Lake Ontario Fish Communities and Fisheries:

2016 Annual Report of the Lake Ontario Management Unit

Ontario

Cover Photos:

(Left) MNRF's "Ontario Explorer" departing the Toronto Harbour, July 17, 2016

(Right top) "Ontario Explorer" docked at the Glenora Fisheries Station, March 28, 2016

(Right bottom) LOMU field crew trap netting Bay of Quinte Walleye for egg collection activities

LAKE ONTARIO FISH COMMUNITIES AND FISHERIES:

2016 ANNUAL REPORT OF THE LAKE ONTARIO MANAGEMENT UNIT

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Lake Ontario Fish Communities and Fisheries: 2016 Annual Report of the Lake Ontario Management Unit

Foreword

The Lake Ontario Management Unit (LOMU) and the Lake Ontario research staff from the Applied Research and Monitoring Section are pleased to provide the 2016 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 many 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.

Lake Ontario, Bay of Quinte, and St. Lawrence River ecosystems have changed over the last two centuries in response to the pressures of industrial development, land settlement and agricultural practices, fishing, pollution, loss of native species, and the introduction of new species. Long-term fisheries and aquatic monitoring, assessment and research programs help understand these changes and support informed management decisions. These decisions need to consider the ecological realities that shape the fishery, such as the natural capacity of the lake to produce fish, the decline or recovery of native species, the impact of non-native species, changes to fish habitat, and climate change, along with social and economic objectives.

Management highlights from 2016 include the development of an Atlantic Salmon Restoration Program: Five Year Implementation Strategy 2016/2020, the release of Fishing in Your Backyard - An Urban Recreational Fisheries Strategy for the Lake Ontario Northwest Waterfront and the creation of a bi-national (Ontario/New York State) stakeholder forum. Management Unit staff participated in several public events including the Toronto Sportsmen's Show, Cottage Life Show, Belleville Cops Kids Fishing and Hamilton Harbour Fun Fishing events. The Management Unit partnered with the Port Credit Salmon and Trout Association to deliver the second Lake Ontario Salmon Symposium in Port Credit Ontario. Three public meetings were held in Port Hope, Port Credit and Whitby, as well, Management Unit staff attended several Angling Club meetings as invited speakers. The MNRF fish culture program and partners produced and stocked more than 2 million fish into Lake Ontario.

The 2016 Lake Unit assessment program included twelve index fishing programs, four recreational angler surveys, commercial fishery assessment and the age interpretation of 2,807 fish. Assessment program additions in 2016 included: expansion of the off-shore large vessel trawling program to include Alewife, and other pelagic prey fish, monitoring in the spring; and acquisition of a new video fish counter to assess adult Atlantic Salmon returning to Lake Ontario tributaries. The assessment program continues to evolve, building on a strong base of long-term monitoring while developing new tools, techniques and expertise.

The Lake Ontario Research Program under Dr. Tim Johnson (Aquatic Monitoring and Research Section) continues to contribute new knowledge and tools to the Lake Ontario Management Team. Included in this report is an update on stocked Bloater behavior using acoustic telemetry; a modelling tool to support fish stocking decisions, research into trout and salmon movement and habitat use using pop-off data storage tags, and research into juvenile salmonid diets.

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: Aurora, Peterborough and Kemptville MNRF District offices for their ongoing cooperation and collaboration; the Credit Valley Conservation, Toronto Region Conservation and Ganaraska Region Conservation Authorities for helping to plan and deliver several key programs; and the Ontario Federation of Anglers and Hunters and the many other partners committed to the Lake Ontario Atlantic Salmon restoration program. Work with University of Windsor and Queen's University is ongoing and should provide unique insight into Lake Ontario fisheries. 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, and the participants in the angler diary and assessment programs.

Our team of skilled and committed staff and partners delivered an exemplary program of over forty field, laboratory and analytical projects that will provide long-term benefits to the citizens of Ontario. We are pleased to share the important information about the activities and findings of the Lake Ontario Management Unit from 2016.

Andy Todd
Lake Ontario Manager
613-476-3147

For more detailed information or copies of this report please contact:

Lake Ontario Management Unit
Ontario Ministry of Natural Resources and Forestry
R.R. #4, 41 Hatchery Lane
Picton, ON K0K 2T0 CAN
Telephone: (613) 476-2400
FAX: (613) 476-7131

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

1. Index Fishing Projects

1.1 Ganaraska Fishway Rainbow Trout Assessment

M.J. Yuille, Lake Ontario Management Unit

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. Since 1987, fish counts were made with a Pulsar Model 550 electronic fish counter. Based on visual counts the electronic counter is about 85.5% efficient, and the complete size of the run has been 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 2016, the fish counter was installed on March 11th, 2016 and ran until May 9th, 2016. In 2016, the Rainbow Trout run in the Ganaraska River was estimated at 4,987 fish, below the average for the previous 10 years (7,192 fish on average from 2006 to 2015). From 2009 to 2013, the Rainbow Trout run in the Ganaraska River increased. Since 2013, the Rainbow Trout run in the Ganaraska River has declined. The total estimated run size from 2016 is down 25% from 2015 and down 59% from the peak in 2013 (Fig. 1.1.1 and Table 1.1.1).

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 fork length (25 inch) fish. In 2016, the condition of male (2,842 g) and female (2,981 g) Rainbow Trout were slightly higher than in 2015, however, male and female condition is 3% lower than the previous 10-year average (Fig 1.1.2 and Table 1.1.2).

The proportion of Rainbow Trout with Lamprey marks in the Ganaraska River has been reported since 1974. In 2016, 27% of fish had Lamprey marks (wound or scar), representing a 7% increase from 2015 (Fig. 1.1.3). Despite this recent increase, lamprey wounds on Ganaraska River Rainbow Trout in 2016 is below the previous 10 year average (38%; Table 1.1.3).

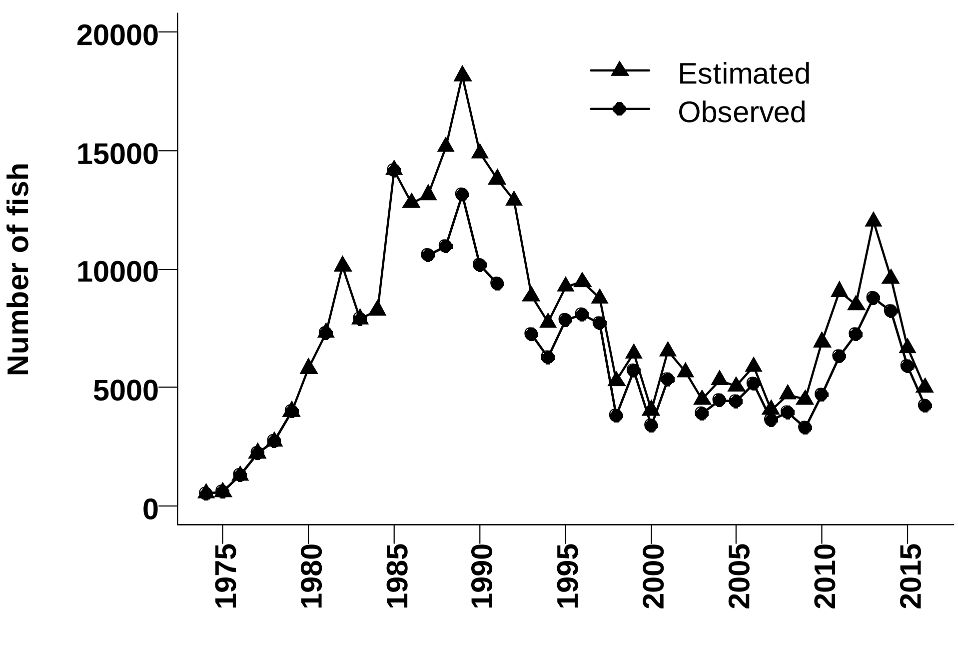


FIG. 1.1.1. Estimated and observed run of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2016.

TABLE 1.1.1. Observed count and estimated run of Rainbow Trout moving upstream at the Ganaraska River fishway at Port Hope, Ontario during spring, 1974-2016. 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

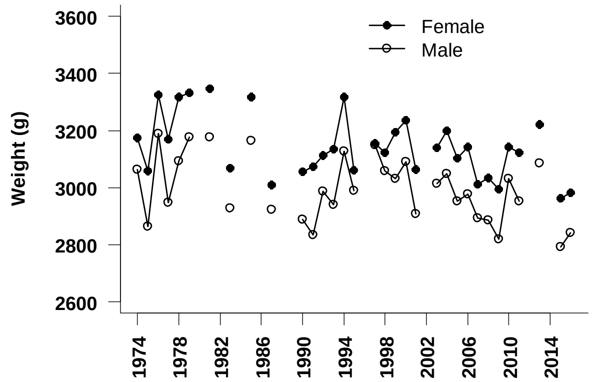


FIG. 1.1.2. Body condition (estimated weight at 635 mm fork length) of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring 1974-2016. Open and filled circles represent male and female Rainbow Trout (respectively).

TABLE 1.1.2. Body condition (estimated weight at 635 mm fork length) of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario during spring, 1974-2016.

Year	Male		Female	
	Weight (g)	Sample Size	Weight (g)	Sample Size
1974	3,064	183	3,175	242
1975	2,863	202	3,058	292
1976	3,188	447	3,325	624
1977	2,947	698	3,171	1038
1978	3,094	275	3,317	538
1979	3,177	372	3,332	646
1981	3,176	282	3,348	493
1983	2,928	327	3,069	481
1985	3,164	446	3,318	760
1987	2,923	84	3,010	110
1990	2,890	261	3,057	198
1991	2,834	127	3,073	289
1992	2,986	142	3,112	167
1993	2,941	89	3,136	172
1994	3,128	116	3,317	181
1995	2,990	147	3,062	155
1997	3,149	157	3,156	148
1998	3,058	131	3,123	262
1999	3,033	182	3,193	293
2000	3,090	125	3,235	234
2001	2,909	308	3,063	299
2003	3,015	93	3,140	144
2004	3,050	143	3,198	248
2005	2,952	145	3,103	176
2006	2,976	102	3,141	217
2007	2,893	75	3,011	131
2008	2,885	125	3,034	148
2009	2,820	78	2,994	211
2010	3,031	74	3,143	156
2011	2,954	94	3,123	204
2013	3,085	163	3,221	217
2015	2,792	86	2,963	119
2016	2,842	105	2,981	132
Average	2,995		3,142	

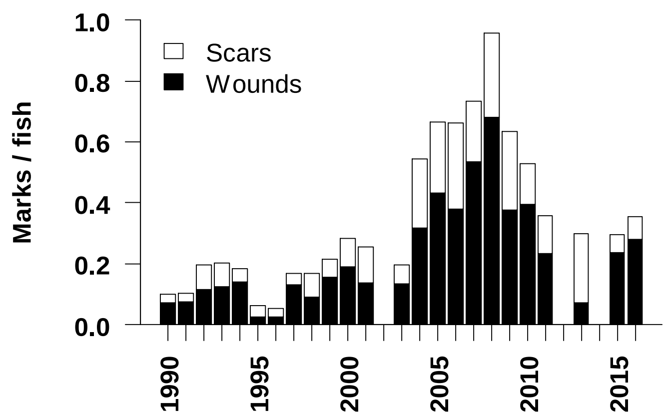


FIG. 1.1.3. Trend in lamprey marks on Rainbow Trout during the spring 1974-2016, at the Ganaraska River fishway at Port Hope, Ontario. Since 1990, A1 and A2 marks (King and Edsall 1979) were called wounds and the remainder of marks were called scars to fit with historical classification.
King, E.L. Jr. and Edsall, T.A. 1979. Illustrated field guide for the classification of sea lamprey attack marks on great lakes lake trout. GLFC Special Publication 79-1.

TABLE 1.1.3. Lamprey marks on Rainbow Trout in spring 1974-2016, at the Ganaraska River fishway, at Port Hope, Ontario. Since 1990, A1 and A2 marks were called wounds and the remainder of marks were called scars to fit with historical classification.

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

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

J. A. Hoyle, Lake Ontario Management Unit

The Lake Ontario and Bay of Quinte annual 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. 1.2.1 and the basic sampling design is summarized in Table 1.2.1. Included in the design are fixed, single-depth sites and depth-stratified sampling areas. In 2016, each site or area was visited from one to three times within specified time-frames, and with one to three gill net gangs set during each visit.

The annual index gill netting field work occurs during the summer months. Summer was chosen based on an understanding of water temperature stability, fish movement/migration patterns, fish growth patterns, and logistical considerations. The time-frames for completion of field work varies among sampling sites/areas (Table 1.2.1). This increases the probability of encountering a wide-range of water temperatures across the depth ranges sampled, both seasonally and by geographic area.

In 2016, several additional gill net sampling locations were sampled. This included sites that had been sampled in the past but not for several decades; these additional sites were EB01, EB03, EB04, and EB05 in the Kingston Basin of eastern Lake Ontario, and Trenton, Belleville, and Deseronto in the upper Bay of Quinte. Also, two extra sampling depths (40 and 50 m) were added to the three deep-water depth-stratified sampling transects in the open waters of Lake Ontario;

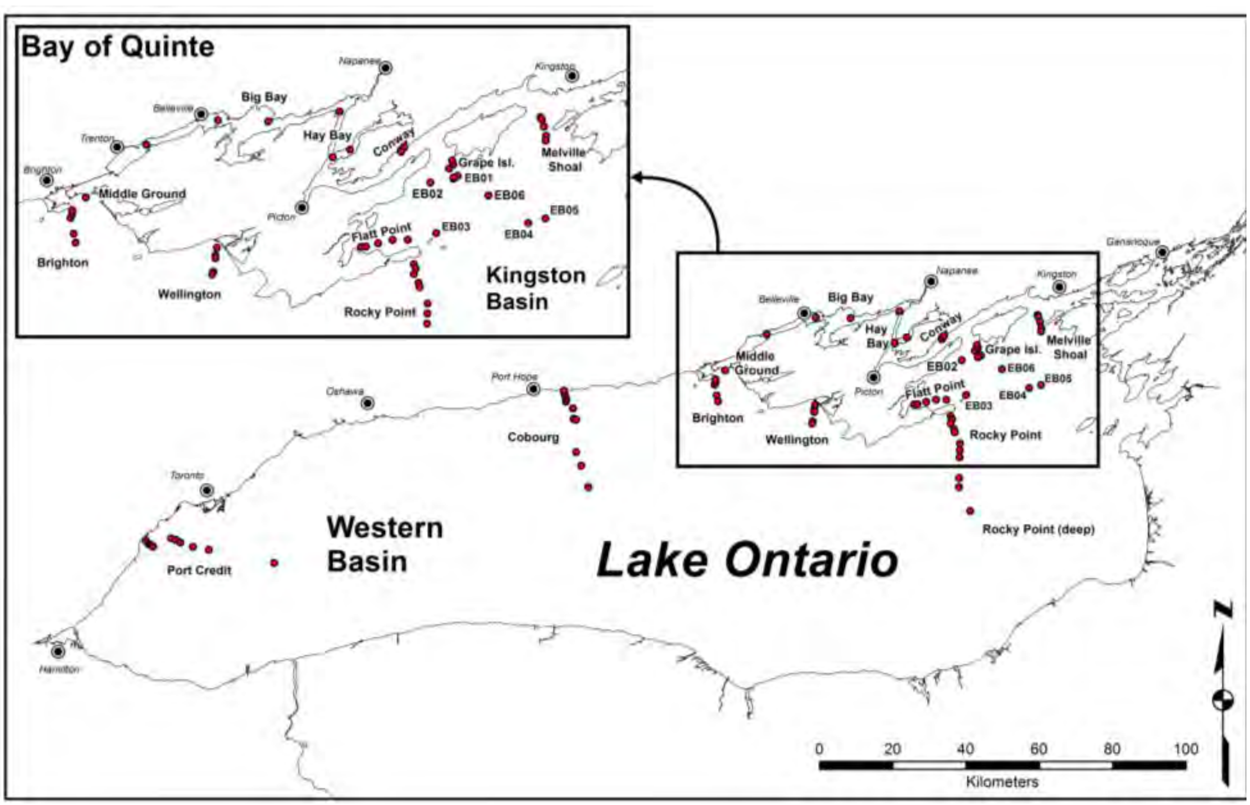


FIG. 1.2.1. Map of north eastern Lake Ontario. Shown are eastern Lake Ontario and Bay of Quinte fish community index gill netting sites.

TABLE. 1.2.1. 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.

Region name	Area name	Design	Site name	Depth (m)	Visits	Replicates 465'	Replicates 500'	Site location (approx) Latitude (dec deg)	Site location (approx) Longitude (dec deg)	Visits x Replicates	Time-frame	Start-up year	Number years
Northwest	Port Credit	Depth stratified	PC08	7.5	1	2		43.5362	-79.5810	2	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	PC13	12.5	1	2		43.5278	-79.5698	2	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	PC18	17.5	1	2		43.5258	-79.5632	2	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	PC23	22.5	1	2		43.5243	-79.5598	2	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	PC28	27.5	1	2		43.5222	-79.5553	2	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	PC40	40	1		3	43.5448	-79.4960	3	Jul 1-Jul 31	2016	1
Northwest	Port Credit	Depth stratified	PC50	50	1		3	43.5415	-79.4790	3	Jul 1-Jul 31	2016	1
Northwest	Port Credit	Depth stratified	0060	60	1		3	43.5355	-79.4640	3	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	0080	80	1		3	43.5267	-79.4205	3	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	0100	100	1		3	43.5218	-79.3665	3	Jul 1-Jul 31	2014	3
Northwest	Port Credit	Depth stratified	0140	140	1		3	43.4975	-79.1452	3	Jul 1-Jul 31	2014	3
Central	Cobourg	Depth stratified	CB08	7.5	2	2		43.9498	-78.1952	4	Jul 1-Sep 15	2010	7
Central	Cobourg	Depth stratified	CB13	12.5	2	2		43.9420	-78.1912	4	Jul 1-Sep 15	2010	7
Central	Cobourg	Depth stratified	CB18	17.5	2	2		43.9367	-78.1897	4	Jul 1-Sep 15	2010	7
Central	Cobourg	Depth stratified	CB23	22.5	2	2		43.9302	-78.1847	4	Jul 1-Sep 15	2010	7
Central	Cobourg	Depth stratified	CB28	27.5	2	2		43.9238	-78.1857	4	Jul 1-Sep 15	2010	7
Central	Cobourg	Depth stratified	CB40	40	1		3	43.9090	-78.1572	3	Jul 1-Jul 31	2016	1
Central	Cobourg	Depth stratified	CB50	50	1		3	43.8832	-78.1540	3	Jul 1-Jul 31	2016	1
Central	Cobourg	Depth stratified	0060	60	1		3	43.8817	-78.1448	3	Jul 1-Jul 31	2014	3
Central	Cobourg	Depth stratified	0080	80	1		3	43.8020	-78.1405	3	Jul 1-Jul 31	2014	3
Central	Cobourg	Depth stratified	0100	100	1		3	43.7692	-78.1213	3	Jul 1-Jul 31	2014	3
Central	Cobourg	Depth stratified	0140	140	1		3	43.7175	-78.0953	3	Jul 1-Jul 31	2014	3
Northeast	Brighton	Depth stratified	BR08	7.5	2	2		43.9925	-77.6763	4	Aug 1-Sep 15	1988	29
Northeast	Brighton	Depth stratified	BR13	12.5	2	2		43.9852	-77.6785	4	Aug 1-Sep 15	1988	29
Northeast	Brighton	Depth stratified	BR18	17.5	2	2		43.9790	-77.6800	4	Aug 1-Sep 15	1988	29
Northeast	Brighton	Depth stratified	BR23	22.5	2	2		43.9600	-77.6717	4	Aug 1-Sep 15	1988	29
Northeast	Brighton	Depth stratified	BR28	27.5	2	2		43.9397	-77.6727	4	Aug 1-Sep 15	1988	29
Northeast	Middle Ground	Fixed site	MG05	5	2	2		44.0152	-77.6453	4	Aug 1-Sep 15	1979	38
Northeast	Wellington	Depth stratified	WE08	7.5	2	2		43.9372	-77.3353	4	Aug 1-Sep 15	1988	29
Northeast	Wellington	Depth stratified	WE13	12.5	2	2		43.9240	-77.3380	4	Aug 1-Sep 15	1988	29
Northeast	Wellington	Depth stratified	WE18	17.5	2	2		43.9193	-77.3377	4	Aug 1-Sep 15	1988	29
Northeast	Wellington	Depth stratified	WE23	22.5	2	2		43.8965	-77.3417	4	Aug 1-Sep 15	1988	29
Northeast	Wellington	Depth stratified	WE28	27.5	2	2		43.8913	-77.3445	4	Aug 1-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	RP08	7.5	2	2		43.9177	-76.8740	4	Jul 21-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	RP13	12.5	2	2		43.9103	-76.8693	4	Jul 21-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	RP18	17.5	2	2		43.9008	-76.8735	4	Jul 21-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	RP23	22.5	2	2		43.8863	-76.9452	4	Jul 21-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	RP28	27.5	2	2		43.8793	-76.8592	4	Jul 21-Sep 15	1988	29
Northeast	Rocky Point	Depth stratified	0040	40	1		3	43.8515	-76.8400	3	Jul 1-Jul 31	2016	1
Northeast	Rocky Point	Depth stratified	0050	50	1		3	43.8348	-76.8400	3	Jul 1-Jul 31	2016	1
Northeast	Rocky Point	Depth stratified	0060	60	1		3	43.8178	-76.8400	3	Jul 1-Jul 31	1997	20
Northeast	Rocky Point	Depth stratified	0080	80	1		3	43.7668	-76.8400	3	Jul 1-Jul 31	1997	20
Northeast	Rocky Point	Depth stratified	0100	100	1		3	43.7443	-76.8400	3	Jul 1-Jul 31	1997	20
Northeast	Rocky Point	Depth stratified	0140	140	1		3	43.6862	-76.8000	3	Jul 1-Jul 31	1997	20
Kingston Basin	Flatt Point	Depth stratified	FP08	7.5	2	2		43.9447	-76.9985	4	Jul 1-Jul 31	1986	31
Kingston Basin	Flatt Point	Depth stratified	FP13	12.5	2	2		43.9457	-76.9870	4	Jul 1-Jul 31	1986	31
Kingston Basin	Flatt Point	Depth stratified	FP18	17.5	2	2		43.9517	-76.9587	4	Jul 1-Jul 31	1986	31
Kingston Basin	Flatt Point	Depth stratified	FP23	22.5	2	2		43.9577	-76.9250	4	Jul 1-Jul 31	1986	31
Kingston Basin	Flatt Point	Depth stratified	FP28	27.5	2	2		43.9582	-76.8897	4	Jul 1-Jul 31	1986	31
Kingston Basin	Grape Island	Depth stratified	GI08	7.5	2	2		44.0940	-76.7902	4	Jul 1-Jul 31	1986	31
Kingston Basin	Grape Island	Depth stratified	GI13	12.5	2	2		44.0880	-76.7868	4	Jul 1-Jul 31	1986	31
Kingston Basin	Grape Island	Depth stratified	GI18	17.5	2	2		44.0803	-76.7965	4	Jul 1-Jul 31	1986	31
Kingston Basin	Grape Island	Depth stratified	GI23	22.5	2	2		44.0668	-76.7815	4	Jul 1-Jul 31	1986	31
Kingston Basin	Grape Island	Depth stratified	GI28	27.5	2	2		44.0637	-76.7860	4	Jul 1-Jul 31	1986	31
Kingston Basin	Melville Shoal	Depth stratified	MS08	7.5	2	2		44.1707	-76.5853	4	Jul 1-Jul 31	1986	31
Kingston Basin	Melville Shoal	Depth stratified	MS13	12.5	2	2		44.1665	-76.5817	4	Jul 1-Jul 31	1986	31
Kingston Basin	Melville Shoal	Depth stratified	MS18	17.5	2	2		44.1543	-76.5762	4	Jul 1-Jul 31	1986	31
Kingston Basin	Melville Shoal	Depth stratified	MS23	22.5	2	2		44.1392	-76.5707	4	Jul 1-Jul 31	1986	31
Kingston Basin	Melville Shoal	Depth stratified	MS28	27.5	2	2		44.1310	-76.5720	4	Jul 1-Jul 31	1986	31
Kingston Basin	Eastern Basin	Fixed site	EB01	31	3		3	44.0665	-76.7757	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	2016	1
Kingston Basin	Eastern Basin	Fixed site	EB02	30	3		3	44.0533	-76.8397	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	1968	49
Kingston Basin	Eastern Basin	Fixed site	EB03	25	3		3	43.9712	-76.8232	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	2016	1
Kingston Basin	Eastern Basin	Fixed site	EB04	27	3		3	43.9910	-76.6092	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	2016	1
Kingston Basin	Eastern Basin	Fixed site	EB05	29	3		3	44.0000	-76.6665	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	2016	1
Kingston Basin	Eastern Basin	Fixed site	EB06	30	3		3	44.0360	-76.7040	9	Jun 20-Jul 17; Jul 18-Aug 14; Aug 15 Sep 9	1968	49

TABLE. 1.2.1 (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		Site location (approx)					
Region name	Area Name	Design	Site name	Depth (m)	Visits	465'	500'	Latitude (dec deg)	Longitude (dec deg)	Visits x Replicates	Time-frame	Start-up year	Number years
Bay of Quinte	Conway	Depth stratified	CO08	7.5	2		2	44.1097	-76.9108	4	Jul 21-Aug 21	1972	45
Bay of Quinte	Conway	Depth stratified	CO13	12.5	2		2	44.1080	-76.9103	4	Jul 21-Aug 21	1972	45
Bay of Quinte	Conway	Depth stratified	CO20	20	2		2	44.1065	-76.9097	4	Jul 21-Aug 21	1972	45
Bay of Quinte	Conway	Depth stratified	CO30	30	2		2	44.1218	-76.9043	4	Jul 21-Aug 21	1972	45
Bay of Quinte	Conway	Depth stratified	CO45	45	2		2	44.1147	-76.9023	4	Jul 21-Aug 21	1972	45
Bay of Quinte	Hay Bay	Depth stratified	HB08	7.5	3		2	44.1090	-77.0298	6	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (2 visits)	1959	58
Bay of Quinte	Hay Bay	Depth stratified	HB13	12.5	3		2	44.0950	-77.0697	6	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (2 visits)	1959	58
Bay of Quinte	Deseronto	Fixed site	DE05	5	2		2	44.1725	-77.0565	4	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (1 visit)	2016	1
Bay of Quinte	Big Bay	Fixed site	BB05	5	4		2	44.1527	-77.2230	8	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (3 visits)	1972	45
Bay of Quinte	Belleville	Fixed site	BE05	5	2		2	44.1523	-77.3413	4	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (1 visit)	2016	1
Bay of Quinte	Trenton	Fixed site	TR05	5	2		2	44.1060	-77.5105	4	Jun 15-Jul 15 (1 visit); Jul 21-Aug 21 (1 visit)	2016	1

Rocky Point, Cobourg and Port Credit. Sampling at all these additional sites will help better assess fish distribution patterns.

Monofilament gill nets with standardized specifications are used (monofilament mesh replaced multifilament in 1992; only catches from 1992-present are tabulated below). 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 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 1.2.1). 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 1.2.1. Gill net set duration usually ranges from 18-24 hr but can be up to three days for the deep-water Lake Ontario sites (40-140 m) at Rocky Point, Cobourg and Port Credit.

Catches were summed across the ten mesh sizes from 1½-6 inch. In the case where the 38 mm mesh size used was 4.6 m in length, the catch in this mesh was adjusted (i.e., multiplied by 15.2/4.6) prior to summing the ten mesh sizes. Therefore, all reported catches represent the total catch in a 152.4 m (500 ft) gang of gill net.

In 2016, 314 gill net samples were made from 21-Jun to 7-Sep. Thirty-five different species and over 50,000 individual fish were caught. About 85% of the observed catch was alewife (Table 1.2.2). Species-specific gill net catch summaries are shown by geographic area/ site in Tables 1.2.3-1.2.24.

Selected biological information is also presented below for Lake Whitefish and Walleye.

Lake Ontario

Northeast (Brighton, Wellington and Rocky Point) and Kingston Basin (Melville Shoal, Grape Island and Flatt Point) Nearshore Areas (Tables 1.2.3-1.2.8 inclusive)

Six depth-stratified sampling areas (Melville Shoal, Grape Island, Flat Point, Rocky

TABLE 1.2.2. Species-specific total gill net catch in **2016** from 21-Jun to 7-Sep. "Standard catch" is the observed catch expanded to represent the catch in a 50 ft panel length of 1 1/2 inch mesh size in cases where only 15 ft was used. A total of 314 gill nets were set and 35 species comprising 50,120 fish were caught.

Species	Observed catch	Standard catch	Mean weight (g)
Lake Sturgeon	3	3	401
Longnose Gar	133	133	2,166
Bowfin	1	1	3,415
Alewife	43,000	87,081	35
Gizzard Shad	596	596	62
Coho Salmon	5	5	3,732
Chinook Salmon	52	57	2,851
Rainbow Trout	3	3	1,123
Brown Trout	27	27	3,053
Lake Trout	519	534	3,443
Lake Whitefish	46	46	778
Cisco	85	90	408
Rainbow Smelt	3	5	25
Northern Pike	16	16	3,550
Longnose Sucker	1	1	997
White Sucker	164	169	553
Shorthead Redhorse	4	4	574
Greater Redhorse	1	1	2,136
Common Carp	5	5	6,392
Golden Shiner	16	16	36
Brown Bullhead	11	11	304
Channel Catfish	6	6	835
Burbot	6	6	2,861
White Perch	925	925	73
White Bass	15	15	281
Rock Bass	56	70	60
Pumpkinseed	53	53	51
Bluegill	35	35	39
Smallmouth Bass	30	32	962
Black crappie	1	1	38
Yellow Perch	3,315	4,008	49
Walleye	407	407	1,577
Round Goby	142	409	40
Freshwater Drum	386	386	1,177
Deepwater Sculpin	53	53	35

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 coldwater 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. 1.2.2) to illustrate abundance trends of the most abundant fish species.

Many species showed peak abundance levels in the early 1990s followed by dramatic abundance decline. Alewife, the most common species caught, has occurred at very high abundance levels the last few years until 2014 when abundance declined precipitously. Alewife abundance increased in 2015 and again in 2016. Yellow Perch remained at a very low level of abundance in 2016. Lake Trout abundance declined in 2016. In 2014, Round Goby abundance declined to its lowest level since 2004, and remained low in 2015 but increased in 2016. Walleye catch declined in 2016. Lake Whitefish remain at a very low abundance level. Rock Bass, Smallmouth Bass, Chinook Salmon and Brown Trout abundance all declined in 2016.

Middle Ground (Table 1.2.9)

Middle Ground represents one of our longest running gill netting locations. Seven species were caught at Middle Ground in 2016. Yellow Perch dominated the catch. Walleye and White Sucker abundance increased in 2016.

Kingston Basin—Deep Sites (EB02 and EB06; Tables 1.2.10 and 1.2.11)

Two single-depth sites (EB02 and EB06) are used to monitor long-term trends in the deep water fish community the Kingston Basin. Results were summarized and presented graphically (Fig. 1.2.3) to illustrate abundance trends of the most abundant species (Alewife, Lake Trout, Lake Whitefish, Yellow Perch, Rainbow Smelt, Cisco, Chinook Salmon and Round Goby). Alewife catches were variable with high catches in some years, 1998-1999, 2010, 2012 and 2016. Lake Trout, Lake Whitefish, Rainbow Smelt, and Cisco abundance

TABLE 1.2.3. Species-specific catch per gillnet set at **Brighton in Northeastern Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.4. Species-specific catch per gillnet set at **Wellington in Northeastern Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.5. Species-specific catch per gillnet set at **Rocky Point (nearshore sites only) in Northeastern Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.6. Species-specific catch per gillnet set at **Flatt Point in the Kingston Basin of Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.7. Species-specific catch per gillnet set at **Grape Island in the Kingston Basin of Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.8. Species-specific catch per gillnet set at **Melville Shoal in the Kingston Basin of Lake Ontario**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

	1992-2000 mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Lake Sturgeon	**0.01**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
Alewife	**71.63**	40.83	39.19	14.14	82.41	177.38	195.64	83.04	134.66	496.46	620.85	**188.46**	666.70	223.18	553.63	93.28	170.89	805.59
Gizzard Shad	**0.00**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinook Salmon	**0.03**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
Rainbow Trout	-	-	-	-	-	-	-	0.05	-	-	-	**0.01**	-	-	-	-	-	-
Brown Trout	-	-	-	-	-	-	0.05	-	0.10	-	0.15	**0.03**	0.05	0.05	-	0.05	-	-
Lake Trout	**3.54**	0.10	0.05	0.05	0.05	-	0.05	0.05	0.10	0.40	0.15	**0.10**	1.02	0.10	0.35	1.00	0.55	0.20
Lake Whitefish	**1.59**	0.10	0.20	0.30	-	-	-	0.05	-	-	-	**0.07**	-	-	-	-	-	-
Cisco	**0.04**	-	-	-	-	-	-	-	-	-	0.20	**0.02**	0.05	0.05	-	0.05	0.27	0.38
Coregonus sp.	**0.04**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rainbow Smelt	**0.08**	-	-	-	-	-	-	-	0.17	-	0.05	**0.02**	-	-	-	-	-	-
Northern Pike	**0.07**	0.10	0.10	0.05	-	-	-	-	-	0.10	0.10	**0.05**	-	-	-	-	0.05	0.05
White Sucker	**0.03**	0.05	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-
Greater Redhorse	**0.01**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moxostoma sp.	**0.04**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common Carp	**0.02**	-	-	0.05	0.10	-	-	-	0.05	-	-	**0.02**	-	-	-	-	-	-
Channel Catfish	**0.15**	-	-	0.05	-	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-
Stonecat	**0.03**	0.33	0.43	-	-	0.50	-	-	-	-	-	**0.13**	-	-	-	-	-	-
Burbot	**0.10**	-	-	-	0.05	-	-	-	-	-	-	**0.01**	-	-	-	-	-	-
White Perch	**0.20**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock Bass	**1.88**	1.99	0.98	1.33	2.25	1.84	1.82	1.72	3.16	0.80	1.28	**1.72**	1.20	1.89	0.42	1.99	1.51	1.02
Pumpkinseed	-	0.17	-	-	-	-	-	-	-	-	-	**0.02**	-	-	-	-	-	-
Smallmouth Bass	**0.53**	0.42	0.25	0.40	0.27	0.15	0.20	0.57	0.70	0.25	0.60	**0.38**	0.40	1.00	-	0.87	0.10	0.20
Yellow Perch	**28.76**	12.57	26.57	20.20	49.72	16.14	44.66	38.74	18.75	9.75	25.97	**26.31**	10.38	8.82	3.92	12.58	6.03	6.11
Walleye	**8.73**	4.63	3.90	3.50	5.08	4.45	5.25	7.30	4.55	7.50	12.45	**5.86**	10.10	7.05	0.55	11.70	7.00	6.95
Round Goby	-	-	-	-	9.02	9.80	5.34	4.84	2.18	1.16	0.50	**3.28**	0.71	1.16	1.16	-	0.50	-
Freshwater Drum	**0.09**	0.05	-	0.05	-	-	-	0.22	-	-	0.10	**0.04**	0.05	-	-	-	0.05	-
Total catch	**118**	61	72	40	149	210	253	137	164	516	662	**227**	691	243	560	122	187	821
Number of species	**12**	12	9	12	9	7	8	10	10	8	12	**10**	10	9	6	8	10	10
Number of sets		20	20	20	20	20	20	20	20	20	20		20	20	20	20	20	20

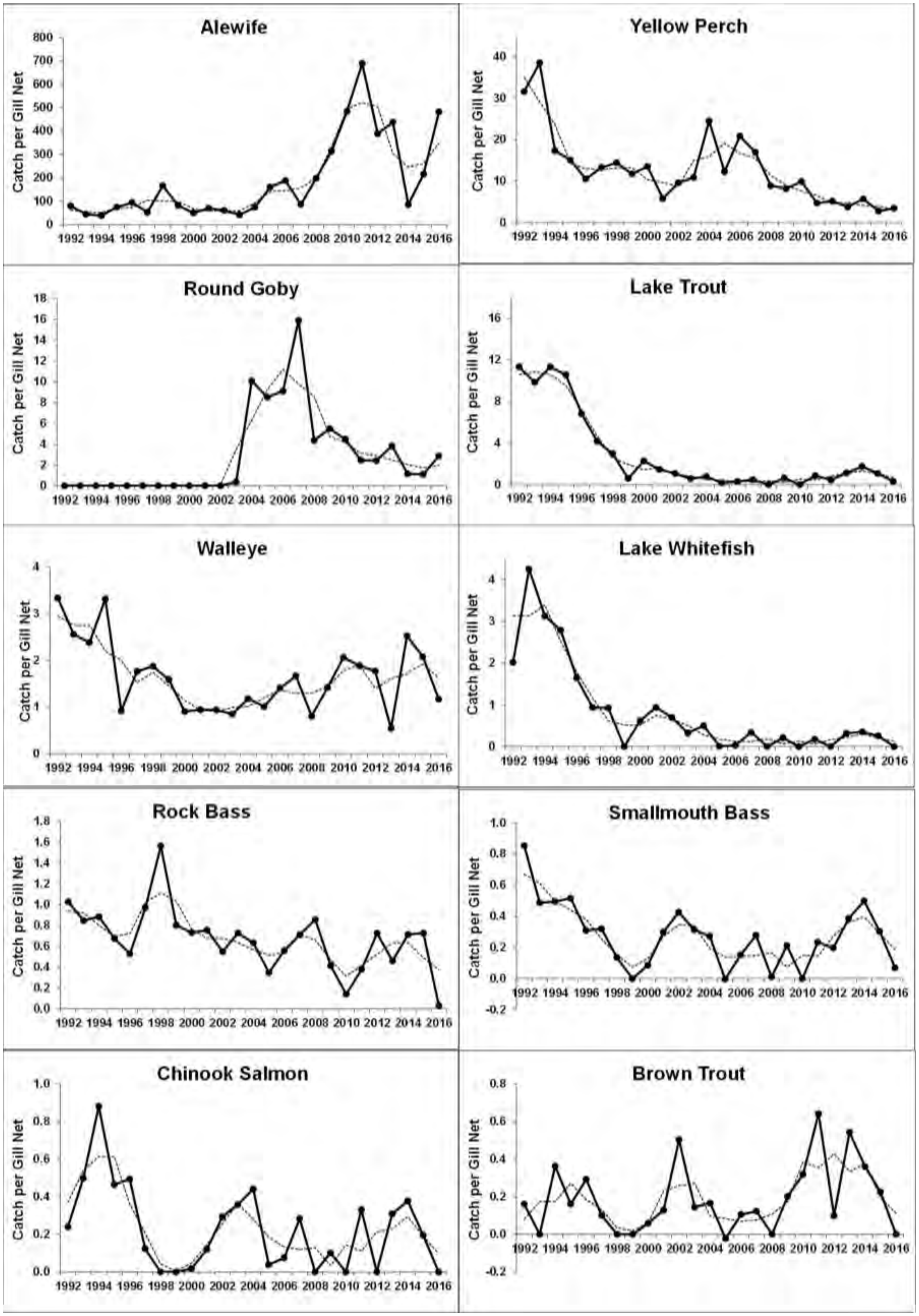


FIG. 1.2.2. Abundance trends for the most common species caught in gill nets at six depth-stratified transects (nearshore out to 30 m) in northeastern Lake Ontario (Melville Shoal, Grape Island, Flatt Point, Rocky Point, Wellington and Brighton; see Fig. 1.2.1). Annual catch per gill net values were corrected (covariate) for the overall mean observed water temperature (14.3 °C). Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.2.9. Species-specific catch per gill net set at **Middle Ground in Northeastern Lake Ontario**, 1992-2016 (no sampling in 2012). Annual catches are averages for 2 gill net gangs set during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gill nets set each year are indicated.

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

TABLE 1.2.10. Species-specific catch per gillnet set at **EB02 in the Kingston Basin of Lake Ontario**, 1992-2016. Annual catches are averages for 3-8 gillnet gangs set during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.11. Species-specific catch per gillnet set at **EB06 in the Kingston Basin of Lake Ontario**, 1992-2016. Annual catches are averages for 3-8 gillnet gangs set during each of 2-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

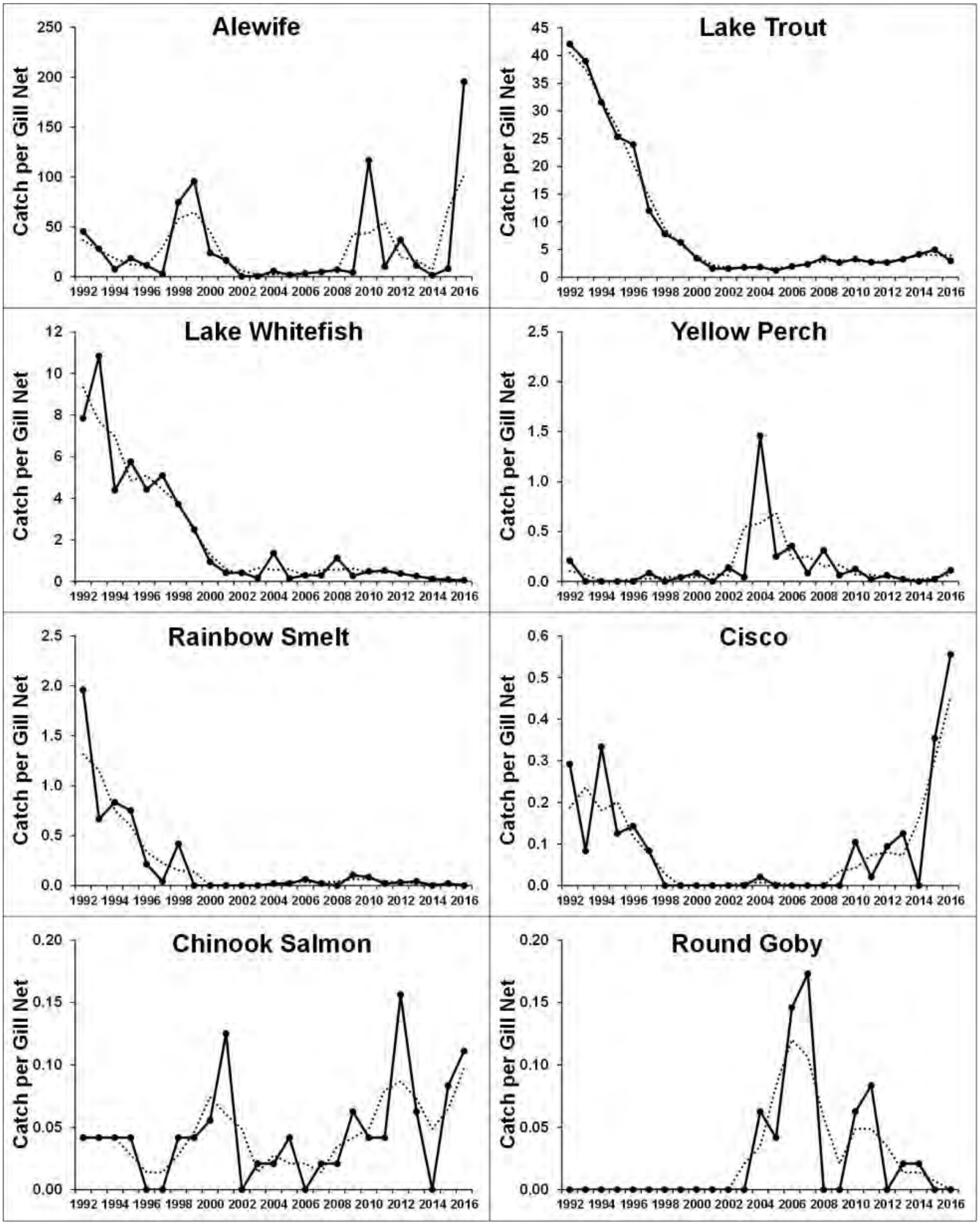


FIG. 1.2.3. Abundance trends (annual means) for the most common species caught in gill nets at the Kingston Basin deep sites, in eastern Lake Ontario (EB02 and EB06; see Fig. 1.2.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

declined throughout the 1990s and remained low during the years that followed except that Lake Trout appears to be increasing gradually in recent years and Cisco abundance increased during 2010 -2016. Chinook Salmon catches were relatively high in 2016. No Round Goby were caught in the past two years.

Kingston Basin (additional gill netting in 2016; Table 1.2.12)

Three additional Kingston Basin deep gill net sampling sites were netted in 2016; EB01, EB03, EB04 and EB05). The sampling included a seasonal component (Jun-Sep). Together, along with EB02 and EB06), this netting provided a more complete description of the Kingston Basin deep-water fish community (Table 1.2.12). Overall, the dominant species were Alewife, Lake Trout, Cisco, and Lake Whitefish; of note, Alewife catches were highest in July.

Lakewide Depth Stratified Transects (Rocky Point, Cobourg, Port Credit; Tables 1.2.13-1.2.15)

In 2016, for the third consecutive year, three lakewide depth-stratified gill net transects, spanning a wide depth range (7.5-140 m), were sampled. Smallmouth Bass, Rock Bass, Yellow Perch, and White Perch were caught only in the east at Rocky Point. Coho Salmon, Rainbow Trout and Gizzard Shad were caught only in central Lake Ontario at Cobourg. Longnose Sucker was caught only in the west at Port Credit.

Rocky Point—Deep Sites (Table 1.2.16)

Ten species have been captured at the Rocky Point deep sampling sites since 1997. Alewife and Lake Trout were the two most abundant species. Lake Trout abundance was relatively stable from 1997-2002, declined significantly through 2004 and recovered in the years following. Round Goby appeared for the first time in 2012 (at the 60 m site) and were captured again in 2015 and 2016. Unlike Cobourg and Port Credit deep gill net sites (see below), Deepwater Sculpin had never been caught in the Rocky Point gill net sites until 2015 but none was captured in 2016.

Cobourg (Tables 1.2.17 and 1.2.18)

Nearshore sites (7.5-27.5 m): Alewife dominated the catch at the Cobourg nearshore sites but the salmonid fish community was also well represented (Table 1.2.17). Twelve species were caught in 2016. Alewife catch declined significantly from 2010-2014 but increased in 2015 and again in 2016.

Deep sites (40-140 m): The deep sites at Cobourg were sampled again in 2016 and with the additional depths (40 and 50 m) four species were caught: Alewife, Lake Trout, Cisco and Deepwater Sculpin. Alewife abundance was low in 2016 (Table 1.2.18).

Port Credit (Tables 1.2.19 and 1.2.20)

Port Credit was sampled for the first time in 2014 and sampling occurred again in 2015 and in 2016 with two additional deep sampling depths added (40 and 50 m).

Nearshore sites (7.5-27.5 m): Six species were caught in 2016. Alewife dominated the catch. Other species caught included Round Goby, Lake Trout, White Sucker, Chinook Salmon and Longnose Sucker (Table 1.2.19).

Deep Sites (40-140 m): Five species were caught at the Port Credit deep sites: Alewife, Lake Trout, Deepwater Sculpin, Chinook Salmon and Burbot (Table 1.2.20).

Bay of Quinte (Conway, Hay Bay and Big Bay; Tables 1.2.21-1.2.23 inclusive)

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. 1.2.4 to illustrate abundance trends of the most abundant species from 1992-2016. Yellow Perch abundance peaked in 1998, declined gradually through 2013, and increased

TABLE 1.2.12. . Species-specific catch per gillnet set at **six sites (EB01, EB02, EB03, EB04, EB05, EB06) in the Kingston Basin of Lake Ontario**, 2016. Catches are averages for 3 gillnet gangs set during each of 3 visits during summer. The total number of species caught and gillnets set each year are indicated.

	EB01			EB02			EB03			EB04			EB05			EB06		
Species	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep
Lake Sturgeon	-	-	-	-	-	-	-	0.33	-	-	-	-	-	-	-	-	-	-
Alewife	46.67	425.33	3.33	1.33	1,060.97	8.33	29.67	311.67	4.33	37.67	158.39	1.00	449.37	5.67	0.67	10.00	81.67	9.67
Chinook Salmon	-	-	-	-	-	0.33	-	-	-	-	-	-	-	-	-	-	0.33	-
Brown Trout	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	-	-	-
Lake Trout	5.17	1.33	6.33	3.00	1.00	1.33	6.00	4.00	5.33	4.67	1.00	1.33	1.33	1.00	0.67	9.33	0.33	2.67
Lake Whitefish	-	1.00	1.67	-	-	-	-	-	-	0.67	0.67	0.33	-	-	-	-	-	0.33
Cisco	-	-	1.33	-	-	3.00	-	-	0.33	-	1.33	2.00	-	-	2.00	-	-	0.33
Rock Bass	-	-	-	-	-	-	-	-	-	-	-	-	0.33	-	-	-	-	-
Yellow Perch	0.33	-	-	-	0.67	-	-	-	-	-	-	-	0.33	0.33	-	-	-	-
Walleye	-	-	0.67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Round Goby	-	-	-	-	-	-	-	-	-	-	-	-	4.33	-	0.33	-	-	-
Total catch	52	428	13	4	1063	13	36	316	10	43	161	5	456	7	4	19	82	13
Number of species	3	3	5	2	3	4	2	3	3	3	4	4	5	3	5	2	3	4
Number of sets	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

TABLE 1.2.13. Species-specific catch per gillnet set at **Rocky Point in northeastern Lake Ontario** by site depth, 2016. Catches are averages for 2 or 3 gill net gangs during each of 1 or 2 visits during summer. The total number of species caught and number of gill nets set are indicated.

	Northeast (Rocky Point)										
Site depth (m)	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140
Alewife	168.70	128.22	120.78	386.61	325.27	26.67	5.67	24.67	49.00	144.33	3.00
Chinook Salmon	0.00	0.00	1.65	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
Brown Trout	0.00	0.00	0.00	0.50	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Lake Trout	0.00	0.00	0.00	0.00	2.00	2.33	13.67	13.33	9.00	3.67	2.00
Lake Whitefish	0.00	0.00	0.00	0.00	0.00	2.00	0.33	0.00	0.00	0.00	0.00
Cisco	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Burbot	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Perch	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
Rock Bass	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smallmouth Bass	3.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellow Perch	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Walleye	0.75	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Round Goby	0.83	0.83	0.00	18.17	15.54	1.33	0.00	0.00	0.00	0.00	0.00
Total catch	173	132	122	406	344	33	20	38	58	148	5
Number of species	4	6	2	5	5	5	3	2	2	2	2
Number of sets	4	4	4	4	4	3	3	3	3	3	3

TABLE 1.2.14. Species-specific catch per gillnet set at **Cobourg in north central Lake Ontario** by site depth, 2016. Catches are averages for 2 or 3 gill net gangs during each of 1 or 2 visits during summer. The total number of species caught and number of gill nets set are indicated.

	North Central (Cobourg)										
Site depth (m)	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140
Alewife	159.43	350.93	374.16	182.76	289.98	77.67	15.00	39.33	1.33	3.00	1.67
Gizzard shad	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coho salmon	0.00	0.00	0.25	0.75	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Chinook salmon	0.25	0.50	1.00	4.50	2.25	0.00	0.00	0.00	0.00	0.00	0.00
Rainbow trout	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brown trout	1.75	0.75	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake trout	0.00	0.00	0.00	0.00	0.50	9.33	4.33	3.33	0.67	1.00	0.00
Lake whitefish	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Cisco	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	1.00	0.00
White sucker	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Walleye	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Round goby	2.48	5.21	1.65	0.83	0.83	0.00	0.00	0.00	0.00	0.00	0.00
Deepwater sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	5.00
Total catch	164	358	377	190	294	87	19	43	2	5	7
Number of species	6	7	5	6	6	2	2	2	2	4	2
Number of sets	4	4	4	4	4	3	3	3	3	3	3

TABLE 1.2.15. Species-specific catch per gillnet set at **Port Credit in northwestern Lake Ontario** by site depth, 2016. Catches are averages for 2 or 3 gill net gangs during each of 1 or 2 visits during summer. The total number of species caught and number of gill nets set are indicated.

	Northwest (Port Credit)										
Site depth (m)	7.5	12.5	17.5	22.5	27.5	40	50	60	80	100	140
Alewife	375.09	177.33	292.13	117.80	209.87	1.67	3.00	4.67	9.67	1.67	5.33
Chinook salmon	0.00	0.00	0.50	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
Lake trout	0.00	0.00	0.50	0.50	0.00	5.67	3.33	2.33	2.00	3.00	1.33
Longnose sucker	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White sucker	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Burbot	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00
Round goby	4.96	1.65	5.46	4.96	11.57	0.00	0.00	0.00	0.00	0.00	0.00
Deepwater sculpin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	12.00
Total catch	380	180	299	123	221	8	6	7	12	5	19
Number of species	2	4	4	3	2	4	2	2	2	3	3
Number of sets	4	4	4	4	4	3	3	3	3	3	3

TABLE 1.2.16. Species-specific catch per gillnet set at **Rocky Point (deep sites only) in northeastern Lake Ontario**, 1997-2016 (no sampling in 2006, 2007 or 2010). Annual catches are averages for 2 or 3 gillnet gangs set at each of up to 6 depths (40, 50, 60, 80, 100 or 140 m) during each of 2 visits during early-summer. Mean catches for 1997-2000 and 2001-2010 time-periods are shown in bold. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.17. Species-specific catch per gill net set at **Cobourg (nearshore sites only) in northeastern Lake Ontario**, 2010-2016. Annual catches are averages for 2 gill net gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during each of 1-3 visits during summer. The total number of species caught and gill nets set each year are indicated.

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

TABLE 1.2.18. Species-specific catch per gill net set at **Cobourg (deep sites only) in northeastern Lake Ontario**, 1997, 1998, and 2014-2016. Annual catches are averages for 2 or 3 gill net gangs set at each of 4-6 depths (40, 50, 60, 80, 100 and 140 m) during each of 1-2 visits during summer. The total number of species caught and gill nets set each year are indicated.

	1997	1998	2014	2015	2016
Alewife	67.16	42.75	29.75	171.50	23.00
Brown Trout	-	-	0.08	-	-
Lake Trout	0.50	0.88	0.17	0.42	3.11
Cisco (Lake Herring)	-	0.13	-	-	0.17
Rainbow Smelt	2.88	0.50	-	-	-
Slimy Sculpin	0.06	-	-	-	-
Deepwater Sculpin	-	-	3.67	0.25	0.89
Total catch	71	44	30	172	26
Number of species	4	4	4	3	4
Number of sets	16	16	12	12	18

TABLE 1.2.19. Species-specific catch per gill net set at Port **Credit (nearshore sites only) in northwestern Lake Ontario**, 2014-2016. Annual catches are averages for 2 gillnet gangs set at each of 5 depths (7.5, 12.5, 17.5, 22.5 and 27.5 m) during summer. The total number of species caught and gillnets set each year are indicated.

	2014	2015	2016
Alewife	24.12	358.58	234.44
Chinook Salmon	0.10	0.20	0.10
Atlantic Salmon	-	0.10	-
Brown Trout	-	0.10	-
Lake Trout	1.20	0.80	0.20
Longnose Sucker	-	0.20	0.10
White Sucker	0.20	1.50	0.20
Round Goby	-	1.32	5.72
Total catch	26	361	235
Number of species	4	8	6
Number of sets	10	10	10

TABLE 1.2.20. Species-specific catch per gill net set at **Port Credit (deep sites only) in northwestern Lake Ontario**, 2014-2016. Annual catches are averages for 3 gillnet gangs set at each of 4-6 depths (40, 50, 60, 80, 100, and 140 m) during summer. The total number of species caught and gillnets set each year are indicated.

	2014	2015	2016
Alewife	79.92	7.33	4.33
Chinook Salmon	-	-	0.06
Lake Trout	1.17	1.42	2.94
Burbot	-	-	0.06
Deepwater Sculpin	2.00	1.42	2.06
Total catch	83	10	9
Number of species	3	3	5
Number of sets	12	12	18

TABLE 1.2.21. Species-specific catch per gillnet set at **Conway in the Bay of Quinte**, 1993-2016. Annual catches are averages for 2-3 gillnet gangs set at each of 5 depths (7.5, 12.5, 20, 30 and 45 m) during each of 2-3 visits during summer. Mean catches for 1993-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.22. Species-specific catch per gillnet set at **Hay Bay in the Bay of Quinte**, 1992-2016. Annual catches are averages for 1-3 gillnet gangs set at each of 2 depths (7.5 and 12.5 m) during each of 1-3 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

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

TABLE 1.2.23. Species-specific catch per gillnet set at **Big Bay in the Bay of Quinte**, 1992-2016. Annual catches are averages for 2 gillnet gangs set during each of 2-4 visits during summer. Mean catches for 1992-2000 and 2001-2010 time-periods are shown in **bold**. The total number of species caught and gillnets set each year are indicated.

