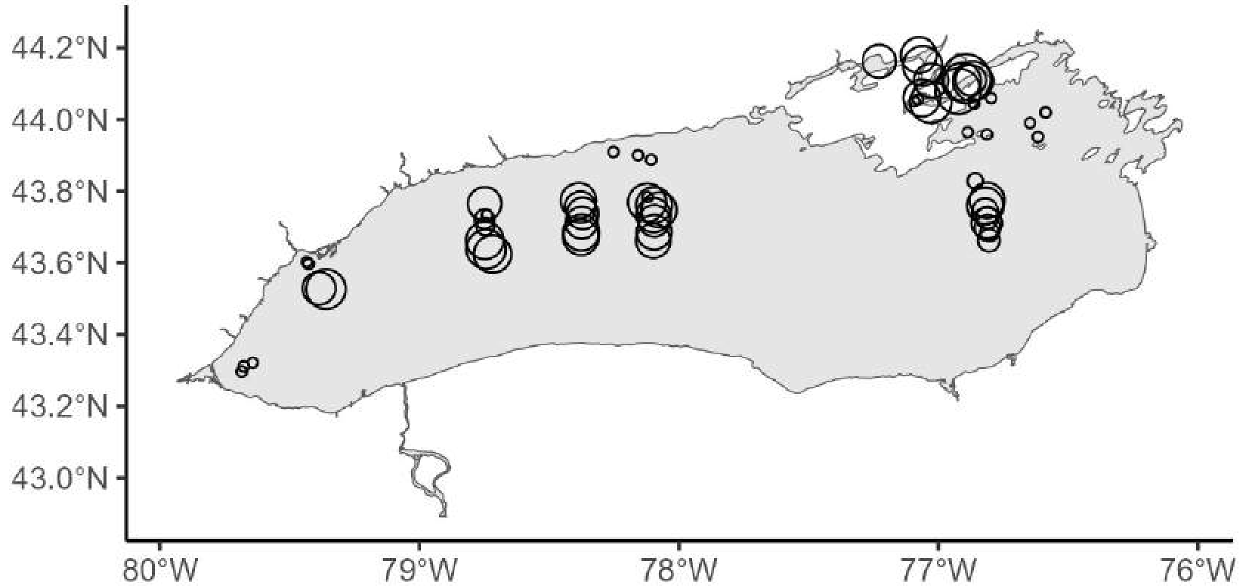


FIG. 1.6.3. Shannon-Weaver Diversity Index from trawl catches across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Spring Prey Fish Survey. Size of the bubble indicates the species diversity captured at the site. Diversity score is a function of the number of species captured at a site and the relative abundance of each species. Larger values indicate greater species richness and evenness of each species abundance. Species richness (number of species captured) ranged from 0 to 12.

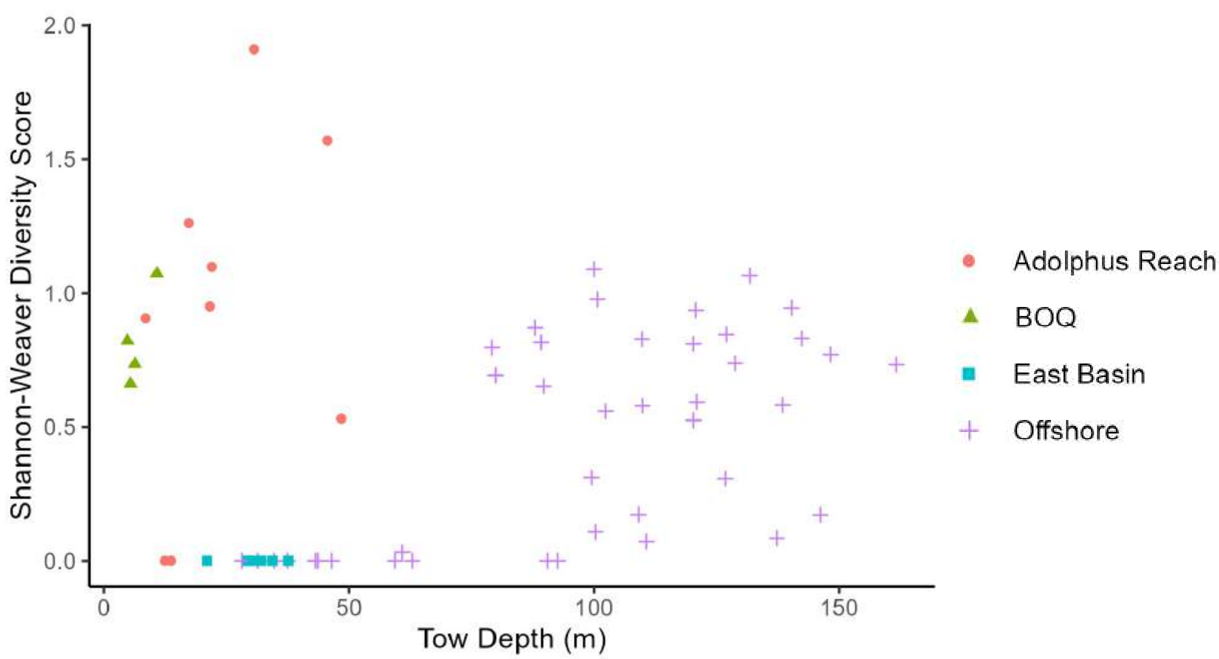


FIG. 1.6.4. Shannon-Weaver Diversity Index by trawl depth for trawl site in the spring prey fish trawls conducted by the OMNRF vessel. Diversity score is a function of the number of species captured at a site and the relative abundance of each species.

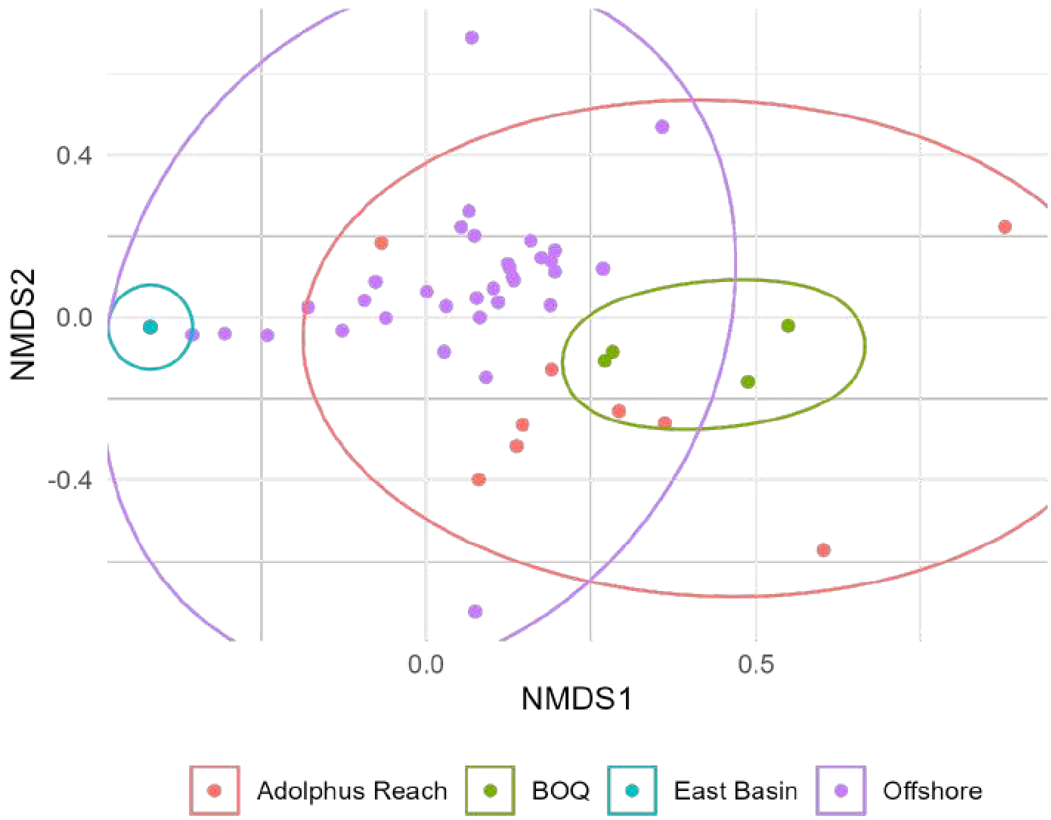


FIG. 1.6.5. Relative abundance of species are used in a non-metric multi-dimensional scaling ordination (NMDS) to represent differences in fish community between areas. Each point represents an individual tow site. Distance between points varies by community similarity. Points that are close together have very similar fish community structure. Ellipses contain geographical regions.

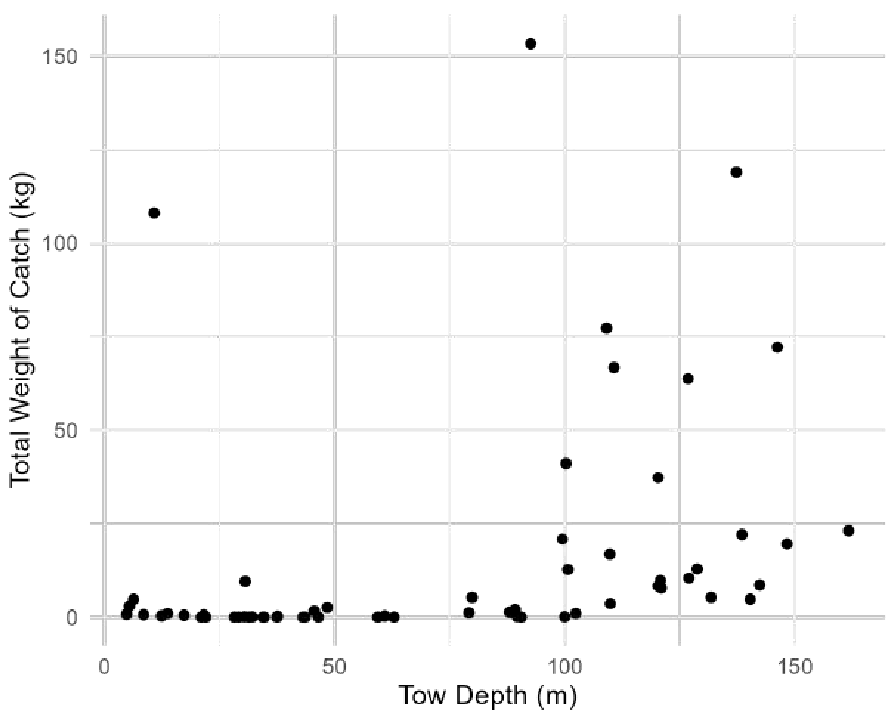


FIG. 1.6.6. Total trawl catch (kg) by station depth illustrates that the majority of the Lake Ontario prey biomass is offshore during the spring survey. The single high abundance site was from the Bay of Quinte and was dominated by White Perch and Freshwater Drum.

1.7 Lake Ontario Fall Benthic Prey Fish Assessment

J. P. Holden, Lake Ontario Management Unit

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 Dreissenid 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 current survey provides an abundances indices for Sculpin sp., Round Goby and Bloater with survey techniques comparable to Lake Michigan.

The Ontario portion of the 2022 survey consisted of 37 trawls conducted from September 29th through October 5th at transects near Port Hope, Rocky Point and in the Kingston Basin (Fig. 1.7.1) in depths ranging from 20 to 156 m. Shallow tows (<40m) in Ontario waters are largely confined to the Kingston Basin due to limited suitable sites across the north shore. Past efforts to trawl these areas have resulted in snags and damaged gear due to rocky substrate and large boulders.

The survey is conducted with a 3/4 Yankee Standard using Thyborne metal doors. Depth loggers and trawl door sensors were used on all trawls to provide estimates of true bottom time and net opening to standardize catches with historical surveys and with US vessels.

Deepwater Sculpin were the most abundant species caught (N = 14,075) followed by Alewife (N = 8,782); and Round Goby (N = 5,672). The full catch data is presented in presented in Table 1.7.1.

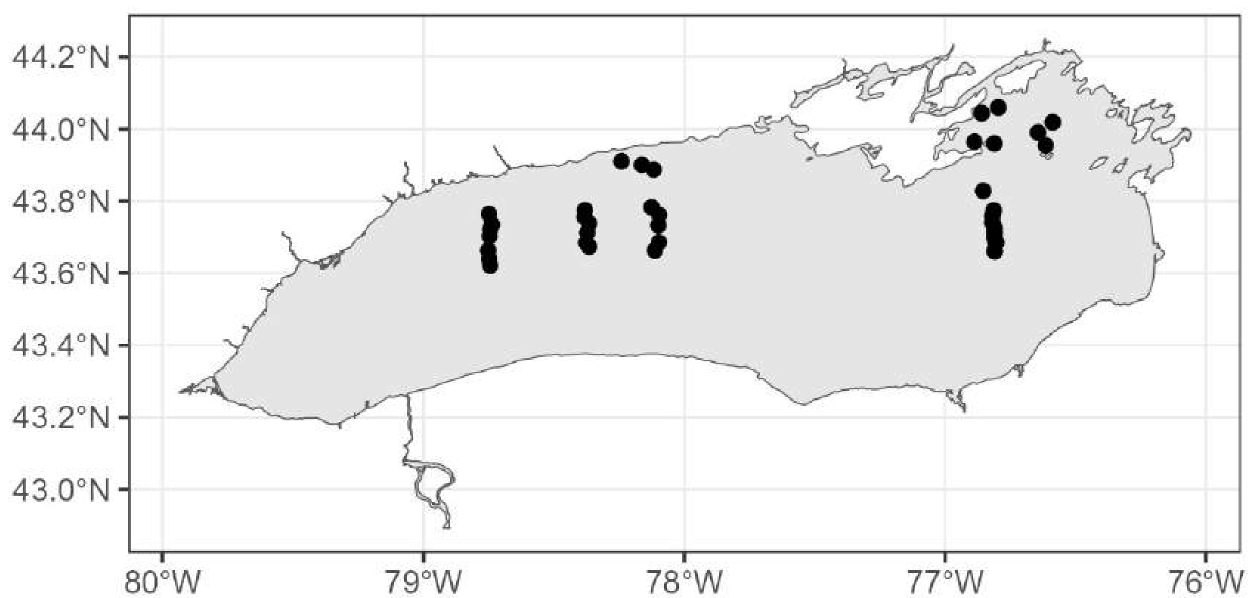


FIG. 1.7.1. Tow sites conducted in the Ontario waters of Lake Ontario by the MNRF vessel Ontario Explorer during the Fall Prey Fish Survey. Additional sites in the US and in Canada were conducted by USGS and NYSDEC.

The Lake Ontario Fall Benthic Prey Fish Survey is a subset of a binational prey fish assessment program. The complete data set is available through the Ontario Open Data Catalogue (https://data.ontario.ca/en/dataset/lake-ontario-prey-fish-trawl-data).

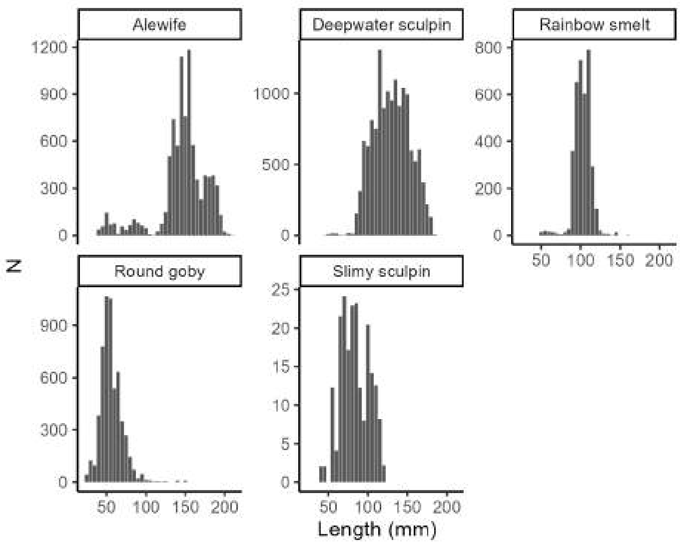


FIG. 1.7.2. Size distribution of Alewife, Deepwater Sculpin, Rainbow Smelt, Slimy Sculpin and Round Goby captured across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Fall Prey Fish Survey. Length is recorded as total length to the nearest millimeter.

TABLE 1.71. Species composition across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Fall Prey Fish Survey.

Species	Total Number	Total Weight (kg)	Number of tows that captured the species
Deepwater sculpin	14,075	307.41052	26
Alewife	8,782	232.61027	31
Round goby	5,672	12.01561	13
Rainbow smelt	3,732	20.70281	32
Slimy sculpin	207	1.66247	12
Spottail shiner	41	0.148	1
Threespine stickleback	6	0.006	2
Sea lamprey	2	0.53197	1
Lake whitefish	2	0.02493	1
Gizzard shad	1	0.0109	1
Freshwater drum	1	2.702	1
Lake trout	1	0.026	1

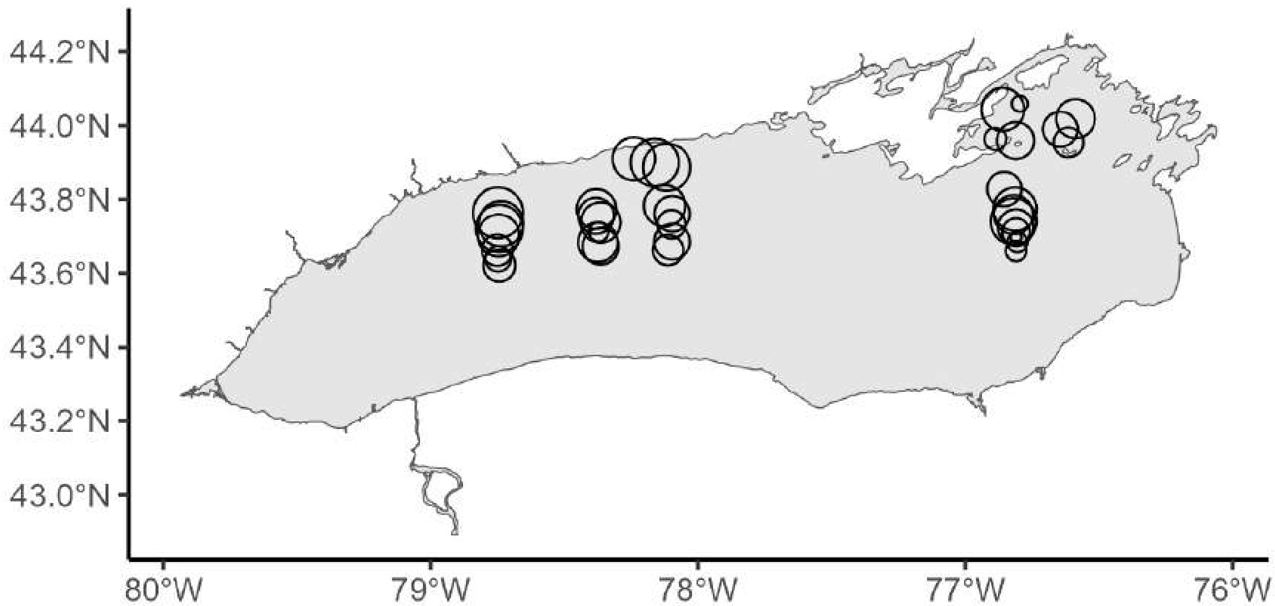


FIG. 1.7.3. Shannon-Weaver Diversity Index from trawl catches across all trawl sites conducted in Ontario waters by the MNRF vessel Ontario Explorer during the Fall Prey Fish Survey. Size of the bubble indicates the species diversity captured at the site. Diversity score is a function of the number of species captured at a site and the relative abundance of each species. Larger values indicate greater species richness and evenness of each species abundance. Species richness (number of species captured) ranged from 1 to 5.

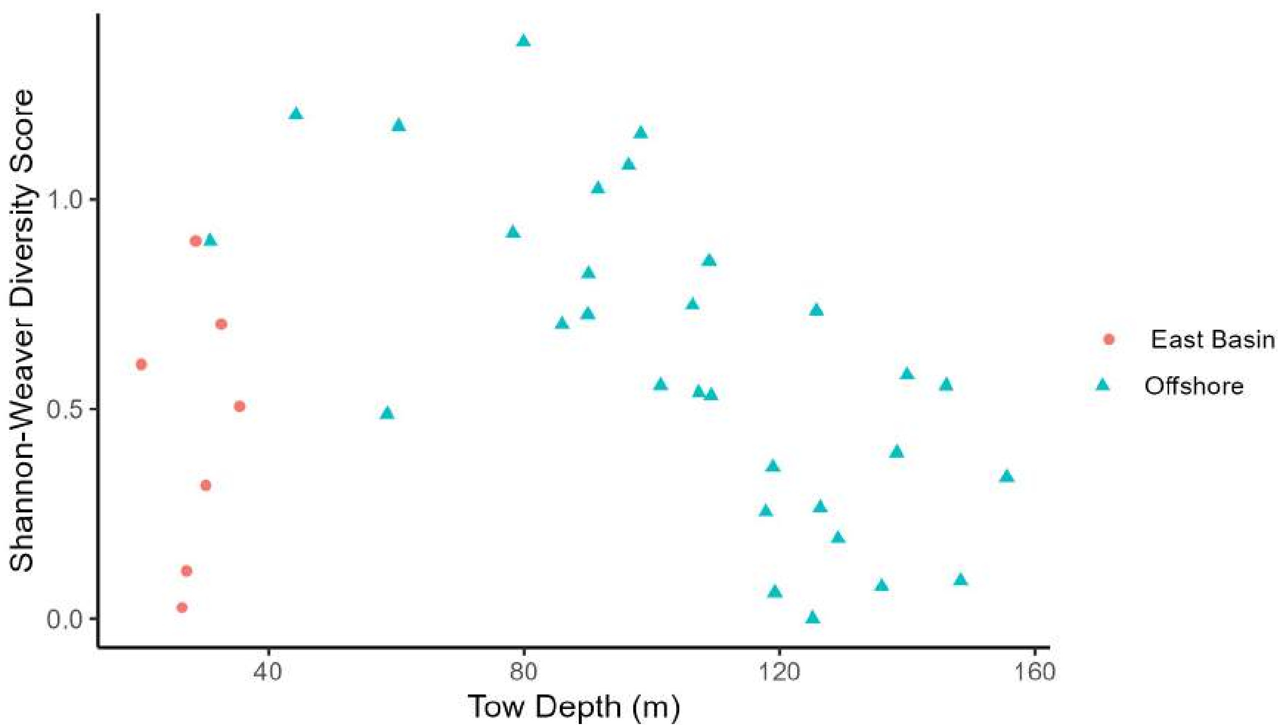


FIG. 1.7.4. Shannon-Weaver Diversity Index by trawl depth for trawl site in the Fall Prey fish trawls conducted by the OMNRF vessel. Diversity score is a function of the number of species captured at a site and the relative abundance of each species.

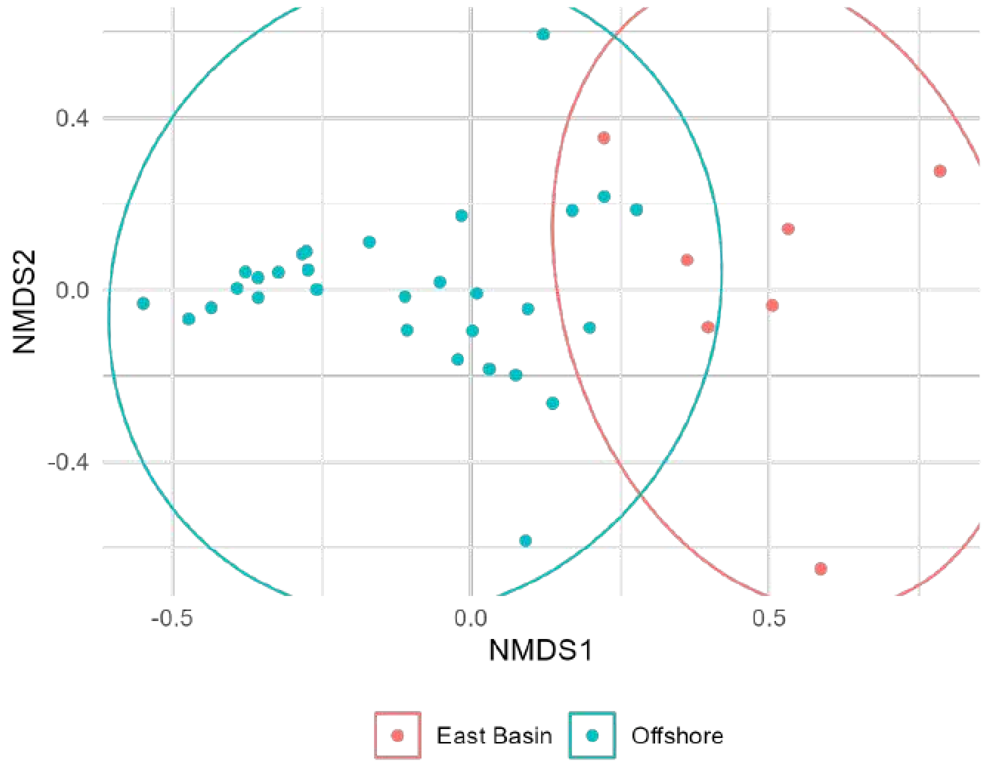


FIG. 1.7.5. Relative abundance of species are used in a non-metric multi-dimensional scaling ordination (NMDS) to represent differences in fish community between areas. Each point represents an individual tow site. Distance between points varies by community similarity. Points that are close together have very similar fish community structure. Ellipses contain geographical regions.

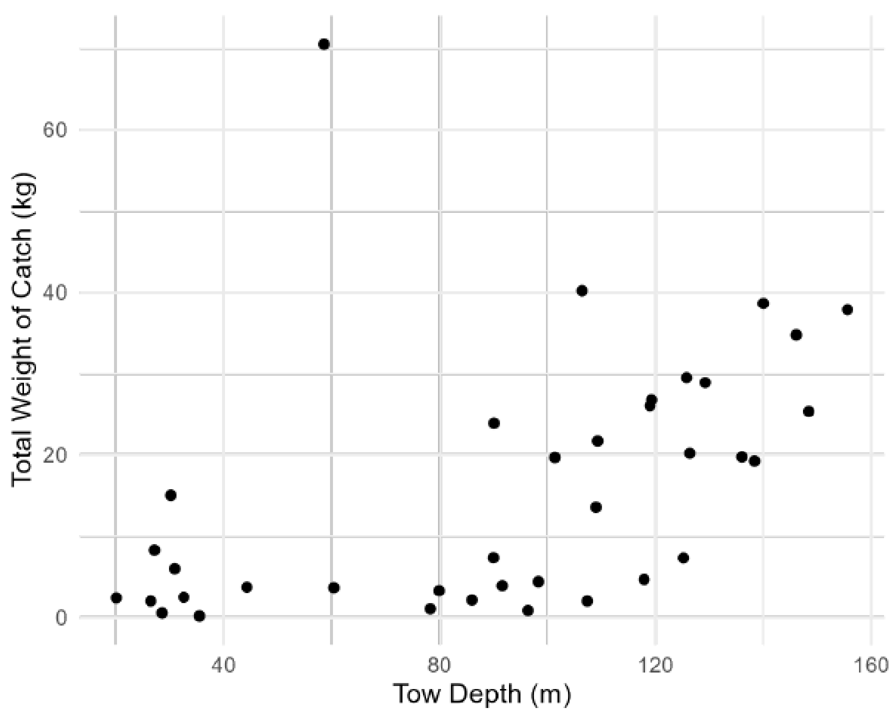


FIG. 1.7.6. Total trawl catch (kg) by station depth. Generally, catch increases with depth due to the large numbers of Deepwater Sculpin that are present in the offshore areas. The single catch that exceeded 60 kg was mostly comprised of Alewife which are generally caught in lower abundance during the fall as they tend to be pelagic at this time.

1.8 Lake St. Francis Community Index Gill Netting

M. J. 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. Since 2019, the St. Lawrence River Fish Community Index Gill Netting Survey (Lake St. Francis and Thousand Islands) was redesigned and has been 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 collaborative effort between OMNRF and New York State Department of Environmental Conservation (NYSDEC) 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.

In 2022, the survey was conducted during the period of September 19th to 21st. 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 used by both OMNRF and NYSDEC initiated in 2002. In total, 220 fish were caught, which included 13 different fish species (Table 1.8.1). The number of fish per net in 2022 (14.67) increased from the 2021 survey but remains below the time series average for the survey and represents the lowest average catch per net in the time series (Fig. 1.8.1). The dominant species in the catch continues to be Yellow Perch (56% of catch, 22% of biomass; Fig. 1.8.2).

Species Highlights

Yellow Perch

Catches of Yellow Perch have declined from peak levels seen previously in 2008 and 2010 (Fig. 1.8.3). 2022 catches of Yellow Perch (8.20 fish per net) remain below the time series average (14.63 fish per net; Table 1.8.1). The proportion of large fish (> 220 mm) observed in catches (22% of catch in 2022) increased from previous surveys, however, overall abundance remains low (Fig. 1.8.3). Yellow Perch catches in 2022 contained fish from age-1 to age-8 with age-3 fish being the most dominant (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 2022 (2.20 fish per net) indicated an increase from the previous survey and is comparable to the previous 10-year average (2.18 fish per net). Smallmouth Bass catches increased in 2022 compared to the 2021 survey (0.87 compared to 0.46 fish per net, respectively), and are above the previous 10-year

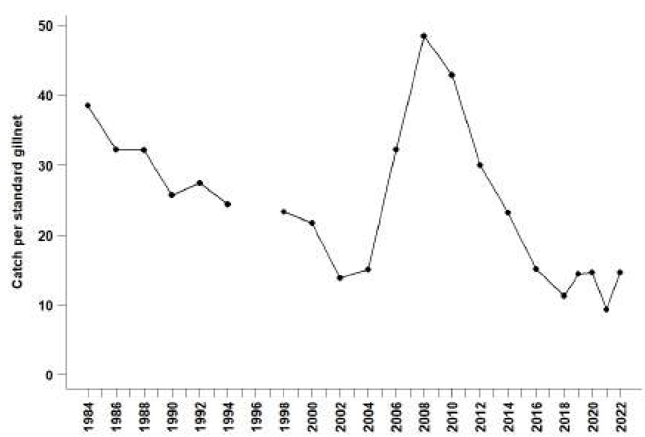


FIG. 1.8.1. Average catch per standard gillnet set of all species combined, Lake St. Francis, 1984 – 2022. Survey was not conducted in 1996.

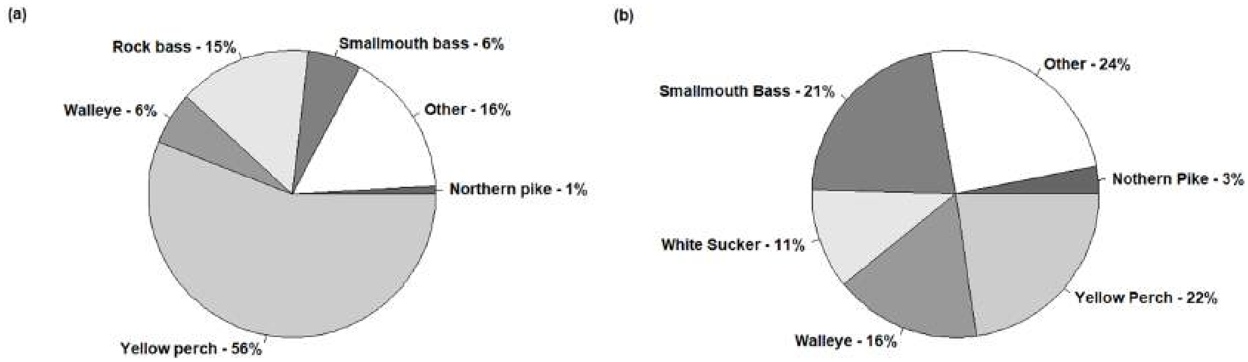


FIG. 1.8.2. Species composition by (a) catch and (b) biomass in the 2022 Lake St. Francis community index gill netting program.

average (0.41 fish per net; Fig. 1.8.5). Smallmouth Bass caught in the 2022 survey ranged from age-3 to age-7, with the highest proportion being age-4. Largemouth Bass catches have been spotty over the past eight surveys. In 2022, Largemouth Bass catches per net (0.27 fish per net) are just below the previous 10-year average (0.37 fish per net). In the 2022 survey, no Pumpkinseed, Bluegill or Black Crappie were caught (Figs. 1.8.5 and 1.8.6).

Northern Pike

Northern Pike catches in 2022 (0.13 fish per net) are consistent with catches over the previous 10-years (average of 0.17 fish per net; Fig. 1.8.7). Northern Pike abundance has been in decline since the early 1990s and is currently at the lowest levels observed in the 35-year time series (Table 1.8.1). Two Northern Pike were caught in 2022, of which one was age-2 (small, ≤ 500 mm) and the other age-4 (large, > 500 mm; Fig. 1.8.7). No Muskellunge were caught in 2022.

Walleye

Walleye represented 6% of the total catch and 16% of total biomass caught in 2022 with 13 individuals caught (Fig. 1.8.2 and Table 1.8.1). The average catch per net declined from 2021 and is currently equal to the previous 10-year average (0.87 fish per net). Generally, catches of small fish (≤ 500 mm) and large (>500 mm) Walleye have been equally represented. In 2022, small fish represented 77% of the catch, while large fish represented the remaining 23% (Fig. 1.8.8). Walleye ages ranged from 1 to 8 years of age with the majority being age-3 (Fig. 1.8.9).

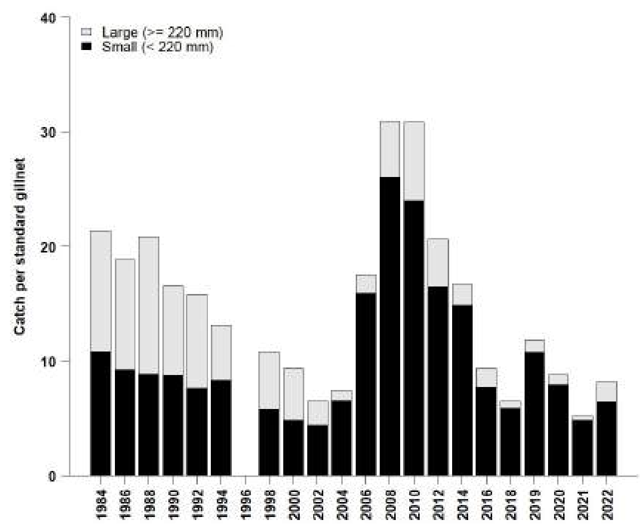


FIG. 1.8.3. Catches of small (≤ 220 mm total length) and large (> 220 mm total length) Yellow Perch in the Lake St. Francis community index netting program, 1984 – 2022. Survey was not conducted in 1996.

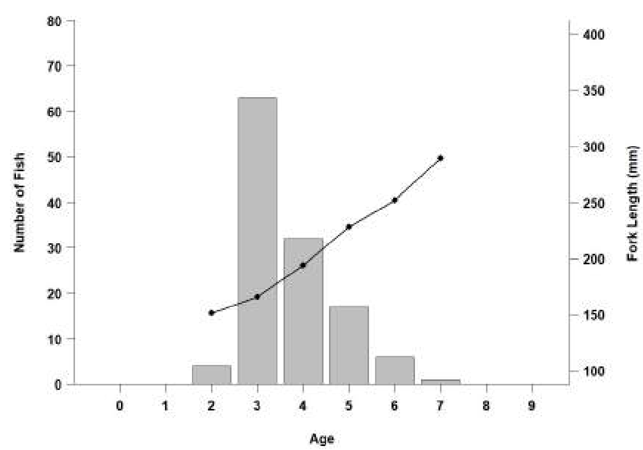


FIG. 1.8.4. Age distribution (bars) and mean fork length at age (mm) of Yellow Perch caught in Lake St. Francis, 2022.

TABLE 1.8.1. Summary of catches per gillnet set in the Lake St. Francis Fish Community Index Gillnetting Program, 1984 - 2022. All catches prior to 2002 were adjusted by a factor of 1.58 to be comparable to the new netting standard initiated in 2002. No survey was conducted in 1996.

Species	1984 - 2010	2012	2014	2016	2018	2019	2020	2021	2022
Lake Sturgeon	0.01	0.03	--	0.03	--	--	--	--	--
Longnose Gar	0.14	0.22	--	0.28	--	0.07	1.13	0.15	0.20
Bowfin	--	--	--	--	--	--	--	--	--
Alewife	0.03	0.14	0.03	--	--	0.20	--	--	--
Gizzard Shad	--	--	--	0.06	--	--	--	--	--
Salvelinus sp.	0.00	--	--	--	--	--	--	--	--
Northern Pike	2.85	0.19	0.31	0.14	0.14	0.20	0.13	0.08	0.13
Muskellunge	0.01	--	0.03	--	--	--	--	--	--
White Sucker	1.45	1.17	1.25	0.56	0.47	0.33	0.67	0.15	0.80
Silver Redhorse	0.03	0.06	0.03	0.06	0.11	--	0.07	--	0.13
Shorthead Redhorse	--	0.28	0.06	0.03	0.03	0.07	--	0.38	0.27
Greater Redhorse	0.01	--	--	--	--	--	--	--	0.07
River Redhorse	0.02	--	--	--	--	--	--	--	--
Moxostoma sp.	0.03	--	--	--	0.11	--	--	--	--
Common Carp	0.04	--	--	--	--	--	--	--	--
Golden Shiner	0.01	--	--	0.06	0.22	--	--	--	--
Creek Chub	0.01	--	--	--	--	--	--	--	--
Fallfish	0.01	--	--	0.03	0.14	--	0.13	0.54	0.53
Brown Bullhead	1.18	0.25	0.14	0.03	--	--	--	--	0.13
White Perch	--	--	--	0.03	--	--	0.07	--	--
Rock Bass	3.44	3.94	2.97	2.72	1.64	0.67	2.00	1.31	2.20
Pumpkinseed	1.28	0.33	0.17	0.17	0.17	--	--	--	--
Bluegill	0.02	--	--	0.03	--	--	0.07	--	--
Smallmouth Bass	0.76	0.47	0.67	0.28	0.44	0.27	0.27	0.46	0.87
Largemouth Bass	0.19	1.53	--	0.69	0.22	--	0.13	--	0.27
Black Crappie	0.04	--	--	0.08	0.03	--	--	--	--
Yellow Perch	16.92	20.64	16.67	9.36	6.50	11.80	8.80	5.23	8.20
Walleye	0.58	0.78	0.81	0.47	1.08	0.80	1.13	1.00	0.87
Freshwater Drum	0.01	--	--	0.03	--	--	--	--	--
All Species	29.06	30.03	23.14	15.14	11.30	14.41	14.60	9.30	14.67
Count of Species	12.85	14	12	20	14	9	12	9	13

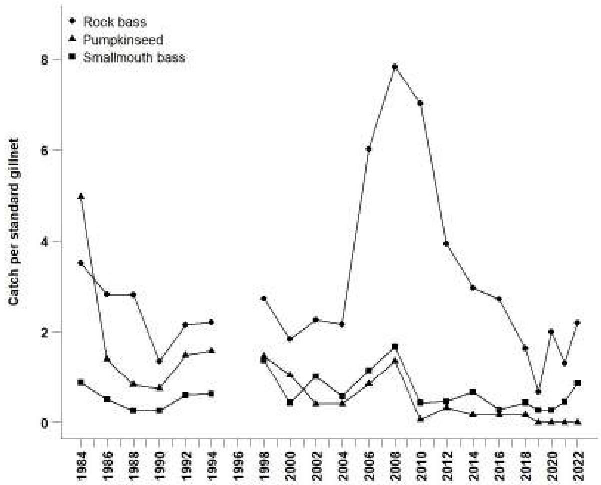


FIG. 1.8.5. Rock Bass (circle), Pumpkinseed (triangle) and Smallmouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 - 2022.

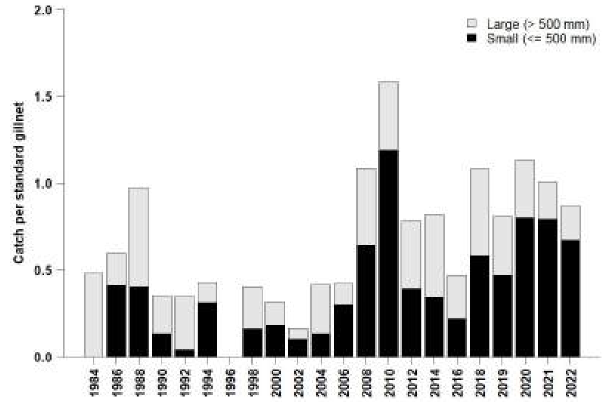


FIG. 1.8.8. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Walleye in the Lake St. Francis community index gill netting program, 1984 – 2022. Survey was not conducted in 1996.

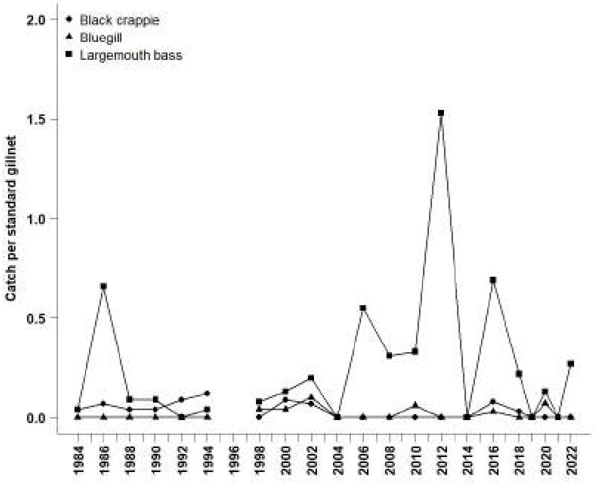


FIG. 1.8.6. Black Crappie (circle), Bluegill (triangle) and Largemouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 – 2022.

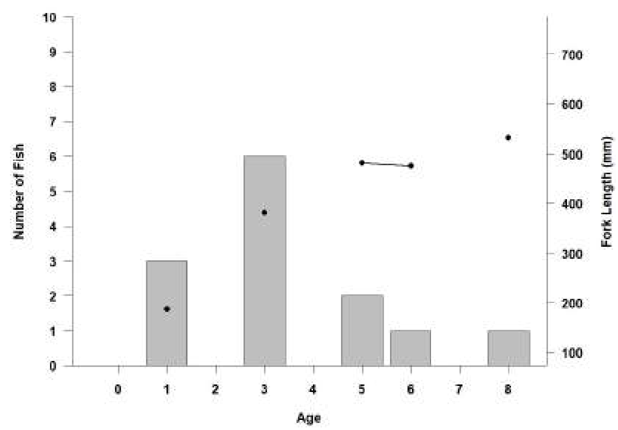


FIG. 1.8.9. Age distribution (bars) and mean fork length (circles) at age of Walleye caught in Lake St. Francis, 2022.

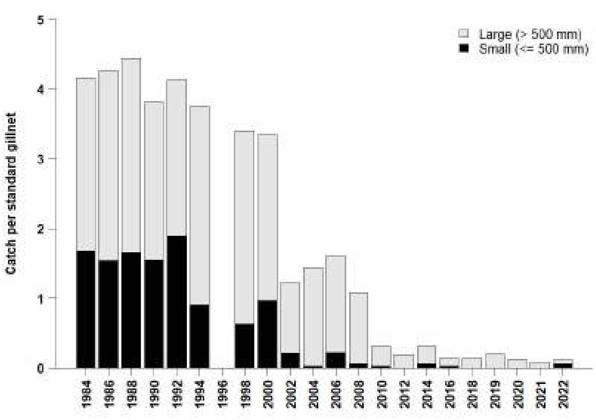


FIG. 1.8.7. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Northern Pike in the Lake St. Francis community index gill netting program, 1984 – 2022. Survey was not conducted in 1996.