	1992-2000 mean	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Lake Sturgeon	**0.02**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Longnose Gar	**1.39**	1.00	1.00	0.17	1.00	1.50	3.00	0.33	2.50	3.77	6.50	**2.08**	2.33	3.83	12.83	0.17	1.67	3.63
Alewife	**0.70**	-	0.88	1.67	3.17	-	0.75	-	1.00	2.67	1.00	**1.11**	0.50	0.50	0.17	2.17	2.17	2.38
Gizzard Shad	**7.23**	2.13	6.63	2.00	0.17	42.17	0.25	1.00	3.67	-	3.33	**6.13**	88.50	10.83	-	-	1.50	3.75
Lake Whitefish	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-	-
Northern Pike	**0.68**	0.13	0.13	-	0.17	0.17	0.50	0.17	-	-	-	**0.13**	-	-	-	-	-	0.25
Mooneye	**0.04**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White Sucker	**7.30**	3.50	9.25	2.33	5.33	2.50	5.00	2.50	4.33	3.33	3.67	**4.18**	4.00	7.00	5.50	3.50	7.00	4.13
Silver Redhorse	-	-	-	-	-	-	-	-	-	-	0.17	**0.02**	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.13
Moxostoma sp.	**0.04**	0.13	-	0.17	-	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-
Common Carp	**0.30**	-	-	0.17	0.17	-	-	-	-	-	-	**0.03**	-	-	-	-	-	-
Brown Bullhead	**6.72**	6.75	5.50	1.83	2.33	0.83	2.00	0.83	0.67	0.67	-	**2.14**	0.17	0.50	1.17	0.33	0.67	0.50
Channel Catfish	**0.37**	-	0.13	-	0.17	-	0.25	-	-	0.17	-	**0.07**	-	-	0.17	0.17	-	0.50
Burbot	**0.04**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White Perch	**90.12**	22.00	36.38	59.83	130.50	79.50	196.75	119.00	127.50	123.17	92.00	**98.66**	91.83	138.00	144.17	17.17	35.67	76.75
White Bass	**0.08**	-	0.13	-	-	-	-	0.17	0.17	-	-	**0.05**	-	0.17	-	0.33	0.50	1.38
Rock Bass	**0.26**	-	-	-	-	0.17	-	-	-	-	-	**0.02**	-	-	0.17	-	0.83	-
Pumpkinseed	**3.97**	17.00	8.25	0.83	4.33	0.33	3.25	0.50	1.00	0.67	0.17	**3.63**	0.83	1.00	2.50	0.67	0.50	1.63
Bluegill	**0.57**	7.13	3.75	0.50	0.33	2.50	6.50	5.33	3.17	5.55	6.67	**4.14**	6.83	1.17	11.33	4.33	11.83	0.63
Smallmouth Bass	**1.11**	0.50	-	-	-	-	0.50	-	-	0.17	-	**0.12**	-	-	-	-	-	-
Largemouth Bass	**0.02**	-	-	-	-	-	0.25	-	-	-	0.17	**0.04**	-	-	-	-	-	-
Black Crappie	**0.11**	0.25	0.38	0.33	0.17	0.17	2.25	1.00	0.33	-	-	**0.49**	-	-	-	-	-	-
Yellow Perch	**138.65**	190.63	182.88	115.33	109.67	103.00	119.00	16.50	63.00	129.54	43.17	**107.27**	47.17	17.67	26.67	71.67	59.00	39.63
Walleye	**16.88**	4.50	7.63	6.50	8.00	5.83	10.75	5.33	9.17	8.00	10.83	**7.65**	6.33	5.17	17.17	6.33	5.33	7.25
Round Goby	-	-	-	0.33	0.33	0.50	-	-	-	-	-	**0.12**	-	-	-	-	-	-
Freshwater Drum	**15.50**	21.25	7.38	7.33	7.33	9.50	19.75	11.33	6.50	8.67	4.83	**10.39**	5.50	3.33	5.33	4.83	10.33	28.38
Total catch	**292**	277	270	199	273	249	371	164	223	286	173	**248**	254	189	227	112	137	171
Number of species	**15**	14	15	16	17	14	16	13	13	12	12	**14**	11	12	12	12	13	14
Number of sets		8	8	6	6	6	4	6	6	6	6		6	6	6	6	6	8

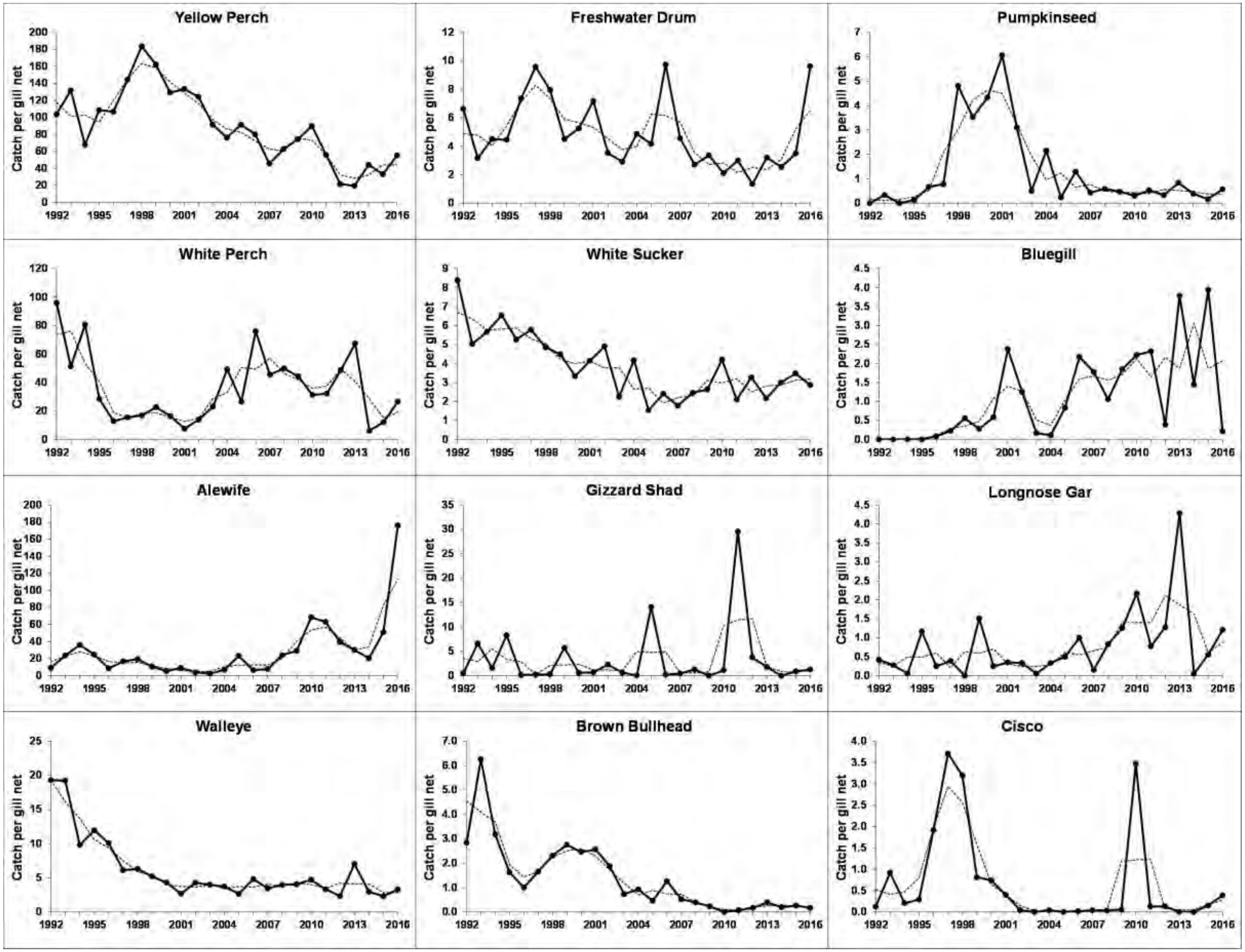


FIG. 1.2.4. Abundance trends (annual means) for the most common species caught in gill nets at three areas in the Bay of Quinte (Conway, Hay Bay and Big Bay; see Fig. 1.2.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

over the last three years. In 2014, White Perch abundance declined to its lowest level since 2001, and in 2015 and 2016 it recovered slightly. Alewife abundance increased from 2007-2010, declined from 2010-2014, and increased significantly through 2016. Walleye abundance declined from 1992-2000 but has remained very stable since. Freshwater Drum and Gizzard Shad catches show no remarkable trends. White Sucker abundance declined since 1992, gradually levelling off in recent years. Brown Bullhead abundance has declined precipitously to low levels. Bluegill and Pumpkinseed abundance increased in the late-1990s then declined through 2004. Thereafter, Bluegill catches increased but Pumpkinseed catches did not. Cisco catches increased in the late-1990s then declined; most recently Cisco catch increased in 2015 and again in 2016.

Bay of Quinte (additional gill netting in 2016; Table 1.2.24)

Three additional upper Bay of Quinte gill net sampling sites were netted in 2016. The sampling included a seasonal component (June and August sampling). Together, along with Big Bay, this netting provided a more complete description of the upper Bay of Quinte fish community (Table 1.2.24). Overall, the dominant species were Yellow Perch, Alewife, White Perch, Gizzard Shad, Freshwater Drum, Walleye and Longnose Gar. The following seasonal highlights were noted. Yellow Perch, Alewife and Walleye catches higher in June than in August. White Perch and Gizzard Shad catches were higher in August than in June.

TABLE 1.2.24. Species-specific catch per gill net set at **upper Bay of Quinte** gill net site locations (**Trenton, Belleville, Big Bay and Deseronto**) in June and August, 2016. The total catch and the number of species caught and gill nets set are indicated.

	Trenton		Belleville		Big Bay		Deseronto		
Species	Jun	Aug	Jun	Aug	Jun	Aug	Jun	Aug	Total
Longnose Gar	18.50	7.00	1.00	25.50	1.50	4.50	-	-	6.94
Alewife	111.00	-	21.50	-	9.00	-	374.38	-	57.32
Gizzard Shad	0.50	181.00	3.00	93.50	1.50	6.50	0.50	2.00	32.78
Northern Pike	-	-	-	-	1.00	-	-	-	0.11
White Sucker	-	1.00	4.00	0.50	1.50	4.75	20.00	-	4.06
Shorthead Redhorse	-	0.50	1.00	-	0.50	-	-	-	0.22
Greater Redhorse	0.50	-	-	-	-	-	-	-	0.06
Common Carp	-	-	-	-	-	-	0.50	-	0.06
Brown Bullhead	-	-	-	1.00	2.00	-	0.50	2.00	0.61
Channel Catfish	0.50	-	-	0.50	0.50	0.75	-	-	0.33
White Perch	19.50	29.50	8.50	33.00	65.00	88.25	10.00	36.50	42.06
White Bass	-	-	-	0.50	1.00	2.25	-	-	0.67
Rock Bass	0.50	-	0.50	-	-	-	0.50	-	0.17
Pumpkinseed	14.50	0.50	0.50	1.50	0.50	2.50	-	2.50	2.78
Bluegill	15.00	-	-	-	1.00	0.50	-	-	1.89
Yellow Perch	59.50	12.50	49.00	13.00	112.50	10.75	231.84	123.00	69.20
Walleye	8.50	9.00	11.00	3.50	16.00	6.00	24.00	3.50	9.72
Freshwater Drum	12.50	11.00	27.00	14.50	87.00	12.50	6.50	4.00	20.83
Total catch	261	252	127	187	301	139	669	174	250
Number of species	12	9	11	11	15	11	10	7	18
Number of sets	2	2	2	2	2	4	2	2	18

Species Highlights

Lake Whitefish

Fourty-five Lake Whitefish were caught and were interpreted for age in the 2016 index gill nets (Table 1.2.25). Fish ranged in age from 1-26 years but most fish (89%) were 10 years old or less. Eight (18%) whitefish were from the 2013 year-class and seven (16%) were from the 2012 year-class.

Walleye

Four hundred and six Walleye were caught and interpreted for age in the 2016 index gill nets (Table 1.2.26). One hundred and eighty-seven (87%) of 214 Walleye caught in the Bay of Quinte gill nets were age 1-4 years. In the Kingston Basin nearshore gill nets, 90% (145) of the 161 Walleye were age-5 or greater. Age-2 walleye from the 2014 year-class were prominent in the age distribution.

TABLE 1.2.25. Age distribution of **45 Lake Whitefish** sampled from summer index gill nets, by region, during 2016. Also shown are mean fork length and mean weight.

	Age / Year-class															
	1	2	3	4	5	6	7	8	9	10	12	13	22	24	26	
Region	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2004	2003	1994	1992	1990	Total
Central														1		1
Northeast		1		4	1		1			1						8
Kingston Basin (deep)	2	1		1		3	3	1		1					1	13
Kingston Basin (nearshore)			1	1		1	2	1	1	1	1	1	1			11
Bay of Quinte		2	7	1		1		1								12
Total aged	2	4	8	7	1	5	6	3	1	3	1	1	1	1	1	45
Mean fork length (mm)	181	218	259	366	380	390	433	415	416	492	516	451	460	602	585	
Mean weight (g)	55	122	193	585	613	731	970	782	867	1589	1881	1012	1232	3192	2588	

TABLE 1.2.26. Age distribution of **406 Walleye** sampled from summer index gill nets, by region, 2016. Also shown are mean fork length, mean weight, mean GSI (females), and percent mature (females). GSI = gonadal somatic index calculated for females only as log10(gonad weight + 1)/log10(weight). Note that a GSI greater than approximately 0.25 indicates a mature female.

	Age / Year-class																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	22	24	
Region	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1996	1994	1992	Total
Central							1										1					2
Northeast	3	3			2			2		2	1		1									14
Middle Ground	7	5	1	1		1																15
Kingston Basin		13	1	2	12	8	3	22	21	10	14	9	20	1	7	1	8	3	2	1	3	161
Bay of Quinte	48	105	21	13	13	6	3	4			1											214
Total aged	58	126	23	16	27	15	7	28	21	12	16	9	21	1	7	1	9	3	2	1	3	406
Mean fork length (mm)	211	307	437	471	507	554	583	600	617	631	647	615	632	590	640	639	631	619	634	580	630	
Mean weight (g)	100	315	976	1262	1777	2197	2562	3017	3258	3592	3697	3232	3562	3047	3835	3455	3582	3426	3148	2991	3423	
Mean GSI (females)	0.05	0.13	0.25	0.30	0.32	0.35	0.42	0.39	0.38	0.44	0.42	0.34	0.38	0.26	0.39		0.38	0.30			0.26	
% mature	0	5	50	71	82	80	100	89	74	88	93	80	92	100	80		100	100		100		

1.3 Lake Ontario and Bay of Quinte Fish Community Index Trawling

J. A. Hoyle, 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 1.3.1).

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. 1.3.1). In 2014, a second trawl site/ depth was added at Rocky Point (60 m) and two trawl sites at each of Cobourg and Port Credit (60 and 100 m depths at both locations). In 2015, the Lake Ontario trawling was expanded significantly to include several more sampling depths at each of Rocky Point, Cobourg, and Port Credit. In 2016 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 or Port Credit. [Note that these sites were sampled in spring and fall prey fish assessments (see Section 1.11 and 1.12)]. In the Bay of Quinte, six fixed-sites, ranging in depth from about 4 to 21 m, are visited annually on two or three occasions during mid to late-summer. Four replicate ¼ mile trawls are made during each visit to each site. The 2016 bottom trawl sampling design is shown in Table 1.3.2.

Thirty species and over 72,000 fish were caught in 78 bottom trawls in 2016 (20-Jun to 7-Sep, Table 1.3.3). Alewife (27%), Gizzard Shad (18%), Round Goby (18%) and Yellow Perch (15%), collectively made up 86% of the catch by number. Species-specific catches in the 2016

TABLE 1.3.1. 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

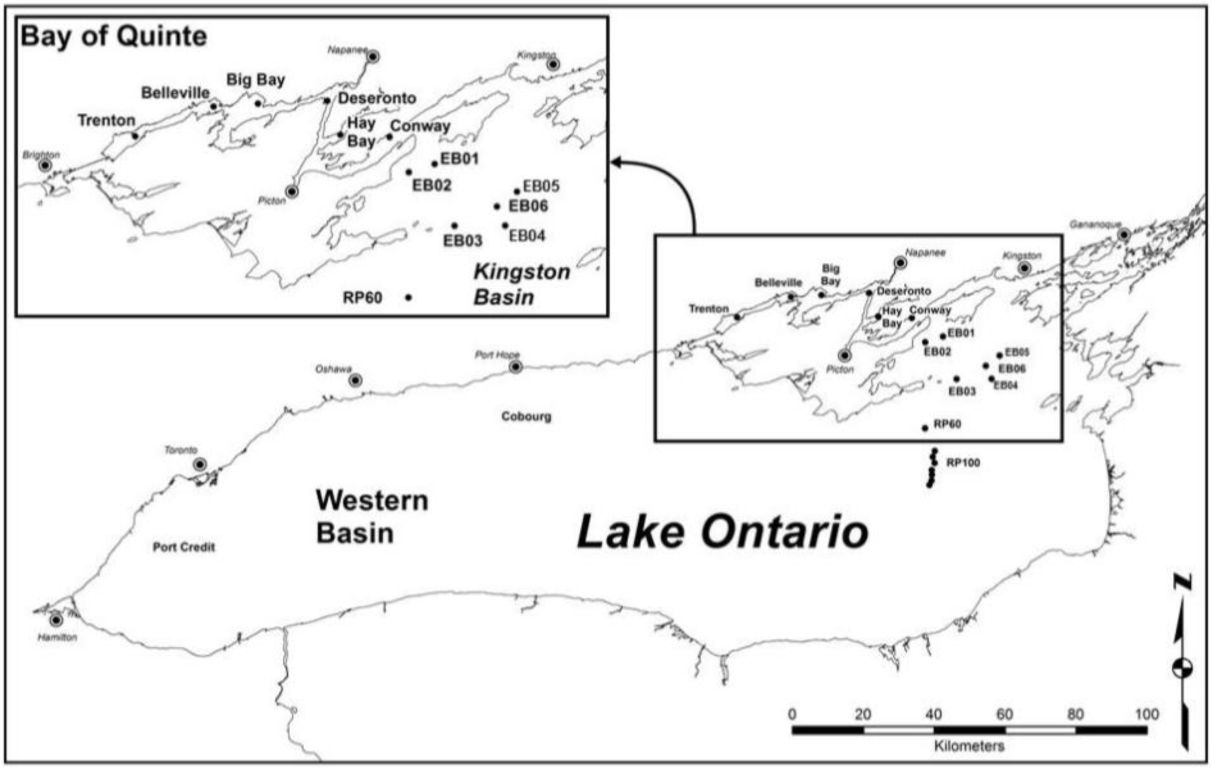


FIG. 1.3.1. Map of north eastern Lake Ontario. Shown are eastern Lake Ontario and Bay of Quinte fish community index bottom trawling site locations.

TABLE 1.3.2. 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 2016 a fourth visit was made to EB03 (Sep) and 4 replicate trawls were conducted.

Area name	Site name	Depth (m)	Visits*	Replicates x distance	Site location (approx) Latitude (dec deg)	Longitude (dec deg)	Visits x reps	Time-frame	Start-up year	Number years
Kingston Basin	EB01	30	3	1 x 1/2 mile	44.06267	-76.79483	3	Jun 20-Sep 9	1972	
Kingston Basin	EB02	30	3	1 x 1/2 mile	44.04733	-76.85667	3	Jun 20-Sep 9	1972	45
Kingston Basin	EB03	21	3	1 x 1/2 mile	43.95533	-76.74350	3	Jun 20-Sep 9	1972	45
Kingston Basin	EB04	35	3	1 x 1/2 mile	43.95733	-76.62083	3	Jun 20-Sep 9	1972	
Kingston Basin	EB05	33	3	1 x 1/2 mile	44.01733	-76.59383	3	Jun 20-Sep 9	1972	
Kingston Basin	EB06	35	3	1 x 1/2 mile	43.99050	-76.64167	3	Jul 1-Aug 30	1972	45
Rocky Point	0060	60	1	1 x 1/2 mile	43.82817	-76.85083	1	July	2014	3
Rocky Point	0080	80	1	1 x 1/2 mile	43.77117	-76.81450	1	July	2015	2
Rocky Point	0090	90	1	1 x 1/2 mile	43.75567	-76.82150	1	July	2015	2
Rocky Point	0100	100	1	1 x 1/2 mile	43.74033	-76.81467	1	July	1997	20
Rocky Point	0110	110	1	1 x 1/2 mile	43.72250	-76.82367	1	July	2015	2
Rocky Point	0120	120	1	1 x 1/2 mile	43.71017	-76.82283	1	July	2015	2
Rocky Point	0130	130	1	1 x 1/2 mile	43.69550	-76.82367	1	July	2015	2
Rocky Point	0140	140	1	1 x 1/2 mile	43.68417	-76.83050	1	July	2015	2
Bay of Quinte	BQ11	4	2	4 x 1/4 mile	44.09750	-77.52117	8	Aug 1-Sep 15	1972	45
Bay of Quinte	BQ12	5	2	4 x 1/4 mile	44.15350	-77.33350	8	Aug 1-Sep 15	1972	45
Bay of Quinte	BQ13	5	2	4 x 1/4 mile	44.16067	-77.22633	8	Aug 1-Sep 15	1972	45
Bay of Quinte	BQ14	5	2	4 x 1/4 mile	44.16833	-77.05700	8	Aug 1-Sep 15	1972	45
Bay of Quinte	BQ15	5	2	4 x 1/4 mile	44.10983	-77.02367	8	Aug 1-Sep 15	1972	45
Bay of Quinte	BQ17	21	2	4 x 1/4 mile	44.10783	-76.90550	8	Aug 1-Sep 15	1972	45

TABLE 1.3.3. Species-specific total bottom trawl catch in 2016 from 20-Jun to 7-Sep. Frequency of occurrence (FO) is the number of trawls, out of a possible 78, in which each species (30 species and 72,138 individual fish) was caught.

Species	FO	Catch	Biomass (kg)	Mean weight (g)
Longnose Gar	3	3	3.58	1193
Alewife	55	19,786	66.51	3
Gizzard Shad	34	12,934	73.31	6
Lake Trout	4	6	0.17	28
Cisco	10	34	2.61	77
Rainbow Smelt	22	981	0.81	1
White Sucker	13	30	9.42	314
Common Carp	5	11	61.49	5590
Golden Shiner	5	48	1.16	24
Spottail Shiner	37	2,525	10.14	4
Brown Bullhead	30	100	27.97	280
Channel Catfish	2	2	1.14	570
American Eel	2	3	1.40	467
Trout-perch	33	650	1.34	2
White Perch	41	5,527	80.33	15
White Bass	33	297	4.27	14
Pumpkinseed	36	753	27.14	36
Bluegill	10	89	4.42	50
Largemouth Bass	18	149	1.09	7
Black Crappie	9	18	0.74	41
Lepomis sp.	26	564	0.25	0
Yellow Perch	48	10,923	76.32	7
Walleye	41	304	56.42	186
Johnny Darter	1	1	-	0
Logperch	7	11	0.02	2
Brook Silverside	10	54	0.05	1
Round Goby	43	13,202	44.32	3
Freshwater Drum	37	2,070	136.03	66
Slimy Sculpin	6	27	0.31	11
Deepwater Sculpin	8	1,036	10.48	10
Totals		72,138	703	10

trawling program are shown in Tables 1.3.4-1.3.14.

Lake Ontario

Kingston Basin (Tables 1.3.4 and 1.3.5)

Bottom trawls were conducted at six sites from June to September 2016. Seven species were caught with the most abundant species being Round Goby, Alewife and Rainbow Smelt. Round Goby abundance increased through the summer; catches were lowest in June and highest in September. Alewife catches were highest in June and July and very low in August and September. Trend through time catches for most common species are shown in Fig. 1.3.2.

TABLE 1.3.4. Species-specific catch per trawl at six sites (**EB01, EB02, EB03, EB04, EB05, EB06**) in the Kingston Basin of Lake Ontario, 2016. Catches are averages for the number of trawls indicated. The total number of fish and species caught and trawls conducted are indicated.

Species	Month Jun	Jul	Aug	Sep	Total
Alewife	51.33	52.05	7.00	5.00	34.80
Lake Trout	0.17	0.00	1.33	0.25	0.32
Cisco	0.67	0.00	0.33	0.13	0.29
Rainbow Smelt	0.33	0.83	3.33	60.30	13.59
Walleye	0.00	0.00	0.67	0.00	0.11
Round Goby	0.17	6.67	725.44	2099.05	558.61
Freshwater Drum	0.00	0.00	0.00	0.06	0.01
Total catch	53	60	738	2165	608
Number of species	5	3	6	6	7
Number of trawls	6	6	3	7	22

EB02 (Table 1.3.6)

Four species: Round Goby, Alewife, Rainbow Smelt and Lake Trout were caught at EB02 in 2016. One of the three Lake Trout caught, a young-of-the-year fish, was of wild origin (fork length 54 mm; weight 1 g). Threespine Stickleback, having risen to high levels of abundance in the late 1990s, declined rapidly after 2003 and was absent in the EB02 catches for the last 10 years. Slimy Sculpin, another formerly abundant species has also been absent for 10 years.

EB03 (Table 1.3.7)

Six species: Round Goby, Rainbow Smelt, Alewife, Cisco, Walleye and Freshwater Drum were caught at EB03 in 2016. Round Goby, having first appeared in the EB03 catches in 2004, now dominate the total catch but did decline in 2016. Rainbow Smelt abundance was higher in the last two years. As was the case for EB02, Threespine Stickleback have been absent from the EB03 catches for 10 years. A number of Cisco were caught, ranging in fork length from 114-381 mm, and weight from 14-712 g.

TABLE 1.3.5. Species-specific catch per trawl at six sites (**EB01, EB02, EB03, EB04, EB05, EB06**) by month in the Kingston Basin of Lake Ontario, 2016. Catches are averages for 1 to 4 trawls during each of 3 or 4 visits during summer. The total number of fish and species caught and trawls conducted are indicated.

	EB01			EB02			EB03				EB04			EB05			EB06			
Species	Jun	Jul	Aug	Jun	Jul	Aug	Jun	Jul	Aug	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Jun	Jul	Sep	Total
Alewife	121.000	2.000	0.000	0.000	310.278	20.000	72.000	0.000	1.000	6.000	1.000	0.000	14.000	110.000	0.000	0.000	4.000	0.000	0.000	34.804
Lake Trout	1.000	0.000	1.000	0.000	0.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.316
Cisco	0.000	0.000	0.000	0.000	0.000	0.000	4.000	0.000	1.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.289
Rainbow Smelt	0.000	0.000	4.000	0.000	2.000	3.000	1.000	2.000	3.000	236.201	0.000	0.000	1.000	0.000	1.000	1.000	1.000	0.000	3.000	13.590
Walleye	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105
Round Goby	0.000	7.000	1206.541	0.000	32.000	457.078	1.000	0.000	512.699	146.496	0.000	1.000	1646.861	0.000	0.000	5243.714	0.000	0.000	1359.143	558.607
Freshwater Drum	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013
Total catch	122	9	1212	0	344	483	78	2	520	389	1	1	1662	110	1	5246	5	0	1362	608
Number of species	2	2	3	0	3	4	4	1	5	5	1	1	3	1	1	3	2	0	2	7
Number of trawls	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	22

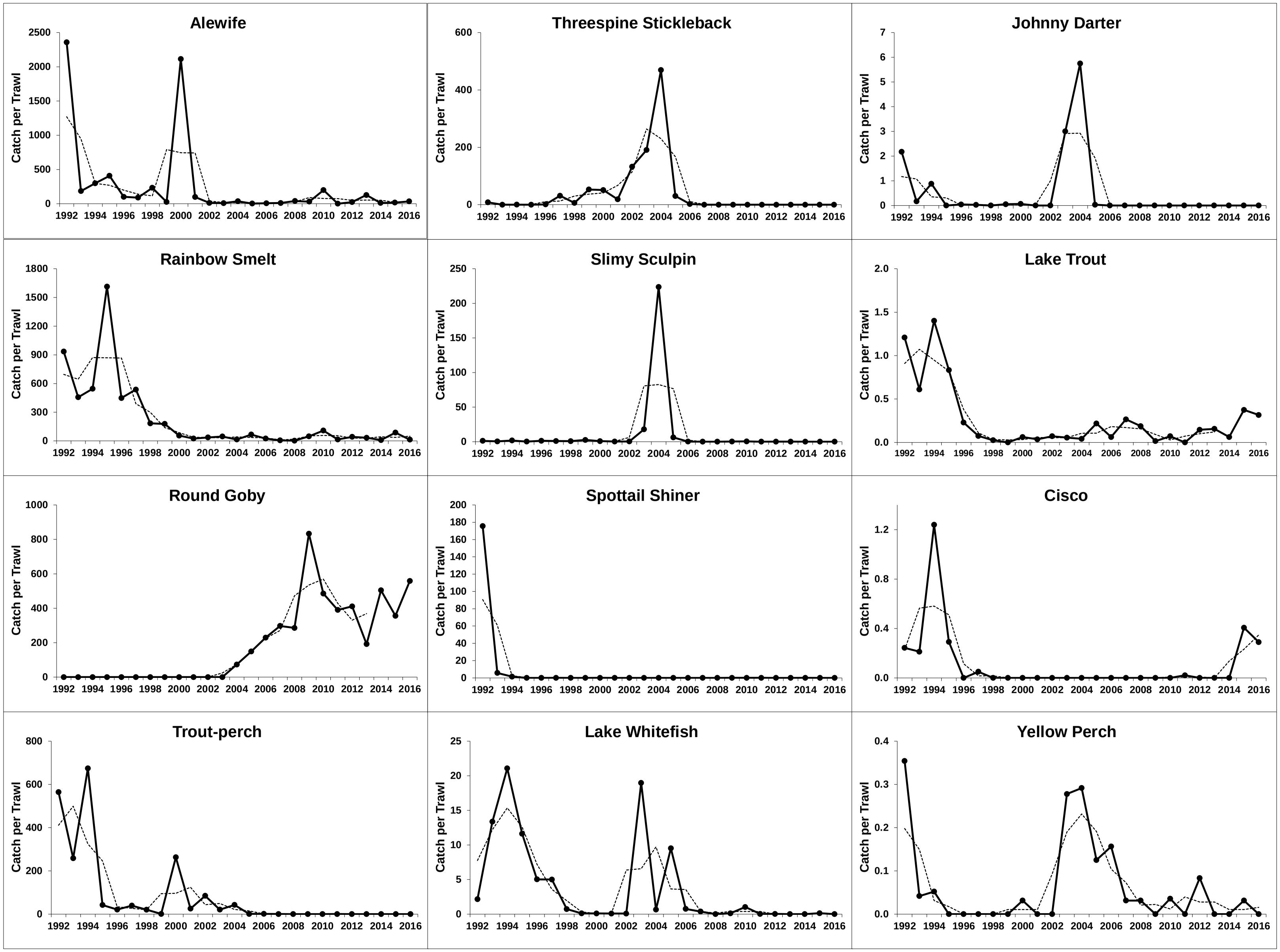


FIG. 1.3.2. Abundance trends (annual means) for the most common species caught in bottom trawls at three to six sites in the Kingston Basin, eastern Lake Ontario (EB01, EB02, EB03, EB04, EB05, EB06); see Fig. 1.3.1). Dotted lines show 3-yr running averages (two years for first and last years graphed).

TABLE 1.3.6. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB02**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																	
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Alewife	**1220.379**	203.397	20.917	19.500	27.100	0.000	0.417	11.000	0.667	72.429	464.097	**81.952**	1.667	24.291	288.143	2.670	44.420	110.090
Rainbow Trout	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Lake Trout	**0.202**	0.000	0.083	0.083	0.000	0.583	0.167	0.583	0.500	0.000	0.167	**0.217**	0.000	0.333	0.333	0.170	0.750	1.000
Lake Whitefish	**3.203**	0.167	0.000	0.583	0.400	0.250	0.000	0.167	0.000	0.250	0.000	**0.182**	0.000	0.083	0.000	0.000	0.000	0.000
Cisco (Lake Herring)	**0.362**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.080	0.000
Coregonus sp.	**0.006**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**440.950**	29.667	7.917	0.917	5.000	19.750	28.750	3.583	5.667	114.416	14.667	**23.033**	1.083	10.333	3.917	8.830	2.920	1.670
Emerald Shiner	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Burbot	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Threespine Stickleback	**13.395**	18.750	34.417	49.500	6.200	9.000	0.167	0.000	0.000	0.000	0.000	**11.803**	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**4.675**	0.250	0.000	0.167	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.042**	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.019**	0.000	0.000	0.000	0.700	0.333	0.083	0.000	0.000	0.000	0.083	**0.120**	0.000	0.167	0.000	0.000	0.000	0.000
Walleye	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000
Johnny Darter	**0.077**	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.000	**0.040**	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.083	250.100	24.833	40.083	119.750	26.667	169.907	143.933	**77.536**	8.083	77.144	28.500	31.080	76.310	163.030
Sculpin sp.	**0.046**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**2.084**	0.417	0.667	44.083	74.900	0.750	0.167	0.000	0.000	0.000	0.000	**12.098**	0.000	0.000	0.000	0.000	0.000	0.000
Deepwater Sculpin	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.670	0.000
Total catch	**1685**	253	64	115	365	56	70	135	34	357	623	**207**	11	112	321	43	125	276
Number of species	**9**	6	5	8	8	7	7	5	4	4	6	**6**	3	6	4	4	6	4
Number of trawls		12	12	12	10	12	12	12	12	12	12		12	12	12	12	12	3

TABLE 1.3.7. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB03**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Alewife	**704.463**	57.375	21.375	8.000	168.385	14.833	15.250	33.917	156.339	0.000	0.250	**47.572**	0.125	33.292	75.500	43.130	1.880	13.860
Gizzard Shad	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.000
Chinook Salmon	**0.014**	0.000	0.000	0.000	0.000	0.667	0.000	0.000	0.000	0.000	0.000	**0.067**	0.000	0.000	0.000	0.000	0.130	0.000
Lake Trout	**0.847**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.083	0.000	**0.033**	0.000	0.000	0.125	0.000	0.000	0.000
Lake Whitefish	**14.412**	0.000	0.000	43.938	2.333	50.000	3.000	1.417	0.000	0.083	4.667	**10.544**	0.125	0.000	0.000	0.000	0.380	0.000
Cisco	**0.292**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.125	0.000	0.000	0.000	1.500	1.000
Rainbow Smelt	**517.419**	20.000	207.511	109.245	1.917	25.667	20.625	21.500	0.250	11.583	217.947	**63.624**	30.750	3.250	111.500	20.630	343.830	135.830
White Sucker	**0.093**	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.000	0.000	0.000	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.130**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**42.456**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.083	**0.033**	0.375	0.000	0.000	0.130	0.000	0.000
American Eel	**0.056**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Brook Stickleback	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Threespine Stickleback	**32.894**	67.375	680.287	459.421	2781.754	116.083	8.500	0.000	0.000	0.000	0.000	**411.342**	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**689.171**	175.000	592.212	56.298	255.161	3.417	3.750	0.417	0.000	0.000	0.000	**108.625**	0.125	0.000	0.000	0.000	0.000	0.000
White Perch	**0.032**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Pumpkinseed	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000
Smallmouth Bass	**0.014**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	**0.008**	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.093**	0.000	0.000	0.625	0.083	0.000	0.500	0.167	0.125	0.000	0.000	**0.150**	0.000	0.000	0.000	0.000	0.130	0.000
Walleye	**0.236**	0.000	0.000	0.063	0.000	0.000	0.125	0.000	0.000	0.417	0.000	**0.060**	0.250	0.250	0.000	0.000	0.000	0.290
Johnny Darter	**0.875**	0.000	0.000	9.875	32.833	0.167	0.000	0.000	0.000	0.000	0.000	**4.288**	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.000	0.333	732.449	850.448	910.409	1100.409	2552.195	1079.944	**722.619**	2322.465	960.945	410.800	1968.920	1309.490	157.100
Freshwater Drum	**0.046**	0.000	0.000	0.000	0.083	0.000	0.125	0.000	0.125	0.000	0.000	**0.033**	0.000	0.250	0.000	0.000	0.500	0.140
Sculpin sp.	**0.194**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Mottled Sculpin	**0.000**	0.000	0.000	0.688	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.069**	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**0.370**	0.000	0.250	6.750	10.833	0.083	0.000	0.000	0.000	0.000	0.000	**1.792**	0.000	0.000	0.000	0.000	0.000	0.000
Total catch	**2004**	320	1502	695	3254	943	902	968	1257	2565	1303	**1371**	2354	998	598	2033	1658	308
Number of species	**10**	4	5	10	10	9	9	9	5	6	7	**7**	8	5	4	4	8	6
Number of trawls		8	8	16	12	12	8	12	8	12	12		8	7	8	8	8	7

TABLE 1.3.8. Species-specific catch per trawl (12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **EB06**, Kingston Basin, Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																
	1992-2000										**2001-2010**						
Species	**mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**mean**	2011	2012	2013	2014	2015	2016
Alewife	**85.631**	5.583	0.250	0.083	1.250	0.417	8.000	0.917	0.667	10.833	1.083	**2.908**	0.667	0.625	0.583	0.000	0.000	1.330
Lake Trout	**0.611**	0.083	0.083	0.083	0.083	0.000	0.000	0.000	0.000	0.000	0.000	**0.033**	0.000	0.125	0.000	0.000	0.250	0.000
Lake Whitefish	**4.546**	0.000	0.167	0.167	0.250	0.000	0.000	0.083	0.000	0.000	0.083	**0.075**	0.000	0.000	0.000	0.000	0.080	0.000
Cisco (Lake Herring)	**0.028**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**743.701**	21.417	6.750	0.250	25.083	142.583	23.917	0.583	1.000	3.500	73.167	**29.825**	18.917	112.933	8.750	0.330	0.000	1.330
Threespine Stickleback	**7.722**	2.583	47.750	11.417	7.500	13.917	1.083	0.000	0.000	0.000	0.000	**8.425**	0.000	0.000	0.000	0.000	0.000	0.000
Trout-perch	**0.991**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Yellow Perch	**0.019**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Johnny Darter	**0.000**	0.000	0.000	0.000	0.333	0.000	0.000	0.000	0.000	0.000	0.000	**0.033**	0.000	0.000	0.000	0.000	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.000	0.000	0.000	5.000	82.934	1.667	8.667	877.914	**97.618**	1.917	200.416	208.949	0.330	0.080	453.050
Sculpin sp.	**0.009**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Slimy Sculpin	**0.083**	0.083	0.000	3.583	399.183	15.750	0.250	0.000	0.000	0.500	1.500	**42.085**	0.000	0.125	0.167	0.000	0.000	0.000
Deepwater Sculpin	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.167	**0.025**	0.000	0.000	0.000	0.000	2.000	0.000
Total catch	**843**	30	55	16	434	173	38	85	3	24	954	**181**	22	314	218	1	2	456
Number of species	**6**	5	5	6	7	4	5	4	3	5	6	**5**	3	5	4	2	4	3
Number of trawls		12	12	12	12	12	12	12	12	12	12		12	8	12	12	12	3

EB06 (Table 1.3.8)

Four species: Round Goby, Alewife and Rainbow Smelt were caught at EB06 in 2016.

Rocky Point (Tables 1.3.9 and 1.3.10)

Three species: Deepwater Sculpin, Slimy Sculpin, and Rainbow Smelt were caught at Rocky Point in 2016. Deepwater Sculpin were most common at 100 to 120 m water depth while Slimy Sculpin were most abundant at 90 m.

Bay of Quinte

Conway (Table 1.3.11)

Ten species were caught at Conway in 2016. The most abundant species were Round Goby, Alewife, Yellow Perch, Cisco and White Sucker.

Hay Bay (Table 1.3.12)

Thirteen species were caught at Hay Bay in 2016. The most abundant species were Alewife, Gizzard Shad, Yellow Perch, White Perch and White Bass.

Deseronto (Table 1.3.13)

Eighteen species were caught at Deseronto in 2016. The most abundant species were Alewife, Yellow Perch, Gizzard Shad, White Perch, Spottail Shiner and Pumpkinseed.

Big Bay (Table 1.3.14)

Nineteen species were caught at Big Bay in 2016. The most abundant species were Gizzard Shad, Yellow Perch, White Perch, Alewife and Freshwater Drum. Three American Eel were caught. These were the first Eel caught at Big Bay since 2002.

Belleville (Table 1.3.15)

Nineteen species were caught at Belleville in 2016. White Perch, Freshwater Drum, Yellow Perch and Spottail Shiner and were the most abundant species in the catch.

TABLE 1.3.9. Species-specific catch per trawl (adjusted to 12 min duration; 1/2 mile) in the fish community index bottom trawling program during summer at **Rocky Point** (multiple water depths), Lake Ontario, 2016. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Site depth (m)							
Site depth (m)	60	80	90	100	110	120	130	140
Rainbow Smelt	0	1	3	3	3	0	0	0
Slimy Sculpin	3	2	12	5	4	1	0	0
Deepwater Sculpin	2	21	75	256	222	236	89	135
Total catch	5	24	90	264	229	237	89	135
Number of species	5	4	4	4	4	3	4	3
Number of trawls	2	4	4	4	4	4	4	4

Trenton (Table 1.3.16)

Seventeen species were caught at Trenton in 2016. The most abundant species were Yellow Perch, Alewife, White Perch, Largemouth Bass, Gizzard Shad and Round Goby.

Species Trends (Fig. 1.3.3)

Bottom trawl results were summarized across the six Bay of Quinte sites and presented graphically to illustrate abundance trends for major species in Fig. 1.3.3. All species show significant abundance changes over the long-term. The most abundant species remain White Perch, Yellow Perch, Alewife and Gizzard Shad. White Perch abundance declined significantly in 2014, remained low in 2015, and increased in 2016. Yellow Perch remain abundant. Alewife abundance declined in 2015 but was very high in 2016. Most centrarchid species are currently at moderate to high levels of abundance as are Gizzard Shad, Spottail Shiner, Round Goby, Trout-perch, and Cisco. Species currently at low abundance levels relative to past levels include Brown Bullhead, Rainbow Smelt, White Sucker, Lake Whitefish, Johnny Darter and American Eel.

Species Highlights

Catches of age-0 fish in 2016 for selected species and locations are shown in Tables 1.3.17-1.3.21 for Lake Whitefish, Cisco, Yellow Perch and Walleye respectively.

TABLE 1.3.10. Species-specific catch per trawl (adjusted to 12 min duration; 1/2 mile) by year in the fish community index bottom trawling program during summer at **Rocky Point, 100 m depth only**), eastern Lake Ontario. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated. No sampling in 2006, 2010.

	Year																	
Species	**1997-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Alewife	**2.063**	2.750	0.375	1.500	5.750	0.125		6.875	1.500	0.375		**2.406**	0.500	0.000	84.500	13.000	114.500	0.000
Lake Trout	**0.063**	0.500	0.000	0.000	0.125	0.000		0.000	0.125	0.000		**0.094**	0.250	0.000	0.000	0.000	0.000	0.000
Lake Whitefish	**0.094**	0.000	0.125	0.000	0.000	0.000		0.000	0.000	0.000		**0.016**	0.000	0.000	0.000	0.000	0.000	0.000
Rainbow Smelt	**200.500**	90.625	37.625	4.125	11.375	5.500		2.250	7.250	6.750		**20.688**	5.500	5.500	11.500	3.333	2.000	3.000
Threespine Stickleback	**0.000**	0.000	0.000	0.000	0.125	0.125		0.000	0.000	0.000		**0.031**	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.000**	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000		**0.000**	0.000	0.000	0.000	0.167	0.000	0.000
Round Goby	**0.000**	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000		**0.000**	0.000	0.000	0.000	0.167	0.000	0.000
Slimy Sculpin	**5.625**	1.250	0.125	2.250	95.750	14.250		24.750	8.875	5.000		**19.031**	2.250	0.000	12.000	8.000	7.500	5.000
Deepwater Sculpin	**0.000**	0.000	0.000	0.000	0.000	0.125		0.750	0.250	0.125		**0.156**	7.500	1.500	6.000	3.833	105.000	256.000
Total catch	**208**	95	38	8	113	20		35	18	12		**42**	16	7	114	29	229	264
Number of species	**3**	4	4	3	5	5		4	5	4		**4**	5	2	4	6	4	3
Number of trawls		4	4	4	4	4	0	4	4	4	0		4	1	2	6	4	1

TABLE 1.3.11. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Conway** (24 m depth), Bay of Quinte. Catches are the mean number of fish observed at each site for the number of trawls indicated. Total catch and number of species caught are indicated.

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

TABLE 1.3.12. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Hay Bay** (7 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

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

TABLE 1.3.13. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Deseronto** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

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

TABLE 1.3.14. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Big Bay** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

	Year																	
Species	**1992-2000 mean**	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	**2001-2010 mean**	2011	2012	2013	2014	2015	2016
Longnose Gar	**0.111**	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.250
Alewife	**33.495**	0.000	224.952	0.000	407.516	35.750	13.000	0.375	190.282	37.875	332.829	**124.258**	52.055	122.472	313.093	100.931	36.500	120.414
Gizzard Shad	**228.179**	0.000	52.250	23.250	58.375	25.875	2.250	2.250	68.745	0.000	66.222	**29.922**	52.250	82.732	3.375	0.125	99.696	1112.491
Rainbow Smelt	**0.039**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike	**0.056**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000
White Sucker	**4.031**	0.750	2.875	1.125	1.375	0.875	0.125	0.375	0.375	0.625	3.750	**1.225**	2.500	2.000	1.250	2.875	0.500	1.625
Moxostoma sp.	**0.007**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Common Carp	**0.545**	0.250	0.000	0.500	0.375	0.250	0.875	0.125	0.375	0.000	1.000	**0.375**	1.375	0.375	0.125	0.000	0.000	0.500
Emerald Shiner	**0.042**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000	0.000	0.000
Spottail Shiner	**16.069**	12.125	63.625	8.875	20.250	56.250	18.625	15.375	10.625	19.500	37.625	**26.288**	53.750	92.750	11.000	82.728	43.750	52.625
Brown Bullhead	**29.570**	16.375	32.625	38.000	23.750	12.125	54.625	9.750	8.750	3.000	4.750	**20.375**	4.250	1.875	6.375	7.875	1.375	2.625
Channel Catfish	**0.151**	0.000	0.125	0.000	0.000	0.125	0.375	0.000	0.000	0.000	0.000	**0.063**	0.000	0.000	0.125	0.500	0.125	0.250
Ictalurus sp.	**0.000**	0.375	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.038**	0.000	0.000	0.000	0.000	0.000	0.000
American Eel	**0.337**	0.125	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.025**	0.000	0.000	0.000	0.000	0.000	0.375
Trout-perch	**23.320**	1.375	9.125	5.000	3.125	21.625	21.000	14.000	65.875	67.750	45.625	**25.450**	86.750	40.875	64.250	643.990	71.875	46.000
White Perch	**446.656**	18.250	793.237	145.125	1499.098	554.616	1252.318	363.567	456.729	1117.116	190.786	**639.084**	1552.354	240.164	540.939	34.250	52.250	211.330
White Bass	**1.221**	0.000	2.125	0.000	0.250	2.625	3.875	0.250	0.750	8.250	0.375	**1.850**	2.375	0.375	0.750	0.625	1.750	1.250
Sunfish	**1.708**	50.000	0.000	0.000	0.000	0.000	25.250	0.000	9.750	0.000	0.000	**8.500**	0.000	0.000	0.000	0.000	0.000	0.000
Rock Bass	**0.000**	0.000	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.013**	0.000	0.000	0.000	0.000	0.000	0.000
Pumpkinseed	**18.612**	83.875	64.125	67.625	36.625	3.750	6.875	1.875	5.750	12.125	5.875	**28.850**	10.250	4.500	16.250	2.125	5.875	23.125
Bluegill	**1.930**	124.875	13.625	14.625	0.750	9.625	6.750	16.000	3.875	10.375	4.250	**20.475**	13.000	3.250	2.125	2.250	13.625	10.375
Smallmouth Bass	**0.032**	0.125	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.038**	0.000	0.000	0.000	0.000	0.000	0.000
Largemouth Bass	**0.000**	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.125	1.500	1.625	**0.375**	0.125	9.500	1.000	0.000	0.000	0.000
Black Crappie	**0.356**	0.625	0.500	0.375	0.375	1.000	2.625	0.250	0.125	0.250	0.000	**0.613**	0.000	0.000	0.000	0.000	0.625	0.125
Lepomis sp.	**0.000**	0.000	66.625	0.000	0.000	1060.443	0.000	4.125	56.481	41.500	170.465	**139.964**	0.500	59.625	5.250	10.750	49.250	18.250
Yellow Perch	**62.998**	381.125	153.463	107.650	200.266	90.623	99.395	33.750	660.643	197.790	184.258	**210.896**	435.501	121.071	82.625	577.728	164.461	321.134
Walleye	**10.485**	7.500	6.125	19.250	16.875	6.500	8.125	8.750	28.125	10.750	7.250	**11.925**	26.750	11.000	4.125	23.375	18.250	10.000
Johnny Darter	**0.037**	1.250	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.150**	0.000	0.000	0.000	0.000	0.000	0.000
Logperch	**0.053**	0.125	0.000	0.250	0.000	0.000	0.125	0.250	3.250	2.250	0.000	**0.625**	0.125	0.000	0.125	3.125	0.000	0.000
Brook Silverside	**0.069**	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.375	**0.050**	0.000	1.125	0.625	0.000	0.250	1.500
Round Goby	**0.000**	0.000	0.125	1.375	15.750	9.500	4.750	50.423	1.125	0.625	0.375	**8.405**	0.750	1.625	0.625	0.375	1.250	0.000
Freshwater Drum	**10.894**	21.750	24.375	9.000	15.625	125.520	178.465	139.361	14.625	11.625	51.500	**59.185**	15.750	31.500	22.750	4.125	6.375	90.201
Total catch	**891**	721	1511	442	2301	2017	1700	661	1586	1543	1109	**1359**	2310	827	1077	1498	568	2024
Number of species	**17**	17	22	15	17	17	20	18	19	16	17	**18**	17	17	19	15	16	19
Number of trawls		8	8	8	8	8	8	8	8	8	8		8	8	8	8	8	8

TABLE 1.3.15. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Belleville** (5 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

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

TABLE 1.3.16. Species-specific catch per trawl (6 min duration; 1/4 mile) by year in the fish community index bottom trawling program at **Trenton** (4 m depth), Bay of Quinte. Catches are the mean number of fish observed for the number of trawls indicated. Total catch and number of species caught are indicated.

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

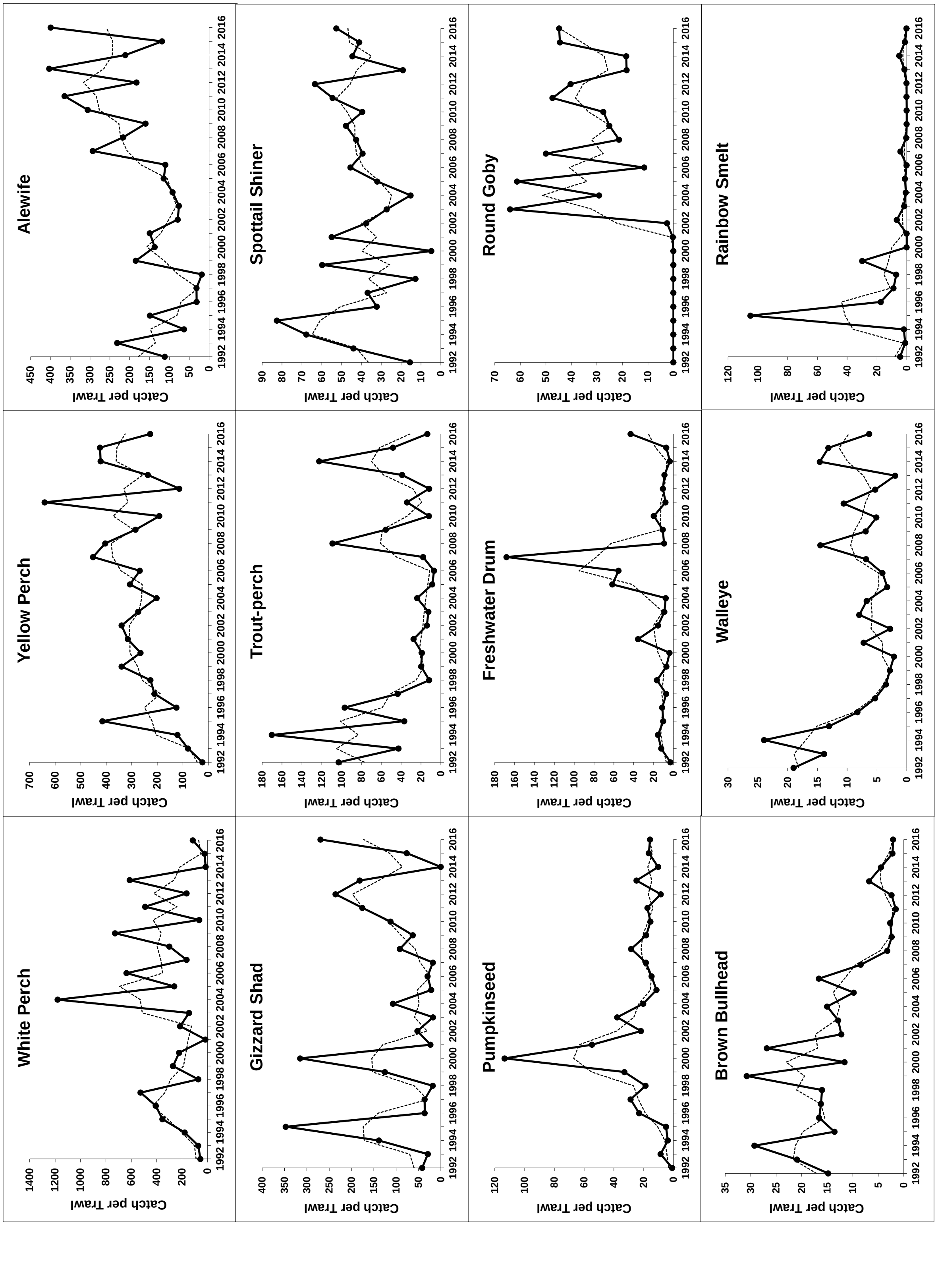


FIG. 1.3.3. Abundance trends (annual means) for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.3.1). Values shown here are 3-yr running averages (two years for first and last years graphed).

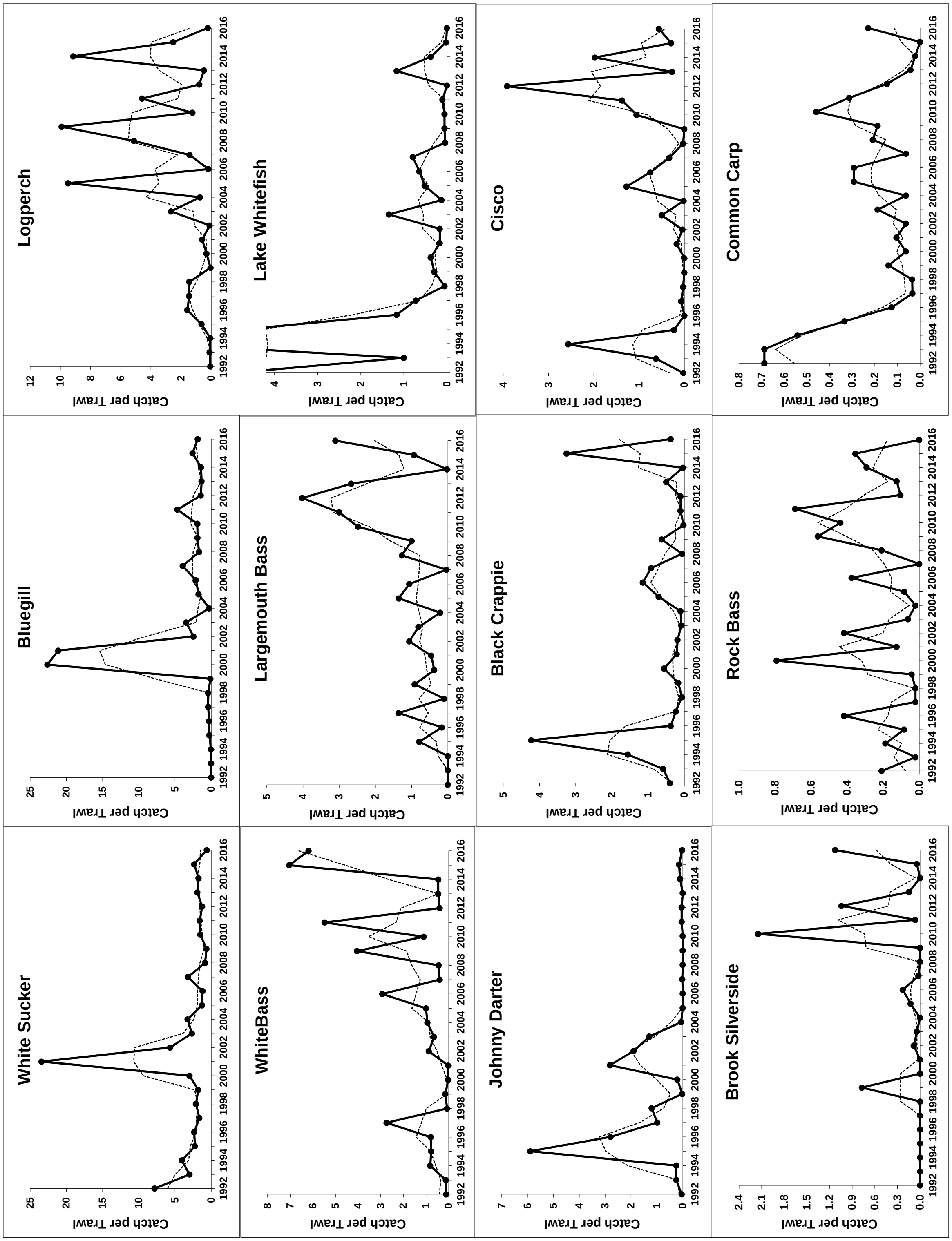


FIG. 1.3.3 (continued). Abundance trends for the most common species caught in bottom trawls at six sites in the Bay of Quinte (Conway, Hay Bay, Deseronto, Big Bay, Belleville and Trenton; see Fig. 1.3.1). Values shown here are 3-yr running averages (two years for first and last years graphed).

TABLE 1.3.17. 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, 1992-2016. Four replicate trawls on each of two to four visits during August and early September were made at each site. Distances of each trawl drag were 1/4 mile for Conway and 1/2 mile for EB03.

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

Not a single age-0 Lake Whitefish was caught in 2016 (Table 1.3.17). Except for the 2003 and 2005 year-classes, age-0 Lake Whitefish catches have been low for more than a decade. By way of contrast, Lake Whitefish abundance measured at older ages suggests less variation in year-class strength over the same time-period. For example, the 2004 year-class figures prominently, relative to the 2003 and 2005 year-classes, in both index gill net surveys (Section 1.2) and the commercial harvest (Section 3.2).

Age-0 Cisco catches at Conway in 2016 were moderate relative to recent years (Table 1.3.18).

TABLE 1.3.18. Mean catch-per-trawl of **age-0 Cisco** at Conway in the lower Bay of Quinte, 1992-2016. Four replicate trawls on each of two to four visits during August and early September were made at the Conway site. Distances of each trawl drag was 1/4 mile.

	Conway	N
1992	0.0	8
1993	1.5	8
1994	7.7	8
1995	1.3	8
1996	0.0	8
1997	0.0	8
1998	0.1	8
1999	0.0	8
2000	0.0	8
2001	0.0	8
2002	0.1	8
2003	2.8	12
2004	0.1	12
2005	7.2	12
2006	4.5	12
2007	2.0	12
2008	0.2	12
2009	0.0	12
2010	6.3	12
2011	8.3	8
2012	23.3	8
2013	1.5	8
2014	11.6	8
2015	1.8	8
2016	3.0	8

Age-0 catches of Yellow Perch were high in 2016 (Table 1.3.19). Following two poor year-classes in 2012 and 2013, the last three year-classes of Yellow Perch were high.

Following two exceptionally strong year-classes in 2014 and 2015, the age-0 Walleye catches in 2016 were low to moderate (Tables 1.3.20 and 1.3.21).

Round Goby first appeared in bottom trawl catches in the Bay of Quinte in 2001 and in the

TABLE 1.3.19. Mean catch-per-trawl of **age-0 Yellow Perch** at six Bay of Quinte sites, 1992-2016. Four replicate trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile.

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

Kingston Basin of eastern Lake Ontario in 2003. The species was caught at all Bay of Quinte trawling sites by 2003, peaking in abundance, at each site, between 2003 and 2005. Catches have been quite variable since but remain high. Round Goby catches in the Kingston Basin increased and remain high in 2016.

TABLE 1.3.20. Mean catch-per-trawl of **age-0 Walleye** at six Bay of Quinte sites, 1992-2016. Four replicate trawls on each of two to three visits during August and early September were made at each site. Distance of each trawl drag was 1/4 mile.

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

TABLE 1.3.21. Age distribution of **268 Walleye** sampled from summer bottom trawls, Bay of Quinte, 2016. Also shown are mean fork length and mean weight. Fish of less than 150 mm fork length were assigned an age of 0, fish between 150 and 290 mm were aged using scales; and those over 290 mm fork length were aged using otoliths.

Age (years)	0	1	2	3	4	5	6	7	8	9	10	13	Total
Year-class	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2003	
Number	74	112	70	2	3	1	1	1	1	1	1	1	268
Mean fork length (mm)	127	214	317	405	453	486	528	501	545	644	551	628	
Mean weight (g)	19	99	336	754	1081	1268	1660	1384	1919	3478	2114	2981	

1.4 Lake Ontario Nearshore Community Index Netting

J. A. Hoyle, Lake Ontario Management Unit

The nearshore community index netting program (NSCIN) was initiated on the upper Bay of Quinte (Trenton to Deseronto), West Lake and Weller's Bay in 2001, and was expanded to include the middle and lower reaches of the Bay of Quinte (Deseronto to Lake Ontario) in 2002. In 2006, the NSCIN program was conducted on Hamilton Harbour and the Toronto Harbour area thanks to partnerships developed with Fisheries and Oceans Canada and the Toronto and Region Conservation Authority. NSCIN was further expanded to other Lake Ontario nearshore areas in subsequent years (Table 1.4.1).

The NSCIN protocol uses 6-foot trap nets and is designed to evaluate the 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 netted. Ecosystem (i.e., Index of Biotic Integrity or IBI) and fish community (e.g., proportion of piscivore biomass or PPB) level measures have been developed to assess relative health of Lake Ontario's nearshore areas. These assessments are particularly useful to monitor the on-going status of impaired fish communities in Lake Ontario Areas of Concern (AOCs) such as Hamilton and Toronto Harbours.

In 2016, NSCIN projects were completed at three nearshore areas: Hamilton Harbour, Toronto Harbour, and the upper Bay of Quinte (Fig. 1.4.1).

Hamilton Harbour *(partnership project with Fisheries and Oceans Canada)*

Twenty-four trap net sites were sampled on Hamilton Harbour from Aug 2-11 with water temperatures ranging from 22.0-26.5°C (Table 1.4.2). More than 12,000 fish comprising 23 species were captured (Table 1.4.3). The most abundant species by number were Brown Bullhead (8,149), White Perch (2,661), Bluegill (416), Channel Catfish (311), Walleye (111), and Common Carp (104). One American Eel was captured; total length of the eel was 846 mm and weight was 2,327 g.

The age distribution and mean length by age-class of selected species are shown in Tables 1.4.4 and 1.4.5. Abundance trends for all species are presented in Table 1.4.6 and graphically for selected species in Fig. 1.4.2. Of particular note

TABLE. 1.4.1. Annual NSCIN trap net schedule for Lake Ontario nearshore areas, 2001-2016. The numbers of trap net samples at each area in each year are indicated.

								Bay of Quinte			
Year	Hamilton Harbour	Toronto Islands	Presquille Bay	Weller's Bay	West Lake	East Lake	Prince Edward Bay	Upper	Middle	Lower	North Channel Kingston
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									

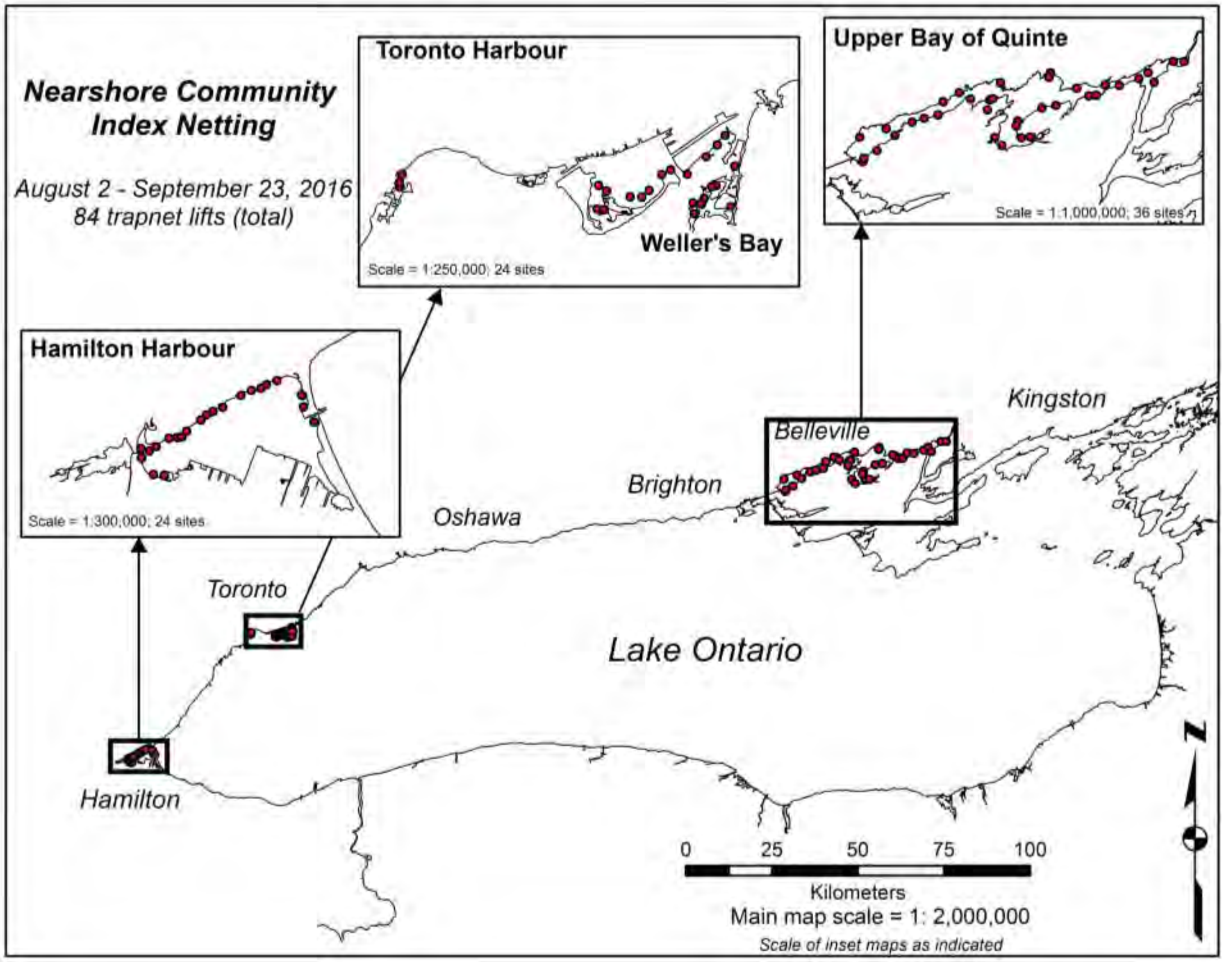


FIG. 1.4.1. Map of Lake Ontario indicating NSCIN trap net locations in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte, 2016.

TABLE 1.4.2. Survey information for the 2016 NSCIN trap net program on Hamilton Harbour, 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, and the number of trap net lifts broken down by target sampling depth, and observed substrate and cover types.

		Hamilton Harbour	Toronto Harbour	Upper Bay of Quinte
Survey dates		Aug 2-11	Sep 6-15	Sep 6-23
Water temperature range (^{o}C)		22.0-26.5	15.7-23.8	20.3-24.1
No. of trap net lifts		24	24	36
No. of lifts by depth:				
	Target (2-2.5 m)	3	9	10
	> Target	7	14	17
	< Target	14	1	9
No. of lifts by substrate type:				
	Hard	2	1	14
	Soft	22	23	22
No. of lifts by degree of cover:				
	None	0	1	9
	1-25%	8	13	16
	26-75%	10	9	9
	76-100%	6	1	2

TABLE 1.4.3. Species-specific catch in the 2016 NSCIN trap net program in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte. Statistics shown include arithmetic and geometric mean catch-per-trap net (CUE), percent relative standard error of mean log10(catch+1), %RSE = 100*SE/mean, and mean fork or total length (mm). A total of 30 species were caught.

	Hamilton Harbour				Toronto Harbour				Upper Bay of Quinte			
Species	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)	Arithmetic mean	Geometric mean	Relative standard error (%)	Mean length (mm)
Longnose Gar	0.750	0.531	24		0.083	0.059	69		0.500	0.234	40	
Bowfin	1.333	0.919	20		0.542	0.321	37		0.750	0.437	27	
Alewife					0.542	0.251	48					
Gizzard Shad	1.708	0.778	29		4.042	0.944	32		1.500	0.651	27	
Rainbow Trout					0.083	0.059	69					
Northern Pike	0.542	0.421	24		1.500	0.986	20		0.528	0.365	24	
Quillback					0.042	0.029	100					
White Sucker	0.042	0.029	100		2.583	0.988	27		0.611	0.311	33	
Silver Redhorse									0.194	0.114	50	
Shorthead Redhorse									0.028	0.019	100	
Greater Redhorse									0.306	0.167	44	
River Redhorse									0.472	0.268	34	
Goldfish	3.458	1.593	21		0.250	0.109	76					
Common Carp	4.333	2.611	15		4.792	2.849	14		0.167	0.122	38	
Golden Shiner									0.111	0.071	58	
Fallfish									0.028	0.019	100	
Rudd	3.958	2.154	19									
Brown Bullhead	339.542	49.427	11		160.375	23.471	13		3.944	2.263	13	
Channel Catfish	12.958	3.849	18		0.125	0.091	55		1.028	0.373	37	
American Eel	0.042	0.029	100		0.042	0.029	100		0.083	0.051	72	
White Perch	110.875	51.161	8		0.042	0.029	100		2.583	0.754	28	
White Bass	0.500	0.364	28						0.278	0.184	36	
Rock Bass	3.333	1.691	21		8.708	3.548	17		2.250	1.357	15	
Pumpkinseed	0.667	0.404	32		15.917	3.830	20		25.056	12.400	7	
Bluegill	17.333	7.189	15		1.458	0.461	44		57.528	29.806	6	
Smallmouth Bass	0.083	0.059	69		0.167	0.091	73		0.167	0.092	58	
Largemouth Bass	0.167	0.109	57		0.542	0.175	67		2.417	1.595	13	
Black Crappie	0.583	0.404	29		0.167	0.091	73		3.444	2.026	13	
Yellow Perch	0.583	0.463	22		3.833	1.310	28		3.861	2.191	13	
Walleye	4.625	1.430	25		0.333	0.189	50		1.611	1.002	17	
Freshwater Drum	1.333	0.541	37		0.750	0.488	28		0.722	0.428	26	
Carassius Auratus x Cyprinus Carpio	0.250	0.161	48									
Notropis hybrids					0.042	0.029	100					
Total catch per net	509				207				110			
Number of species	23				24				26			
Number of nets	24				24				36			
Total catch	12,216				4,967				3,966			

Table 1.4.4. Age distribution of selected species caught in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte, 2016.

		Age (years) / Year-class											
		0	1	2	3	4	5	6	7	8	9	11	13
Location	Species	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2005	2003
Hamilton Harbour													
	Northern Pike		2	2	4	3	1						
	White Bass			1	3	4	3						
	Pumpkinseed			11	3	1							
	Bluegill		6	13	4	5	1	1					
	Smallmouth Bass								2				
	Largemouth Bass		2			1		1					
	Black Crappie		12	2									
	Yellow Perch		2	4	6	1							
	Walleye					31							
Toronto Harbour													
	Northern Pike		5	11	6	3	1	2		3	1		
	Pumpkinseed			11	13	6							
	Bluegill		3	4	3	2							
	Smallmouth Bass		1	1		1	1						1
	Largemouth Bass		1	1									
	Black Crappie			3	1								
	Yellow Perch		14	1	8	5	1						
Upper Bay of Quinte													
	Northern Pike		2	8	4	1		2	1				
	Pumpkinseed				9	9	9	4					
	Bluegill			2	6	13	6	5					
	Smallmouth Bass				1	1	1	2	1				
	Largemouth Bass	5	15	8	3		1			2		1	
	Black Crappie		19	9	4								
	Yellow Perch		1	5	10	8	2	5	1				
	Walleye		6	14	1	1	3	2	1		1	1	

Table 1.4.5. Mean fork length (mm) of selected species caught in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte, 2016.

		Age (years) / Year-class											
		0	1	2	3	4	5	6	7	8	9	11	13
Location	Species	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2005	2003
Hamilton Harbour													
	Northern Pike		471	599	568	747	800						
	White Bass			281	307	304	341						
	Pumpkinseed			117	126	132							
	Bluegill		105	121	133	160	181	190					
	Smallmouth Bass								399				
	Largemouth Bass		202			390		398					
	Black Crappie		141	189									
	Yellow Perch		151	168	222	225							
	Walleye					516							
Toronto Harbour													
	Northern Pike		396	548	679	726	632	771		776	690		
	Pumpkinseed			127	135	139							
	Bluegill		100	135	138	148							
	Smallmouth Bass		193	300		328	366						
	Largemouth Bass		236	283									470
	Black Crappie			192	236								
	Yellow Perch		161	194	220	221	230						
Upper Bay of Quinte													
	Northern Pike		467	566	688	740		577	754				
	Pumpkinseed				129	142	154	160					
	Bluegill			101	124	141	167	159					
	Smallmouth Bass				329	349	415	459	439				
	Largemouth Bass	139	197	267	293		385			412		424	
	Black Crappie		180	223	262								
	Yellow Perch		132	155	189	217	192	237	244				
	Walleye		251	371	455	427	533	524	609		577	589	

TABLE 1.4.6. Species-specific abundance trends (mean catch per trap net) in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte. Annual total catch per net lift, number of net sets, and number of species are also indicated.

	Hamilton Harbour							Toronto Harbour						Upper Bay of Quinte									
Species	2006	2008	2010	2012	2014	2015	2016	2006	2007	2010	2012	2014	2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Longnose Gar	0.47	0.71	0.28	0.67	0.17	0.54	0.75	0.17			0.04	0.17	0.08	2.92	0.36	0.44	1.56	0.50	2.08	0.19	1.42	2.22	0.50
Spotted Gar			0.04																				
Bowfin	0.58	1.17	2.42	1.17	1.54	0.83	1.33	0.33	0.08	0.46	0.42	0.13	0.54	0.92	1.11	0.50	0.81	0.75	0.50	0.92	1.31	0.53	0.75
Alewife				0.04	0.71	13.75		3.79	4.58	0.42	9.50	17.91	0.54										
Gizzard Shad	3.42	0.50	2.38	2.13	1.21	0.33	1.71	2.71	0.42	0.04	1.08	0.35	4.04	0.39	1.00	0.06	0.64	0.14	0.33	0.06	0.25	0.58	1.50
Chinook Salmon								0.08															
Rainbow Trout	0.05	0.04								0.04			0.08										
Atlantic Salmon												0.04											
Brown Trout					0.04			0.04			0.08	0.13											
Lake Trout	0.05																						
Coregonus sp.				0.25																			
Northern Pike	1.11	1.08	1.08	0.29	0.25	0.54	0.54	1.17	0.83	1.38	1.25	1.00	1.50	0.44	0.33	0.28	0.83	0.78	0.53	0.28	0.28	0.28	0.53
Muskellunge		0.04																			0.03		
Suckers	0.05																						
Quillback		0.04			0.08								0.04			0.03						0.03	
White Sucker	0.11	0.21	0.46	0.29	2.17	0.63	0.04	4.17	3.83	2.29	1.13	1.17	2.58	0.44	0.92	0.64	0.44	0.42	0.72	0.86	0.72	0.25	0.61
Bigmouth Buffalo	0.05				0.04	0.04																	
Silver Redhorse		0.04										0.04		0.64	0.50	1.44	0.44	0.17	0.47	0.83	0.47	0.11	0.19
Shorthead Redhorse	0.11	0.04	0.25					0.04						0.19	0.33	0.36	0.06	0.19	0.08	0.31	0.17	0.11	0.03
Greater Redhorse					0.08	0.04									0.08	0.06		0.44	0.28	0.83	0.11	0.14	0.31
River Redhorse														0.11	0.44	0.03		0.14	0.08	0.14		0.03	0.47
Black Buffalo						0.04																	
Minnow		0.04																					
Goldfish	0.32	0.92	2.71	0.88	0.58	1.08	3.46	0.04		0.04			0.25										
Common Carp	4.47	3.92	2.20	1.21	2.25	2.38	4.33	1.58	2.50	4.75	3.67	2.00	4.79	0.19	0.22	0.19	0.33	0.22	0.47	0.25	0.25	0.11	0.17
Golden Shiner															0.22		0.06	0.14	0.03	0.06			0.11
Fallfish																							0.03
Rudd				0.04		0.38	3.96																
Black Bullhead	0.05																						
Brown Bullhead	380.79	189.33	482.67	76.25	251.71	753.79	339.54	32.63	14.79	8.42	198.00	71.65	160.38	7.25	6.42	2.56	10.56	13.69	7.11	15.28	6.08	5.75	3.94
Channel Catfish	34.84	15.92	8.00	14.17	49.58	11.25	12.96	0.04		0.17	0.08	0.04	0.13	0.72	0.81	0.28	0.53	0.58	0.31	0.06	0.53	0.19	1.03
American Eel					0.08	0.13	0.04					0.09	0.04					0.11	0.03	0.44	0.28	0.03	0.08
White Perch	48.42	34.88	84.38	69.92	169.29	132.04	110.88	0.04		0.25	0.92	0.04	0.04	4.61	4.31	3.86	1.69	3.75	3.58	19.42	0.19	0.31	2.58
White Bass	2.00	1.75	1.46	0.29	0.75	0.58	0.50	0.33		0.04	0.04	0.22		0.03	0.14			0.17	0.08			0.08	0.28
Rock Bass	0.58	1.08	1.48	1.17	2.00	1.04	3.33	0.33	1.13	2.58	4.75	1.78	8.71	4.83	3.97	3.89	2.44	4.50	1.08	7.97	4.92	2.50	2.25
Green Sunfish	0.05																						
Pumpkinseed	0.68	1.13	3.33	2.04	1.00		0.67	7.29	16.29	7.67	12.75	2.48	15.92	18.61	18.14	23.42	29.08	37.53	28.11	14.72	15.25	50.33	25.06
Bluegill	4.05	3.21	9.08	14.42	14.96	3.42	17.33	0.54	3.96	1.13	2.04	0.87	1.46	63.92	159.11	71.75	61.50	136.03	74.92	53.56	75.81	62.89	57.53
Smallmouth Bass	0.11		0.13				0.08	0.04	0.04	0.08	0.08	0.09	0.17	0.11	0.92	0.56	0.44	0.47	0.14	0.47	0.03	0.06	0.17
Largemouth Bass	0.26	0.17	0.33	0.25	0.13	0.08	0.17	1.08	1.25	1.38	5.00	0.61	0.54	4.53	5.39	4.33	4.25	10.39	2.72	4.33	3.58	3.33	2.42
Black Crappie	2.32	0.17	0.42	0.58	0.08		0.58	0.83	0.42	0.13	1.13	0.70	0.17	12.92	17.33	10.03	7.53	8.64	4.78	11.36	5.36	4.22	3.44
Yellow Perch	0.11	0.63	4.16	0.25	1.08	0.71	0.58	1.08	5.96	2.63	20.63	2.17	3.83	4.72	7.00	2.64	6.11	6.25	1.31	2.69	4.94	3.75	3.86
Walleye	1.05	0.17	0.04		2.46	2.04	4.63	0.38	0.08			0.09	0.33	1.61	2.50	1.75	2.53	2.36	1.44	7.56	1.33	0.94	1.61
Round Goby	0.05																						
Freshwater Drum	1.37	1.71	1.24	0.33	1.08	1.88	1.33	1.08	1.29	0.83	0.63	0.83	0.75	1.25	1.17	1.89	1.97	1.67	2.19	0.94	0.94	0.97	0.72
Carassius auratus x Cyprinus carpio							0.25																
Notropis hybrids													0.04										
Total catch	488	259	609	187	503	928	509	60	57	35	263	105	207	131	233	131	134	230	133	144	124	140	110
Number of net lifts	19	24	24	24	24	24	24	24	24	24	24	24	24	36	36	36	36	36	36	36	36	36	36
Number of species	28	25	22	21	25	23	23	24	16	20	20	24	24	22	24	23	21	25	25	24	23	25	26

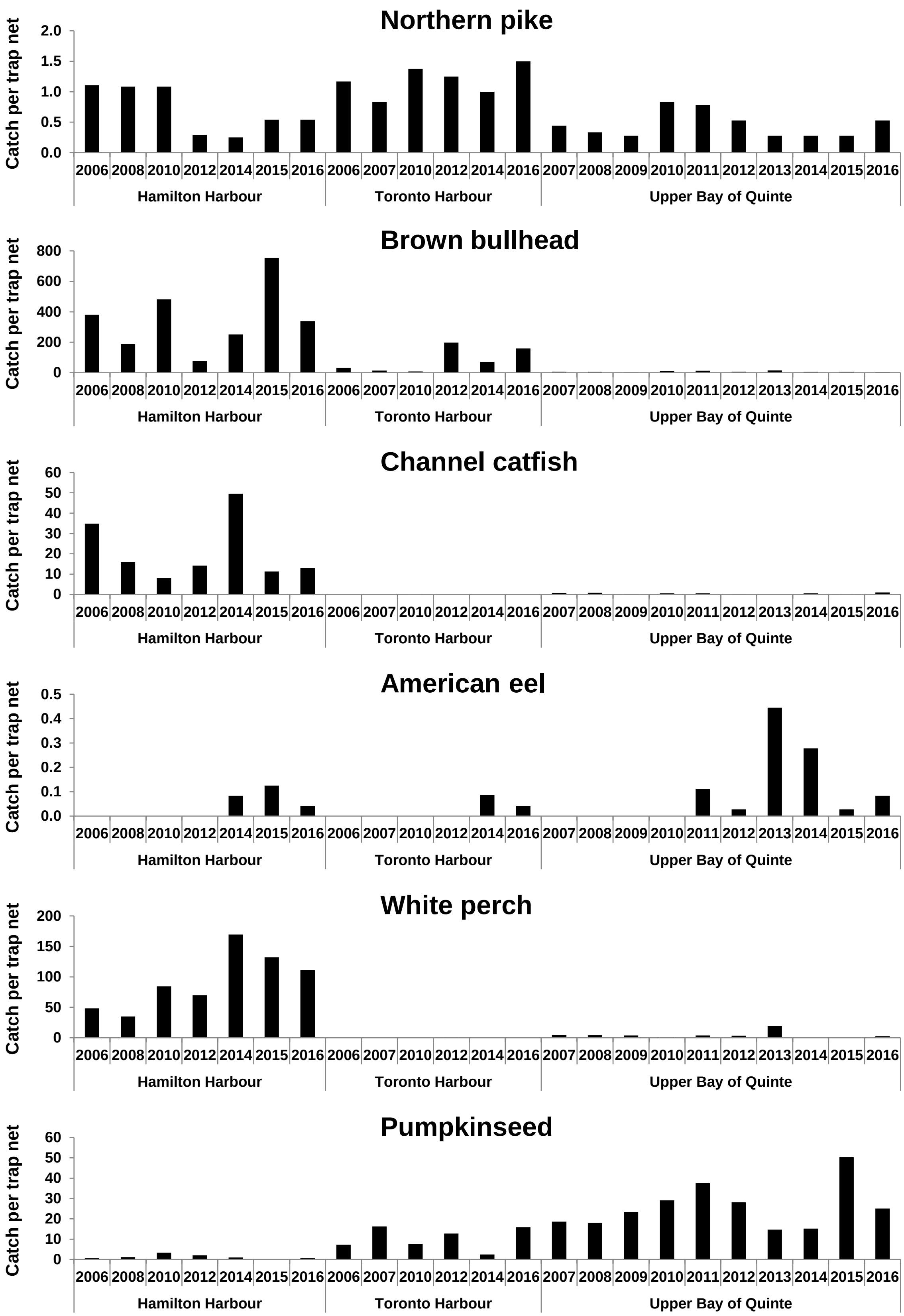


FIG. 1.4.2. Abundance trends for selected species caught in nearshore trap nets in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte. Values shown are annual arithmetic means.

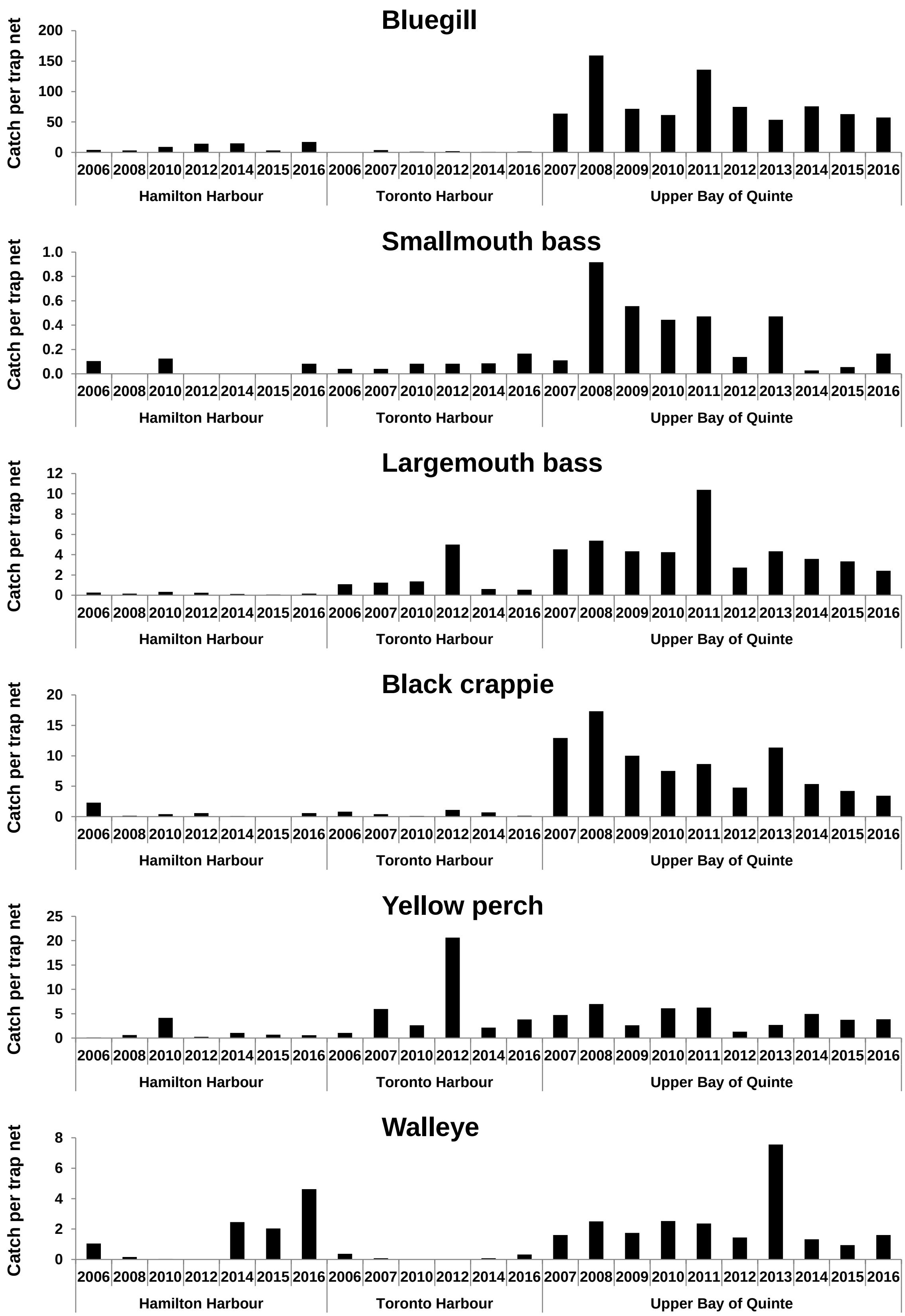


FIG. 1.4.2. (continued) Abundance trends for selected species caught in nearshore trap nets in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte. Values shown are annual arithmetic means.

was the strong showing of age-4 Walleye from the 2012 Walleye stocking event (see Section 8.7) and the absence of Walleye from stocking events in the following years.

Toronto Harbour *(partnership project with Fisheries and Oceans Canada)*

Twenty-four trap net sites were sampled on Toronto Harbour from Sep 6-15 with water temperatures ranging from 15.7-23.8°C (Table 1.4.2). Nearly 5,000 fish comprising 24 species were captured (Table 1.4.3). The most abundant species by number were Brown Bullhead (3,849), Pumpkinseed (382), Rock Bass (209) and Common Carp (115). One American Eel was captured; total length of the eel was 740 mm and weight was 936 g.

Upper Bay of Quinte

Thirty-six trap net sites were sampled on the upper Bay of Quinte from Sep 6-23 with water temperatures ranging from 20.3-24.1°C (Table 1.4.2). Nearly 4,000 fish comprising 26 species were captured (Table 1.4.3). The most abundant species by number were Bluegill (2,071), Pumpkinseed (902), Brown Bullhead (142), Yellow Perch (139), Black Crappie (124) and White Perch (93). Three American Eel were caught. The eel were 666, 768 and 915 mm total length and weighed 637, 1,242 and 1,807 g in weight, respectively.

Northern Pike abundance declined from 2001-2009, increased significantly in 2010, declined from 2010-2013, remained steady until 2015, then increased in 2016. Brown Bullhead and Channel Catfish remained at low abundance. American Eel abundance increased in 2016 compared to 2015 but remained below the high abundance levels of 2013 and 2014. White Perch abundance was unusually high in 2013 but very few were caught in 2014 (7) and 2015 (11). In 2016, 93 were caught. Pumpkinseed abundance increased in 2015 and deceased in 2016. Bluegill abundance was similar to recent years. Smallmouth Bass abundance increased in 2016. Largemouth Bass decreased slightly in 2016. Black Crappie abundance declined in 2014, 2015 and again in 2016 compared to 2013. Yellow Perch abundance remained steady. Walleye abundance, having been unusually high in 2013, declined in 2014 and 2015, and increased in 2016 (Table 1.4.6 and Fig. 1.4.2).

Ecosystem Health Indices

Indices have been developed based on the NSCIN trap netting to evaluate ecosystem health in Lake Ontario nearshore areas. The degree of exposure of the nearshore area sampled to Lake Ontario (e.g., highly sheltered embayments vs. those broadly exposed to the open waters of Lake Ontario) influences the ecosystem health indices. Therefore, indices are presented separately for sheltered and exposed embayments (Figs. 1.4.3 to 1.4.6).

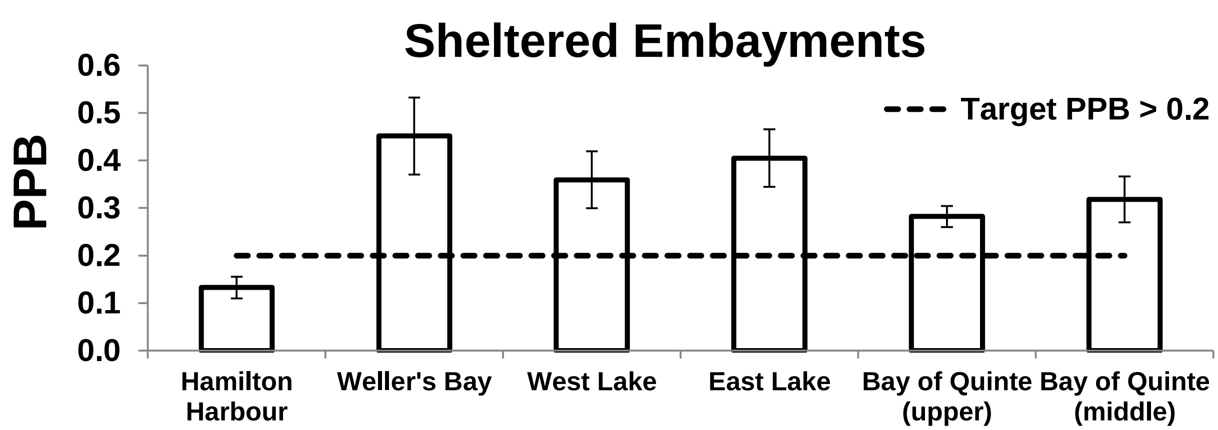


FIG. 1.4.3. Proportion of total fish community biomass represented by piscivore species (PPB) in the nearshore trap net surveys in five sheltered Lake Ontario embayments (2006-2016). A PPB>0.2 is indicative of a balanced trophic structure (depicted by a dashed line). Piscivore species included Longnose Gar, Bowfin, Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye. Error bars are +-2SE.

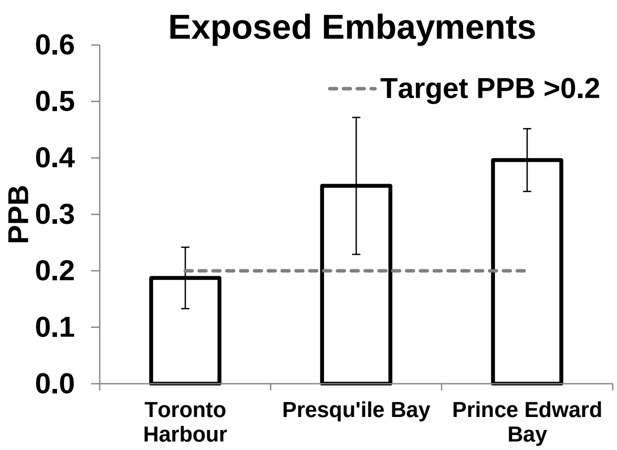


FIG. 1.4.4. Proportion of total fish community biomass represented by piscivore species (PPB) in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2016). A PPB>0.2 is indicative of a balanced trophic structure (depicted by a dashed line). Piscivore species included Longnose Gar, Bowfin, Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye. Error bars are +-2SE.

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 2016 were 0.13, 0.18 and 0.28 in Hamilton Harbour, Toronto Harbour, and the upper Bay of Quinte, respectively. The PPB at Hamilton Harbour remained significantly below both 0.2 and that of other sheltered Lake Ontario embayments (Fig. 1.4.3). The PPB at Toronto Harbour was just below the target value and that of other exposed Lake Ontario embayments (Fig. 1.4.4). PPB at the upper Bay of Quinte was well above the target value.

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 were 47 (fair), 46 (fair) and 71 (good) in Hamilton Harbour, Toronto Harbour and the upper Bay of Quinte, respectively. The IBI at Hamilton Harbour remained significantly below those of other sheltered Lake Ontario embayments, while the IBI at the upper Bay of Quinte was similar to values at other Lake Ontario sheltered nearshore areas (Fig. 1.4.5). Toronto Harbour IBI was lower than other exposed embayments, (Fig 1.4.6).

Trap Net and Electrofishing Comparison

Electrofishing sampling was conducted in conjunction with trap net sampling at selected upper Bay of Quinte locations (20 of 36 sites). The standard Fisheries and Oceans 100 m transect

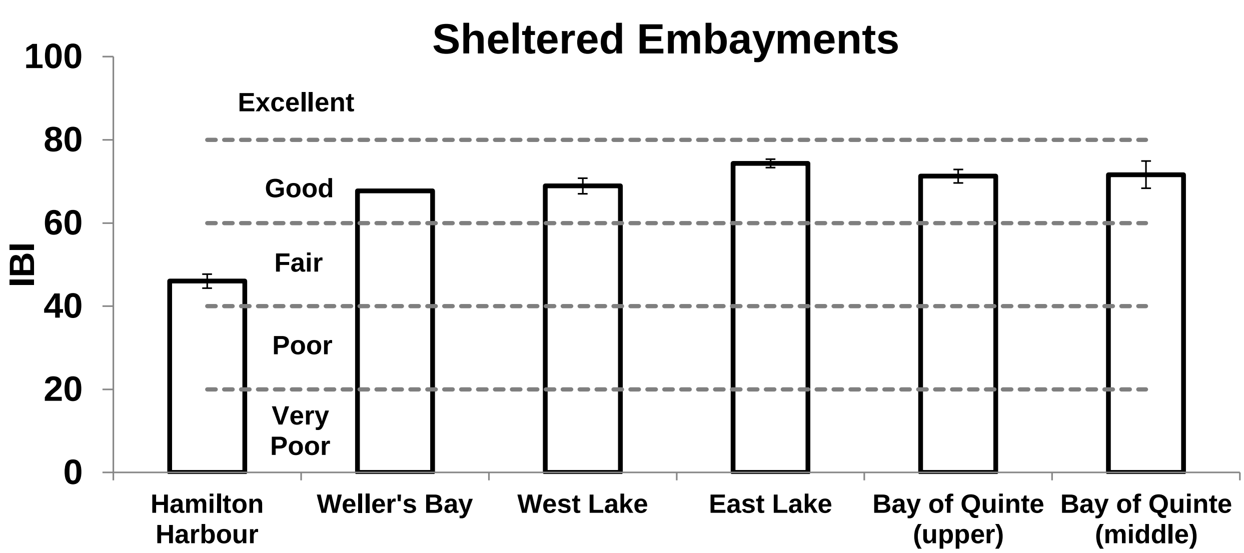


FIG. 1.4.5. Index of biotic integrity (IBI), as a measure of ecosystem health, in the nearshore trap net surveys in five sheltered Lake Ontario embayments (2006-2016). IBI classes can be described as follows: 0-20 very poor, 20-40 poor, 40-60 fair, 60-80 good, and 80-100 excellent ecosystem health. Error bars are +-2SE.

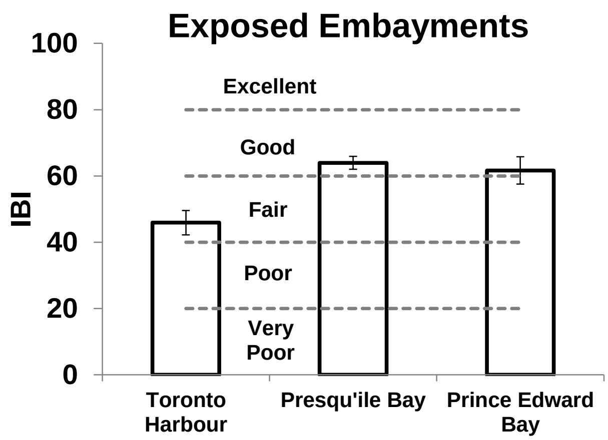


FIG. 1.4.6. Index of biotic integrity (IBI), as a measure of ecosystem health, in the nearshore trap net surveys in three exposed Lake Ontario embayments (2006-2016). IBI classes can be described as follows: 0-20 very poor, 20-40 poor, 40-60 fair, 60-80 good, and 80-100 excellent ecosystem health. Error bars are +-2SE.

sampling electrofishing protocol was used. Catch comparison by the two gear types is shown in Table 1.4.7. A total of 32 species were caught; 26 by electrofishing and 25 by trap net sampling. Seven unique species were captured by electrofishing and six unique species by trap nets. A total of 784 fish were caught by electrofishing and 2,043 fish were caught by the trap nets.

The most common species caught by electrofishing were Yellow Perch, Brook Silverside, Gizzard shad, Bluegill and Largemouth Bass, and for the trap nets were Bluegill, Pumpkinseed, Yellow Perch, Black Crappie and Largemouth Bass. Electrofishing sampling caught more small fish species such as cyprinids. Trap nets caught more centrarchids. Between gear differences in species composition were also reflected in the size distribution of fish caught in the two gear types; electrofishing gear tended to catch smaller-sized fish and trap net gear tended to catch more medium-sized fish (Fig. 1.3.7).

FIG. 1.4.7. Species-specific catch-per-unit-effort for boat electrofishing and trap netting gear types in the upper Bay of Quinte in 2016 for the 20 sites that were sampled by both gear types. A total of 32 species was caught by the two gear types.

	Gear type	
Species	E-Fish	Trap Net
Longnose Gar	0.15	0.70
Bowfin	0.05	0.90
Alewife	1.00	-
Gizzard Shad	4.15	2.25
Northern Pike	0.15	0.40
White Sucker	0.20	0.25
Shorthead Redhorse	-	0.05
Greater Redhorse	-	0.20
River Redhorse	-	0.55
Common Carp	0.30	0.15
Golden Shiner	0.15	0.20
Common Shiner	0.10	-
Spottail Shiner	0.65	-
Bluntnose Minnow	0.25	-
Fallfish	-	0.05
Brown Bullhead	0.45	2.40
Channel Catfish	-	1.60
American Eel	0.20	0.10
White Perch	0.40	2.25
White Bass	0.05	0.30
Rock Bass	0.75	3.15
Pumpkinseed	1.00	14.85
Bluegill	2.90	56.50
Smallmouth Bass	0.05	0.15
Largemouth Bass	2.00	3.40
Black Crappie	-	4.50
Lepomis *sp.*	0.65	-
Yellow Perch	13.75	5.10
Walleye	1.05	1.40
Logperch	0.80	-
Brook Silverside	7.95	-
Freshwater Drum	0.05	0.75
Number species	**26**	**25**
Unique species	**7**	**6**
Common species	**19**	**19**
Total fish caught	**784**	**2,043**

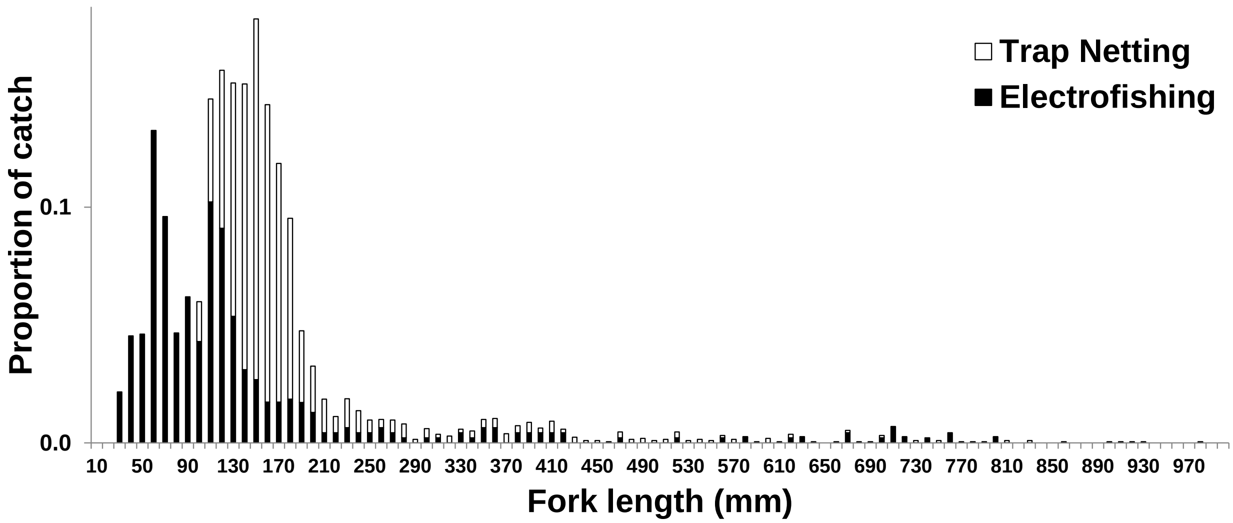


FIG. 1.4.7. Size distribution of the fish caught during boat electrofishing and trap netting gear types in the upper Bay of Quinte in 2016 for the 20 sites that were sampled by both gear types.

1.5 Lake-wide Hydroacoustic Assessment of Prey Fish

J. P. Holden, Lake Ontario Management Unit
M. J. Connerton, New York State Department of Environmental Conservation, Cape Vincent Fisheries Station
B. C. Weidel, Unites States Geological Service, Oswego

Hydroacoustic assessments of Lake Ontario prey fish have been conducted since 1991 with a standardized mid-summer hydroacoustic survey implemented in 1997. The survey is conducted jointly by the Ontario Ministry of Natural Resources and Forestry (OMNRF), the New York State Department of Environmental Conservation (NYSDEC) and the US Geological Survey (USGS). Results from the hydroacoustic survey complement information obtained in spring bottom trawl surveys; provides whole-lake indices of abundance; and describes midsummer distribution of pelagic prey fish species.

The index survey consists of five, north-south, shore-to-shore transects in the main lake, and one transect in the Kingston Basin (Fig. 1.5.1). Hydroacoustic data were collected beginning at approximately one hour after sunset from 10m of depth on one shore and running to 10m of depth on the opposite shore at or until approximately one hour before sunrise. Since 2005, transects have been randomly selected annually from within 15 km corridors. The corridor approach was adopted to include a random component to the survey while accommodating logistical constraints such as suitable ports. A dogleg at the southern portions of transects 3, 4 and 5 is used to increase the length of the transect that occurs in less than 100 m of water along the southern shore which has a much steeper slope than the northern shore. Temperature profiles were conducted at multiple intervals along each transect.

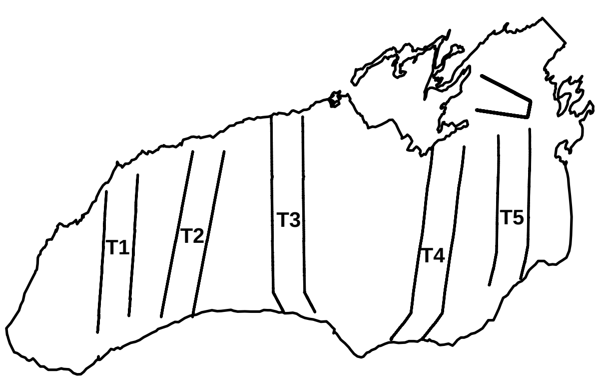


FIG. 1.5.1. The Lake Ontario Lake-wide prey fish survey uses cross-lake hydroacoustic transects. Transect corridors are logistically constrained but utilize a random starting point within the corridor for each annual survey.

Since 1997, annual hydroacoustic survey index values have been calculated with slightly different methods (e.g., varying target strength thresholds, and species partitioning methods) and different analytical software, which has also evolved enabling more sophisticated approaches (e.g., noise filtering). In the 2015 report, historical data were re-analyzed using a standardized approach to target strength thresholds for Alewife and Rainbow Smelt, noise filtering and species partitioning. Acoustic data can distinguish between position and sizes of targets but not species. Historical midwater trawling data (2000 to 2004) showed a thermal separation between the two primary species of interest, Alewife and Rainbow Smelt. Midwater tows in depths where water temperatures were 9°C or warmer were dominated by catches of Alewife (95% total catch weight of prey fish species) whereas tows in depths at temperatures below 9°C captured mostly Rainbow Smelt (84%).

In addition to the standard index transects additional sampling effort has also been regularly conducted throughout the survey. Recently there was a focus on upward looking acoustics to quantify the relative proportion of the Alewife that occurred in the near surface portion of the water column unable to be measured by traditional down-looking acoustics. In 2016, two additional projects were conducted to broaden the scope of the summer acoustic survey. Generally, the cross-lake transects sample lake depths in proportion to their overall area in the lake, however shallower depths, less than 30 m have been underrepresented (Fig. 1.5.2). Additional transects were added to increase the shallow depths as well as look at the variability in the area where the thermocline intersects bottom where fish density has historically been highly variable. Sampling at depths from 0-20 meters was still underrepresented relative to lake area and will require more targeted sampling in the future. Midwater trawling was also conducted in eastern portions of Lake Ontario by NYSDEC and USGS in 2016 in an effort to expand assessment of native Coregonid species (Cisco and Bloater). All transect paths are plotted in Fig. 1.5.3. Midwater trawls conducted in 2016 show some mixing of Alewife and Rainbow Smelt, which may be a result of net contamination from warmer temperatures or variable fishing depths throughout the tow duration; the historical assumption of thermal separation (Fig. 1.5.4) of Alewife and Rainbow Smelt is still supported with these catches. Biological samples from midwater trawls suggest that the previous upper target strength level is generally too high based on the size distribution within the catch and has the potential to incorrectly categorize large species, like Cisco, that were abundant at several transects, as either Alewife or Rainbow Smelt. Based on an analysis of the length frequency distribution based on trawl catches of Cisco (Fig. 1.5.5) and the published relationship between fish size and target strength, the maximum target strength defining Alewife and Rainbow Smelt was lowered to -39 dB and historical index values recalculated (Table 1.5.1). Catches of Cisco in 2016 appear to be limited geographically to eastern portions of the lake and by depth (less

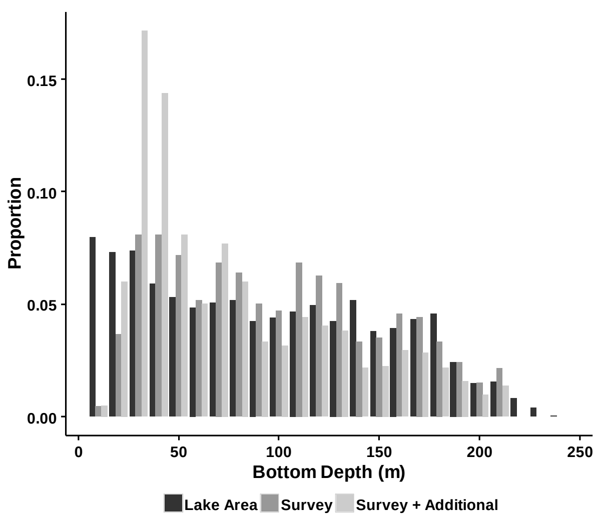


FIG. 1.5.2. Distribution of survey depths (based on 500 m intervals) in the traditional survey transects and including the additional nearshore transect relative to lake area by depth.

FIG. 1.5.3. Spatial coverage of acoustic data collected in 2016. Transects are categorized based the analysis to which each contributed.

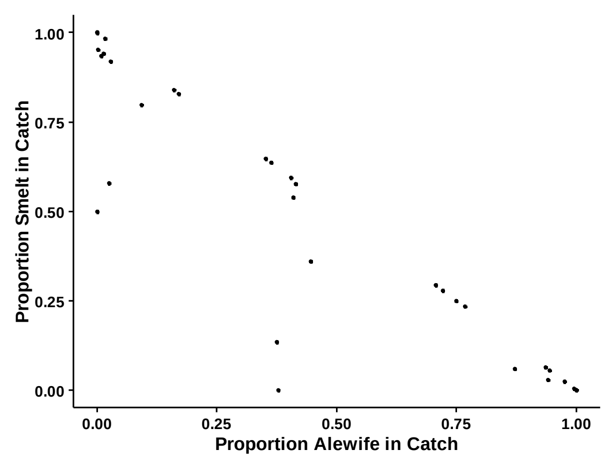


FIG. 1.5.4. Proportion of Alewife and Rainbow Smelt weight contributing to the total catch weight within each midwater trawl.

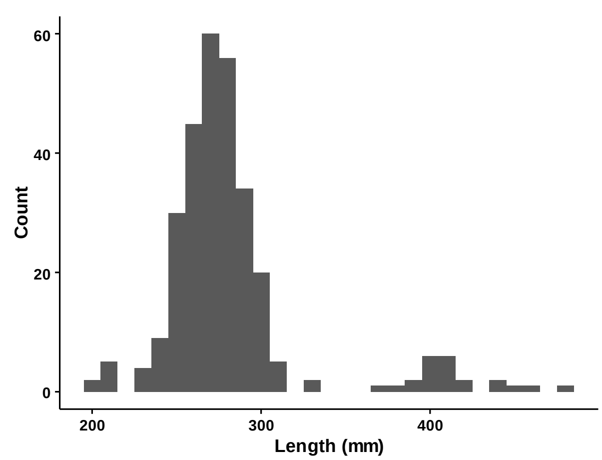


FIG. 1.5.5. Length frequency of Cisco caught in midwater tows.

TABLE 1.5.1. Acoustic parameter settings and target strength thresholds used for the 2016 survey.

Parameter	Specification
Sounder	BioSonics DT-X
Transducer Frequency	120 kHZ split beam
Ping Rate	1 ping per second
Pulse Width	0.4 milliseconds
Analytical Software	Echoview (version 7.1)
Alewife target threshold range	-50 to -39dB, water temp. > 9°C
Rainbow Smelt target threshold range	-52 to -39dB, water temp. =< 9°C
Cisco target threshold range	-39 to -30dB, all water temps.

than 100 m); therefore the index for Cisco in 2016 is reported as fish per hectare based on acoustic analysis of the transects where Cisco were captured rather than as a whole lake index until additional future sampling and analyses establishes their geographic extent throughout the lake

Comparisons of Alewife biomass estimates between acoustics and spring bottom trawls show that surveys are correlated but that acoustic estimates of Alewife are lower. Vertical gillnets and towed up-looking acoustics show that a large proportion (on average 50%) of Alewife occupy the near-surface portion of the water column (<4 m depth) and are not detectable with the down-looking transducer used in the survey. While a significant proportion of the Alewife biomass is detected in this portion of the water column, the conversion still does not reconcile the difference between bottom trawl and acoustics population estimates. The values for Alewife reported here do not include a conversion factor to account for this unmeasured biomass and thus should be treated as an index of abundance between years and not as a whole lake population estimate.

Alewife abundance in 2016 increased relative to 2015 estimates (Fig. 1.5.6). The increase in population is likely explained by increases in the age-1 population of Alewife. Differences between target strength distribution over the most recent years, where recruitment to age 1 in 2014 and 2015 was low, supports this assumption (Fig. 1.5.7, see also Section 7.6). Alewife were spatially distributed throughout the lake (Fig. 1.5.8) but showed a bimodal distribution with bottom depth (Fig. 1.5.9). Distribution of Alewife during the survey however, varies from year to year and no consistent spatial trend has been found. Research to explain their distribution is ongoing. The additional shallow transects resulted in a marginally higher population estimate (663 million, 95% confidence interval 601 – 729 million), but this was not statistically different than the standard population estimate (578

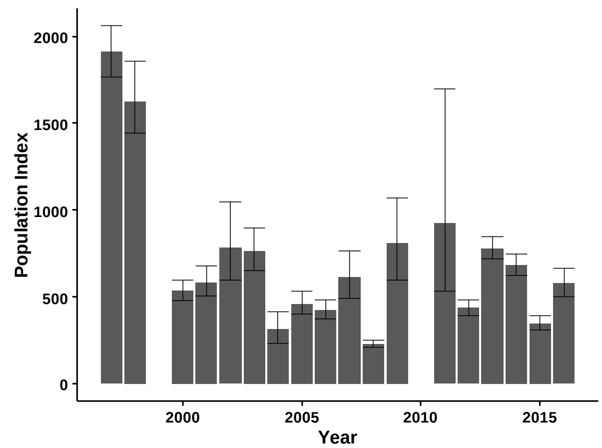


FIG. 1.5.6. Abundance index (in millions of fish) of yearling-and-older Alewife from 1997-2016. Summer acoustic estimates were not conducted in 1999 and 2010.

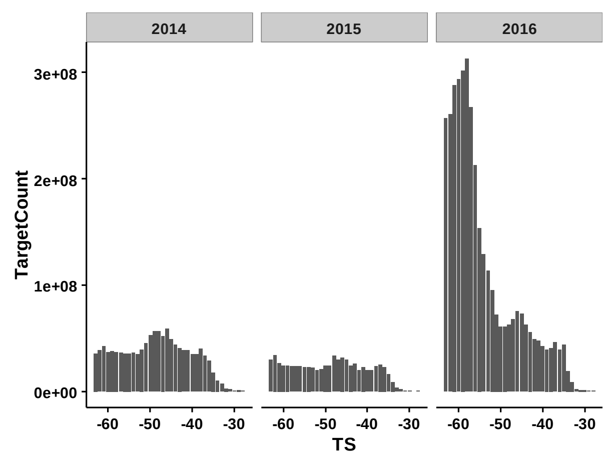


FIG. 1.5.7. Lake-wide estimates of Alewife partitioned by target strength in 1 dB bins for surveys conducted from 2014 to 2016.

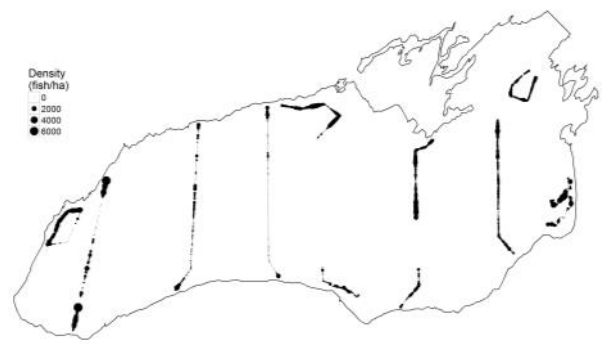


FIG. 1.5.8. Relative distribution of Alewife determined by acoustics (fish/ha) observed during the hydroacoustic survey in July 2016. Points are scaled to reflect observed density (fish/ha).

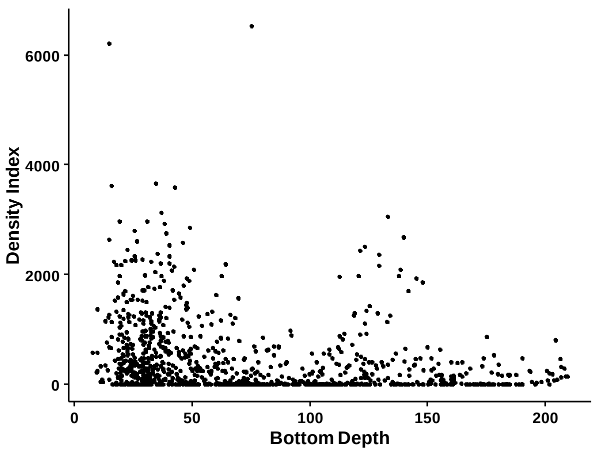


FIG. 1.5.9. Relative distribution of Alewife (fish/ha) in proportion to Lake bottom depth of the 500 m portion of the transect.

million, 95% confidence interval 501 – 664 million). The size distribution (inferred by target strength distribution) does not indicate differences in size structure (Fig. 1.5.10).

Rainbow Smelt abundance in 2016 decreased relative to 2015 estimates (Fig. 1.5.11). The highest densities of Rainbow Smelt were distributed along the southern shore (Fig.1.5.12). The highest concentrations of Rainbow Smelt were found over bottom depths shallower than 75 m (Fig. 1.5.13). Midwater trawl catches support this limited distribution (Fig. 1.5.14).

Cisco were infrequently caught during previous midwater trawling efforts (2000-2004). Further analysis is required to determine whether low catches during that time period are a function of spatial coverage of those surveys or low abundance and is not the primary focus of this report. Catches of Cisco were geographically

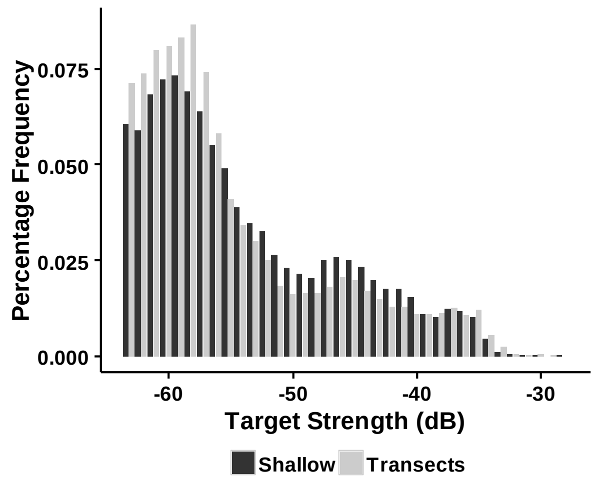


FIG. 1.5.10. Relative frequency distribution of the size of Alewife, inferred by target strength, between the regular survey cross lake transects and the targeted nearshore transects.

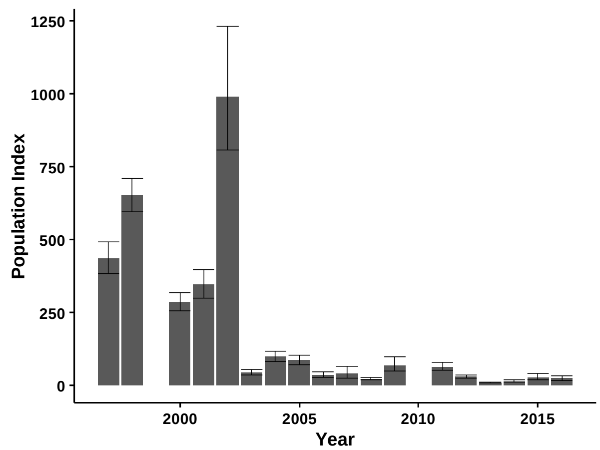


FIG. 1.5.11. Abundance (in millions of fish) of yearling-and-older Rainbow Smelt from 1997-2016. Summer acoustic estimates were not conducted in 1999 and 2010

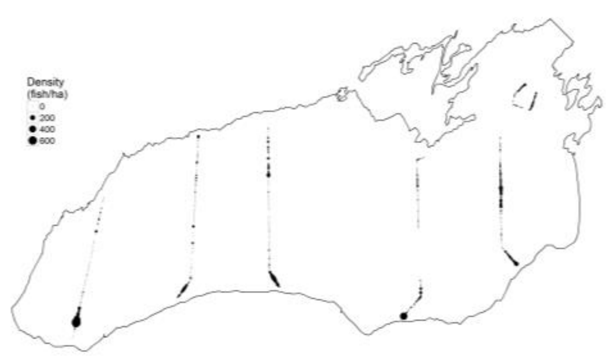


FIG. 1.5.12. Relative distribution of Rainbow Smelt (fish/ha) observed during the hydroacoustic survey in July 2016. Points are scaled to reflect observed density (fish/ha).

confined to the transects along the eastern shore of Lake Ontario (Fig 1.5.15). Both acoustic estimates and midwater trawls suggest peak abundance within a fairly narrow depth range (25 and 50 m; Fig. 1.5.16 and 1.5.17). These depths are representative of water temperatures in the 10-15°C range, which is consistent with temperatures where Cisco are commonly caught in Community Index Gill Netting (Fig. 1.5.18, see also Section 1.2 for methods and sites). Mean catch per trawl is more variable between transects (Fig. 1.5.19) than what the acoustic densities suggest (Fig. 1.5.20). Acoustic estimates however have the benefit of greater spatial range and the ability to sample the entire water column simultaneously. Despite those differences, overall density estimates between methods provide similar results. Midwater trawl catches estimate a density

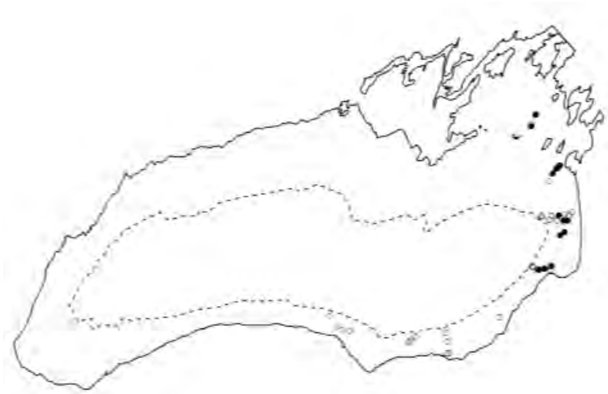


FIG. 1.5.15. Paired acoustic data collection and midwater trawls were conducted in the eastern portion of Lake Ontario. Filled points indicate tows were Cisco were caught.