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

M. J. 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 2022, the survey was conducted between September 6th and September 14th. 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 1,112 fish comprising 19 species (summary in Table 1.9.1). The average number of fish per set was 44.48; an increase from the previous 10-year average (31.88 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 2022, Yellow Perch catches increased 32% from 2021 catch estimates to 24.64 fish per net and represented 55% 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 2022 Thousand Islands survey are above the

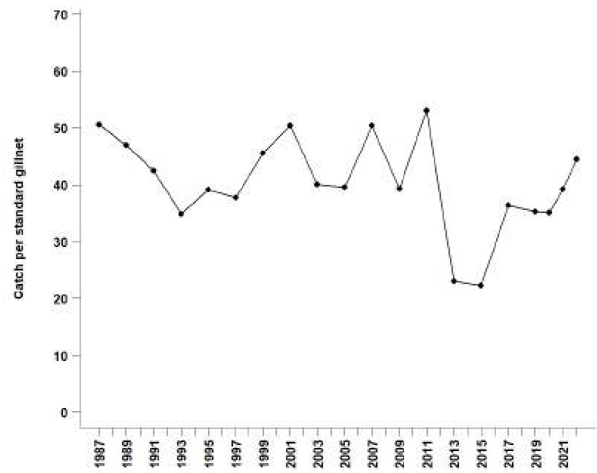


FIG. 1.9.1. Total number of fish (all species) per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

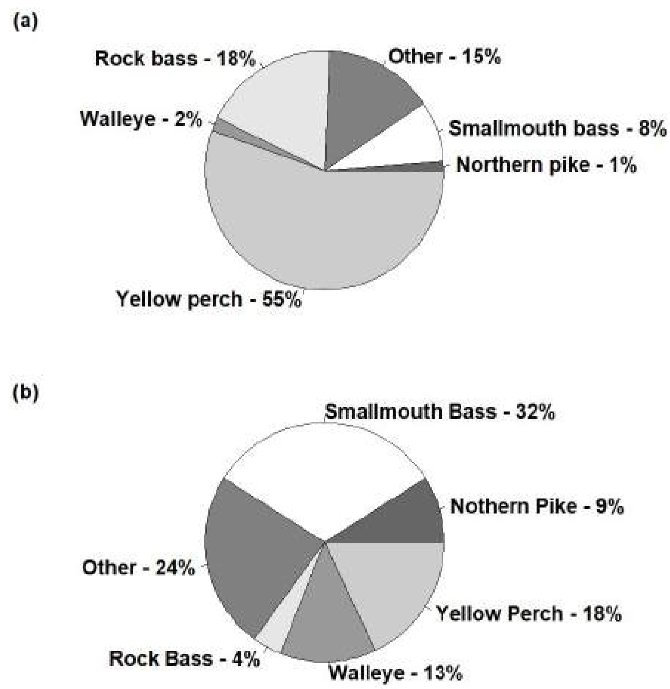


FIG. 1.9.2. Species composition by (a) catch and (b) biomass in the 2022 gillnet survey in the Thousand Island area of the St. Lawrence River.

previous 10-year average (average of 18.13 from 2012 to 2021). Age distributions and mean length at age for 2022 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). Rock Bass were the most abundant centrarchid species in the 2022 survey, representing 18% of the total catch by number, whereas Smallmouth Bass represented 32% of the total biomass (Figs. 1.9.2 and 1.9.4). Catches of Smallmouth Bass in 2022 declined from 2021 representing the second consecutive decline since a peak in 2020 (Fig. 1.9.4). Length at age for Smallmouth Bass is comparable to the time series average for age-1 fish, while age-3 and age-5 length at age are above the time series average (Table 1.9.3 and Fig. 1.9.6). Size at age-3 and age -5 has increased through the time series for Smallmouth Bass, while size at age-1 has remained stable (Fig. 1.9.6). Catches of Pumpkinseed increased slightly in 2022. While catches of Pumpkinseed are still low, the increase in 2022 is the first increase in catch per net in over 20 years (Fig. 1.9.4). Bluegill, Largemouth Bass and Black Crappie were historically at much lower levels than the former three species. Largemouth Bass catches in 2022 increased from the previous survey and are above the previous 10 -year average (0.33 fish per net; Fig 1.9.5).

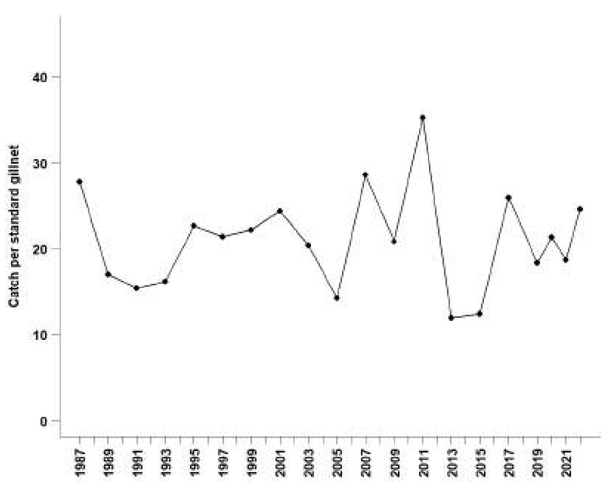


FIG. 1.9.3. Yellow Perch catch per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

Northern Pike

Northern Pike remain at low levels, reached after a slow steady decline spanning almost the entire history of the Thousand Islands survey (Fig. 1.9.7). Total catches of Northern Pike in 2022 were consistent with the previous five surveys dating back to 2015 (Fig. 1.9.7). Catches of small Northern Pike (≤ 500 mm) have been limited over the past 15 surveys, with one being caught in 2022 (Fig 1.9.7). Condition as determined by mean lengths of age-4, age-5 and age-6 Northern Pike was mixed in 2022 with age-4, age-5 and age -6 condition being below, comparable and above (respectively) the time-series average (Fig. 1.9.8 and Tables 1.9.2 and 1.9.3). In general, Northern Pike condition has remained above the time-series average over the past five surveys.

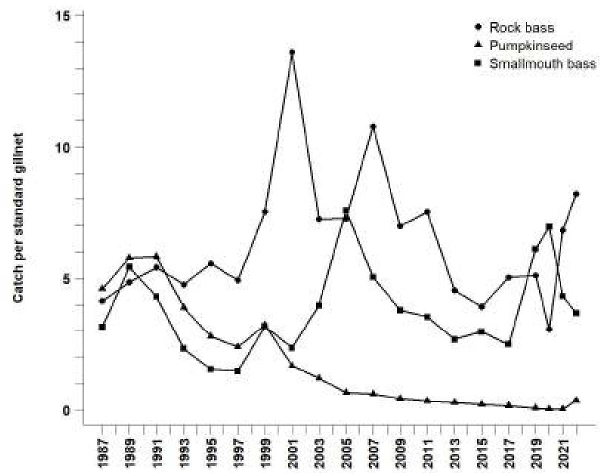


FIG. 1.9.4. Rock Bass (circle), Pumpkinseed (triangle) and Smallmouth Bass (square) catches per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

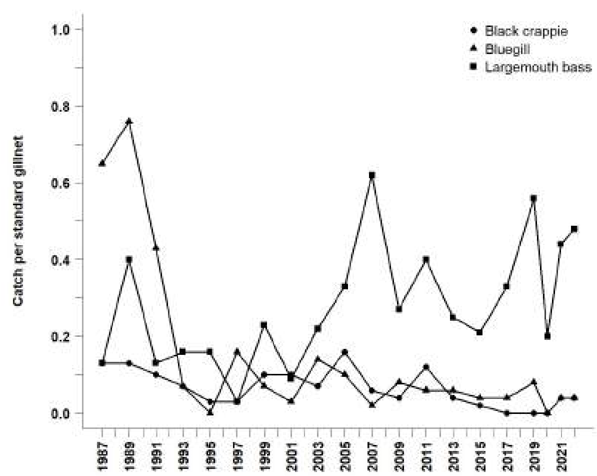


FIG. 1.9.5. Black Crappie (circle) Bluegill (triangle) and Largemouth Bass (square) catches per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

Walleye

Walleye represented 2% of the total catch and 13% of total biomass caught in 2022 with 20 individuals caught. The average catch per net was 0.80, which is above the previous 10-year average (0.62 Walleye per gill net). Catches of small (≤ 500 mm) and large (>500 mm) fish remain stable with 44% and 36% of the catch representing small and large fish (respectively; Fig. 1.9.9). Walleye ages ranged from 2 to 24 years old (Table 1.6.2).

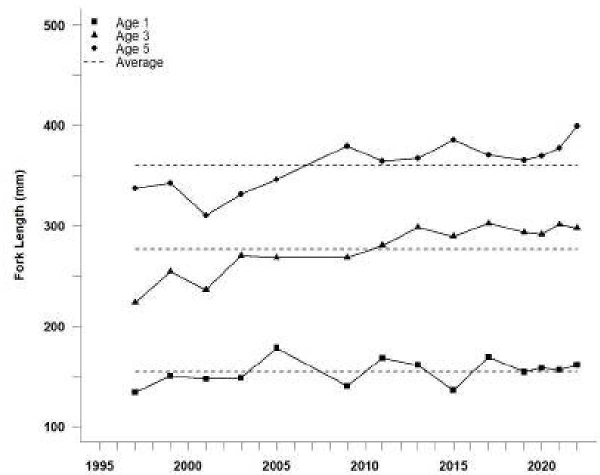


FIG. 1.9.6. Mean fork length (mm) of age-1 (square), age-3 (triangle) and age-5 (circle) Smallmouth Bass from 1997 to 2022. Dashed lines represent the average fork length from 1997 to 2022 for the aforementioned ages.

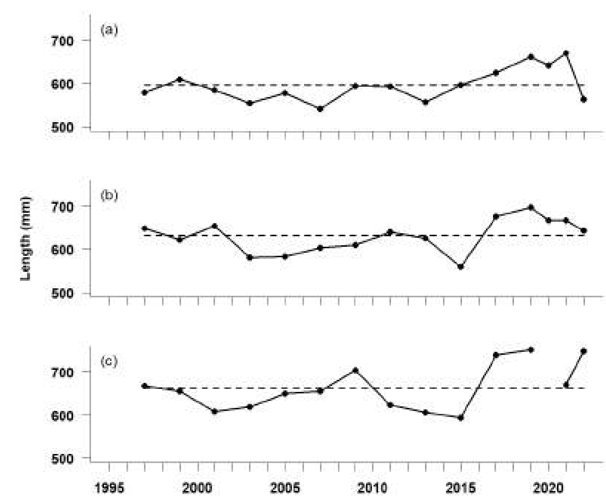


FIG. 1.9.8. Mean fork length (mm) of (a) age-4, (b) age-5 and (c) age -6 Northern Pike from 1997 to 2022. Dashed lines represent the average fork length from 1997 to 2022 for the aforementioned ages.

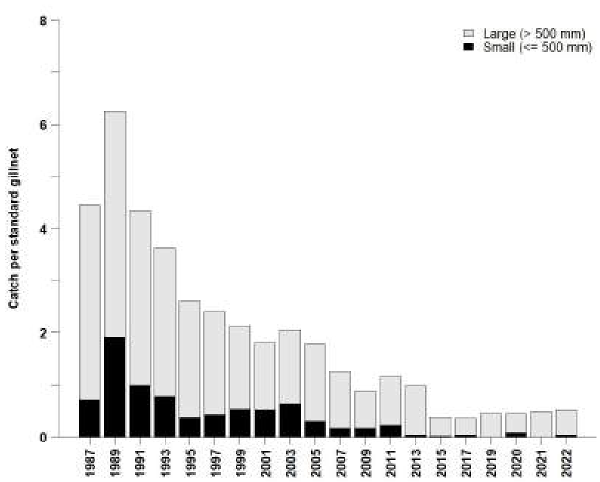


FIG. 1.9.7. Catches of small (≤ 500 mm fork length) and large (> 500 mm fork length) of Northern Pike per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

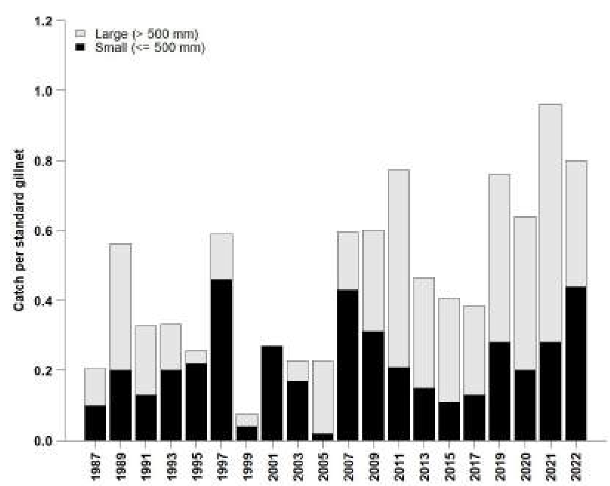


FIG. 1.9.9. Catches of small (≤ 500 mm fork length) and large (> 500 mm fork length) of Walleye per standard gillnet set in the Thousand Islands area of the St. Lawrence River, 1987-2022.

TABLE 1.9.1. Catches per standard gill net set in the Thousand Islands area of the St. Lawrence River, 1987-2022. 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.

Species	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019	2020	2021	2022
Lake sturgeon	--	--	--	--	--	--	0.04	--	0.02	0.02	0.02	0.05	0.05	--	--	--	0.12	--	0.04	0.04
Longnose gar	--	--	0.04	--	--	0.04	--	--	0.08	0.05	--	0.04	0.05	--	--	--	0.08	0.08	--	--
Bowfin	0.08	0.10	--	0.08	0.04	0.07	--	0.02	0.08	0.06	0.09	0.07	0.13	0.02	0.02	0.02	0.04	0.08	--	--
Alewife	0.49	--	0.11	0.04	0.04	--	--	--	--	0.02	0.14	0.07	--	0.12	0.27	0.46	1.32	--	0.52	0.4
Gizzard shad	--	0.38	0.52	--	--	--	0.04	0.11	--	0.05	0.02	--	0.09	0.14	0.12	0.08	--	0.12	5.64	0.72
Chinook salmon	--	--	0.04	--	--	--	0.04	0.04	--	--	--	--	0.03	--	--	--	--	--	--	--
Rainbow trout	--	--	--	--	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Brown trout	--	0.04	--	--	--	--	--	--	--	--	--	--	0.04	0.02	--	--	--	--	--	--
Lake trout	--	0.20	--	0.19	0.15	0.16	--	--	--	--	--	--	--	--	--	0.02	--	--	--	--
Lake herring	--	0.04	--	--	0.07	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chub	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern pike	4.46	7.10	4.79	4.20	2.80	2.69	2.37	2.00	2.26	1.97	1.42	0.97	1.29	1.10	0.43	0.35	0.44	0.44	0.48	0.52
Muskellunge	--	--	0.04	--	0.04	--	--	0.02	0.04	--	--	--	--	--	--	--	--	--	0.04	--
Chain pickerel	--	--	--	--	--	--	--	--	--	--	--	0.02	--	--	--	--	--	--	--	--
White sucker	1.09	2.27	1.50	1.74	1.55	1.38	1.96	1.06	1.05	0.70	0.43	0.27	0.66	0.30	0.22	0.33	0.4	0.2	0.28	0.52
Silver redhorse	--	--	--	--	--	--	0.25	0.05	--	0.07	0.07	0.02	0.13	0.07	0.03	--	0.04	--	--	--
Shorthead redhorse	--	--	--	--	--	--	--	--	--	0.04	--	--	--	--	--	--	--	--	--	--
Greater redhorse	--	--	--	--	--	--	--	0.05	0.12	--	--	--	--	--	--	--	--	--	--	--
Moxostoma sp.	--	0.15	0.08	0.16	0.36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Common carp	0.05	0.11	0.11	0.04	0.11	0.42	0.14	0.13	0.13	0.04	0.02	--	0.05	--	--	--	0.04	0.04	0.04	0.08
Golden shiner	0.05	0.03	--	0.08	0.04	--	0.04	--	--	0.05	0.07	0.36	0.13	0.09	0.24	0.42	0.12	0.36	0.16	0.68
Fallfish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.12
Brown bullhead	2.56	2.04	2.76	1.18	1.06	2.09	4.24	4.64	2.97	5.16	1.27	4.09	1.86	0.66	0.52	0.17	1.24	1.04	0.44	2.4
Channel catfish	0.81	0.15	0.59	0.19	0.33	0.33	0.65	0.35	0.39	0.22	0.74	0.61	0.69	0.29	0.22	--	0.08	0.08	--	--
White perch	0.08	--	0.43	0.04	0.07	--	0.08	0.18	0.02	0.16	--	--	--	0.12	--	--	0.04	0.04	0.04	0.2
White bass	0.05	0.83	0.47	0.27	--	0.08	--	--	--	--	--	--	0.32	--	0.03	--	0.04	0.04	--	--
Rock bass	4.14	5.68	5.90	5.53	6.16	5.60	8.39	14.94	8.26	7.99	12.16	7.88	8.49	5.24	4.50	5.04	5.12	3.08	6.84	8.2
Pumpkinseed	4.61	6.62	6.45	4.51	3.07	2.56	3.73	1.86	1.33	0.74	0.70	0.47	0.38	0.33	0.23	0.17	0.08	0.04	0.04	0.36
Bluegill	0.65	0.89	0.48	0.07	--	0.20	0.07	0.04	0.14	0.10	0.02	0.09	0.07	0.07	0.05	0.04	0.08	--	0.04	0.04
Smallmouth bass	3.16	6.21	4.78	2.70	1.66	1.66	3.45	2.58	4.59	8.38	5.72	4.30	3.97	3.07	3.42	2.5	6.12	6.96	4.32	3.68
Largemouth bass	0.13	0.44	0.15	0.20	0.19	0.03	0.26	0.10	0.23	0.36	0.71	0.30	0.41	0.28	0.23	0.33	0.56	0.2	0.44	0.48
Black crappie	0.13	0.14	0.11	0.08	0.04	0.04	0.11	0.11	0.08	0.17	0.07	0.05	0.13	0.05	0.02	--	--	--	0.04	0.04
Yellow perch	27.79	19.26	17.07	18.85	24.52	23.53	24.89	27.29	22.80	15.81	32.28	23.83	39.65	13.72	14.42	25.96	18.36	21.36	18.68	24.64
Walleye	0.21	0.62	0.37	0.37	0.28	0.68	0.07	0.30	0.27	0.25	0.69	0.67	0.88	0.52	0.45	0.38	0.76	0.64	0.96	0.8
Round goby	--	--	--	--	--	--	--	--	--	0.86	0.22	0.21	0.02	0.02	0.05	0.02	0.12	0.16	0.08	--
Freshwater drum	--	0.04	0.11	--	0.04	0.11	--	0.12	0.05	0.33	0.04	0.24	0.13	0.10	0.22	0.02	0.12	0.16	0.08	0.56
Total Catch	50.54	53.38	46.90	40.52	42.62	41.71	50.82	55.99	44.91	43.60	56.90	44.61	59.65	26.33	25.69	36.31	35.32	35.12	39.20	44.48

TABLE 1.9.2. Age distribution of selected species caught in the 2022 Thousand Islands Community Index Gill Netting program.

	Year-class/Age																								
	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Species	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Yellow Perch	--	--	31	34	39	29	4	6	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Walleye	--	--	11	--	1	--	--	1	--	--	--	--	--	--	--	1	--	3	1	1	--	--	--	--	1
Northern Pike	1	--	1	1	2	3	1	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Smallmouth	--	17	18	11	10	5	15	4	7	3	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 1.9.3. Mean fork length (mm) of selected species caught in the 2022 Thousand Islands Community Index Gill Netting program.

	Year-class/Age																								
	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Species	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Yellow Perch	--	--	163	171	211	228	266	264	280	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Walleye	--	--	375	--	502	--	--	580	--	--	--	--	--	--	--	650	--	668	631	695	--	--	--	--	584
Northern Pike	225	--	545	615	565	643	749	731	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Smallmouth Bass	--	161	239	297	332	399	408	423	449	473	467	--	--	--	--	--	--	--	--	--	--	--	--	--	--

1.10 Spring Muskellunge Netting

C. Lake, Lake Ontario Management Unit

The Spring Muskellunge Netting (SMN) program was conducted for the first time in 2022. The goal of the program is to acquire information on the distribution, relative abundance and biological characteristics of Muskellunge (*Esox masquinongy*) populations in the Canadian waters of the upper St. Lawrence River. SMN utilizes live capture trap net or hoop net gear set in areas of known or presumed Muskellunge spawning habitat. Captured fish are PIT-tagged and biological metrics such as sex, condition, length and weight are recorded. In 2022, the SMN program was conducted from the east end of Wolfe Island downstream to approximately Landon's Bay (Fig. 1.10.1).
The 2022 program ran for a total of 19 days over four weeks (May 2nd - May 27th). A total of 76 nets were set (Table 1.10.1).

Catches varied by species and gear (Table 1.10.2), and by project week (Table 1.10.3). Esocids are featured in bold text. During the netting period, water temperature warmed quickly. Temperature data were collected on each lift day, and is presented in (Fig. 1.10.2).

TABLE 1.10.1. Number of net sets by type and week.

Week	Hoop Net	Trap Net	Total
1	4	11	15
2	4	15	19
3	8	16	24
4	6	12	18
Total	22	54	76

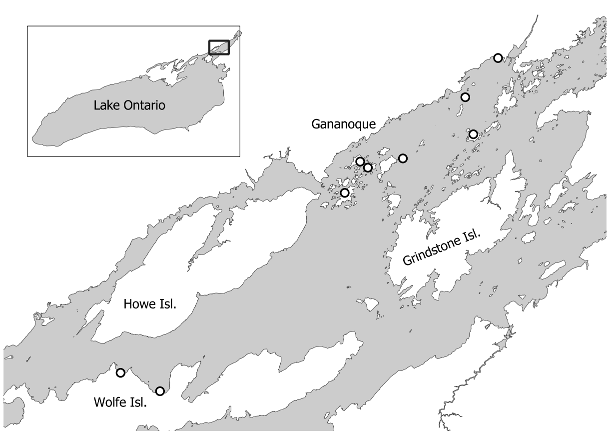


FIG. 1.10.1. Spring Muskellunge netting sites (open circles).

TABLE 1.10.2. Numbers of fish captured by species and gear.

Species	Hoop	Trap	Total
Rock Bass	298	712	1,010
Brown Bullhead	83	565	648
Yellow Perch	136	230	366
Northern Pike	**27**	**264**	**291**
White Sucker	0	92	92
Bowfin	31	59	90
Smallmouth Bass	3	71	74
Pumpkinseed	31	29	60
Blue Gill	34	6	40
Largemouth Bass	8	8	16
Muskellunge	**0**	**6**	**6**
Common Carp	1	3	4
Longnose Gar	1	2	3
American Eel	0	2	2
Chain Pickerel	**1**	**0**	**1**
Golden Shiner	0	1	1
Total	654	2,050	2,704

TABLE 1.10.3. Numbers of fish captured by species and week.

Species	1	2	3	4	Total
Rock Bass	51	154	528	277	1,010
Brown Bullhead	53	194	122	279	648
Yellow Perch	11	297	46	12	366
Northern Pike	**97**	**98**	**65**	**31**	**291**
White Sucker	5	50	30	7	92
Bowfin	75	5	6	4	90
Smallmouth Bass	2	25	25	22	74
Pumpkinseed	10	19	20	11	60
Blue Gill	2	35	1	2	40
Largemouth Bass	6	7	2	1	16
Muskellunge	**1**	**1**	**0**	**4**	**6**
Common Carp	1	2	0	1	4
Longnose Gar	1	0	0	2	3
American Eel	0	0	0	2	2
Chain Pickerel	**0**	**1**	**0**	**0**	**1**
Golden Shiner	1	0	0	0	1

Muskellunge are the target species of this project, however, the other Esocids (Northern Pike, *Esox lucius* and Chain Pickerel, *Esox niger*) are also of interest. Northern Pike were abundant and in spawning condition at the beginning of the survey, and catches appear to reflect the peak and decline of spawning activity (Fig. 1.10.3).

Chain Pickerel were first documented in Ontario waters in 2008 (Hoyle & Lake, 2011). During the 2022 survey, one Chain Pickerel was captured in a hoop net.

A total of 6 Muskellunge were captured during the 2022 program (Table 1.10.4). Muskellunge were captured in the first and second week (one fish each week), and four were captured during the last week.

TABLE 1.10.4. Biological data for captured Muskellunge.

Week	Total Length (mm)	Weight (g)	Sex	Condition
1	936	6,500	male	fully dev.
2	981	6,000	male	fully dev.
4	1,211	12,800	male	spawning
4	1,115	9,700	female	spawning
4	1,375	22,300	female	spawning
4	1,182	12,400	male	fully dev.

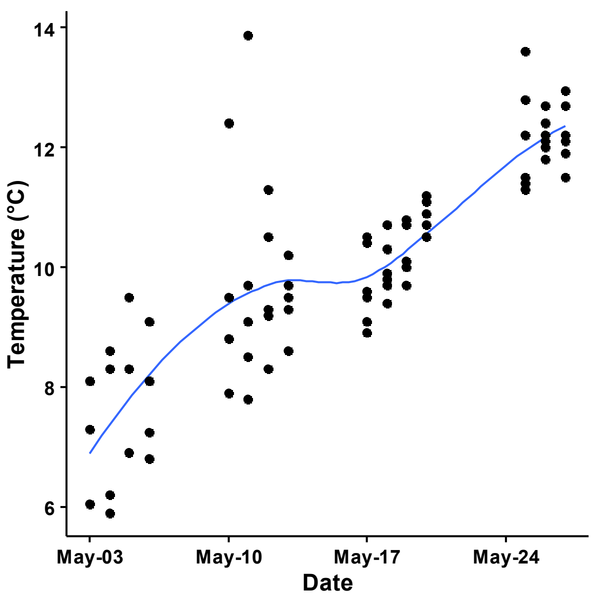


FIG. 1.10.2. Temperature recorded at net lift.

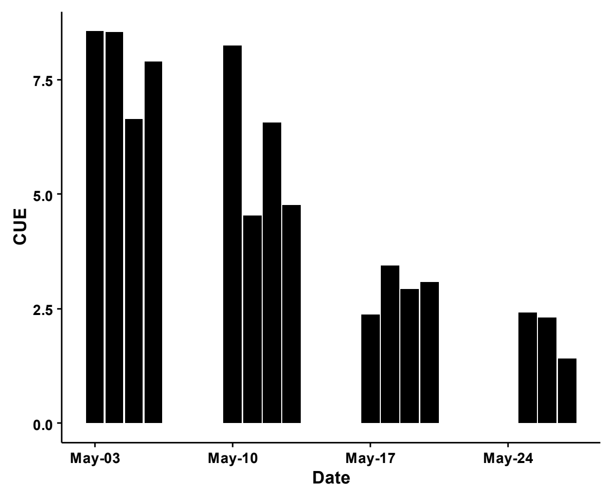


FIG. 1.10.3. Northern Pike catch per unit effort (24hrs) for all gear types combined.

Reference

Hoyle, J. A., & Lake, C. (2011). First occurrence of Chain Pickerel (*Esox niger*) in Ontario: possible range expansion from New York waters of eastern Lake Ontario. *The Canadian Field-Naturalist*, *125*(1), 16-21.

1.11 Juvenile Chinook Salmon Assessment

M.J. Yuille, Lake Ontario Management Unit

In recent years, the Lake Ontario Chinook Salmon Mass Marking Study estimated an average of 50% of the Chinook Salmon in Lake Ontario originated from agency stocking programs and the remainder were of naturalized origin. In addition, many naturalized Chinook Salmon have been collected during electrofishing programs conducted in Lake Ontario tributaries. In 2014, a program was initiated to assess naturalized production of juvenile Chinook Salmon in Lake Ontario streams. This program was based on previous surveys conducted during spring 1997 to 2000.

In 2017, modifications to the survey resulted in the sampling of six Lake Ontario tributaries, which included: Bronte Creek, Credit River, Duffins Creek, Wilmot Creek, Ganaraska River and Shelter Valley Creek. The 2022 Juvenile Chinook Salmon assessment program was conducted in accordance to the changes made in 2017. Each of the six Lake Ontario tributaries were electrofished with the objectives of: providing presence/absence data regarding natural production of juvenile salmonids and collecting Chinook Salmon smolts for otolith microchemistry research. At a coarse level, this technique may be used to distinguish between stocked and naturalized fish based on the chemical composition of the otolith, allowing us to track the contribution of naturalized fish to the Lake Ontario recreational fishery without the need of fin clips. Once refined, this technique may allow the Lake Ontario Management Unit to determine which tributaries naturally produced salmon and trout originate.

During 2022, juvenile Chinook Salmon were surveyed by electrofishing in six Lake Ontario tributaries (Table 1.11). The survey took place on four days during May 9th to May 12th, 2022. With the exception of Bronte Creek and Credit River, only one site was visited per tributary.

Age-0 Chinook Salmon were caught in all six tributaries visited (Table 1.11). Age-0 Coho were caught at Wilmot Creek. In 2022, field crews targeted Chinook Salmon smolts for the otolith microchemistry project, thus only observed catches of Chinook and Coho Salmon have been reported (Table 1.11). The otoliths from these fish provide a microchemical baseline representing the tributary in which they were collected. Results will be made available in the following years.

Year to year variability in abundance of Chinook Salmon in Lake Ontario streams is still not well understood. Moreover, a widespread increase in Chinook Salmon abundance across streams may be consistent with ecosystem changes in Lake Ontario over the last 20 years. Assessment of naturalized Chinook Salmon production in streams should provide additional insights into wild and naturalized fish production. Additionally, this program is providing essential baseline information for the development of a new assessment technique that will aid in estimating Chinook Salmon natural production in Lake Ontario.

TABLE 1.11. Location, sampling date and catch by species of Age-0 Chinook and Coho Salmon in Lake Ontario tributaries during electrofishing surveys in 2022.

				Chinook Salmon		Coho Salmon	
Site	**Latitude**	**Longitude**	**Date**	**Caught**	**Otoliths Collected**	**Caught**	**Otoliths Collected**
	Bronte Creek						
BN01	43°26.10' N	79°54.02' W	May 9	33	32	-	-
BN04	43°24.39' N	79°44.42' W	May 9	14	13	-	-
	Credit River						
CR01	43°37.45' N	79°44.13' W	May 10	16	16	-	-
			May 11	22	22	-	-
CR08	43°38.59' N	79°46.69' W	May 10	3	3	-	-
CR14	43°37.99' N	79°44.36' W	May 11	7	7	-	-
	Duffins Creek						
DU02	43°52.99' N	79°3.67' W	May 11	62	34	-	-
	Ganaraska River						
GN10	43°59.36' N	78°19.74' W	May 12	53	34	-	-
	Shelter Valley Creek						
SE07	43°59.29' N	78°0.11' W	May 12	63	33	-	-
	Wilmot Creek						
WM10	43°54.81' N	78°36.61' W	May 12	145	85	3	3

2. Recreational Fishery

2.1 Fisheries Management Zone 20 Council (FMZ 20) / 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. Over the past decade, the FMZ20 Council has been involved in renewing the Fish Community Objectives, developing a stocking plan, identifying issues and concerns, and acting as liaison to improve broader pubic awareness about the fishery.

FMZ20 Council members represent 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.

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.

Other groups help with the annual delivery of our stocking program through the operation of community-based hatcheries. The Napanee Rod and Gun Club, Credit River Anglers and Metro East Anglers stock various species including Rainbow Trout, Brown Trout and Coho Salmon. The Islington Sportsman Club, Belfountain Community Hatchery and Ontario Streams stock Atlantic Salmon.

Volunteers at the Ganaraska River-Corbett Dam Fishway assist MNRF staff to 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 Open-Water Angler Survey

S. Beech, Lake Ontario Management Unit

The Bay of Quinte open-water recreational angling survey was scheduled to begin on May 7th (Walleye angling "opening-weekend") but due to unforeseen circumstances didn't begin until June 18th, 2022 and was conducted until August 12th, 2022.

A roving survey design spanning from Trenton to Lake Ontario was implemented. 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. In 2022, sampling was stratified by geographic area (12 sampled out of 21; Fig. 2.2.1), season (three sampled: (1) May 7 - 8, (2) May 10 - Jun 17, (3) Jun 18 - Aug 12), and day-type (weekdays and weekend days). Only season three was sampled in 2022 and geographic area included zones 29-34 and 91-96 in the upper and middle Bay of Quinte, respectively. Sampling was conducted four days per week (two weekdays and both weekend days).

A total of 856 anglers in 439 boats were interviewed by field crews during the survey (Table 2.2.1). Of the anglers interviewed, 55% were local (Brighton to Gananoque, south of HWY 401), 43% were from Ontario (outside the local area), 1% were from elsewhere in Canada, and 1% were from USA. Total angling effort was estimated to be 54,997 angler hours for all anglers.

Anglers caught 18 different species (Table 2.2.2). Of the anglers interviewed, 50% indicated that they were targeting Walleye, 26% were targeting Largemouth Bass, 4% were targeting Northern Pike, 9% were targeting Smallmouth Bass, and 3% were targeting Yellow Perch. Fishing effort was 37,675 hours for anglers targeting Walleye, 3,057 hours for anglers targeting Northern Pike, 19,283 hours for anglers targeting Largemouth Bass, 6,909 hours for anglers targeting Smallmouth Bass, and 1,989 for anglers targeting Yellow Perch (Tables 2.2.2 and 2.2.3).

Numbers of Walleye caught and harvested were 15,233 and 9,814, respectively. Numbers of Walleye caught and harvested per hour by anglers targeting Walleye were 0.430 and 0.260, respectively. 9,488 and 1,309 Largemouth Bass were caught and harvested, respectively.

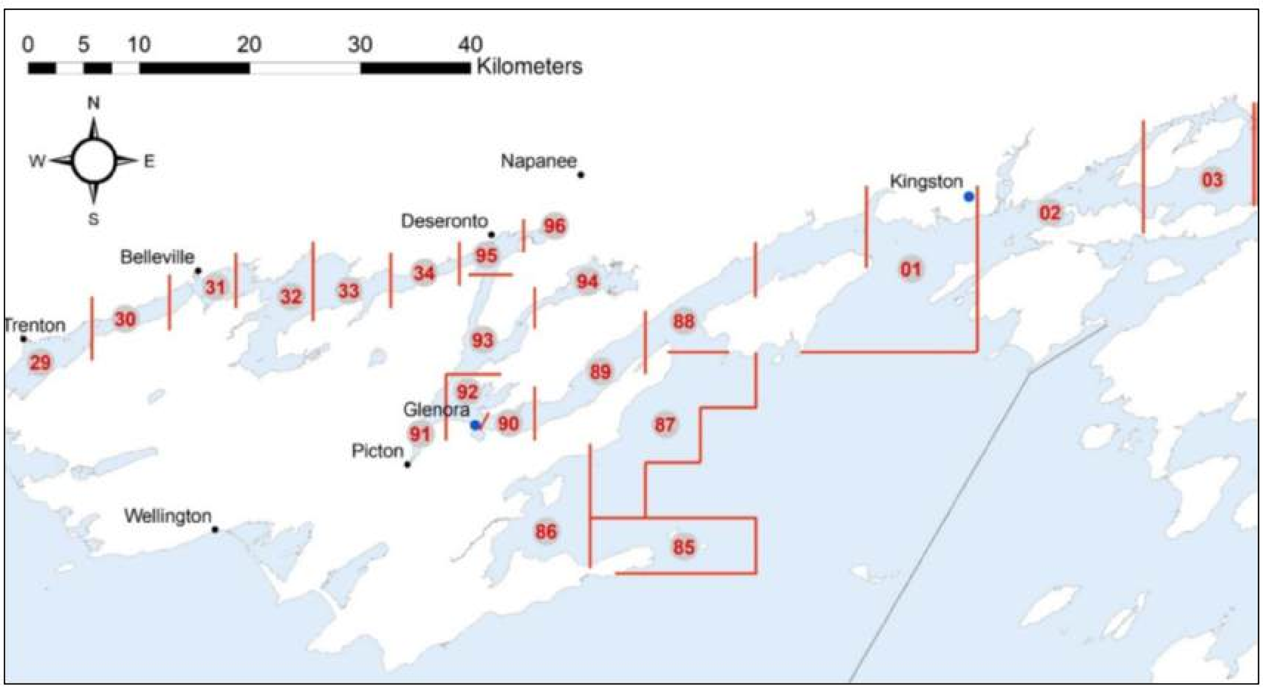


FIG. 2.2.1. Map of the Bay of Quinte - Eastern Lake Ontario showing angling survey areas. 2022 survey areas included zones 29-34 and 91-96 .

Largemouth Bass caught and harvested per hour by anglers targeting Largemouth Bass were 0.449 and 0.068, respectively. Anglers also caught and harvested 1,096 and 118 Northern Pike, respectively, as well as 1,495 and 0 Smallmouth Bass, respectively (Table 2.2.2 and 2.2.3). Open-water Walleye angling fishery trend statistics from 1988-2022 are shown graphically in Fig. 2.2.2 and from 1957-2022 in Table 2.2.4.

The regional patterns of Walleye, Largemouth Bass, Smallmouth Bass, Yellow Perch, Black Crappie, and Northern Pike angling effort are depicted in Fig. 2.2.3. Targeted Walleye angling in past sampling years was highest in May and June, but this period was not captured in 2022. Compared to 2019, season three targeted effort, catch, and harvest increased from 33,926, 11,484, and 7,850, respectively, in 2022.

The size distributions of Largemouth Bass and Yellow Perch harvested by anglers and sampled by field crews are shown in Fig. 2.2.4. Northern Pike were not included because only two fish were sampled. The size distribution of Walleye harvested in the upper and middle Bay of Quinte is shown in Fig. 2.2.6. The size distribution of Walleye (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. No Walleye >25 inches was sampled in 2022. The age distributions of Walleye and Largemouth Bass sampled are shown in Fig. 2.2.5. Age-2, 3 and 4 year-old Walleye dominated the harvest whereas age-2

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, 2022.

Total angling effort (hours)	54,997
Number of boats checked	439
Number of anglers interviewed	856
Anglers per boat	1.95
Rods per boat	1

TABLE 2.2.2. Species-specific statistics for the open-water recreational fishery on the Bay of Quinte 2022. 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 fish 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 Targeted
Bowfin	-	-	177	-	-	-	-
Lake whitefish	128	<0.01	13	1	13	1	0.101
Northern pike	3,057	0.04	1,096	0.62	118	0.11	0.221
Common carp	182	<0.01	0	-	-	-	-
Brown bullhead	-	-	10	-	-	-	-
Channel catfish	284	<0.01	175	0.35	62	0.35	0.218
White perch	809	0.01	9,939	0.28	2797	0.28	3.459
Rock bass	353	<0.01	1,196	0.5	150	0.13	1.691
Pumpkinseed	535	0.01	717	0.48	0	0	0.643
Bluegill	717	0.01	191	0	0	0	0
Smallmouth bass	6,909	0.09	1,495	0.69	0	0	0.148
Largemouth bass	19,283	0.26	9,488	0.91	1309	0.14	0.449
Black crappie	344	<0.01	332	0.4	133	0.4	0.388
Lepomis sp.	281	<0.01	7,657	0.08	97	0.01	2.231
Yellow perch	1,989	0.03	12,995	0.12	377	0.03	0.809
Walleye	37,675	0.5	15,233	1	9814	0.64	0.403
Round goby	-	-	36	-	-	-	-
Freshwater drum	1,058	0.01	5,230	0.11	186	0.04	0.54
Any species	1,830	0.02	-	-	-	-	-

TABLE 2.2.3. Angling statistics for Walleye, Largemouth Bass, and Northern Pike surveyed during the open-water recreational fishery on the Bay of Quinte, 2022. “Targeted” statistic refers to the anglers targeting the indicated species.

	Northern Pike	Largemouth Bass	Walleye
Catch by targeted anglers	675	8,657	15,173
Catch by all anglers	1,096	9,488	15,233
Harvest by targeted anglers	118	1,309	9,814
Harvest by all anglers	118	1,309	9,814
Targeted effort (angler hours)	3,057	19,283	37,675
Targeted effort (rod hours)	3,057	19,283	37,675
Targeted CUE	0.221	0.449	0.403
All anglers CUE	0.02	0.173	0.277
Targeted HUE	0.039	0.068	0.26
All anglers HUE	0.002	0.024	0.178

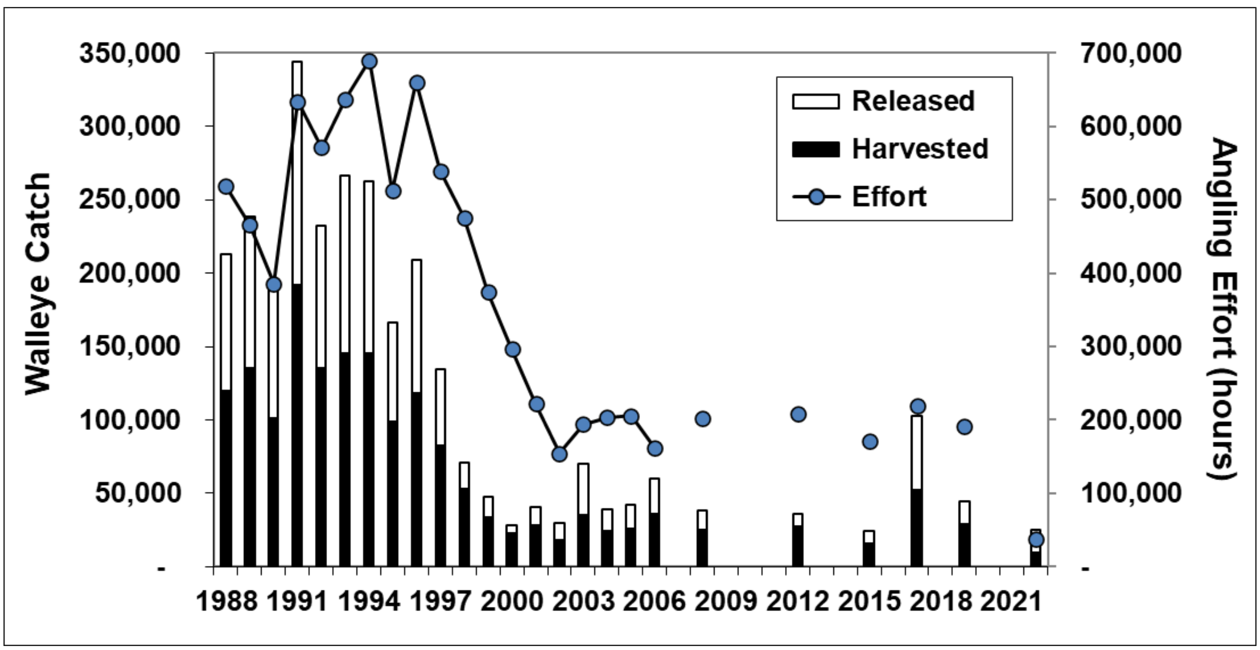


FIG. 2.2.2. Trends in Walleye angling effort and catch (release and harvested), 1988 - 2022 for the open-water recreational fishery on the Bay of Quinte (note 2017 and 2019 include the eastern Lake Ontario region and season 5 and 2022 only includes season 3).