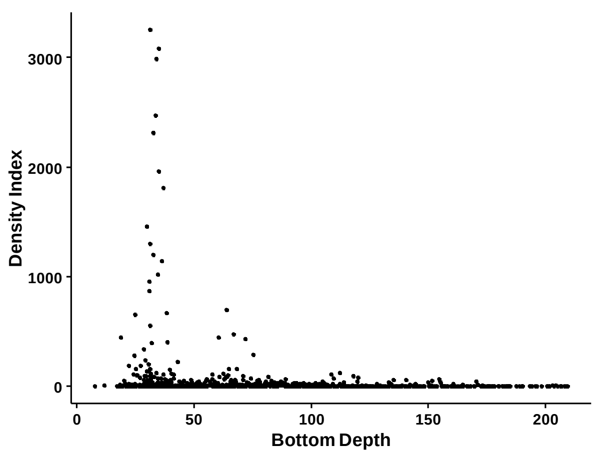


FIG. 1.5.13. Relative distribution of Rainbow Smelt determined by acoustics (fish/ha) in proportion to lake bottom depth of the 500 m portion of the transect.

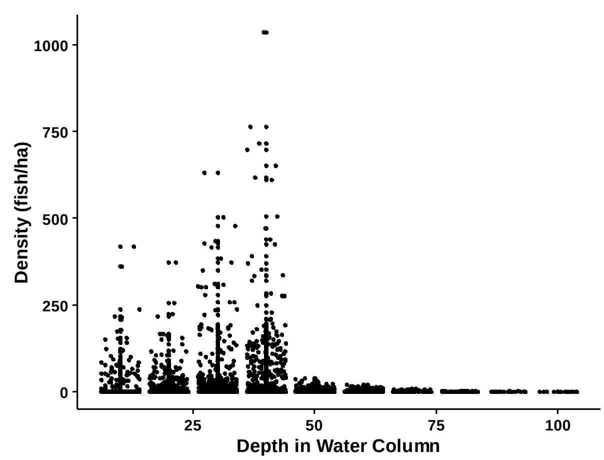


FIG. 1.5.16. Relative distribution of Cisco within the water column determined by acoustics (fish/ha). Data have been exported from acoustic software in 5 m depth bins and then horizontally jittered for plotting.

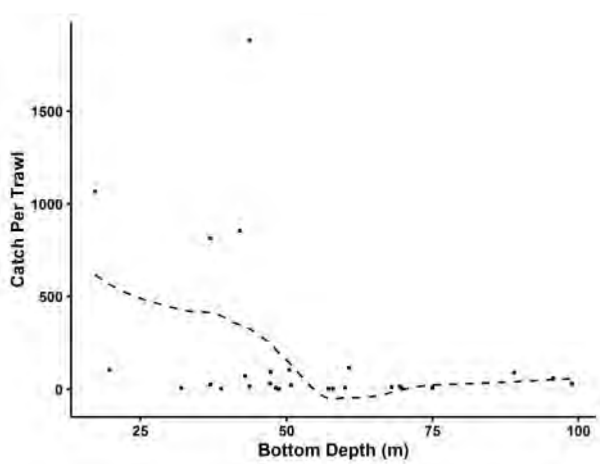


FIG. 1.5.14. Relative catch of Rainbow Smelt (fish/10 min tow) relative to lake bottom depth where midwater tow occurred.

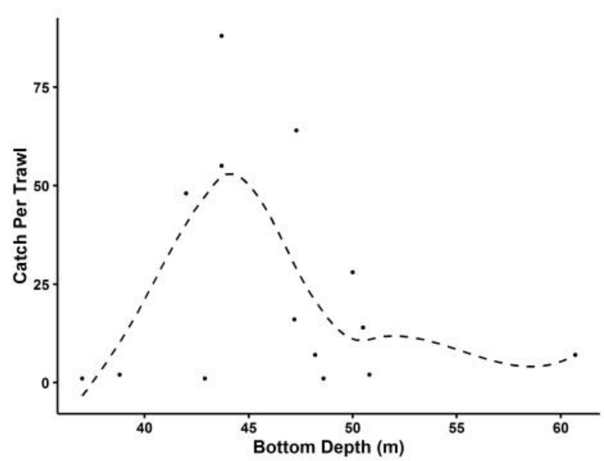


FIG. 1.5.17. Relative catch of Cisco (fish/10 min tow) relative to lake bottom depth where midwater tow occurred.

of 36 fish per hectare and acoustic estimates range between 25 fish/ha using data from the entire transect to 51 fish/ha where acoustic data is limited specifically to the same area and water column the midwater trawls were conducted.

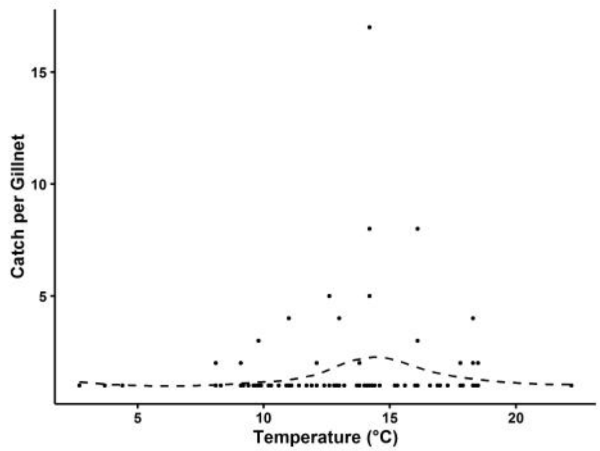


FIG. 1.5.18. Relative catch of Cisco (fish/12 min tow) in Fish Community Index Trawling (Section 1.3) relative to temperature on the lake bottom where trawl is fished.

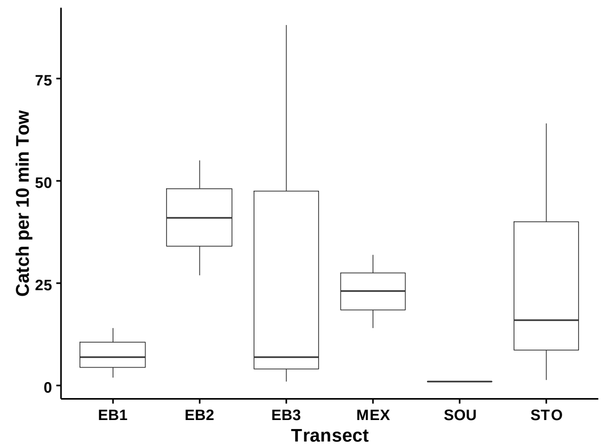


FIG. 1.5.19. Catch variability in Cisco catches in midwater tows between transect areas. Boxes indicate 50% of the sample. Line within the box indicated the median catch. Whiskers extend to 1.5 times the interquartile range. Extreme values beyond 1.5 times the quantile range are indicated by single points.

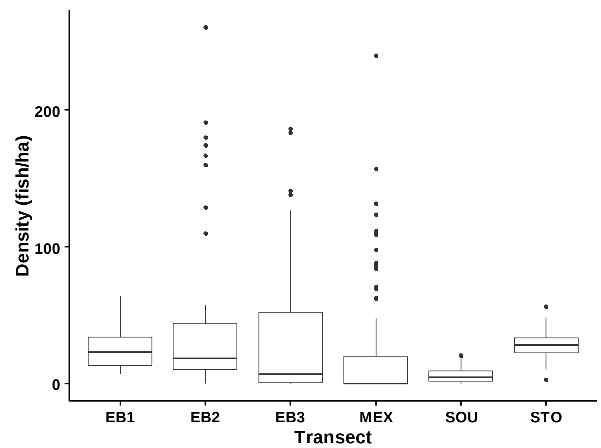


FIG. 1.5.20. Variability in Cisco density determined by acoustics between transect areas. Boxes indicate 50% of the sample. Line within the box indicated the median catch. Whiskers extend to 1.5 times the interquartile range. Extreme values beyond 1.5 times the quantile range are indicated by single points.

1.6 St. Lawrence River Fish Community Index Netting—Lake St. Francis

M.J. Yuille, Lake Ontario Management Unit

Every other year in early fall, the Lake Ontario Management Unit conducts an index gillnet survey in Lake St. Francis. 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 examination. The survey is part of a larger effort to monitor changes in the fish communities in four distinct sections of the St. Lawrence River: Thousand Islands, Middle Corridor, Lake St. Lawrence and Lake St. Francis. This is coordinated with New York Department of Environmental Conservation (NYSDEC) to provide comprehensive assessment of fisheries resources in the upper St. Lawrence River.

In 2016, the survey was conducted during the period of September 6th to 19th. Thirty-six 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. In total, 544 fish were caught, which included 20 different fish species (Table 1.6.1). The average number of fish per set was 15.11, down 66% from 2014. The number of fish per set continued to decline from the record high in 2008 and is well below the 1984 – 2016 average for the survey (Fig. 1.6.1). The diversity of species is the highest observed in this survey. The dominant species in the catch continued to be Yellow Perch (62% of the catch), followed by Rock Bass (18%; Fig. 1.6.2). In 2016, a Lake Sturgeon was caught and released in

TABLE 1.6.1. Summary of catches per standard gillnet set in the Lake St. Francis Fish Community Index Netting Program, 1984 - 2016. 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.

	1984	1986	1988	1990	1992	1994	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016
Lake Sturgeon	--	--	--	--	--	--	--	0.04	--	0.03	--	0.03	--	--	--	0.03
Longnose Gar	--	0.23	0.09	--	0.66	0.26	0.14	0.13	0.40	--	0.06	--	--	0.22	--	0.28
Bowfin	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alewife	0.04	--	--	--	--	--	--	--	0.03	0.06	0.22	--	--	--	--	--
Salvelinus sp.	--	--	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern Pike	4.18	3.93	4.44	3.82	4.13	3.91	3.71	3.34	1.23	1.45	1.67	1.08	0.31	0.19	0.31	0.14
Muskellunge	--	--	0.04	--	--	--	--	--	--	0.06	--	--	--	--	0.03	--
White Sucker	1.71	2.17	1.01	1.71	1.41	1.67	1.99	1.63	0.74	1.06	0.97	1.94	1.56	1.17	1.25	0.56
Moxostoma sp.	--	--	0.04	0.18	0.04	0.09	0.18	0.09	--	--	0.11	0.19	0.14	0.33	0.08	0.10
Common Carp	0.13	--	--	0.09	--	--	--	--	0.09	--	0.25	0.03	--	--	--	--
Golden Shiner	--	--	--	--	--	0.04	--	--	0.03	--	--	--	--	--	--	0.06
Creek Chub	--	--	--	0.09	--	--	0.09	--	--	--	--	--	--	--	--	--
Fallfish	--	--	--	0.40	--	--	--	--	--	--	--	--	--	--	--	0.03
Brown Bullhead	1.14	1.27	0.62	1.36	0.70	0.44	0.95	3.25	0.54	1.38	2.81	1.97	0.56	0.25	0.14	0.03
Rock Bass	3.52	3.48	2.81	1.36	2.15	2.11	2.58	1.85	2.26	2.17	5.69	7.89	7.03	3.94	2.97	2.72
Pumpkinseed	4.97	1.72	0.84	0.75	1.49	1.76	1.54	1.06	0.41	0.41	0.89	1.50	0.06	0.33	0.17	0.17
Bluegill	--	--	--	--	--	--	0.05	0.04	0.10	--	--	--	0.06	--	--	0.03
Smallmouth Bass	0.88	0.63	0.26	0.26	0.62	0.62	1.40	0.44	1.02	0.59	1.17	1.67	0.44	0.47	0.67	0.28
Largemouth Bass	0.04	--	0.09	0.09	--	0.04	0.09	0.13	0.20	--	0.61	0.31	0.33	1.53	--	0.69
Black Crappie	0.04	0.09	0.04	0.04	0.09	0.13	--	0.09	0.07	--	--	--	--	--	--	0.08
Yellow Perch	21.45	16.32	20.88	16.57	15.83	13.72	11.89	9.36	6.49	7.45	16.36	31.03	30.83	20.64	16.67	9.36
Walleye	0.48	0.45	0.97	0.35	0.35	0.26	0.36	0.31	0.16	0.41	0.39	1.08	1.58	0.78	0.81	0.47
Freshwater Drum	--	--	--	--	--	--	--	--	0.04	--	--	--	--	--	--	0.03
All Species	38.64	30.30	32.18	25.72	27.48	25.06	24.96	21.76	13.81	15.04	31.19	48.89	42.89	30.03	23.10	15.06
Count of Species	13	10	14	13	11	13	13	14	16	11	14	13	12	14	12	20

the fish community index gill nets; the last Lake Sturgeon caught in this program was in 2008 (Table 1.6.1).

Species Highlights

Catches of Yellow Perch continued to decline from peak levels seen previously in 2008 and 2010 (Fig. 1.6.3). Current Yellow Perch catch per net (9.36 fish per net) is below the 1984 – 2016 survey average (20.20 fish per net; Table 1.6.1). An increase in the catch of large fish (> 220 mm) observed in 2008 has been followed by continued decline from 2010 to 2016 (Fig. 1.6.3). The catch per net of large fish in 2016 (1.64 fish per net) was comparable to 2014 (1.88 fish per net; Fig. 1.6.3) and was one of the lowest observed in the time series. Yellow Perch catch in 2016 contained fish from age-2 to age-9 with age-4 fish representing 45% of the total catch (Fig. 1.6.4).

The centrarchids are represented by six species in Lake St. Francis: Rock Bass, Pumpkinseed, Bluegill, Smallmouth Bass, Largemouth Bass and Black Crappie (Fig. 1.6.5 and 1.6.6). While Rock Bass remain the most abundant of the centrarchids, catches in 2016 were 54% of the previous decade. Smallmouth Bass catches declined in the 2016 catch and are currently 64% below the previous 10 year average (Fig. 1.6.5). Growth as determined by mean length of age-1 Smallmouth Bass (164 mm in 2016) declined 9% below the long-term average (180 mm, 1998 to 2016), however age-5 mean fork length (401 mm) continues to remain above the long-term average (373 mm; Fig. 1.6.6). Pumpkinseed catches were unchanged from 2014 to 2016 (Fig. 1.6.5). Bluegill, Largemouth Bass and Black Crappie were historically at much lower levels than the former three species, and

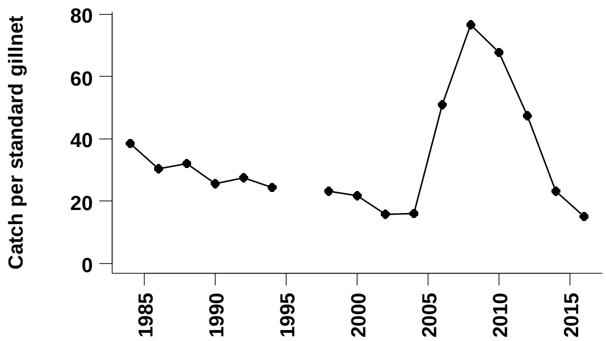
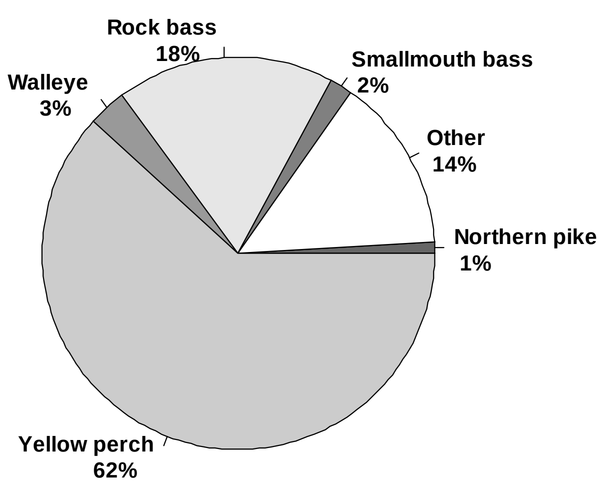
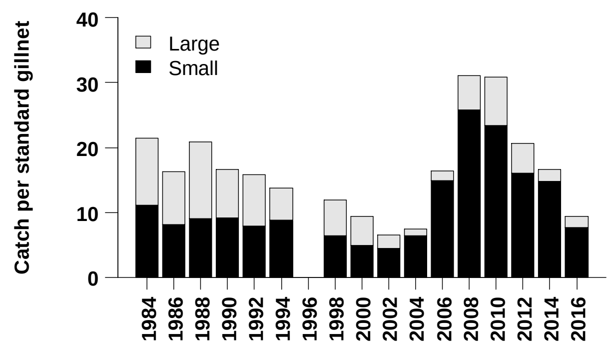
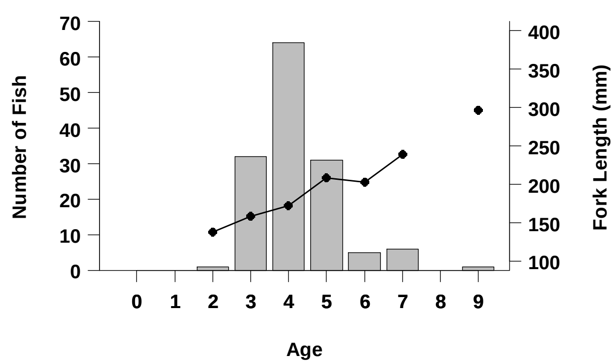


FIG. 1.6.1. Average catch per standard gillnet set of all species combined, Lake St. Francis, 1984 – 2016. Survey was not conducted





.3. Catches of small (<=220 mm total length) and large (> n total length) Yellow Perch in the Lake St. Francis ity index netting program, 1984 – 2016. Survey was not ed in 1996.



.4. Age distribution (bars) and mean fork length at age (mm) w Perch caught in Lake St. Francis, 2016.

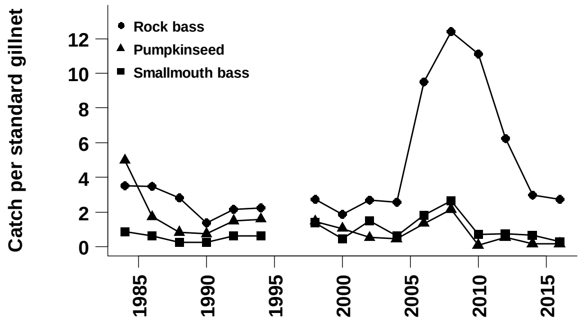


FIG. 1.6.5. Rock Bass (circle), Pumpkinseed (triangle) and Smallmouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 - 2016.

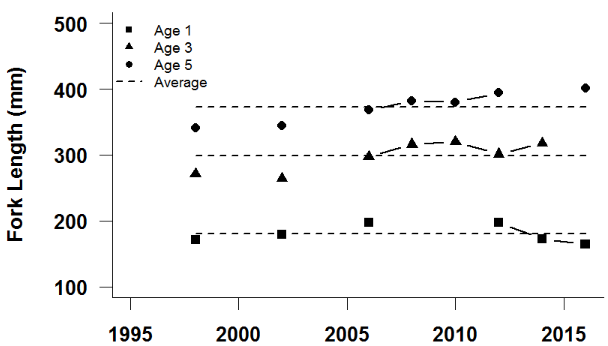


FIG. 1.6.6. Mean fork length (mm) of age-1 (square), age-3 (triangle) and age-5 (circle) Smallmouth Bass from 1998 to 2016. Dashed lines represent the average fork length from 1998 to 2016 for the aforementioned ages.

remain so. While Largemouth Bass appear to have peaked in 2012 catches, none were caught in the following 2014 survey. In 2016, Largemouth Bass CUE was above the previous 10 year average (Fig. 1.6.7).

In 2016, catches of Northern Pike were the lowest in the 1984 – 2016 time series (Fig. 1.6.8). A total of five Northern Pike were caught in 2016, ranging in from age-2 to age-9 (Fig. 1.6.9). Catches of small fish (≤ 500 mm) continue to remain low; in 2016 only a single small Northern Pike was caught. Northern Pike abundances have been in decline since the early 1990s and are currently at the lowest levels observed in the 32 year time series. No Muskellunge were caught in 2016.

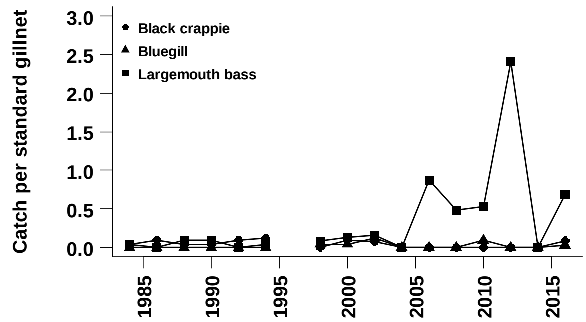


FIG. 1.6.7. Black crappie (circle), Bluegill (triangle) and Largemouth Bass (square) catches per standard gillnet set in Lake St. Francis, 1984 – 2016.

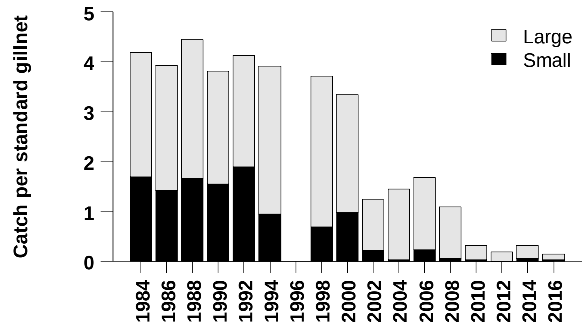


FIG. 1.6.8. Catches of small (<= 500 mm total length) and large (> 500 mm total length) Northern Pike in the Lake St. Francis community index gill netting program, 1984 – 2016. Survey was not conducted in 1996.

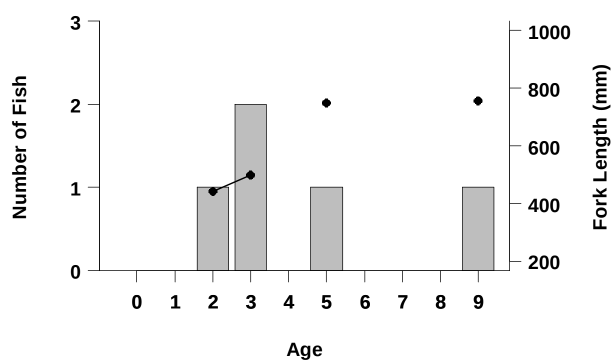


FIG. 1.6.9. Age distribution (bars) and mean fork length (circles) at age of Northern Pike caught in Lake St. Francis, 2016.

1.7 Credit River Chinook Salmon Spawning Index

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

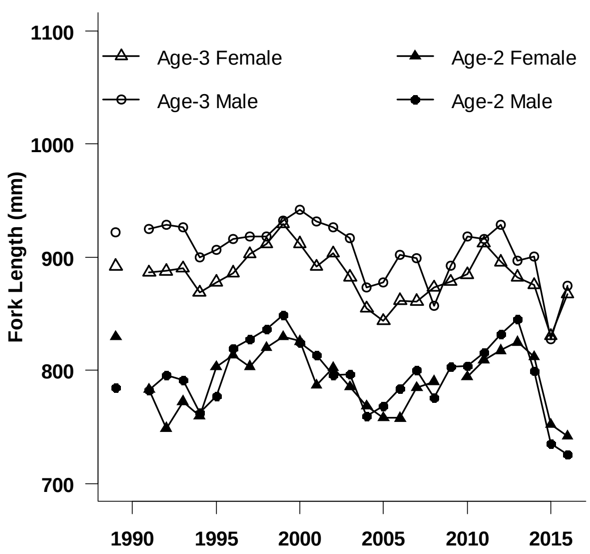
The Credit River, below the Kraft Dam in Streetsville, has been the long-term sampling site for Chinook Salmon gamete collection. Chinook Salmon are captured during the fall spawning run at the beginning of October using electrofishing gear. LOMU staff have utilized the spawn collections to index growth, condition and lamprey marking of Chinook Salmon.

Weight and otoliths are collected from fish used in the spawn collection, which has the 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 checked 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 2016 Chinook Salmon index were taken on October 4–6 and 11–14. Detailed sampling occurred on 461 Chinook Salmon, 48 fish were sampled for the representative length sample and no Chinook Salmon were observed with an adipose fin clip.

In 2016, the mean length of age-3 females (867 mm) and males (875 mm) increased from 2015 and are 2% and 4% below the long term average of 883 mm and 906 mm, respectively (Fig. 1.7.1). Length of age-2 females (742 mm) declined from 2015 and is now 6% below the long term mean of 791 mm. Length of age-2 males (726 mm) also declined from 2015 and is now 14% below the peak length observed in 2013 (841 mm) and 9% below the average length (796 mm) for the time series (1989-2016).

The estimated weight (based on a log-log regression) of a 900 mm (total length) Chinook Salmon is used as an index of condition. In 2016, female condition was comparable to 2015, while the condition of males increased (Fig. 1.7.2). Female condition in 2016 (7,832 g) is comparable to the average condition from 2003 to 2016 (7,738 g). Male condition (7,964 g) increased and is currently 8% above the average condition between 2003 and 2016. It should be noted that the absolute difference between maximum and minimum condition for female (1995 and 2007) and male (1995 and 2005) Chinook Salmon in this time series is 1,433 g and 1,149 g (respectively).



sex, caught for spawn collection in the Credit River during the fall spawning run (approximately first week of October), 1989-2016.

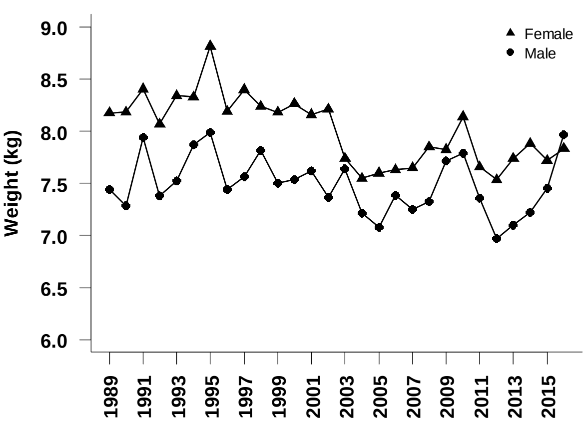


FIG. 1.7.2. Condition index as the mean weight of a 900 mm (total length) Chinook Salmon in the Credit River during the spawning run (approximately first week of October), 1989-2016.

1.8 Juvenile Atlantic Salmon Parr Survey

M.D. Desjardins, Lake Ontario Management Unit

In 2016, Atlantic Salmon spring fingerlings (average 2 g) were stocked in the Credit River and its tributaries (Section 6) to restore self-sustaining populations (Section 8.2). The purpose of this survey was to evaluate growth and survival of Atlantic Salmon parr stocked as spring fingerlings and, in conjunction with smolt surveys (Section 1.9) evaluate the relative contribution of each river reach to the smolt migration.

Atlantic Salmon parr were surveyed at six reaches in the Credit River and Black Creek (Table 1.8.1) during October 2016, after most of the year's growth was complete, and when fish size (>98 mm) indicates potential smolting. Atlantic Salmon were captured by electrofishing. Largely, other species were released upon capture, and were not generally recorded. Biological information (length, weight) was collected on all Atlantic Salmon captured and fish were tagged with half-duplex passive integrated transponder (PIT) tags at all sites. Two thousand one hundred and sixty-seven (2,167) PIT tags were implanted into the body cavity of Atlantic Salmon parr (Table 1.8.2). Larger PIT tags (23 mm) were used on fish >108 mm. Smaller PIT tags (12 mm) were used on fish <108 and >68 mm. A piece of caudal or adipose fin was clipped from all Atlantic Salmon for genetic determination of strain, and provided a secondary mark. The smallest fish (<67 mm) were not PIT-tagged but these fish could be recognized on recapture by the fin clip used for a genetic sample. Repeat sampling occurred at three reaches to obtain population and density estimates. Eighty-three (83) tagged/marked Atlantic Salmon were recaptured generally at the same location (Table 1.8.2) as originally tagged.

TABLE 1.8.1. TABLE 1.8.1. Location of stocked river reaches with geo-coordinates (downstream end) and dimensions of sampling sites in the Credit River, 2016. Reach numbers (1-4) indicate relative watershed position with 1 denoting the furthest upstream reach and subsequent numbers increasing progressively downstream. Sites marked with an asterisk (*) were not stocked in 2016 but were sampled to examine fish movement.

Sub-watershed	Reach	Latitude	Longitude	Stream length (m)	Stream width (m)	Area sampled (m^2)	Days sampled
Upper Credit Mainstem	1 - Meadow (Forks Prov. Park)	43° 48.75'	80° 00.87'	432	8.7	3737	2
	2 - Stuck truck (Forks Prov. Park) *	43° 48.61'	80° 00.29'	363	11.6	4200	1
	3 - Brimstone (Forks Prov. Park)	43° 48.17'	79° 59.71'	564	12.6	7106	2
	4 - Ellies (Forks o' Credit Rd.) *	43° 48.28'	79° 59.51'	314	15.7	4930	1
West Credit	Belfountain C.A.	43° 47.82'	80° 00.41'	320	10.8	3443	2
BlackCreek	6th Line	43° 37.91'	79° 57.03'	349	7.3	2530	1

TABLE 1.8.2. Number of applied and recaptured PIT tags by location and Atlantic Salmon age-group in 2016. Recaptures do not include fish tagged in previous years

	Age 0			Age 1 and older			
Reach	Number of PIT tags	Not tagged	Recaptured	Number of PIT tags	Not tagged	Recaptured	Total number
Meadow (Forks Prov. Park)	425	5	19	68	3	3	523
Stuck truck (Forks Prov. Park)	17			41	2		60
Brimstone (Forks Prov. Park)	664	11	13	106	5	5	804
Ellies (Forks o' Credit Rd.)	6			15	2		23
Belfountain C.A.	597	14	34	71	1	9	726
6th Line	144	15		13			172
Total	1,853	45	66	314	13	17	2,308

Twelve additional fish were recaptured from the previous years (2015) tagging efforts.

The size (fork length and weight) of age-0 stocked spring fingerling Atlantic Salmon (Table 1.8.3) following approximately five months of growth continues to be low relative to previous years. Average size of Atlantic Salmon at 6th line, Brimstone, and at the Belfountain CA were amongst the smallest recorded since the beginning of the monitoring program. The Meadow site (Forks Provincial Park) was the only stocking location where more than one-half of the stocked Atlantic Salmon are likely to smolt in 2017. Delayed smoltification at the remaining sites may result in higher than anticipated densities following next year's stocking events and fewer smolts produced in subsequent years.

It is noteworthy to mention data collected from two stream sections that were not stocked in 2016 (Ellies and Stuck truck). Fish found at these locations were likely displaced from upstream stocked reaches. Density of YOY Atlantic Salmon were very low at these sites (23 fish collected from roughly 9,000 m^{-2} of sampled habitat) however their mean size was larger than those captured at the nearest upstream stocked reach. Size distributions also indicate a higher proportion of smolts from these locations in 2017 (Table 1.8.3). Data from these locations also confirm the theory that stocked fish stray little from initial stocking locations.

Overall, the decline in the size of YOY Atlantic Salmon continues despite efforts since 2014 to reduce the total density and biomass of stocked fish at each site (Table 1.8.4) while the density of stocked fingerlings, measured the following fall after five months of stream life, continue to meet assessment and recovery targets of 0.05-0.50 fish m^{-2} (Table 1.8.5).

TABLE 1.8.3. Mean fork length and weight of sampled Atlantic Salmon by location and age group in 2016.

Reach	Age 0 Length (mm)	Age 0 Weight (g)	% expected to smolt in 2017	Age 1 and older Length (mm)	Age 1 and older Weight (g)
Meadow (Forks Prov. Park)	101.3	11.8	59	139.1	30.7
Stuck truck (Forks Prov. Park)	103.8	12.3	80	141.0	31.4
Brimstone (Forks Prov. Park)	90.8	8.3	24	138.9	29.9
Ellies (Forks o' Credit Rd.)	99.2	11.7	67	146.3	37.5
Belfountain C.A.	85.1	6.9	9	131.3	24.8
6th Line	83.4	6.6	14	143.8	33.2

TABLE 1.8.4. Estimated population size, density, and biomass of Age-0 Atlantic salmon at spring fingerling stocking locations in the Credit River in 2016.

Reach	Age/size (mm)	Number	Lower 95% CI	Upper 95% CI	Density (No. m^{-2})	Biomass (g m^{-2})
Meadow (Forks Prov. Park)	Age 0 <98	1,002	536	1,790	0.27	2.17
	Age 0 ≥98	1,398	810	2,354	0.37	5.41
Brimstone (Forks Prov. Park)	Age 0 <98	5,247	2,972	8,992	0.82	5.77
	Age 0 ≥98	1,354	550	2,708	0.21	2.70
West Credit Belfountain CA	Age 0 <98	2,586	1,848	3,607	0.75	4.81
	Age 0 ≥98	248	89	489	0.07	0.83

TABLE 1.8.5. 2012-2016 trends in stocked Atlantic Salmon size / biomass at the time of stocking (May) vs size of electrofished Atlantic Salmon (October) and the likelihood of smolting for upper Credit River Main-stem stocking locations. Data for sites in reaches 1-4 as been pooled due to inconsistences of annual stocking.

	May		October	
Year	Stocked size (g)	Stocked biomass (g)	Fall size (g)	% smolt
2012	1.5	152,508	19.3	67
2013	2.02	242,295	16.3	77
2014	3.22	331,311	11.4	63
2015*	2.79	247,745	9.6	42
2016	2	90,229	10.03	42

* indicates year when the reduction of stocked biomass was initiated

1.9 Credit River Atlantic Salmon Smolt Survey

M.D. Desjardins, Lake Ontario Management Unit

Monitoring Atlantic Salmon throughout their life cycle is critical to the success of the Lake Ontario Atlantic Salmon Restoration Program and this information is necessary to choose 'best' management strategies in the future. Collecting information while salmon are "out-migrating" to Lake Ontario is an important fisheries reference point, because it represents the outcome of stream-life and allows biologists to compare stream and lake survival. This is particularly important for the restoration program as it is implementing a stocking strategy that is exploring the use of three stocked life stages (spring fingerlings, fall fingerlings, and spring yearlings), and three strains (LeHave, Sebago, and Lac St. Jean). Assessing the relative contribution/ survival of the strains and life stages will allow for the optimization of the stocking program in the future and in turn improve the chances for restoration.

In 2016, the Lake Ontario Management Unit and Credit Valley Conservation conducted the sixth year of out-migrant sampling on the Credit River using a Rotary Screw Trap. The trap was deployed on April 11 soon after the stocking of spring yearling Atlantic Salmon which occurred on April 6 and 7 at Terra Cotta and Norval. Daily trap sampling occurred for the next 66 days until trap removal on June 16. In 2016, 2,851 fish representing 22 species were collected (Table 1.9.1.). Atlantic Salmon catches in 2016 were high, second only to catches in 2015 (Table 1.9.2.). As in 2015, these high catches are likely due to the close alignment of the dates of yearling stocking (April 6) and the commencement of trapping (April 11).

Tissues from 417 Atlantic Salmon were submitted to MNRF – Aquatic Research and Monitoring Section for genetic analysis to determine strain assignment and parentage (life-stage stocked). The proportion of each strain and life-stage caught in 2016 reflects the amounts of each stocked. The most numerous strain caught across all life-stages was LaHave (85%) (Table 1.9.2.). This strain made up 80% of the spring fingerlings stocked in 2015 and 100% of the spring yearlings stocked in 2016. When examined across the six years of sampling (2011-2016) the catches of Sebago and LaHave are similar comprising 45% and 47% respectively of the catch in years when stocking efforts are comparable between the strains. The Lac St. Jean strain does not represent a significant proportion of the smolt catch in any year, however, this strain was stocked only recently and not in numbers that are comparable to the other strains.

TABLE 1.9.1. List of species collected using the Rotary Screw Trap during 2016.

Species	Catch
Chinook Salmon	1,858
Atlantic Salmon	417
Common Shiner	331
Rainbow Darter	49
Sea lamprey	35
Stonecat	28
Blacknose dace	27
Rainbow Trout	27
Longnose Dace	23
Bluntnose Minnow	15
River Chub	6
Coho Salmon	6
Fathead Minnow	5
White Sucker	5
Hornyhead Chub	4
Golden Shiner	3
Brook Stickleback	3
Creek Chub	3
Johnny Darter	2
Fantail Darter	2
Northern Hog Sucker	1
Emerald Shiner	1
Total	2,851

Once again, the poorest performing life-stage appears to be fall fingerlings. Since the onset of sampling fall fingerlings have never made up more than ten percent of the catch (Table 1.9.2). The most abundant life-stage was spring yearlings. This is the second sampling season where that life-stage dominated the catch at 55%. Prior to 2015, the most abundant life-stage was spring fingerlings (Table 1.9.2). This shift in catch composition reflects changes to the spring yearling stocking strategy that came out of findings of the 2014 Atlantic Salmon Science Workshop. The workshop called for the production of larger spring yearlings to improve their performance. An artifact of producing larger yearlings is a later stocking date. Yearling stocking shifted from mid-march (2011-2013) to early April (2015-2016). Stocking now occurs immediately prior to the commencement of sampling. The fact that yearling catches were low prior to this timing shift likely indicates that spring yearlings out-migrate soon after stocking and during the years when stocking was early (mid-march), the bulk of the yearling out-migration occurred prior to trap deployment. Since 2015, catches are bimodal with an early peak reflecting spring yearling out-migration (mid April) and a later peak (early May) reflecting spring fingerling out-migration (Fig. 1.9.1). Overall, the performance of spring fingerling and spring yearling life-stages seems to be comparable now that the yearling stocking window has changed (Table 1.9.2).

Of interest is the relative abundance of unassigned individuals. These are wild caught fish that cannot be traced back to hatchery mating records. Their abundance has been increasing accounting for over one third of the catch in most years after 2014. The recent increase also seems to be skewed toward Sebago strain unassigned fish. It is important to note that Sebago strain Atlantic Salmon are stocked by New York State and these fish are encountered in Ontario tributaries. Wild crosses between New York and Ontario stocked Sebago strain would produce the unassigned classification; however, the high proportion of these fish in our assessments seems questionable and deserves more detailed assessment.

TABLE 1.9.2. Composition of the out-migrant catch 2011-2016 by stocked life-stage and strain.

				Parentage				
Year	Days sampled	Atlantic Salmon catch	Strain	Fall fingerling	Spring fingerling	Spring yearling	Unassigned	Ambiguous strain
2011	51	227	LaHave	18	150	27	17	
			Sebago					
2012	82	308	LaHave	2	87	2	20	
			Sebago	4	124		12	25
2013	52	227	LaHave	9	107	29	20	
			Sebago	2	59		26	4
			LaHave	12	67	29	19	
2014	51	351	Sebago	6	30	4	99	
			Lac St. Jean	12		20		20
			LaHave	30	23	246	15	
2015	71	798	Sebago	1	11	158	214	
			Lac St. Jean	1	3		6	20
2016	66	417	LaHave	4	44	207	67	
			Sebago		14		17	
			Lac St. Jean		4			22
Totals	373	2328		101	723	722	532	91

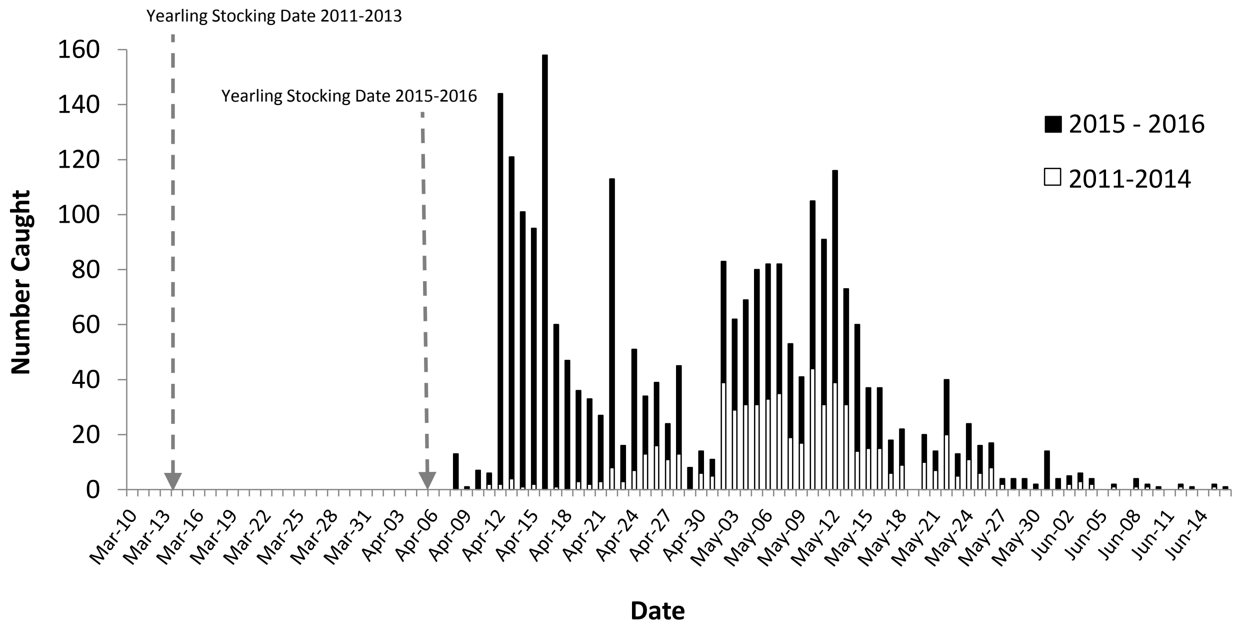


FIG. 1.9.1. Timing of the Atlantic Salmon catch 2011-2016. Catches have been pooled (2011-2014) and (2015-2016) to display the shift in catch following the implementation of stocking changes initiated in the spring of 2014. Note that high water events in 2014 delayed sampling until late April in that year.

1.10 Juvenile Chinook Assessment

M.J. Yuille, Lake Ontario Management Unit

In recent years, the Lake Ontario Chinook Salmon Mass Marking Study indicated 40-60% 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 2016, modifications to the survey resulted in the sampling of six Lake Ontario tributaries, which included: Bronte Creek, Oakville Creek, Duffins Creek, Wilmot Creek, Ganaraska River and Shelter Valley Creek. While the over-arching objectives of the juvenile Chinook assessment program remained intact (quantifying naturalized Chinook Salmon production), modifications were made to the program to allow for the development of a new assessment tool known as otolith microchemistry. Once refined, 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.

During 2016, juvenile Chinook Salmon were surveyed by electrofishing in six Lake Ontario tributaries (Table 1.10.1). The survey took place over three days spanning May 10-12, 2016. With the exception of Oakville Creek, only one site was visited per tributary (Tables 1.10.1 and 1.10.2).

Estimated catches of age-0 Chinook Salmon were highest in Wilmot Creek (1,573.80 fish/site); approximately 5X higher than the Ganaraska River (279.57 fish/site) and Shelter Valley Creek (249.40 fish/site; Figure 1.10.1 and Table 1.10.1). Wilmot Creek had the highest age-0 Chinook Salmon biomass (8.83 g/m^2) followed by Shelter Valley Creek (3.25 g/m^2) and Ganaraska River (0.94 g/m^2; Table 1.10.1).

Chinook Salmon parr/smolts will be collected in the spring over the next two years to establish the micro-chemical baseline for the otoliths. 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 1.10.1. Location, sampling date site dimensions and abundance estimates (number, linear density (fish/m) and biomass (g/m^2)) of age-0 Chinook Salmon in six Lake Ontario tributaries in 2016. The abundance was estimated for each species at each site using: N = catch + (catch / (1/(1-0.2617)*mean weight*0.27116)-1). The spatial coordinates are at the downstream end of each site.

Site	Latitude	Longitude	Date	Site width (m)	Site length (m)	Estimated no.	No./m	g/m^2
	Bronte Creek							
BN04	43° 24.35'	79° 44.47'	May 10	12.70	108.00	143.81	1.33	0.14
	Oakville Creek							
OA02	43° 27.62'	79° 45.16'	May 10	17.66	35.00	17.10	0.49	0.04
OA06	43° 27.19'	79° 41.54'	May 10	8.00	55.00	11.07	0.20	0.03
	Duffins Creek							
DU06	43° 51.21'	79° 03.74'	May 11	14.02	62.00	101.57	1.64	0.16
	Wilmot Creek							
WMA10	43° 54.81'	78° 36.60'	May 11	8.38	28.70	1573.80	54.84	8.83
	Ganaraska River							
GN10	43° 59.36'	78° 19.72'	May 11	15.50	26.00	279.57	10.75	0.94
	Shelter Valley Cr.							
SE09	44° 00.04'	77° 59.70'	May 12	6.47	16.00	249.40	15.59	3.25

TABLE 1.10.2. Catch by species of fish in Lake Ontario tributaries during electrofishing surveys in 2016.

Site	Date	Sea lamprey	Coho salmon		Chinook salmon		Rainbow trout		Atlantic salmon		White sucker	Carps and minnows	Hornyhead chub	River chub	Pugnose shiner	Common shiner	Fathead minnow	Blacknose dace	Longnose dace	Creek chub	Stonecat	Rock bass	Rainbow darter	Fantail darter	Johnny darter	Mottled sculpin
			Age-0	1+	Age-0	1+	Age-0	1+	Age-0	1+																
	Bronte Creek																									
BN04	May 10	1	--	--	48	--	--	--	--	--	--	12	--	61	2	--	--	--	37	--	10	3	19	17	--	--
	Oakville Creek																									
OA02	May 10	--	--	--	6	--	--	--	--	--	--	10	--	--	1	13	--	--	13	--	4	--	12	14	--	--
OA06	May 10	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Duffins Creek																									
DU06	May 11	--	--	--	34	--	--	1	1	--	--	--	--	--	--	1	--	43	49	1	1	--	6	--	29	--
	Wilmot Creek																									
WM10	May 11	--	--	--	522	--	--	18	--	--	3	--	--	--	--	--	--	--	5	--	--	--	--	--	--	16
	Ganaraska River																									
GN10	May 11	--	1	--	93	--	--	11	--	1	--	--	46	--	--	--	1	117	1	--	--	--	--	--	--	--
	Shelter Valley Cr.																									
SE09	May 12	--	--	--	83	--	--	20	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

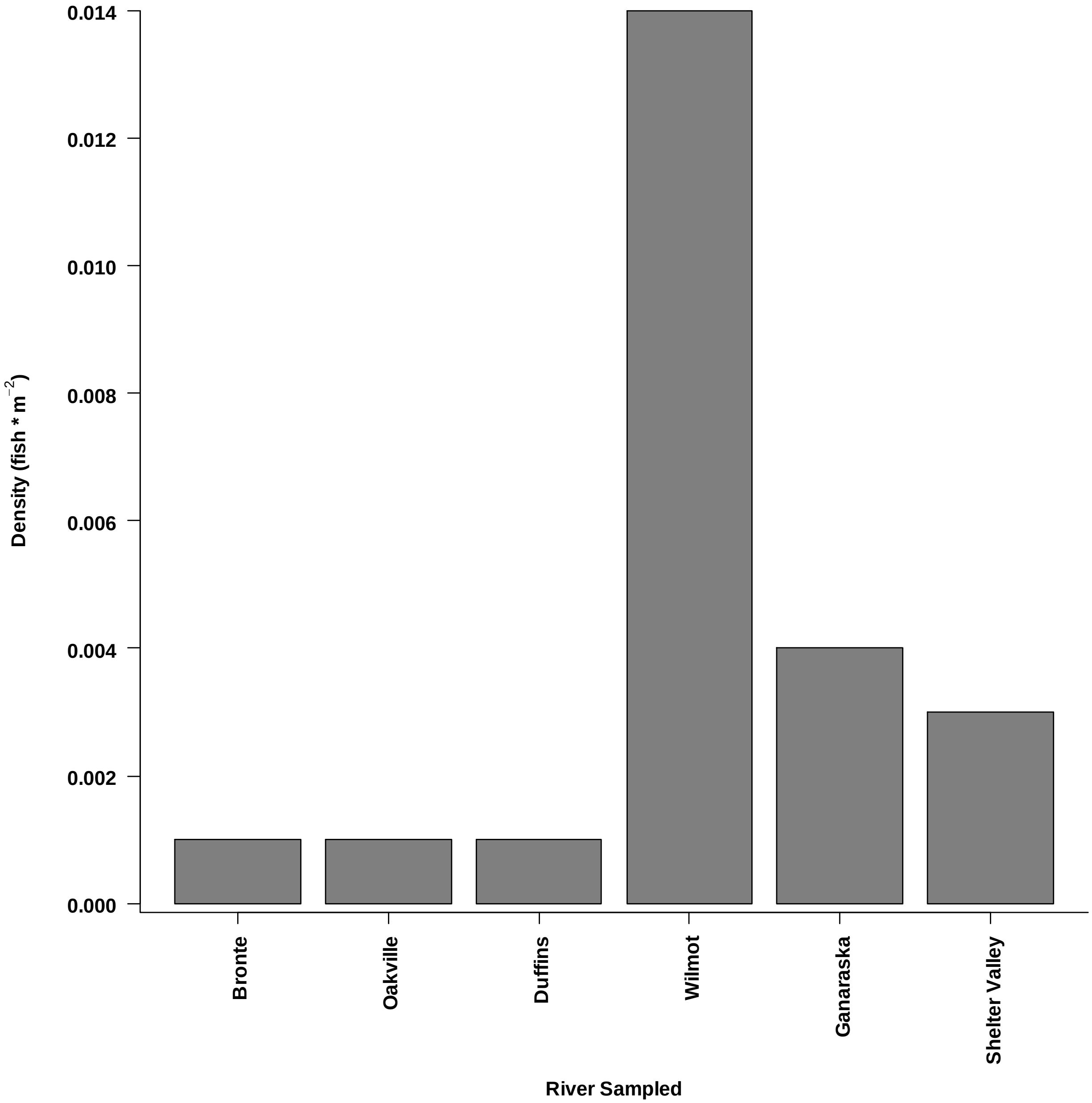


FIG. 1.10.1. Linear density (fish/m^2) of Chinook Salmon in 2016 at sites in six Lake Ontario tributaries (Bronte Creek, Oakville Creek, Duffins Creek, Wilmot Creek, Ganaraska River and Shelter Valley Creek).

1.11 Lake Ontario Spring Prey Fish Trawling

J.P. Holden, M.J. Yuille, J.A. Hoyle Lake Ontario Management Unit, MNRF
M.G. Walsh, B.C. Weidel Lake Ontario Biological Station, USGS
M.J. Connerton Cape Vincent Fisheries Station, NYSDEC

Since 1978 the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Geological Survey (USGS) have annually conducted 100-120 bottom trawl tows, primarily in US waters in early spring, 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 safe stocking levels of predator species (i.e. Chinook Salmon and Lake Trout).

In 2016, the Ontario Ministry of Natural Resources and Forestry (OMNRF) joined the spring trawl survey for the first time, and an additional 46 Canadian sites were sampled. Trawling at Hamilton and Toronto (shallow sandy sites) was conducted by the USGS, while deep Toronto sites, Oshawa, Cobourg, Prince Edward County and in the Kingston Basin were sampled by OMNRF (Fig. 1.11.1). A total of 188 sites conducted throughout the lake were sampled in 2016 (46 in Canadian waters, 142 in US waters) spanning bottom depths from 8-225m (25-743 ft.) between April 19th and May 10th.

As a whole, the survey generally samples depths in proportion to the lake area (Fig. 1.11.2) however there are differences in how those samples are distributed between jurisdictions (Fig. 1.11.3). The south shore has well distributed coverage as most depths between 8-200m can be surveyed at each transect. Bottom trawling along the north shore is less uniform due to a lack of

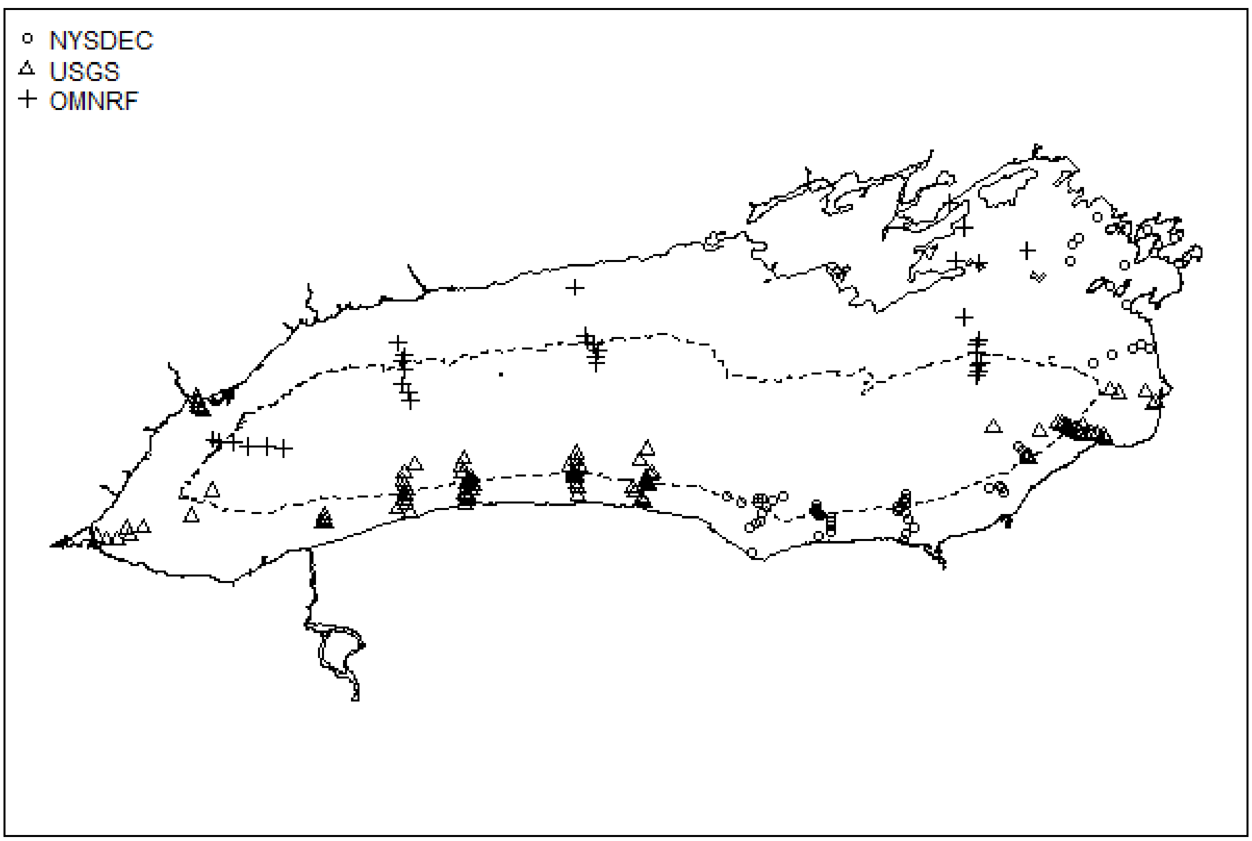


FIG. 1.11.1. Geographic distribution of trawl sites conducted by MNRF, USGS and NYSDEC.

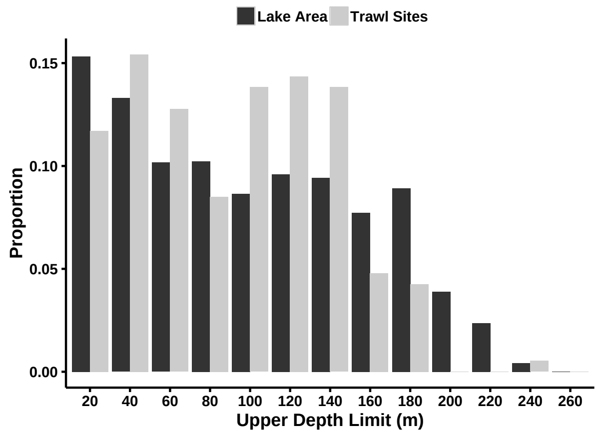


FIG. 1.11.2. Depth distribution of trawl sites relative to the lake area at depth.

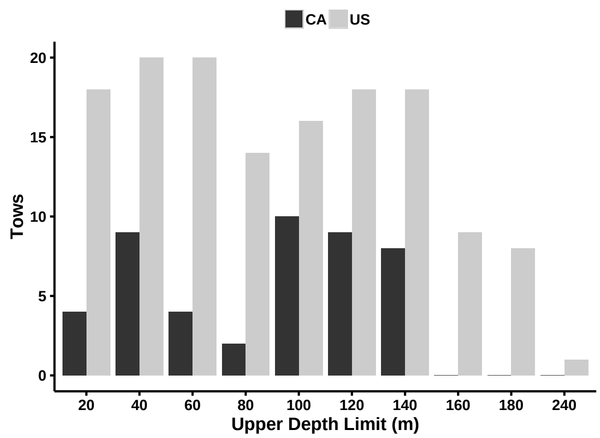


FIG. 1.11.3. Comparison of depth distribution of trawls conducted in US and Canadian water.

suitable trawl sites at shallower depths. Attempts to trawl at depths shallower than 80 m at the current sites have consistently resulted in snags and torn trawl nets. Depths greater than 80 m, however, tend to be more bottom trawl friendly and thus there is an emphasis on conducting trawls at those depths along the north shore. During the day, in early spring, most Lake Ontario Alewife are found near the lake bottom in the warmer, deeper water (75 m – 150 m) thus trawl sites in depths greater than 80 m provide suitable index sites for Alewife. Additionally, shallow tows (<40 m) in Ontario waters occur disproportionately in the Kingston Basin. Efforts continue to seek suitable trawl locations along the north shore portion of the main lake utilizing new technology such as side-scan sonar.

All vessels followed a standardized trawl protocol that utilized a polypropylene mesh bottom trawl referred to as "3N1" (see Table 1.11.1 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. A target of 10 min tow time was set for the survey as was a standardized 3:1 warp to bottom depth ratio.

Species diversity varied between sites and depths (Fig. 1.11.4). Overall 20 different fish species were captured in the survey however 12 species were caught in five or fewer trawls. Rainbow Smelt, Alewife and Round Goby were the most commonly encountered species occurring in 47%, 41% and 36%, of the trawls, respectively. The ten most common species are listed in Table 1.11.2.

Spatial distribution of abundance is presented in Fig. 1.11.5. Alewife density is significantly higher than the other species (10-100x greater) and is presented with a different scale to maintain spatial trends. Rainbow Smelt and Round Goby abundance appears higher along

TABLE 1.11.1. Gear specifications for the polypropylene mesh bottom trawl referred to as "3N1", and equipped with rubber discs that elevate the footrope off bottom to minimize catches of dreissenid mussels.

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

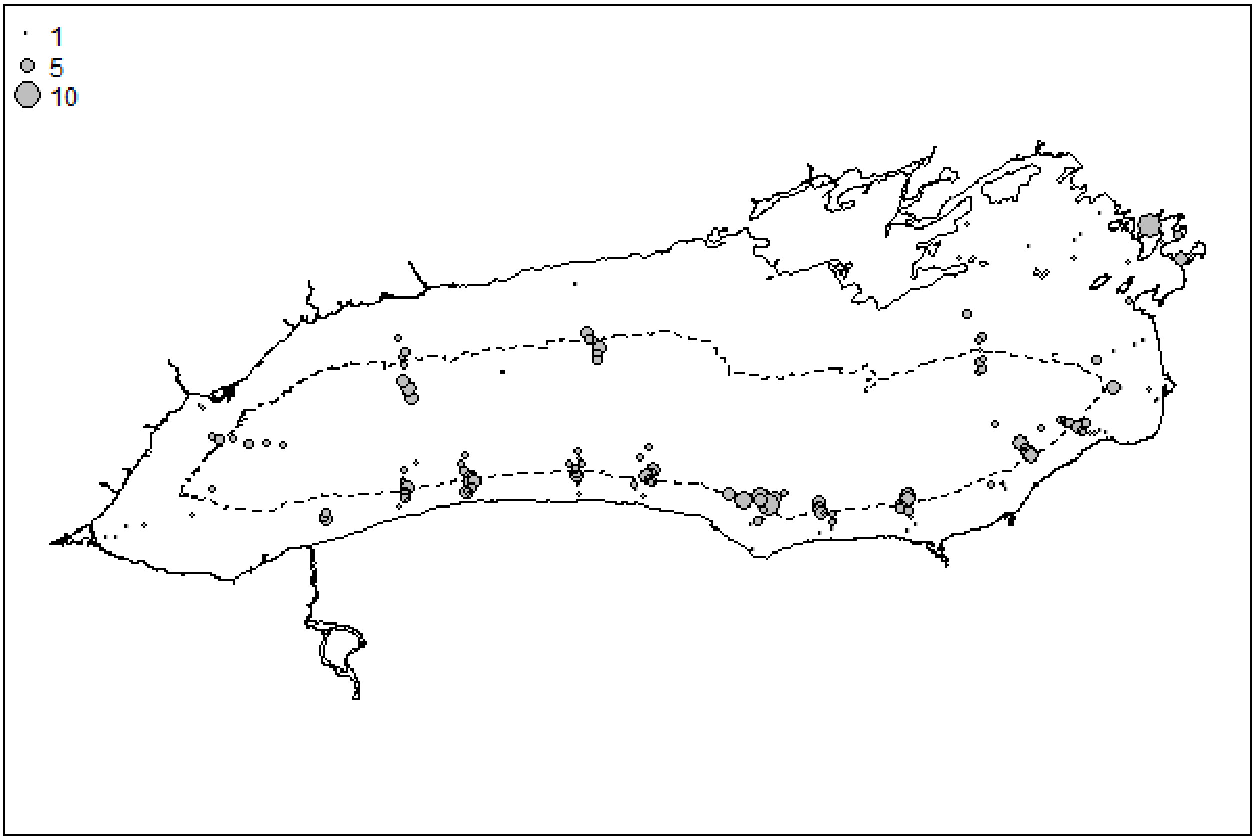


FIG. 1.11.4. Species diversity per trawl site. Points are scaled to number of species caught ranging from 1 to 10 species at the most diverse site.

TABLE 1.11.2. Ten most common species caught during the 2016 spring bottom trawl survey.

Species	Number of Trawl Sites	Percentage of Sites
Rainbow smelt	90	48%
Alewife	78	41%
Round goby	68	36%
Deepwater sculpin	51	27%
Lake trout	46	24%
Slimy sculpin	28	15%
Threespine stickleback	19	10%
Yellow perch	15	8%
Lake whitefish	5	3%
Spottail shiner	4	2%

the south shore whereas Alewife seemed to have a patchy distribution throughout the lake. The higher abundance of Rainbow Smelt and Round Goby along the south shore may be related to available trawl sites in optimum depths (i.e. <100 m). Rainbow Smelt and to a lesser degree Round Goby, have abundances in depths shallower than 100 m (Fig. 1.11.6) and the number of sites trawled in those depths is greater on the south shore. Alewife catches peak between 80-100 m and while Deepwater Sculpin abundance peaks between 120-150 m there is generally an increasing trend with depth.

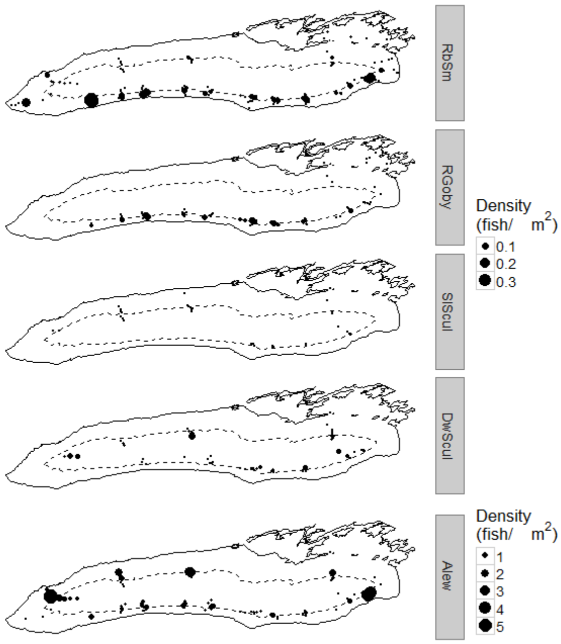


FIG. 1.11.5.Relative density (fish/m^2) of common species (Alewife, Rainbow Smelt, Round Goby, Slimy Sculpin and Deepwater Sculpin) catches throughout the survey area.

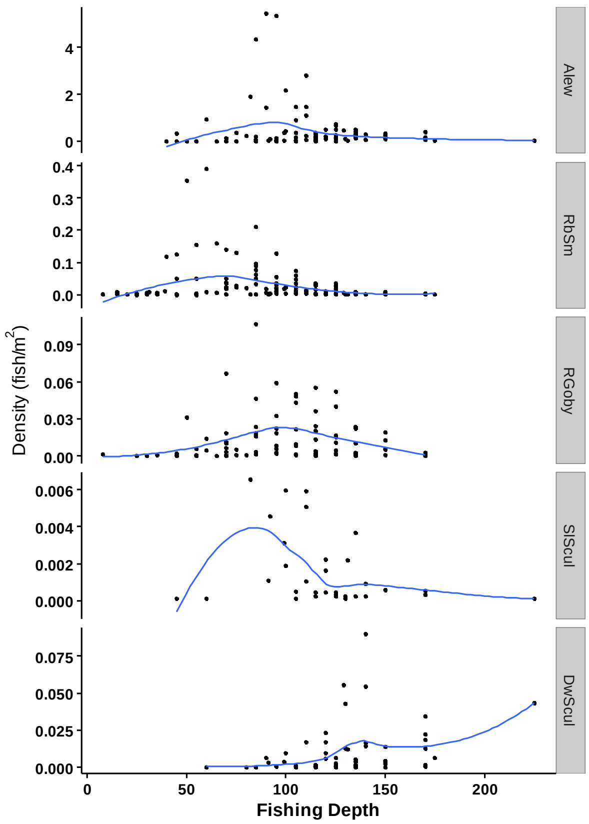


FIG. 1.11.6. Relative density (fish/m^2) of common prey species (Alewife, Rainbow Smelt, Round Goby, Slimy Sculpin and Deepwater Sculpin) by trawl depth.

1.12 Lake Ontario Fall Benthic Prey Fish Assessment

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

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

A benthic prey fish assessment in the main basin of Lake Ontario has typically only been conducted by the US Geological Survey (USGS). The historical survey assessed prey fish along six southern-shore, US transects in depths from 8 - 150 m. 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). This section will emphasize lake wide results. Species specific results are reported in the Status of Stocks section of this report (Section 7).

The 2016 survey consisted of 142 trawls conducted from October 3-19 throughout the entire lake (Fig. 1.12.1). As a whole, the survey

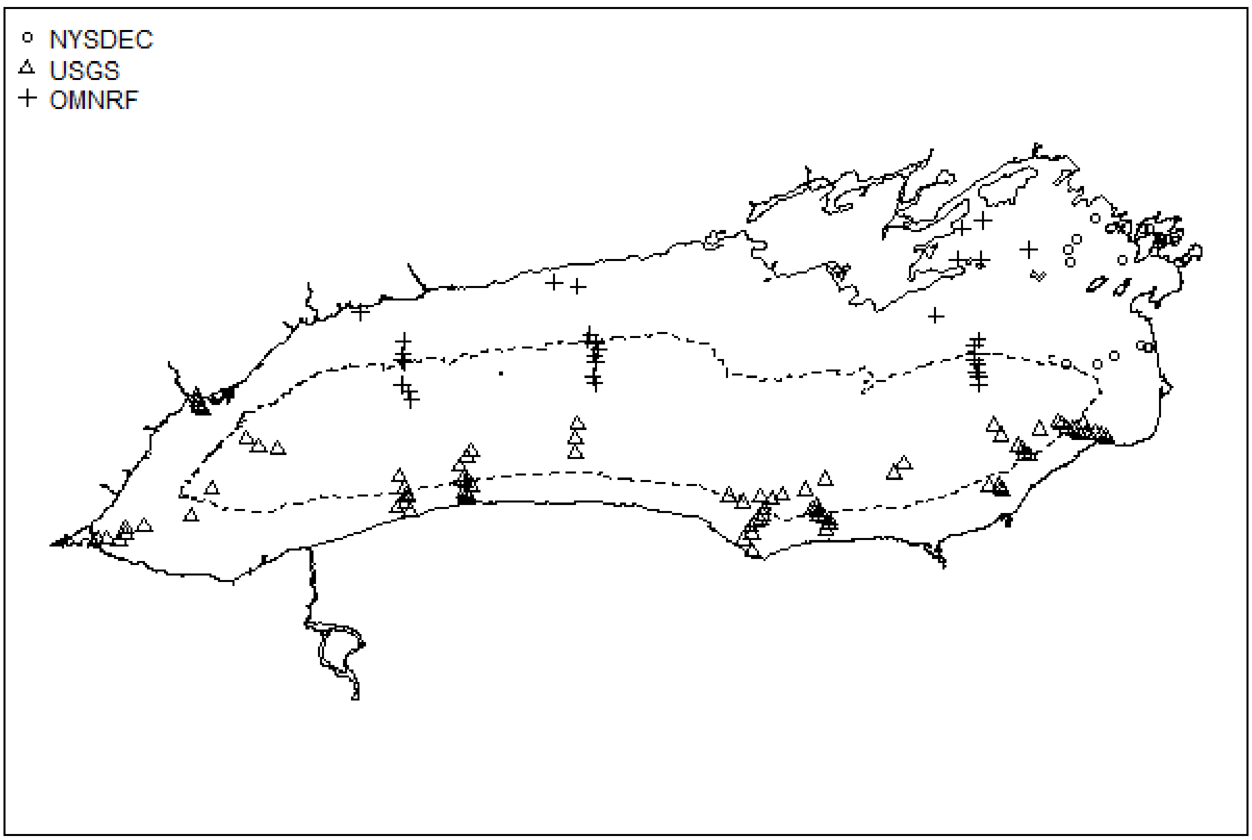


FIG. 1.12.1. Geographic distribution of trawl sites conducted by MNRF, USGS and NYSDEC.

generally samples depths in proportion to the lake area (Fig. 1.12.2) however there are differences in how those samples are distributed between jurisdictions (Fig. 1.12.3). Shallow tows (<40m) in Ontario waters are largely confined to the Kingston Basin. Efforts continue to find suitable trawl locations along the north shore portion of the main lake to improve the spatial coverage of this survey.

All vessels used a similar trawl (3/4 Yankee Standard, see Section 1.3 for specifications) however doors and warp ratios varied between vessels. Depth loggers were used on USGS and OMNRF trawls to provide estimates of true bottom time in order to standardize catches to area swept.

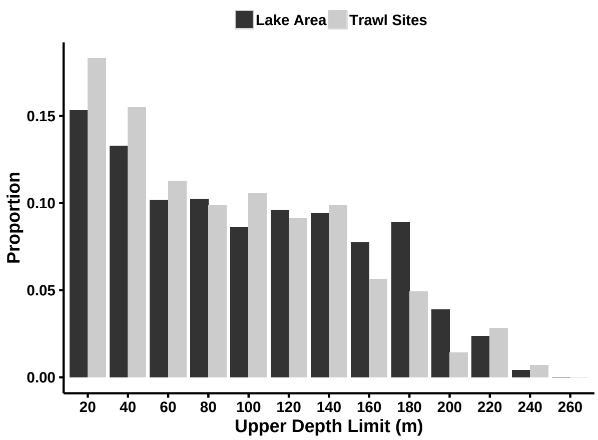


FIG. 1.12.2. Depth distribution of trawl sites relative to the lake area at depth.

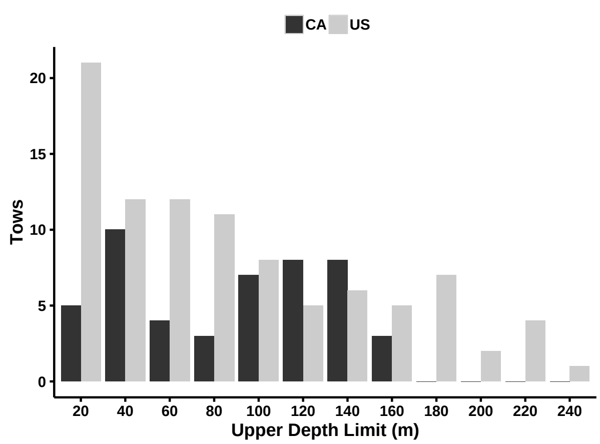


FIG. 1.12.3. Comparison of depth distribution of trawls conducted in US and Canadian water.

Species diversity varied between sites (Fig. 1.12.4). Overall 34 different fish species were captured in the survey however 20 species were encountered in five or fewer trawls. Alewife was the most common species encountered in catches (86% of trawls) followed by Round Goby (71%), Rainbow Smelt (61%), Deepwater Sculpin (44%) and Slimy Sculpin (33%) (Table 1.12.1).

Spatial distribution of abundance is presented in Fig 1.12.5. Alewife and Round Goby densities were highest and are consistently found throughout the lake. Both Alewife and Rainbow Smelt are thought to be mostly pelagic (suspended) at this time of the year, so this benthic survey may not accurately reflect their distribution and density. Bottom depth has a strong effect on species abundance. Round Goby occupy depths shallower than Slimy Sculpin which are shallower than Deepwater Sculpin (Fig. 1.12.6).

TABLE 1.12.1. Percentage of trawls in which the ten most common species occurred.

Species	% Trawl Sites
Alewife	86
Round Goby	70
Rainbow Smelt	61
Deepwater Sculpin	44
Slimy Sculpin	33
Yellow Perch	16
Lake Trout	15
Gizzard Shad	9
Brown Bullhead	8
Spottail Shiner	8

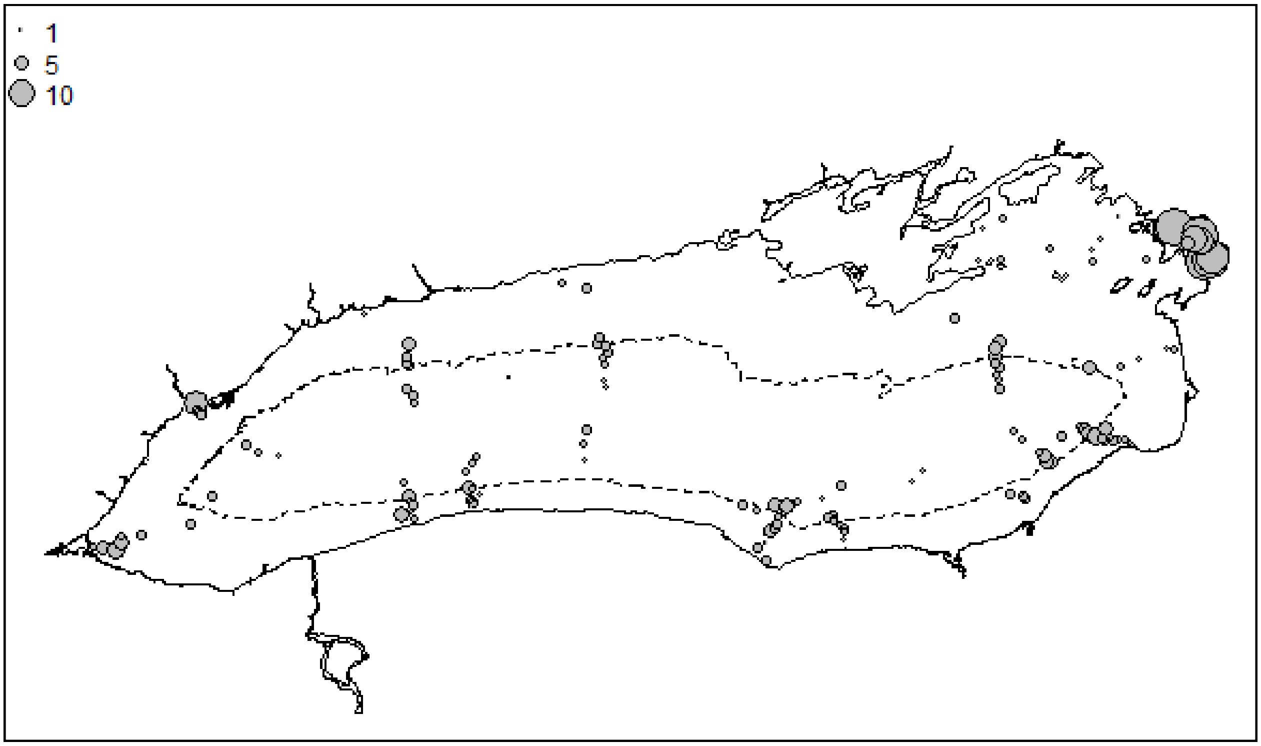


FIG. 1.12.4. Species diversity per trawl site. Points are scaled to number of species caught ranging from 1 to 10 species at the most diverse site.

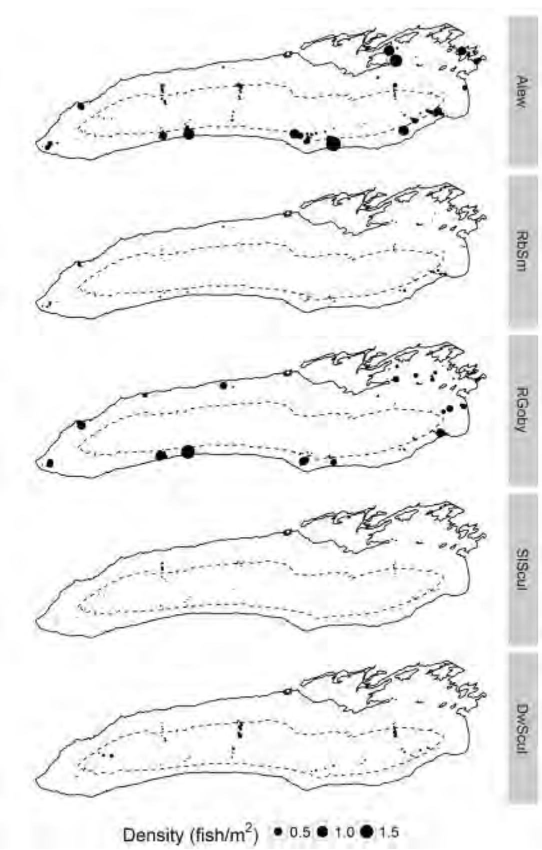


FIG. 1.12.5. Relative density (fish/m^2) of the most common species (Alewife, Rainbow Smelt, Round Goby, Slimy Sculpin and Deepwater Sculpin) catches throughout the survey area

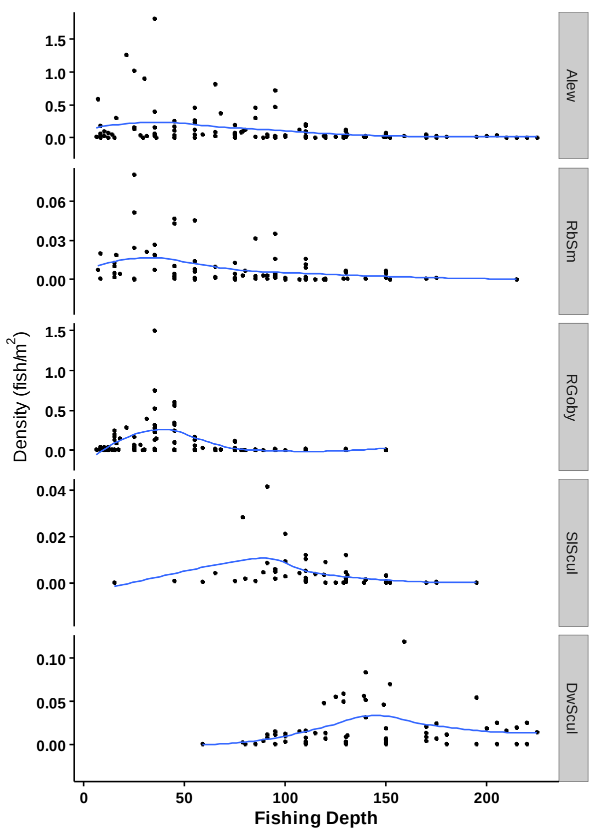


FIG. 1.12.6. Relative density (fish/m^2) of common prey species (Alewife, Rainbow Smelt, Round Goby, Slimy Sculpin and Deepwater Sculpin) by trawl depth.

2. Recreational Fishery

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

C. Lake, Lake Ontario Management Unit

Fisheries Management Zone 20 (FMZ20) Council provides recommendations to the Lake Ontario Manager regarding the management of the Lake Ontario recreational fishery. The FMZ 20 Council has spent many hours reviewing information, attending meetings, listening to issues, discussing options and providing advice. In 2016, the Council provided a great deal of discussion and input on the question of appropriate stocking levels of predatory fishes (specifically, Chinook Salmon and Lake Trout), in light of back-to-back weaker than anticipated Alewife year-classes in 2013 and 2014 (Section 7.6). This has required participation in several face-to-face meetings as well as some council members representing Ontario at a bi-national forum with stakeholders from New York State. In April, a Trout and Salmon Symposium was held in Port Credit, that was very well attended, and co-hosted by MNRF's Lake Ontario Management Unit and the Port Credit Trout and Salmon Association.

Many of our volunteer clubs (council-affiliated and others) also help with the physical delivery of several management programs. Multiple clubs help with the planning and implementation of Lake Ontario's net pen rearing initiatives for Chinook Salmon (Section 6.2). Others help with the annual delivery of our stocking program through the operation of community based hatcheries. The Napanee Rod and Gun Club helps MNRF meet its stocking targets by rearing Brown Trout. The Credit River Anglers stock Rainbow Trout and Coho Salmon. The Metro- East Anglers, through their operation of the Ringwood hatchery, help the province meet its Rainbow Trout, Brown Trout, Atlantic Salmon, and Coho Salmon targets. Volunteers at the Ganaraska River-Corbett Dam Fishway spend many hours ensuring the fishway is operating properly, installing and maintaining the fish counter, helping to assess the spring Rainbow Trout population, and helping with fall Chinook Salmon egg collection. Numerous anglers / clubs also participate regularly by supplying catch and harvest information in our volunteer angler diary programs.

2.2 Western Lake Ontario Boat Angling Fishery

M. J. Yuille and N.J. Jakobi, Lake Ontario Management Unit

Stocking of Coho Salmon and Chinook Salmon by New York State and Ontario in the late 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 6.1, 8.2, 8.5) creating a world-class fishery. Significant natural reproduction of Rainbow Trout and Chinook Salmon has further added to the quality of angling in Lake Ontario. OMNRF has surveyed this fishery in most years since 1977. This survey provides the only statistics for this fishery in Ontario waters and is the primary source for biological monitoring of salmon and trout in the Ontario waters of Lake Ontario. We have relied on catch rates to index the abundance of these salmon and trout populations. Moreover, this survey has provided a broad geographic and seasonal array of biological samples.

This fishery was monitored at boat launch ramps during April to the end of August from the Niagara River to Wellington (Fig. 2.2.1). The survey design was similar to most previous surveys in the past three decades. The survey was temporally and spatially stratified by month and sectors (respectively, Fig. 2.2.1). Catch, harvest and effort information were obtained through angler interviews at selected high-effort ramps (one in each sector) after fishing trips were completed. Fishing effort was monitored by counting boat trailers at all ramps on a weekly basis. We limited interviews to the Niagara and Hamilton sectors in April and May, as past surveys indicated effort was sparse elsewhere during these months. Anglers were surveyed in all sectors from June to August. Fishery statistics for marina-based anglers were estimated based on the 2011 marina based fishery scaled to the 2016 ramp based fishery.

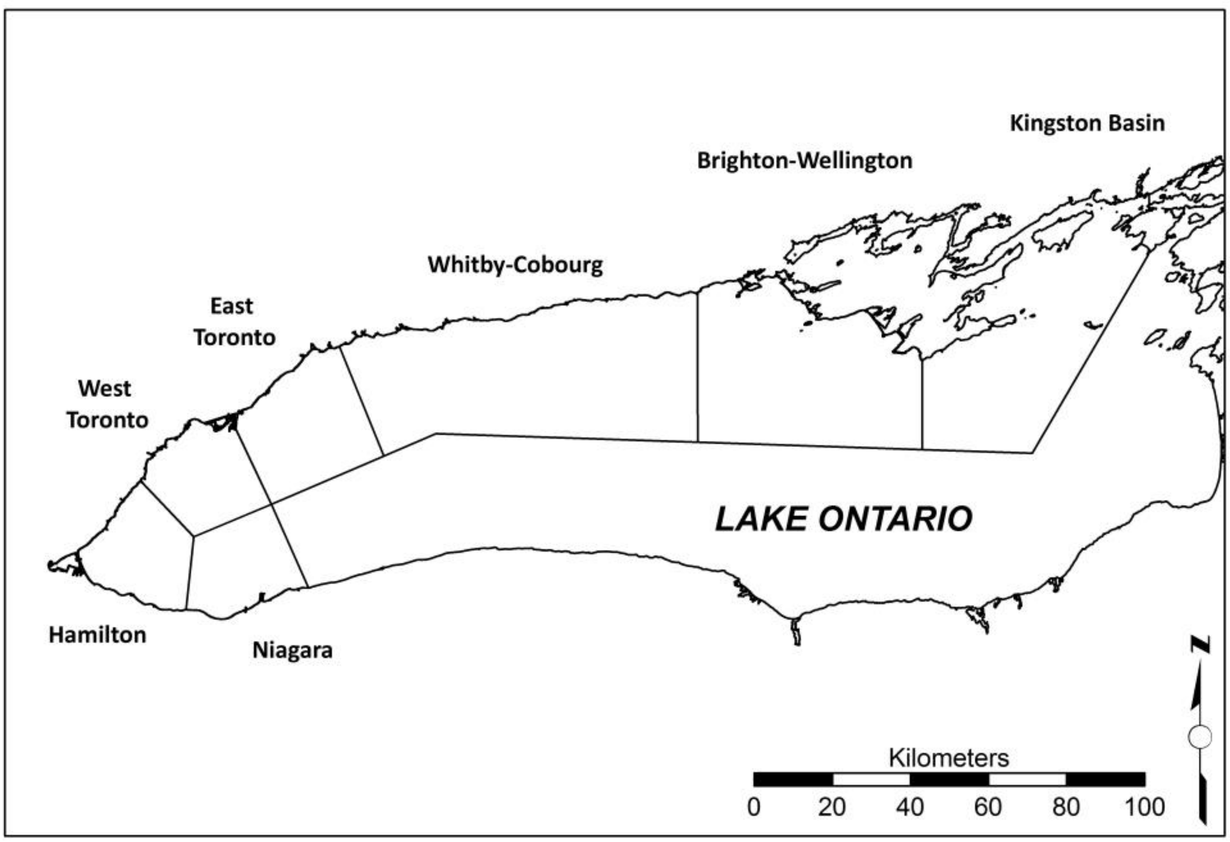


FIG. 2.2.1. Spatial stratification of OMNRF Western Lake Ontario Angler Survey. Kingston Basin was not surveyed in 2016.

Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario for 1977 to 2016 are provided in Table 2.2.1. Angling effort in 2016 (353, 945 angler-hrs; Fig. 2.2.2) has not varied greatly since 1994 (Fig. 2.2.2). The catches of Chinook Salmon remain high in 2016, however catches of Rainbow Trout and Coho Salmon declined significantly since the last survey in 2013 (Table 2.2.1; Fig. 2.2.3). Chinook Salmon dominated the catch (49,779), followed by Rainbow Trout (18,109), Lake Trout (6,814) and Coho Salmon (5,746). Together they represented about 97% of the total catch of all species. Of the six aforementioned salmon and trout species, anglers primarily targeted Chinook Salmon (77% of angling effort), followed by Rainbow Trout (49%) and Coho Salmon (20%; Fig. 2.2.3). Catch rates for the time series from 1977-2016 show major shifts in salmon and trout populations and the quality of angling in Lake Ontario (Fig. 2.2.3). In 2016, catch rates for Chinook Salmon were higher than the previous survey in 2013, while catch rates for Rainbow Trout in 2016 were significantly lower than 2013 (Fig. 2.2.4).

TABLE. 2.2.1. Angling statistics for the salmon and trout fishery in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2016. Anglers were only allowed to fish with one rod prior to 1998.

	Catch						Harvest						Effort	
Year	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

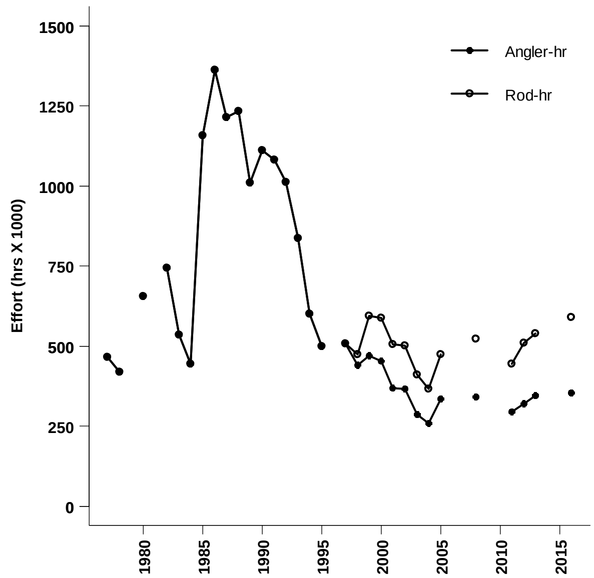


FIG. 2.2.2. Fishing effort (angler hours and rod hours) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2016. Anglers were only allowed to fish with one rod prior to 1998.

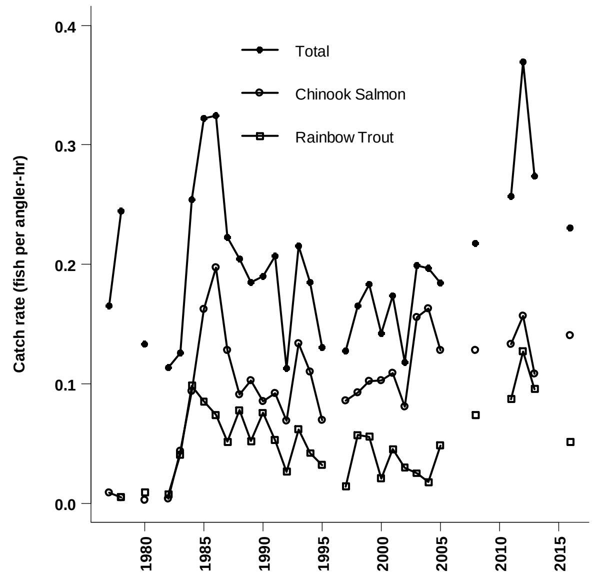


FIG. 2.2.4. The catch rate (number of fish per angler hour) of salmon and trout in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 to 2016.

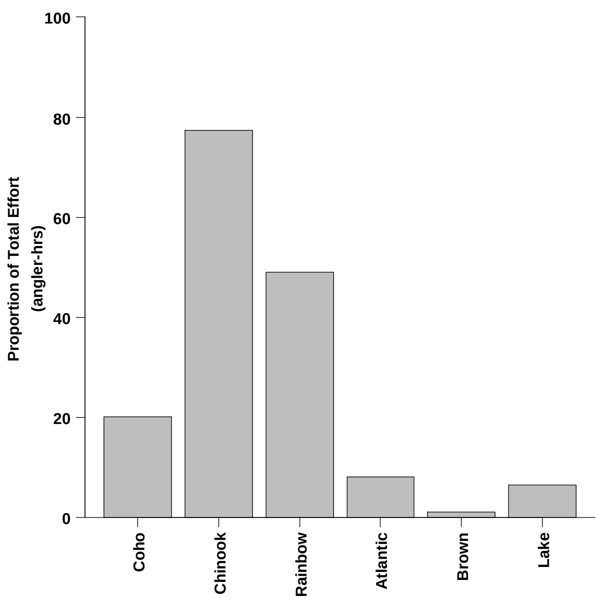


FIG. 2.2.3. The proportion of angling effort (angler hours) for specific salmon and trout species relative to the total estimated angling effort in 2016.

2.3 Lake Ontario Volunteer Angler Diary Program

M. J. Yuille, Lake Ontario Management Unit

A mass-marking and tag monitoring study was initiated in 2008 by NYSDEC and OMNRF to determine the origin (stocked or wild), distribution, and movement of Chinook Salmon in Lake Ontario (see Section 2.2). All Chinook Salmon stocked into Lake Ontario from 2008-2011 were marked with an adipose fin clip and a portion were also tagged with a coded-wire tags. Lake Ontario anglers have been contributing to the collection of data on Lake Ontario salmonids, including these marked Chinook Salmon, through a volunteer diary program. Since 2011, anglers have participated in a volunteer diary program reporting catch, biological and fin clip information on Chinook Salmon from their annual fishing trips. In 2014, the angler diary program expanded to collect catch and effort information as well as biological information on all Lake Ontario salmonid species (Coho Salmon, Chinook Salmon, Rainbow Trout, Atlantic Salmon, Brown Trout and Lake Trout) caught. This information was collected again in 2016.

In 2016, 15 boats (anglers originating from Ontario and Québec, Fig. 2.3.1) participated in the program; a decrease of four participants from 2015. Anglers participating in the diary program fished from April to October out of ports spanning from the Niagara River to Wellington, providing good temporal and spatial distribution of fishery information (see Section 2.2, Fig. 2.2.1). Of all participants, 53% were affiliated with an angling club and 13% were charter boat operators. In 2016, anglers made 286 fishing trips and recorded data on 1,078 Lake Ontario salmonids (Tables 2.3.1 and 2.3.2). Anglers were asked to record location (nearest port), disposition (kept or released), fish lengths and weights as well as examine every salmonid landed for fin clips.

Of the five salmonid species, Chinook Salmon were targeted most frequently and represented the highest catch in 2016 (Fig. 2.3.2 and Tables 2.3.1, 2.3.2 and 2.3.3). Similar to

FIG. 2.3.1. Geographical distribution of participants in the 2016 Lake Ontario Volunteer Angler Diary program. Image courtesy of Google Earth.

TABLE 2.3.1. Distribution of angler catches and targets (in brackets) for the six Lake Ontario salmonid species across seven months (April – September 2016) as reported in the 2016 Lake Ontario Angler Diary Program.

2016 Lake Ontario Angler Diary								
Month	Number of Trips	Coho Salmon	Chinook Salmon	Rainbow Trout	Atlantic Salmon	Brown Trout	Lake Trout	Total
April	8	1 (3)	0 (7)	1 (3)	--	6 (7)	6 (4)	14 (24)
May	34	19 (11)	53 (31)	9 (5)	1 (0)	0 (2)	23 (7)	105 (56)
June	51	13 (14)	121 (50)	22 (14)	--	0 (6)	10 (10)	166 (94)
July	110	43 (37)	385 (110)	57 (51)	4 (1)	0 (24)	17 (10)	506 (233)
August	70	6 (16)	161 (69)	57 (28)	2 (1)	2 (15)	14 (7)	242 (136)
September	13	0 (2)	31 (13)	10 (4)	--	0 (1)	4 (2)	45 (22)
Total	286	82 (83)	751 (280)	156 (105)	7 (2)	8 (55)	74 (40)	1,078 (565)

TABLE. 2.3.2. Distribution of angler catch and targets (in brackets) for the six Lake Ontario salmonid species across six sector locations as reported in the 2016 Lake Ontario Angler Diary Program. See Section 2.2 Fig. 2.2.1 for a map of the six defined areas.

2016 Lake Ontario Angler Diary								
Sector	Number of trips	Coho Salmon	Chinook Salmon	Rainbow Trout	Atlantic Salmon	Brown Trout	Lake Trout	Total
Brighton-Wellington	64	1 (4)	214 (63)	6 (8)	--	0 (6)	23 (4)	244 (85)
Whitby-Cobourg	57	11 (39)	129 (57)	12 (52)	--	0 (32)	1 (7)	153 (187)
East Toronto	2	--	7 (2)	5 (0)	--	--	1 (0)	13 (2)
West Toronto	--	--	--	--	--	--	--	--
Hamilton	94	45 (25)	253 (90)	88 (26)	4 (0)	3 (4)	28 (17)	421 (162)
Niagara	67	25 (15)	139 (66)	44 (18)	3 (2)	5 (13)	21 (12)	237 (126)
Undefined	2	11 (39)	129 (57)	12 (52)	--	0 (32)	1 (7)	153 (187)
Total	286	82 (83)	751 (280)	156 (105)	7 (2)	8 (55)	74 (40)	1,078 (565)

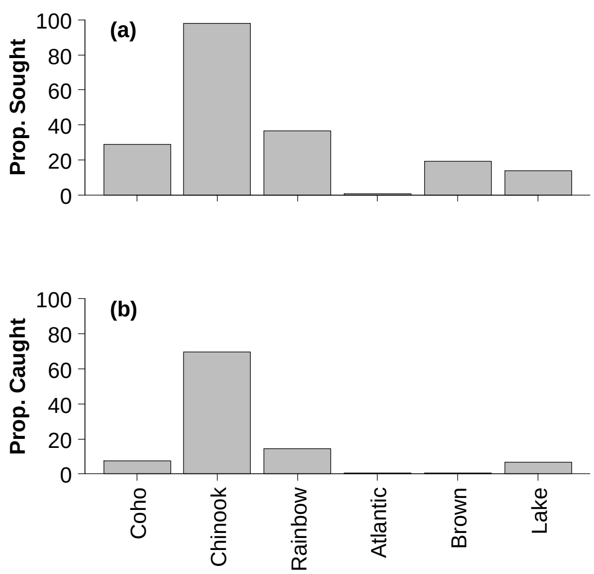


FIG. 2.3.2. Proportion of species sought (a) and caught (b) from all 286 trips recorded in the 15 Lake Ontario Volunteer angler diaries submitted to the Lake Ontario Management Unit. Species labels include Coho Salmon (Coho), Chinook Salmon (Chinook), Rainbow Trout (Rainbow), Atlantic Salmon (Atlantic), Brown Trout (Brown) and Lake Trout (Lake).

2014, Rainbow Trout were the second most frequently targeted and caught species in 2016 (Fig. 2.3.2, Tables 2.3.1 and 2.3.2).

In 2016, Brown Trout had the highest percent harvest (88% of catch) followed by Coho Salmon (61%), Rainbow Trout (60%), Chinook Salmon (45%) and Lake Trout (19%) (Fig. 2.3.3). No clips were observed on any Coho or Atlantic Salmon caught. Thirty percent of Lake Trout, 3% of Chinook Salmon and 2% of Rainbow Trout caught had fin clips (Fig. 2.3.4).

Seasonal and geographical catch summaries are provided in Tables 2.3.1 and 2.3.2 (respectively). Most angling trips were recorded in July and August (63% combined) and originated predominantly from Hamilton, Niagara and Brighton-Wellington sectors (79% of trips). Chinook Salmon were predominantly caught in July and August (73% of catch) and in the Hamilton and Whitby-Cobourg sectors (62%

TABLE 2.3.3. Annual angler participation and spatial distribution of Chinook Salmon captured in the Lake Ontario Volunteer Angler Diary Program, 2011-2016. See Section 2.2 Fig. 2.2.1 for a map of the six defined areas.

			Chinook Salmon caught							
Survey Year	Number of volunteer anglers	Number of trips	Niagara	Hamilton	West Toronto	East Toronto	Whitby-Cobourg	Brighton-Wellington	Undefined	Total catch
2011	26	626	757	19	370	120	309	635	47	2,257
2012	31	645	676	195	367	39	324	488	147	2,236
2013	21	424	246	145	84	24	105	331	10	945
2014	26	474	376	183	32	4	38	193	3	829
2015	19	435	116	331	51	48	222	130	59	957
2016	15	301	139	253	--	7	129	214	129	871
Total	138	2,905	2,310	1,126	904	242	1,127	1,991	395	6,267

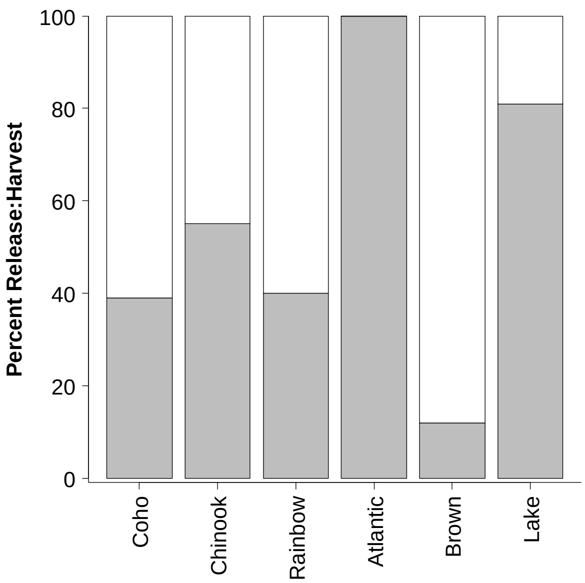


FIG. 2.3.3. Percent released (grey) and harvested (white) for each salmonid species (Coho Salmon (Coho), Chinook Salmon (Chinook), Rainbow Trout (Rainbow) Atlantic Salmon (Atlantic), Brown Trout (Brown) and Lake Trout (Lake)) reported in the 2016 Lake Ontario Angler Diary Program.

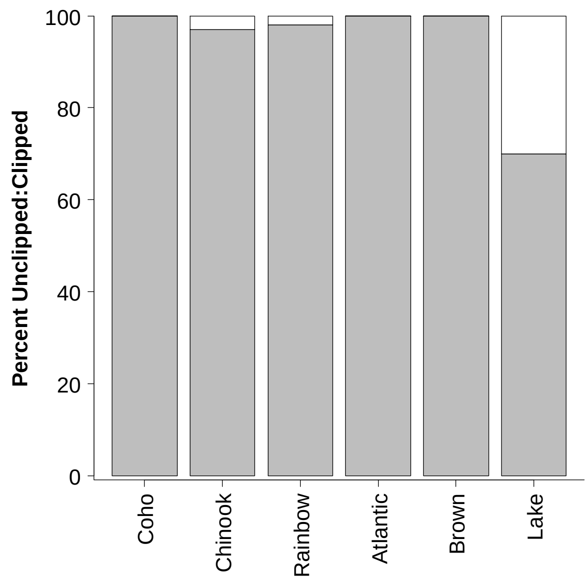


FIG. 2.3.4. Percent composition of unclipped (grey) vs clipped (white) for each salmonid species (Coho Salmon (Coho), Chinook Salmon (Chinook), Rainbow Trout (Rainbow) Atlantic Salmon (Atlantic), Brown Trout (Brown) and Lake Trout (Lake)) reported in the 2016 Lake Ontario Angler Diary Program..

combined). Most Rainbow Trout were caught in July and August (73% combined) and in the Niagara and Hamilton sectors (84% combined). Lastly, Lake Trout were predominantly caught in the Hamilton, Niagara and Brighton-Wellington sectors (97% of catch) evenly distributed throughout the April to September season (Table 2.3.1).

We would like to thank all Lake Ontario Volunteer Angler Diary participants who generously volunteered their time to collect marking and biological information for this program. Participants that gave permission for their names to appear in this report include: Herman Baughman, Dan Brown, Bill Cuthill, Blair Cyr, Richard Dew, Al van Dusen , Gene Frederick, Ken Herrington, Jean-Marie LaFleche, Jack Laki, Andrew Lalonde, Jean Morneau, Al Oleksuik, Paul Paulin, Stan Smaggas, Shane Thombs and Bob Warner.

2.4 Bay of Quinte Ice Angling Survey

J. A. Hoyle, Lake Ontario Management Unit

Only the ice-fishing component of the Bay of Quinte recreational angling fishery was monitored in 2016; the open-water fishery was not surveyed. The ice-fishing survey was previously surveyed in 2014. The ice-fishing survey was conducted from Trenton in the west to east of Glenora (Fig. 2.4.1). Angling effort was measured using aerial counts of anglers and huts (two days per week: one weekday and one weekend day). An on-ice angling component to the survey was also planned but poor ice conditions prevented this component of the survey from being completed. Total angling effort was estimated based on the proportion of aerial counts, per survey strata, in 2016 (Table 2.4.1) compared to 2014 and assuming only eight weeks of fishing in 2016 compared to eleven weeks in 2014. Similarly, catch and harvest per unit effort estimates from 2014 were applied to the 2016 effort estimate to obtain an estimate of Walleye catch and harvest in the 2016 ice fishery.

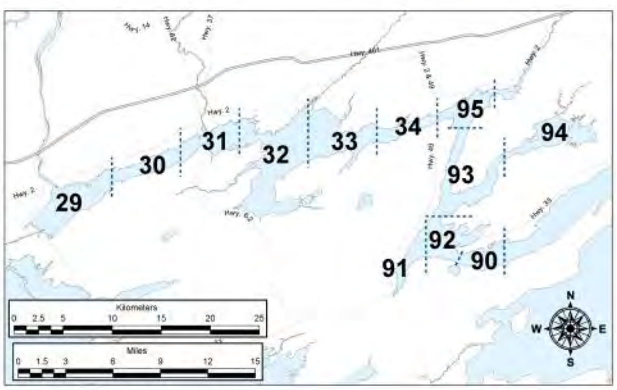


FIG. 2.4.1. Map of the Bay of Quinte showing angling survey areas from Trenton in the west to east of Glenora.

Ice conditions were very poor. Sixteen aerial flights were conducted from Jan 14-Mar 1, 2016 (Table 2.4.1). The maximum number of ice-huts counted during aerial flights was 338 huts (January 23); while the maximum number of on-ice anglers observed was 237 (January 30). Figure 2.4.2 and Table 2.4.2 summarize ice-fishing survey results for 1993-2016. The 2016 survey estimated a total of 61,333 hours of ice-fishing effort. An estimated 6,524 and 4,430 Walleye were caught and harvested, respectively.

TABLE 2.4.1. Aerial angler (on-ice) and hut (portable and permanent) counts by date and day type for 16 aerial flights during winter 2016.

		Angling mode			
Date	Day type	On-ice	Portable hut	Permanent hut	Total count
Jan-14	Weekday	8	7	-	15
Jan-20	Weekday	24	37	7	68
Jan-23	Weekend	76	300	38	414
Jan-25	Weekday	42	43	35	120
Jan-30	Weekend	237	151	24	412
Jan-31	Weekend	48	28	20	96
Feb-05	Weekday	1	1	1	3
Feb-06	Weekend	26	6	2	34
Feb-11	Weekday	-	4	5	9
Feb-13	Weekend	4	48	18	70
Feb-14	Weekend	15	57	23	95
Feb-17	Weekday	6	15	27	48
Feb-21	Weekend	66	55	26	147
Feb-22	Weekday	80	34	31	145
Feb-28	Weekend	92	58	24	174
Mar-01	Weekday	9	14	3	26
Average		46	54	18	117

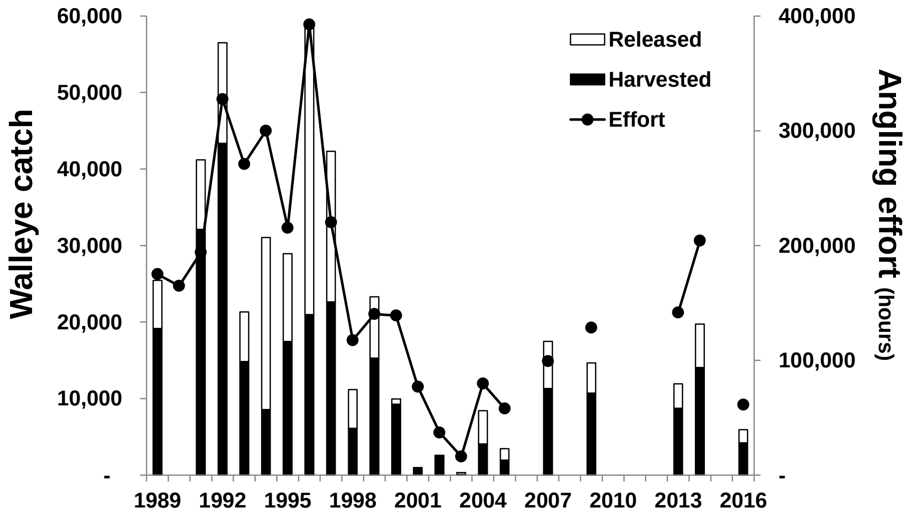


FIG. 2.4.2. Bay of Quinte ice angling fishery statistics, 1989-2016, including angling effort (angler hours), and walleye catch and harvest (number of fish).

TABLE 2.4.2. Bay of Quinte ice angling fishery statistics, 1982-2016, including angling effort (angler hours), 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. *2016 Walleye catch and harvest values were estimated based on 2014 catch and harvest rates.

	Walleye Anglers					
	Effort	Catch rate	Harvest rate	Catch	Harvest	Mean weight (kg)
1982	80,129		0.103		8,223	1.209
1984	108,024		0.091		9,869	1.924
1986	143,960		0.165		23,768	2.272
1988	163,669		0.045		7,416	2.198
1989	175,119	0.145	0.109	25,458	19,147	1.738
1990	164,916					
1991	194,088	0.212	0.165	41,204	32,111	1.909
1992	327,546	0.172	0.132	56,494	43,343	1.388
1993	271,088	0.079	0.055	21,326	14,816	1.603
1994	300,049	0.104	0.029	31,060	8,557	2.239
1995	215,518	0.134	0.081	28,939	17,445	1.900
1996	392,602	0.149	0.053	58,468	20,972	1.563
1997	220,263	0.192	0.103	42,315	22,631	1.563
1998	117,602	0.095	0.052	11,167	6,089	2.327
1999	140,363	0.166	0.109	23,293	15,285	2.300
2000	139,047	0.072	0.066	9,949	9,240	2.359
2001	77,074	0.013	0.012	982	938	2.546
2002	37,129	0.070	0.066	2,601	2,468	2.358
2003	16,237	0.020	0.004	321	70	3.391
2004	79,767	0.105	0.051	8,413	4,075	1.668
2005	58,091	0.059	0.034	3,450	1,947	1.879
2007	99,368	0.176	0.114	17,480	11,313	1.008
2009	128,415	0.114	0.083	14,666	10,695	1.607
2013	141,660	0.084	0.062	11,943	8,716	1.374
2014	204,283	0.097	0.069	19,740	14,044	1.439
2016	61,333	0.097*	0.069*	5,927	4,216	

2.5 Bay of Quinte Volunteer Walleye Angler Diary Program

J. A. Hoyle, Lake Ontario Management Unit

A volunteer angler diary program was conducted during fall 2016 on the Bay of Quinte. The diary program focused on the popular fall recreational fishery for "trophy" Walleye, primarily on the middle and lower reaches of Bay of Quinte. This was the fifth year of the diary program. Anglers that volunteered to participate were given a personal diary and asked to record information about their daily fishing trips and catch (see Fig. 2.5.1). A total of 13 diaries were returned as of February 2017. We thank all volunteer anglers for participating in the program. A map showing the distribution of volunteer addresses of origin is shown in Fig. 2.5.2.

Objectives of the diary program included:

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

Two of the 13 returned diaries reported zero fishing trips. The number of fishing trips reported in each of the remaining 11 diaries ranged from two to 20 trips. Fishing trips were reported for 59 out of a possible 100 calendar days from Sep 3 to Dec 11, 2016. There were from one to four volunteer angler boats fishing on each of the 59 days, and a total of 93 trip reports targeted at Walleye; 33 charter boat trips and 60 non-charter boat trips (Table 2.5.1). Of the 93

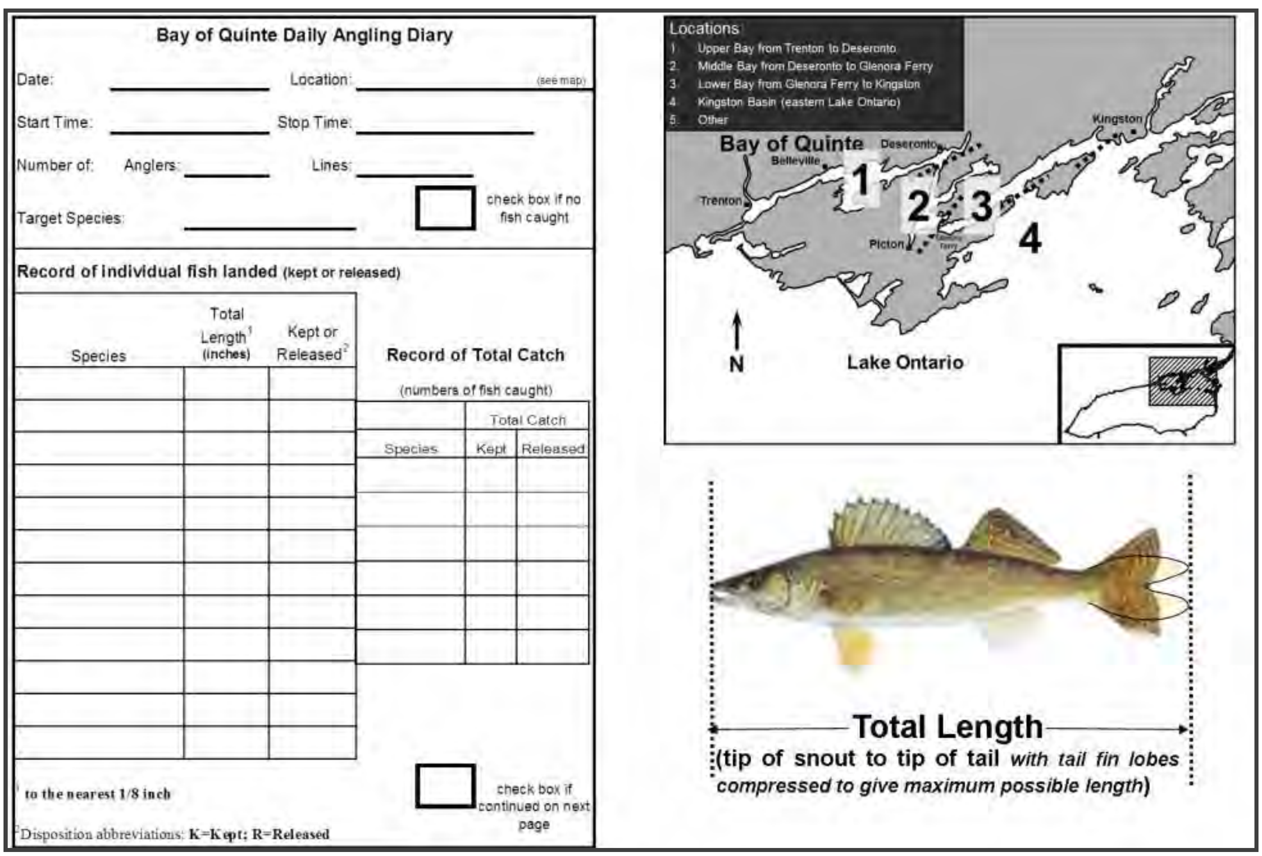


FIG. 2.5.1. Volunteer angler diary used to record information about daily fishing trips and catch.

FIG. 2.5.2. Map showing the distribution of volunteer addresses of origin. Image courtesy of Google Earth.

trips, 71 (76%) were made on Locations 2 and 3, the middle and lower reaches of the Bay of Quinte (see Fig. 2.5.1). The overall average fishing trip duration was 7.2 hours for charter boats and 4.3 hours for non-charter boats, and the average numbers of anglers per boat trip were 4.7 and 1.8 for charter and non-charter boats, respectively (Table 2.5.1). In Location 3, where two lines are permitted, most anglers used two lines (1.9 rods per angler on average).

Fishing Effort

A total of 1,602 angler hours of fishing effort was reported by volunteer anglers (Table 2.5.2). The seasonal pattern of fishing effort is shown in Fig. 2.5.3. Most fishing effort occurred in Location 2 (48%; middle Bay) (Fig. 2.5.4). Location 4 showed increased fishing effort compared to previous years.

Catch

Eight species and a total of 261 fish were reported caught by volunteer anglers. The number of Walleye caught was 184; 112 (61%) kept and 72 (39%) released (Table 2.5.3). The next most abundant species caught was Freshwater Drum (38) followed by Northern Pike (19), White Perch (11), and White Bass (5).

Fishing Success

The overall fishing success for Walleye in fall 2016 was 2.0 Walleye per boat trip or 0.115 fish per angler hour of fishing (Table 2.5.2). Fifty

Table 2.5.1. Reported total number of boat trips, average trip duration, and average number of anglers per trip for charter and non-charter Walleye fishing trips during fall 2012-2016 on the Bay of Quinte.

Year	Trip type	Total number of boat trips	Average trip duration (hours)	Average number of anglers per trip
2012	Charter	121	7.7	4.4
	Non-charter	137	5.6	2.3
2013	Charter	72	7.4	4.0
	Non-charter	83	4.9	2.1
2014	Charter	123	7.5	4.4
	Non-charter	87	5.3	2.3
2015	Charter	118	7.5	4.3
	Non-charter	117	5.3	2.0
2106	Charter	33	7.2	4.7
	Non-charter	60	4.3	1.8

Table 2.5.2. Reported total number of diaries (with at least one reported fishing trip), boat trips and effort, total angler effort, total number of Walleye caught, harvested, and released, average number of Walleye caught per boat fishing trip, average number of Walleye caught per boat hour, average number of Walleye caught per angler hour, and the "skunk" rate (percentage of trips with no Walleye catch) for Walleye fishing trips during fall 2012-2016 on the Bay of Quinte.

	Year				
Statistic	2012	2013	2014	2015	2016
Number of diaries	22	19	20	22	11
Number of boat trips	258	155	210	235	93
Boat effort (hours)	1,694	941	1,375	1,506	498
Angler effort (hours)	5,915	3,093	5,164	5,266	1,602
Catch	542	574	682	436	184
Harvest	291	307	336	285	112
Released	251	267	346	151	72
Fish per boat trip	2.1	3.7	3.3	1.9	2.0
Fish per boat trip	0.320	0.610	0.496	0.289	0.370
Fish per angler hour	0.092	0.186	0.132	0.083	0.115
"Skunk rate"	36%	19%	27%	34%	44%

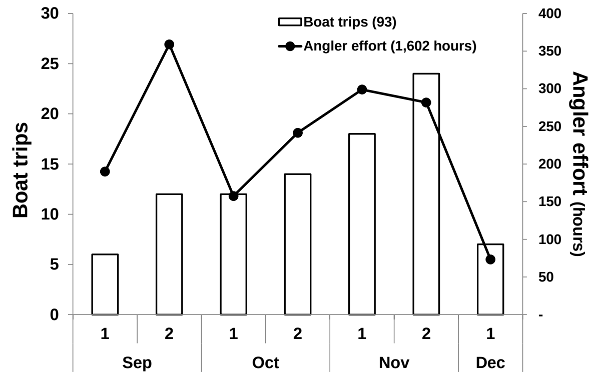


FIG. 2.5.3. Seasonal breakdown (summarized by first and second half of each month from the first half of Sep to the first half of Dec) of fishing effort (boat trips and angler hours) reported by volunteer Walleye anglers during fall 2016 on the Bay of Quinte.