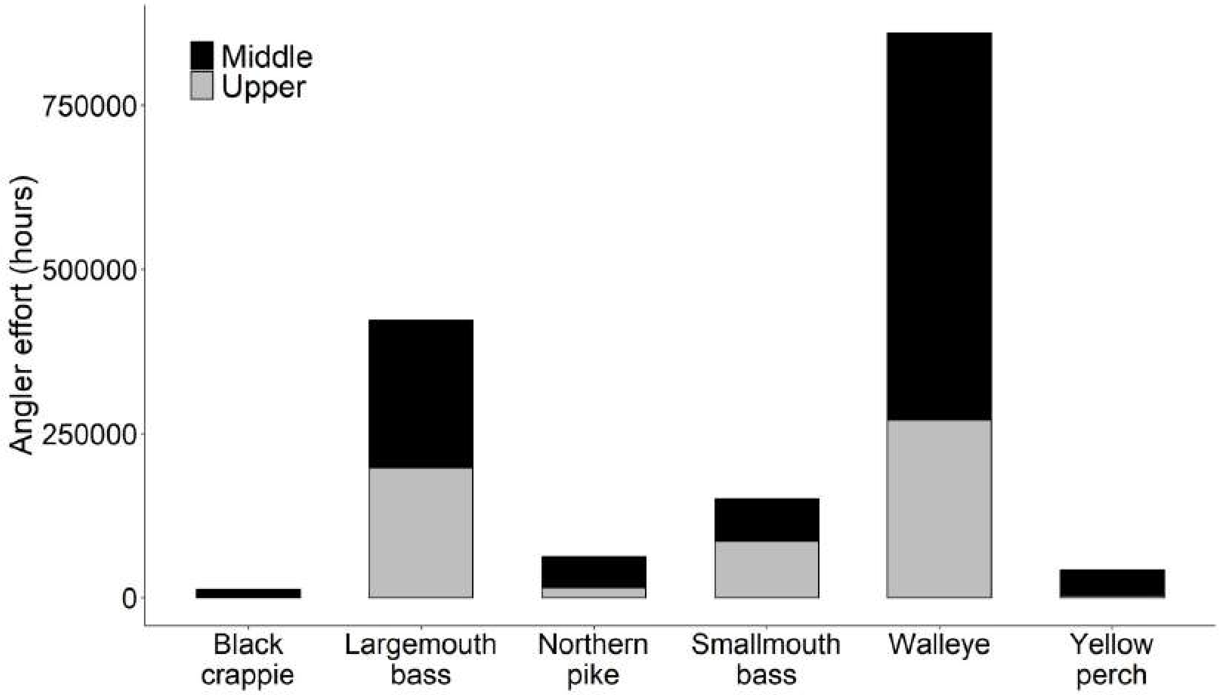


FIG. 2.2.3. Targeted Largemouth Bass, Northern Pike, Smallmouth Bass, Walleye, Yellow Perch and Black Crappie angling effort (hours) by region surveyed in the open-water recreational fishery on the Bay of Quinte, 2022 (regions include the survey areas as follows: Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91;).

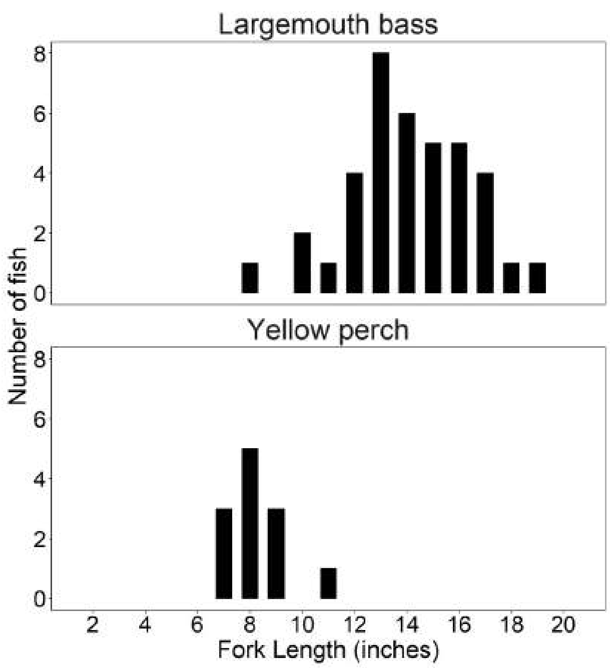


FIG. 2.2.4. Size distribution of Yellow Perch, and Largemouth Bass, sampled during the open-water recreational fishery on the Bay of Quinte, 2022.

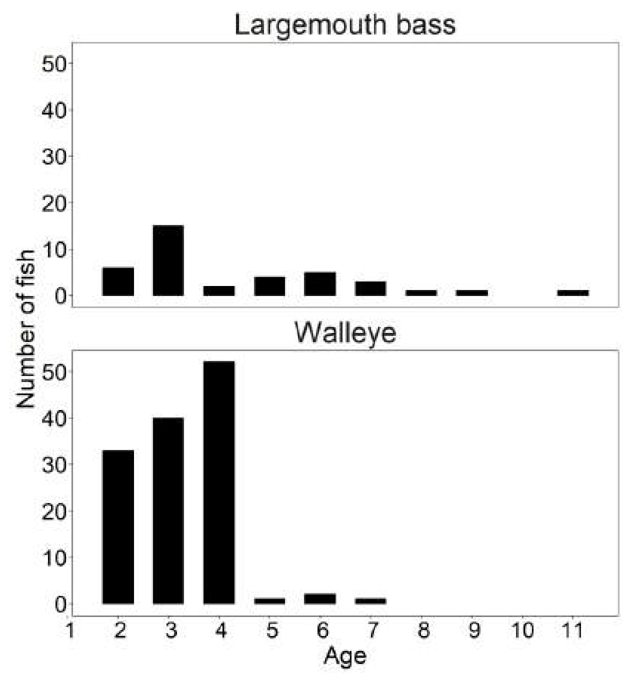


FIG. 2.2.5. Age distribution of Walleye, and Largemouth Bass sampled during the open-water recreational fishery on the Bay of Quinte, 2022.

TABLE 2.2.4. Bay of Quinte 1957-2022, 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
2022	54,997	37,675	0.403	0.260	15,173	9,814	0.795

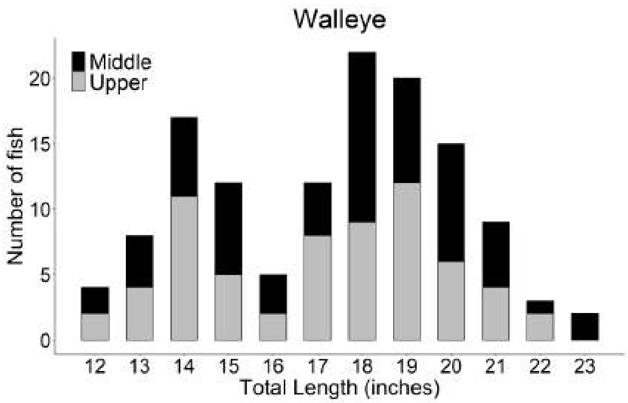


FIG. 2.2.6. Size distribution of Walleye sampled and reported harvested during the open-water recreational fishery on the Bay of Quinte, 2022. Also depicted is the survey areas where Walleye were sampled (Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91).

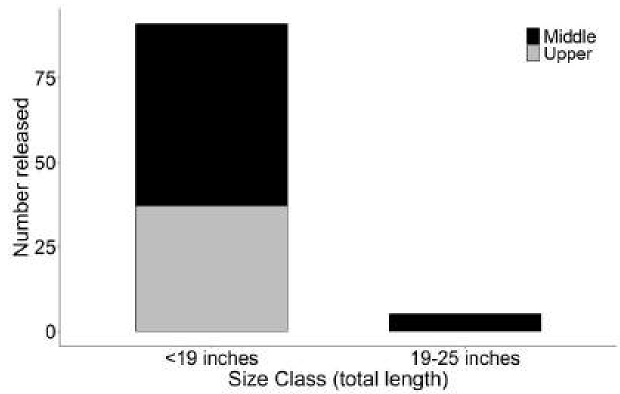


FIG. 2.2.7. Size distribution of Walleye reported to be released by anglers during the open-water recreational fishery on the Bay of Quinte, 2022. Also depicted is the survey areas where Walleye were sampled (Upper = 29, 30, 31, 32, 33, 34, 95, 96; Middle = 93, 94, 92, 91).

2.3 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) 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 September from the Niagara River to Wellington (Fig. 2.3.1). Typically, the LOMU angler survey ends in August, however in 2022, the month of September was included to extend the effort estimates to capture the staging fishery. The survey was temporally and spatially stratified by month and sectors (Fig. 2.3.1). 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 twice a week (one weekday and one weekend day). We limited interviews to the Niagara and Hamilton sectors (1 and 2, respectively; Fig. 2.3.1) in April and May, as past surveys indicated effort was sparse elsewhere during these months. Anglers were surveyed in all

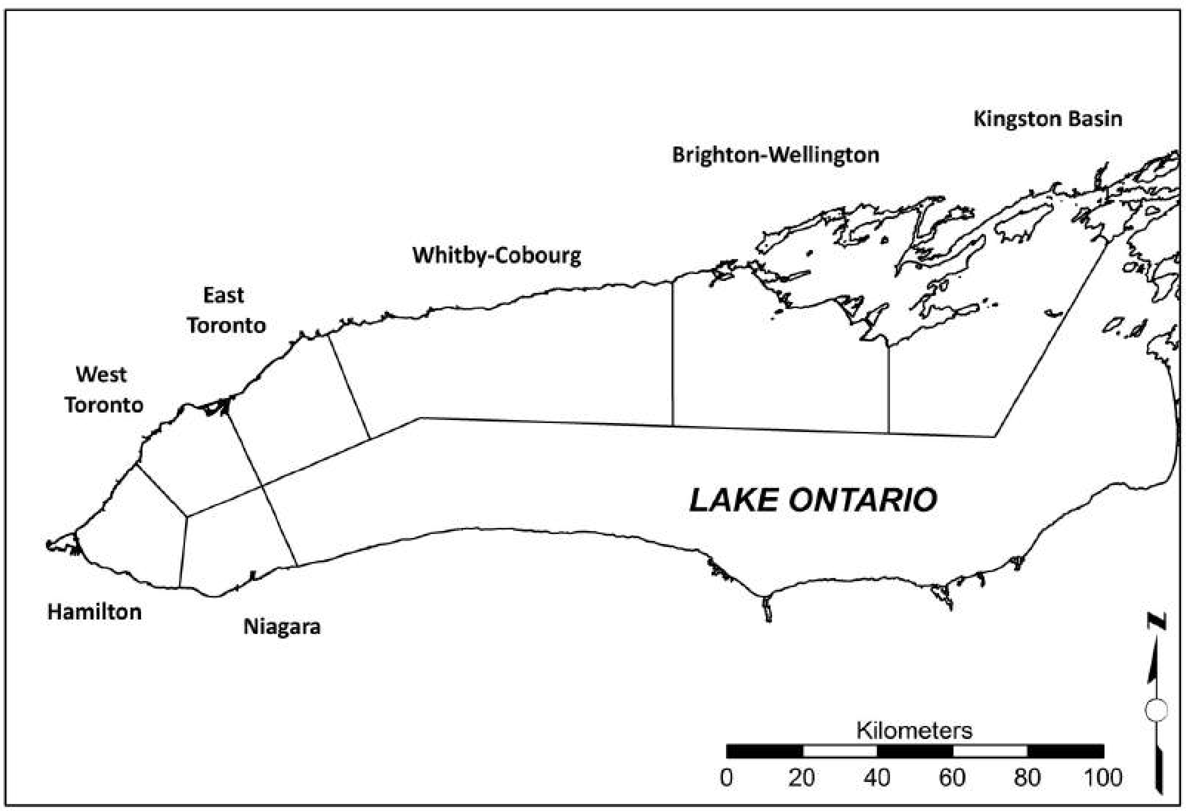


FIG. 2.3.1. Spatial stratification of OMNRF Western Lake Ontario Angler Survey. Kingston Basin was not surveyed in 2022.

sectors from June through to the end of September. Fishery statistics for marina-based anglers were estimated based on the 2011 marina-based fishery scaled to the 2022 ramp-based fishery.

Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario for 1977 to 2022 are provided in Table 2.3.1. Angling effort in 2022 (233,081 angler-hrs; Fig. 2.3.2) showed a decrease of approximately 30,000 angler-hrs from 2019 (Table 2.3.1 and Fig. 2.3.2). Overall fishing in 2022 showed increased catches in all species except Rainbow Trout, which has been relatively stable over the past three surveys (Table 2.3.1). Chinook Salmon represented the highest total catch (57,563), followed by Coho Salmon (22,513) and Rainbow Trout (21,309). Together they represented about 92% of the total catch of all salmon and trout species. In 2022, 91% of interviewed anglers were targeting salmon and trout. Of those anglers, anglers primarily targeted Chinook Salmon (57%), followed by Rainbow Trout (15%), Coho Salmon (14%), Lake Trout (8%), Brown Trout (5%) and Atlantic Salmon (2%; Fig. 2.3.4). Catch rates for the time series from 1977-2022 show major shifts in salmon and trout populations and the quality of angling in Lake Ontario (Fig. 2.3.4). In 2022, we continue to see catch rates increase for salmon and trout (in total) in Lake Ontario (Fig. 2.3.2). This has been driven by increases in Chinook and Coho catch rates over the past few years (Fig. 2.3.4 and Table 2.3.1).

Of the Chinook Salmon harvested in 2022, 51% were age-3, 33% were age-2 and 16% were age-1 (Fig. 2.3.5). Since 1995, the average age composition of Chinook harvested has been 25% age-1, 39% age-2, 34% age-3 and 2% age-4.

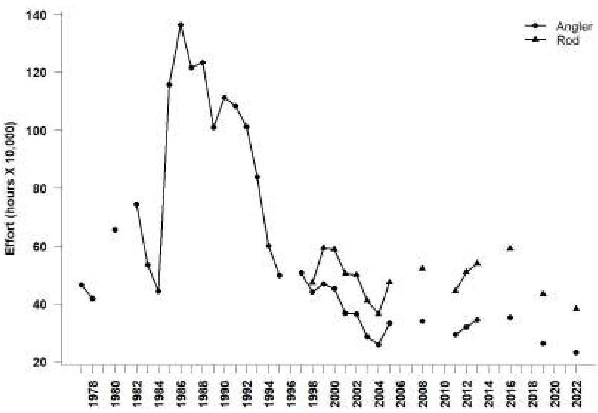


FIG. 2.3.2. Fishing effort (angler hours and rod hours) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2022. Anglers were only allowed to fish with one rod prior to 1998.

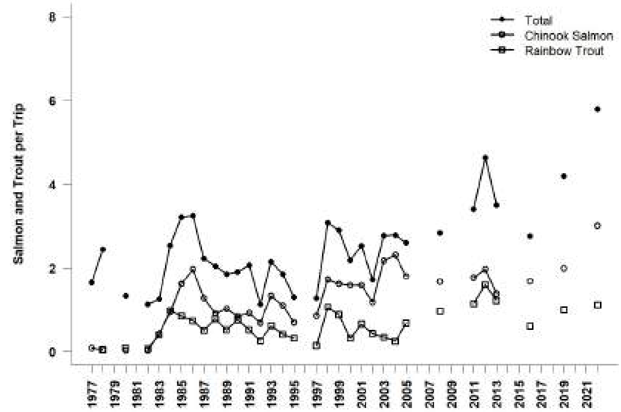


FIG. 2.3.4. The catch rate (number of fish per boat trip) of Chinook Salmon (open circle), Rainbow Trout (open square) and all salmon and trout (closed circle) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2022. A boat trip was defined as two anglers fishing with two rods each for five hours. These values depicting an average boat trip were derived from the Lake Ontario salmon and trout angler survey time series.

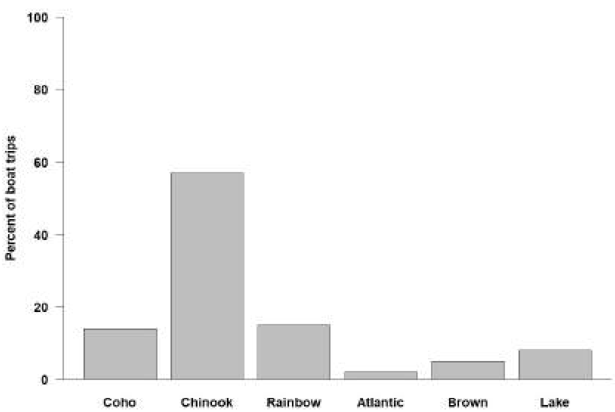


FIG. 2.3.3. The proportion of angling effort (angler hours) for specific salmon and trout species relative to the total estimated angling effort in 2022

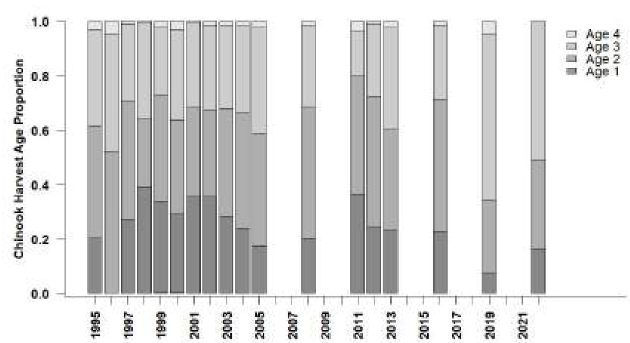


FIG. 2.3.5. Age proportions of harvested Chinook Salmon in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1995 to 2022.

TABLE 2.3.1. Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2022. 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
2022	57,563	21,309	22,513	942	1,305	6,973	21,815	12,733	14,184	44	1,021	1,151	382,447	233,081

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 not held in 2022, as in-person meetings had yet to resume following the COVID-19 pandemic. Topics typically covered at a CFAGM were instead addressed at the LOLC meeting later in the year.

The LOLC met on August 25 in Picton. Topics of discussion included commercial fish license administration updates, commercial harvest summaries, an overview of the spring eel trap and transport program and results of the 2022 turtle bycatch audit.

3.2 Quota and Harvest Summary

S. Beech, Lake Ontario Management Unit

Lake Ontario supports a commercial fish industry in 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 2022 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 2022, are shown in Tables 3.2.1 (base quota), 3.2.2 (issued quota), 3.2.3 (harvest, landed value, and price per pound).

The total harvest (landed value) of all species was 315,065 lb ($574,204) in 2022, down from 2021 (538,507 lb). The harvest (landed value) for Lake Ontario, the St. Lawrence River, and East and West Lakes was 228,995 lb ($416,340), 56,173 lb ($125,662), and 29,898 lb ($32,202). Yellow Perch, Lake Whitefish, and Sunfish were the dominant species in the harvest for Lake Ontario (including East and West Lakes) (Fig. 3.2.2). Yellow Perch was dominant in the St. Lawrence River followed by Sunfish (Fig. 3.2.3).

Fishery Trends

Annual harvest and landed value for Lake Ontario (including East and West Lakes) and the St. Lawrence River from 1993-2022 is shown in Fig 3.2.4. Commercial harvest declined in the early 2000s and appeared to stabilize between 2003-2013 at about 400,000 lb and 150,000 lb for

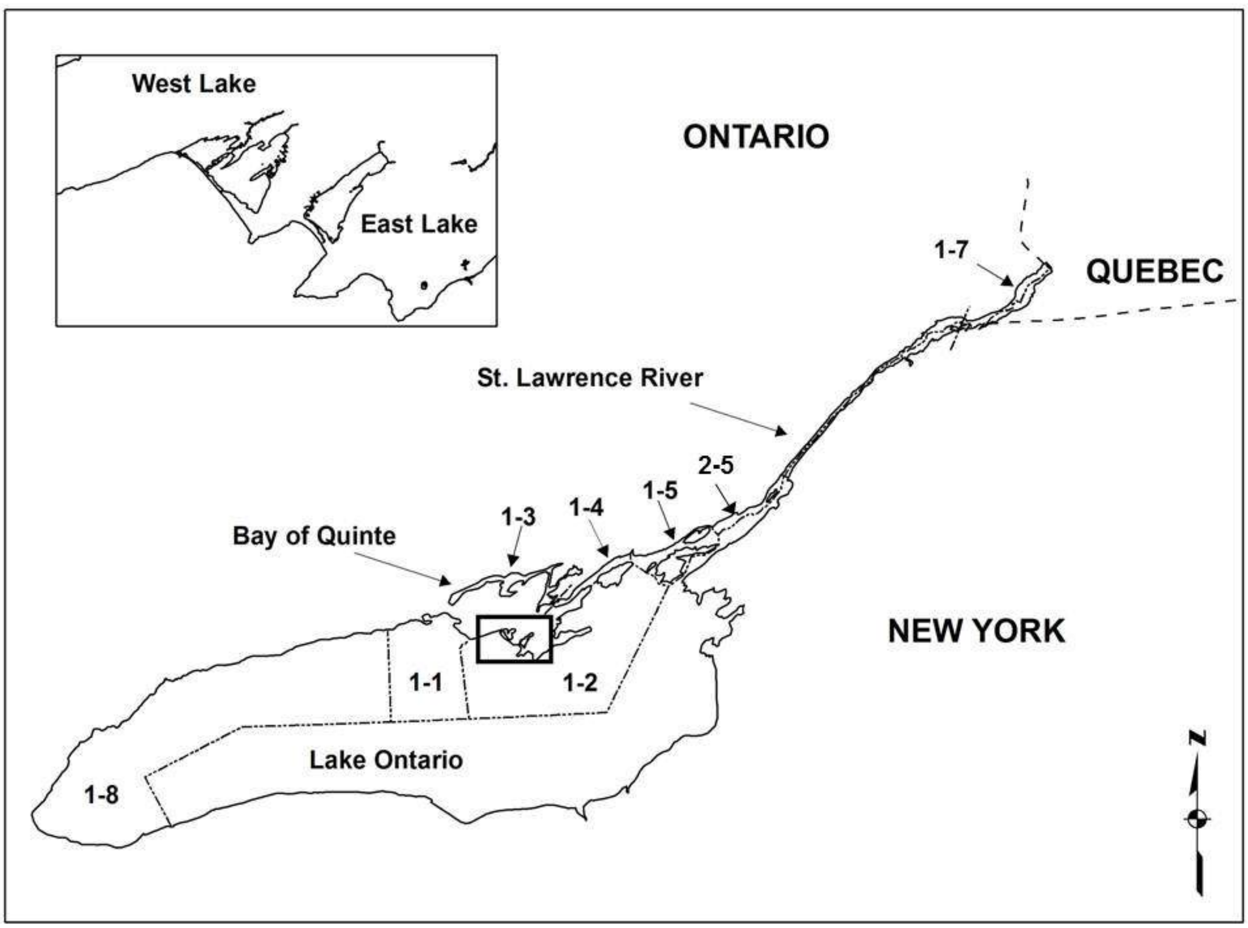


FIG. 3.2.1. Map of Lake Ontario and the St. Lawrence River showing commercial fishing quota zones in Canadian waters.

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), 2022.

	West Lake	East Lake	Lake Ontario				St. Lawrence River			
Species			1-1	1-2	1-3	1-4	1-5	1-7	2-5	Total
Black Crappie	9,850	3,100	4,540		14,824	1,100	14,170	4,840	17,590	70,014
Lake Whitefish	0	0	6,549	97,744	12,307	18,282	0	0	0	134,882
Sunfish	18,080	14,600	0	0	0	0	0	0	0	32,680
Walleye	0	0	4,211	32,934	0	10,952	0	0	0	48,097
Yellow Perch	2,829	896	18,223	73,458	88,818	88,822	51,788	14,438	53,000	392,272
Total	30,759	18,596	33,523	204,136	115,949	119,156	65,958	19,278	70,590	677,945

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), 2022.

	West Lake	East Lake	Lake Ontario				St. Lawrence River			
			1-1	1-2	1-3	1-4	1-5	1-7	2-5	Total
Black Crappie	3,100	9,850	2,270	0	10,081	550	7,085	4,840	8,795	46,571
Lake Whitefish	0	0	3,274	91,431	10,204	9,087	0	0	0	113,996
Lepomis	14,600	18,080	0	0	0	0	0	0	0	32,680
Walleye	0	0	3,516	12,536	0	30,300	0	0	0	46,352
Yellow Perch	896	2,829	10,477	41,232	71,118	71,170	39,163	11,550	26,500	274,935
Total	18,596	30,759	19,537	145,199	91,403	111,107	46,248	16,390	35,295	514,534

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), 2022.

	West Lake	East Lake	Lake Ontario				St. Lawrence River					
			1-1	1-2	1-3	1-4	1-5	1-7	2-5	Total Harvest	Landed value	Price per lb
Black Crappie	903	94	1		4,217	29	1,372	407	50	7,073	22,726	3.31
Bowfin	1,075	862			1,508		1,083	76	507	5,111	3,052	0.70
Brown Bullhead		3,058	8	66	2,968		2,994	1,175	235	10,502	4,363	0.42
Burbot				24						24	0	
Cisco	19			8	2,086	131				2,244	477	0.21
Common Carp	13				388					400	92	0.22
Freshwater Drum		14	49	243	8,589	11,537				20,432	2,052	0.10
Lake Whitefish			82	39,410	4,125	51				43,669	66,416	1.52
Lepomis	7,995	8,581	927		22,540	14	3,716	660	338	44,770	58,625	1.29
Northern Pike	998	618	93	152	3,985	1,446	266			7,557	2,183	0.29
Rock Bass	1,027	829	1,591	204	3,512	699	479	29	88	8,459	5,451	0.68
Suckers						19				19	4	0.20
Walleye			442	1,846		16,917				19,205	39,655	2.06
White Bass					30	243				273	221	0.81
White Perch	2,224	351	41	29	13,599	4,947				21,191	10,138	0.49
White Sucker		371		67	8,536	863				9,836	1,004	0.10
Yellow Perch	666	200	2,372	6,034	35,160	27,169	19,501	11,031	12,167	114,300	357,746	3.15
Total Harvest	14,920	14,978	5,606	48,082	111,241	64,066	29,410	13,377	13,386			
Total Landed	17,788	14,414	11,613	85,003	185,339	134,384	62,361	31,061	32,240			

Lake Ontario and the St. Lawrence River respectively. After 2013, harvest showed a declining trend but was variable annually, particularly in Lake Ontario. Harvest increased significantly in both areas in 2016-2017 and declined in 2018 in both geographic areas. Overall, average harvest over the past decade in both geographic areas has declined from the 2003 -2013 average.

Major Species

For major species, annual trends of commercial harvest, landed value and quota, across quota zones or geographic areas, is shown in Fig. 3.2.5 to Fig. 3.2.11. Species-specific price-per-lb values are means across quota zones and waterbodies.

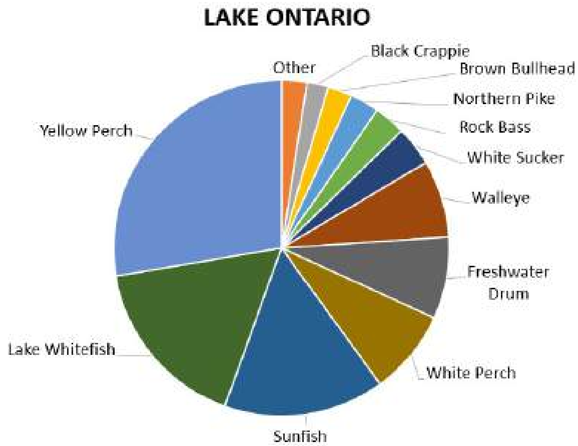


FIG. 3.2.2. Commercial harvest by species in **Lake Ontario** (Quota Zones 1-1, 1-2, 1-3 ,1-4 and 1-8) and Embayments (East Lake and West Lake), 2022.

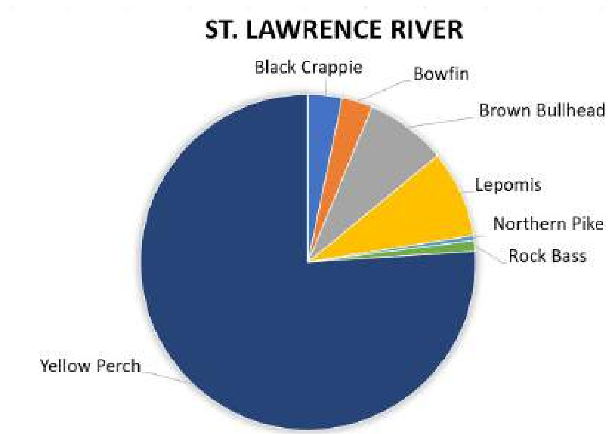


FIG. 3.2.3. Commercial harvest by species in **the St. Lawrence River** (Quota Zones 1-5, 1-7 and 2-5), 2022.

Yellow Perch

Yellow Perch 2022 commercial harvest relative to base quota by quota zone is shown in Fig. 3.2.6. Overall, 29% (114,300 lb) of the Yellow Perch base quota (392,273 lb) and 42% of issued quota (274,935 lb) was harvested in 2022. The highest Yellow Perch harvest came from quota zones 1-3. Trends in Yellow Perch quota (base), harvest and landed value are shown Fig. 3.2.6. In 2019, quota was reduced 20% in quota zone 1-7 and left unchanged in all other quota zones. Harvest increases in 2022 in quota zones 1-5, 2-5 and 1-3 and decreased in 1-1, 1-2, 1-4 and 1-7 (Fig. 3.2.7). Yellow Perch price-per-lb has increase since 2018 reaching a time series high of $3.15.

Lake Whitefish

Lake Whitefish 2022 commercial harvest relative to base quota by quota zone and is shown in Fig. 3.2.5. Overall, 32% (43,669 lb) of the Lake Whitefish base quota and 38% of the issued quota

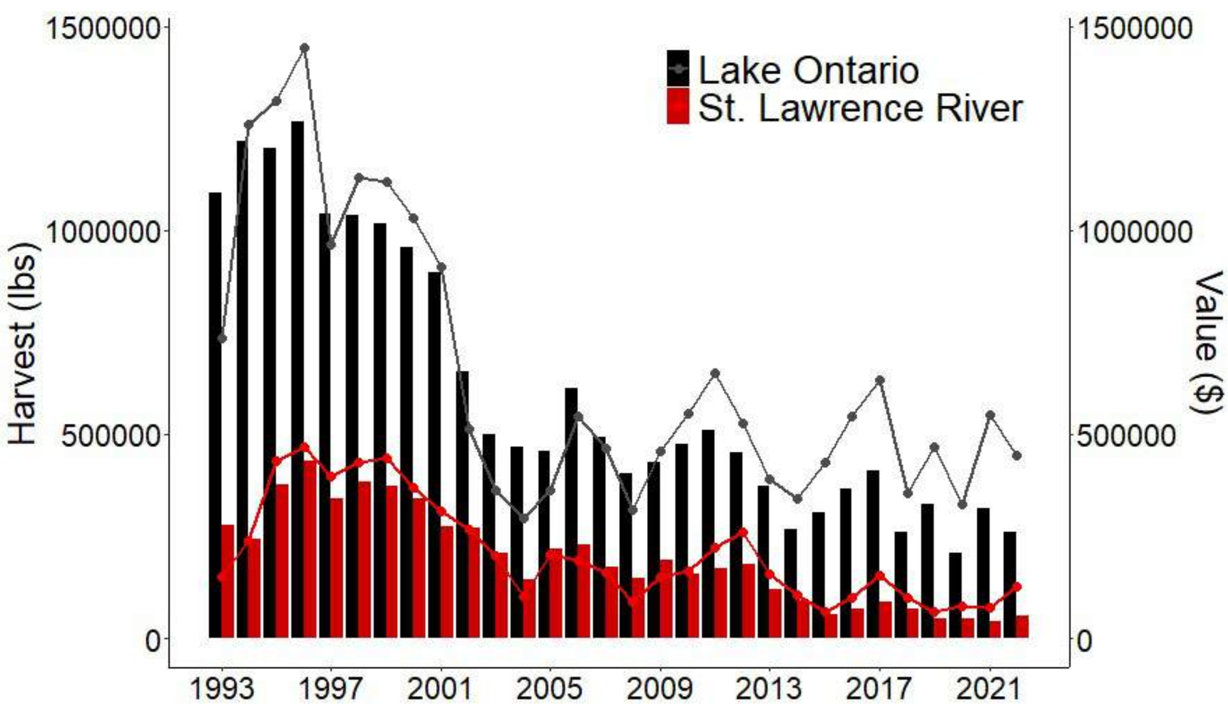


FIG. 3.2.4. Total commercial fishery harvest (bars) and value (points) for **Lake Ontario** (Quota Zones 1-1, 1-2, 1-3 ,1-4 and 1-8) and Embayments (East Lake and West Lake), and the **St. Lawrence River** (Quota Zones 1-5, 2-5 and 1-7), 1993-2022.

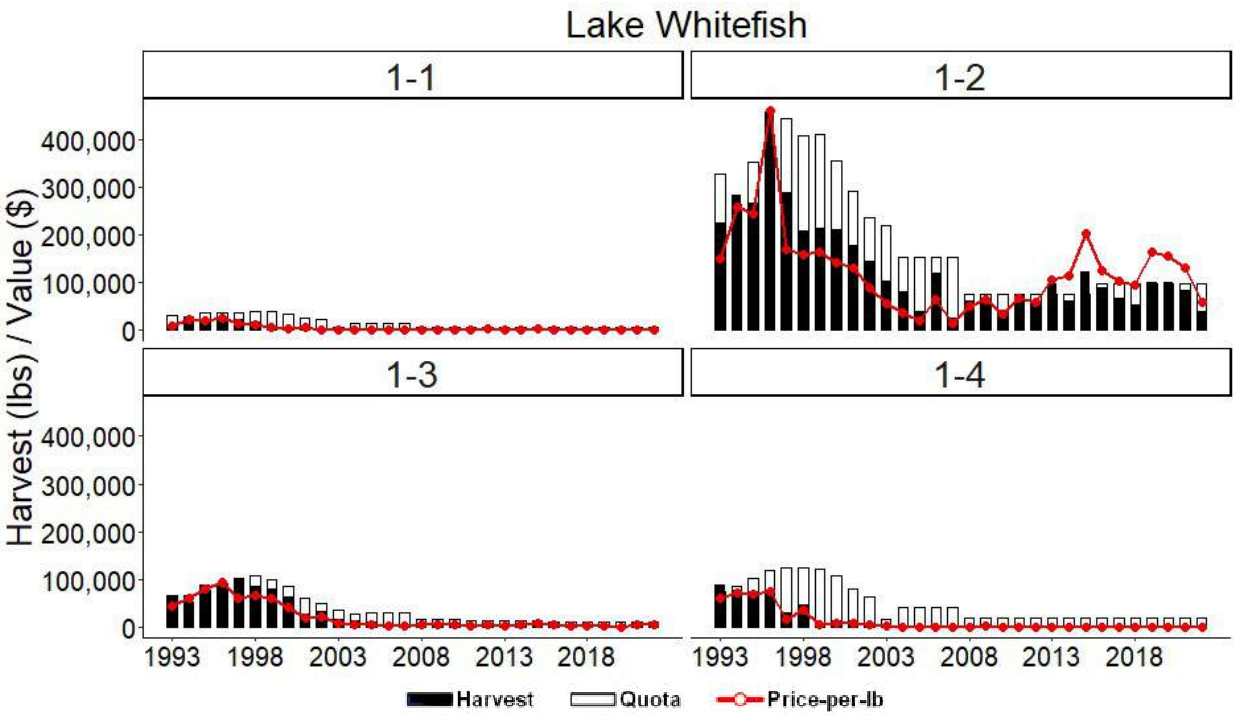


FIG. 3.2.5. Commercial base quota, harvest and price-per-lb for **Lake Whitefish** in Quota Zones 1-1, 1-2, 1-3 and 1-4, 1993-2022.

(113,996 lb) was harvested in 2022. 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 is usually higher than base quota in quota zone 1-2 but did not exceed base quota in 2022 (Fig. 3.2.8). Trends in Lake Whitefish quota (base), harvest and landed value are shown in Fig. 3.2.9. Base quota remained unchanged in 2022 compared to 2021.

Seasonal whitefish harvest and biological attributes (e.g., size and age structure) information are reported in Section 3.3. Lake Whitefish price-per-lb was $1.52 in 2022 and has had a slightly decreasing trend since 2018.

Walleye

Walleye 2022 commercial harvest relative to base quota by quota zone is shown in Fig. 3.2.7. Walleye harvest decreased slightly in 2022. Overall, 40% (19,205 lb) of the Walleye base quota (48,092 lb) and 41% of the issued quota (46,352 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 2022, this resulted in issued quota and harvest being considerably higher than base quota in quota zone 1-4 (Fig. 3.2.7). Quota has remained constant since the early 2000s (just under 50,000 lb for all quota zones combined). Walleye price-per-lb increased between 2011 and 2018 but declined in subsequent years averaging $2.06 in 2022.

Black Crappie

Black Crappie 2022 commercial harvest relative to base quota for Lake Ontario, East and West Lakes, and the St. Lawrence River is shown in Fig. 3.2.10. Overall, only 10% (7,072 lb) of the Black Crappie base quota (73,013 lb) was harvested in 2022. The highest Black Crappie harvest came from quota zone 1-3 and 1-5. Trends in quota (base), harvest and landed value are shown in Fig. 3.2.10. Black Crappie harvest has been trending down in in all geographics areas since the early 2010s but increased in 2022 in Lake Ontario and the St. Lawrence River. Average price-per-lb remains high, reaching a new high of $3.31 in 2022.

Sunfish

Sunfish 2022 commercial harvest relative for Lake Ontario, East and West Lakes, and the St. Lawrence River is shown in Fig. 3.2.9. 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 was from quota zone 1-3. Trends in Sunfish quota (base), harvest and landed value are shown in Fig. 3.2.9. In 2022, harvest increased in the St. Lawrence river and decreased in Lake Ontario and East and West Lakes. Price-per-lb declined between 2018-2020 but increased in 2021 and 2022 to previous levels ($1.29 in 2022).

Cisco

Cisco 2022 commercial harvest for Quota zones 1-1, 1-2, 1-3 and 1-4 is shown in Fig. 3.2.8. The majority of harvest was taken from Quota Zone 1-3 with minimal amounts taken from other zones. Trends in Cisco quota (base), harvest and landed value are shown in Fig. 3.2.8. Current harvest levels are extremely low relative to past levels. Price-per-lb decreased in 2022 to $0.21 compared to $0.29 in 2021.

Northern Pike

Northern Pike commercial harvest and landed value trends for Lake Ontario, East and West Lakes, and the St. Lawrence River is shown in Fig. 3.2.11. Highest pike harvest came from Lake Ontario. Harvest remains low as compared to previous years. Northern Pike is managed as an incidental harvest fishery. In 2018-2022, 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.

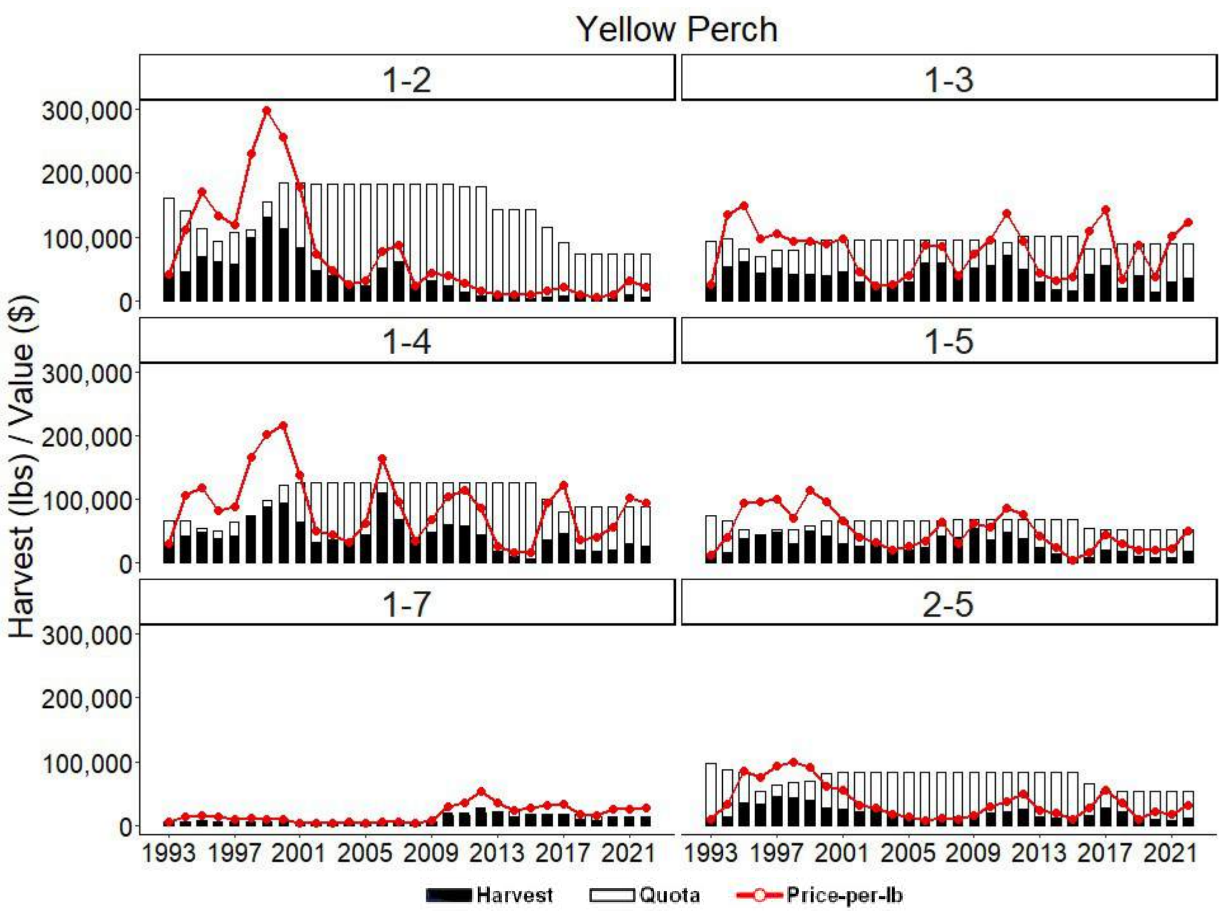


FIG. 3.2.6. Commercial base quota, harvest and price-per-lb for **Yellow Perch** in Quota Zones 1-2, 1-3, 1-4, 1-5, 2-5 and 1-7, 1993-2022.

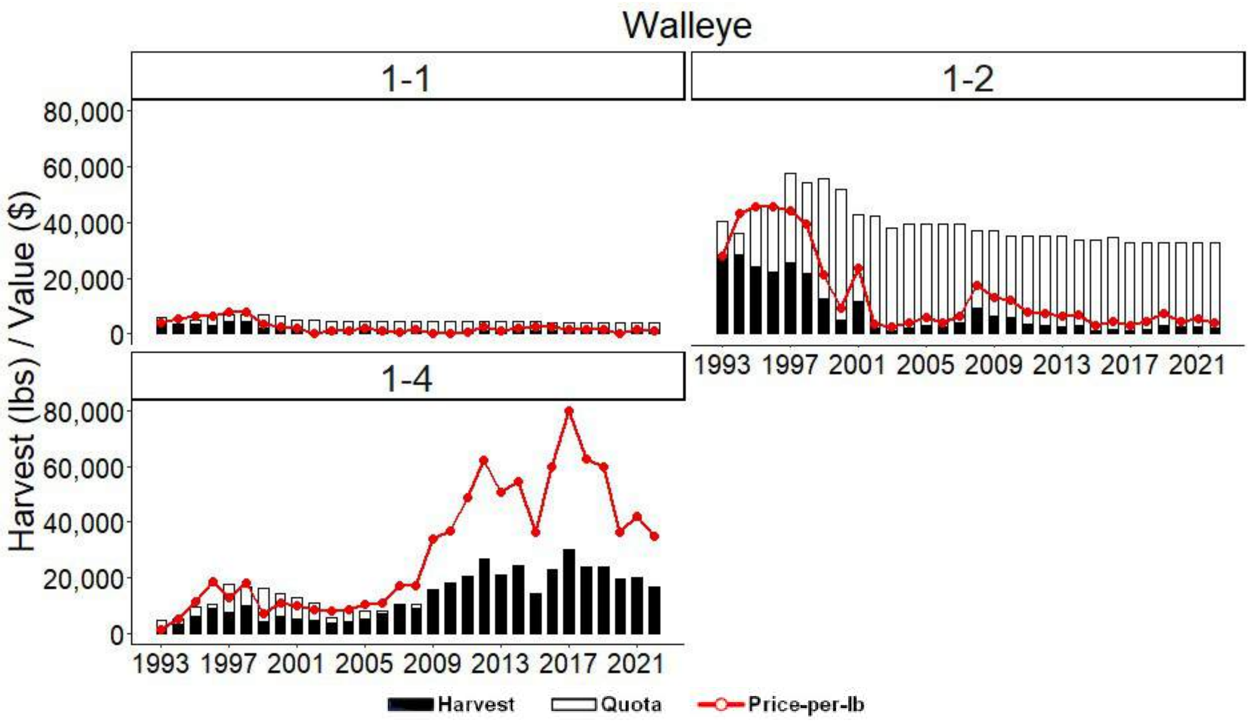


FIG. 3.2.7. Commercial base quota, harvest and price-per-lb for **Walleye** in Quota Zones 1-1, 1-2 and 1-4, 1993-2022.

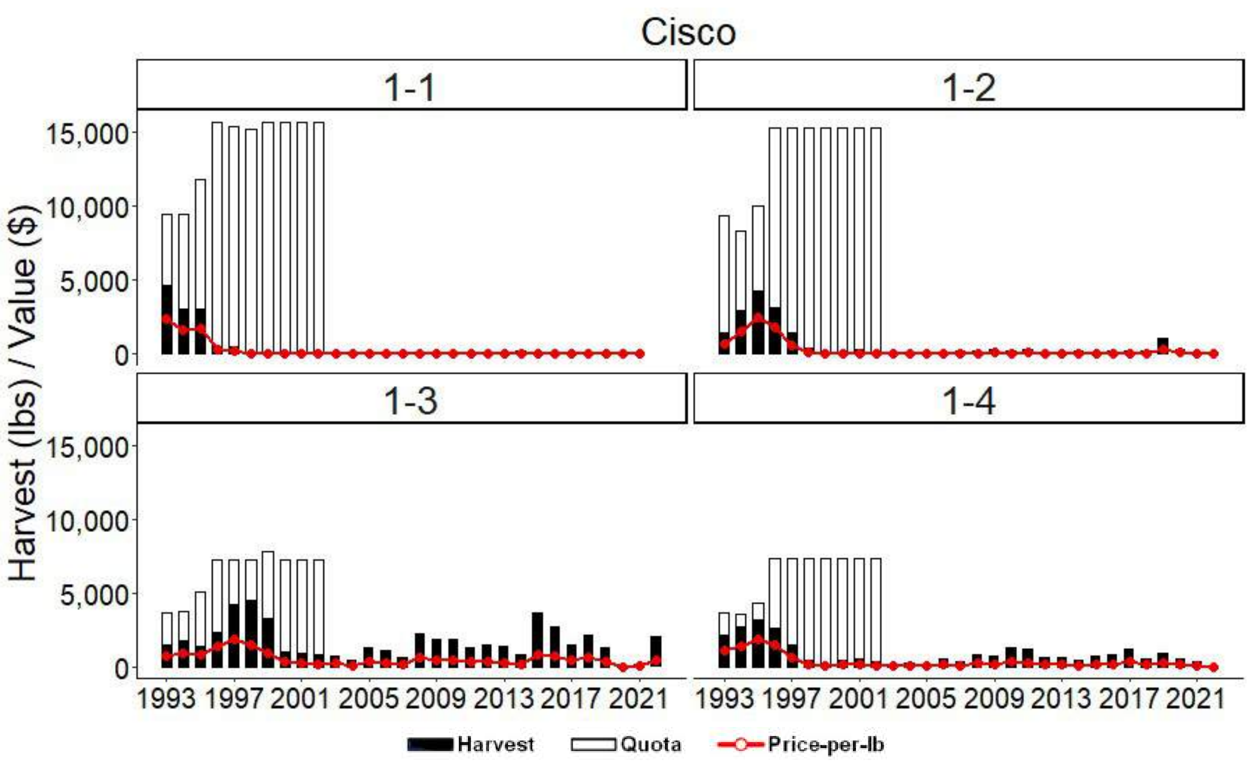


FIG. 3.2.8. Commercial base quota, harvest and price-per-lb for **Cisco** in Quota Zones 1-1, 1-2, 1-3, 1-4 1993-2022.

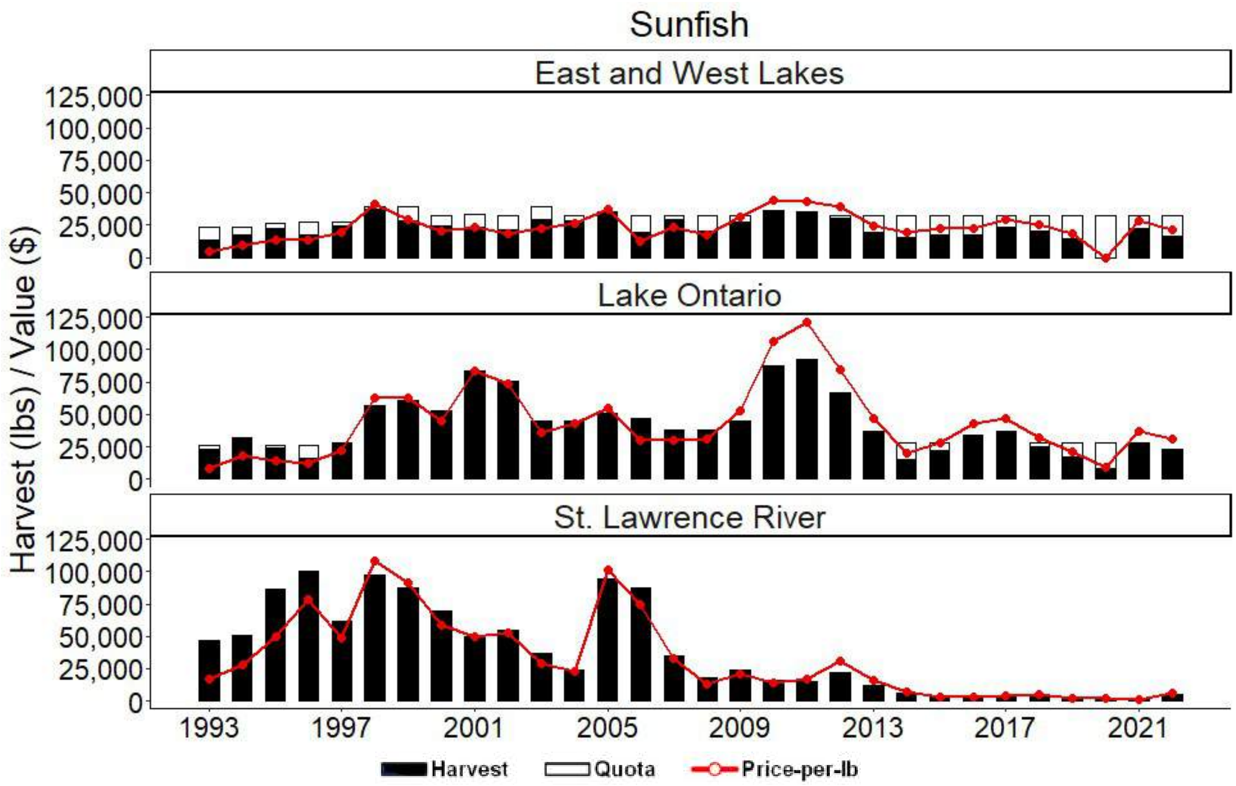


FIG. 3.2.9. Commercial base quota, harvest and price-per-lb for **Sunfish** in East and West Lakes, Lake Ontario (Quota Zones 1-1, 1-2, 1-3, and 1-4) and St. Lawrence River (Quota Zones 1-5, 1-7 and 2-5), 1993-2022.

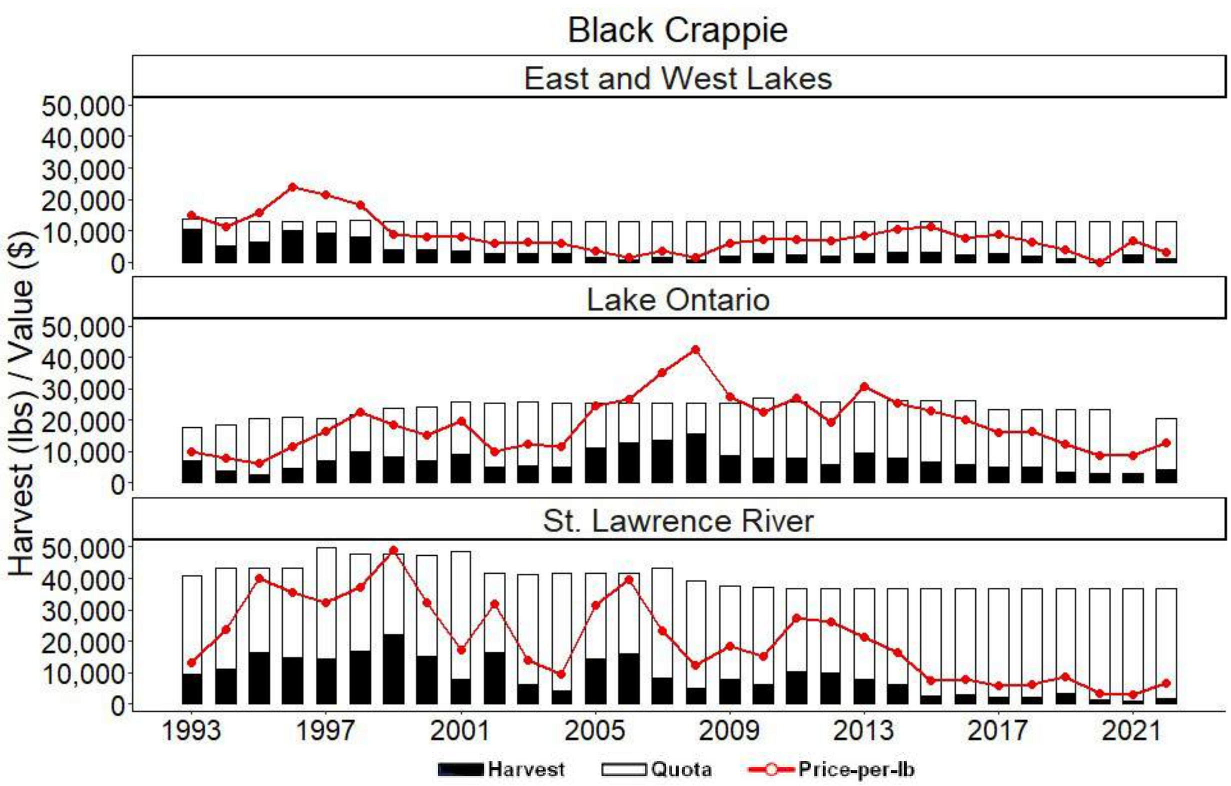


FIG. 3.2.10. Commercial base quota, harvest and price-per-lb for **Black Crappie** in East and West Lakes, Lake Ontario (Quota Zones 1-1, 1-2, 1-3, and 1-4) and St. Lawrence River (Quota Zones 1-5, 1-7 and 2-5), 1993-2022.

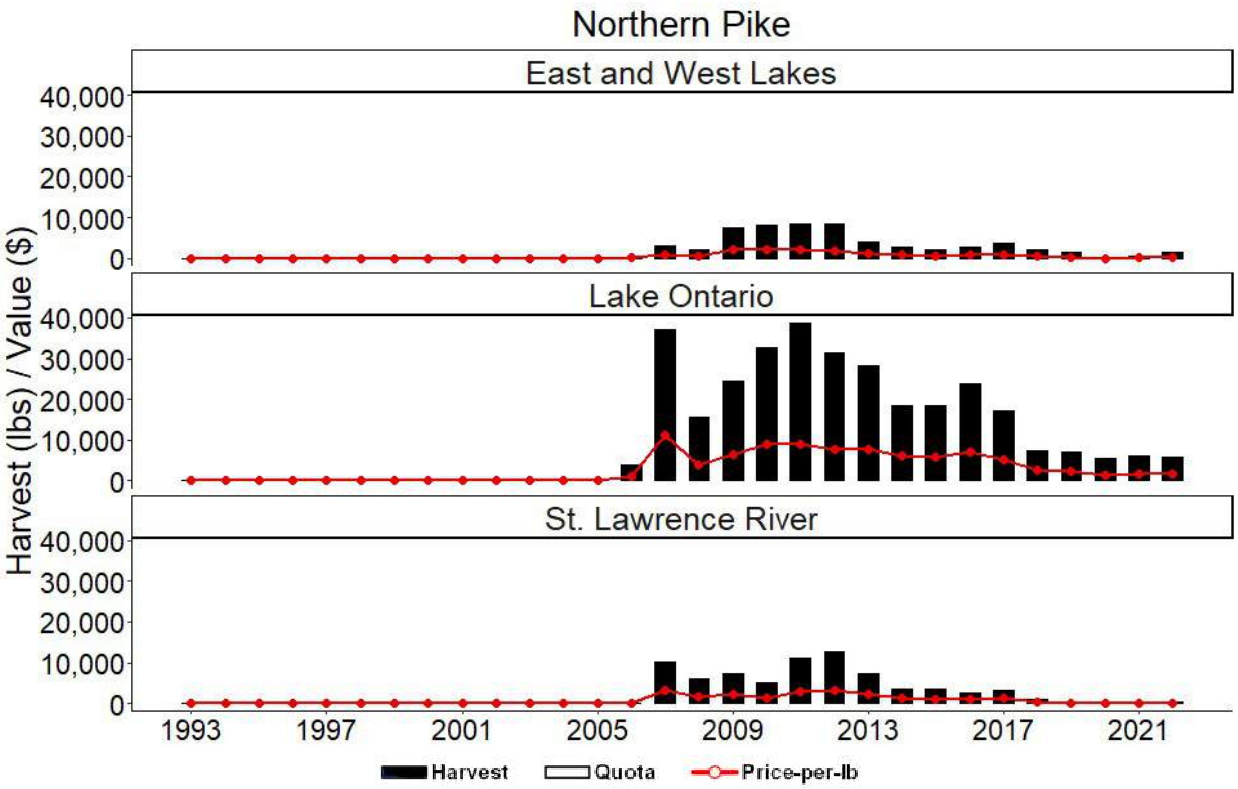


FIG. 3.2.11. Commercial base quota, harvest and price-per-lb for **Northern Pike** in East and West Lakes, Lake Ontario (Quota Zones 1-1, 1-2, 1-3, and 1-4) and St. Lawrence River (Quota Zones 1-5, 1-7 and 2-5), 1993-2022.

3.3 Lake Whitefish and Cisco Commercial Catch Sampling

S. Beech, Lake Ontario Management Unit

Commercially harvested Lake Whitefish and Cisco are sampled annually (when possible) for biological information. Biological sampling of the catch is necessary to breakdown total harvest (see Section 3.2), into size and age-specific harvest.

Commercial catch sampling collected biological information from spawning-time fisheries in the Bay of Quinte (quota zone 1-3) from October 26th to November 23th and the south shore of Prince Edward County (quota zone 1-2) from November 15th to November 29th. Biological information is obtained through taking large numbers of length tally measurements as well as a length-stratified sub-sample for more detailed biological sampling for each quota zone. Whitefish length and age distribution information is presented in Fig. 3.3.1 and Fig. 3.3.2. In total, fork length was measured for 5,707 fish and age was interpreted using otoliths for 337 fish (Table 3.3.2 and Table 3.3.3).

Lake Whitefish

Commercial Lake Whitefish harvest and fishing effort by gear type, month and quota zone for 2022 is reported in Table 3.3.1. Total Lake Whitefish harvest for 2022 was 43,669 lb; 38% of the issued quota.

Most of the harvest was taken in gill nets, 90% by weight; 10% of the harvest was taken in impoundment gear. Ninety-seven percent of the gill net harvest occurred in quota zone 1-2. Fifty-two 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 November (Table 3.3.1).

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 482 mm and 9.9 years

TABLE 3.3.1. 2022 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 (# of yards or nets)		
Gear type	Month	1-2	1-3	1-4	1-2	1-3	1-4
Gillnet							
	Feb			16			164
	Mar			13			480
	Apr	469		23	1,680		80
	May	63			560		
	Jun	23			700		
	Jul	511			8,000		
	Aug	9,743			36,800		
	Sept	6,474			19,200		
	Oct	1,702			1,500		
	Nov	***20,426***			***15,800***		
	Dec						
Impoundment							
	Feb						5
	Mar						
	Apr		7			5	2
	May					5	
	Jun						
	Jul						
	Aug						
	Sept						
	Oct		***1,398***			***10***	
	Nov		***2,720***			***17***	
	Dec						

respectively (Fig. 3.3.2). Fish ranged from ages 4-30 years (Table 3.3.2). The most abundant age-classes in the fishery were ages 6-18 years which together comprised 96.5% of the harvest by number (90.5% by weight).

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

Mean fork length and age for Lake Whitefish harvested in quota zone 1-3 were 469mm and 10 years, respectively (Fig. 3.3.1). Fish ranged from ages 4-29 years. The most abundant age-classes in the fishery were ages 5-19 years which together comprised 96.8% of the harvest by number (89.6% by weight).

Condition

Lake Whitefish (Bay of Quinte and Lake Ontario spawning groups; sexes combined) relative weight (see Rennie & Verdon, 2008) is shown in Fig. 3.3.3. Condition declined markedly in 1994 and has remained low but stable.

Cisco

Commercial harvest of Cisco in 2020 was 2,244 lb with 93% harvested (by weight) in quota zone 1-3 and the majority of the harvest taken in November. Harvest in all quota zones has been minimal since 2000 but varies annually, particularly in quota zone 1-3.

TABLE 3.3.2. Age-specific vital statistics of Lake Whitefish sampled and harvested including number aged, number measured for length, proportion by number of fish sampled, mean weight (kg) and fork length (mm) of fish sampled, and harvest by number and weight (kg) for quota zone 1-2 and 1-3, 2022.

	Quota zone 1-2 (Lake)								Quota zone 1-3 (Bay)						
	Sampled			Harvested					Sampled			Harvested			
Age (years)	Number aged	Number lengthed	Propor-tion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)	Age (years)	Number aged	Number lengthed	Propor-tion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)
4	4	32	0.010	119	89	0.751	413	4	-	1	0.001	1	1	0.876	420
5	1	24	0.007	89	92	1.034	439	5	1	18	0.014	20	17	0.824	436
6	9	272	0.085	1023	1087	1.062	445	6	2	18	0.014	21	19	0.920	439
7	22	928	0.289	3490	4244	1.216	464	7	6	74	0.059	85	77	0.900	438
8	6	246	0.077	926	970	1.047	447	8	46	492	0.396	567	632	1.114	461
9	8	379	0.118	1428	2023	1.417	480	9	24	256	0.206	295	355	1.206	471
10	5	161	0.050	605	944	1.560	504	10	9	84	0.068	97	120	1.242	481
11	7	292	0.091	1098	1572	1.431	484	11	5	48	0.038	55	76	1.384	487
12	5	200	0.062	753	1071	1.421	499	12	6	44	0.035	51	68	1.351	485
13	7	189	0.059	711	1264	1.776	532	13	4	26	0.021	30	50	1.651	550
14								14	4	26	0.021	30	45	1.498	505
15	6	85	0.027	321	630	1.963	557	15	5	28	0.023	33	65	1.980	530
16	8	158	0.049	596	1018	1.708	540	16	3	19	0.016	22	35	1.546	514
17	6	112	0.035	420	809	1.927	542	17	4	35	0.028	41	57	1.418	508
18	3	72	0.022	269	550	2.043	553	18	1	11	0.009	13	15	1.149	468
19	1	20	0.006	74	136	1.835	544	19	6	22	0.018	25	46	1.812	555
20	1	2	0.001	8	20	2.328	585	20	1	1	0.001	1	3	2.588	630
21	1	5	0.002	20	43	2.183	564	21	1	12	0.010	14	18	1.234	478
22								22	2	7	0.006	8	17	2.031	585
23								23							
24	-	1	0.000	5	9	1.968	571	24	1	13	0.010	14	26	1.834	551
25															
26	1	2	0.001	8	23	2.675	589	26	-						
27	-	1	0.000	5	9	2.009	562	27	1	1	0.001	1	3	2.403	590
28	2	15	0.005	55	100	1.835	553	28	1	1	0.001	1	3	2.582	587
29	1	5	0.002	20	44	2.226	560	29	-	4	0.003	5	10	2.227	564
30	1	4	0.001	16	37	2.247	580	30							
Total	105	3205	1	12060	17873			Total	133	1242	1	1430	1871		
Weighted mean						1.48								1.31	

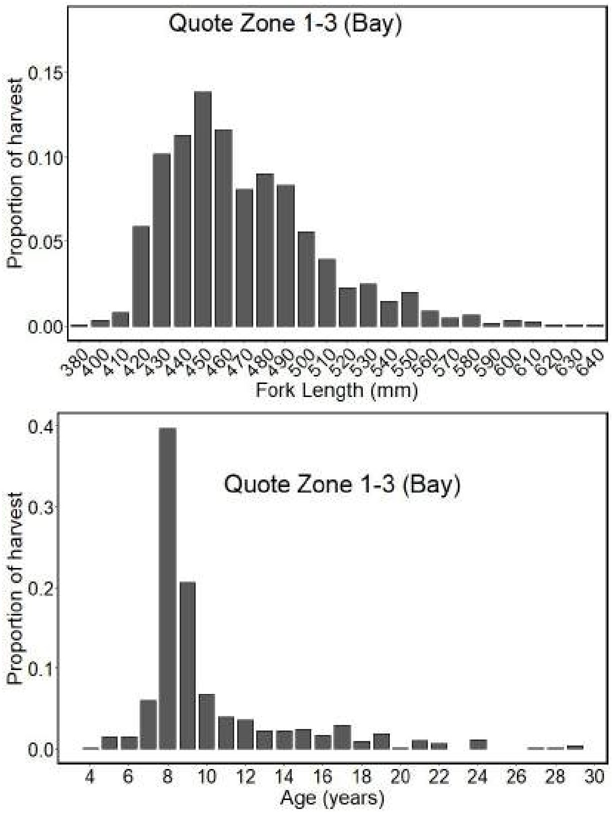


FIG. 3.3.1. Size and age distribution (by number) of Lake Whitefish sampled in quota zone 1-3 during the 2022 commercial catch sampling program.

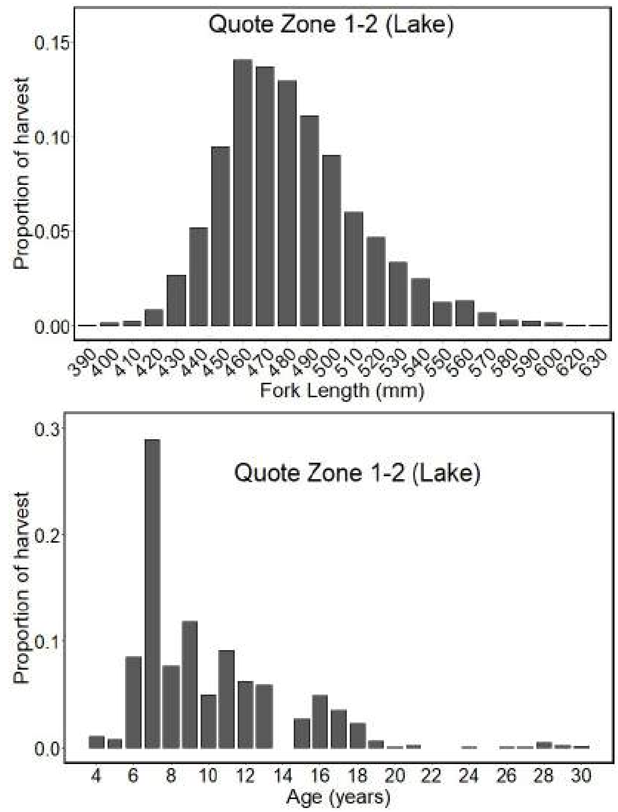


FIG. 3.3.2 Size and age distribution (by number) of Lake Whitefish sampled in quota zone 1-2 during the 2022 commercial catch sampling program.

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

Mean fork length and age for Cisco harvested in quota zone 1-3 were 356mm and 7 years, respectively (Fig. 3.3.4 and Fig 3.3.5). Fish ranged from ages 2-17 years (Table 3.3.3). The most abundant age-classes in the fishery were ages 3-12 years which together comprised 97.8% of the harvest by number (97.1% by weight).

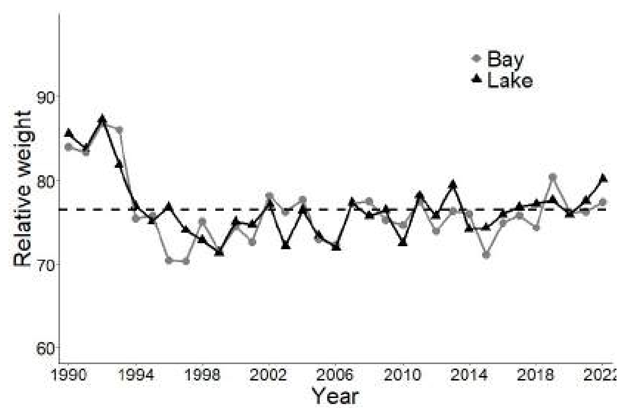


FIG. 3.3.3. Lake Whitefish (sexes combined) relative weight for the Lake Ontario and Bay of Quinte spawning groups (see Rennie & Verdon, 2008), 1990-2022.

TABLE 3.3.3. Age-specific vital statistics of Cisco sampled and harvested including number aged, number measured for length, proportion by number of fish sampled, mean weight (kg) and fork length (mm) of fish sampled, and harvest by number and weight (kg) for quota zone 1-3, 2022.

Quota Zone 1-3 (Bay) Cisco							
	Sampled			Harvested			
Age (years)	Number aged	Number Lengthed	Propor-tion	Number	Weight (kg)	Mean weight (kg)	Mean Length (mm)
2	2	6	0.004	7	2	0.324	295
3	20	234	0.186	292	129	0.442	324
4	4	39	0.031	48	19	0.400	316
5	12	198	0.157	247	133	0.540	342
6	2	21	0.017	26	12	0.438	328
7	5	114	0.091	142	85	0.595	360
8	28	342	0.271	426	287	0.674	375
9	15	221	0.176	276	199	0.723	374
10	4	22	0.017	27	22	0.807	398
11	1	19	0.015	24	15	0.614	376
12	2	21	0.017	26	18	0.693	383
13	1	7	0.005	8	7	0.814	412
14	1	7	0.005	8	6	0.746	393
15	1	7	0.005	8	8	0.988	393
16	-	-	-	-	-	-	-
17	1	3	0.003	4	3	0.783	420
Total	99	1,261	1	1,569	2,086		
Weighted mean						0.6	

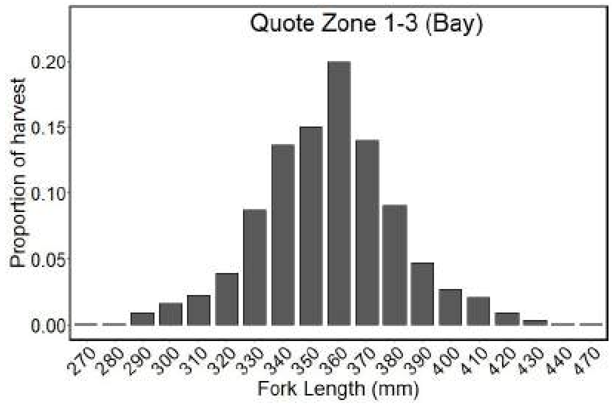


FIG. 3.3.4. Size distribution (by number) of Cisco sampled in quota zone 1-3 during the 2022 commercial catch sampling program.

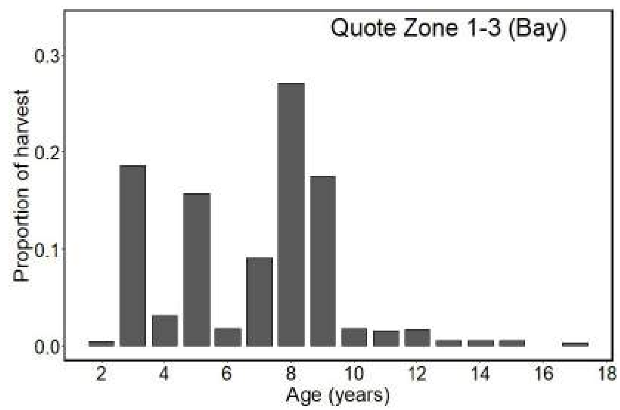


FIG. 3.3.5. Age distribution (by number) of Cisco sampled in quota zone 1-3 during the 2022 commercial catch sampling program.

Reference

Rennie, M. D., & Verdon, R. (2008). Development and evaluation of condition indices for the lake whitefish. *North American Journal of Fisheries Management*, *28*(4), 1270-1293.

4. Age and Growth Summary

B. Maynard and S. Beech, 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. In 2022, a total of 3,516 structures were processed from 11 different field projects (Table 4.1).

TABLE 4.1. Project-specific summary of age and growth structures interpreted for age (n=3516) in support of 8 different Lake Ontario Management Unit field projects, 2022.

Project	Species	Structure	N
Lake Ontario and Bay of Quinte Community Index Gillnetting			
	Lake Whitefish	Otoliths	53
	Walleye	Otoliths	184
	Walleye	Scales	99
	Pike	Cleithra	11
	Largemouth Bass	Scales	15
	Smallmouth Bass	Scales	28
	Black Crappie	Scales	2
	White Perch	Scales	200
	White Bass	Scales	11
	Bluegill	Scales	51
	Rock Bass	Scales	42
	Pumpkinseed	Scales	104
	Yellow Perch	Scales	200
	Cisco	Otoliths	81
	Deepwater Sculpin	Otoliths	1
	Brown Trout	Otoliths	12
	Chinook Salmon	Otoliths	6
	Lake Trout	Otoliths	224
Lake Ontario and Bay of Quinte Community Index Trawling			
	Round Goby	Otoliths	156
	Lake Whitefish	Otoliths	1
	Cisco	Otoliths	2
	Lake Trout	Otoliths	1
	Largemouth Bass	Scales	24
	Walleye	Otoliths	3
	Walleye	Scales	85
Bay of Qunite Open Water Creel			
	Northern Pike	Scales	2
	Largemouth Bass	Scales	38
	Walleye	Scales	129
Toronto Harbour Nearshore Community Index Netting			
	Walleye	Otoliths	5
	Yellow Perch	Scales	31
	Black Crappie	Scales	31
	Largemouth Bass	Scales	41
	Bluegill	Scales	29
	Pumpkinseed	Scales	30
	Rock Bass	Scales	30
	Northern Pike	Cleithra	29

TABLE 4.1. *continued.*

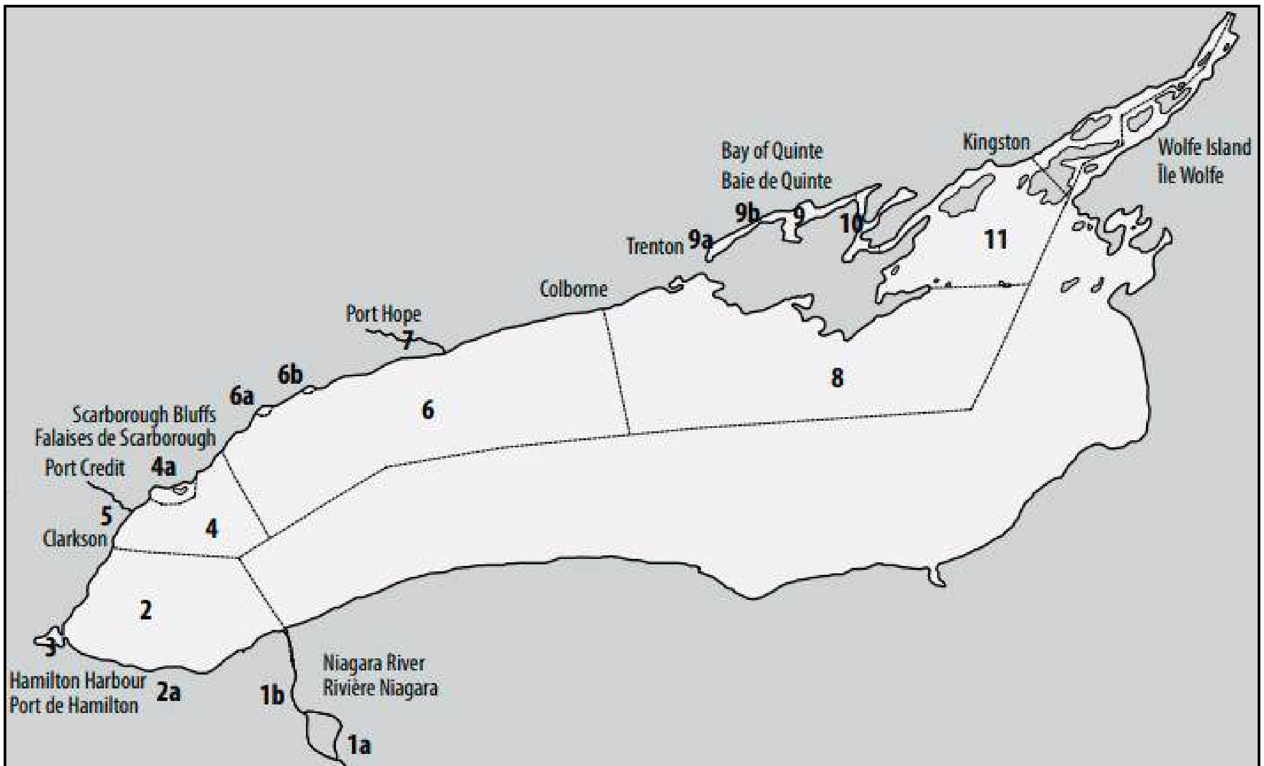
Project	Species	Structure	N
Upper Bay Nearshore Community Index Netting			
	Walleye	Otoliths	21
	Walleye	Scales	1
	Northern Pike	Cleithra	7
	Rock Bass	Scales	20
	Pumpkinseed	Scales	35
	Bluegill	Scales	24
	Smallmouth Bass	Scales	15
	Largemouth Bass	Scales	22
	Black Crappie	Scales	50
	Yellow Perch	Scales	35
Weller's Bay Nearshore Community Index Netting			
	Walleye	Otoliths	20
	Rock Bass	Scales	10
	Pumpkinseed	Scales	32
	Bluegill	Scales	30
	Smallmouth Bass	Scales	31
	Largemouth Bass	Scales	34
	Black Crappie	Scales	1
	Northern Pike	Cleithra	13
	Yellow Perch	Scales	8
Spring Muskellunge Index Netting			
	Muskie	Scales	6
	Chain Pickerel	Scales	1
Commercial Catch Sampling			
	Lake Whitefish	Otoliths	241
	Cisco - Bay	Otoliths	101
Lake St. Francis Community Index Netting			
	Northern Pike	Cleithra	4
	Yellow Perch	Scales	217
	Walleye	Otoliths	32
	Smallmouth Bass	Scales	22
	Largemouth Bass	Scales	7
Thousand Islands Community Index Netting			
	Northern Pike	Cleithra	13
	Yellow Perch	Scales	145
	Walleye	Otoliths	20
	Smallmouth Bass	Scales	92
	Largemouth Bass	Scales	12
Credit River Chinook Assessment and Egg Collection			
	Chinook Salmon	Otoliths	203
Total			3516

5. Contaminant Monitoring

B. Maynard and S. Beech, Lake Ontario Management Unit

Lake Ontario Management Unit (LOMU) cooperates annually with several agencies to collect fish samples for contaminant testing. In 2022, 470 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 2022 is shown in Table 5.2.



2. Western Lake Ontario – open water from Niagara River to Clarkson Harbour

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

6. Northwestern Lake Ontario – from east of Scarborough Bluffs to Colborne

8. Northeastern Lake Ontario – from east of Colborne to south of the area from Main Duck Island across to Point Traverse

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

9a. Upper Bay of Quinte – Trenton nearshore Area

9b. Upper Bay of Quinte – Belleville nearshore Area

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

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, 2022.

Project	Block	Species	Total
Walleye Egg Collection			
	Trent River	Walleye	28
Lake Ontario and Bay of Quinte Community Index Gillnetting			
	8	Rock Bass	6
		Smallmouth Bass	7
		Walleye	10
		White Sucker	2
		Yellow Perch	10
	9	Black Crappie	1
		Bluegill	4
		Channel Catfish	1
		Freshwater Drum	10
		Pumpkinseed	10
		Walleye	1
		White Bass	1
		White Sucker	9
		Yellow Perch	9
	10	Black Crappie	1
		Bluegill	10
		Brown Bullhead	10
		Largemouth Bass	7
		Rock Bass	2
		Walleye	5
		White Perch	10
	11	Brown Trout	5
		Northern Pike	3
		Rock Bass	4
		Smallmouth Bass	8
		White Sucker	1
		Yellow Perch	10
Upper Bay Nearshore Community Index Netting			
	9	Black Crappie	9
		Bluegill	2
		Channel Catfish	3
		Common Carp	2
		Northern Pike	4
		Smallmouth Bass	7
		Walleye	1
		White Bass	1
		Yellow Perch	1
	9a	Brown Bullhead	10
		Pumpkinseed	9
	9b	Black Crappie	10
		Brown Bullhead	10
		Pumpkinseed	6
		Rock Bass	10
Weller's Bay Nearshore Community Index Netting			
	Weller's Bay	Black Crappie	1
		Bluegill	10
		Bowfin	6
		Brown Bullhead	10
		Centrarchidae hybrids	2
		Common Carp	3
		Freshwater Drum	1
		Gizzard Shad	1
		Largemouth Bass	10
		Longnose Gar	8
		Northern Pike	10
		Pumpkinseed	10
		Rainbow Trout	1
		Rock Bass	9
		Smallmouth Bass	10
		Walleye	10
		White Perch	2
		White Sucker	5
		Yellow Perch	8
Toronto Harbour Nearshore Community Index Netting			
	4a	Bluegill	2
		Northern Pike	10
		Yellow Perch	10
Lake Ontario and Bay of Quinte Community Index Trawling			
	11	White Sucker	4
	9	Bluegill	4
	9a	Pumpkinseed	1
	9b	Pumpkinseed	4
Spring Preyfish Trawling			
	11	Rainbow Smelt	10
	2	Rainbow Smelt	1
	4a	Rainbow Smelt	2
	6	Rainbow Smelt	22
	8	Rainbow Smelt	10
Thousand Islands Community Index Netting			
	12	Black Crappie	1
		Common Carp	2
Total			470

TABLE 5.2. Summary of the number of fish samples collected, by species, for contaminant analysis by the MECP, 2000 - 2022.

	Year																						
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Black Crappie			20	20	3	20		20		20	29			35	2	14				8		1	23
Bluegill		26		20	10	23			102	88		40	40	3		10			10	10		7	32
Bowfin																							6
Brown Bullhead		40	44	40	25	30	33	40	68	63	56	81	34	78	53	52			9	50		15	40
Brown Trout	40	3	20		31		22	6	29	34	34	12	20	6	10	1			20	6			5
Centrarchidae hybrids																							2
Channel Catfish	20	20	7	23		17				8		15	20	4	10			10		9		4	4
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		1	7
Freshwater Drum			43		16		13	2	32	20	37			42	2		12	18		10			11
Gizzard Shad																	7	10					1
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	5		
Largemouth Bass		4	25	28	20	9	8	89	26	40	28	55	20	11	7	18	20	4	10	37		27	17
Longnose Gar																							8
Northern Pike		53	39	60	22	40	22	94	35	28	31	20	34	47	16	18	24	35	5	13		4	27
Pumpkinseed		60	25	57	8	11	23	78	92	105	19	43	31	14			15	20		12			40
Rainbow Smelt																3			4	5		12	45
Rainbow Trout	40	37	28	20	37	20	29	20	21	20	33		1	22		20			2	11			1
Rock Bass		36	30	38	11	21	27	30	20	40	42	80	5	24			20	20	17	57		2	31
Shorthead Redhorse																				5			
Silver Redhorse							1												9	1	1		
Smallmouth Bass		20	87	22	21	28	35	23	39	40	31	58	15	19	20	20	25	37	16	22		20	32
Walleye		42	51	40	61	30	62	98	61	40	70	71	24	73	59	67	56	29	53	72		30	55
White Bass											20									11		8	2
White Perch		40		40	40	14	21	20	35	20	7			40	8	11	4		4	43		10	12
White Sucker							1								25	7	21	30	16	14			21
Yellow Perch	20	60	66	58	75	40	86	90	60	91	80	20	44	81	22	20	39	50	20	31		18	48
Total	180	445	546	473	482	303	450	628	702	677	589	509	327	545	319	310	293	312	265	496	6	159	470

6. Stocking Program

6.1 Stocking Summary

C. Lake , Lake Ontario Management Unit

Fish stocking is a fisheries management tool used to meet specific goals including supporting recreational fisheries and species restoration. In 2022, 1,666,180 fish were stocked into Lake Ontario, equaling 39,349 kilograms of biomass (Fig. 6.1.1; Table 6.1.1). Fish are allocated to one of seven sub-zones based on several factors, including: natural reproduction within the zone, size of local fisheries and suitable available habitat (Fig. 6.1.2). 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.

The Stocking Strategy provides production targets for MNRF Fish Culture Stations (Table 6.1.2). These facilities also provide healthy, disease-free fish (eggs and fry) to a number of facilities participating in the Community Hatchery Program (Table 6.1.3). Stocking events are summarized by species, life stage and location for native species (Table 6.1.4) and for introduced species (Table 6.1.5). Stocking data for 2022 can be found for all of the Great Lakes on the Great Lakes Fisheries Commission stocking data portal at: http://fsis.glfc.org/stocking/events/2022/.

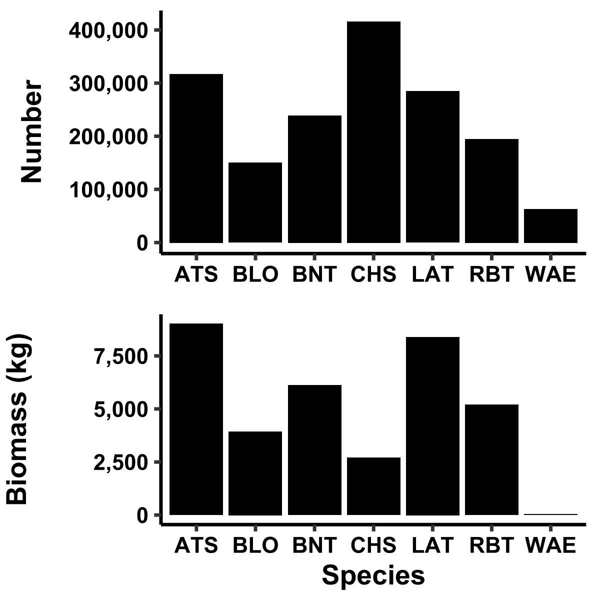


FIG. 6.1.1. **TOP**: Number of fish stocked into the Ontario waters of Lake Ontario in 2022 (total = 1,666,180). **BOTTOM**: Biomass of fish stocked into the Ontario waters of Lake Ontario in 2022 (total = 39,347.1 kg.). Adult, egg and Nonfeeding fry life stages not included in totals. ATS = Atlantic Salmon, BLO = Bloater, BNT = Brown Trout, CHS = Chinook Salmon, LAT = Lake Trout, RBT = Rainbow Trout, WAE = Walleye.

TABLE 6.1.1. Numbers of fish stocked into the Ontario waters of Lake Ontario in 2022. Numbers reflect both MNRF-produced fish and those raised by community groups.