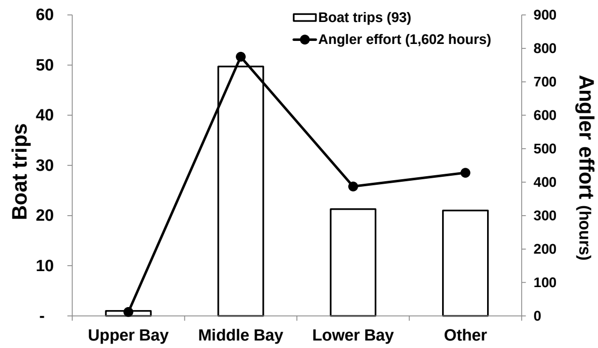


FIG. 2.5.4. Geographic breakdown of fishing effort (boat trips and angler hours) reported by volunteer Walleye anglers during fall 2016 on the Bay of Quinte.

TABLE 2.5.3. Number of fish, by species, reported caught (kept and released) by volunteer anglers during the fall Walleye diary program, 2012 -2016.

	2012		2013		2014		2015		2016	
Species	Kept	Released	Kept	Released	Kept	Released	Kept	Released	Kept	Released
Longnose Gar	0	0	0	0	0	0	0	0	0	1
Chinook Salmon	0	1	0	0	0	2	0	0	0	0
Rainbow Trout	0	0	0	0	0	3	0	0	0	0
Brown Trout	1	0	0	0	0	1	1	0	0	0
Lake Trout	0	1	0	0	0	4	3	10	0	1
Lake Whitefish	0	1	0	0	0	0	0	0	0	0
Northern Pike	1	47	4	20	2	36	2	14	1	18
White Perch	0	0	0	12	0	0	1	0	0	11
White Bass	0	0	0	3	0	7	9	5	0	5
Morone sp.	1	15	0	0	0	0	0	0	0	0
Sunfish	0	0	0	0	0	0	0	2	0	0
Smallmouth Bass	0	0	0	3	1	2	0	1	1	1
Largemouth Bass	0	0	0	0	0	0	0	0	0	0
Yellow Perch	4	32	2	6	0	0	1	0	0	0
Walleye	292	252	307	267	338	350	285	151	112	72
Freshwater Drum	1	43	0	25	1	53	8	81	0	38

-six percent of all boat trips reported catching at least one Walleye ("skunk" rate 44%). Seasonal fishing success, for geographic Locations 2 and 3 combined, is shown in Fig. 2.5.5. Success was highest in late September and low thereafter except for a high catch rate in December (by angler hour). Fishing success was higher in location 2 (middle Bay; 1.7 Walleye per boat trip or 0.128 fish per angler hour) than in Location 3 (lower Bay; 0.7 Walleye per boat trip or 0.033 fish per angler hour).

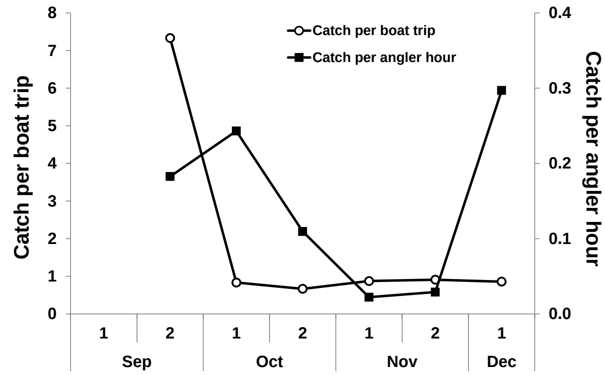


FIG. 2.5.5. Walleye fishing success (catch per boat trip and per angler hour) reported by volunteer Walleye anglers in areas 2 and 3 during fall 2016 on the Bay of Quinte ((summarized by first and second half of each month from the first half of Sep to the first half of Jan).

Length Distribution of Walleye Caught

Ninety-five percent of Walleye caught by volunteer anglers were between 14 and 30 inches in total length (Fig. 2.5.6). Over the five years of the volunteer angler diary program 2,204 Walleye lengths have been reported (Fig. 2.5.7). The proportion of Walleye released was highest for smallest and largest fish and lowest for fish of intermediate size. Only 16% of fish caught that were between 16 and 25 inches were released. Sixty-four percent of fish less than 16 inches and greater than 25 inches were released.

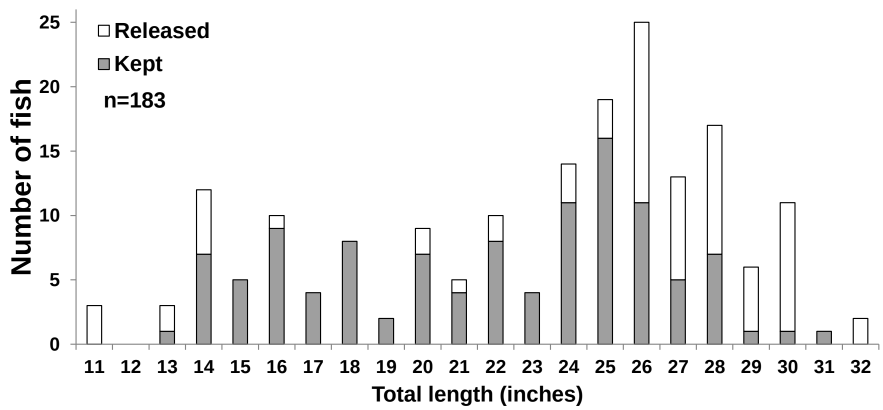


FIG. 2.5.6. Length distribution of 183 Walleye caught (kept and released) by volunteer Walleye anglers during fall 2016 on the Bay of Quinte.

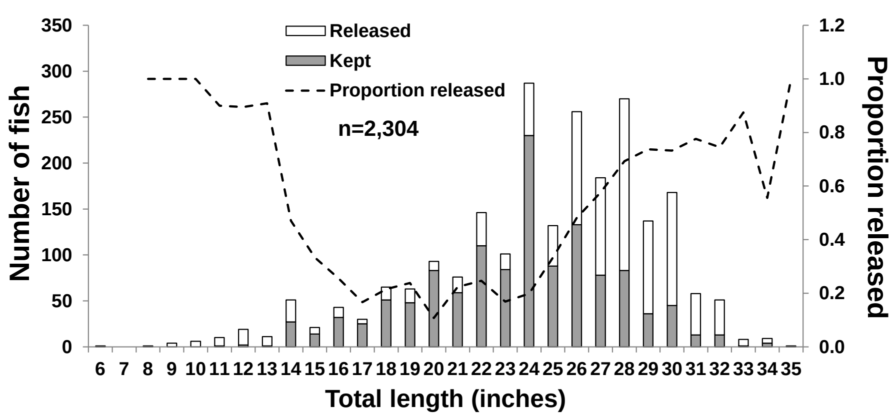


FIG. 2.5.7. Length distribution of 2,304 Walleye caught (kept and released) by volunteer Walleye anglers during fall 2012 to 2016 on the Bay of Quinte. Also shown is the proportion of fish released (dotted line)

3. Commercial Fishery

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

A. Mathers, 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 committee met once during 2016. One of the topics of discussion was the expansion of the American Eel trap and transport program (Section 8.3) to include a fall season. Other notable topics of discussion at the LOLC meeting included status of fish stocks, licence restrictions, quota and harvest levels for Yellow Perch, Lake Whitefish, Northern Pike and Walleye, as well as the quota 'pool' system.

3.2 Quota and Harvest Summary

J. A. Hoyle, Lake Ontario Management Unit

Lake Ontario supports a commercial fish industry; the commercial harvest comes primarily from the Canadian waters of Lake Ontario east of Brighton (including the Bay of Quinte, East and West Lakes) and the St. Lawrence River (Fig. 3.2.1). Commercial harvest statistics for 2016 were obtained from the commercial fish harvest information system (CFHIS) which is managed, in partnership, by the Ontario Commercial Fisheries Association (OCFA) and MNRF. Commercial quota, harvest and landed value statistics for Lake Ontario, the St. Lawrence River and East and West Lakes, for 2016, are shown in Tables 3.2.1 (base quota), 3.2.2 (issued quota), 3.2.3 (harvest) and 3.2.4 (landed value).

The total harvest of all species was 438,826 lb ($632,677) in 2016, up 72,121lb (20%) from 2015. The harvest (landed value) for Lake Ontario, the St. Lawrence River, and East and West Lakes was 335,452 lb ($509,585), 73,935 lb ($101,263), and 29,439 lb ($34,683), respectively (Fig. 3.2.2 and Fig. 3.2.3). Yellow Perch, Lake Whitefish, Sunfish and Walleye were the dominant species in the harvest for Lake Ontario. Yellow Perch was dominant in the St. Lawrence River. Sunfish was the dominant fish in East and West Lakes.

Major Fishery Trends

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

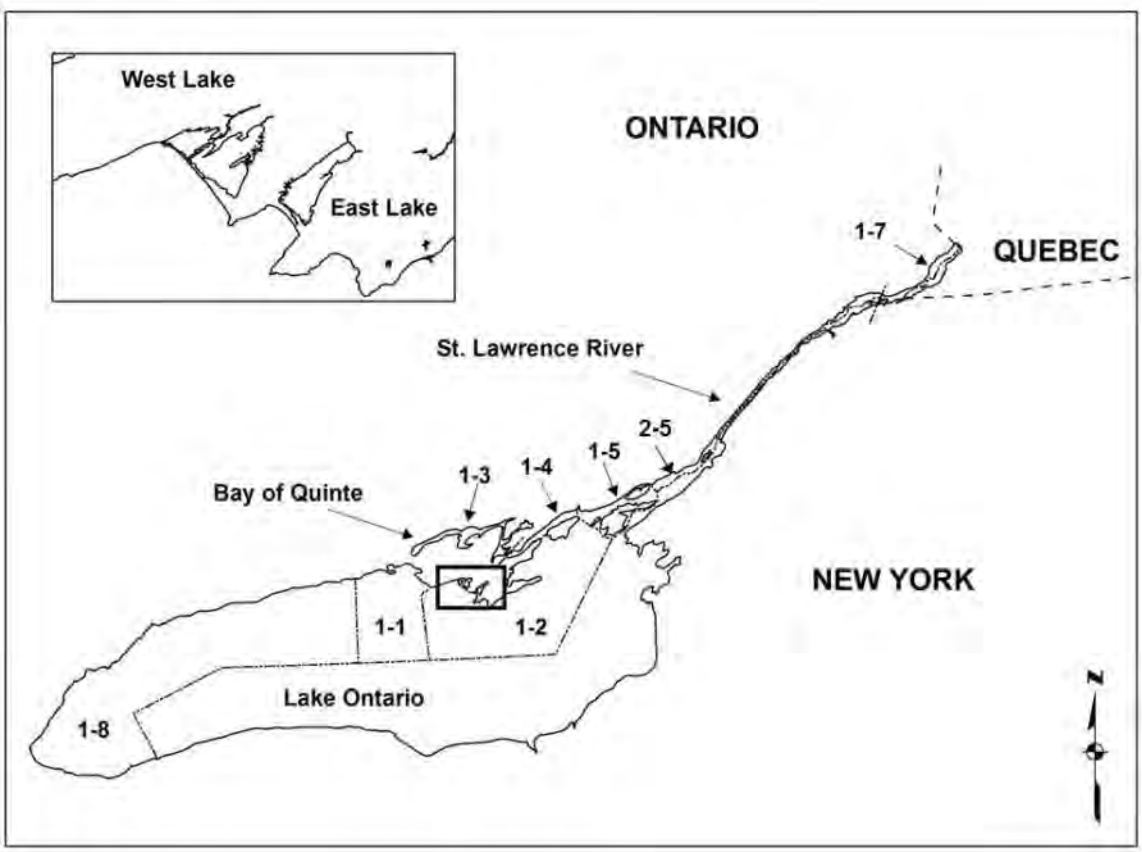


FIG. 3.2.1. Map of Lake Ontario and the St. Lawrence River showing commercial fishing quota zones in Canadian waters.

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), 2016.

	Lake Ontario					St. Lawrence River			East Lake	West Lake	Base Quota by Waterbody		
Species	1-1	1-2	1-3	1-4	1-8	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	Total
Black Crappie	4,540	3,000	14,824	1,100	2,800	14,170	17,590	4,840	3,100	9,850	26,264	36,600	75,814
Bowfin	0	0	0	0	500	0	0	0	0	0	500	0	500
Brown Bullhead	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Whitefish	6,549	97,745	12,307	18,282	208	0	0	0	0	0	135,091	0	135,091
Sunfish	28,130	0	0	0	0	0	0	0	14,600	18,080	28,130	0	60,810
Walleye	4,210	34,431	0	9,452	800	0	0	0	0	0	48,893	0	48,893
Yellow Perch	28,472	114,778	80,742	100,936	10,400	55,181	66,251	18,048	1,120	3,536	335,328	139,480	479,464
Total	71,901	249,954	107,873	129,770	14,708	69,351	83,841	22,888	18,820	31,466	574,206	176,080	800,572

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), 2016.

	Lake Ontario					St. Lawrence River			East Lake	West Lake	Issued Quota by Waterbody		
Species	1-1	1-2	1-3	1-4	1-8	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	Total
Black Crappie	2,820	1,500	11,738	650	1,400	7,085	8,795	4,840	3,100	9,850	18,108	20,720	51,778
Bowfin	0	0	0	0	500	0	0	0	0	0	500	0	500
Brown Bullhead	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Whitefish	360	150,654	6,593	5,681	104	0	0	0	0	0	163,392	0	163,392
Sunfish	28,130	0	0	0	0	0	0	0	14,600	18,080	28,130	0	60,810
Walleye	1,371	14,903	0	32,219	400	0	0	0	0	0	48,893	0	48,893
Yellow Perch	15,644	60,664	70,788	80,482	5,200	31,150	42,069	18,048	1,120	3,536	232,778	91,267	328,702
Total	48,325	227,721	89,119	119,032	7,604	38,235	50,864	22,888	18,820	31,466	491,801	111,987	654,075

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), 2016.

	Lake Ontario					St. Lawrence River			East Lake	West Lake	Totals		
Species	1-1	1-2	1-3	1-4	1-8	1-5	2-5	1-7	1	1	Lake Ontario	St. Lawrence River	All Waterbodies
Black Crappie	487	4	5,421	18	0	2,076	568	201	3	2,195	5,930	2,845	10,973
Bowfin	340	0	1,756	29	0	4,569	1,282	234	191	254	2,125	6,085	8,655
Brown Bullhead	13	35	10,014	73	0	149	1,056	14,256	196	24	10,135	15,461	25,816
Common Carp	362	737	2,052	1,587	0	13	0	0	151	328	4,738	13	5,230
Freshwater Drum	4	94	5,304	11,848	0	0	0	0	0	0	17,250	0	17,250
Cisco	3	213	2,692	802	0	1	0	0	0	33	3,710	1	3,744
Lake Whitefish	356	90,521	4,201	474	0	0	0	0	0	0	95,552	0	95,552
Northern Pike	4,015	1,109	17,038	1,742	0	2,692	0	0	813	2,043	23,904	2,692	29,452
Rock Bass	588	386	3,651	1,301	0	555	777	308	950	1,218	5,926	1,640	9,734
Sunfish	2,040	5	31,788	274	0	2,015	641	464	9,401	8,287	34,107	3,120	54,915
Walleye	985	1,644	0	22,748	0	0	0	0	0	0	25,377	0	25,377
White Bass	0	296	129	6,160	0	0	0	0	0	3	6,585	0	6,588
White Perch	6	72	1,370	607	0	33	0	0	224	1,030	2,055	33	3,342
White Sucker	528	1,412	7,877	2,076	0	140	0	0	670	122	11,893	140	12,825
Yellow Perch	1,751	6,066	41,953	36,395	0	9,528	15,348	17,029	472	831	86,165	41,905	129,373
Total	11,478	102,594	135,246	86,134	0	21,771	19,672	32,492	13,071	16,368	335,452	73,935	438,826

TABLE 3.2.4. Commercial **harvest (lb), price per lb, and landed value** for fish species harvested from the Canadian waters of Lake Ontario and the St. Lawrence River, and the total for all waterbodies including East and West Lakes, 2016.

	Lake Ontario			St. Lawrence River			All Waterbodies		
Species	Harvest	Price per lb	Landed value	Harvest	Price per lb	Landed value	Harvest	Price per lb	Landed value
Black Crappie	5,930	$3.43	$20,317	2,845	$2.69	$7,655	10,973	$3.09	$33,960
Bowfin	2,125	$0.34	$718	6,085	$0.81	$4,944	8,655	$0.58	$5,013
Brown Bullhead	10,135	$0.27	$2,719	15,461	$0.43	$6,719	25,816	$0.39	$10,010
Common Carp	4,738	$0.16	$766	13	$0.30	$4	5,230	$0.16	$846
Freshwater Drum	17,250	$0.10	$1,677	0			17,250	$0.10	$1,677
Cisco	3,710	$0.28	$1,048	1	$0.25		3,744	$0.28	$1,055
Lake Whitefish	95,552	$1.39	$132,597	0			95,552	$1.39	$132,597
Northern Pike	23,904	$0.30	$7,143	2,692	$0.34	$924	29,452	$0.30	$8,710
Rock Bass	5,926	$0.61	$3,594	1,640	$0.75	$1,223	9,734	$0.64	$6,246
Sunfish	34,107	$1.25	$42,562	3,120	$1.15	$3,589	54,915	$1.22	$66,989
Walleye	25,377	$2.62	$66,510	0			25,377	$2.62	$66,510
White Bass	6,585	$0.41	$2,721	0			6,588	$0.41	$2,732
White Perch	2,055	$0.45	$919	33	$0.45	$15	3,342	$0.48	$1,600
White Sucker	11,893	$0.10	$1,226	140	$0.10	$14	12,825	$0.10	$1,316
Yellow Perch	86,165	$2.61	$225,067	41,905	$1.82	$76,176	129,373	$2.27	$293,415
Total	335,452		$509,585	73,935		$101,262	438,826		$632,677

3.2.5) respectively. In 2014, harvest declined again in both major geographic areas. In 2015, harvest declined in the St. Lawrence River and increased slightly in Lake Ontario. Harvest increased significantly in both areas in 2016.

Major Species

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

Yellow Perch

Yellow Perch 2016 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.6. Overall, 27% (129,373 lb) of the Yellow Perch base quota (479,464 lb) was harvested in 2016 up from only 7% harvested the previous year. The highest Yellow Perch harvest came from quota zones 1-3 and 1-4. A very small proportion of base quota was harvested in most quota zones.

Trends in Yellow Perch quota (base), harvest and price-per-lb are shown Fig. 3.2.7. Quota was reduced 20% in 2016 in all quota zones except 1-7 where it remained the same as 2015. Harvest increased in 2016 in all the major quota zones (Fig. 3.2.7).

Lake Whitefish

Lake Whitefish 2016 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.8. Overall, 71% (95,552 lb) of the Lake Whitefish base quota was harvested in 2016. Most of the Lake Whitefish harvest came from quota zone 1-2. Lake Whitefish is managed as one population across quota zones. Therefore, quota can be transferred among quota zones. Issued quota and harvest was significantly higher than base quota in quota zone 1-2 (Fig. 3.2.8). Relatively small proportions of base quota were harvested in quota zones 1-1, 1-3 and 1-4.

Trends in Lake Whitefish quota (base), harvest and price-per-lb are shown in Fig. 3.2.9. Base quota was decreased by 10% in quota zones 1-1, 1-3, and 1-4, and increased in quota zone 1-2 by 15% plus the amount of the decrease in the

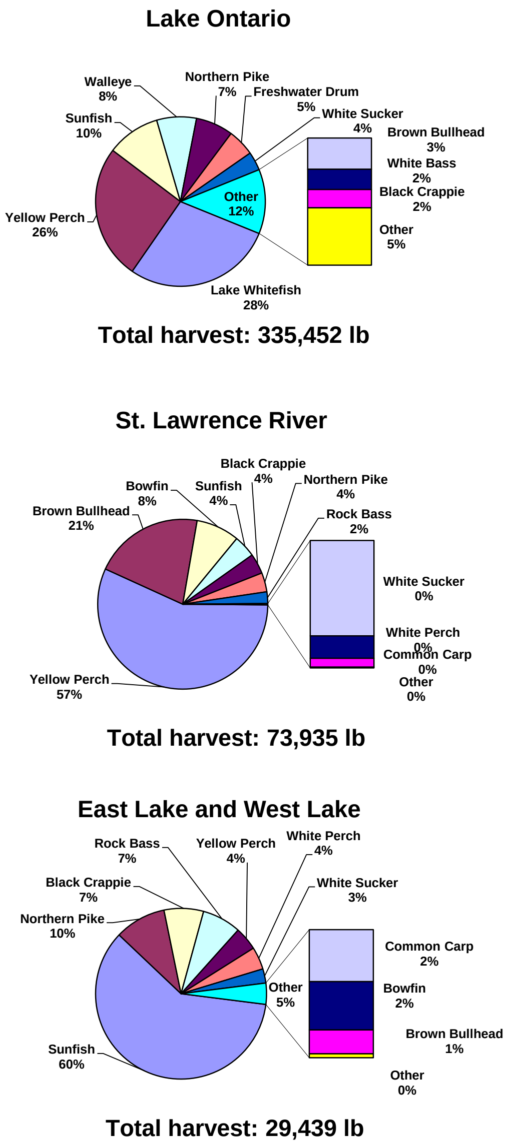


FIG. 3.2.2. Pie-charts showing breakdown of 2016 commercial harvest by species **(% by weight)** for Lake Ontario (quota zones 1-1, 1-2, 1-3, 1-4 and 1-8), the St. Lawrence River (quota zones 1-5, 2-5 and 1-7), and for East and West Lakes combined.

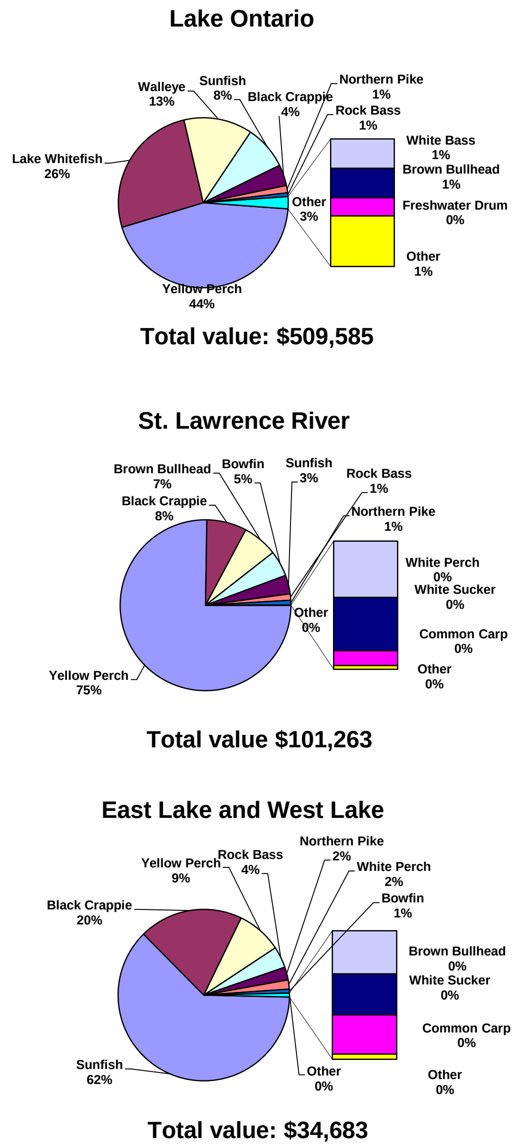


FIG. 3.2.3. Pie-charts showing breakdown of 2016 commercial harvest by species **(% by landed value)** for Lake Ontario (quota zones 1-1, 1-2, 1-3, 1-4 and 1-8), the St. Lawrence River (quota zones 1-5, 2-5 and 1-7), and for East and West Lakes combined.

other three zones. These base quota adjustments reflected variation in annual harvest performance among the quota zones. In 2016, an additional 20% of base quota was issued to a “pool” on November 1.

Seasonal whitefish harvest and biological attributes (e.g., size and age structure) information are reported in Section 3.3. Lake Whitefish price-per-lb declined somewhat in 2016 from peak levels the previous two years.

Walleye

Walleye 2016 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.10. Walleye harvest increased in 2016. Overall, 52% (25,377 lb) of the Walleye base quota (48,893 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

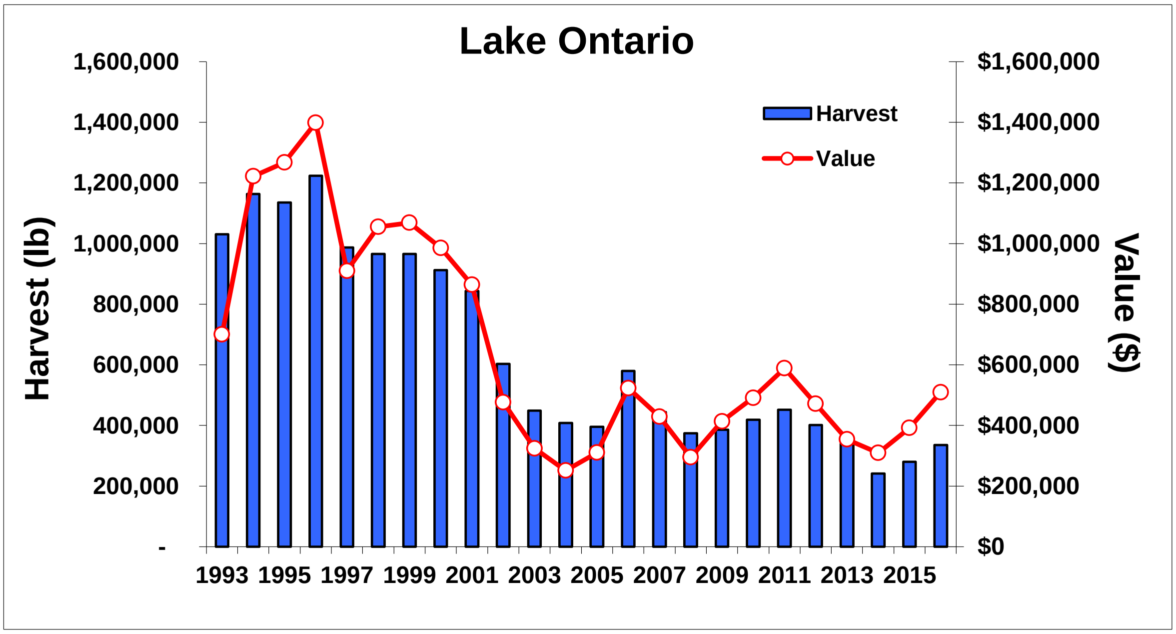


FIG. 3.2.4. Total commercial fishery harvest and value for **Lake Ontario** (Quota Zones 1-1, 1-2, 1-3 ,1-4 and 1-8) 1993-2016.

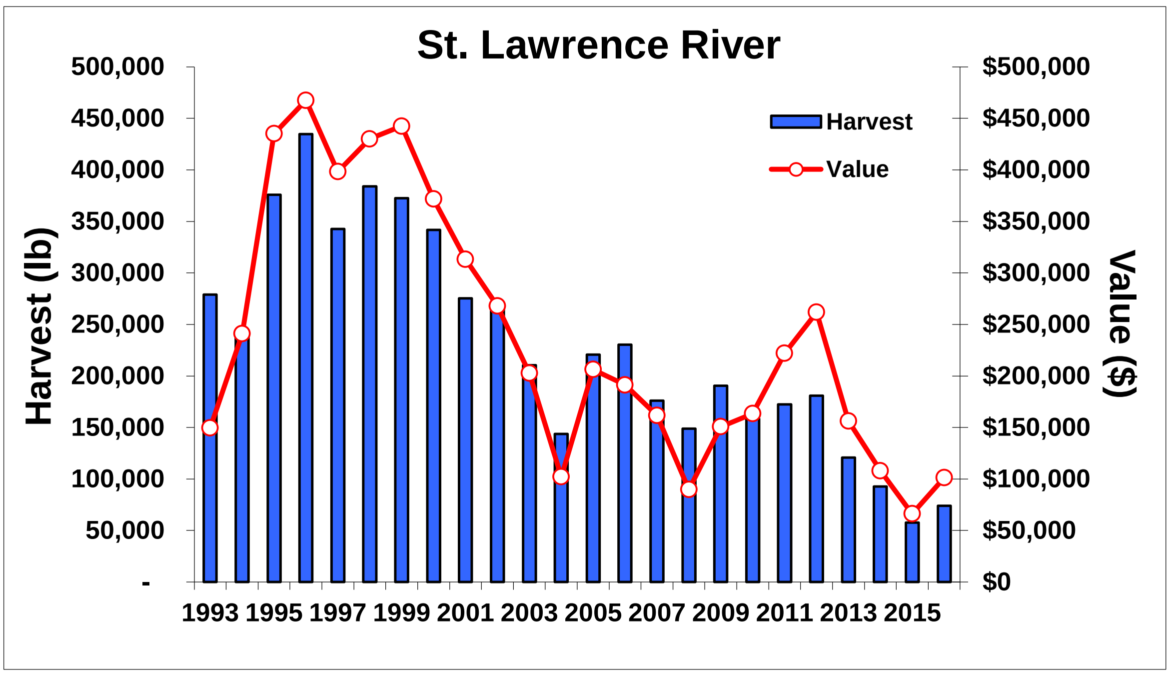


FIG. 3.2.5. Total commercial fishery harvest and value for the **St. Lawrence River** (Quota Zones 1-5, 2-5 and 1-7), 1993-2016.

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 2016, this resulted in issued quota and harvest being considerably higher than base quota in quota zone 1-4 (Fig. 3.2.10).

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

Black Crappie

Black Crappie 2016 commercial harvest relative to issued and base quota by quota zone

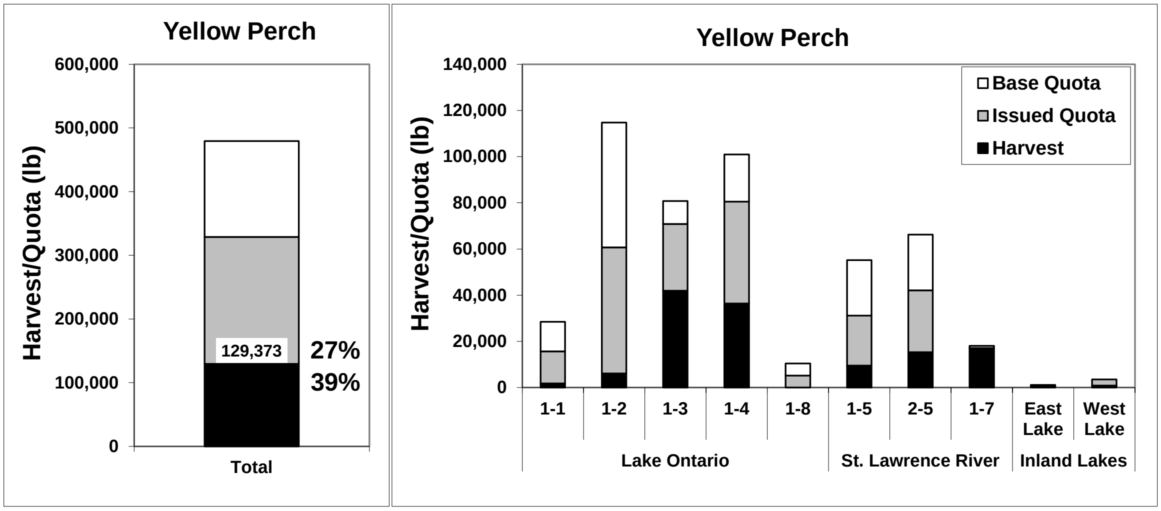


FIG. 3.2.6. **Yellow Perch** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2016.

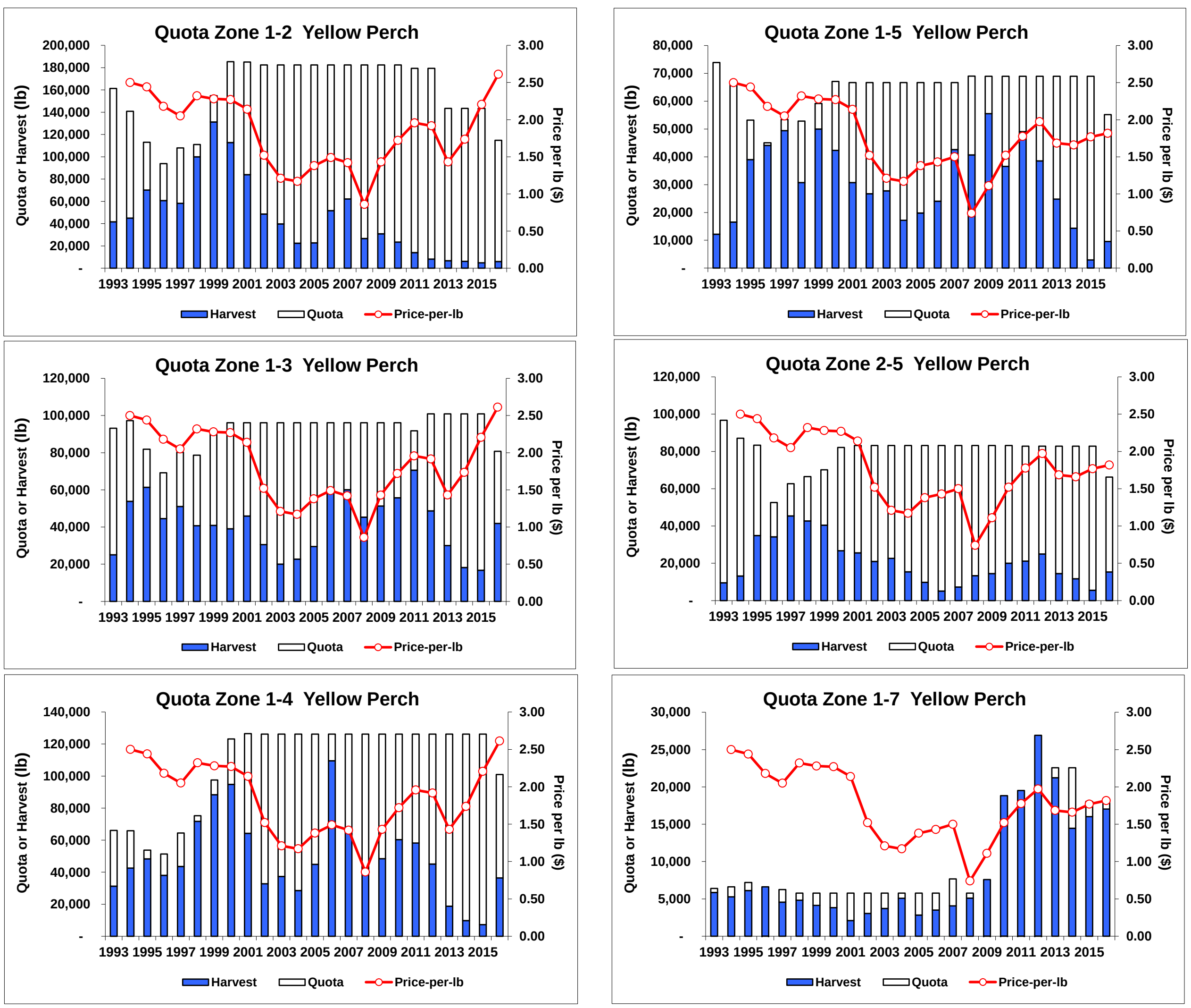


FIG. 3.2.7. Commercial base quota, harvest and price-per-lb for **Yellow Perch** in Quota Zones 1-2, 1-3, 1-4, 1-5, 2-5 and 1-7, 1993-2016.

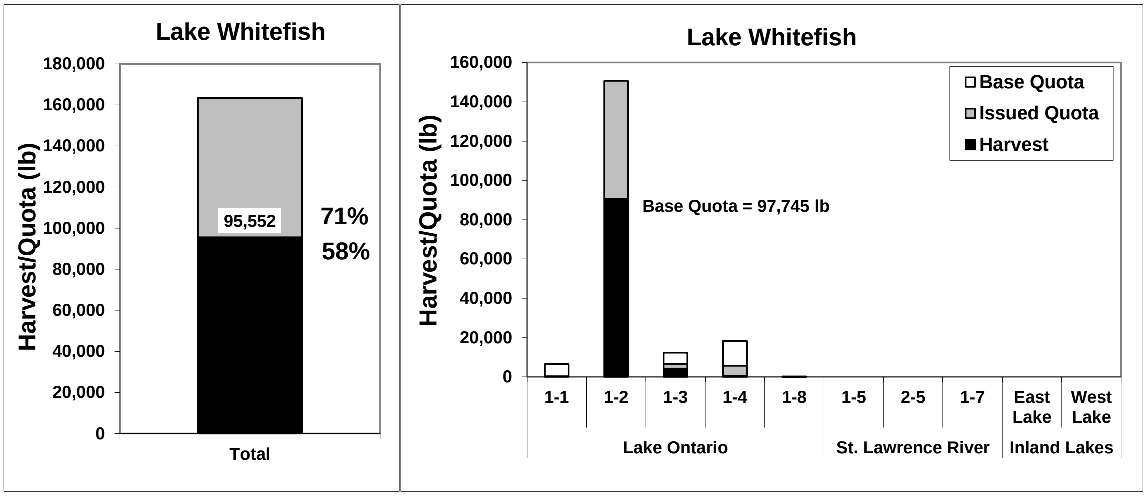


FIG. 3.2.8. **Lake Whitefish** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2016.

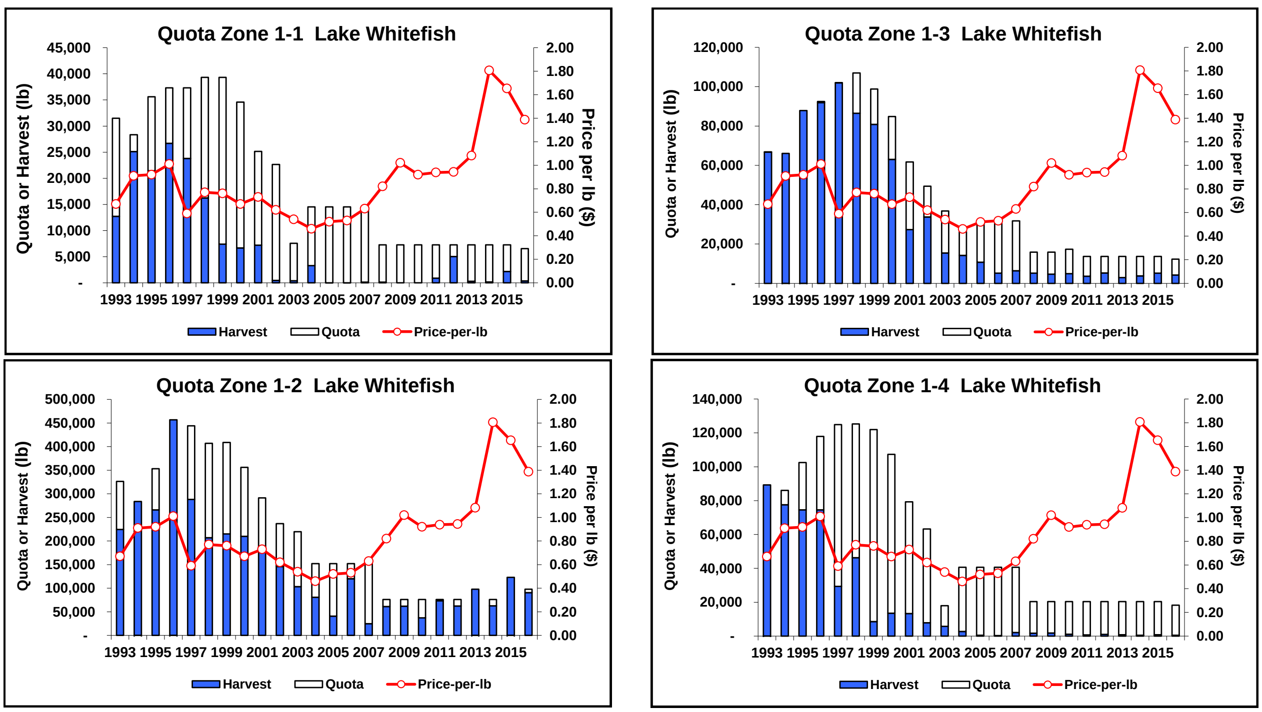


FIG. 3.2.9. Commercial base quota, harvest and price-per-lb for **Lake Whitefish** in Quota Zones 1-1, 1-2, 1-3 and 1-4, 1993-2016.

and total for all quota zones combined is shown in Fig. 3.2.12. Overall, only 14% (10,973 lb) of the Black Crappie base quota (76,114) was harvested in 2016. The highest Black Crappie harvest came from quota zones 1-3, West Lake, and 1-5. Only a very small proportion of base quota was harvested in other quota zones.

Trends in Black Crappie quota (base), harvest and price-per-lb are shown in Fig. 3.2.13. Black Crappie price-per-lb is currently high.

Sunfish

Sunfish 2016 commercial harvest relative to issued and base quota by quota zone and total for all quota zones combined is shown in Fig. 3.2.14. Only quota zones 1-1 (embayment areas only), East Lake and West Lake have quotas for Sunfish; quota is unlimited in the other zones. Most Sunfish harvest comes from quota zone 1-3, East Lake and West Lake.

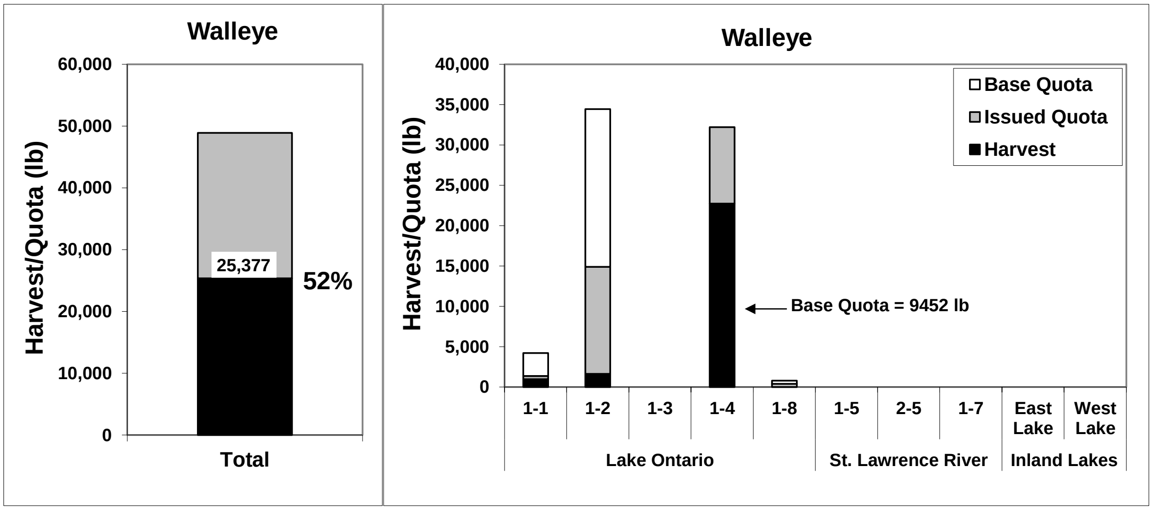
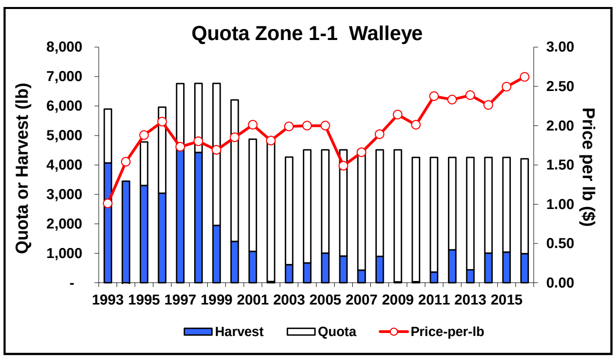
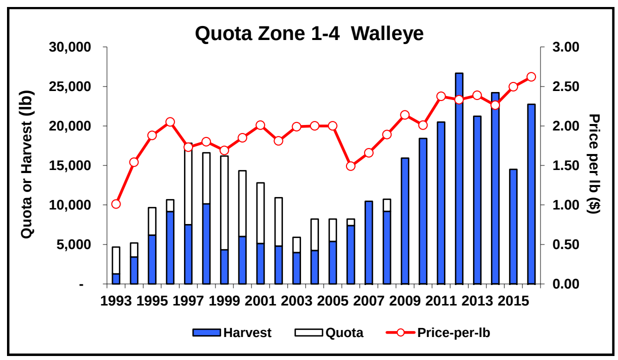


FIG. 3.2.10. **Walleye** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2016.





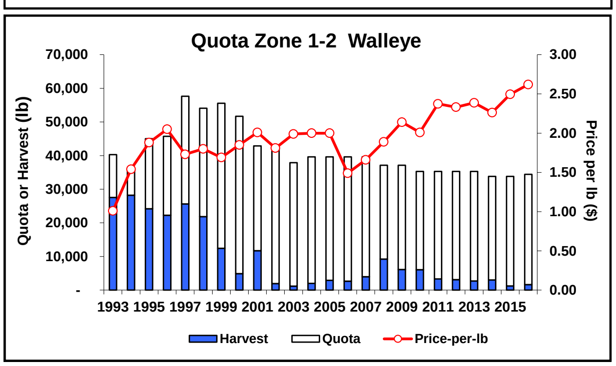


FIG. 3.2.11. Commercial base quota, harvest and price-per-lb for **Walleye** in Quota Zones 1-1, 1-2 and 1-4, 1993-2016.

Trends in Sunfish quota (base), harvest and price-per-lb are shown in Fig. 3.2.15. In 2016, harvest increased in quota zone 1-3. Sunfish price -per-lb is currently high.

Brown Bullhead

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

Trends in Brown Bullhead quota (base), harvest and price-per-lb are shown in Fig. 3.2.17. With the exception of quota zone 1-7, current harvest levels are extremely low relative to past levels.

Northern Pike

Northern Pike 2016 commercial harvest by quota zone is shown in Fig. 3.2.18. Highest pike harvest came from quota zone 1-3.

Trends in Northern Pike harvest and price-per-lb are shown in Fig. 3.2.19. In 2016, harvest increased in all quota zones except 1-4 and 1-5.

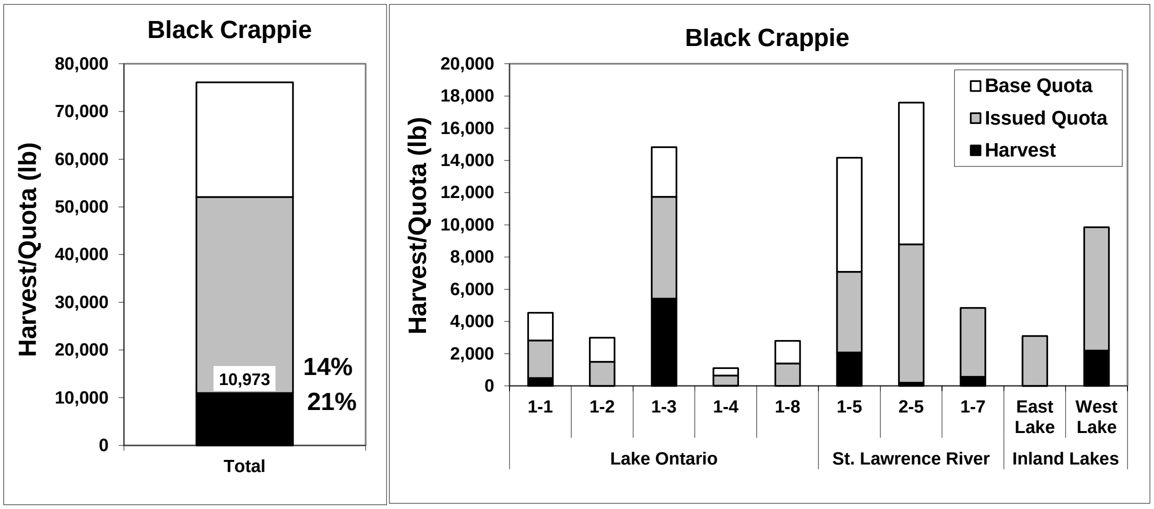


FIG. 3.2.12. **Black Crappie** commercial harvest relative to issued and base quota (total for all quota zones combined; left panel) and by quota zone (right panel), 2016.

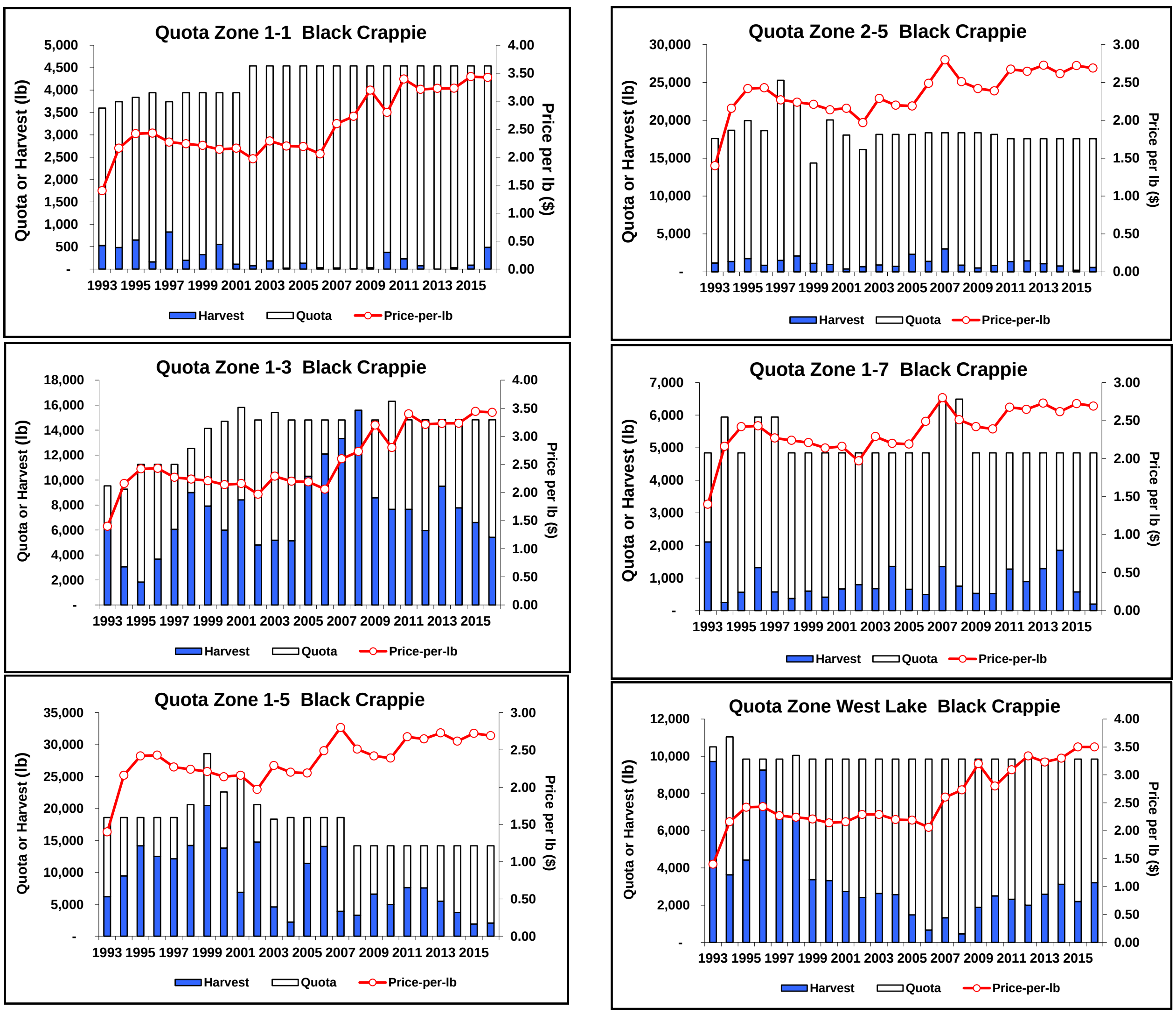


FIG. 3.2.13. Commercial base quota, harvest and price-per-lb for **Black Crappie** in Quota Zones 1-1, 1-3, 1-5, 2-5, 1-7 and West Lake, 1993-2016.

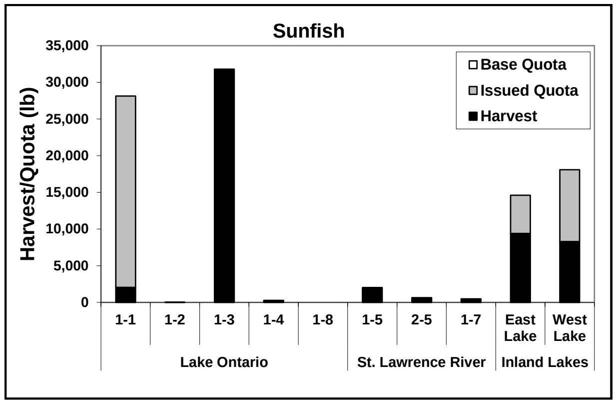


FIG. 3.2.14. **Sunfish** commercial harvest relative to issued and base quota for quota zones 1-1, East Lake and West Lake, 2016. The remaining quota zones have unlimited quota.

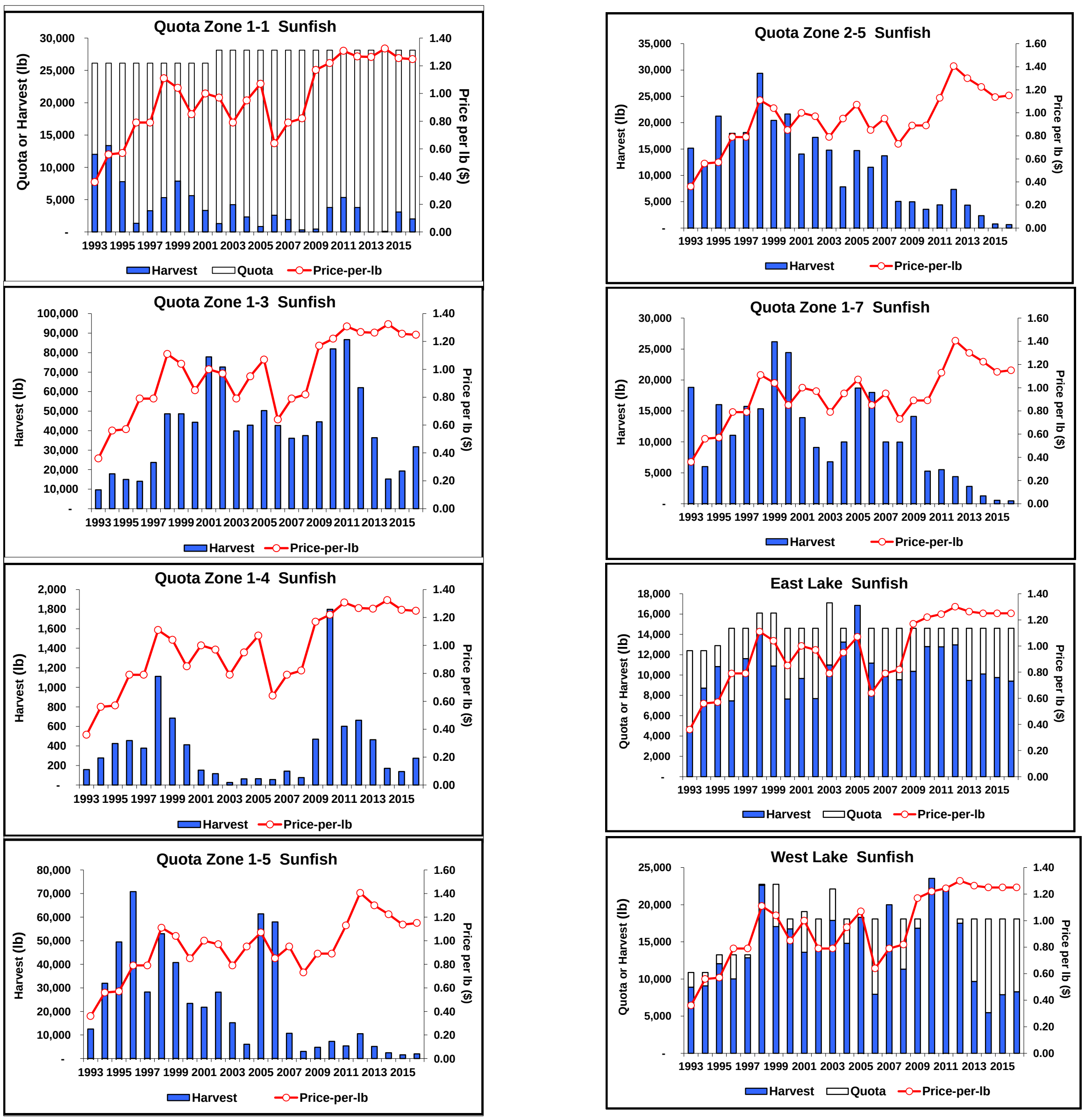


FIG. 3.2.15. Commercial base quota, harvest and price-per-lb for **Sunfish** in Quota Zones 1-1, 1-3, 1-4, 1-5, 2-5 and 1-7, East Lake and West Lake, 1993-2016.

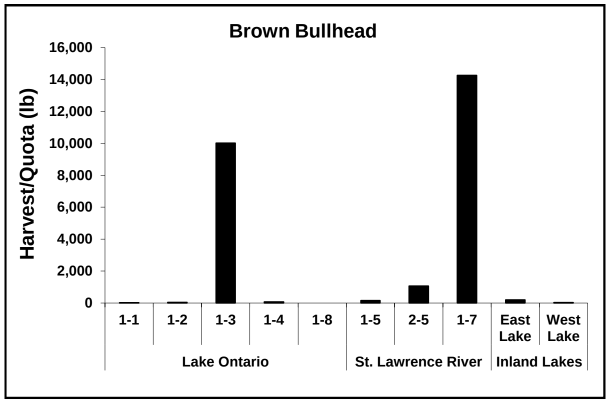


FIG. 3.2.16. **Brown Bullhead** commercial harvest relative to issued and base quota for quota zones 1-1, East Lake and West Lake, 2016. The remaining quota zones have unlimited quota.