Species	Life stage	Number	Biomass
Atlantic Salmon	Fry	7,782	1
	Spring Fingerling	211,767	624
	Spring Yearling	88,373	6,180
	Fall Yearling	9,049	2,208
	Adult	653	2,668
Bloater	Fall Fingerling	71,921	199
	Fall Yearling	16,554	380
	Sub-adult	61,636	3,356
	Adult	154	86
Brown Trout	Spring Fingerling	35,000	70
	Fall Fingerling	40,000	1,000
	Spring Yearling	164,012	5,055
	Adult	404	900
Chinook Salmon	Spring Fingerling	415,817	2,694
Lake Trout	Spring Yearling	284,963	8,392
Rainbow Trout	Spring Yearling	194,960	5,202
	Adult	122	305
Walleye	Summer Fingerling	63,013	29
Totals		1,666,180	39,349

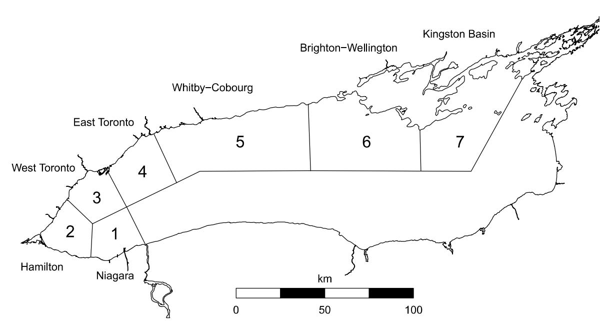


FIG. 6.1.2. Map of Lake Ontario stocking zones.

Fig. 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. Tables 6.1.4 and 6.1.5 provide detailed information on fish stocking by species, location and life stage for 2022.

Atlantic Salmon (317,624; 11,681 kg.) were stocked in support of an ongoing program to restore self-sustaining populations of this native species to Lake Ontario. Atlantic Salmon are produced at MNRF hatcheries, with some eggs being delivered to academic and community volunteer facilities for rearing. In addition to these regular stocking activities, surplus brood Atlantic Salmon (adults) are occasionally available for release. These fish are tagged, and tracked as part of an angler outreach program (Section 6.3).

Bloater (150,265; 4,021 kg.) were stocked in 2022. 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.

Chinook Salmon spring fingerlings (415,817; 2,694 kg.) were stocked to provide put-grow-and-take fishing opportunities. All Chinook Salmon for the Lake Ontario program were produced at Normandale Fish Culture Station. A significant number of Chinook were transferred to volunteer-run net pens to enhance imprinting and growth during the last month of captivity. See Section 6.2 for a full description of the 2022 net pen program.

Coho Salmon are produced by stocking partner Metro East Anglers at the Ringwood Fish Culture Station. No Coho were produced in 2022.

Lake Trout spring yearlings (284,963; 8,392 kg.) were stocked in 2022 as part of an established, long-term rehabilitation program, supporting of the Lake Trout Stocking Plan.

Rainbow Trout (195,082; 5,507 kg.) and Brown Trout (239,416; 7,025 kg.) were stocked at various locations to support shore and boat fisheries. Community hatcheries contribute to the stocking of both species. See Table 6.1.5 for details.

Walleye stocking began in 2012 in an effort to re-establish this native, predatory fish to the fish communities of Hamilton Harbour and Toronto Harbour and to promote urban, near-shore angling. In 2022, 63,013 (29 kg.) summer fingerling Walleye were stocked in Hamilton Harbour.

TABLE. 6.1.2. MNRF fish stocking targets and actual numbers stocked in 2022 (MNRF-produced fish only).

Species/Life Stage	Stocked	Target	Percent
Atlantic Salmon			
Spring Fingerling	211,767	250,000	85%
Spring Yearling	88,373	105,000	84%
Bloater			
All Life Stages	150,265	250,000	60%
Brown Trout			
Spring Yearling	164,012	165,000	99%
Chinook Salmon			
Spring Fingerling	415,817	425,000	98%
Lake Trout			
Spring Yearling	284,963	282,000	101%
Rainbow Trout			
Spring Yearling	175,960	180,000	98%
Walleye			
Summer Fingerling	63,013	100,000	63%

TABLE 6.1.3. Fish provided to community hatcheries by MNRF.

Species / Life Stage	Target	Partner
Atlantic Salmon		
Egg	20,000	Belfountain Hatchery
Egg	16,600	Classroom Hatchery Program
Egg	20,000	Islington Sportsman Club
Egg	10,000	Ontario Streams
Egg	70,000	SSFC
Spring Fingerling	5,000	Credit River Anglers Assoc.
Brown Trout		
Egg	96,000	Metro East Anglers
Egg	50,000	Napanee Rod and Gun Club
Rainbow Trout		
Egg	19,000	Metro East Anglers
Egg	5,000	S. Central Ont F&W Assoc.

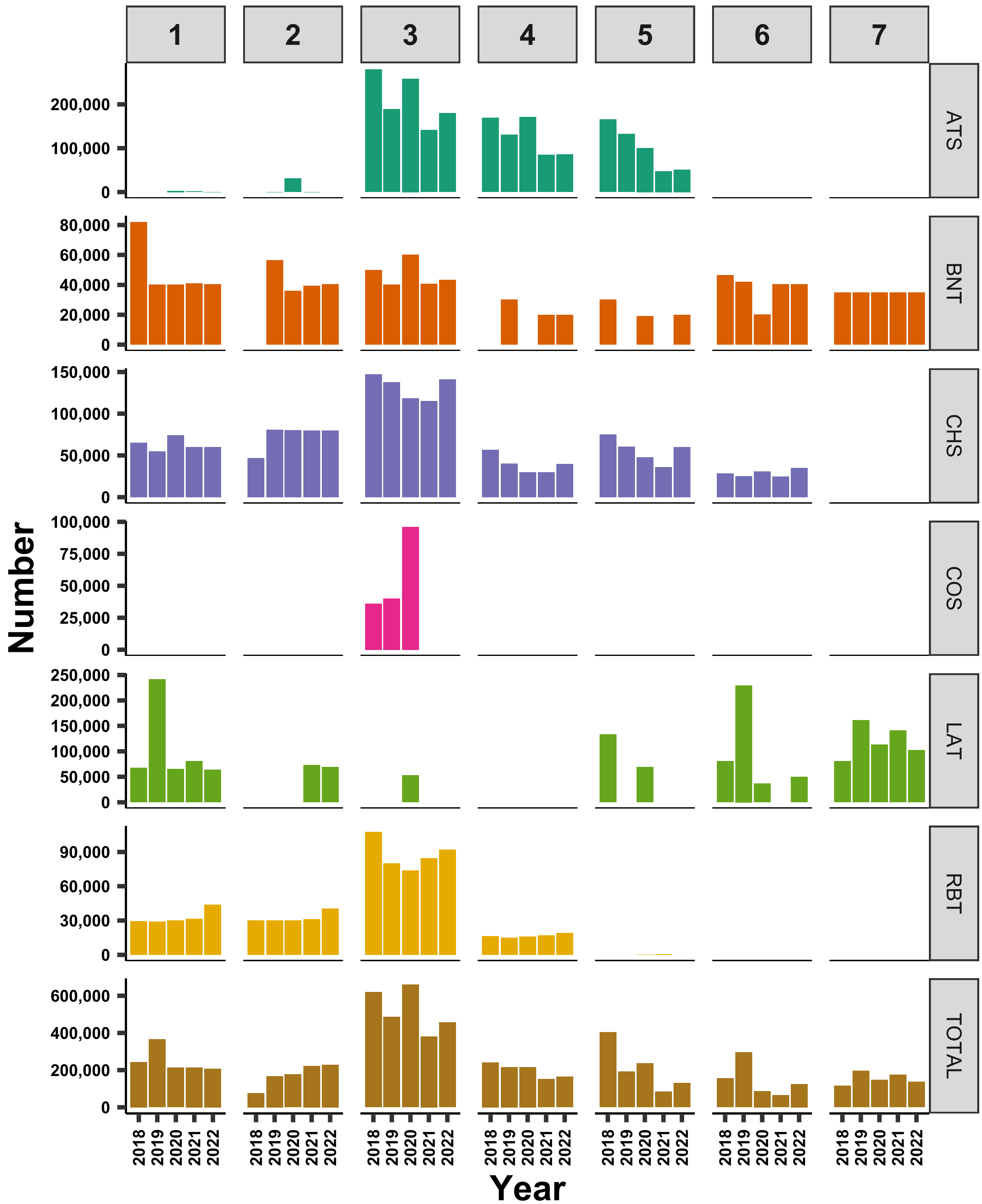


FIG. 6.1.3. Numbers of salmon and trout stocked in the Ontario waters of Lake Ontario for the most recent five years. Data are presented by species (rows) and by stocking zone (columns). The bottom panel ("Total") shows the total for all six species for the same time frame. Note that the y-axes are variable.

ATS = Atlantic Salmon, BNT = Brown Trout, CHS = Chinook Salmon, COS = Coho Salmon, LAT = Lake Trout, RBT = Rainbow Trout.

TABLE 6.1.4. Native fish species stocked into the Ontario waters of Lake Ontario and its tributaries in 2022.

Waterbody	Site	Hatchery	Strain	Marks	Stocking Month	Age (Mos)	Weight (g)	Number
Atlantic Salmon - Fry								
Credit R.	Goyech Property	Belfountain	LaHave R.	--	5	2	0.2	2,925
Credit R.	Keith Property	Belfountain	LaHave R.	--	5	2	0.2	920
Credit R.	W. Credit - Shaw's Cr. Rd.	Belfountain	LaHave R.	--	5	2	0.2	1,965
Credit R.	W. Credit - Winston Churchill Blvd.	Belfountain	LaHave R.	--	5	2	0.2	1,972
Atlantic Salmon - Spring Fingerling								
Credit R.	Black Cr. - 15th Side Rd.	MNRF-NM	LaHave R.	--	5	5	3.1	21,877
Credit R.	Black Cr. - 6th Line	MNRF-NM	LaHave R.	--	5	5	2.3	20,399
Credit R.	Ellie's Ice Cream Parlour	MNRF-NM	LaHave R.	--	5	5	3.4	20,641
Credit R.	Forks	MNRF-NM	LaHave R.	--	5	5	3.1	19,965
Credit R.	Grange Sideroad	MNRF-NM	LaHave R.	--	5	5	4.3	20,081
Credit R.	Inglewood	MNRF-NM	LaHave R.	--	6	5	2.8	18,494
Credit R.	Terra Cotta	MNRF-NM	LaHave R.	--	5	5	2.5	19,752
Duffins Cr.	Reesor Cr. - Hwy 7	MNRF-NM	LaHave R.	--	5	5	2.2	15,155
Duffins Cr.	Reesor Cr. - Sideline 34	MNRF-NM	LaHave R.	--	5	5	2.5	10,157
Duffins Cr.	W. Duffins Cr. - North Rd. Con 7	MNRF-NM	LaHave R.	--	5	5	2.7	15,153
Duffins Cr.	W. Duffins Cr. - Sideline 28 - Wixon Cr.	MNRF-NM	LaHave R.	--	5	5	3.4	15,083
Duffins Cr.	W. Duffins Cr. - Sideline 32	MNRF-NM	LaHave R.	--	5	5	2.6	15,010
Atlantic Salmon - Spring Yearling								
Credit R.	Pt. Credit Hrbr.	MNRF-NM	Sebago Lk.	--	5	18	66.7	22,141
Duffins Cr.	Rotary Park Ramp	MNRF-NM	Sebago Lk.	--	4	17	65.4	15,419
Ganaraska R.	Port Hope - Eldorado Place	MNRF-NM	Sebago Lk.	AD	5	18	73.7	50,813
Atlantic Salmon - Fall Yearling								
Western Basin	Lakefront Promenade	MNRF-NM	LaHave R.	AD	11	22	243	9,049
Atlantic Salmon - Adult								
Ganaraska R.	Port Hope - Mill St. boat ramp	MNRF-HW	LaHave R.	--	2	72	4500	343
Western Basin	Port Dalhousie East	MNRF-NM	Sebago Lk.	--	4	63	4300	49
Western Basin	Port Dalhousie East	MNRF-NM	Sebago Lk.	--	10	48	3500	261
Bloater - Fall Fingerling								
Central Basin	Cobourg Hrbr. West	MNRF-HW	Lk. Michigan	--	11	9	3.3	46,366
Central Basin	Cobourg Hrbr. West	MNRF-WL	Lk. Michigan	--	10	7	1.8	25,555
Bloater - Fall Yearling								
Central Basin	Cobourg Hrbr. West	MNRF-HW	Lk. Michigan	--	11	21	21.7	11,631
Central Basin	Cobourg Hrbr. West	MNRF-WL	Lk. Michigan	--	10	18	26	4,923
Bloater - Sub-adult								
Central Basin	Cobourg Hrbr. Pier	MNRF-CH	Lk. Michigan	--	10	32	64.5	18,751
Central Basin	Cobourg Hrbr. West	MNRF-HW	Lk. Michigan	--	5	25	26	7,218
Central Basin	Cobourg Hrbr. West	MNRF-WL	Lk. Michigan	--	11	31	52	35,419
Central Basin	Cobourg Hrbr. West	MNRF-WL	Lk. Michigan	--	10	102	469	248
Bloater - Adult								
Central Basin	Cobourg Hrbr. West	MNRF-WL	Lk. Michigan	--	10	114	555	154

MNRF Fish Culture Stations: CH = Chatsworth, HW = Harwood, NM = Normandale, WL = White Lake.
Volunteer and other hatcheries: Belfountain = Belfountain Hatchery, Islington = Islington Sportsman Club, MEA = Metro East Anglers (Ringwood), Springside = Springside Park Hatchery.

Marks (fin clips): AD = adipose.

TABLE 6.1.4. (cont.) Native fish species stocked into the Ontario waters of Lake Ontario and its tributaries in 2022.

Waterbody	Site	Hatchery	Strain	Marks	Stocking Month	Age (Mos)	Weight (g)	Number
Lake Trout - Spring Yearling								
Central Basin	Ogden Point	MNRF-HW	Seneca Lk.	LVAD	4	16	32	49,990
Eastern Basin	Amherst Isl. - Big Bar Shoal	MNRF-WL	Slate Is.	LVAD	5	18	30	21,466
Eastern Basin	Amherst Isl. - Ferry	MNRF-WL	Slate Is.	LVAD	5	18	30	22,666
Eastern Basin	Pigeon Isl.	MNRF-HW	Seneca Lk.	LVAD	5	16	34.4	18,103
Eastern Basin	South of Long Point	MNRF-HW	Seneca Lk.	LVAD	5	16	35.1	17,702
Eastern Basin	Long Point	MNRF-WL	Slate Is.	LVAD	5	18	30	22,600
Western Basin	Beacon Inn	MNRF-CH	Seneca Lk.	LVAD	4	17	27.4	23,175
Western Basin	Beacon Inn	MNRF-CH	Slate Is.	LVAD	4	17	26.4	40,414
Western Basin	Grimsby - Forty Mile Cr. Park	MNRF-CH	Seneca Lk.	LVAD	4	17	27.4	28,285
Western Basin	Grimsby - Forty Mile Cr. Park	MNRF-CH	Slate Is.	LVAD	4	17	26.4	40,562
Walleye - Non-feeding Fry								
Hamilton Hrbr	Fisherman's Pier	MNRF-WL	Bay of Quinte	--	5	1		1,073,870
Walleye - Summer Fingerling								
Hamilton Hrbr	Pier 4 Park	MNRF-WL	Bay of Quinte	--	6	3	0.5	63,013

MNRF Fish Culture Stations: CH = Chatsworth, HW = Harwood, NM = Normandale, WL = White Lake.
Volunteer and other hatcheries: Belfountain = Belfountain Hatchery, Islington = Islington Sportsman Club, MEA = Metro East Anglers (Ringwood), Springside = Springside Park Hatchery.

Marks (fin clips): LVAD = left ventral and adipose.

TABLE 6.1.5. Introduced fish species stocked into the Ontario waters of Lake Ontario and its tributaries in 2022.

Waterbody	Site	Hatchery	Strain	Marks	Stocking Month	Age (Mos)	Weight (g)	Number
Brown Trout - Spring Fingerling								
Eastern Basin	Finkle's Shore Ramp	Springside	Ganaraska R.	--	5	5	2	35,000
Brown Trout - Fall Fingerling								
Central Basin	Frenchman's Bay	MEA-RW	Ganaraska R.	--	11	12	25	20,000
Central Basin	Whitby Hrbr.	MEA-RW	Ganaraska R.	--	11	12	25	20,000
Brown Trout - Spring Yearling								
Central Basin	Athol Bay	MNRF-CH	Ganaraska R.	AD	3	16	30.1	40,346
Western Basin	Grimsby - Forty Mile Cr. Park	MNRF-CH	Ganaraska R.	AD	3	16	31.5	40,014
Western Basin	Humber Bay Park	MNRF-CH	Ganaraska R.	AD	3	16	30.9	22,637
Western Basin	Lakefront Promenade	MNRF-CH	Ganaraska R.	AD	3	16	29.5	20,704
Western Basin	Port Dalhousie East	MNRF-CH	Ganaraska R.	AD	3	16	31.5	40,311
Brown Trout - Adult								
Western Basin	Bronte Hrbr.	MNRF-CH	Ganaraska R.	--	11	57	2228	404
Chinook Salmon - Spring Fingerling								
Bronte Cr.	4th Side Rd. Bridge	MNRF-NM	Credit R.	--	5	6	4.9	40,723
Central Basin	Bluffer's Park - Netpen	MNRF-NM	Credit R.	--	5	6	7.4	39,987
Central Basin	Oshawa Netpen	MNRF-NM	Credit R.	--	5	6	8.6	19,984
Central Basin	Port Darlington - Netpen	MNRF-NM	Credit R.	--	5	6	7.7	19,985
Central Basin	Wellington Channel	MNRF-NM	Credit R.	--	5	6	5.8	35,009
Central Basin	Whitby Netpen	MNRF-NM	Credit R.	--	5	6	9.8	19,991
Credit R.	Eldorado Park	MNRF-NM	Credit R.	--	5	6	5.3	50,167
Credit R.	Norval	MNRF-NM	Credit R.	--	5	6	5.6	50,683
Hamilton Hrbr	Grindstone Cr. - Hidden Valley	MNRF-NM	Credit R.	--	5	6	6	9,050
Humber R.	E. Branch Islington	MNRF-NM	Credit R.	--	5	6	5.7	30,057
Western Basin	Bronte Netpen	MNRF-NM	Credit R.	--	5	6	6.9	30,079
Western Basin	Pt. Credit Netpen	MNRF-NM	Credit R.	--	5	6	6.8	10,089
Western Basin	Pt. Dalhousie Netpen	MNRF-NM	Credit R.	--	5	6	7	60,013
Rainbow Trout - Spring Yearling								
Bronte Cr.	2nd Side Rd. Bridge	MNRF-HW	Ganaraska R.	--	5	14	24	20,309
Bronte Cr.	4th Side Rd. Bridge	MNRF-WL	Ganaraska R.	--	5	13	24	20,000
Credit R.	Eldorado Park	MNRF-WL	Ganaraska R.	--	6	13	26	28,555
Credit R.	Norval	MNRF-WL	Ganaraska R.	--	6	13	26	31,346
Humber R.	E. Branch Islington	MNRF-WL	Ganaraska R.	--	5	13	26	15,800
Humber R.	King Vaughan Line	MNRF-WL	Ganaraska R.	--	5	13	26.5	16,100
Niagara R.	Queenston	MNRF-HW	Ganaraska R.	--	5	14	28.4	15,000
Rouge R.	Morningside Creek at Steeles Ave.	MEA-RW	Ganaraska R.	--	5	12	30	19,000
Western Basin	Port Dalhousie East	MNRF-HW	Ganaraska R.	--	6	14	29.3	28,850
Rainbow Trout - Adult								
Western Basin	Lakefront Promenade	MNRF-HW	Ganaraska R.	--	6	73	2500	122

MNRF Fish Culture Stations: CH = Chatsworth, HW = Harwood, NM = Normandale, WL = White Lake.
Volunteer and other hatcheries: Belfountain = Belfountain Hatchery, Islington = Islington Sportsman Club, MEA = Metro East Anglers (Ringwood), Springside = Springside Park Hatchery.

Marks (fin clips): AD = adipose.

6.2 Chinook Salmon 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 near shore structure 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 are tended 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. Up to eight net pen sites are located around the lake (Fig. 6.2.1), however not every site is necessarily used each year. In 2022, Wellington did not participate. The program was not run in 2020 due to COVID-19.

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.

A total of 200,128 Chinook Salmon were released from 7 sites (16 net pens, total) in 2022. This represents 48.1% of the total number (415,817) of Chinook Salmon stocked in the Ontario waters of Lake Ontario in 2022 (Fig. 6.2.2).

Fish were reared and delivered by MNRF staff at the Normandale Fish Culture Station, and survival and growth was good at all sites. Fish were delivered at an average size of 2.9g, and kept in the net pens for an average of 31.7 days, gaining an average of 4.8g across all sites. In 2022, volunteers spent a total of 222 days caring and feeding for the penned fish. See Tables 6.2.1 and 6.2.2 for site-specific data on project duration and growth. Long-term trends in pen duration and growth are illustrated in Figs. 6.2.3 and 6.2.4, respectively.

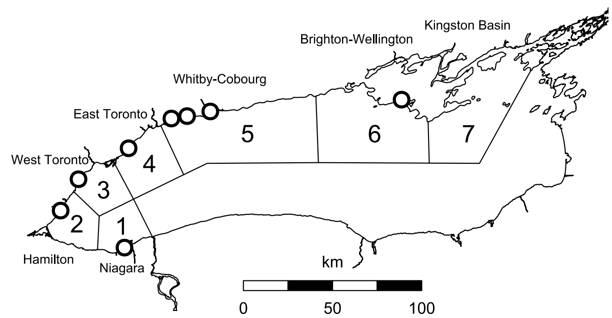


FIG. 6.2.1. Map of Lake Ontario stocking zones and net pen sites.

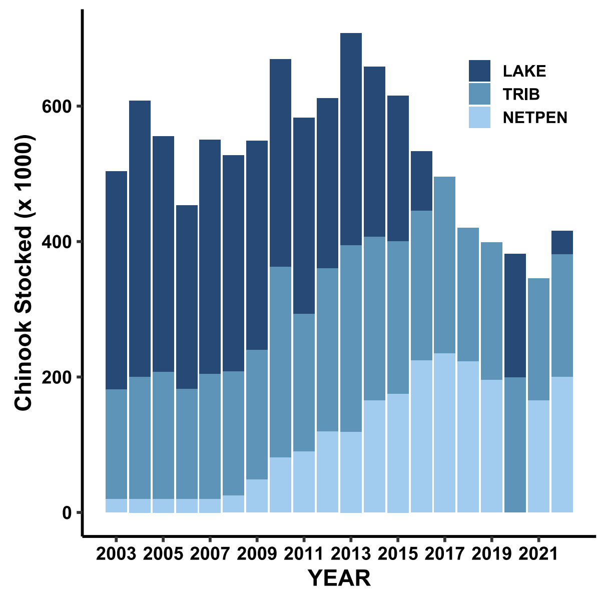


FIG. 6.2.2. Number of Chinook Salmon released from Ontario net pens versus those stocked in tributaries or directly into Lake Ontario.

TABLE 6.2.1: Pen program fish delivery and release dates (sorted by delivery date).

Site	Group	Pens	Stocking Date	Release Date	Days
Bronte	HRSTA	2	Apr-04	May-04	31
Credit	PCSTA	1	Apr-04	May-08	35
Bluffers	MEA	3	Apr-05	May-05	31
Whitby	MEA	2	Apr-05	May-07	33
Darlington	MEA	2	Apr-07	May-06	30
Oshawa	MEA	2	Apr-07	May-07	31
Dalhousie	SCFGC	4	Apr-11	May-11	31

TABLE 6.2.2. Fish delivery size, growth and total numbers by pen site (sorted by number of fish).

Site	Group	Stocking Size (g)	Release Size (g)	Growth (g)	Number
Credit	PCSTA	3	6.8	3.9	10,119
Darlington	MEA	2.8	7.7	5	19,985
Whitby	MEA	3	9.8	6.8	19,991
Oshawa	MEA	2.9	8.6	5.6	20,014
Bronte	HRSTA	3	6.9	3.9	30,079
Bluffers	MEA	3	7.4	4.4	39,987
Dalhousie	SCFGC	2.7	7	4.3	60,013

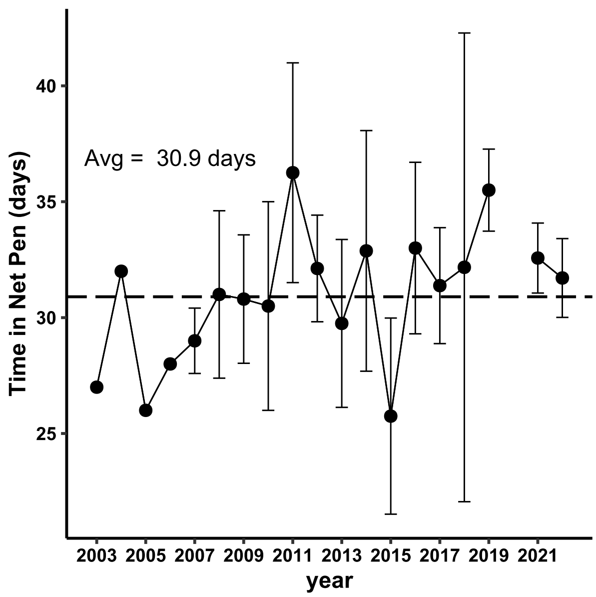


FIG. 6.2.3. Average duration for all years of the stocking net pen program.

For the duration of the time in the net pen, fish health is paramount. To help ensure fish remain healthy, a maximum of 15,000 fish are placed in each net pen, keeping the overall density under the guideline of 32g of fish per litre of water. Net pen sizes have been standardized, and each have a volume of approximately 4,000 litres. Fig. 6.2.5 shows the average density of fish (at time of release) in the net pens.

Each site is issued a combination temperature/ dissolved oxygen data logger, allowing the various sites' water quality to be monitored and compared (see Fig. 6.2.6 for temperature; Fig. 6.2.7 for dissolved oxygen). The loggers are suspended mid-depth inside the net pen, and measurements are recorded every five minutes.

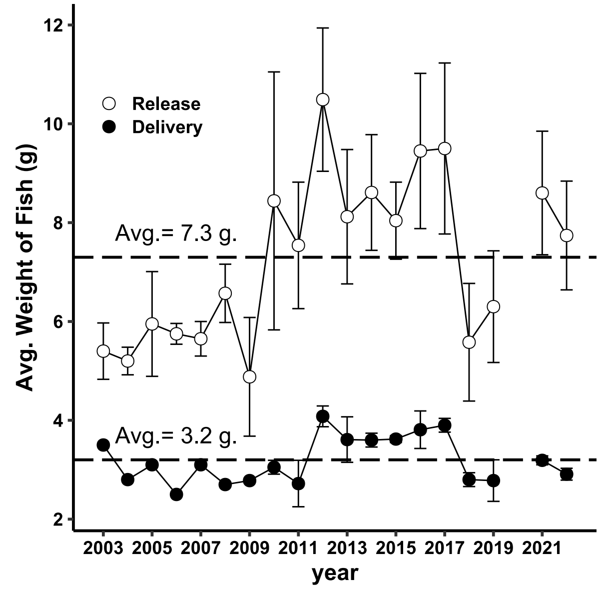


FIG. 6.2.4. Chinook size at delivery and release size for all years of the net pen program.

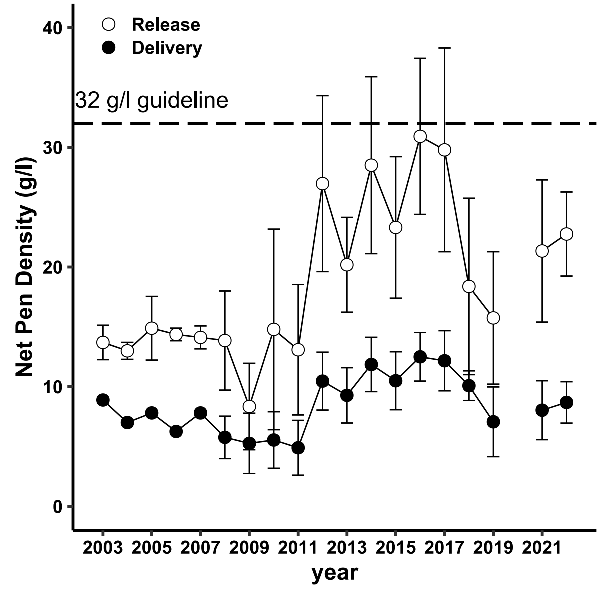


FIG. 6.2.5. Average density (g/l) of Chinook Salmon held per stocking net pen. The guideline is represented by the dashed line.

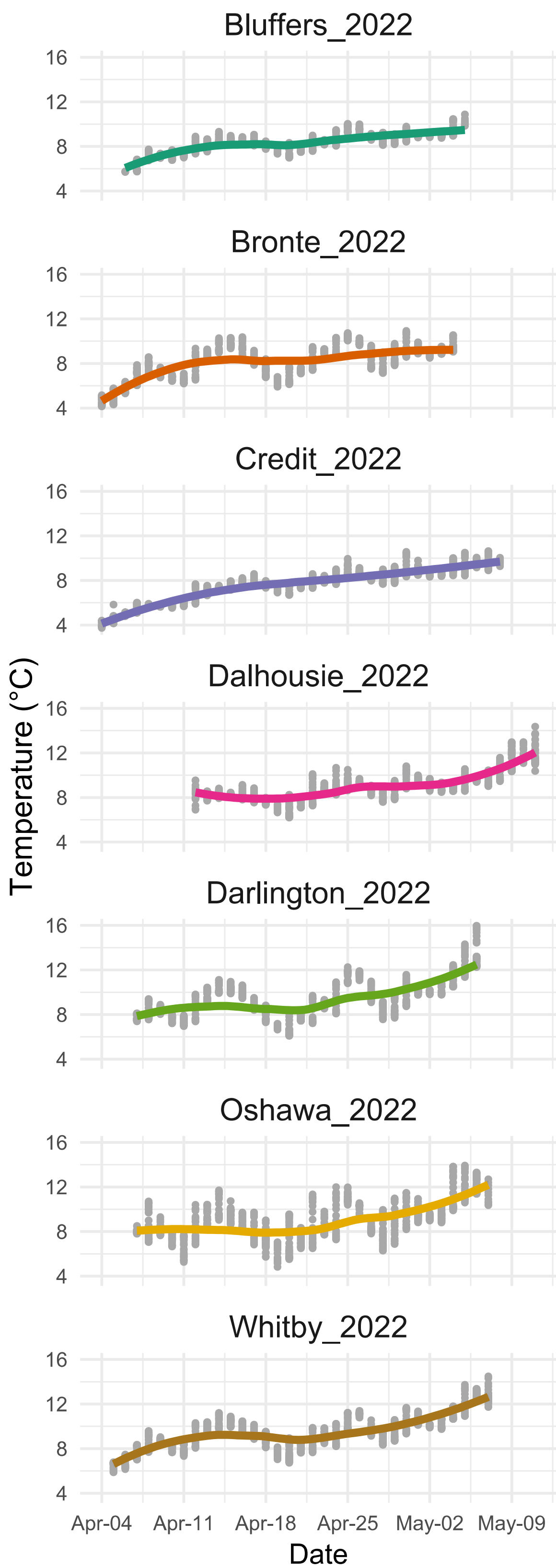


FIG. 6.2.6. Temperature data for the net pen program.

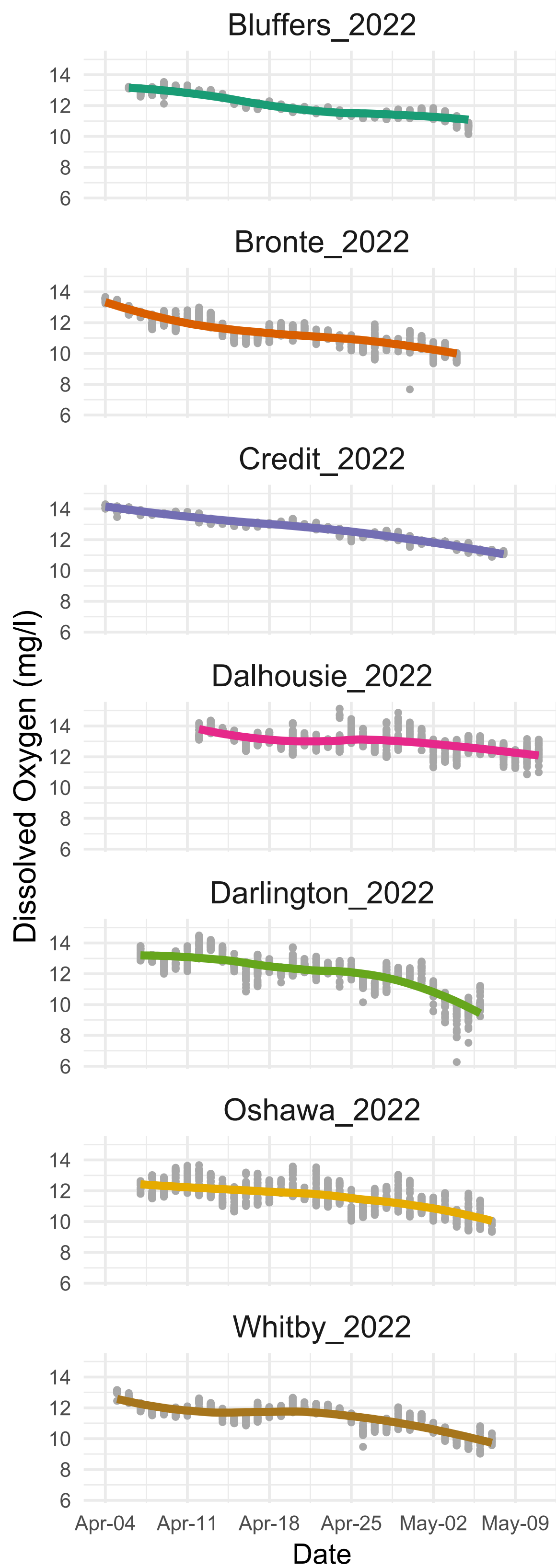


FIG. 6.2.7. Dissolved oxygen data for the net pen program.

6.3 Atlantic Salmon Surplus Broodstock Tagging

C. Lake, Lake Ontario Management Unit

In order to support ongoing restoration efforts, the Ministry of Natural Resources and Forestry maintains Atlantic Salmon 'brood stock' in several provincial fish culture stations. Brood stock are adult (sexually mature) fish that are kept in the hatchery so that their offspring can be raised and eventually stocked at various life stages. As brood stock age, the quality of their gametes may decline. 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.

To make the best use of these 'surplus' fish, they are released into Lake Ontario to provide angling opportunities. In order to better understand survival and movement, fish were tagged near the dorsal fin with a coloured streamer tag labelled with a unique identifying number and phone number printed on it.

The total number of tagged fish released in 2022 was 610. Reported recapture locations by release site are shown in Fig. 6.3.1.

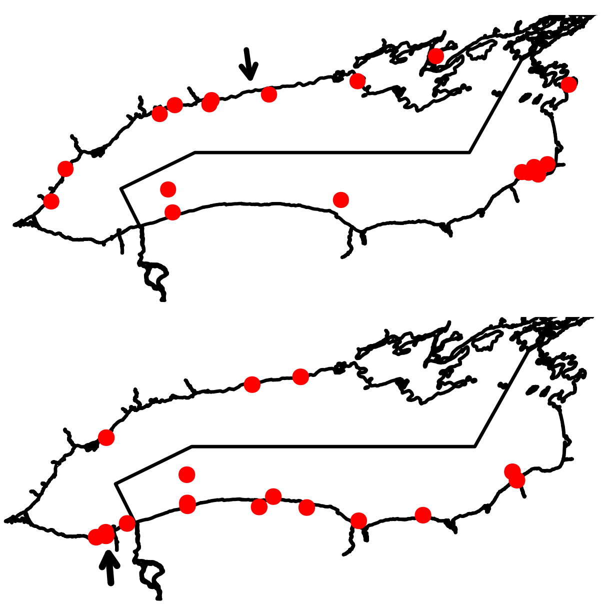


FIG. 6.3.1. Recapture locations (n=102) of fish stocked in **2022 only**. Arrows indicate stocking location (top = Port Hope, bottom = Port Dalhousie).

When anglers report catching one of these fish, basic information on movement and survival can be calculated. See Table 6.3.1 for numbers released since the start of the brood retirement project. Numbers caught by year and location are given in Table 6.3.2, and the resulting recapture rate is given in Table 6.3.3. Note that fish may be caught in years subsequent to their stocking year, so recapture values may change in future reports.

TABLE 6.3.1. Numbers of tagged broodstock Atlantic Salmon stocked by location and year.

Location	2018	2019	2020	2021	2022	Total
Bronte Harbour	196	---	---	---	---	196
Cobourg Marina	---	556	---	---	---	556
Grimsby	---	300	---	---	---	300
Newcastle	---	249	---	---	---	249
Port Dalhousie	96	164	313	1,081	267	1,921
Port Hope	---	93	215	600	343	1,251
Total	292	1,362	528	1,681	610	4,473

TABLE 6.3.2. Numbers of tagged broodstock Atlantic Salmon recaptured by stocking location and year.

Location	2018	2019	2020	2021	2022	Total
Bronte Harbour	6	---	---	---	---	6
Cobourg Marina	---	24	---	---	---	24
Grimsby	---	14	---	---	---	14
Newcastle	---	14	---	---	---	14
Port Dalhousie	5	13	13	64	8	103
Port Hope	---	---	10	51	17	78
Total	11	65	23	115	25	239

TABLE 6.3.3. Recapture percentages of tagged broodstock Atlantic Salmon by stocking location and year.

Location	2018	2019	2020	2021	2022	Total
Bronte Harbour	3.1%	---	---	---	---	3.1%
Cobourg Marina	---	4.3%	---	---	---	4.3%
Grimsby	---	4.7%	---	---	---	4.7%
Newcastle	---	5.6%	---	---	---	5.6%
Port Dalhousie	5.2%	7.9%	4.2%	5.9%	3.0%	5.4%
Port Hope	---	---	4.6%	8.5%	5.0%	6.2%
Total	3.8%	4.8%	4.4%	6.8%	4.1%	5.3%

All project data can be found here - https://geohub.lio.gov.on.ca/datasets/ mnrf::lake-ontario-tagged-atlantic-salmon/about

7. Research Activities

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

Project Leads: Emma Bloomfield, Allison McDonald, and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Heather Niblock and Kelly Bowen (Fisheries and Oceans Canada)

Lower trophic (feeding) organisms, like phytoplankton and zooplankton, are essential components of aquatic food webs. Prey fish (e.g., Cisco [*Coregonus artedi*] and Alewife [*Alosa pseudoharengus*]) rely on zooplankton for energy and they in turn provide energy to top consumers (e.g., Chinook Salmon [*Oncorhynchus tshawytscha*] and Walleye [*Sander vitreus*]). Ecological changes, such as climate change and nutrient reductions, can rapidly impact lower trophic levels with impacts extending from the bottom up to top consumers. Therefore, continued monitoring of lower trophic organisms and the factors that impact them is essential for fisheries management.

Valuable long-term data about lower trophic positions in Lake Ontario is collected through the Station 81 program. Sampling was conducted at Station 81 from 1981 – 1995 by Fisheries and Oceans Canada (DFO). Sampling resumed in 2007 as a partnership between MNRF's Aquatic Research and Monitoring Section, MNRF's Lake Ontario Management Unit, and DFO. Station 81 is in eastern Lake Ontario near the centre of the Kingston Basin (44° 01.02'N, 76° 40.23'W) in approximately 34 m of water (Fig. 7.1.1).

In 2022, Station 81 was sampled biweekly, between May 2nd and November 2nd. During each visit, the lake's physical properties were determined, including temperature, amount of dissolved oxygen, and Secchi disk depth (an index of water clarity). Samples of phytoplankton and zooplankton were collected to determine species composition and biomass. Water samples were also collected to determine phosphorus and nitrogen (nutrient) concentrations.

Phosphorus is an important plant nutrient that often limits primary productivity (phytoplankton and algae growth). Too much phosphorus can cause harmful algal blooms and anoxic (low oxygen) conditions that harm fish. In response to high phosphorus concentrations in the late 1970's, binational efforts were initiated to reduce phosphorous loading in the Great Lakes. The target of 10 µg/L of total phosphorus and 2.6 µg/L of Chlorophyll *a* (a measure of

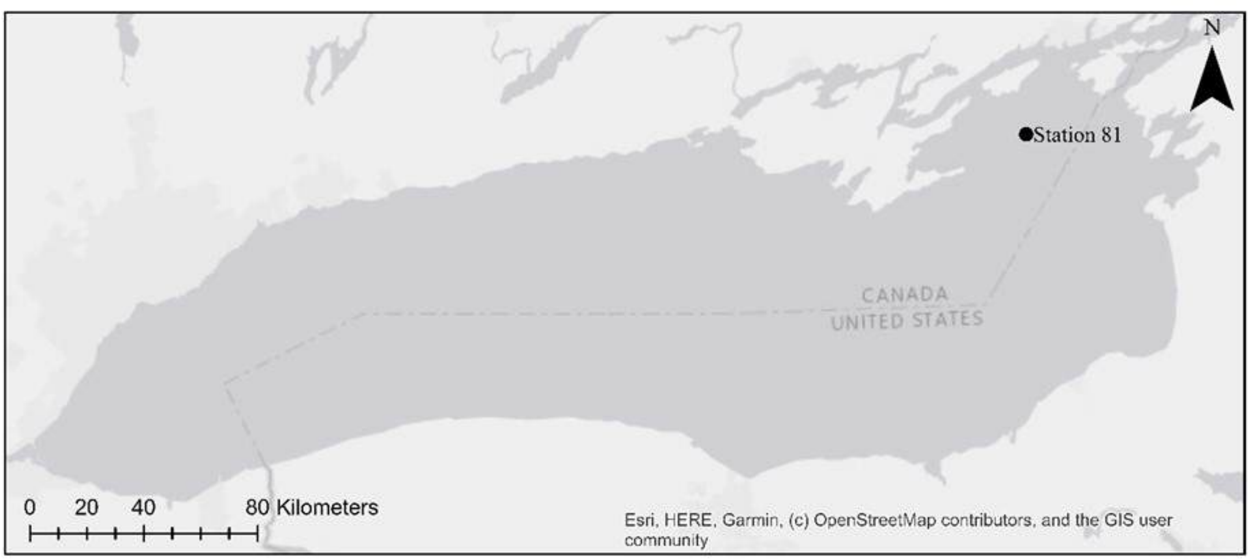


FIG. 7.1.1 Map of Lake Ontario showing the location of the Station 81 sampling site.

phytoplankton biomass) were established for Lake Ontario. The average spring total phosphorous level declined through the 1980s and early 1990s and has been variable during the recent time period (the past 15 years; Fig. 7.1.2). Average spring Chlorophyll *a* in the recent time period is less than in the 1980s and 1990s and is now at or below target concentrations (Fig. 7.1.2). Consistent with reduced productivity, Secchi disk depth (water clarity) is higher in the recent time period (Fig. 7.1.2).

Since data collection at Station 81 began in 1981, mean annual epilimnetic (upper layer) water temperature has been increasing (Fig. 7.1.3). The lowest mean annual temperature was in 1982 (14.1˚C) while the highest mean annual temperature to date was in 2012 (18.0˚C). The lake is warming at an average rate of 0.036˚C per year or about 1.5˚C since sampling initially began 41 years ago. For temperature sensitive organisms like fish, even relatively small changes in temperature can have large impacts on factors like growth rate, foraging efficiency, and reproduction.

Station 81 is a long-term monitoring program that provides valuable information about the composition and health of the base of Lake Ontario's food web. Here we have outlined changes in water temperature, nutrients, and indicators of productivity. Previous reports have presented dramatic declines in zooplankton abundance and a change in zooplankton community composition. Continued maintenance and analysis of these long-term datasets will ensure that resource managers are best equipped to identify and respond to changes that may impact Lake Ontario's ecosystem and fisheries.

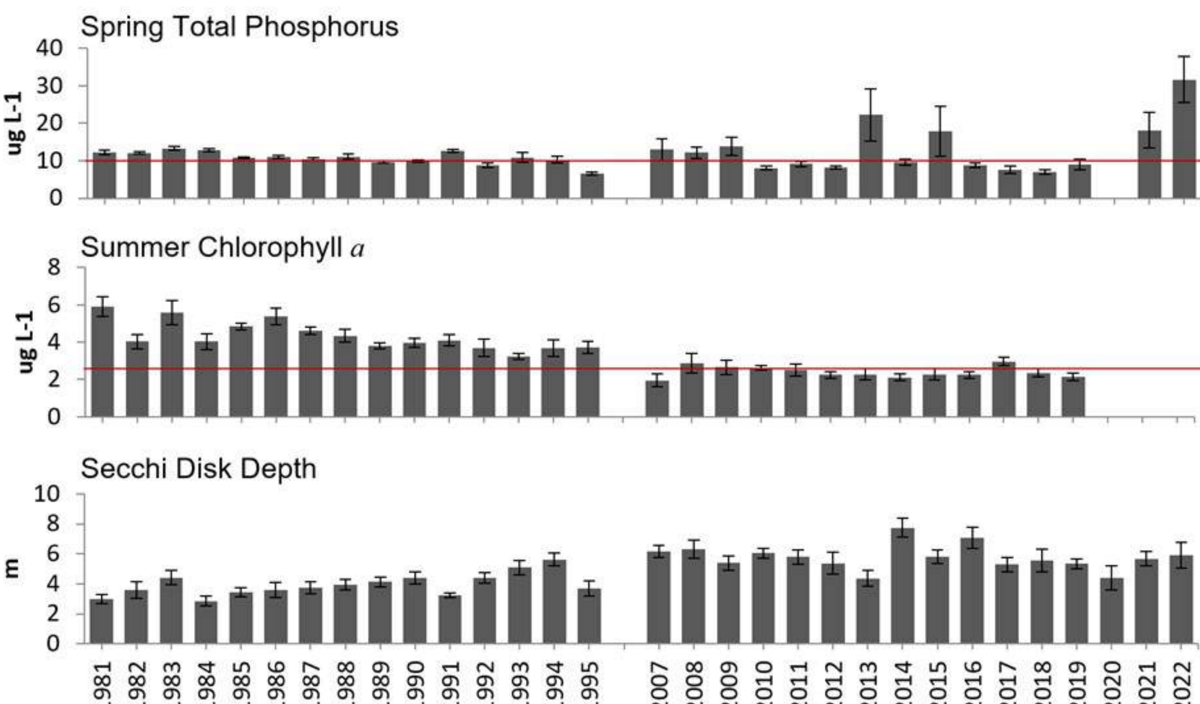


FIG. 7.1.2. Spring total phosphorous (μg/L), summer Chlorophyll *a* (μg/L), and Secchi disk depth (m) averaged across sampling trips at Station 81 (mean ± SE). Spring is early May to late June and summer is late June to late September. Red lines are the target total phosphorus and Chlorophyll *a* levels.

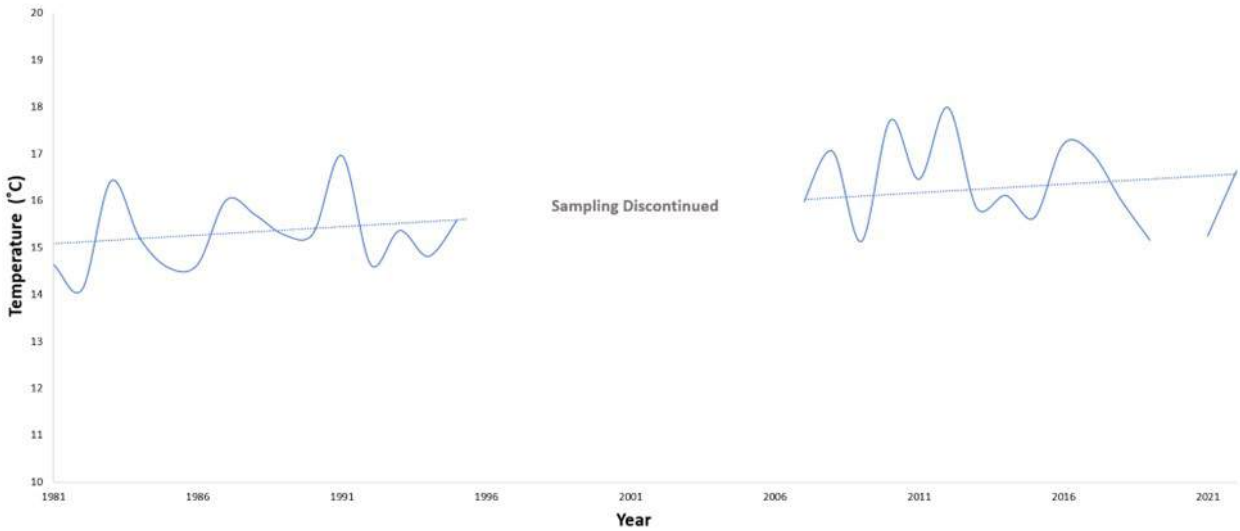


FIG. 7.1.3. Mean annual epilimnion (upper layer) water temperature from 1981 to 2022 (with 2020 omitted due to Covid-19 sampling constraints). Daily water temperature was calculated as the mean temperature of the water column from the surface to the thermocline, or to 20 m if no thermocline existed. Annual means were seasonally weighted between May 1 and October 31. Trend line is the linear regression of water temperature over time.

7.2 Investigating the spatial and temporal variability of light and temperature in Lake Ontario

Project Leads: Adam Rupnik and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Yulu Shi and Mathew Wells (University of Toronto, Scarborough); Jon Midwood (Fisheries and Oceans Canada); Brian Lantry (US Geological Survey); Dimitry Gorsky (US Fish and Wildlife Service); Bruce Tufts (Queen's University)

Temperature and light are important indicators of an aquatic habitat's physical and biological processes, such as food web production (zooplankton growth, fish growth, etc.), habitat preferences, as well as the general levels of activity throughout the lake. Winds and currents are constantly mixing the waters of the upper, warm layer of the lake (called the epilimnion, separated from the cold deep hypolimnion by a narrow band of rapidly changing temperature called the thermocline). The depth of the thermocline is not constant and can vary across the surface of the lake. The variability in the thermocline depth has a dramatic effect on the spatial boundaries for animals like fish and plankton, which makes understanding its variability important for lake managers and researchers alike. Despite the importance of this information, there has been little systematic spatial monitoring of thermocline depth.

To describe the temporal and spatial variability in the temperature and light environment within Lake Ontario, 13 light and temperature logger arrays were deployed within Lake Ontario to monitor fluctuations in these variables (Fig. 7.2.1). Logger arrays extended from 10 m below the surface to the bottom of the lake. So far, we have completed the first year of a three-year commitment to deploy and service the array.

Depending on the orientation of the land and the wind, winds can either drive upwelling (thermocline tilting up with colder hypolimnetic water moving closer to the surface) or downwelling (downward tilt) of stratified water masses on different sides of the lake. Water currents in the surface layer (epilimnion) are driven by the shear stress of the wind force at the surface – due to Coriolis forces these "Ekman currents" are directed to the right of the wind's direction. Thus, a sustained westerly wind pushes surface waters towards the southern side of Lake Ontario. Since the overall lake level doesn't change markedly, the accumulation of epilimnetic water on the south side of the lake causes colder hypolimnetic water to move closer to the surface

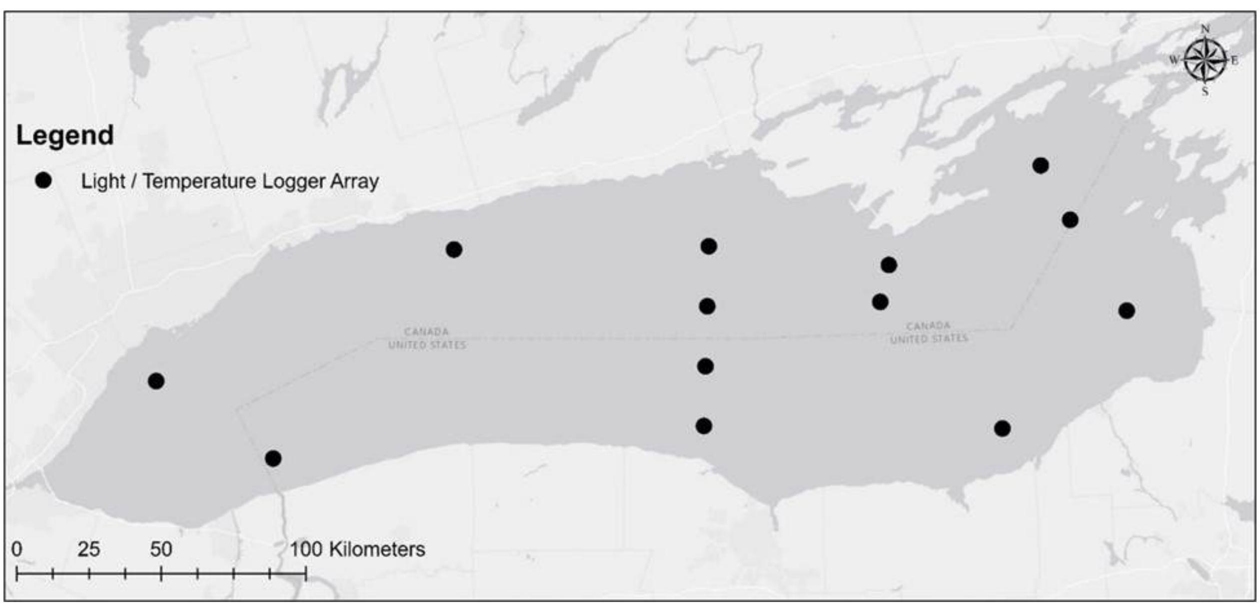


FIG. 7.2.1: Locations of 13 light / temperature logger arrays throughout Lake Ontario. Logger arrays extend from 10 meters below the surface to the lake bottom.

along the north shore, resulting in tilting of the thermocline higher upwind and lower downwind. During summer stratification, upwelling events with colder water coming up are more prevalent along the north-western side of the lake near Toronto, while downwelling events with warmer water moving down are more frequent at the south-eastern side. For typical winds, the upwelling of hypolimnion tilts up the thermocline to 10-20m depth, while extreme downwelling events can push the thermocline down to 50-60 m depth.

Fig. 7.2.2 shows the temperature anomalies of 13 GLOS moorings. Sites with cooler summer temperatures appear to have warmer winter temperatures, while sites with warmer summer temperatures have colder winter temperatures. These seasonal dichotomies appear to align with the west-east axis of the lake with cooler winter and warmer summer temperatures occurring in the west, while eastern sites exhibit the opposite pattern.

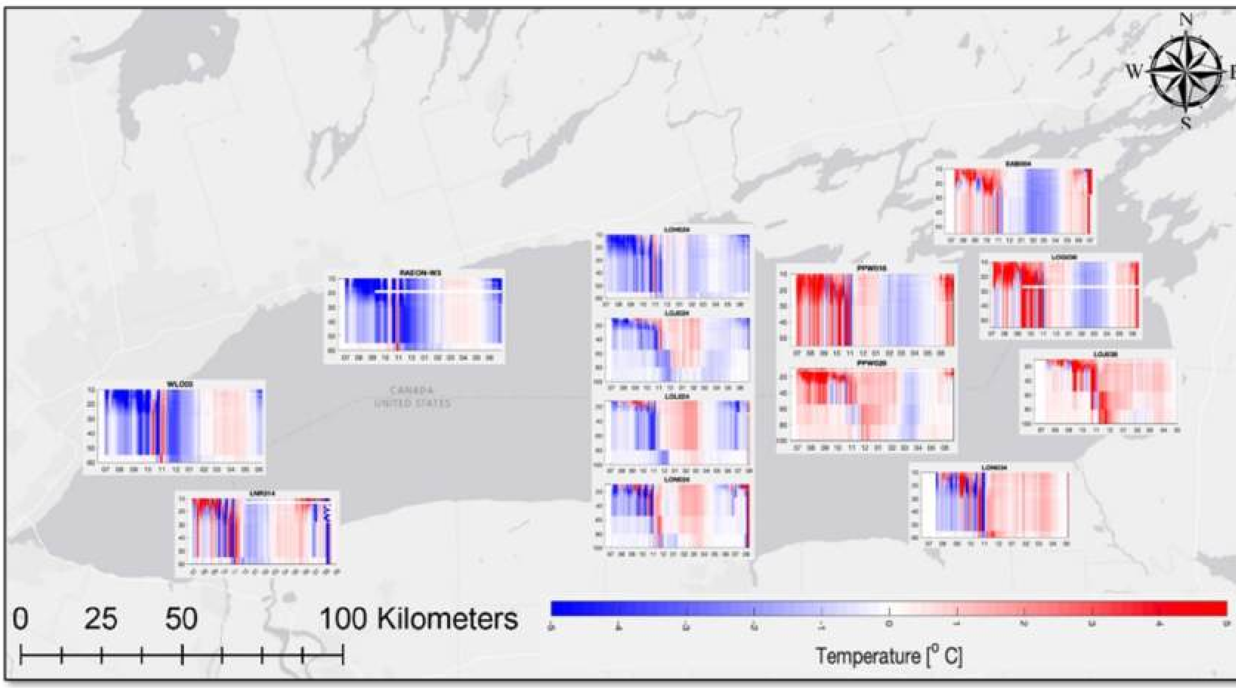


FIG. 7.2.2. Temperature anomalies from weekly mean of 13 moorings. Red represents positive anomalies and blue represents negative anomalies.

7.3 Mortality and behaviour of stocked bloater across varying depths in Lake Ontario

Project Leads: Lydia Paulic, Silviya Ivanova, and Aaron Fisk (University of Windsor); Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Dimitry Gorsky and John Sweka (US Fish and Wildlife Service)

Until the mid-1950s, Bloater (*Coregonus hoyi*) were an abundant native forage fish in Lake Ontario but underwent a dramatic population decline in the 1950s due to environmental changes, overharvest, and the establishment of non-native species. By the 1980s, Bloater were extirpated (locally extinct) from the lake entirely. A binational restoration 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) was developed to re-establish the species and diversify the prey fish community.

Current stocking of hatchery-raised juvenile Bloater occurs over deeper water (~50 m) to reduce predation effects and increase proximity to preferred habitat. However, recent acoustic telemetry research has quantified significant mortality due to predation and possibly barotrauma (stress due to rapid changes in depth as fish descend in the water column). To see if this mortality could be reduced, acoustically tagged juvenile bloater were stocked over three depths (5 m, 50 m, and 100 m) in eastern Lake Ontario. Preliminary results indicate tagged bloater dispersed rapidly (Fig. 7.3.1), had high initial mortality at the deeper stocking sites, and had higher predation at the 5 m stocking site (Fig. 7.3.2). Continued examination of the movement and predation of Bloater will be used to estimate survival of the stocked population. A better understanding of movement and mortality of stocked fish will aid in refining stocking practices and inform restoration potential for the species.

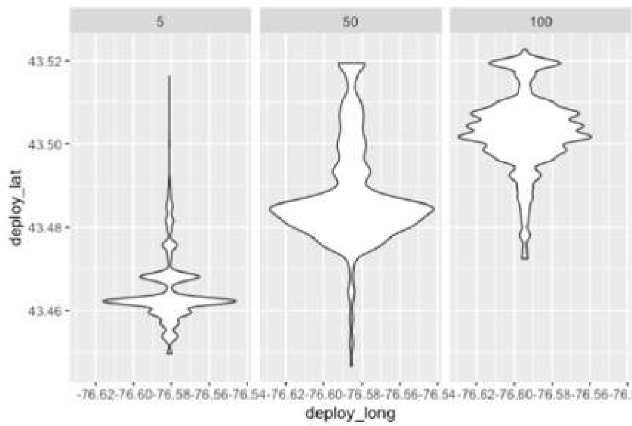


FIG. 7.3.1. Distribution of bloater post-release across three stocking depths (5m, 50m, and 100m) in Lake Ontario.

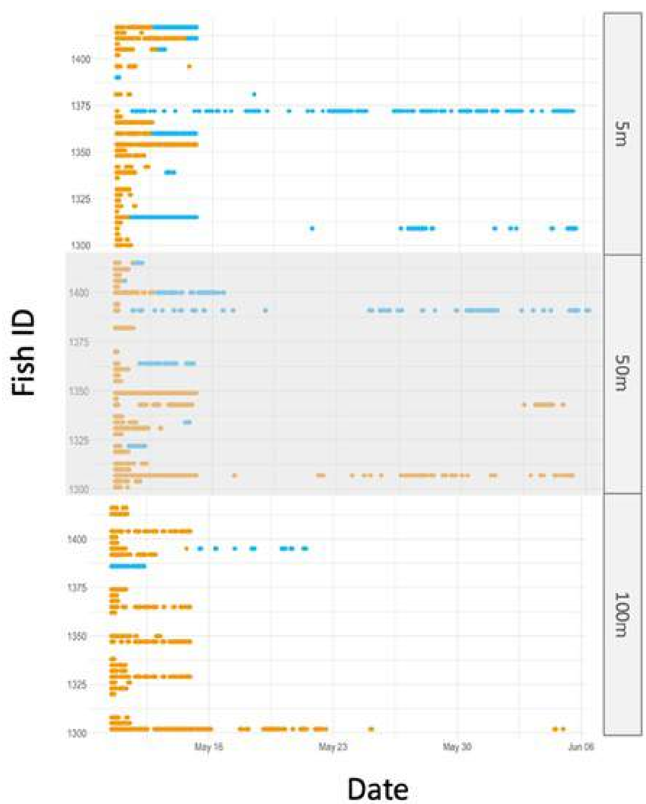


FIG. 7.3.2. Temporal record of detection for all Bloater (*Coregonus hoyi*) following release into southeastern Lake Ontario. Orange indicates non-predated detections and blue indicates predated detections. Most detection histories lasted only a few days.

7.4 Lake Whitefish telemetry in Lake Ontario

Project Leads: Brent Metcalfe, Adam Rupnik, Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)

Lake Whitefish (*Coregonus clupeaformis*) are one of the most commercially important fish species in the Laurentian Great Lakes and have supported a commercial harvest in Lake Ontario for more than a century. In recent decades, Lake Whitefish abundance has declined to a low but stable level and anecdotal observation suggest changes in behaviour and distribution that may have important ramifications for energy acquisition that ultimately affect growth and production. The MNRF has a keen interest in learning more about the production potential of this important member of the Lake Ontario fish community and is combining acoustic telemetry with other bioenergetic / health metrics to learn more about their ability to respond to ecological change.

In the fall of 2021 and 2022, during November spawning runs, staff from the Glenora Fisheries Station collected 30 Lake Whitefish per year from the waters of Lake Ontario near Point Petre, along the south shore of Prince Edward County (Fig. 7.4.1). Short nighttime gillnet sets were used to collect fish. Fish were transported to shore where acoustic telemetry tags and data loggers fitted with depth and temperature sensors were surgically implanted in the body cavity of each fish. Once implanted, fish were released back into the lake. A network of acoustic receivers (moored devices that record the serial number and any sensor (i.e. depth and temperature) information from fish tags that swim by, while also adding a date and time stamp) has been deployed in Lake Ontario by MNRF and other researchers to track movement of multiple species of tagged fish throughout the year (Fig. 7.4.1).

Initial results from the first year of telemetry data collection suggested that most Lake Whitefish travelled from the capture location, east to the Kingston Basin of Lake Ontario, and rarely moved to the south or west parts of the lake (Fig. 7.4.1). Fish generally remained at bathymetric depths less than 80 m throughout the year (Fig. 7.4.2), and depth-sensitive tags suggested Lake Whitefish suspend in the water column below the thermocline and are not exclusively bottom dwelling as is frequently assumed (Table 7.4.1).

While the telemetry data is helping build an understanding of Lake Whitefish movement, distribution, and behaviour, the internal data loggers contain more extensive data that will help researchers evaluate habitat use and activity needed to manage this important species in an

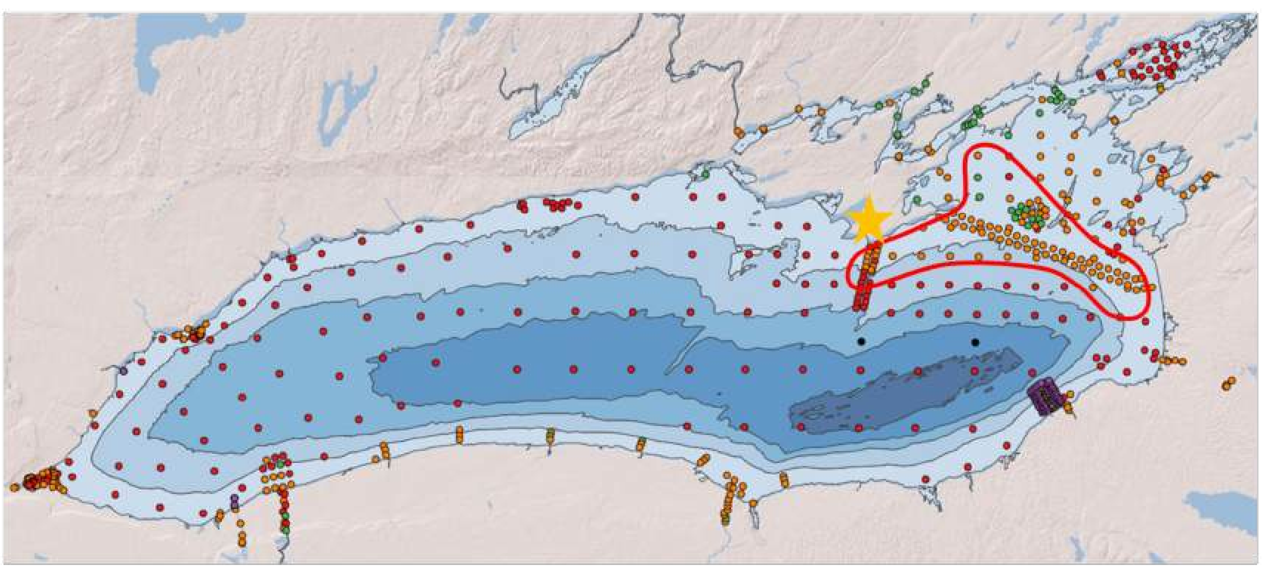


FIG. 7.4.1. Map of Lake Ontario showing acoustic receiver placement (red, green, violet, orange circles), Point Petre capture and tagging location (yellow star), and general location of travel of tagged Lake Whitefish throughout the year (area encircled by red polygon). Basemap courtesy of USFWS.

ever-changing environment (e.g., climate change and invasive species). Tagged fish are marked with a bright orange external hoop tag and the two internal tags should be returned to MNRF for a reward.

TABLE 7.4.1. Average seasonal depth of occupancy (± 1 standard deviation) for 13 Lake Whitefish fitted with depth sensitive tags in fall 2021.

Season	Mean depth of occupancy (m)	Range (m)
Winter (January – April)	28.6 ± 13.5	9.7 – 46.7
Spring (May – June)	35.6 ± 13.8	10.9 – 46.7
Summer (July – October)	35.8 ± 4.5	14.6 – 43.1
Fall (November – December)	15.7 ± 9.5	1.8 – 52.0

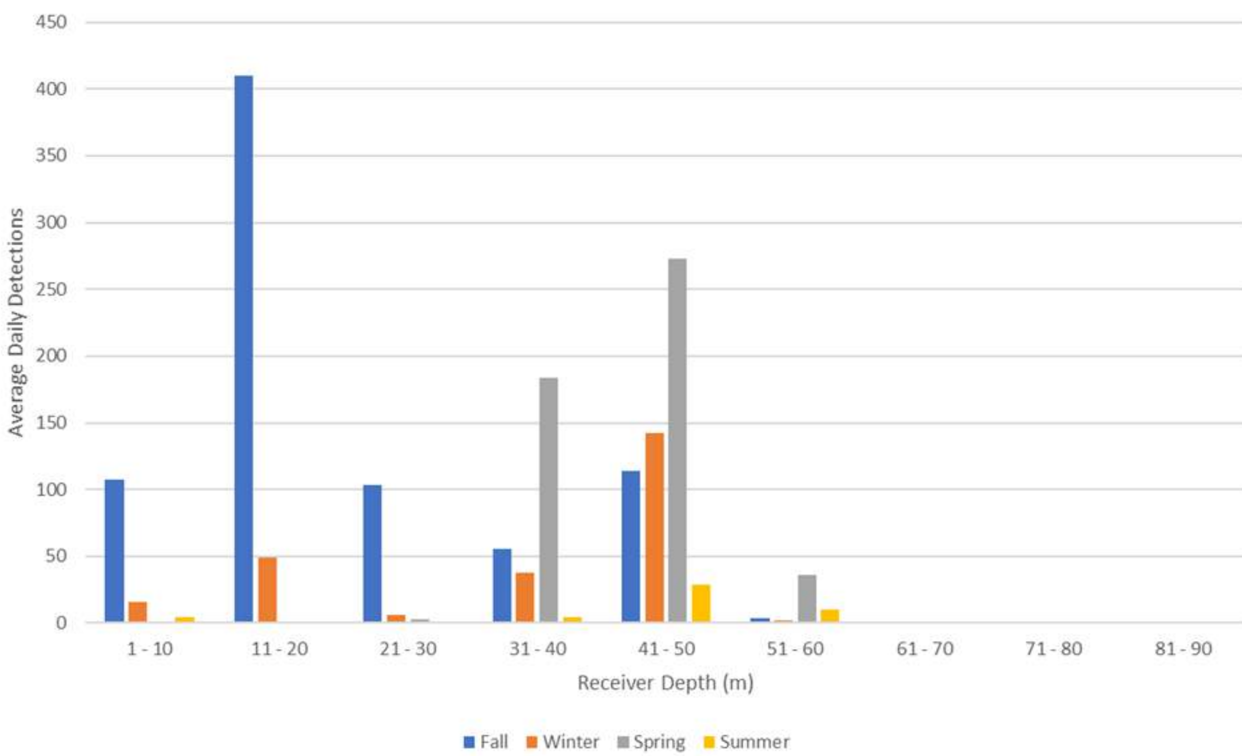


FIG. 7.4.2. Lake Whitefish (*Coregonus clupeaformis*) detections by receiver depth (bathymetric depth) and season (blue = fall, orange = winter, grey = spring, yellow = summer) from November 2021 (initial tag deployment) to July 2022 (initial receiver download). NOTE: fewer detections were recorded in summer because receivers were downloaded in July while lake remains stratified through September.

7.5 What's swimming in the middle of Lake Ontario? Expanding acoustic receiver coverage into central Lake Ontario

Project Leads: Adam Rupnik and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Aaron Fisk (University of Windsor); John Midwood & Sarah Larocque (Fisheries and Oceans Canada); Dimitry Gorsky (US Fish and Wildlife Service); Scott Minihkeim (US Geological Survey).

Application of acoustic telemetry has dramatically increased within Lake Ontario since 2010. Until recently, receiver deployments were limited to the eastern and western ends of the lake. In 2021, MNRF redistributed receivers into the central basin, as well as coordinating deployment of 40 new receivers acquired through GLATOS (the Great Lakes Acoustic Telemetry Observation System; *https://glatos.glos.us/*). These new deployments now provide whole lake, offshore coverage of tagged fish movements (Fig. 7.5.1).

After approximately one year of deployment, 317 individuals representing 9 species yielded 477,584 detections just in the central basin. Species detected include Bloater (*Coregonus hoyi*; 6), Brown Trout (*Salmo trutta*; 1), Chinook Salmon (*Oncorhynchus tshawytscha*; 43), Cisco (*Coregonus artedi*; 3), Lake Sturgeon (*Acipenser fulvescens*; 2), Lake Trout (*Salvelinus namaycush*; 99), Lake Whitefish (*Coregonus clupeaformis*; 30), Rainbow Trout (*Oncorhynchus mykiss*; 1), and Walleye (*Sander vitreus*; 73).

Only four species were consistently detected throughout the year. Chinook Salmon appear to inhabit this area relatively consistently, whereas Lake Trout, Lake Whitefish, and Walleye appear to disperse to other regions of the lake in the fall and increase again in the spring, suggesting different habitat preferences for spawning / overwintering for these fish during the winter months (Fig. 7.5.2).

Acoustic telemetry will continue to inform our understanding on where and when fish are in different regions of Lake Ontario, and what may cause movements between regions. Understanding the distribution and behaviour of fish gives researchers and managers insight in how to best manage and conserve fish populations for both the health of the ecosystem and continued human use.

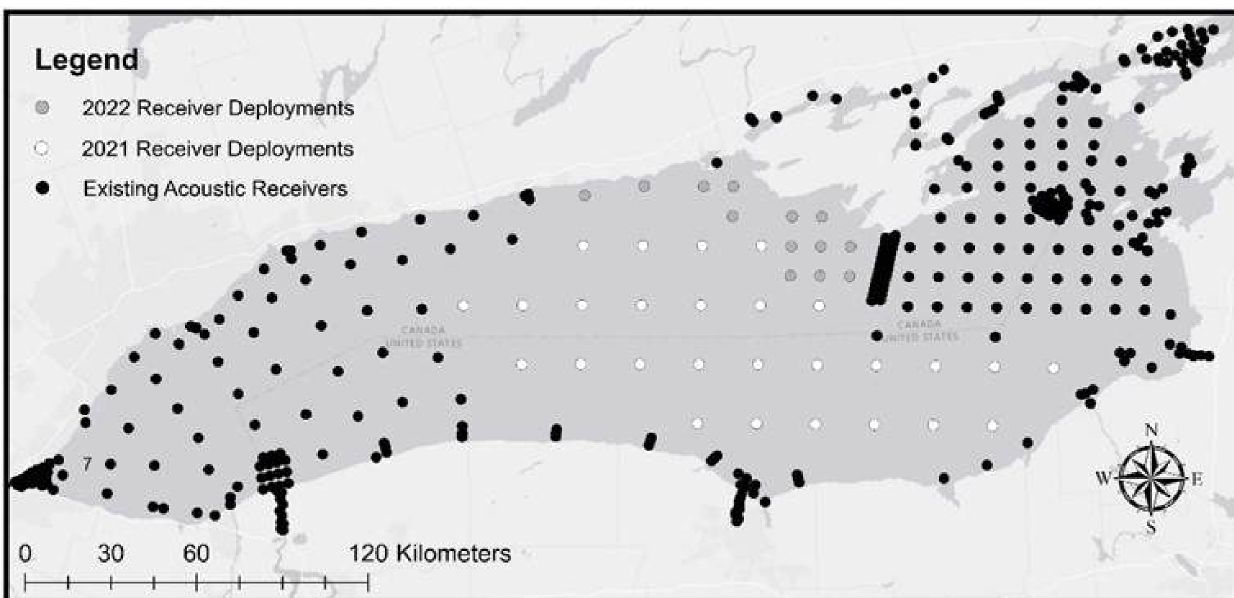


FIG. 7.5.1. Acoustic receivers deployed in Lake Ontario in 2021 and 2022. Black circles indicate pre-existing receiver deployments, gray indicates receivers deployed in 2022, and white indicates receivers deployed in 2021. Only data from receivers deployed in 2021 was used in this report.

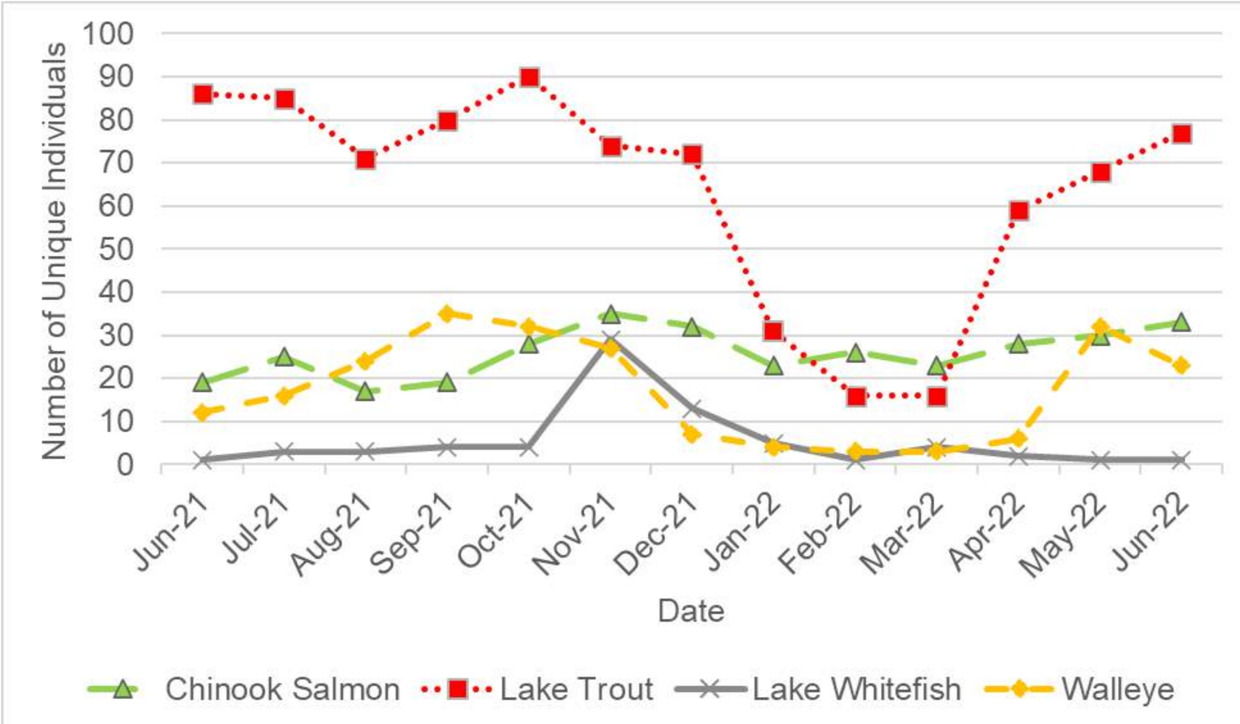


FIG. 7.5.2. Monthly count of unique individuals for four species (Chinook Salmon, Lake Trout, Lake Whitefish, and Walleye) detected between June 2021 and June 2022.

7.6 Long-term changes in the trophic ecology of three species of salmonids

Project Leads: Emma Bloomfield and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)

Understanding how species and ecosystems respond to ecological changes, such as altered nutrient availability and invasive species, is critical for successful resource management. Investigating trophic (feeding) ecology through time can reveal responses to past stressors and provide baseline information to identify future diet shifts that may result in changes in growth and production. Stable isotopes are a tool that can reveal trophic information about an organism based on chemical analysis of their tissue. Stable isotope analysis of archived tissue provides a unique opportunity to go back in time and retroactively study trophic ecology.

The Glenora Fisheries Station has an extensive archive of fish scales. We used this archive to conduct carbon and nitrogen stable isotope analysis on scales from Lake Trout (*Salvelinus namaycush*), Chinook Salmon (*Oncorhynchus tshawytscha*), and Rainbow Trout (*Oncorhynchus mykiss*) over five ecological stanzas (periods of time that are ecologically different). Our ecological stanzas were pre-phosphorous control, post-phosphorous control, dreissenid (i.e., zebra [*Dreissena polymorpha*] and quagga mussel [*Dreissena bugensis*]) invasion, Round Goby (*Neogobius melanostomus*) invasion, and Alewife (*Alosa*

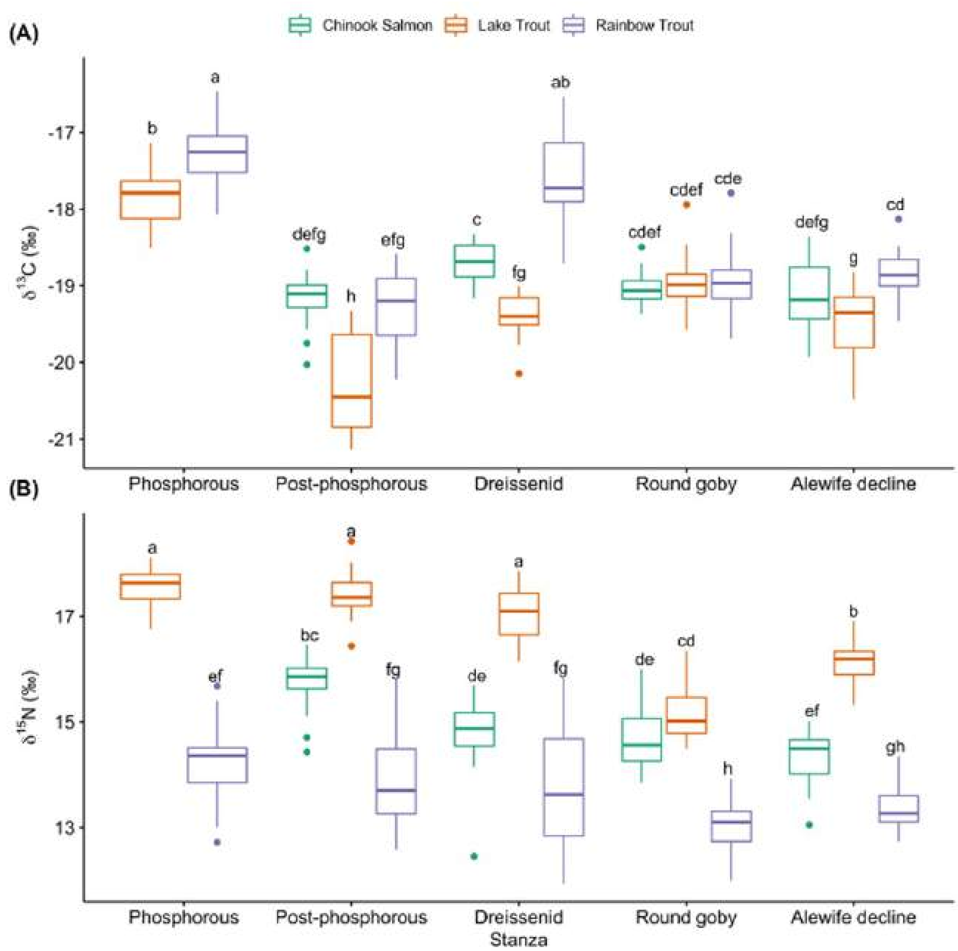


FIG. 7.6.1. Boxplot of the carbon ($\delta^{13}C$; A) and nitrogen ($\delta^{15}N$; B) stable isotope values of lake trout (orange), rainbow trout (purple), and Chinook salmon (green) derived from scales. Results are divided by ecological stanza. The solid line is the median value, the box is the inter-quartile range, and whiskers extend to the highest or lowest value within 1.5 times the inter-quartile range. Different letters indicate a significant difference between groups.

pseudoharengus) decline. Drastic ecosystem changes associated with each of these stanzas may impact how energy flows through the food web to top consumers like trout and salmon. Phosphorous acts as a fertilizer, with too much causing poor water quality while too little can limit productivity. Additionally, invasive species can negatively impact native prey but may also become a new food source.

Statistical analysis of the scale stable isotope values of each species revealed long-term changes in trophic ecology (Fig. 7.6.1). The carbon stable isotope signature ($\delta^{13}C$) was higher after dreissenid invasion for all species, indicating greater reliance on nearshore energy sources (Fig. 7.6.1A). This finding matches our prediction, because dreissenid mussels can concentrate energy in nearshore and bottom regions though filter feeding. Additionally, the nitrogen isotope signature ($\delta^{15}N$) decreased for all species through time, indicating a decreased trophic position (eating lower in the food chain; Fig. 7.6.1B). Invasive species can shorten food chains and low phosphorous in the offshore may reduce the amount of energy available to support higher trophic positions.

The stable isotope signatures of Lake Trout, Chinook Salmon, and Rainbow Trout were also analyzed collectively, revealing increased trophic similarity. Isotopic niches (the area a species occupies in isotope space) overlapped significantly (≥60%) in the recent Round Goby invasion and Alewife decline stanzas (Fig. 7.6.2A). Also, during these recent ecological stanzas, the carbon stable isotope range (CR) and total area (TA) decreased, indicating a smaller range of energy sources are being used (Fig. 7.6.2B, Fig. 7.6.2C).

Overall, stable isotope analysis of archived scales revealed significant changes in the trophic ecology of three species of trout and salmon over the past five decades. Using a lower diversity of energy sources may make the trout and salmon community more susceptible to future stressors. This highlights the importance of current efforts to diversify Lake Ontario's prey base (i.e., Bloater [*Coregonus hoyi*] restoration) and prevent the establishment of additional invasive species.

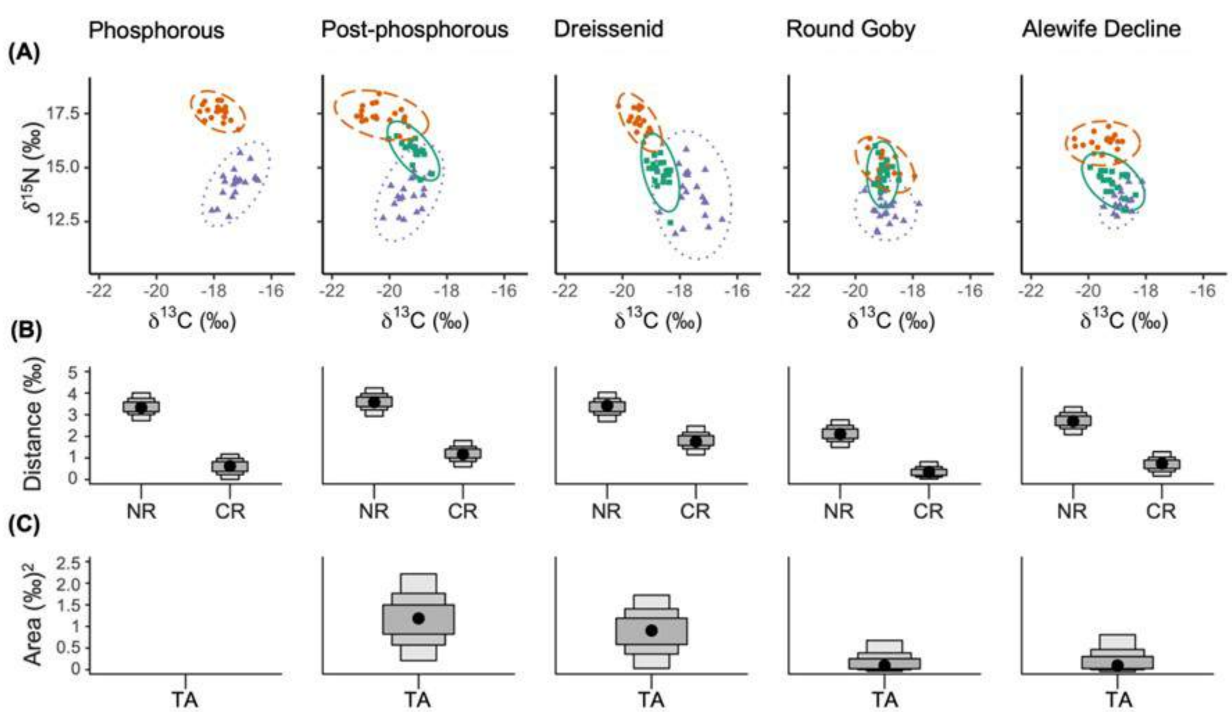


FIG. 7.6.2. Stable isotope biplot with isotopic niches (95% standard ellipse areas) for lake trout (orange circles), rainbow trout (purple triangles) and Chinook salmon (green squares) in each ecological stanza (A). Layman metrics, describing the stable isotope signature of the three species collectively (A and B). NR = nitrogen isotope range, CR = carbon isotope range, and TA = total isotope area. Boxplots include the 50% credible interval (dark gray), 75% credible interval (light gray), 95% credible interval (white), and the mode value (black dot).