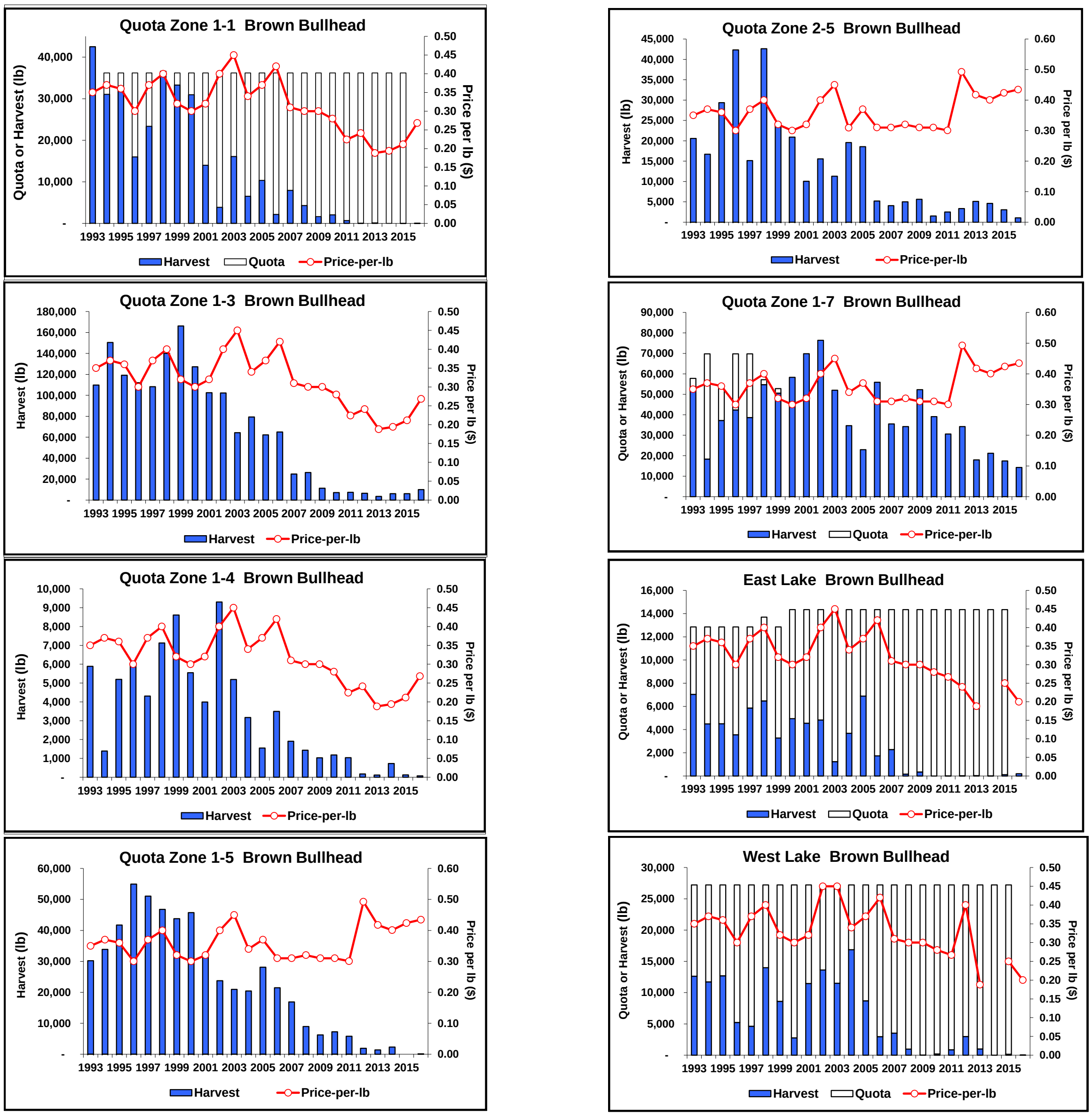


FIG. 3.2.17. Commercial base quota, harvest and price-per-lb for **Brown Bullhead** in Quota Zones 1-1, 1-3, 1-4, 1-5, 2-5 and 1-7, East Lake and West Lake, 1993-2016.

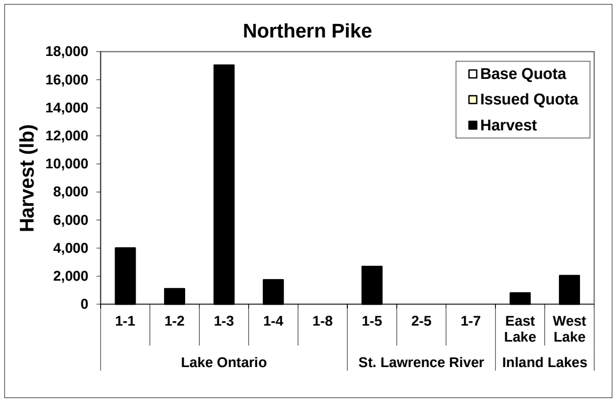


FIG. 3.2.18. **Northern Pike** commercial harvest by quota zone, 2016. In quota zones 2-5 and 1-7 no harvest is permitted; all other zones have unlimited quota.

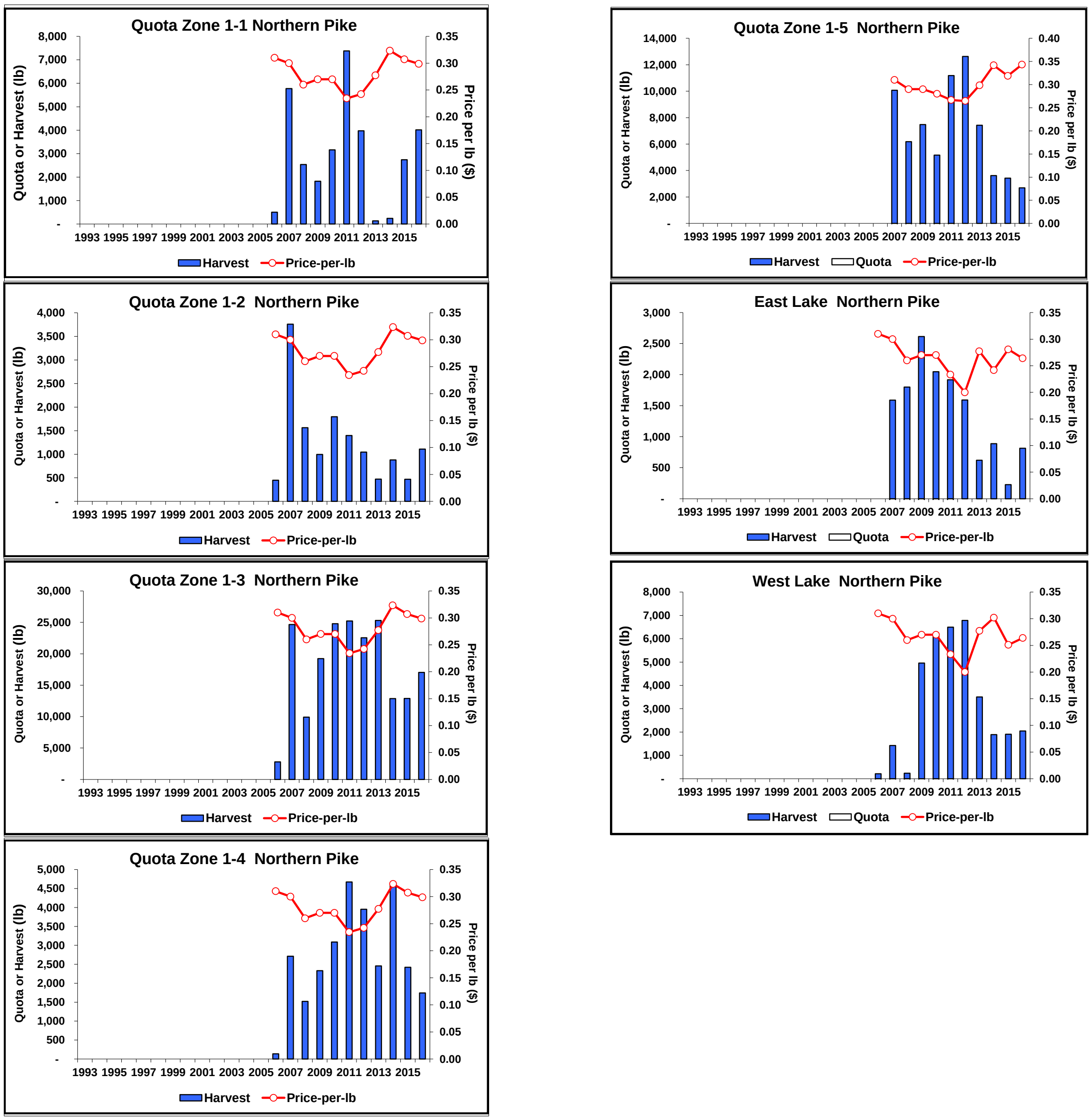


FIG. 3.2.19. Commercial base quota, harvest and price-per-lb for **Northern Pike** in Quota Zones 1-1, 1-2, 1-3, 1-4, and 1-5, East Lake and West Lake, 1993-2016.

3.3 Lake Whitefish Commercial Catch Sampling

J. A. Hoyle, Lake Ontario Management Unit

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

Commercial Lake Whitefish harvest and fishing effort by gear type, month and quota zone for 2016 is reported in Table 3.3.1. Most of the harvest was taken in gill nets, 96% by weight; 4% of the harvest was taken in impoundment gear. Ninety-five percent of the gill net harvest occurred in quota zone 1-2. Forty-six percent of the gill net harvest in quota zone 1-2 was taken in November. In quota zone 1-3 most impoundment gear harvest and effort occurred in October (Table 3.3.1).

Cumulative daily commercial Lake Whitefish harvest relative to quota 'milestones' is shown in Fig. 3.3.1. About 47,000 lbs were harvested before November 1, the date on which an additional 20% of base quota was issued to the "pool".

Biological sampling focused on the November spawning-time gill net fishery on the south shore of Prince Edward County (quota zone 1-2), and the October/November spawning-time impoundment gear fishery in the Bay of Quinte (quota zone 1-3). The Lake Whitefish sampling design involves obtaining large numbers of length tally measurements and a smaller length-stratified sub-sample for more detailed biological sampling for the lake (quota zone 1-2) and bay (quota zone 1-3) spawning stocks. Whitefish length and age distribution information is presented in (Fig. 3.3.2 and Fig. 3.3.3). In total, fork length was measured for 2,476 fish and age was interpreted using otoliths for 263 fish (Table 3.3.2, Fig. 3.3.2

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

		Harvest (lbs)				Effort (number of yards or nets)			
Gear type	Month	1-1	1-2	1-3	1-4	1-1	1-2	1-3	1-4
Gill net	Jan				128				1,000
	Feb								
	Mar		646		154		5,200		1,400
	Apr		293				3,200		
	May		2,617		5		12,000		480
	Jun		8,291				24,130		
	Jul		17,189				44,520		
	Aug		7,514				24,760		
	Sep		6,871				26,080		
	Oct		3,951				8,000		
	Nov	356	***42,393***		39	3,000	***31,300***		280
	Dec		756		117		5,300		1,280
Impoundment	Mar			27				77	
	Apr			3				12	
	May			3	4			18	3
	Jun				5				2
	Sep				7				4
	Oct			174	20			26	17
	Nov			***4,044***				***173***	

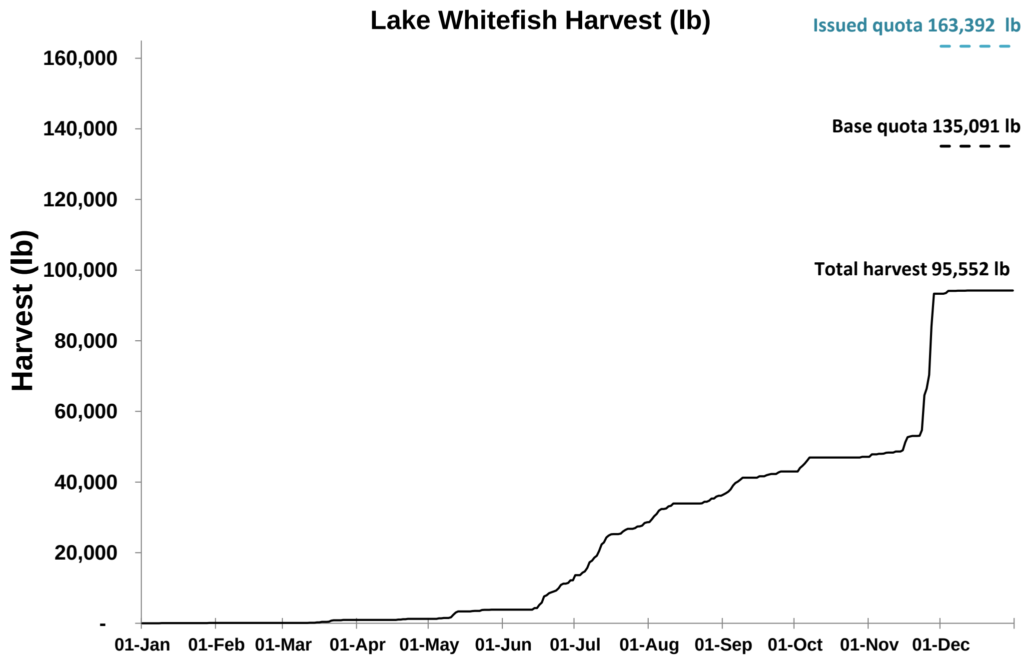


FIG. 3.3.1. Cumulative daily commercial Lake Whitefish harvest (2016) relative to quota 'milestones'.

TABLE 3.3.2. Age-specific vital statistics of **Lake Whitefish** sampled and harvested including number aged, number measured for length, and proportion by number of fish sampled, harvest by number and weight (kg), and mean weight (kg) and fork length (mm) of the harvest for quota zones 1-2 and 1-3, 2016.

	Quota zone 1-2 (Lake stock)								Quota zone 1-3 (Bay stock)						
	Sampled			Harvested					Sampled			Harvested			
Age (years)	Number aged	Number lengthed	Proportion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)	Age (years)	Number aged	Number lengthed	Proportion	Number	Weight (kg)	Mean weight (kg)	Mean length (mm)
1	-	-	0.000	-	-			1	-	-	0.000	-	-		
2	1	1	0.001	22	9	0.400		2	0	7	0.008	15	3	0.200	
3	-	-	0.000	-	-			3	1	14	0.015	30	7	0.247	304
4	9	27	0.017	577	419	0.727	405	4	2	11	0.012	23	10	0.453	364
5	3	8	0.005	177	134	0.755	404	5	9	66	0.072	140	103	0.735	401
6	18	272	0.173	5,861	5,684	0.970	441	6	13	62	0.068	131	80	0.611	386
7	11	260	0.166	5,605	5,617	1.002	446	7	32	160	0.176	341	276	0.808	415
8	8	149	0.095	3,221	2,966	0.921	440	8	47	271	0.299	578	521	0.902	433
9	6	83	0.053	1,801	2,331	1.294	499	9	6	20	0.022	44	33	0.766	412
10	20	397	0.254	8,569	12,049	1.406	499	10	13	91	0.100	194	226	1.163	468
11	13	134	0.086	2,897	4,308	1.487	514	11	10	66	0.073	142	175	1.239	474
12	4	24	0.015	511	696	1.363	516	12	3	16	0.017	34	50	1.484	506
13	13	119	0.076	2,558	3,922	1.533	516	13	11	61	0.067	129	212	1.643	525
14	5	51	0.032	1,092	1,336	1.223	492	14	-	-	0.000	-	-		
15	4	10	0.006	214	364	1.703	519	15	3	27	0.029	57	67	1.188	488
16	4	4	0.003	86	153	1.770		16	-	-	0.000	-	-		
17	5	12	0.007	248	444	1.791	528	17	1	3	0.003	6	9	1.417	521
18	4	4	0.003	86	153	1.770		18	2	5	0.006	11	21	1.845	561
19	2	2	0.001	43	76	1.770		19	-	-	0.000	-	-		
20	2	2	0.001	43	76	1.770		20	2	7	0.008	15	24	1.628	537
21	2	2	0.001	43	76	1.770		21	-	-	0.000	-	-		
22	-	-	0.000	-	-			22	-	-	0.000	-	-		
23	1	7	0.004	144	255	1.770	535	23	3	12	0.013	25	43	1.759	564
24	-	-	0.000	-	-			24	2	6	0.006	12	23	1.980	576
25	-	-	0.000	-	-			25	1	5	0.005	10	22	2.262	598
26	-	-	0.000	-	-			26	-	-	0.000	-	-		
27	-	-	0.000	-	-			27	-	-	0.000	-	-		
28	-	-	0.000	-	-			28	-	-	0.000	-	-		
29	-	-	0.000	-	-			29	-	-	0.000	-	-		
30	-	-	0.000	-	-			30	-	-	0.000	-	-		
Total	135	1,566	1	33,800	41,060			Total	161	909	1	1,936	1,906		
Weighted mean						**1.215**		Weighted mean						**0.984**	

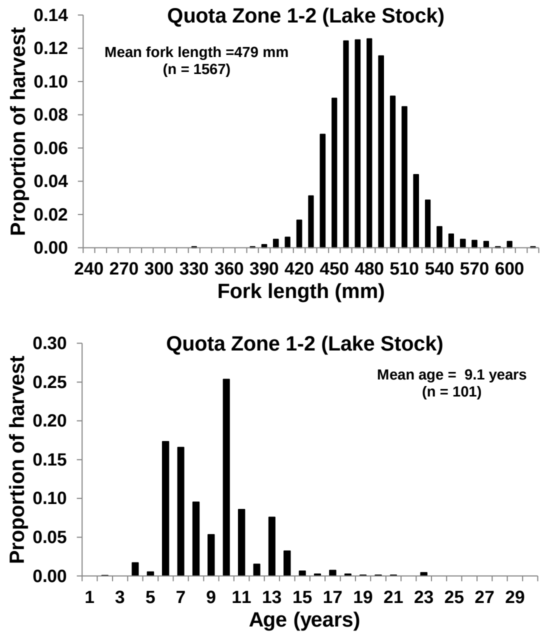


FIG. 3.3.2. Size and age distribution (by number) of **Lake Whitefish** sampled in quota zone 1-2 during the 2016 commercial catch sampling program.

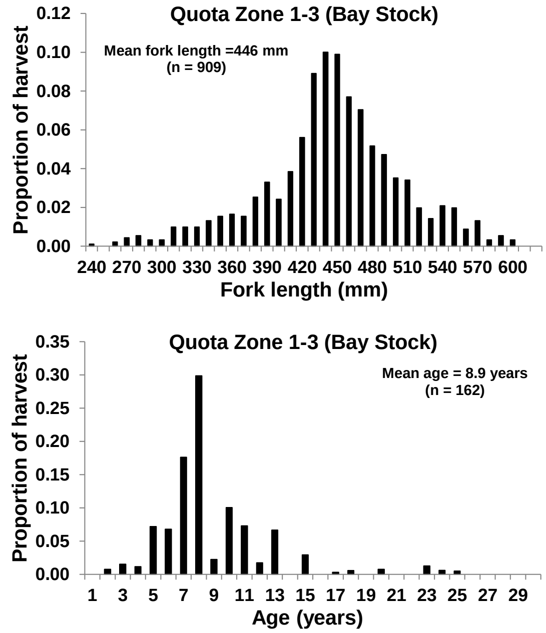


FIG. 3.3.3. Size and age distribution (by number) of **Lake Whitefish** sampled in quota zone 1-3 during the 2016 commercial catch sampling program.

and 3.3.3).

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

The mean fork length and age of Lake Whitefish harvested during the gill net fishery in quota zone 1-2 were 479 mm and 9.1 years respectively (Fig. 3.3.2). Fish ranged from ages 4 -23 years. The most abundant age-classes in the fishery were aged 6-11 years which together comprised 83% of the harvest by number (80% by weight).

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

Mean fork length and age were 446 mm and 8.9 years, respectively (Fig. 3.3.3). Fish ranged from ages 2-25 years. The most abundant age-classes in the fishery were aged 5-11 years which together comprised 81% of the harvest by number (74% by weight).

Condition

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

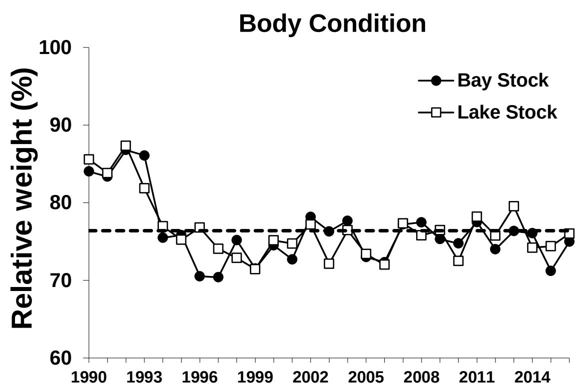


FIG. 3.3.4. **Lake Whitefish** (Lake Ontario and Bay of Quinte spawning stocks and sexes combined) relative weight (see [1]Rennie et al. 2008), 1990-2016.

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

4. Age and Growth Summary

S. Kranzl and J. A. Hoyle, Lake Ontario Management Unit

Biological sampling of fish from Lake Ontario Management Unit field projects routinely involves collecting and archiving structures used for such purposes as age interpretation and validation, origin determination (e.g. stocked versus wild), life history characteristics and other features of fish growth. Coded wire tags, embedded in the nose of fish prior to stocking, are sometimes employed to uniquely identify individual fish (e.g., to determine stocking location and year, when recovered). In 2016, a total of 2,807 structures were processed from 11 different field projects (Table 4.1) and interpreted from 14 different fish species (Table 4.2)

TABLE 4.1. Project-specific summary of age and growth structures interpreted for age (n=2,807) in support of 11 different Lake Ontario Management Unit field projects, 2016 (CWT, Code Wire Tags).

Project	Species	Structure	n
Ganaraska Rainbow Trout Assessment			
	Rainbow Trout	Scales	121
Lake Ontario and Bay of Quinte Community Index Gillnetting			
	Northern Pike	Cleithra	16
	Walleye	Otoliths	407
	Lake Whitefish	Otoliths	46
	Lake Trout	Otoliths	530
	Chinook	CWT	39
	Lake Trout	CWT	137
Lake Ontario and Bay of Quinte Community Index Trawling			
	Walleye	Otoliths	68
	Walleye	Scales	128
	Cisco	Otoliths	9
Community Index Netting			
	Northern Pike	Cleithra	12
	White Bass	Scales	11
	Pumpkinseed	Scales	15
	Bluegill	Scales	29
	Smallmouth Bass	Scales	2
	Largemouth Bass	Scales	4
	Black Crappie	Scales	13
	Yellow Perch	Scales	13
	Walleye	Otoliths	31
Upper Bay of Quinte Nearshore Community Index Netting			
	Northern Pike	Cleithra	18
	Pumpkinseed	Scales	31
	Bluegill	Scales	32
	Smallmouth Bass	Scales	6
	Largemouth Bass	Scales	35
	Black Crappie	Scales	32
	Yellow Perch	Scales	32
	Walleye	Otoliths	30
continued			
Toronto Nearshore Community Index Netting			
	Northern Pike	Cleithra	31
	Pumpkinseed	Scales	30
	Bluegill	Scales	13
	Smallmouth Bass	Scales	4
	Largemouth Bass	Scales	3
	Black Crappie	Scales	4
	Yellow Perch	Scales	29
Lake St. Francis			
	Northern Pike	Cleithra	5
	Smallmouth Bass	Scales	10
	Yellow Perch	Scales	140
	Walleye	Otoliths	17
Western Lake Ontario Creel			
	Chinook Salmon	Otoliths	137
Credit River Chinook Assessment and Egg Collection			
	Chinook Salmon	Otoliths	200
Ganaraska Chinook Assessment and Egg Collection			
	Chinook Salmon	Otoliths	70
Commercial Catch Sampling			
	Lake Whitefish	Otoliths	267
Total			2,807

TABLE 4.2. Species-specific summery of age and growth structures interpreted for age (n=2,807) in 2016.

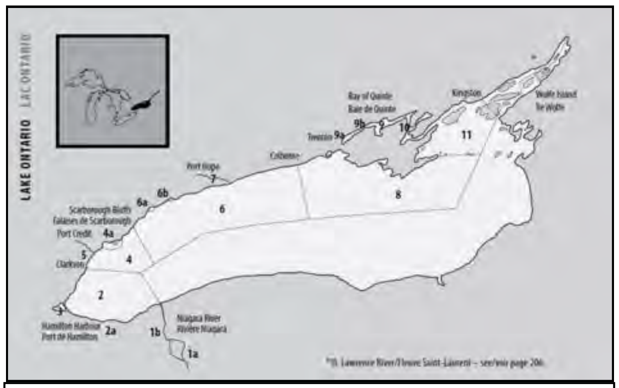
	Structure				
Species	Scales	Otoliths	Cleithra	Code Wire Tags	Total
Black Crappie	49				49
Bluegill	74				74
Chinook Salmon		407		39	446
Lake Trout		530		137	667
Lake Whitefish		313			313
Cisco		9			9
Largemouth Bass	42				42
Northern Pike			82		82
Pumpkinseed	76				76
Rainbow Trout	121				121
Smallmouth Bass	22				22
Walleye	128	553			681
White Bass	11				11
Yellow Perch	214				214
Total	737	1,812	82	176	2,807

5. Contaminant Monitoring

S. Kranzl and J. A. Hoyle, Lake Ontario Management Unit

Lake Ontario Management Unit (LOMU) cooperates annually with several agencies to collect fish samples for contaminant testing. In 2016, 293 contaminant samples were collected for Ontario's Ministry of the Environment and Climate Change (MOECC) Guide to Eating Ontario Fish 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 MOECC from 2000 to 2016 is shown in Table 5.2.



3. Hamilton Harbour – harbour area
4. Toronto Offshore Area – open water from east of Clarkson Harbour to Scarborough Bluffs
4a. Toronto Waterfront Area – nearshore area from the west side of Humber Bay Park to the east side of Ashbridges Bay Park (including Toronto Islands)
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
15. Lake St. Francis – St. Lawrence River from downstream of the Moses Saunders Dam to Quebec border

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

TABLE 5.1. Number of fish samples provided to MOECC for contaminant analysis, by region and species, 2016.

Region	Block	Species	Total
Hamilton Harbour	3	Walleye	30
		Northern Pike	8
		Smallmouth Bass	2
		White Perch	4
		Common Carp	10
Toronto Offshore	4	Lake Trout	10
		White Sucker	2
Toronto Waterfront	4a	Gizzard Shad	6
		Northern Pike	10
		Yellow Perch	9
		White Sucker	8
		Pumpkinseed	9
		Smallmouth Bass	4
		Freshwater Drum	10
Northwest Lake Ontario	6	Lake Trout	8
(Cobourg)		White Sucker	1
		Gizzard Shad	1
		Walleye	2
Northeast Lake Ontario	8	Lake Whitefish	8
(Rocky Point, Wellington,		Walleye	10
Brighton)		Yellow Perch	10
		White Sucker	10
		Common Carp	4
		Lake Trout	10
		Northern Pike	2
		Smallmouth Bass	10
		Freshwater Drum	1
Lake St. Francis	15	Smallmouth Bass	9
		Walleye	14
		Yellow Perch	20
		Northern Pike	4
		Rock Bass	20
		Pumpkinseed	6
		Freshwater Drum	1
		Largemouth Bass	20
Total			293

TABLE 5.2. Summary of the number of fish samples collected, by species, for contaminant analysis by the MOECC, 2000 - 2016.

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

6. Stocking Program

6.1 Stocking Summary

C. Lake , Lake Ontario Management Unit

In 2016, OMNRF stocked approximately 2.3 million salmon and trout into Lake Ontario (Table 6.1.1; Fig. 6.1.1). This number of fish equaled approximately 42,600 kilograms of biomass added to the Lake (Fig. 6.1.1). Fig. 6.1.2 shows stocking trends in the Ontario waters of Lake Ontario from 1968 to 2016. Table 6.1.2 provides detailed information on fish stocking for 2016.

Approximately 533,000 Chinook Salmon spring fingerlings were stocked at various locations to provide put-grow-and-take fishing opportunities. NYSDEC stocked an additional 60,000 Chinook in the Niagara River to compensate for an unforeseen production shortfall in Ontario. These fish are not reported here, so the total number stocked for 2016 appears slightly lower than normal. All Chinook Salmon for the Lake Ontario program were produced at Normandale Fish Culture Station. About 225,000 (42% of total stocking) Chinook Salmon were held in pens at eight sites in Lake Ontario for a short period of time prior to stocking. This ongoing project is being done in partnership with local angler and community groups. It is hoped that pen-imprinting will help improve returns of mature adults to these areas in the fall, thereby enhancing local near shore and tributary fishing opportunities. See section 6.2 for a detailed report of the 2016 net pen program.

Atlantic Salmon were stocked in support of an ongoing program to restore self-sustaining populations of this native species to the Lake

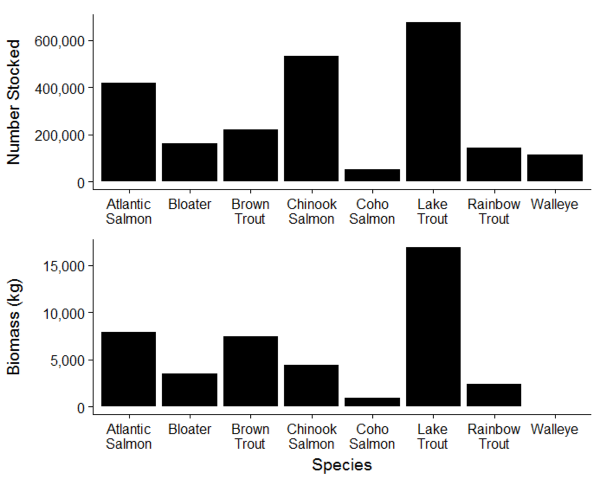


FIG. 6.1.1. Top panel: number of fish stocked into the Ontario waters of Lake Ontario (excluding fry and eggs in 2016. Total = 2,315,687. Bottom panel: biomass of fish stocked into the Ontario waters of Lake Ontario (excluding fry and eggs in 2016. Total = 43,552 kg.

TABLE 6.1.1. Fish stocked into the Ontario waters of Lake Ontario for 2016, and targets for 2017.

Species	Life Stage	2016	2017
Atlantic Salmon	Eyed Eggs *	22,880	
	Spring Fingerling	193,823	200,000
	Fall Fingerling	101,362	100,000
	Spring Yearling	121,571	100,000
	Sub Adult	422	-
	Adult	102	-
		417,280	400,000
Bloater	Sub Adult	90,305	250,000
	Fall Yearlings	71,375	-
		161,680	250,000
Brown Trout	Fall Fingerling	55,000	50,000
	Spring Yearling	163,727	165,000
		218,727	215,000
Chinook Salmon	Spring Fingerling	533,123	470,000
Coho Salmon	Fall Fingerling	50,000	80,000
Lake Trout	Fall Fingerling	173,208	-
	Spring Yearling	502,249	352,000
		675,457	352,000
Rainbow Trout	Spring Yearling	143,698	140,000
Walleye	Fry *	168,000	
	Summer Fingerling	115,722	100,000
		283,722	100,000
Grand Total		2,315,687	2,007,000

* Eggs and Walleye fry not included in totals.

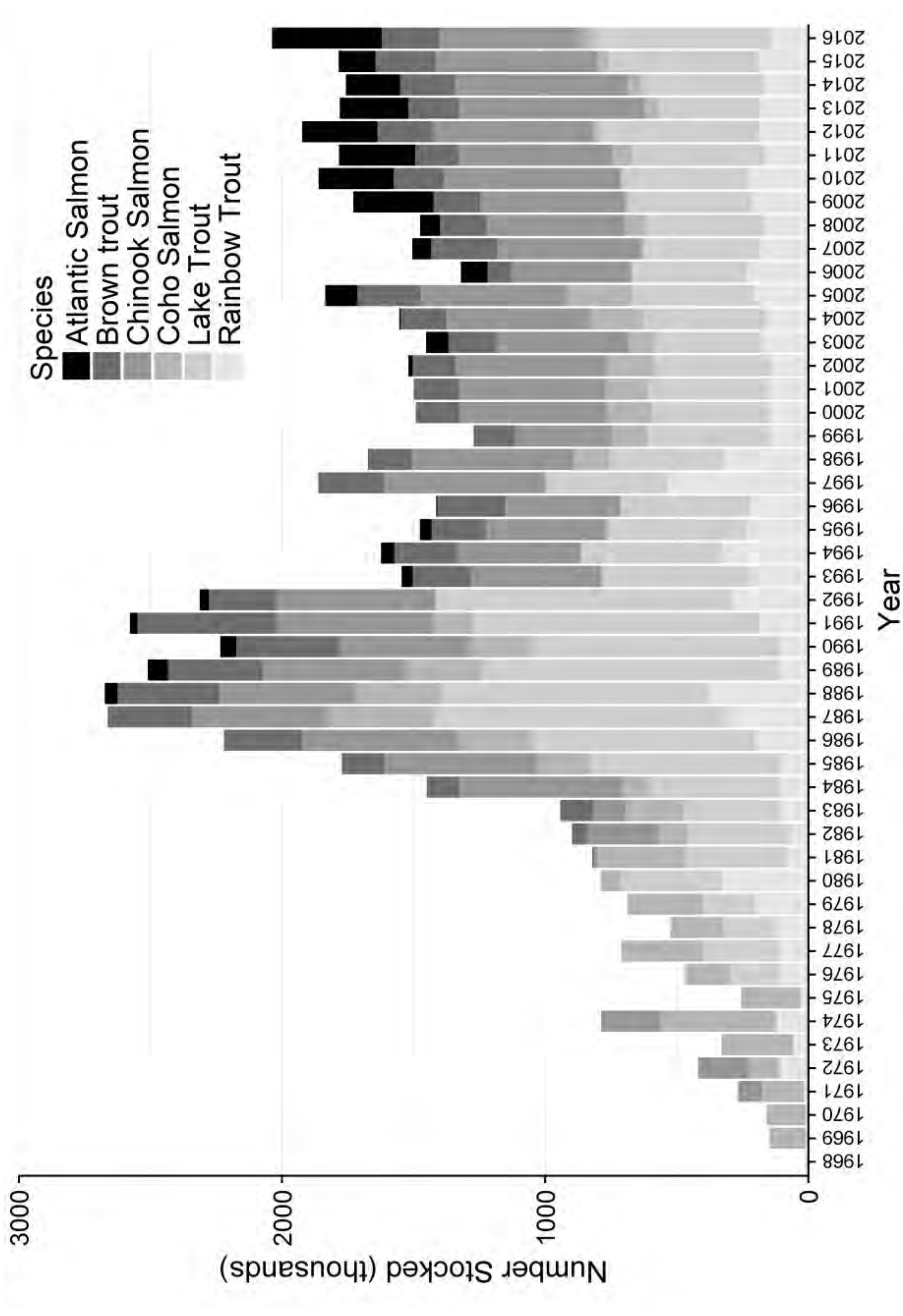


FIG. 6.1.2. Trends in salmon and trout stocking in Ontario waters of Lake Ontario, 1968-2016.

Ontario basin (Section 8.2). Approximately 417,000 Atlantic Salmon of various life stages were stocked in 2016 into various tributaries including: Credit River, Duffins Creek and Cobourg Brook. New for 2016, the Ganaraska River was also stocked with advanced life stages (spring yearlings and older), with the goal of establishing a fishery. OMNRF is working cooperatively with the Ontario Federation of Anglers and Hunters and a network of other partners to plan and deliver this phase of Atlantic Salmon restoration, including setting stocking targets to help meet program objectives. Atlantic Salmon are produced at both OMNRF and partner facilities. Three Atlantic Salmon brood stocks from different source populations in Nova Scotia, Quebec and Maine are currently housed at OMNRF's Harwood and Normandale Fish Culture Stations. All fish have been genotyped to facilitate follow-up assessment on stocked fish and their progeny in the wild.

Over 500,000 Lake Trout spring yearlings were stocked in the spring of 2016 as part of an established, long-term rehabilitation program, supporting of the Lake Trout Stocking Plan (Section 8.5). Three strains, originating from Seneca Lake, Slate Islands and Michipicoten Island are stocked as part of our annual target. An additional number of Lake Trout (173,000) were stocked in the fall of 2016 as fall fingerlings. This was done in order to meet new Lake Trout stocking targets in 2017 more quickly.

Approximately 160,000 Bloater were stocked in 2016. 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 being stocked in 2013. MNRF Fish Culture Section staff continue to work with our partner agencies to advance our understanding of the complicated process of rearing Bloater. See section 8.4 for a detailed description of this restoration effort.

Rainbow Trout (143,000) and Brown Trout (218,000) were stocked at various locations to support shore and boat fisheries. Community hatcheries contribute to the stocking of both of these species – see Table 6.1.2 for details. Coho Salmon were produced by stocking partner Metro East Anglers (approximately 50,000 fall fingerlings). Coho Salmon and Rainbow Trout were also produced by the Credit River Angler's Association, but data were not submitted to MNRF.

Walleye were once again stocked into Hamilton Harbour in an effort to establish native, predatory fish to help in the recovery of the fish community, which is currently dominated by Channel Catfish and Brown Bullhead. Approximately 168,000 Walleye fry were stocked in the spring of 2016, followed by over 115,000 fry stocked in July.

OMNR remains committed to providing diverse fisheries in Lake Ontario and its tributaries, based on wild and stocked fish, as appropriate. Detailed information about OMNRF's 2016 stocking activities is found in Table 6.1.2.

TABLE 6.1.2 Fish stocked in the Ontario waters of Lake Ontario and its tributaries during 2016.

Species	Lifestage	Waterbody	Site	Month Stocked	Year Spawned	Hatchery	Strain	Age (Months)	Weight (g)	Biomass (kg)	Marks	Number Stocked
BLOATER												
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	Harwood	Lake Michigan	23	25.0	430.5	None	17,221
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	Harwood	Lake Michigan	23	25.0	142.0	None	5,678
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	Harwood	Lake Michigan	23	25.0	429.4	None	17,174
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	White Lake	Lake Michigan	20	24.6	290.3	None	11,800
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	White Lake	Lake Michigan	20	25.0	346.4	None	13,855
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	White Lake	Lake Michigan	20	25.0	128.0	None	5,120
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2015	White Lake	Lake Michigan	20	24.4	461.6	None	18,918
Bloater	Sub Adult	Lake Ontario	Main Duck Isl.	11	2014	White Lake	Lake Michigan	31	90.9	49.0	None	539
							Sub total:		**33.1**	**2,277.1**		**90,305**
Bloater	Fall Yearlings	Lake Ontario	Main Duck Isl.	11		Normandale	Lake Michigan	18	15.9	442.8	None	27,814
Bloater	Fall Yearlings	Lake Ontario	Station 81	11		Chatsworth	Lake Michigan	18	17.7	770.2	None	43,561
							Sub total:		**16.8**	**1,213.0**		**71,375**
									Sub Adult:	2,277.1		90,305
									Fall Yearling:	1,213.0		71,375
									Total:	**3,490.0**		**161,680**
ATLANTIC SALMON												
Atlantic Salmon	Egg	Garaska R.	Shiloh Rd.	2	2015	Harwood	LaHave	2			None	3,651
Atlantic Salmon	Egg	Garaska R.	Shiloh Rd.	2	2015	Harwood	LaHave	2			None	7,302
Atlantic Salmon	Egg	Garaska R.	Shiloh Rd.	2	2015	Harwood	LaHave	2			None	10,953
Atlantic Salmon	Egg	Garaska R.	Shiloh Rd.	2	2015	Harwood	LaHave	2			None	974
							Sub total:					**22,880**
Atlantic Salmon	Spring Fingerling	Cobourg Br.	Dale Rd.	5	2015	Normandale	LaHave	5	2.1	51.3	None	25,014
Atlantic Salmon	Spring Fingerling	Cobourg Br.	Hie - McNichol Properties	5	2015	Normandale	LaHave	5	2.3	57.8	None	25,007
Atlantic Salmon	Spring Fingerling	Credit R.	Black Cr. - 15th Sideroad	5	2015	Normandale	LaHave	5	2.0	39.5	None	20,036
Atlantic Salmon	Spring Fingerling	Credit R.	Black Cr. - 6th Line	6	2015	Normandale	LaHave	5	2.3	46.0	None	19,990
Atlantic Salmon	Spring Fingerling	Credit R.	Forks of the Credit	5	2015	Normandale	LaHave	5	1.9	38.0	None	19,985
Atlantic Salmon	Spring Fingerling	Credit R.	Forks of the Credit - Meadow	5	2015	Normandale	LaHave	5	2.1	52.3	None	25,004
Atlantic Salmon	Spring Fingerling	Credit R.	West Credit - Belfountain	5	2015	Normandale	LaHave	5	2.5	61.5	None	24,993
Atlantic Salmon	Spring Fingerling	Credit R.	West Credit - Shaw's Creek Rd.	5	2015	Belfountain Hatchery	LaHave		0.2	1.2	None	6,594
Atlantic Salmon	Spring Fingerling	Credit R.	West Credit - Winston Churchill Blvd.	5	2015	Belfountain Hatchery	LaHave		0.2	1.1	None	6,000
Atlantic Salmon	Spring Fingerling	Duffins Cr.	East Duffins Cr. - Claremont Field Centre	5	2015	Normandale	LaHave	5	2.1	43.5	None	21,200
							Sub total:		**1.7**	**391.9**		**193,823**
Atlantic Salmon	Fall Fingerling	Cobourg Br.	Danforth Rd.	10	2015	Normandale	LaHave	10	16.0	80.0	AD	5,016
Atlantic Salmon	Fall Fingerling	Cobourg Br.	Division St.	10	2015	Normandale	LaHave	10	15.6	78.5	AD	5,034
Atlantic Salmon	Fall Fingerling	Credit R.	Ellie's Ice Cream Parlour	10	2015	Normandale	Sebago	10	21.9	109.5	None	5,006
Atlantic Salmon	Fall Fingerling	Credit R.	Ellie's Ice Cream Parlour	10	2015	Normandale	LaHave	10	15.6	78.0	AD	4,993
Atlantic Salmon	Fall Fingerling	Credit R.	McLaughlin Rd. Bridge	10	2015	Normandale	LaHave	10	17.5	181.1	AD	10,357
Atlantic Salmon	Fall Fingerling	Credit R.	McLaughlin Rd. Bridge	10	2015	Normandale	LaHave	10	15.5	156.0	AD	10,067
Atlantic Salmon	Fall Fingerling	Credit R.	Norval	10	2015	Normandale	LaHave	10	15.5	155.0	AD	10,007
Atlantic Salmon	Fall Fingerling	Credit R.	Terra Cotta	10	2015	Normandale	LaHave	10	16.5	165.5	AD	10,026
Atlantic Salmon	Fall Fingerling	Duffins Cr.	5th Concession	11	2015	Normandale	LaHave	10	16.9	287.5	None	16,979
Atlantic Salmon	Fall Fingerling	Duffins Cr.	West Duffins Cr. - Sideline 32	11	2015	Normandale	LaHave	10	16.5	36.5	None	2,207
Atlantic Salmon	Fall Fingerling	Duffins Cr.	West Duffins Cr. - Sideline 32	11	2015	Normandale	LaHave	10	16.5	82.5	None	4,989
Atlantic Salmon	Fall Fingerling	Duffins Cr.	West Duffins Cr. - Sideline 32	11	2015	Normandale	LaHave	10	15.8	123.1	AD	7,776
Atlantic Salmon	Fall Fingerling	Shelter Valley Cr.	Skyview Rd.	10	2015	Normandale	Sebago	10	22.6	201.5	None	8,905
							Sub total:		**17.1**	**1,734.9**		**101,362**

Continued on next page

TABLE 6.1.2 Fish stocked in the Ontario waters of Lake Ontario and its tributaries during 2016.

Species	Lifestage	Waterbody	Site	Month Stocked	Year Spawned	Hatchery	Strain	Age (Months)	Weight (g)	Biomass (kg)	Marks	Number Stocked
Atlantic Salmon	Spring Yearling	Cobourg Br.	Danforth Rd.	4	2014	NORMANDALE	LaHave	16	45.37	244.9	NA	5,397
Atlantic Salmon	Spring Yearling	Cobourg Br.	Division St.	4	2014	NORMANDALE	LaHave	16	35.89	180.0	NA	5,014
Atlantic Salmon	Spring Yearling	Credit R.	Norval	4	2014	NORMANDALE	LaHave	16	45.13	274.9	NA	6,092
Atlantic Salmon	Spring Yearling	Credit R.	Norval	4	2014	NORMANDALE	LaHave	16	45.87	319.5	NA	6,966
Atlantic Salmon	Spring Yearling	Credit R.	Terra Cotta	4	2014	NORMANDALE	LaHave	16	46.01	599.1	NA	13,021
Atlantic Salmon	Spring Yearling	Duffins Cr.	5th Concession	4	2014	NORMANDALE	LaHave	16	33.62	269.3	NA	8,010
Atlantic Salmon	Spring Yearling	Duffins Cr.	East Duffins Cr. - Paulynn Park	4	2014	NORMANDALE	LaHave	16	35.33	285.0	NA	8,066
Atlantic Salmon	Spring Yearling	Ganaraska R.	Newtonville Rd.	3	2014	NORMANDALE	Lac Saint-Jean	16	47.45	23.5	AD	495
Atlantic Salmon	Spring Yearling	Ganaraska R.	Newtonville Rd.	3	2014	NORMANDALE	Lac Saint-Jean	16	28	149.9	AD	5,352
Atlantic Salmon	Spring Yearling	Ganaraska R.	Newtonville Rd.	3	2014	NORMANDALE	Sebago	16	33.9	237.3	AD	7,000
Atlantic Salmon	Spring Yearling	Ganaraska R.	Newtonville Rd.	3	2014	NORMANDALE	Sebago	16	43.33	390.4	AD	9,010
Atlantic Salmon	Spring Yearling	Ganaraska R.	Newtonville Rd.	4	2014	NORMANDALE	Sebago	16	39.74	400.1	AD	10,067
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	NORMANDALE	Sebago	16	39.11	136.0	AD	3,477
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	NORMANDALE	Lac Saint-Jean	16	28.01	14.0	AD	500
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	Sebago	16	50	29.5	AD	590
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	LaHave	16	50	777.6	AD	15,552
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	Sebago	16	50	217.4	AD	4,348
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	Sebago	16	50	13.1	AD	262
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	LaHave	16	50	105.5	AD	2,110
Atlantic Salmon	Spring Yearling	Ganaraska R.	Shiloh Rd.	4	2014	Ringwood (OFAH 2006)	LaHave	16	50	46.9	AD	938
Atlantic Salmon	Spring Yearling	Ganaraska R.	Soper Rd.	4	2014	NORMANDALE	Sebago	16	44.1	58.9	AD	1,335
Atlantic Salmon	Spring Yearling	Ganaraska R.	Soper Rd.	4	2014	NORMANDALE	Lac Saint-Jean	16	45.19	339.9	AD	7,522
Atlantic Salmon	Spring Yearling	Lake Ontario	Port Dalhousie East	6	2014	NORMANDALE	LaHave	16	63	28.2	NA	447
							Sub total:		**43.4**	**5,140.7**		**121,571**
Atlantic Salmon	Sub Adult	Garaska R.	Shiloh Rd.	11	2014	Normandale	LaHave	23	**131.2**	**55.4**	AD	**422**
Atlantic Salmon	Adult	Garaska R.	Shiloh Rd.	11	2010	Normandale	Mersey Biodiversity	69	5,410.0	319.2	PIT TAG	59
Atlantic Salmon	Adult	Garaska R.	Shiloh Rd.	11	2010	Normandale	Mersey Biodiversity	69	6,070.0	261.0	PIT TAG	43
									5,740.0	**580.2**		**102**
									Egg:	-		22,880
									Spring Fingerling:	391.9		193,823
									Fall Fingerling:	1,734.9		101,362
									Spring Yearling:	5,140.7		121,571
									Sub Adult	55.4		422
									Adult	580.2		102
									Total (not including eggs):	**7,903.1**		**417,280**

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TABLE 6.1.2 Fish stocked in the Ontario waters of Lake Ontario and its tributaries during 2016.

Species	Lifestage	Waterbody	Site	Month Stocked	Year Spawned	Hatchery	Strain	Age (Months)	Weight (g)	Biomass (kg)	Marks	Number Stocked
Brown Trout	Fall Fingerling	Lake Ontario	Amherst Island	9		Springside Park Hatchery	Garaska R.			-	None	10,000
Brown Trout	Fall Fingerling	Lake Ontario	Bowmanville Cr.	11		Ringwood (OFAH 2006)	Garaska R.			-	None	35,000
Brown Trout	Fall Fingerling	Lake Ontario	Finkle's Shore Ramp	9		Springside Park Hatchery	Garaska R.			-	None	10,000
							Sub total:					**55,000**
Brown Trout	Spring Yearling	Lake Ontario	Athol Bay	4	2014	Chatsworth	Garaska R.	17	48.3	980.0	None	20,307
Brown Trout	Spring Yearling	Lake Ontario	Athol Bay	3	2014	Chatsworth	Garaska R.	16	48.2	985.0	None	20,448
Brown Trout	Spring Yearling	Lake Ontario	Fifty Point CA	3	2014	Chatsworth	Garaska R.	16	39.3	800.0	None	20,351
Brown Trout	Spring Yearling	Lake Ontario	Fifty Point CA	3	2014	Chatsworth	Garaska R.	16	47.4	977.3	None	20,626
Brown Trout	Spring Yearling	Lake Ontario	Humber Bay Park	3	2014	Chatsworth	Garaska R.	16	43.8	890.0	None	20,301
Brown Trout	Spring Yearling	Lake Ontario	Lakefront Promede	4	2014	Chatsworth	Garaska R.	17	51.1	1075.0	None	21,050
Brown Trout	Spring Yearling	Lake Ontario	Port Dalhousie East	3	2014	Chatsworth	Garaska R.	16	39.3	800.0	None	20,351
Brown Trout	Spring Yearling	Lake Ontario	Port Dalhousie East	3	2014	Chatsworth	Garaska R.	16	47.3	960.1	None	20,293
							Sub total:		**45.6**	**7,467.3**		**163,727**
									Fall Fingerling:	-		55,000
									Spring Yearling:	7,467.3		163,727
									Total:	**7,467.3**		**218,727**
CHINOOK SALMON												
Chinook Salmon	Spring Fingerling	Bronte Cr.	2nd Side Road Bridge	5	2015	Normandale	Lake Ontario	7	7.4	223.2	None	30,003
Chinook Salmon	Spring Fingerling	Bronte Cr.	4th Side Road Bridge	5	2015	Normandale	Lake Ontario	7	7.4	223.2	None	30,004
Chinook Salmon	Spring Fingerling	Credit R.	Eldorado Park	5	2015	Normandale	Lake Ontario	7	7.5	439.6	None	59,005
Chinook Salmon	Spring Fingerling	Credit R.	Norval	5	2015	Normandale	Ganaraska R.	7	6.8	312.0	AD	45,688
Chinook Salmon	Spring Fingerling	Credit R.	Norval	5	2015	Normandale	Ganaraska R.	7	8.1	351.8	AD	43,484
Chinook Salmon	Spring Fingerling	Highland Cr.	Colonel Danforth Park	5	2015	Normandale	Lake Ontario	7	7.2	86.6	None	11,999
Chinook Salmon	Spring Fingerling	Lake Ontario	Burlington Cal	5	2015	Normandale	Lake Ontario	7	7.6	226.9	None	30,008
Chinook Salmon	Spring Fingerling	Lake Ontario	Port Dalhousie East	5	2015	Normandale	Lake Ontario	7	7.5	171.3	None	22,999
Chinook Salmon	Spring Fingerling	Lake Ontario	Wellington	5	2015	Normandale	Lake Ontario	7	7.7	269.2	None	35,000
							Sub total:		**7.5**	**2,303.9**		**308,190**
Chinook Salmon	Spring Fingerling	Lake Ontario	Bluffer's Park - Netpen	5	2015	Normandale	Lake Ontario	7	11.0	495.9	None	45,079
Chinook Salmon	Spring Fingerling	Lake Ontario	Bronte Harbour - Netpen	5	2015	Normandale	Lake Ontario	7	10.0	148.0	None	14,828
Chinook Salmon	Spring Fingerling	Lake Ontario	Oshawa Harbour - Netpen	5	2015	Normandale	Lake Ontario	7	9.0	224.9	None	24,986
Chinook Salmon	Spring Fingerling	Lake Ontario	Port Credit Mari - Netpen	5	2015	Normandale	Lake Ontario	7	9.8	98.4	None	10,017
Chinook Salmon	Spring Fingerling	Lake Ontario	Port Dalhousie East - Netpen	5	2015	Normandale	Lake Ontario	7	7.3	364.9	None	49,991
Chinook Salmon	Spring Fingerling	Lake Ontario	Port Darlington - Netpen	5	2015	Normandale	Lake Ontario	7	11.0	275.1	None	25,007
Chinook Salmon	Spring Fingerling	Lake Ontario	Wellington Channel - Netpen	5	2015	Normandale	Lake Ontario	7	7.0	209.7	None	30,003
Chinook Salmon	Spring Fingerling	Lake Ontario	Whitby Harbour - Netpen	5	2015	Normandale	Lake Ontario	7	10.5	262.7	None	25,022
							Sub total:		**9.4**	**2,079.6**		**224,933**
									Total:	**4,383.4**		**533,123**
COHO SALMON												
Coho Salmon	Fall Fingerling	Credit R.	Norval	10	2015	Ringwood (OFAH 2006)	Lake Ontario				AD	**50,000**

Continued on next page

TABLE 6.1.2 Fish stocked in the Ontario waters of Lake Ontario and its tributaries during 2016.

Species	Lifestage	Waterbody	Site	Month Stocked	Year Spawned	Hatchery	Strain	Age (Months)	Weight (g)	Biomass (kg)	Marks	Number Stocked
Lake Trout	Fall Fingerling	Lake Ontario	Pig Pt.	11	2015	Harwood	Michipicoten	12	19.4	709.2	RPAD	36,631
Lake Trout	Fall Fingerling	Lake Ontario	Pig Pt.	11	2015	Harwood	Seneca	11	14.7	250.3	RPAD	17,026
Lake Trout	Fall Fingerling	Lake Ontario	The Head	11	2015	Harwood	Michipicoten	12	18.4	682.1	RPAD	37,073
Lake Trout	Fall Fingerling	Lake Ontario	The Head	11	2015	White Lake	Slate	12	9.9	815.7	RPAD	82,478
							Sub total:		**15.6**	**2,457.3**		**173,208**
Lake Trout	Spring Yearling	Lake Ontario	Big Bar Shoal	4	2014	White Lake	Slate	17	26.0	1037.5	LPAD	39,902
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Slate	13	30.0	600.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Slate	13	30.0	600.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Seneca	13	30.0	600.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Slate	13	30.0	285.5	LPAD	9,515
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Seneca	13	30.0	138.8	LPAD	4,626
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Slate	13	30.0	600.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Seneca	13	29.0	580.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	North Bay	Seneca	13	30.0	600.0	LPAD	20,000
Lake Trout	Spring Yearling	Lake Ontario	Cobourg Harbour Pier	4	2014	White Lake	Slate	17	26.0	35.0	LPAD	1,346
Lake Trout	Spring Yearling	Lake Ontario	False Duck Isl.	4	2014	Harwood	Seneca	15	28.8	879.3	LPAD	30,562
Lake Trout	Spring Yearling	Lake Ontario	False Duck Isl.	4	2014	White Lake	Seneca	15	28.0	276.4	LPAD	9,873
Lake Trout	Spring Yearling	Lake Ontario	Fifty Point CA	3	2014	Chatsworth	Seneca	14	26.2	1014.9	LPAD	38,708
Lake Trout	Spring Yearling	Lake Ontario	Fifty Point CA	3	2014	Chatsworth	Seneca	14	24.9	920.0	LPAD	36,948
Lake Trout	Spring Yearling	Lake Ontario	Gore Shoal	4	2014	Harwood	Michipicoten	16	32.9	727.1	LPAD	22,074
Lake Trout	Spring Yearling	Lake Ontario	Grape Isl.	4	2014	Harwood	Seneca	15	26.5	796.2	LPAD	30,044
Lake Trout	Spring Yearling	Lake Ontario	Petticoat Pt.	4	2014	White Lake	Slate	17	26.0	1039.8	LPAD	39,993
Lake Trout	Spring Yearling	Lake Ontario	Pig Pt.	4	2014	White Lake	Seneca	15	28.0	1026.3	LPAD	36,654
Lake Trout	Spring Yearling	Lake Ontario	Pobbs Bank	4	2014	Harwood	Michipicoten	16	37.6	642.1	LPAD	17,069
Lake Trout	Spring Yearling	Lake Ontario	Pt. Petre	4	2014	Harwood	Seneca	15	31.3	856.1	LPAD	27,351
Lake Trout	Spring Yearling	Lake Ontario	Pt. Petre	4	2014	Harwood	Seneca	15	24.7	65.8	LPAD	2,663
Lake Trout	Spring Yearling	Lake Ontario	Scotch Bonnet Shoal	4	2014	Harwood	Seneca	15	24.7	380.8	LPAD	15,415
Lake Trout	Spring Yearling	Lake Ontario	Wicked Bank	4	2014	Harwood	Michipicoten	16	37.4	729.5	LPAD	19,506
							Sub total:		**29.0**	**14,431.0**		**502,249**
									Fall Fingerling:	2,457.3		173,208.0
									Spring Yearling:	14,431.0		502,249.0
									Total:	**16,888.3**		**675,457**
RAINBOW TROUT												
Rainbow Trout	Spring Yearling	Bronte Cr.	2nd Side Road Bridge	4	2015	Harwood	Garaska R.	12	19.4	291.0	None	14,998
Rainbow Trout	Spring Yearling	Bronte Cr.	Lowville Park	4	2015	Harwood	Garaska R.	12	19.4	291.0	None	15,002
Rainbow Trout	Spring Yearling	Credit R.	Eldorado Park	5	2015	Harwood	Garaska R.	13	17.1	296.5	None	17,327
Rainbow Trout	Spring Yearling	Credit R.	Norval	5	2015	Harwood	Garaska R.	13	18.9	347.9	None	18,370
Rainbow Trout	Spring Yearling	Humber R.	East Branch Islington	5	2015	Harwood	Garaska R.	13	21.4	320.9	None	15,002
Rainbow Trout	Spring Yearling	Humber R.	King Vaughan Line	5	2015	Harwood	Garaska R.	13	21.4	320.8	None	14,999
Rainbow Trout	Spring Yearling	Lake Ontario	Port Dalhousie East	4	2015	Harwood	Garaska R.	12	18.3	550.2	None	30,000
Rainbow Trout	Spring Yearling	Rouge R.	Little Rouge R. Steeles	5		Ringwood (OFAH 2006)	Lake Ontario				None	18,000
									Total:	**2,418.3**		**143,698**
WALLEYE												
Walleye	Non-feeding Fry	Hamilton Harbour	Hamilton Harbour	5	2016	White Lake	Bay of Quinte	1	-	-	None	168,000
Walleye	Summer Fingerling	Hamilton Harbour	Hamilton Harbour	6	2016	White Lake	Bay of Quinte	3	0.5	52.1	None	115,722
							Total (not including non-feeding fry):			**52.1**		**115,722**

6.2 Chinook Salmon Net Pen Imprinting Project

C. Lake, Lake Ontario Management Unit

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

Compared to fish released directly from the hatchery, net pen fish are larger, survive better and may have a greater degree of site fidelity, or imprinting, to the stocking site based on marking experiments conducted by the New York Department of Environmental Conservation (NYSDEC). As a result of their time in the net pens as young fish, it is hoped that mature fish will return to the area and provide a quality near shore fall fishery for anglers.

Net pens were first used in the Ontario waters of Lake Ontario in 2003, when pens were installed in Barcovan and Wellington. Beginning in 2008, the program expanded west across a number of locations. The program has evolved over the years, with some sites dropped while other sites have been added or expanded. A thorough review of the history of the program was described in the 2014 Annual Report.

2016 Net Pen Program

A total of 224,933 Chinook Salmon were held at 8 sites (17 net pens) in 2016. This represents 42% of the total number stocked (533,123; Fig. 6.2.1a). Overall, fish growth and health was reported as good, with few mortalities. Fish were delivered to the pens at 3.8g and weighed 9.45g when released 33 days later (average values across all pen sites). Table 6.2.1 shows site-specific details on fish size, duration of penning, and numbers released. Combination temperature/dissolved oxygen data loggers were deployed into one net pen per site so that the health and growth of the fish can be better understood. Degree days, a metric that incorporates site temperature and length of time in the pen, was calculated and included in Table 6.2.1. Examining degree days helps make between-site comparisons easier when looking at fish growth.