7.7 Descriptive population metrics of Bay of Quinte and eastern Lake Ontario fish species

Project Leads: Brent Nawrocki and Tim Johnson (OMNRF, Aquatic Research and Monitoring Section)
Collaborators: Erin Brown and Sarah Beech (OMNRF, Lake Ontario Management Unit)

The Lake Ontario Management Unit collects over 200,000 fish annually in the Bay of Quinte and eastern Lake Ontario. Many of these fish are captured through long-term monitoring programs using gill nets, trawl nets, and trap nets (see Sections 1.1, 1.2 and 1.3).

Biological data, such as length (FLEN), weight (RWT), and age are collected from many Bay of Quinte and eastern Lake Ontario fish species and are used to track changes in fish populations. Here, we used biological data to calculate descriptive population metrics for species of ecological, cultural, and economic importance. Biological metrics were determined for 31 different fish species. We calculated (a) growth curves (FLEN-RWT regression), (b) fish condition (relative weight or the "plumpness" of the fish), (c) mean length-at-age (Von Bertalanffy growth model), and (d) age class proportions for 25 Bay of Quinte and 19 Eastern Lake Ontario species representing 4 different trophic guilds (piscivores, omnivores, invertivores, planktivores). To estimate these population metrics, we used biological data from fish species collected at long-term sites between 1993-2019 by gill nets and bottom trawls (informed by Community Index Gill Netting and Community Index Trawling programs). Trap net data collected from NSCIN (Nearshore Community Index Netting) from geographically comparable areas between 2001-2017 were also included in Bay of Quinte data summaries. We used a piscivore, Smallmouth Bass (*Micropterus dolomieu*), to demonstrate how we can create biological data summaries for fish collected in either the Bay of Quinte (Fig. 7.7.1) and eastern Lake Ontario (Fig. 7.7.2).

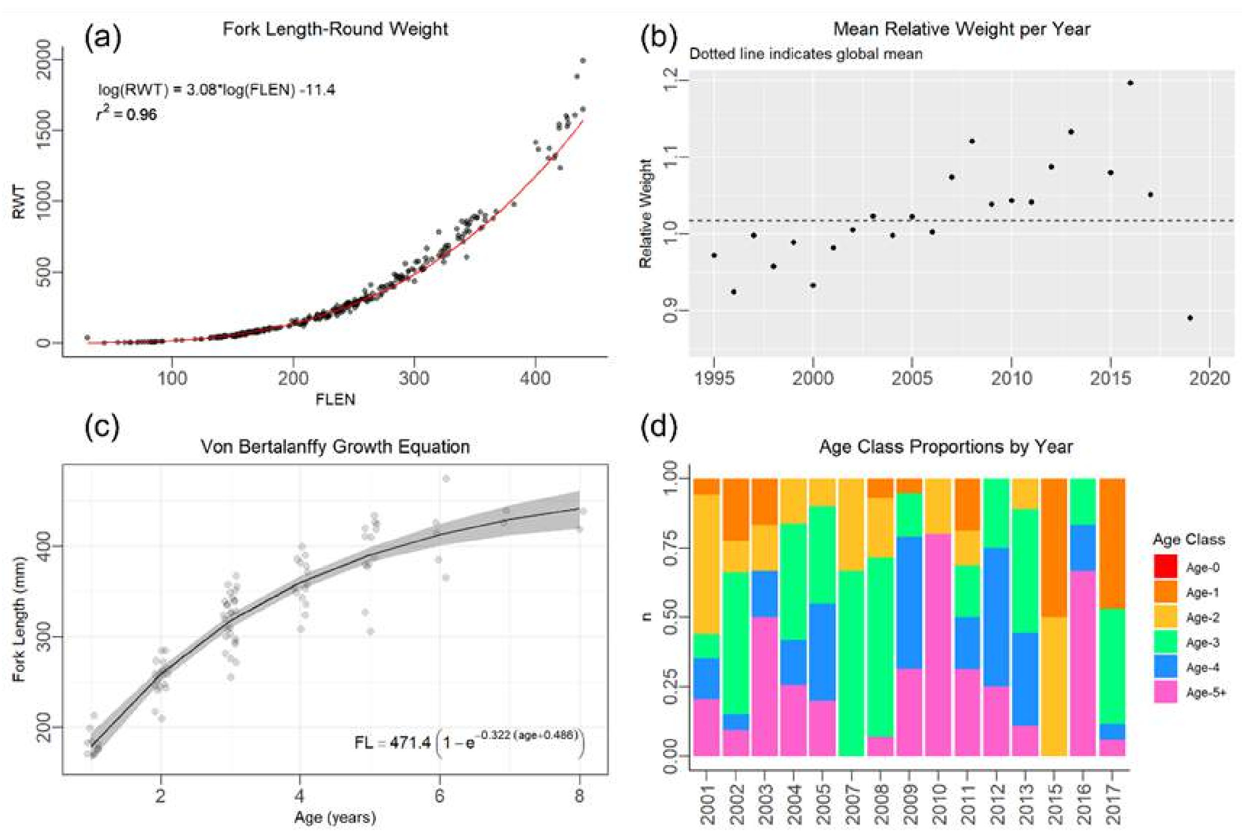


FIG. 7.7.1. Biological data-based population metric summary for Smallmouth Bass (*Micropterus dolomieu*) collected in the Bay of Quinte, Lake Ontario from 1993-2019.

In general, eastern Lake Ontario-collected Smallmouth Bass were larger in size (size range: 100 - ~530 mm; Fig. 7.7.2a) than Bay of Quinte-collected Smallmouth Bass (size range: 20 - ~450 mm; Fig. 7.7.1a). Growth curves revealed eastern Lake Ontario Smallmouth Bass (Fig. 7.7.2a) grew faster than Bay of Quinte Smallmouth Bass (Fig. 7.7.1a), which is further supported by the greater mean-length-at-age curve seen in eastern Lake Ontario (Fig. 7.7.2c) compared to Bay of Quinte Smallmouth Bass (Fig. 7.7.1c). While eastern Lake Ontario individuals grew faster than Bay of Quinte individuals, Bay of Quinte Smallmouth Bass exhibited a much greater range of fish condition (relative weight range: 0.85-1.2; Fig. 7.7.1b), compared to eastern Lake Ontario Smallmouth Bass (relative weight range: 0.95-1.05; Fig. 7.7.2b). However, the global mean relative weight across all years was comparable in Bay of Quinte and eastern Lake Ontario Smallmouth Bass. More proportional age class data were available for Bay of Quinte Smallmouth Bass (Fig. 7.7.1d) and revealed that when looking at comparable years (2010-2015), Bay of Quinte Smallmouth Bass were comparatively older than eastern Lake Ontario Smallmouth Bass (Fig. 7.7.2d).

These findings demonstrate that differences exist in species population metrics with respect to individuals collected from either the Bay of Quinte or eastern Lake Ontario. Demonstrated differences in biological metrics suggest that the lake ecosystem continues to change, so monitoring broadly with considerations of differing bay and open-water fish communities and habitats is important. Differences in fish condition, growth curves, and age composition between bay and open-lake fish communities also serve as a baseline for comparing these parameters to other species of comparable trophic guilds (compare Smallmouth Bass to other piscivores) in bay or lake communities to begin to address questions related to changes in food web properties in Lake Ontario.

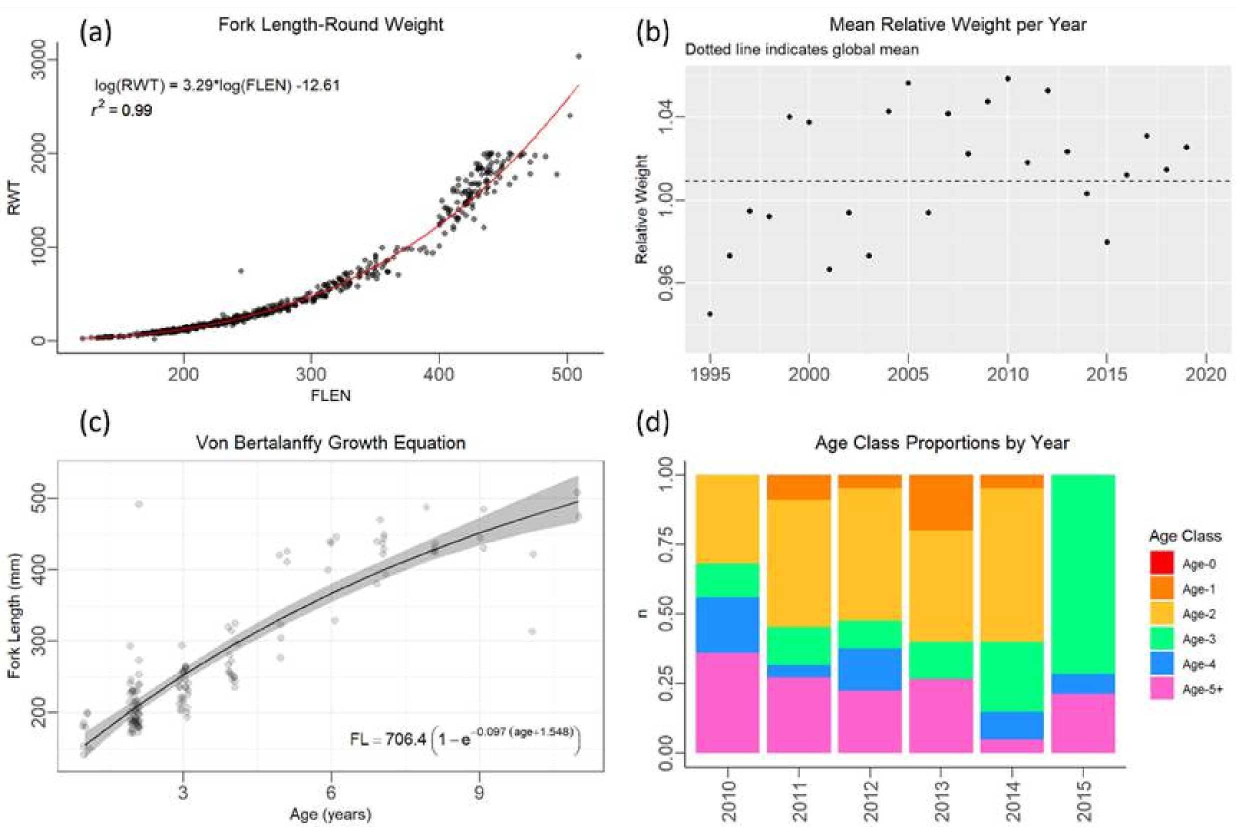


FIG. 7.7.2. Biological data-based population metric summary for Smallmouth Bass (*Micropterus dolomieu*) collected in eastern Lake Ontario from 1993-2019.

7.8 New Research Vessel on Lake Ontario: R/V Jack Christie (C31893ON)

Project Leads: Tim Johnson and Brent Metcalfe (OMNRF, Aquatic Research and Monitoring Section)

The Great Lakes Trophic Dynamics research team at the Glenora Fisheries Station took possession of a new research vessel in October 2021 (Fig. 7.8.1). The vessel, built by Hike Metal Products Limited (Wheatley, Ontario), is a customized version of their successful Hike30 Patrol-boat series. The all-aluminum 34-foot vessel enhances the Ministry's ability to conduct research activities in support of Great Lakes fisheries management, resource sustainability, and enhanced ecosystem understanding. Features built into the vessels will allow it to conduct lower trophic level monitoring to watch for changes at the base of Lake Ontario's foodweb, to deploy and recover acoustic telemetry gear that allows researchers to track the movement of fish and learn more about their behaviour and habitat use, and to deploy and recover various other specialized aquatic science equipment (e.g., remotely operated vehicles, mid-water trawls, underwater cameras, etc.).

The vessel (*Jack Christie*) is named as a tribute to the legacy that Dr. W. J. "Jack" Christie, a former OMNRF scientist who was the first leader of the Glenora Fisheries Station. His research into the causes of declining fisheries and its relationship to poor environmental health was renown internationally, and this modest gesture serves as a reminder of the impact he had in formulating principles and practices that continue to guide our collective approach to fisheries and aquatic science.

The vessel is a fast, powerful, highly maneuverable boat designed to perform a variety of missions in moderate sea and weather conditions commonly encountered on Lake Ontario. The vessel has an aluminum hull with a flush main deck over the engines, and a raised fore deck. It is a modified-planing hull design with a deep 'V' bow, reverse-angle side chines and lift strakes. The wheelhouse is located

FIG. 7.8.1. The new research vessel, Jack Christie (C31893ON), based at the Glenora Fisheries Station.

forward of midship and arranged such that it contains a cuddy-cabin for gear storage, a head, a wet-locker, a standing-height work bench, a seated-height computer table, and seating to accommodate three or four people. The vessel is powered by twin stern-drive engines (see Table 7.8.1 for vessel particulars).

TABLE 7.8.1 Vessel particulars for *R/V Jack Christie*.

Vessel details	
Name:	*Jack Christie*
Licence number:	C31893ON
Model:	*Hike Xplorer* Series
Hull build number:	218
VHF call sign:	CHA2069
MMSI number:	316047134
Length (overall):	11.62m (38’-1”)
Beam (max. with fendering):	3.44m (11’-3”)
Draft (drives down):	1.06m (3’6”)
Fixed height above waterline:	5.03m (16’6”)
Fully loaded (full fuel, 3 crew):	10 069 kg (22 198 lbs.; 9.9098LT)
Propulsion Engines:	2 x Volvo Penta model D4-270/DPI Marine Diesel Engine with Stern Drives, G7 props
Horsepower (each engine):	270 B.H.P. at 3500 R.P.M.
Maximum speed:	58 Km/h (32 knots; 36 Mph)
Fuel capacity (100% full):	584.2L per tank (1168.4 litres) #2 Diesel
Range (at loaded displacement):	550 km (300 nm)
Endurance (at max. speed):	7 hours

7.9 Evaluation of Fishway Performance on the Ganaraska River

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

Stocked and natural populations of migratory salmon and trout rely on tributaries throughout Lake Ontario to serve as spawning and nursery habitat. Physical barriers such as perched culverts and dams can increase habitat fragmentation and reduce tributary connectivity by preventing fish from reaching adequate spawning sites. To mitigate the effects of habitat fragmentation, these physical barriers can be equipped with passage facilities (herein fishways) to restore connectivity within tributaries. While fishways reduce the degree to which barriers affect river connectivity, they do not eliminate adverse effects entirely. Thus, it is important to determine the extent to which migratory fish species can locate and navigate the fishway to assess the impact on spawning run success.

With completely naturalized, self-sustaining, migratory salmon and trout populations, the Ganaraska River is considered a sentinel river for Lake Ontario and has been monitored by the Lake Ontario Management Unit (LOMU) since 1974. This study calculated the fishway performance of the Ganaraska Fishway; a pool-and-weir fishway located on the Ganaraska River at the Corbett Dam, Port Hope. The primary and secondary objectives of this study include:

Primary Objectives:

1) Determine fishway attraction efficiency and attraction time
2) Determine fishway passage efficiency and passage time
3) Determine fishway performance and performance time

Secondary Objectives:

1) Determine the effect of biological variables (fish size, sex, condition, etc.) on fishway performance
2) Determine the effect of capture gear (backpack electrofishing, boat electrofishing, fishway basket) on fishway performance

Methods

In 2022, fish were captured using one of two methods: 1) directly from the fishway basket and 2) electrofishing by boat at the mouth of Port Hope harbour (Fig. 7.9.1). In both cases, Atlantic Salmon, Rainbow Trout, Brown Trout, Chinook Salmon, and Coho Salmon were targeted. For each captured fish, a cursory visual examination was conducted by field staff to determine the condition status of the fish. If field staff considered the fish to be in good status, a 23-mm HDX PIT tag was implanted on the ventral side just above the pelvic girdle. Each fish that received a PIT tag also had a FLOY tag applied below the dorsal fin on the right side. The FLOY tag serves multiple purposes including: visual identification of repeat captures at the fishway basket, for which the PIT tag ID and recapture time were recorded before being released on the upstream portion of the dam, as well as calibration of the fishway camera system. The following biological characteristics were also measured for all captured fish: fork length (mm), round weight (g), sex, gonad condition, IJC lamprey markings

FIG. 7.9.1. Port Hope Harbour tagging reach used for boat electrofishing (shaded area).

and presence or absence of gill lice. After, receiving both tags and biological measurements were recorded, fish captured from the fishway basket were transported by truck and released downstream from the study area (Fig. 7.9.2) and fish captured via boat electrofishing were immediately released back into the water at the site of capture (Fig. 7.9.1).

To monitor fish movements inside and around the fishway, a radio telemetry array comprised of four stationary antennas was installed. Numbered 1 through 4, these antennas were located: 1) downstream from the fishway, 2) at the plunge pool below the fishway entrance, 3) inside the fishway entrance, and 4) at the fishway exit (Fig. 7.9.2). Each time the array received a signal, the associated reader recorded the unique tag ID, antenna number, date, time, and detection period. Data were stored until they could be manually downloaded during site visits.

Completion time and efficiency were calculated for each segment of the fishway and were separated by species and capture method. Formulas used to calculate attraction, passage, and performance efficiency and time are listed in Table 7.9.1. For the purpose of efficiency calculations, fish detected at upstream antennas were assumed to have passed all prior downstream antennas, regardless of whether detections were actually made. This assumption does not apply to time calculations, as sequential timestamps for each antenna are necessary to accurately predict traversal time.

Experimental Design Changes from 2019/2021

A marked change in the 2022 study involved the use of the fishway basket as a means of collecting fish. It is possible that fish captured using the basket may bias results towards better fishway performance by pre-selecting individuals that are known to be capable of traversing the fishway; the fishway basket was excluded in the 2019 and 2021 studies for these reasons. However, the efficiencies in fish capture using this method offer operational advantages that could streamline future studies if biases prove to be insignificant. Additionally, this is the first study to incorporate boat electrofishing as a capture method. By incorporating staging fish at the mouth of the river, investigators were capturing a random sample of fish with limited impact on the spawning migration and angling pressures, thus reducing bias. Operational constraints prevented the full suite of boat electrofishing planned. Subsequently, the number of individuals caught via boat electrofishing was too low to serve as an adequate baseline, preventing conclusions about the comparative effect of each method from being made. Future studies should consider boat electrofishing as a viable method for fish capture provided adequate sampling time is available. Previous iterations of this study exclusively employed backpack electrofishing to capture and tag fish, which should be considered when comparing the results of the current study with past years (MNRF 2020, MNRF 2022).

FIG. 7.9.2. Ganaraska River downstream release area used for fish tagged from the fishway basket (shaded area) and telemetry array antenna locations (numbered).

Also worth noting, are differences in the way attraction efficiency and fishway performance time were calculated in this study. In 2019, detection at the downstream antenna and release time were used interchangeably to calculate performance time, depending on what data was available for each individual. In this study, downstream antenna detections are used exclusively. In addition, the telemetry array used in this study includes an antenna at the plunge pool, which was used to calculate attraction efficiency and time. In 2019, attraction efficiency and time were calculated using detections from an antenna inside the fishway entrance.

Flow conditions in the fishway may have changed between the 2019 and 2022 studies due to dredging that occurred at the Corbett Dam in August of 2022.

Results

From September 12-30, 185 Chinook Salmon, 39 Coho Salmon and three Rainbow Trout were collected from the fishway basket, tagged and released. Of this group, 91 Chinook Salmon, 20 Coho Salmon and three Rainbow Trout were detected by one or more antennae in the study area.

On September 20 and 23, 12 Chinook Salmon and four Coho Salmon were caught via boat electrofishing, PIT-tagged and released. Of this group, three Chinook Salmon and one Coho Salmon were detected by one or more antennae in the study area. Due to the low sample size of fish captured via electrofishing, the effect of capture gear could not be investigated in this study.

In addition to fish tagged as part of this study, ten unknown HDX tags were detected on the telemetry array. The tag ID numbers were cross referenced with previous studies conducted by LOMU and other MNRF branches. Five of these tags were associated with Atlantic Salmon stocked by the MNRF's Fish Culture branch as part of a study comparing different rearing and release conditions (Table 7.9.7). These fish were only detected on one antenna, so the direction of travel could not be determined. The remaining unknown tags could not be identified.

One-way ANOVA showed no statistically significant differences in the fork length and Fulton's condition for Chinook Salmon that reached different segments of the fishway (Fig. 7.9.3). Significant differences were found between the group means for round weight ($F = 2.7353$, p-value = 0.0451), although post hoc

TABLE 7.9.1. Primary objectives, definitions, and calculations.

Primary Objectives	Definition	Calculation
Attraction Efficiency (E_A)	Proportion of fish that pass the downstream array (1) that are detected at or beyond the plunge array (2).	$E_A = N_{plunge} / N_{downstream}$
Attraction Time (T_A)	Time elapsed from detection on the downstream array (1) and detection at the plunge array (2).	$T_A = T_{plunge} - T_{downstream}$
Jump Efficiency (E_J)	Proportion of fish detected at the plunge array (2) that are detected at or beyond the entrance array (3).	$E_J = N_{entrance} / N_{plunge}$
Jump Time (T_J)	Time elapsed from detection on the plunge array (2) and detection at the entrance array (3).	$T_J = T_{entrance} - T_{plunge}$
Passage Efficiency (E_P)	Proportion of fish that enter the fishway (3) that successfully exit upstream (4)	$E_P = N_{exit} / N_{entrance}$
Passage Time (T_P)	Time elapsed from entering the fishway (3) to exiting the fishway (4).	$T_P = T_{exit} - T_{entrance}$
Fishway Performance (E_F)	Proportion of fish that pass the downstream array (1) that exit the fishway. (4)	$E_F = N_{exit} / N_{downstream}$
Fishway Performance Time (T_F)	Time elapsed from detection on the downstream array (1) and detection at the fishway exit (4).	$T_F = T_{exit} - T_{downstream}$

Tukey's test did not find any significant differences. There were only two fish for which the plunge antennae was the furthest detection location. Thus, the plunge antenna was excluded from statistical analysis due to the low sample size relative to the other arrays.

One-way ANOVA showed no statistically significant differences in the fork length and round weight for Coho Salmon, but statistically significant differences existed between the group means for Fulton's condition (F = 4.0591, p-value = 0.01.41) (Fig. 7.9.4). Post hoc Tukey's test revealed these differences to be between fish that were not detected on any antennae and those that were detected at the exit (p-value = 8.7189e-03).

The sample size for Rainbow Trout was insufficient for statistical analysis.

TABLE 7.9.2. Summary of total number of detections for each antenna location.

	Fishway Basket				Electrofishing			
Species	Downstream	Plunge	Entrance	Exit	Downstream	Plunge	Entrance	Exit
Coho	20	16	16	14	1	1	1	1
Chinook	91	70	68	48	3	2	2	2
Rainbow	3	2	1	1	0	0	0	0

TABLE 7.9.3. Summary of attraction efficiency, passage efficiency and fishway performance.

Primary Objective	**Species**	Fishway Basket %	Fishway Basket n	Electrofishing %	Electrofishing n
Attraction efficiency (E_A)	Coho	80.0	20	100.0	1
	Chinook	76.9	91	66.7	3
	Rainbow	66.7	3	-	0
Jump efficiency (E_J)	Coho	100.0	16	100.0	1
	Chinook	97.1	70	100.0	2
	Rainbow	50.0	2	-	0
Passage efficiency (E_P)	Coho	87.5	16	100.0	1
	Chinook	70.6	68	100.0	2
	Rainbow	100	1	-	0
Fishway performance (E_F)	Coho	70.0	20	100.0	1
	Chinook	52.7	91	66.7	3
	Rainbow	33.3	3	-	0

TABLE 7.9.4. Summary of attraction time, passage time and fishway performance time.

Primary Objective	Species	Fishway Basket (hrs)				Electrofishing (hrs)			
		Min	Mean ± SD	Max	n	Min	Mean ± SD	Max	n
Time to reach study area	Coho	1.9	81.6 ± 122	336.7	16	-	-	-	0
	Chinook	2.1	86.2 ± 93.1	504.5	85	139.4	265 ± 109	335.4	3
	Rainbow	67.4	90.5 ± 20.1	103.2	3	-	-	-	0
Attraction Time (T_A)	Coho	1.4	2.5 ± 1.6	3.6	2	-	-	-	0
	Chinook	0.5	21.9 ± 24.2	68.7	12	-	14.4	-	1
	Rainbow	-	9.7	-	1	-	-	-	0
Jump Time (T_J)	Coho	-	-	-	0	-	-	-	0
	Chinook	0.04	41.9 ± 46.4	118.3	5	-	-	-	0
	Rainbow	-	-	-	0	-	-	-	0
Passage Time (T_P)	Coho	1.1	5.8 ± 6.8	19.0	7	-	1.8	-	1
	Chinook	0.6	13.6 ± 15.6	56.3	20	-	-	-	0
	Rainbow	-	22.8	-	1	-	-	-	0
Fishway Performance Time (T_F)	Coho	2.0	35.2 ± 45.3	120.0	10	-	-	-	0
	Chinook	1.1	51.0 ± 58.1	248.0	47	9.6	79.1 ± 98.3	149.0	2
	Rainbow	-	61.5	-	1	-	-	-	0

TABLE 7.9.5. Summary of biological information collected on tagged fish caught from the fishway basket at the Ganaraska Fishway. *One Coho Salmon is not included in the sex ratio as its sex was unknown.

Species	n	M:F	Gill Lice	Lamprey Marks	Fork Length (mm ± SD)	Weight (g ± SD)	Condition (K ± SD)
Coho	39	14 : 22*	0	27	623 ± 91	3165 ± 1002	1.24 ± 0.11
Chinook	185	158 : 27	87	112	735 ± 140	5083 ± 2375	1.19 ± 0.15
Rainbow	3	1 : 2	2	3	658 ± 129	3610 ± 1814	1.19 ± 0.08

TABLE 7.9.6. Summary of biological information collected on tagged fish caught via electrofishing at Port Hope Harbour.

Species	n	M:F	Gill Lice	Lamprey Marks	Fork Length (mm ± SD)	Weight (g ± SD)	Condition (K ± SD)
Coho	4	2:2	0	6	614 ± 39.7	2925 ± 829	1.24 ± 0.15
Chinook	12	10:2	4	3	687 ± 156	4800 ± 2859	1.35 ± 0.18

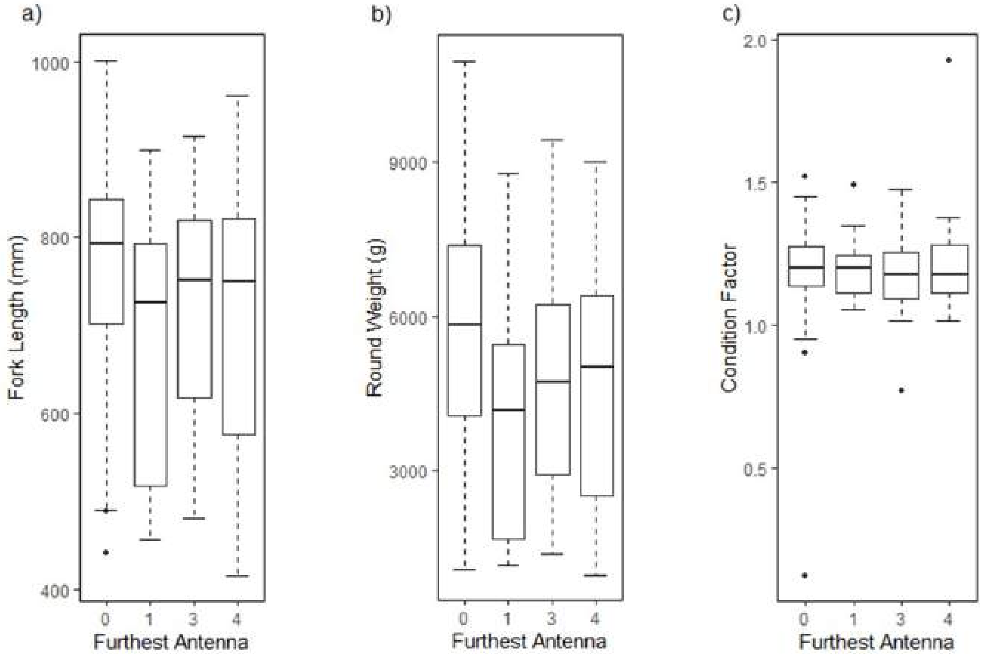


FIG. 7.9.3. Comparisons of fish (a) fork length, (b) weight, and (c) Fulton's condition factor between tagged Chinook Salmon that (0) were not detected by the array (n=94), and those that had their furthest detection at the (1) downstream antenna (n=21), (3) entrance antenna (n=20), and (4) exit antenna (n=47). The plunge antenna was excluded due to low relative sample size (n=2) The bold center line denotes median values. Significant differences were found via one-way ANOVA for round weight, but post hoc Tukey's test did not find any significant differences. No other significant differences were found.

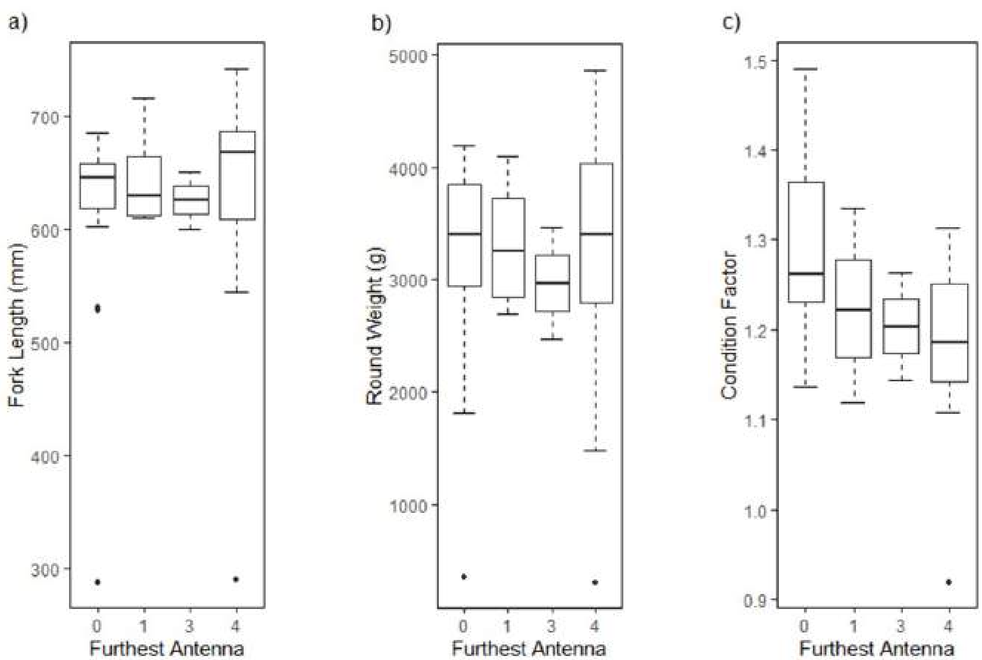


FIG. 7.9.4. Comparisons of fish (a) fork length, (b) weight, and (c) Fulton's condition factor between tagged Coho Salmon that (0) were not detected by the array (n=19), and those that had their furthest detection at the (1) downstream antenna (n=4), (3) entrance antenna (n=2), and (4) exit antenna (n=14). All fish detected at the plunge antenna proceeded to another upstream antennae. The bold center line denotes median values. Significant differences were found between fish that were not detected and fish that were detected at the exit antenna based on Fulton's condition factor but not fork length and weight, via one-way ANOVA and post hoc Tukey's test. No other significant differences were found.

TABLE 7.9.7. Summary of stocking information for PIT tagged Atlantic Salmon that were detected during the fishway performance study. A total of 25,799 and 28,165 PIT tagged Atlantic Salmon were stocked into the Ganaraska River in 2020 and 2021 (respectively).

					Release					
PIT #	Species	Strain	Year Class	Life Stage	Location	Method	Date	Clip	Treatment	Detected
982.126058456031	Atlantic	Sebago	2019	Spring Yearling	Ganaraska	Shore	2020/04/08	AD	Control	Entrance
982.091062935242	Atlantic	Sebago	2020	Spring Yearling	Ganaraska	Instream	2021/04/08	AD	Control	Plunge
982.091062914556	Atlantic	Sebago	2020	Spring Yearling	Ganaraska	Shore	2021/04/27	AD	Enriched	Downstream
982.091061188733	Atlantic	Sebago	2020	Spring Yearling	Ganaraska	Shore	2021/05/28	AD	Control	Exit
982.091061188666	Atlantic	Sebago	2020	Spring Yearling	Ganaraska	Shore	2021/05/28	AD	Control	Entrance

8. Partnerships

8.1 Agency Collaboration towards Lake St. Francis Fish Community Assessment

M. Yuille[1], S. Bernatchez[2], D. Hatin[2], C. Lake[1], Y. Paradis[2], N. Vachon[2]

[1]Lake Ontario Management Unit, Ontario Ministry of Natural Resources and Forestry
[2]Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs

Lake St. Francis is home to important recreational, commercial and Indigenous fisheries. The fish community of Lake St. Francis is managed through multiple government agencies including the Province of Québec, the Province of Ontario and New York State. The majority of the waters fall within Québec and Ontario jurisdictions (Fig. 8.1.1). In 2020, discussions between the Ontario Ministry of Natural Resources and Forestry (MNRF) and the Québec Ministère de l'Environnement, de la Lutte Contre les Changements Climatiques, de la Faune et des Parcs (MELCCFP) began, and plans were set in motion to collaborate on the assessment of the Lake St. Francis fish community in 2022. The 2022 fish community assessment represents the first collaborative netting for Lake St. Francis in the history of each agency program (Fig. 8.1.1).

Catches from these agency programs are used to estimate fish abundance, measure biological attributes and examine trends. Structures and tissues are collected for age interpretation, stomach content, contaminant, genetic and pathological analyses. It is important to note that while both agency programs are designed to evaluate the Lake St. Francis fish community there are differences in program design and gear specifications. The MELCCFP program sets two full gillnets strapped together per site whereas the MNRF program sets one gillnet per site. To account for twice the effort and facilitate comparison, catches per net in the Québec program have been divided by two. In addition to the number of nets, the gillnet specifications are different between agencies (Table 8.1.1). To account for these differences MNRF set both types of gillnets (ON nets and QC

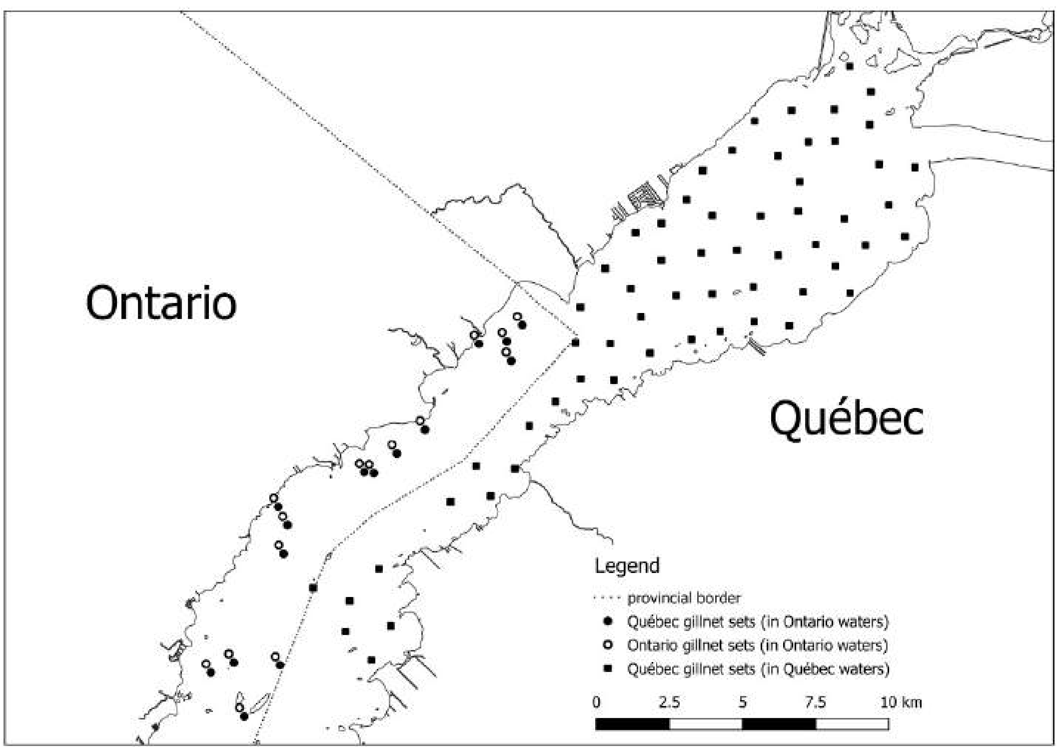


FIG. 8.1.1. Map of Lake St. Francis showing netting locations during the collaborative 2022 fish community assessment. Québec MELCCFP nets are represented in squares while Ontario MNRF nets are represented by the circles. The gear type is also shown with open symbols representing MNRF style gillnets and closed symbols representing MELCCFP style gillnets (see Table 8.1.1).

TABLE 8.1.1. Gillnet specifications used by each agency. Specifications described for MELCCFP represent the "Québec Nets" and specifications described for MNRF represent the "Ontario Nets".

Agency	Gillnet length (m)	Gillnet height (m)	# of nets per site	Panel length (m)	Mesh Size 25 mm (1'')	38 mm (1½'')	51 mm (2'')	64 mm (2½'')	76 mm (3'')	89 mm (3½'')	102 mm (4'')	127 mm (5'')	152 mm (6'')
MELCCFP (Québec)	60.6	1.8	2	7.6	X	X	X	X	X		X	X	X
MNRF (Ontario)	60.96	2.44	1	7.62		X	X	X	X	X	X	X	X

nets) at each site in Ontario waters to facilitate gear and fish community comparisons across Lake St. Francis.

In 2022, the survey was conducted during the period of August 29th and September 28th. Combined, 150 nets were deployed across 75 sites. The nets were fished for approximately 24 hours. In total, 5,986 fish were caught, which included 23 different fish species (Table 8.1.2). The number of fish per net in Québec (90.7) was comparable to the previous Québec survey in 2014 (90.2) and was higher than average catches in Ontario waters with both QC and ON nets (21.1 and 14.7 respectively; Fig. 8.1.2). The dominant species caught across programs continues to be Yellow Perch (Figs. 8.1.3, 8.1.4 and 8.1.5).

Species Highlights

Yellow Perch

In both surveys, catches of Yellow Perch have declined from peak levels seen previously in 2010 and 2014 (MNRF and MELCCFP, respectively; Tables 8.1.2 and 8.1.3; Figs. 8.1.6 and 8.1.7). The proportion of large fish (≥ 220 mm) has remained low in the Québec survey and declined through time in the Ontario survey (Fig. 8.1.7). In 2022, large Yellow Perch represented 28%, 22% and 17% of the catch in ON nets, QC nets in ON waters and QC nets in QC waters (respectively).

Northern Pike

Northern Pike catches in 2022 remained low in both programs across all gear types (Figs. 8.1.9 and 8.1.10). Northern Pike abundance has been in decline since the early 1990s and is currently at the lowest levels observed in the 35-year time series (Tables 8.1.2 and 8.1.3 and Fig. 8.1.9). While few Northern Pike were caught in 2022, both programs and gear types encountered these fish (Figs. 8.1.10 and 8.1.11). Both programs show small (< 500 mm) Northern Pike have been rare since the early 2000s (Fig. 8.1.10).

Walleye

Walleye represented 6% of the total catch in Ontario waters and 2% of the total catch in Québec waters in 2022 a total of 135 individuals were caught across both programs (Tables 8.1.2 and 8.1.3; Figs. 8.1.12 and 8.1.13). The average catch per net in both programs has increased through time and was comparable across all gear types in 2022 (Figs. 8.1.12 and 8.1.13). The proportion of large Walleye (> 500 mm) was comparable in both programs across gear types (20%, 17% and 25% for ON nets in ON waters, QC nets in ON waters and QC nets in QC waters, respectively; Fig. 8.1.14).

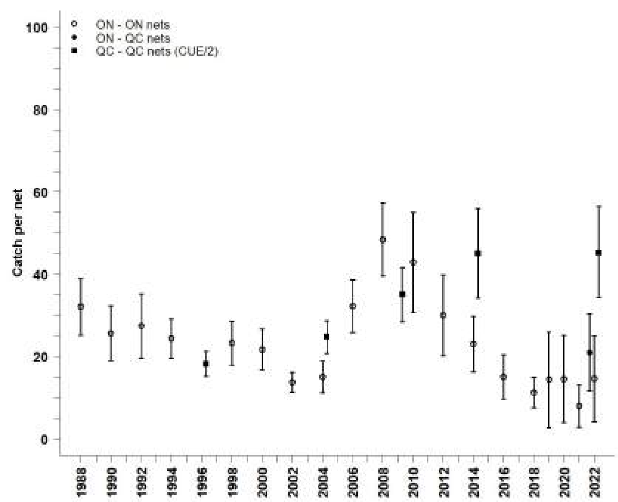


FIG. 8.1.2. Average catch per standard gillnet set of all species combined in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

Smallmouth and Largemouth Bass

In both surveys, the average catch of Smallmouth Bass increased in 2022 (Tables 8.1.2 and 8.1.3 and Fig. 8.1.15). Catches in the Ontario waters were comparable between the two gear types and catches in the Québec program were higher than those observed in the Ontario program (Fig. 8.1.15). Largemouth Bass catches have been spotty over the past eight surveys in the Ontario program, with the highest catches observed in 2012 (Fig. 8.1.16). In the Québec program, catches of Largemouth Bass have been low and stable throughout the time series with an increase observed in 2022 (Fig. 8.1.16). Average catch of Largemouth Bass using the Québec nets in Ontario waters were comparable to catches in Ontario nets (Fig. 8.1.16).

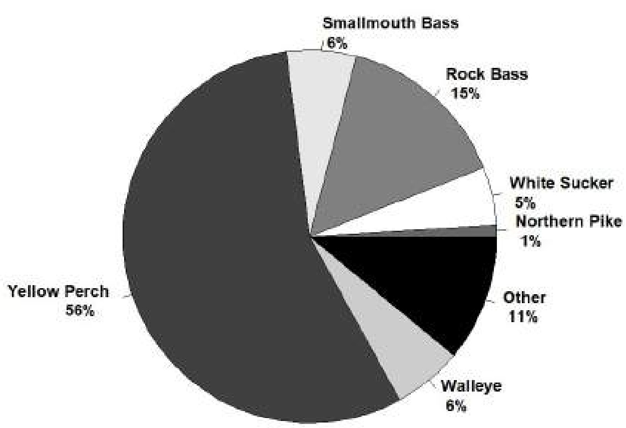


FIG. 8.1.3. Species catch composition based on total abundance in the Ontario nets set in Ontario waters during the 2022 Lake St. Francis fish community assessment.

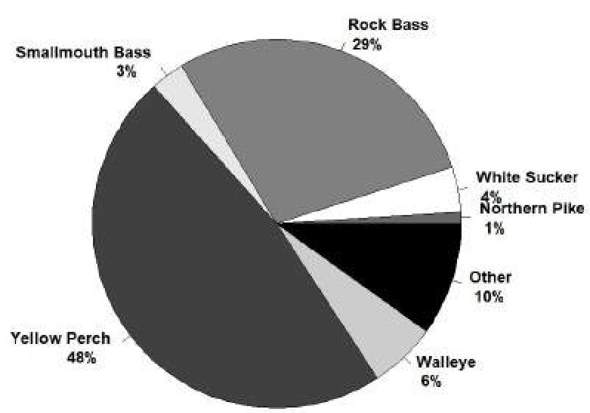


FIG. 8.1.4. Species catch composition based on total abundance in the Québec nets set in Ontario waters during the 2022 Lake St. Francis fish community assessment.

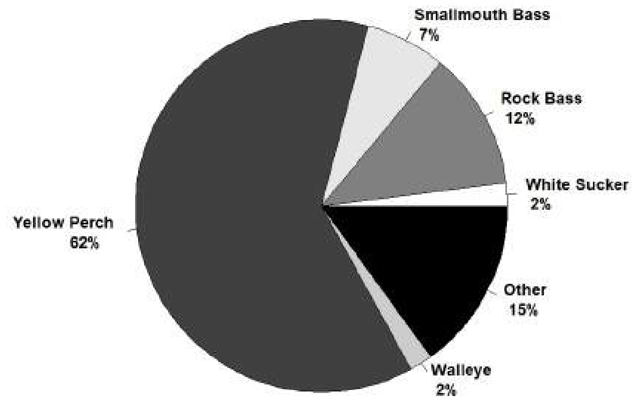


FIG. 8.1.5. Species catch composition based on total abundance in the Québec nets set in Québec waters during the 2022 Lake St. Francis fish community assessment. Northern Pike are not represented as their catch contributed <0.05% of the total species catch composition.

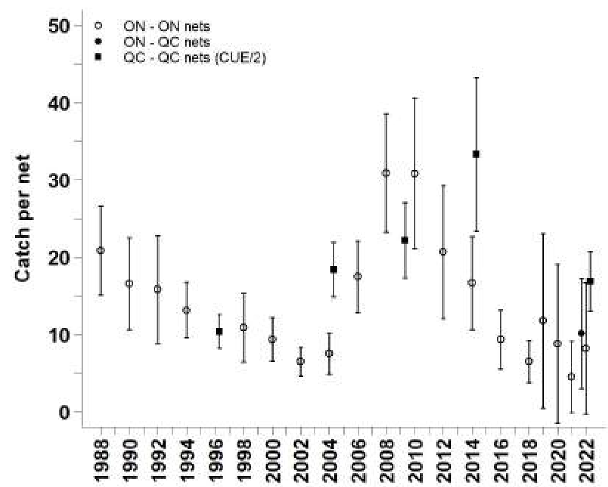


FIG. 8.1.6. Average catch of Yellow Perch per standard gillnet set in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

TABLE 8.1.2. Average number of fish caught per gillnet set in the Ontario waters of Lake St. Francis, 1984 - 2022 by MNRF using Ontario net specifications (see Table 8.1.1). All catches prior to 2002 were adjusted by a factor of 1.58 to be comparable to the new netting standard initiated in 2002. No survey was conducted in 1996. Average number of fish caught per species using Québec net specifications (see Table 8.1.1) in the Ontario waters is presented in the column "Québec Nets".

	Ontario Nets																					Québec Nets
	1984	1986	1988	1990	1992	1994	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2019	2020	2021	2022	2022
Lake sturgeon	--	--	--	--	--	--	--	0.04	--	0.03	--	0.03	--	0.03	--	0.03	--	--	--	--	--	--
Longnose gar	--	0.18	0.09	--	0.66	0.24	0.12	0.13	0.40	--	0.05	--	--	0.22	--	0.28	--	0.07	1.13	0.13	0.20	0.53
Bowfin	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alewife	0.04	--	--	--	--	--	--	--	0.03	0.06	0.20	--	--	0.14	0.03	--	--	0.20	--	--	--	--
Gizzard shad	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06	--	--	--	--	--	--
Coho salmon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chinook salmon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Salvelinus sp.	--	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rainbow smelt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern pike	4.17	4.26	4.43	3.82	4.13	3.75	3.40	3.34	1.23	1.45	1.63	1.08	0.31	0.19	0.31	0.14	0.14	0.20	0.13	0.07	0.13	0.13
Muskellunge	--	--	0.04	--	--	--	--	--	--	0.03	--	--	--	--	0.03	--	--	--	--	--	--	--
White sucker	1.71	1.76	1.01	1.71	1.40	1.66	1.74	1.62	0.74	1.06	0.93	1.97	1.56	1.17	1.25	0.56	0.47	0.33	0.67	0.13	0.80	0.93
Silver redhorse	--	--	--	--	--	--	--	--	--	--	0.18	0.14	0.08	0.06	0.03	0.06	0.11	--	0.07	--	0.13	--
Shorthead redhorse	--	--	--	--	--	--	--	--	--	--	--	--	--	0.28	0.06	0.03	0.03	0.07	--	0.33	0.27	--
Greater redhorse	--	--	--	--	--	--	--	0.09	--	--	--	--	--	--	--	--	--	--	--	--	0.07	--
River redhorse	--	--	--	--	--	--	0.20	--	--	--	--	--	0.06	--	--	--	--	--	--	--	--	--
Moxostoma sp.	--	--	0.04	0.18	0.04	0.12	--	--	--	--	--	0.06	--	--	--	--	0.11	--	--	--	--	--
Common carp	0.13	--	--	0.09	--	--	--	--	0.09	--	0.23	0.03	--	--	--	--	--	--	--	--	--	--
Golden shiner	--	--	--	--	--	0.04	--	--	0.03	--	--	--	--	--	--	0.06	0.22	--	--	--	--	--
Spottail shiner	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.13
Creek chub	--	--	--	--	--	--	0.08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fallfish	--	--	--	0.09	--	--	--	--	--	--	--	--	--	--	--	0.03	0.14	--	0.13	0.47	0.53	0.67
Brown bullhead	1.14	1.03	0.61	0.40	0.70	0.43	0.83	3.25	0.54	1.38	2.53	1.97	0.56	0.25	0.14	0.03	--	--	--	--	0.13	--
White perch	--	--	--	--	--	--	--	--	--	--	0.03	--	--	--	--	0.03	--	--	0.07	--	--	--
Rock bass	3.51	2.83	2.81	1.36	2.15	2.21	2.73	1.84	2.26	2.17	6.03	7.83	7.03	3.94	2.97	2.72	1.64	0.67	2.00	1.13	2.20	6.07
Pumpkinseed	4.96	1.4	0.83	0.75	1.49	1.58	1.46	1.05	0.41	0.41	0.85	1.36	0.06	0.33	0.17	0.17	0.17	--	--	--	--	0.07
Bluegill	--	--	--	--	--	--	0.04	0.04	0.10	--	--	--	0.06	--	--	0.03	--	--	0.07	--	--	--
Smallmouth bass	0.88	0.51	0.26	0.26	0.61	0.63	1.38	0.44	1.02	0.59	1.15	1.67	0.44	0.47	0.67	0.28	0.44	0.27	0.27	0.40	0.87	0.60
Largemouth bass	0.04	0.66	0.09	0.09	--	0.04	0.08	0.13	0.20	--	0.55	0.31	0.33	1.53	--	0.69	0.22	--	0.13	--	0.27	0.20
Black crappie	0.04	0.07	0.04	0.04	0.09	0.12	--	0.09	0.07	--	--	--	--	--	--	0.08	0.03	--	--	--	--	--
Yellow perch	21.42	18.85	20.85	16.55	15.80	13.15	10.86	9.35	6.48	7.49	17.50	30.89	30.83	20.64	16.67	9.36	6.50	11.80	8.80	4.53	8.20	10.13
Walleye	0.48	0.59	0.97	0.35	0.35	0.43	0.40	0.31	0.16	0.41	0.43	1.08	1.58	0.78	0.81	0.47	1.08	0.80	1.13	0.87	0.87	1.27
Logperch	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Round goby	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.33
Freshwater drum	--	--	--	--	--	--	--	--	0.04	--	--	0.03	--	--	--	0.03	--	--	--	--	--	--
All Species	38.56	32.14	32.13	25.68	27.43	24.41	23.31	21.73	13.80	15.08	32.25	48.44	42.89	30.03	23.11	15.11	11.31	14.40	14.60	8.07	14.67	21.07
Count of Species	13	11	14	13	11	13	13	14	16	11	14	14	12	14	12	20	14	9	12	9	13	12

TABLE 8.1.3. Average number of fish caught per station (n = 60) in the Québec waters of Lake St. Francis, 1996 – 2022 by MELCCFP using Québec net specifications. As two gillnets are set per station during the MELCCFP assessment program, the average catch per station was divided by two to get the average catch per gillnet.

	1996	2004	2009	2014	2022
Lake sturgeon	0.01	0.03	0.06	--	--
Longnose gar	0.03	0.04	--	--	0.02
Bowfin	--	--	--	--	--
Alewife	0.07	0.12	0.31	0.03	3.04
Gizzard shad	--	--	--	--	--
Coho salmon	0.01	--	--	--	--
Chinook salmon	0.01	--	--	--	--
Salvelinus sp.	--	--	--	--	--
Rainbow smelt	--	--	--	0.06	0.02
Northern pike	3.24	1.68	0.23	0.66	0.25
Muskellunge	--	0.01	--	--	0.11
White sucker	1.37	0.97	1.34	1.56	0.83
Silver redhorse	0.09	0.03	0.02	0.19	0.02
Shorthead redhorse	0.04	0.04	0.21	0.19	0.21
Greater redhorse	--	--	--	--	--
River redhorse	--	--	--	--	--
Moxostoma sp.	--	--	--	--	--
Common carp	0.05	--	--	--	--
Golden shiner	1.84	0.09	0.16	0.06	0.34
Spottail shiner	0.72	0.34	5.10	2.38	0.41
Creek chub	--	--	--	--	--
Fallfish	--	--	0.02	0.03	0.67
Brown bullhead	0.15	0.21	0.26	0.34	0.61
White perch	--	--	--	0.19	--
Rock bass	5.40	6.63	13.02	11.06	6.35
Pumpkinseed	1.04	1.10	0.48	2.41	0.87
Bluegill	--	0.01	--	--	0.03
Smallmouth bass	0.43	0.40	2.84	2.59	4.05
Largemouth bass	0.28	0.51	0.40	0.59	1.58
Black crappie	0.12	0.04	0.03	0.09	0.03
Yellow perch	20.77	36.79	44.40	66.56	33.77
Walleye	0.76	0.50	1.16	0.81	1.36
Logperch	--	--	--	0.09	0.02
Round goby	--	0.03	0.21	0.31	0.03
All Species	36.44	49.59	70.24	90.22	54.61
Count of Species	20	20	18	20	22

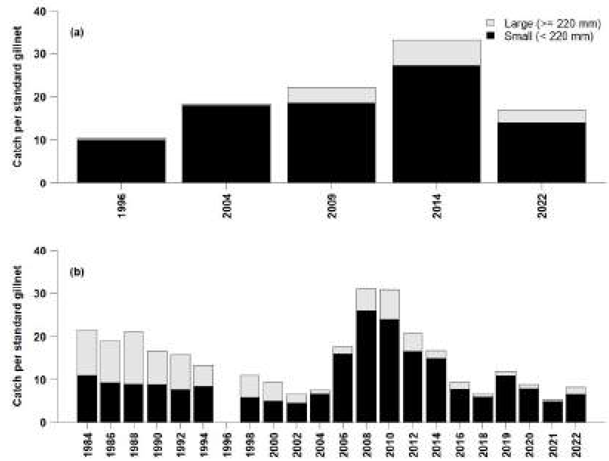


FIG. 8.1.7. Catches of small (< 220 mm total length) and large (≥ 220 mm total length) Yellow Perch in the (a) Québec and (b) Ontario Lake St. Francis community index netting program, 1984 – 2022. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Ontario data represent catches using Ontario nets only. Survey in Ontario waters was not conducted in 1996.

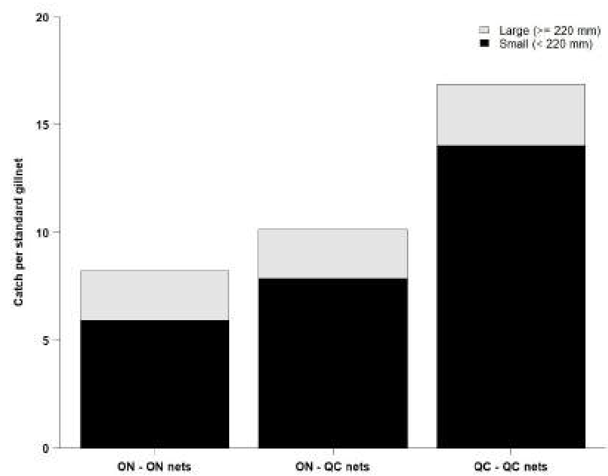


FIG. 8.1.8. Catches of small (< 220 mm total length) and large (≥ 220 mm total length) Yellow Perch in the 2022 Lake St. Francis fish community assessment program using Ontario nets in Ontario waters (“ON – ON”), Québec nets in Ontario waters (“ON – QC”) and Québec nets in Québec waters (“QC – QC”). To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site.

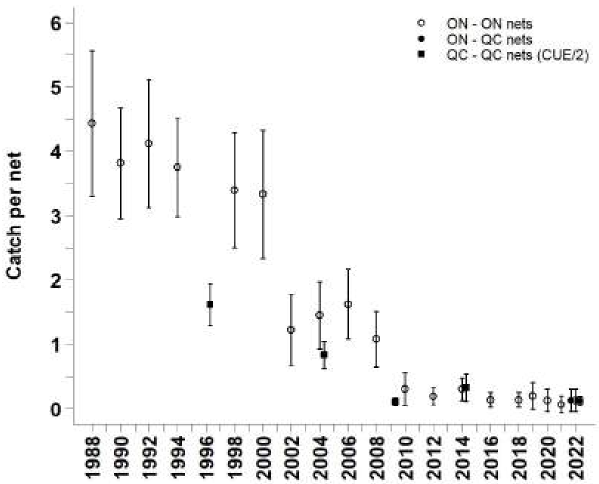


FIG. 8.1.9. Average catch of Northern Pike per standard gillnet set in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

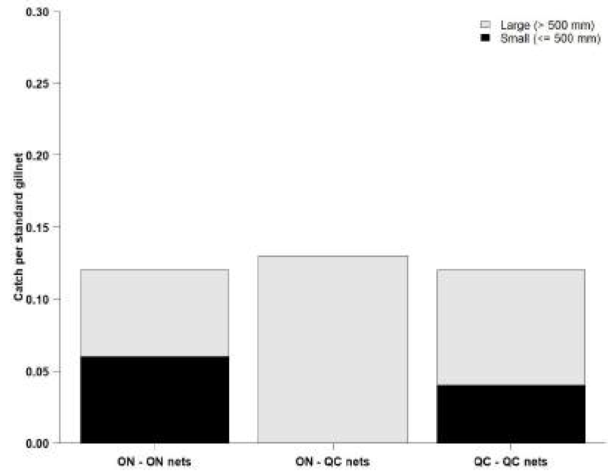


FIG. 8.1.11. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Northern Pike in the 2022 Lake St. Francis fish community assessment program using Ontario nets in Ontario waters ("ON – ON"), Québec nets in Ontario waters ("ON – QC") and Québec nets in Québec waters ("QC – QC"). To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site.

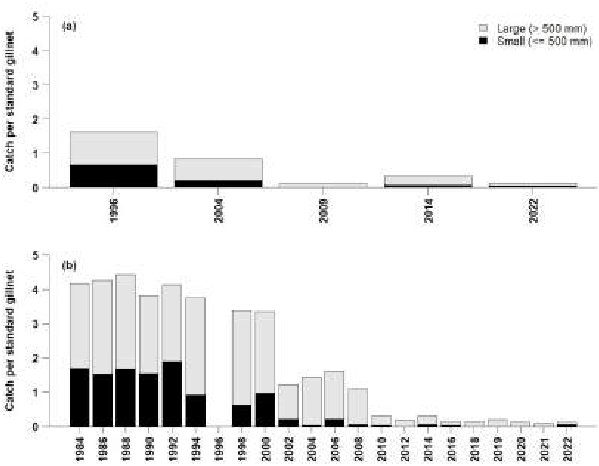


FIG. 8.1.10. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Northern Pike in the (a) Québec and (b) Ontario Lake St. Francis community index netting program, 1984 – 2022. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Ontario data represent catches using Ontario nets only. Survey in Ontario waters was not conducted in 1996.

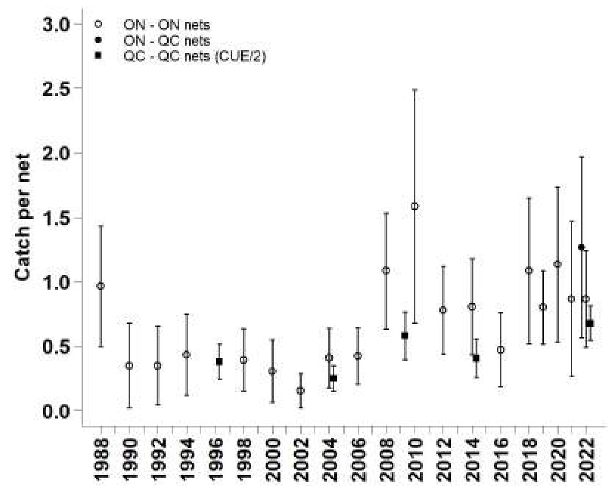


FIG. 8.1.12. Average catch of Walleye per standard gillnet set in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

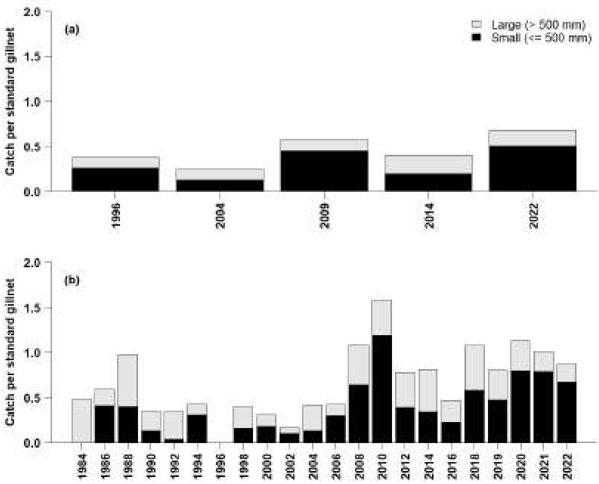


FIG. 8.1.13. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Walleye in the (a) Québec and (b) Ontario Lake St. Francis community index netting program, 1984 – 2022. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Ontario data represent catches using Ontario nets only. Survey in Ontario waters was not conducted in 1996.

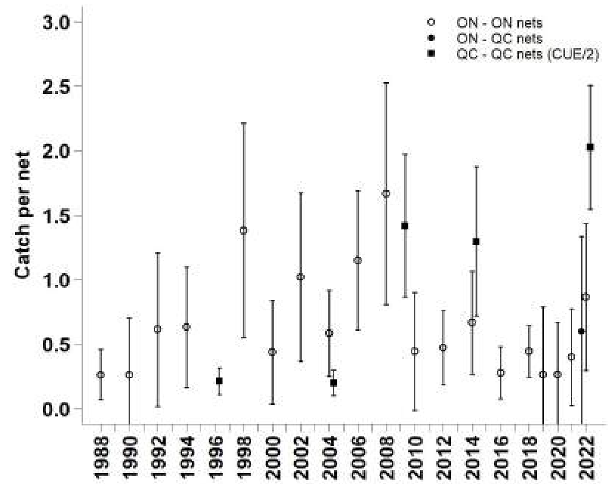


FIG. 8.1.15. Average catch of Smallmouth Bass per standard gillnet set in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

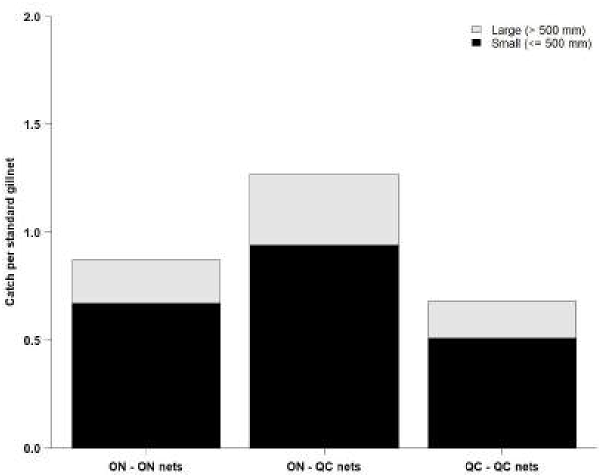


FIG. 8.1.14. Catches of small (≤ 500 mm total length) and large (> 500 mm total length) Walleye in the 2022 Lake St. Francis fish community assessment program using Ontario nets in Ontario waters (“ON – ON”), Québec nets in Ontario waters (“ON – QC”) and Québec nets in Québec waters (“QC – QC”). To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site.

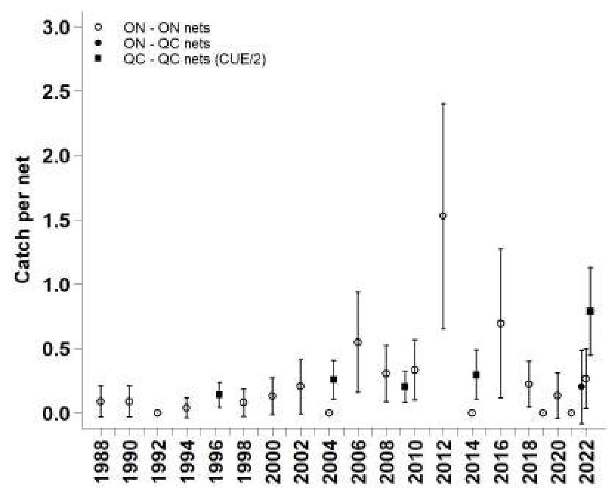


FIG. 8.1.16. Average catch of Largemouth Bass per standard gillnet set in Lake St. Francis for Ontario nets set in Ontario waters (open circles), Québec nets set in Ontario waters (closed circle) and Québec nets set in Québec waters (closed squares), 1984 – 2022. Error bars represent 95% confidence intervals. To standardize catch per unit effort, catches in the Québec program have been divided by two as they set two nets at each site while Ontario sets only one net per site. Survey in Ontario waters was not conducted in 1996.

9. Environmental Indicators

9.1 Water Temperature

L. Sunderland, Lake Ontario Management Unit

Winter Severity Index

Winter severity is often correlated with year-class strength in temperate fish species. Winter severity is measured as the number of days in December through April with a mean water temperature less than 4°C. Mean daily surface water temperature was obtained from the Belleville (Upper Bay of Quinte) Water Treatment Water Facility. The temperature data comes from water drawn from the bottom at a depth of approximately 3.2m. Water temperatures are homothermous in this section of the bay.

A long-term (1944-2022) winter severity index is presented in Fig. 9.1.1. The winter of 2021/22 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. Mid-summer water temperature is calculated using daily temperatures in July and August (mean of 62 days).

Bay of Quinte

A long-term (1943-2022) mid-summer water temperature index is presented in Fig. 9.1.2. Mean daily surface water temperature was obtained from the Belleville Water Treatment Facility as described for the winter severity index.

Water temperatures in the summer of 2022 were warmer than the long-term average. Fifteen 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 2022 were above the average for the time series (2002-2022; Fig. 9.1.3).

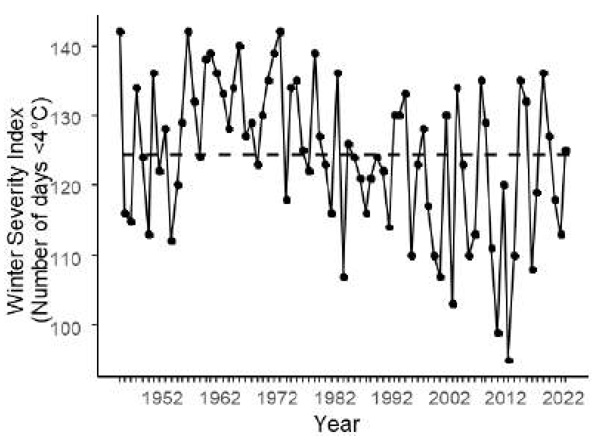


FIG. 9.1.1. Winter severity index for the Bay of Quinte, 1944-2022. The long-term average index is depicted with a dashed line. Mean daily surface water temperature data was obtained from the Bellville (Bay of Quinte) Water Treatment Facility.

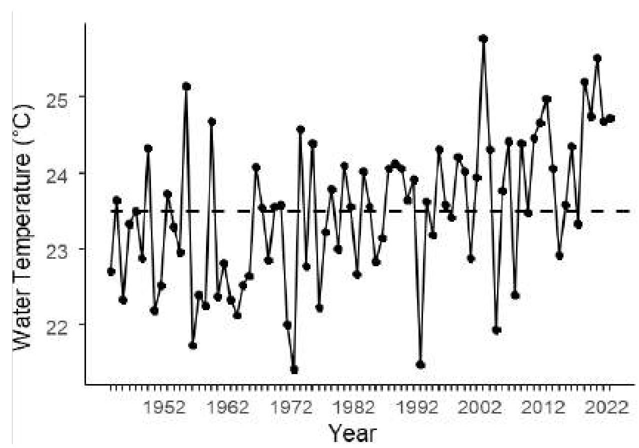


FIG. 9.1.2. Mean mid-summer water temperature for the Bay of Quinte, 1943-2022. The long-term average is depicted with a dashed line. Mean daily surface water temperature data was obtained from the Bellville (Bay of Quinte) Water Treatment Facility.

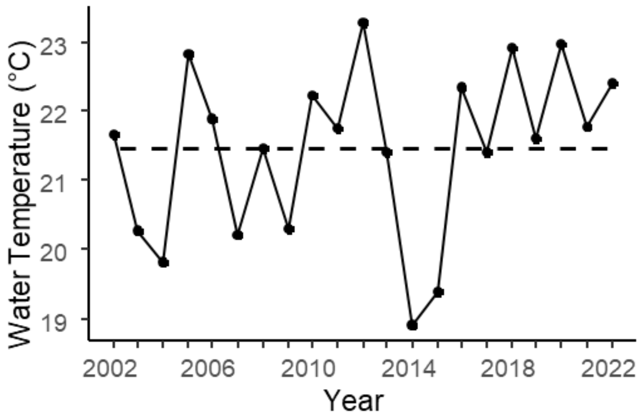


FIG. 9.1.3. Mean mid-summer water temperature for Lake Ontario, 2002-2022. The average for the time series is depicted with a dashed line. Data provided by National Data Buoy Center NOAA (http://www.ndbc.noaa.gov/).

9.2 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 (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 – 2022 (Fig. 9.2.1). 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 2020 had higher than average small craft warnings (Fig. 9.2.1a). In 2022, the number of small craft warning hours was significantly lower than 2020 and below the average for the time series (Fig. 9.2.1a). 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. 9.2.1b). This index shows a decrease from 2021 to 2022, but the relative contribution of east winds remains above the time series average (Fig. 9.2.1b).

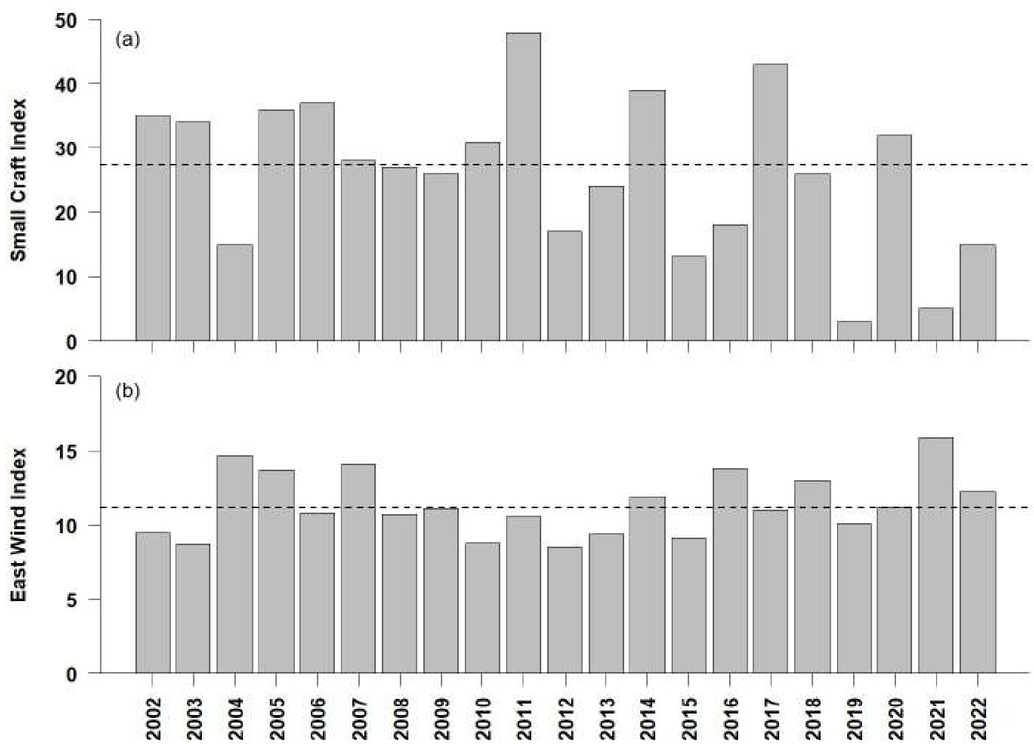


FIG. 9.2.1. Lake Ontario wind as characterized by the Small Craft Index (a) and East Wind Index (b). The Small Craft Index represents the total number of hours from July 1st to August 31st each year (2002 – 2022), where the wind velocity was ≥ 20 knots. The East Wind Index represents the number of hours from July 1st to August 31st each year (2002 – 2022) that an eastern wind predominated. Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

9.3 Tributary Water Flow

L. Sunderland, 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^3s^{-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 9.3) were retrieved in August 2023 and summarised to characterise tributary water flow regimes. At the time of this report, 2022 daily discharge data are considered provisional by 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 2022, the average annual discharge at the Credit River (Station ID: 02HB029) was 8.25 m^3s^{-1}. This was below the long-term average (Fig. 9.3.1). The central flow Julian day date was 82, indicating that flows occurred earlier relative to the 5-year average (136).

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 2022, the average annual discharge at the Ganaraska River (Station ID: 02HD012) was 3.01 m^3s^{-1}. This was below the long-term average (Fig. 9.3.2). The central flow Julian day date was 126, indicating that flows occurred earlier relative to the 5-year average (141).

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 2022, the average annual discharge at the Salmon River (Station ID: 02HM003) was 11.47 m^3s^{-1}. This was above the long-term average (Fig. 9.3.3). The central flow Julian day date was 104, indicating that flows occurred later relative to the 5-year average (112).

TABLE 9.3. Information of three Lake Ontario tributaries used in the stream flow analysis including river name, station ID, latitude and longitude (Degree Decimal Minutes), gross drainage area (km^2), and 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	2005-2022
Ganaraska	02HD012	43°59.450 N	78°16.683 W	241.87	1976-2022
Salmon	02HM003	44°12.433 N	77°12.550 W	906.73	1958-2022

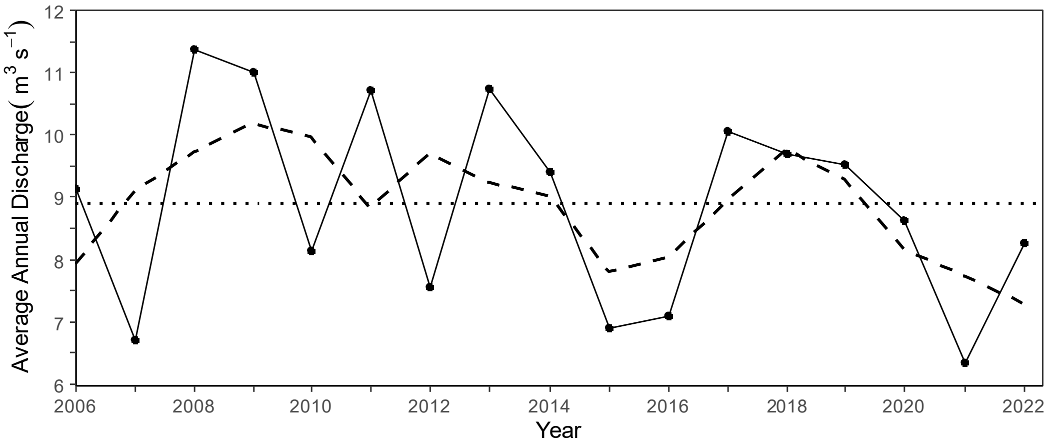


FIG. 9.3.1. Average annual discharge (m^3s^{-1}) for the Credit River, Ontario (Station ID: 02HB029) from 2006 to 2022. The horizontal dotted line is the historical average discharge and the dashed line represents the 3-year running mean.

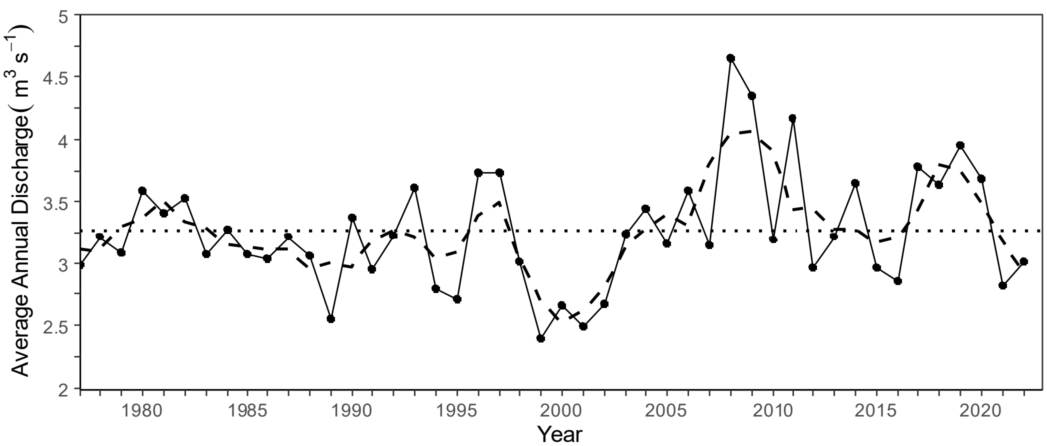


FIG. 9.3.2. Average annual discharge (m^3s^{-1}) for the Ganaraska River, Ontario (Station ID: 02HD012) from 1977 to 2022. The horizontal dotted line is the historical average discharge and the dashed line represents the 3-year running mean.

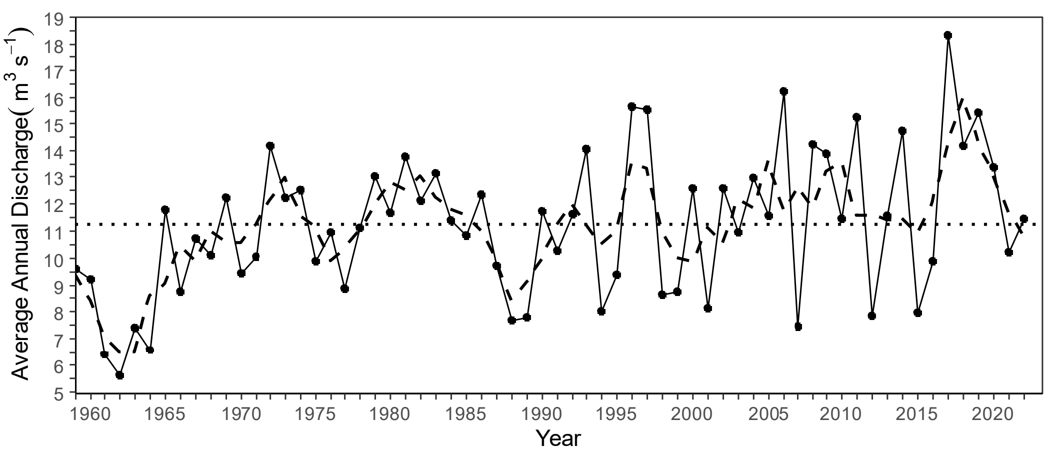


FIG. 9.3.3. Average annual discharge (m^3s^{-1}) for the Salmon River, Ontario (Station ID: 02HM003) from 1977 to 2022. The horizontal dotted line is the historical average discharge and the dashed line represents the 3-year running mean.

10. Staff 2022

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11. Operational Field and Lab Schedule, 2022

Operational Field and Lab Schedule, 2022 (SPA = Special Purpose Account; COA = Canada Ontario Agreement; OPG = Ontario Power Generation).

Field and Lab Projects	Dates	Species Assessed, Monitored or Stocked	Project Lead	Operational Lead	Funding Source
Ganaraska River Fish Counter Salmon and Trout Assessment	Mar-Nov	Migratory Trout & Salmon	Yuille	Maynard	COA/SPA
Ganaraska Fishway Rainbow Trout Assessment	Mar-Apr	Rainbow Trout	Yuille	Maynard	SPA
Ganaraska River Evaluation of Fishway Performance	Apr-Nov	Migratory Trout & Salmon	Yuille/Maynard	Maynard	COA
Walleye Egg Collection	Mar-Apr	Walleye	E. Brown	Wingrove	SPA
Turtle Bycatch Assessment	Apr-May	Outreach/Compliance	Lake	DeBeouf	SPA
Largemouth Bass Broodstock Collection	May	Largemouth Bass	Lake	Wingrove	SPA
Bluegill Broodstock Collection	May	Bluegill	Lake	Maynard	SPA
Foodweb Dynamics in Lake Ontario	Apr-Nov	Fish Community	Dr. Johnson	Metcalfe/Rupnik	COA/SPA
Asian Grass Carp Emergency Response	Apr-Nov	Grass Carp	McNevin	Kranzl/McNevin	SPA
Chinook Salmon Net Pens	Apr	Chinook Salmon	Lake	Lake	SPA
Lake Ontario Spring Prey Fish Trawling Survey	Apr	Alewife/Smelt/Bloater	Holden	Chicoine/Campbell	SPA
Fish Contaminant Sampling	Apr-Dec	Sport Fish	E. Brown/Kranzl	Jakobi/Kranzl	SPA
St. 81 - Offshore Limnology and Zooplankton Survey	May-Oct	Lower Food Web	Dr. Johnson	Metcalfe	SPA
Bay of Quinte Open Water Creel Survey	May-Aug	Fish Community	E.Brown	DeBeouf	SPA
Western Basin Creel	May-Sept	Salmonids	Yuille	Chan	SPA
Muskellunge Index Netting	May	Esocids	Lake	Wingrove	SPA
Juvenile Chinook Salmon Assessment	May	Chinook Salmon	Yuille	Maynard	SPA
Lake Trout Tug Stocking	May	Juvenile Lake Trout	Lake	Chicoine	SPA
Spring American Eel Trap and Transfer	Apr-Jun	American Eel	LaRose	Tsinaridis	OPG
Eastern Lake Ontario and Bay of Quinte Fish Community Index Netting	Jun-Nov	Fish Community	E. Brown/Beech	Wingrove	SPA
Eastern Lake Ontario and Bay of Quinte Fish Community Index Trawling	Jun-Sep	Fish Community	E. Brown/Beech	Kranzl	SPA
Acoustic Telemetry Receiver Servicing	June/Aug	Multiple Species	Dr. Johnson	Chicoine/Scholz	COA/SPA
Credit River Fish Counter Salmon and Trout Assessment	Mar-Nov	Migratory Trout & Salmon	Yuille	Maynard	COA/SPA
Wellers Bay Nearshore Community Index Netting	Aug	Nearshore Fish Community	Beech	Campbell	COA
Upper Bay Nearshore Community Index Netting	Aug-Sept	Nearshore Fish Community	Beech	Hoyle	COA
Toronto Harbour Nearshore Community Index Netting	Sept	Nearshore Fish Community	Beech	Campbell	COA
Genetic Markers of Thermal Stress in Yellow Perch	Sept	Yellow Perch	Patricia Voyer (MSc student at U Windsor)	Metcalfe	COA/SPA
St. Lawrence River Fish Community Index Netting	Sept	Fish Community	Yuille	Wingrove	COA
Lake St. Francis Fish Community Index Netting	Sept	Fish Community	Yuille	Wingrove	COA
Fall American Eel Trap and Transfer	Sept-Oct	American Eel	LaRose	Tsinaridis	OPG
Public Outreach - Port Hope Salmon Festival	Sept	Public Outreach/Education	Maynard	Maynard	SPA
Lake Ontario Fall Benthic Prey Fish Trawling Survey	Sept-Oct	Round Goby/Bloater/Slimy and Deepwater Sculpin	Holden	Montgomery/ Campbell	COA
Credit River Chinook Salmon Assessment and Egg Collection	Oct	Chinook Salmon	Yuille	Ballingall	SPA
Lake Whitefish Acoustic Tagging	Nov	Lake Whitefish	Dr. Johnson	Kranzl/Metcalfe	COA / SPA
Lake Whitefish Commercial Catch Sampling	Oct-Nov	Lake Whitefish	E. Brown	Mindle	SPA
Cisco Commercial Catch Sampling	Oct-Nov	Cisco	E. Brown	Mindle	SPA
Age and Growth (Lab)	Year-Round	Multiple Species	Kranzl	Maynard	SPA/COA

12. Primary Publications 2022

Primary Publications of Glenora Fisheries Station Staff[1] in 2022

Bowen, K. L., Currie, W. J., Niblock, H., Ward, C. L., **Metcalfe, B.**, Cuddington, K. M. D., **Johnson, T.B.**, & Koops, M. A. (2022). Importance of long-term intensive monitoring programs for understanding multiple drivers influencing Lake Ontario zooplankton communities. *Journal of Great Lakes Research*, *48*(3), 717-733.

Gutgesell, M., McMeans, B. C., Guzzo, M. M., de Groot, V., Fisk, A. T., **Johnson, T. B.**, & McCann, K. S. (2022). Subsidy accessibility drives asymmetric food web responses. *Ecology*, *103*(12), e3817.

Ivanova, S. V., Raby, G., **Johnson, T. B.**, Larocque, S. M., & Fisk, A. T. (2022). Effects of life stage on the spatial ecology of Chinook salmon (*Oncorhynchus tshawytscha*) during pelagic freshwater foraging. *Fisheries Research*, *254*, 106395.

Larocque, S. M., Colborne, S. F., Fisk, A. T., & **Johnson, T. B.** (2022). Improving trophic niche and diet resolution of the salmonid community of Lake Ontario using three stable isotopes and multiple tissues. *Fisheries Research*, *255*, 106455.

Larocque, S. M., **Lake, C., Johnson, T. B.**, & Fisk, A. T. (2022). Patterns in spatial use of land-locked Atlantic salmon (*Salmo salar*) in a large lake. *Journal of Great Lakes Research*, *48*(2), 381-391.

Midwood, J. D., Blair, S. G., Boston, C. M., **Brown, E.**, Croft-White, M. V., Francella, V., Gardner Costa, J., Liznick, K., Portiss, R., Smith-Cartwright, L., & van der Lee A. (2022). First assessment of the fish populations beneficial use impairment in the Toronto and Region Area of Concern. *Can. Tech. Rep. Fish. Aquat. Sci*. 3503: xvii + 283 p

Nawrocki, B. M., Zhu, C., & **Johnson, T. B.** (2022). Comparative trophic ecology of nearshore juvenile salmonids in Lake Ontario. *Journal of Great Lakes Research*, *48*(6), 1669-1680.

Nawrocki, B. M., **Metcalfe, B. W.**, **Holden, J. P.**, Lantry, B. F., & **Johnson, T. B.** (2022). Spatial and temporal variability in lake trout diets in Lake Ontario as revealed by stomach contents and stable isotopes. *Journal of Great Lakes Research*, *48*(2), 392-403.

Weidel, B. C., Ackiss, A. S., Chalupnicki, M. A., Connerton, M. J., Davis, S., Dettmers, J. M., Drew, T., Fisk, A. T., Gordon, R., Hanson, S. D., **Holden, J. P.**, Holey, M. E., Johnson, J. H., **Johnson, T. B.**, **Lake C.**, Lantry, B. F., Loftus, K. K., Mackey, G. E., McKenna, J. E., Jr., Millard, M. J., Minihkeim, S. P., O'Malley, B. P., **Rupnik, A.**, **Todd, A.**, & LaPan, S. R. (2022). Results of the collaborative Lake Ontario bloater restoration stocking and assessment, 2012–2020. *Journal of Great Lakes Research*, *48*(2), 371-380.

[1] **Names of staff of the Glenora Fisheries Station are indicated in bold font.**

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ISSN 1201-8449