The net pen program has increased considerably over the years, with more net pen

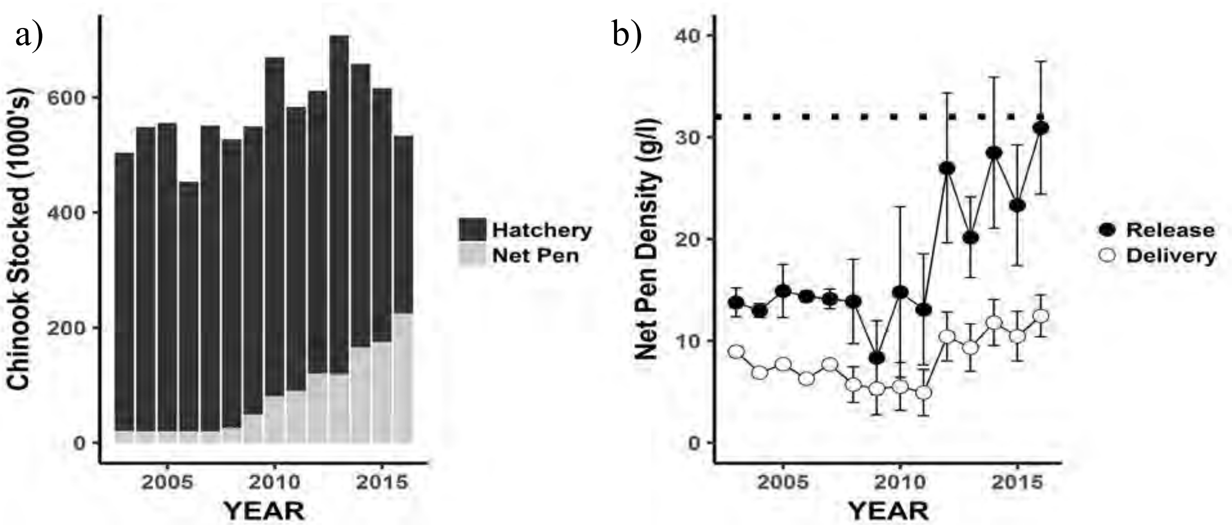

FIG. 6.2.1 a) Number of Chinook Salmon released (2003-2016) from net pens versus those stocked traditionally (Ontario data only; New York data not shown); b) Average density (g/l) of Chinook Salmon held per net pen. The guideline of 32 g/l is represented by the dashed line.

sites and a greater percentage of Chinook Salmon allocated to the program. In order to ensure good fish health and growth, a maximum density of 32 g/l (grams of fish per liter of water) is used as a guide. The volume of the standard net pen is 4000 liters, so the maximum number of 8.0 g fish that should be held in an individual net pen is 16,000.

The Ontario program has taken a conservative approach, generally stocking a maximum of 15,000 fish in a pen. Fig.6.2.1b shows the average density of fish (at time of release) in the net pens, with the guideline (32 g/l) denoted by the horizontal dotted line. The average net pen density has been below the guideline every year, but has increased in recent years.

TABLE. 6.2.1. Summary data of the 2016 Chinook Salmon net pen program.

Net Pen Location	Volunteer Group *	# Stocked (into pens)	Number of Pens	Fish per pen	Date stocked	Size at stocking (g)	Date released	Days held	Degree Days	Size at release (g)	Growth in pen	Mortalities (# fish)	Number released
Bluffer's Park	MEA	45,087	3	15,029	Apr-10	3.84	May-12	33	307	11.00	7.16	8	45,079
Bronte Harbour	HRSTA	15,056	1	15,056	Apr-09	4.37	May-16	38	344	9.98	5.61	228	14,828
Oshawa Harbour	MEA	24,986	2	12,493	Apr-05	3.47	May-06	32	268	9.00	5.53	-	24,986
Port Credit	PCSTA	10,017	1	10,017	Apr-09	4.37	May-11	33	352	9.82	5.45	-	10,017
Port Dalhousie	SCFGC	50,003	4	12,501	Apr-07	3.70	May-05	29	194	7.30	3.60	12	49,991
Port Darlington	MEA	25,007	2	12,504	Apr-06	3.68	May-05	30	245	11.00	7.32	-	25,007
Wellington	CLOSA	30,003	2	15,002	Apr-05	3.47	May-04	30	244	6.99	3.52	-	30,003
Whitby Harbour	MEA	25,030	2	12,515	Apr-06	3.47	May-14	39	375	10.50	7.03	8	25,022
Average		28,149	-	13,139	-	3.80	-	33	291.25	9.45	5.65	64	28,117
Total		225,189	17	-	-	-	-	-		-		256	224,933

* CLOSA (Central Lake Ontario Salmon Anglers); HRSTA (Halton Region Salmon and Trout Assoc.); MEA (Metro East Anglers); PCSTA (Port Credit Salmon & Trout Assoc.); SCFGC (St. Catherines Fish & Game Club).

7. Stock Status

7.1 Chinook Salmon

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

Chinook salmon were stocked in Lake Ontario beginning in 1968 to suppress an over-abundant Alewife population, provide a recreational fishery and restore predator-prey balance to the fish community. At present Chinook Salmon are the most sought after species in the main basin recreational fishery, which is supported by a mix of stocked and naturalized fish. Salmon returning to rivers to spawn also support important shore and tributary fisheries.

In 2016, Chinook Salmon represented 12% of the total number of fish stocked and 6% of total biomass stocked into Lake Ontario by MNRF (Section 6.1). Ontario's Chinook Salmon stocking levels have remained relatively constant since 1985 (500,000 fish target) (Fig. 7.1.1), however cuts to NY stocking rates were agreed upon during lake wide cuts in 1996. Despite recent stable stocking levels, Chinook Salmon CUE in the Fish Community Index Gill Netting has been variable, but 2016 showed an increase relative to 2015 (Fig.7.1.2). CUE in 2016 gill nets marks the first increase in Chinook Salmon catches since 2011 (Fig.7.1.2).

Chinook Salmon mark and tag monitoring data were reported from five Lake Ontario Management Unit (LOMU) surveys: i) Western Lake Ontario Boat Angling Survey (Section 2.2), ii) Chinook Salmon Angling Tournament and Derby Sampling, iii) Lake Ontario Volunteer Angler Diary Program (Section 2.3), iv) Eastern Lake Ontario and Bay of Quinte Fish Community Index Gill Netting (Section 1.2) and v) Credit River Chinook Salmon Spawning Index (Section 1.7). Gill nets caught small Chinook Salmon and complement the angler programs that caught larger fish (Fig. 7.1.3). 2016 officially marks the end of the Chinook Salmon CWT study. In general, the maximum age of a Lake Ontario Chinook Salmon is 4 years. The last stocking event related to the Mark and Tag program was in 2011, thus all fish associated with this program left the Lake Ontario ecosystem in the fall of 2015. New York State Department of Environmental Conservation (NYSDEC) will be collaborating with the Lake Ontario Management Unit in writing a final report on the Chinook Salmon CWT study in the near future. Currently, NYSDEC has been stocking Chinook and Coho

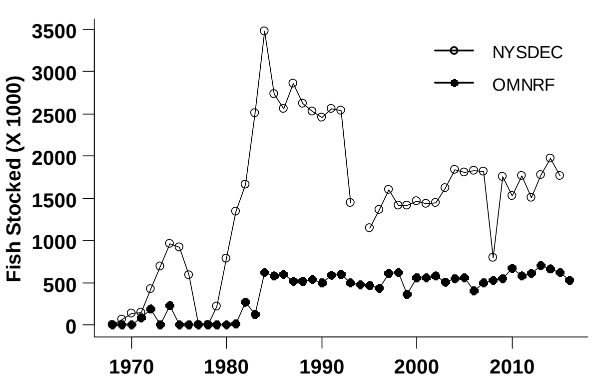

FIG 7.1.1. Number of Chinook Salmon stocked by New York State Department of Environmental Conservation (NYSDEC) and MNRF from 1968 – 2016 (Section 6.1).

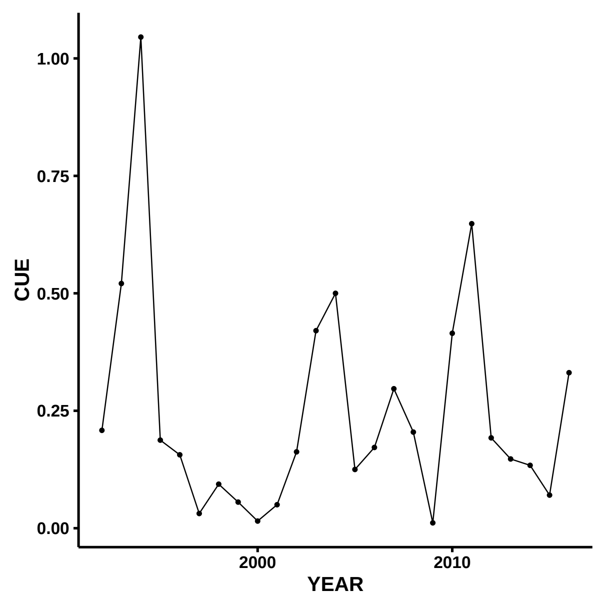

FIG. 7.1.2. Number of Chinook Salmon caught per gill net (CUE) from the Fish Community Index Gill Netting Program (see Section 1.2) from 1992 – 2016.

Salmon with adipose clips and CWTs to assess the effectiveness of net pen stocking. Anglers that observed fish with an adipose fin clip in 2016 were likely catching fish associated with this NYSDEC program. Note that Coho Salmon stocked by MNRF, via Metro East Anglers, also have adipose clips but do not have CWTs. CWTs collected from the Chinook Salmon Mark and Tag program from 2009 to 2015 showed a mixed population of Chinook Salmon (natural vs. stocked and New York vs. Ontario fish) originating from geographically widespread stocking locations. The mark and tag monitoring program confirmed that Chinook Salmon returns to the Credit River tend to originate from fish stocked in the Credit River with a few strays from Bronte Creek stocking locations.

Catch per unit effort (CUE), total catch and total harvest is assessed by the Western Lake Ontario Boat Fishery (Section 2.2). In 2016, total effort increased slightly from 2013 (Fig. 7.1.4) and total catch and harvest were 8% and 9% above the mean through 1997 to 2016 (Fig. 7.1.5). Release rates in both the Western Lake Ontario Boat Fishery and the Lake Ontario Volunteer Angler Program (Section 2.3) have generally increased through time (Sections 2.2 and 2.3). In 2016, the release rates in the Western Lake Ontario Boat Fishery declined to 50% from the 2004 to 2016 average of 59%. Chinook Salmon release rates reported in the Lake Ontario Volunteer Angler Program were lower in 2016 (55%) compared to 2015 (68%) and 2014 (65%).

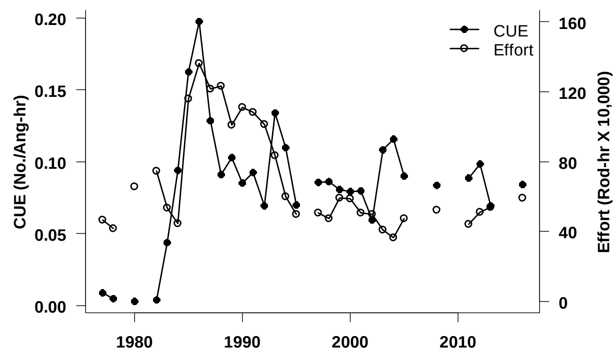

FIG 7.1.4. Catch rate (CUE) of Chinook Salmon and annual total effort (rod-hrs) in the Ontario waters of Lake Ontario (excluding the Eastern Basin), 1977 to 2016.

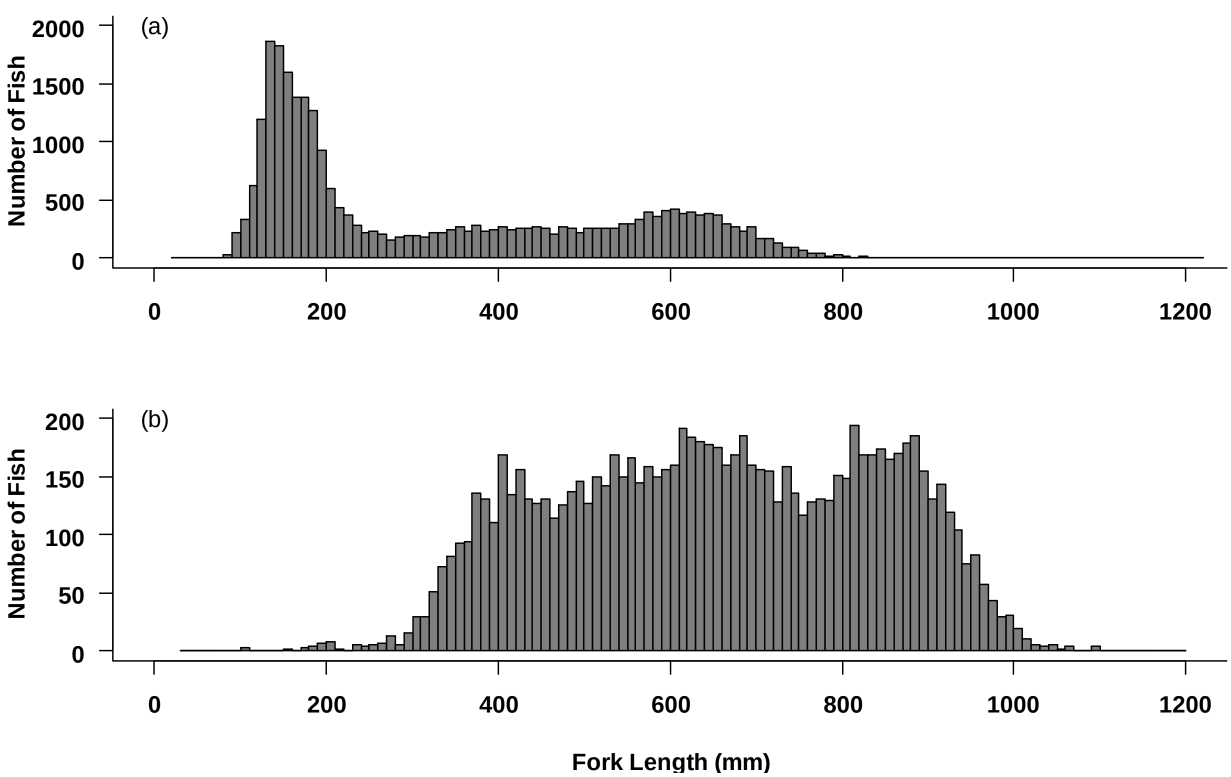

FIG 7.1.3. Size distribution (fork length in mm) of Chinook Salmon caught (a) in the Fish Community Index Gill Netting Program from 1992 – 2016 (Section 1.2) and (b) by anglers in the Western Lake Ontario Angler Survey from 1995 to 2016.

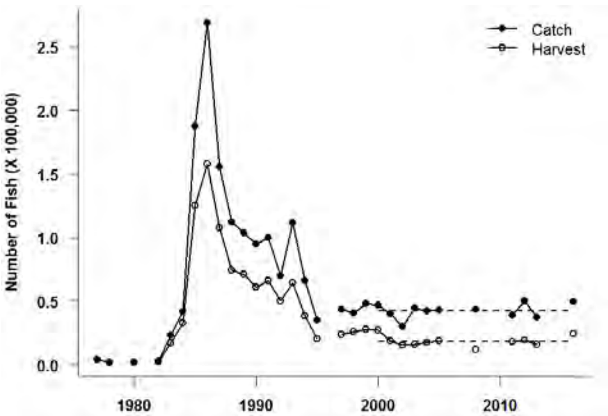

FIG 7.1.5. Number of Chinook Salmon caught (closed circle) and harvested (open circle) annually in the Ontario waters of Lake Ontario (excluding he Eastern Basin), 1977 to 2016. Dashed line represents the mean catch and harvest from 1997 to 2016.

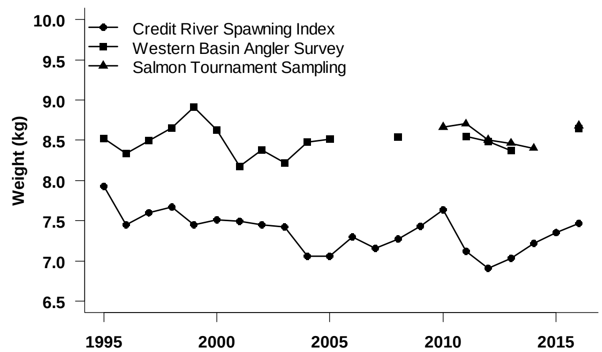

FIG 7.1.6. Condition index of Chinook Salmon from Credit River Spawning Index (circle), Western Basin Angling Survey (square) and the Salmon Tournament Sampling (triangle) from 1989 – 2016. Condition index is the predicted weight (based on a log-log regression) of a 900 mm total length Chinook Salmon.

The condition of Lake Ontario Chinook Salmon has been evaluated through three separate LOMU programs: i) Credit River Chinook Salmon Spawning Assessment (Section 1.7), ii) Chinook Salmon Tournament Sampling and iii) Western Lake Ontario Angler Survey (Section 2.2). Chinook Salmon in the Credit River index have a lower condition relative to fish sampled in the lake during mid-summer when condition should be at a maximum. Chinook Salmon condition, evaluated using data from the Credit River Chinook Spawning Index Program (Section 1.7) has declined since 1989 (Fig. 7.1.6). In 2012, Credit River Chinook Salmon condition was the lowest in the time series. Since 2012, Chinook Salmon condition in the Credit River has increased. In contrast, these overall trends were not observed in either the Western Lake Ontario Boat Fishery or the tournament sampling (Fig. 7.1.6). Despite the decline in Chinook Salmon condition from 2011 to 2013 in the Western Lake Ontario Boat Fishery, the 2016 condition index increased and is above the long-term 1995 to 2016 average. A similar decline in condition was observed in Chinook Salmon sampled in tournaments; however the condition declines observed in the angler survey and tournament sampling are subtle relative to observations in the Credit River condition index (Fig. 7.1.6).

The Lake Ontario Management Unit continued to sample Chinook Salmon on the Ganaraska River in 2016 with the goal of diversifying Chinook Salmon egg collection sources. In contrast to the Credit River, where adult returns are predominantly stocked fish, adult Chinook Salmon returning to the Ganaraska River to spawn are naturalized. In contrast to observations in 2015, the average fork length of adults returning to the Ganaraska River was lower than those returning to the Credit River. Condition of the Chinook Salmon returning to the Ganaraska River in 2016 was slightly lower than 2015 and remained below Chinook Salmon condition on the Credit River. In 2016, average weight and length of adult Chinook Salmon returning to the Credit River declined for the third year in a row (see Section 1.7, Fig. 1.7.1). Despite this decline in overall size, the condition of these returning fish has either remained stable (females) or increased (males) since 2012 (see Section 1.7, Fig. 1.7.2).

Using Chinook Salmon otoliths, in-year growth was calculated by measuring the distance from the last annuli to the outer edge of the otolith. Chinook Salmon experienced exceptional in-year growth from 2010 to 2012, followed by a sharp decline in 2013 (Fig. 7.1.7). In 2014, Chinook Salmon growth was the second lowest in the time series, increasing from 2013 levels (lowest in the 2006-2014 time series), however it remains below the average growth from 2008 (Fig. 7.1.7). In-year growth was determined to be correlated with summer water temperatures (Section 11.1).

Mean summer temperatures for Lake Ontario were above the long-term average in 2016; a sharp contrast to the 2014 and 2015

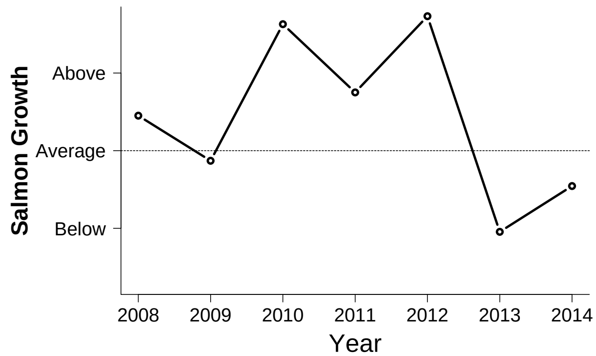

FIG. 7.1.7. Mean in-year growth determined by otolith measurements of age-2 and age-3 Chinook Salmon collected during the Credit River Spawning Index (Section 1.7).

seasons, which marked the coldest mean summer water temperatures recorded since 2002 (see Section 11.1). In addition, the winter of 2016 was significantly less severe compared to the previous two years (see Section 11.1). While, these two factors may not be the driving force behind Chinook Salmon growth and condition and catch per unit effort in the recreational fishery, they likely have a significant contribution, as cooler temperatures are associated with lower metabolic activity and growth.

7.2 Rainbow Trout

M. J. Yuille , Lake Ontario Management Unit

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

The OMNRF stocks only Ganaraska River strain Rainbow Trout into Lake Ontario. Rainbow Trout represent 6.1% of all fish stocked by number and 6.1% of the biomass into Lake Ontario by the OMNRF. In 2016, 143,698 Rainbow Trout were stocked, slightly below the 2007 to 2016 average of 164,560 (Fig. 7.2.1).

The spring spawning run of Rainbow Trout in the Ganaraska River has been estimated at the fishway at Port Hope since 1974 (see Section 1.1). In 2016, the Rainbow Trout run in the Ganaraska River declined to 4,987 from 6,669 in 2015 and remains below the previous 10 year average (7,103 fish from 2007 – 2016; Fig. 7.2.2).

The Lake Ontario ecosystem has changed dramatically during this time series (e.g., phosphorus abatement, dreissenid mussel invasion, round goby invasion). During this time period (1974 to 2016), Rainbow Trout condition has declined (Fig. 7.2.3a). With the exceptions of 1994 and 1996, the highest condition values occurred in the 1970's, prior to invasion of Zebra Mussels, Quagga Mussels and Round Goby. Condition declined through the 1980's to a low point in 1987. From 1990 to 2016, the long-term trend shows slight decline in relative weight. Data on Rainbow Trout condition over the past 10 years are the most informative for the current population (Fig. 7.2.3b). Rainbow Trout condition declined to a low in 2008 then has increased up to 2013, the highest in the whole time series since 1997. In 2015, Rainbow Trout condition declined significantly, to the lowest point since 1986. Rainbow Trout condition has remained unchanged from 2015 to 2016 (Fig. 7.2.3b).

After a sharp increase in catch per unit effort (CUE) from 1979 to 1984 (the highest in the 34 year time series), the CUE declined until 2004 in the Western Lake Ontario Boat Fishery (Fig. 7.2.4). After 2004 (the lowest CUE since1982), the CUE steadily increased to 2013. The Lake Ontario Management Unit, did not

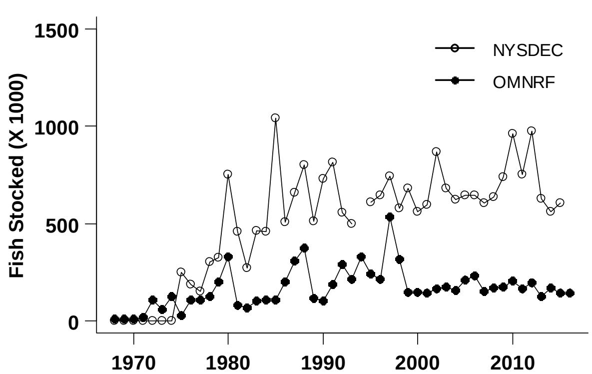

FIG 7.2.1. Number of Rainbow Trout stocked by New York State Department of Environmental Conservation (NYSDEC) and OMNRF from 1968 – 2016 (see Section 6.1).

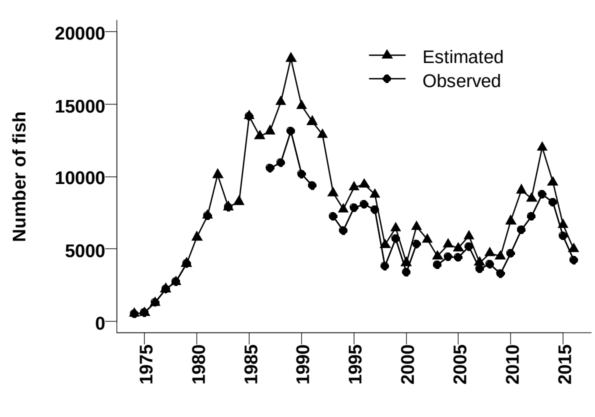

FIG 7.2.2. Estimated run of Rainbow Trout at the Ganaraska River fishway at Port Hope, Ontario from 1974 – 2016.

evaluate the Western Lake Ontario Boat Fishery in 2014 or 2015, but Rainbow Trout CUE in 2016 showed a significant decline, falling below the average CUE for both the full time series (1977-2016) and the past 10 years (2007 to 2016; Fig. 7.2.4). Effort in this fishery has remained fairly stable since 1994 (Fig. 7.2.4). Total numbers of Rainbow Trout caught and harvested in the Western Lake Ontario Boat Fishery naturally followed the same trends found in CUE with total harvest generally lower than total catch (Fig. 7.2.5).

In the fall of 2014, New York anglers reported and New York State Department of Environmental Conservation (NYSDEC) observed disoriented Rainbow Trout in the Salmon River, New York. After hearing these reports, the Lake Ontario Management Unit actively searched for distressed and disoriented Rainbow Trout in Lake Ontario tributaries, however, none were observed. Tissues from distressed Rainbow Trout collected by NYSDEC contained low levels of Thiamine (Vitamin B1). Despite not observing distressed Rainbow Trout in Ontario, it remains uncertain if low Thiamine levels are having an impact on Rainbow Trout in Canadian waters.

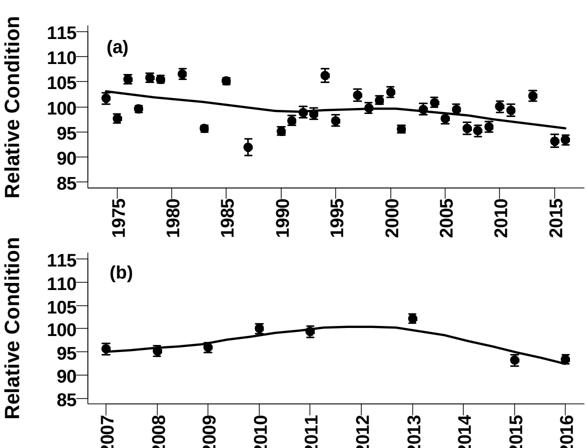

FIG 7.2.3. Relative weight of Rainbow Trout sampled at the Ganaraska River fishway at Port Hope, Ontario for (a) the whole time series 1974 – 2016 and (b) a 10 year average (2007 – 2016; see Section 1.1).

While the condition of Rainbow Trout in 2016 has not declined from 2015, the number of fish passing through the Ganaraska Fishway during the spring spawning run continued to decline (Figs. 7.2.2 and 7.2.3, see also Section 1.1). It is unknown whether these declines are related to the Thiamine issues observed in 2014 in New York, a result of lower than average seasonal summer temperatures in 2014 and 2015 (Section 11.1), more severe winters in 2013-2014 and 2014 -2015 (see Section 11.1), or below average flows during the spawning runs (Section 11.4), but it is likely the combination of multiple factors.

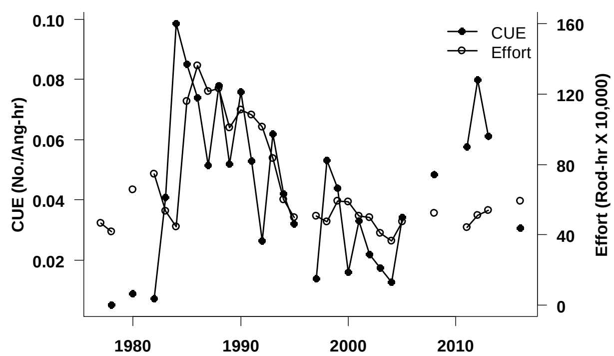

FIG 7.2.4. Catch rate (CUE) of Rainbow Trout and total effort (rod-hrs) in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1977 – 2016.

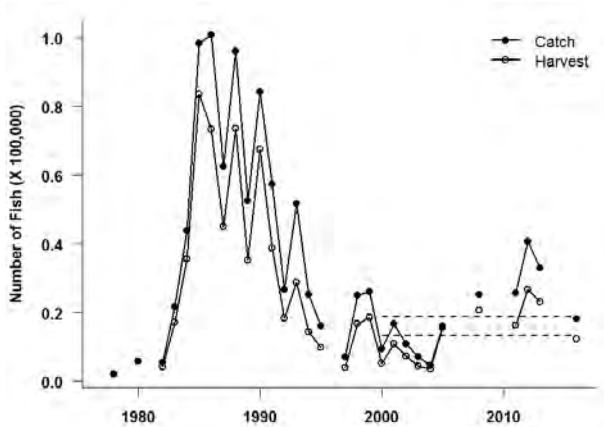

FIG 7.2.5. Number of Rainbow Trout caught (closed circle) and harvested (open circle) annually by the boat fishery in the Ontario waters of Lake Ontario (excluding Kingston Basin), 1978 – 2016. The dashed line represents the mean catch and harvest from 2000 to 2016.

7.3 Lake Whitefish

J. A. Hoyle, Lake Ontario Management Unit

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

Commercial Fishery

Lake Whitefish commercial quota and harvest increased from the mid-1980s through the mid-1990s, declined through to the mid-2000s then stabilized at a relatively low level (Fig. 7.3.1). Quota and harvest averaged 120,000 lb and 80,000 lb respectively, over the 2008-2016 time-period. In 2016, base quota was 135,091 lb, issued quota was 163,392 lb and the harvest was 95,552 lb (Section 3.2). In recent years, most of the harvest occurs in quota zone 1-2, eastern Lake Ontario (Fig. 7.3.2). Here, most of the harvest occurs at spawning time in November and early December (Fig. 7.3.3). Although harvest at other times of the year is less than at spawning time, considerable gill net fishing effort does occur. Highest harvest rates (HUE) occur at spawning time.

The age distribution of Lake Whitefish harvested is comprised of many age-classes (Fig. 7.3.4). Most fish are age-5 to age-13.

Abundance

Lake Whitefish abundance is assessed in a number of programs. Summer gill net sampling is used to assess relative abundance of juvenile and

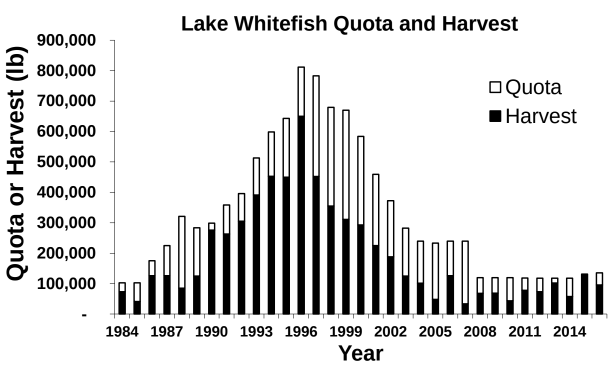

FIG. 7.3.1. Lake Whitefish commercial quota and harvest, 1984-2016.

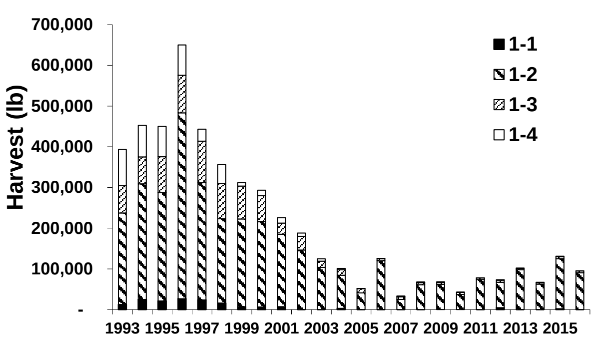

FIG. 7.3.2. Lake Whitefish commercial harvest by quota zone, 1993-2016.

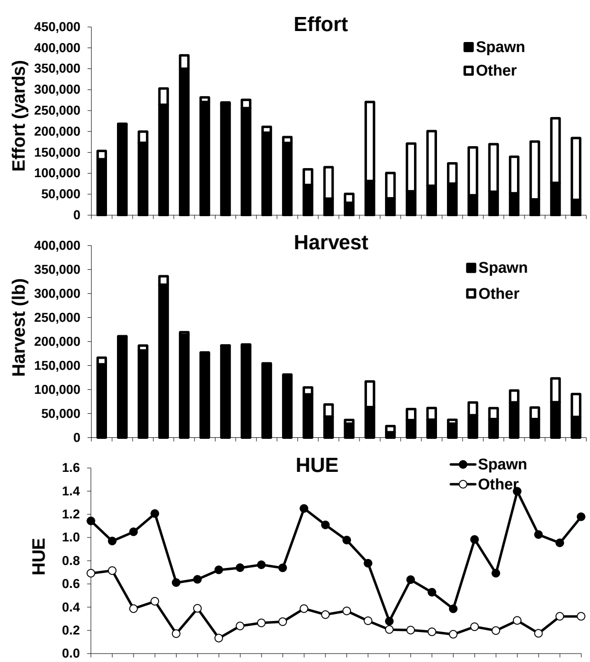

FIG. 7.3.3. Commercial Lake Whitefish gill net fishing effort (top panel), harvest (middle panel), and harvest-per-unit-effort (HUE; bottom panel) in quota zone 1-2, 1993-2016. "Spawn" includes November and December, and "Other" includes January through October.

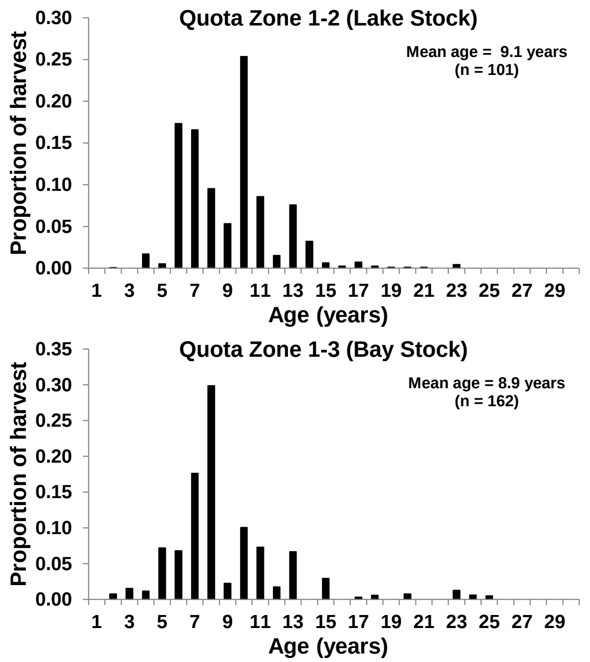

FIG. 7.3.4. Lake Whitefish age distributions (by number) in the 2016 quota zones 1-2 (upper panel) and 1-3 (lower panel) fall commercial fisheries.

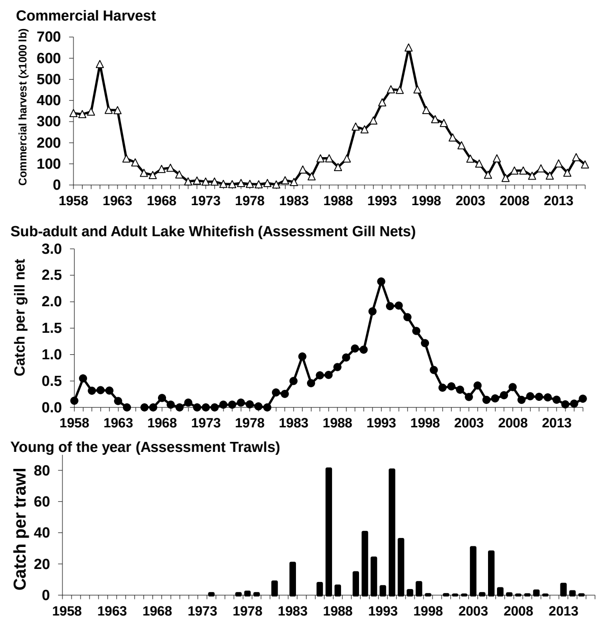

FIG. 7.3.5. Lake Whitefish commercial harvest (upper panel). Lake Whitefish abundance in eastern Lake Ontario assessment gill nets, 1958-2016 (sub-adult and adult; middle panel) and bottom trawls, 1972-2016 (young-of-the-year; lower panel).

adult fish in eastern Lake Ontario (Fig. 7.3.5, and see Section 1.2). Young-of-the-year (YOY) abundance is assessed in bottom trawls (Section 1.3) at Conway (lower Bay of Quinte) and Timber Island (EB03 in eastern Lake Ontario) (Fig. 7.3.5). Lake Whitefish abundance, like commercial harvest, has been stable at a relatively low level for the last decade. Young-of-the-year catches have been variable.

Growth

Trends in length-at-age for Lake Whitefish caught during summer assessment gill nets for age -2, age-3, and age-10 (males and females) fish are shown in Fig. 7.3.6. Generally, fork length-at-age declined during the 1990s then stabilized in the early 2000s.

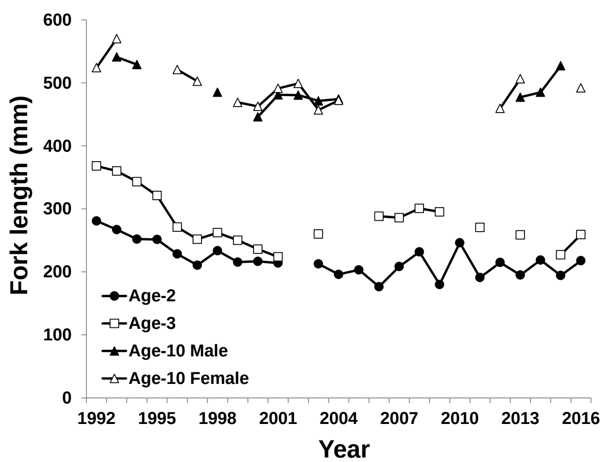

FIG. 7.3.6. Trends in Lake Whitefish fork length-at-age for age-2, age-3, age-10 males and females, caught in summer assessment gill nets, 1992-2016.

Condition

Trends in Lake Whitefish condition during summer and fall are shown in Fig. 7.3.7. Condition was high from 1990-1994, declined through 1996. Condition then increased to intermediate levels for Lake Whitefish sampled during summer but condition remained low for fish sampled during fall.

Overall Status

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

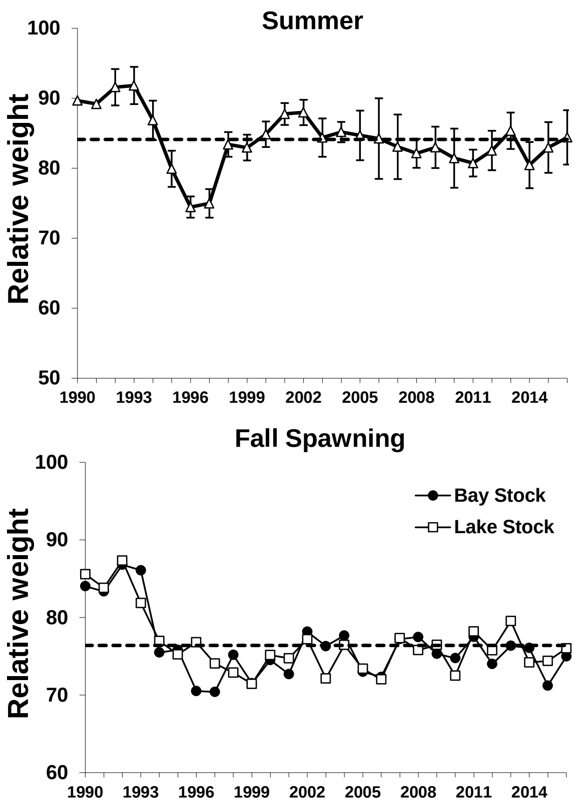

FIG. 7.3.7. Condition (relative weight) of Lake Whitefish sampled during summer assessment gill net surveys in eastern Lake Ontario (upper panel error bars ±2SE) and fall commercial catch sampling (lower panel) in the Bay of Quinte ("Bay Stock") and the south shore Prince Edward County ("Lake Stock"), 1990-2016.

7.4 Walleye

J. A. Hoyle, Lake Ontario Management Unit

Walleye is the Bay of Quinte fish community's primary top piscivore and of major interest to both commercial (Section 3.2) and recreational fisheries (Section 2.4). The Walleye population in the Bay of Quinte and eastern Lake Ontario is managed as a single large stock. The Walleye's life history-specific movement and migration patterns between the bay and the lake determines the seasonal distribution patterns of the fisheries. Understanding Walleye distribution is also crucial to interpret summer assessment netting results (Sections 1.2 and 1.3). After spawning in April, mature Walleye migrate from the Bay of Quinte toward eastern Lake Ontario to spend the summer months. These mature fish return back "up" the bay in the fall to over-winter. Immature Walleye generally remain in the bay year-round.

Recreational Fishery

The recreational fishery consists of a winter ice-fishery and a three season (spring/summer/fall) open-water fishery. Most Walleye harvest by the recreational fishery occurs in the upper and middle reaches of the Bay of Quinte during the winter ice-fishery (Fig. 7.4.1) and the spring/early summer open-water fishery. All sizes of fish are caught during winter while mostly juvenile fish (age-2 and age-3) are caught during spring and summer. A popular "trophy" Walleye fishery occurs each fall based on the large, migrating fish in the middle and lower reaches of the Bay of Quinte at that time (see Section 2.5). Trends in the open-water fishery are shown in Fig. 7.4.2 (see also Section 2.4). Annual Walleye angling effort and catch (ice and open-water fisheries combined) has been relatively stable averaging about 330,000 hours and 55,000 fish during the last decade.

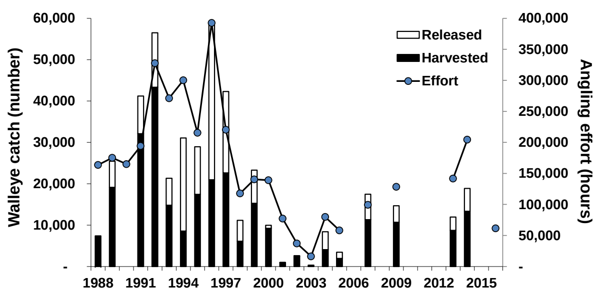

FIG. 7.4.1. Bay of Quinte recreational angling effort and walleye catch (released and harvested) during the winter ice-fishery, 1988-2015. No data for 2006, 2008, 2010-2012 or 2015.

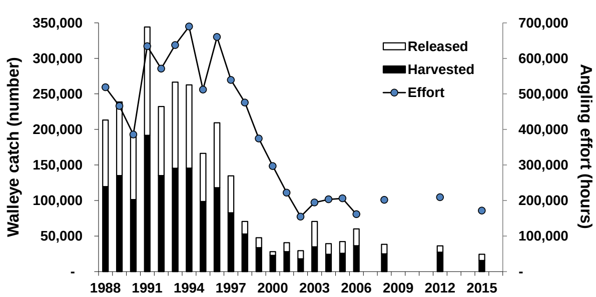

FIG. 7.4.2. Bay of Quinte recreational angling effort and walleye catch (released and harvested) during the open-water fishery, 1988-2014. No data for 2007, 2009-2011, or 2013-2014.

Commercial Fishery

Walleye harvest by the commercial fishery is highly regulated and restricted. No commercial Walleye harvest is permitted in the upper and middle reaches of the bay (Trenton to Glenora). A relatively modest Walleye commercial quota

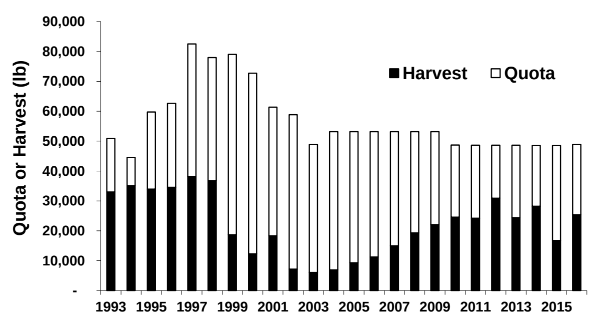

FIG. 7.4.3. Walleye commercial quota and harvest, 1993-2016.

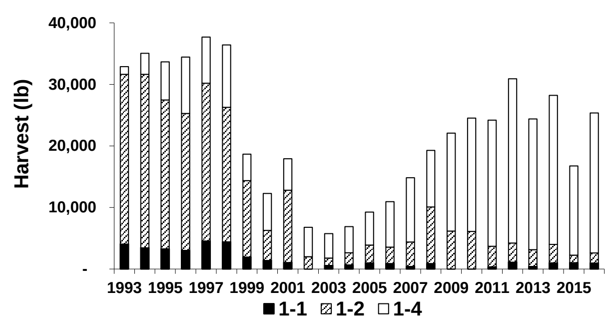

FIG. 7.4.4. Walleye commercial harvest by quota zone, 1993-2016.

(48,546 lbs; Fig. 7.4.3) is allocated in the lower Bay of Quinte and Lake Ontario with additional seasonal, gear, and fish-size restrictions. The commercial harvest of Walleye was 25,377 lbs in 2016. Commercial Walleye harvest has shifted location from quota zone 1-2 to 1-4 over the last decade (Fig. 7.4.4). This shift has likely resulted in smaller, younger Walleye being harvested but this has not been measured.

Annual Harvest

Total annual Walleye harvest in the recreational and commercial fisheries (by number and weight) over the last decade (2007-2016) is given in Table 7.4.1. The recreational fishery takes about 80% of the annual harvest with the open-water component of the recreational fishery making up 58% (by number) of total annual harvest.

Abundance

Walleye abundance is assessed in a number of programs. Summer gill net sampling (Section 1.2) is used to assess relative abundance of juvenile (Bay of Quinte) and adult (eastern Lake Ontario) fish (Fig. 7.4.5). Fig. 7.4.6 shows the 2015 Walleye age distribution in these two geographic areas. Young-of-the-year (YOY) abundance is assessed in Bay of Quinte bottom trawls (Fig. 7.4.7; Section 1.3).

Except for an unusually high catch in 2013, juvenile abundance in the Bay of Quinte has been relatively stable since 2001 (Fig. 7.4.5). In eastern Lake Ontario index gill nets, after an unusually low catch in 2013, Walleye abundance in eastern Lake Ontario increased to a level similar to that observed in the previous few years (Fig. 7.4.5). The 2014 catch of YOY Walleye in bottom trawls was the highest since 1994 (Fig. 7.4.7) and the 2015 year-class was also very large. The 2016 year-class was of moderate strength. These recent year-classes foreshadow continued stability in the Walleye population and fisheries.

TABLE 7.4.1. Mean annual Walleye harvest by major fishery over the last decade (2007-2016).

	Annual Walleye Harvest			
	Pounds of fish	Number of fish	% by weight	% by number
Commercial	23,080	9,232	22%	20%
Recreational				
Open-water Angling	52,548	26,051	50%	58%
Ice Angling	29,393	9,814	28%	22%
Total	105,021	45,097	100%	100%

Growth

Walleye length-at-age for age-2 and age-3

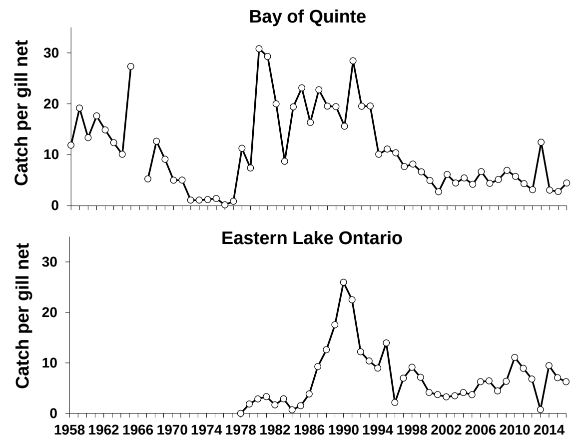

FIG. 7.4.5. Walleye abundance in summer gill nets in the Bay of Quinte, 1958-2016 (upper panel) and eastern Lake Ontario, 1978-2016 (lower panel).

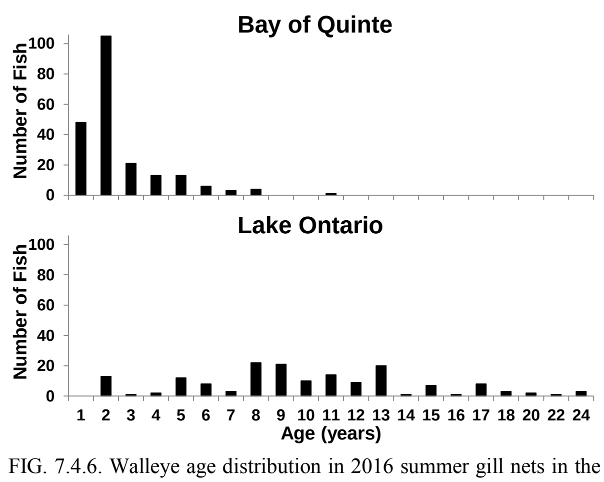

FIG. 7.4.6. Walleye age distribution in 2016 summer gill nets in the Bay of Quinte (upper panel) and eastern Lake Ontario (lower panel).

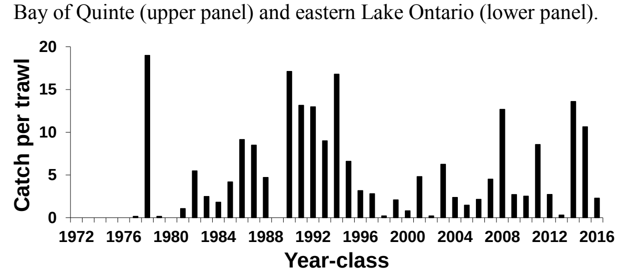

FIG. 7.4.7. Young-of-the-year Walleye catch per trawl in the Bay of Quinte, 1972-2016.

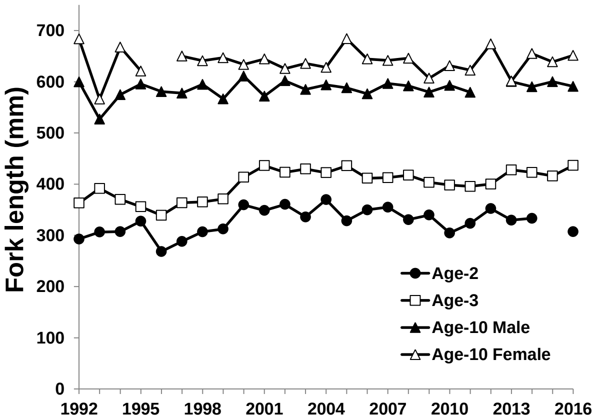

FIG. 7.4.8. Trends in Walleye fork length-at-age for age-2, age-3, age-10 males and females, caught in summer assessment gill nets, 1992-2016.

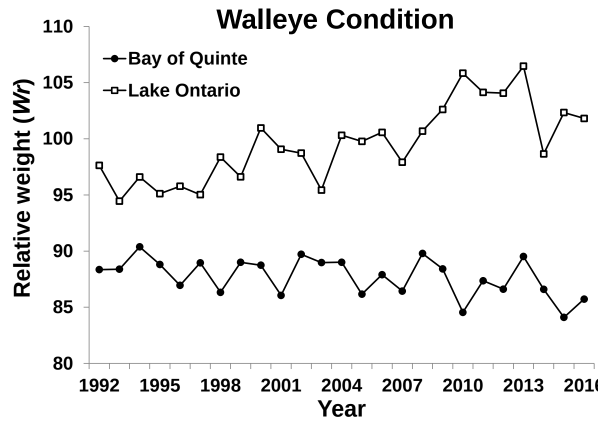

FIG. 7.4.9. Trends in Walleye condition (relative weight), caught in summer assessment gill nets, 1992-2016.

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

Condition

Walleye condition (relative weight) is shown in Fig. 7.4.9. Condition has remained stable in Bay of Quinte fish (immature) and showed an increasing trend in Lake Ontario (mature fish) until 2014 when condition declined sharply; condition increased in 2015 and held steady in 2016.

Other Walleye Populations

The Bay of Quinte/eastern Lake Ontario Walleye population is the largest on Lake Ontario; smaller populations exist in other nearshore areas of the lake and St. Lawrence River. Walleye in these other areas are regularly assessed with a standard trap net program (Nearshore Community Index Netting; see Section 1.4). Mean (2006-2016) Walleye trap net catches in 13 geographic nearshore areas are shown in Fig. 7.4.10. Highest Walleye abundance occurs in the Bay of Quinte, East Lake, West Lake, Weller's Bay and Hamilton Harbour. Walleye abundance increased in Hamilton Harbour following 2012 Walleye stocking efforts (see Section 8.7).

Overall Status

The overall status of Lake Ontario Walleye is good. The Bay of Quinte/eastern Lake Ontario population did decline during the 1990s but stabilized at levels that still supports a high quality fishery.

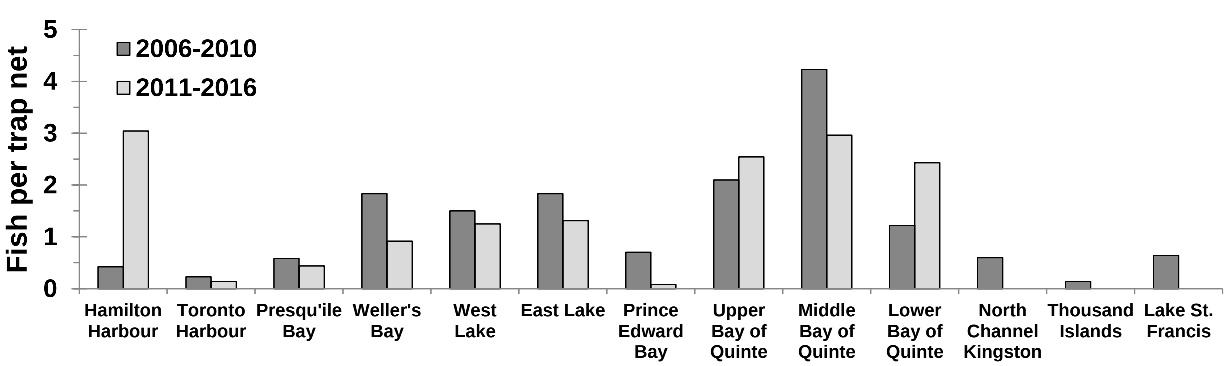

FIG. 7.4.10. Walleye abundance (mean annual number of fish per trap net) in 13 geographic nearshore areas of Lake Ontario and the St. Lawrence River arranged from west (Hamilton Harbour) to east (Lake St. Francis). Catches are annual means for all sampling from 2006-2010 and 2001-2016 time-periods with individual areas having been sampled from one to ten years over the eleven year time-period.

7.5 Northern Pike

M. Hanley, Lake Ontario Management Unit

Northern Pike (*Esox lucius*) are a cool-water piscivore which are native to Lake Ontario and the St. Lawrence River. They are most often associated with shallow, weedy areas of lakes and rivers and are classified as ambush predators. Northern Pike are popular sportfish in Lake Ontario and the St. Lawrence River. In addition, they have been permitted as a harvested species in the commercial fishery in the Bay of Quinte and the Eastern Basin of Lake Ontario beginning in the fall of 2006 (see Section 3.2). Northern Pike are an indicator species of water-level changes, as flooding in the spring initiates spawning due to improved access to nursery habitat in flooded marshes and weedy shallow bays. Additionally, water levels determine offspring survival and subsequent recruitment. Years with high water levels that are maintained for a long period of time are associated with strong year-classes of Northern Pike.

In assessment gear, Northern Pike are most often encountered during the Nearshore Community Index Netting (NSCIN) program (see Section 1.4). The NSCIN program began in 2001 and is performed annually in the Upper Bay of Quinte. Additionally, this program is undertaken in various other locations in Lake Ontario and the St. Lawrence River on a yearly rotating basis (see Section 1.4). Catch per unit effort (CUE) of Northern Pike in NSCIN nets in the Upper Bay of Quinte from 2013-2015 (0.28 pike/net) had remained at half of the long term average (0.56 pike/net), but in 2016, CUE (0.53 pike/net) came very close to this long-term average (Fig. 7.5.1). A target catch rate of 0.69 fish/net in the NSCIN program was set in the Bay of Quinte Fisheries Management Plan (BQFMP) to provide an index identifying changes in abundance. Similar to recent years, the CUE of pike in Upper Bay of Quinte NSCIN nets did not reach this target (Fig. 7.5.1).

Other locations around Lake Ontario and the St. Lawrence River are also used in the NSCIN program to assess fish communities throughout the system. In 2016, the Toronto Waterfront and Hamilton Harbor locations were sampled in addition to the Upper Bay of Quinte. These two Areas of Concern (AOCs) have been chosen as sampling locations every second year since 2006 to determine species composition and abundance in these high profile AOCs. Northern Pike are often caught in Hamilton Harbour and Toronto Harbour NSCIN trap nets so these locations were used to compare average CUE and average length of pike captured in the Upper Bay of Quinte (Fig. 7.5.2). In comparing the three locations, Toronto Waterfront trap nets capture the most pike and the largest pike when compared to the other two locations. The Upper Bay of Quinte captures the smallest and fewest pike, while Hamilton Harbor is an intermediate type between the two (Fig. 7.5.2).

Northern Pike are captured in the gill nets used in the Community Index Netting Program in the Lake St. Francis region of the St. Lawrence River (see Section 1.6). Catch per standard gill net in 2016 was lower than in 2014 and shows a continued decline in CUE in this area (Fig. 7.5.3). Pike captured from gill nets are predominantly large fish (>500 mm) and very few small fish

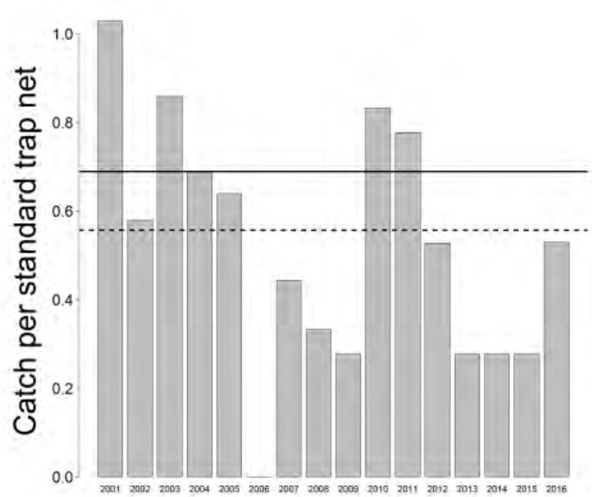

FIG. 7.5.1. Northern Pike abundance in the Upper Bay of Quinte Nearshore Community Index Netting program 2001-2016 (no netting in 2006). The dotted line indicates the long-term CUE average and the solid line represents the BQFMP target CUE.

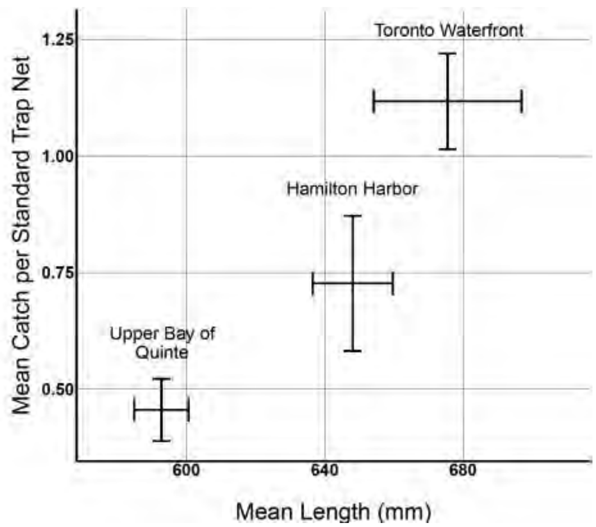

FIG. 7.5.2. Mean length and mean catch in Nearshore Community Index Netting Program of Northern Pike in three different locations. Each point represents the mean length and CUE of Northern Pike through time at each location. Error bars are ±1 standard error.

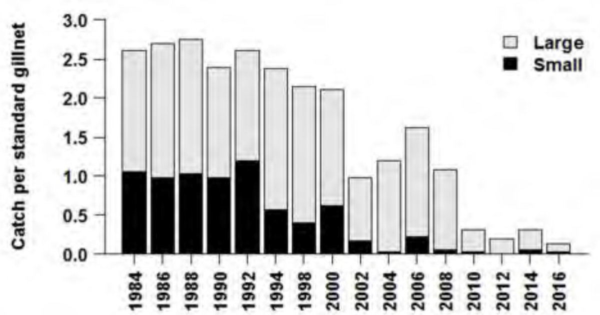

FIG. 7.5.3.Catch per unit effort of Northern Pike in Community Index gill nets in Lake St. Francis from 1984-2016. Each bar is divided into small (<500 mm) and large (>500 mm) Northern Pike CUE.

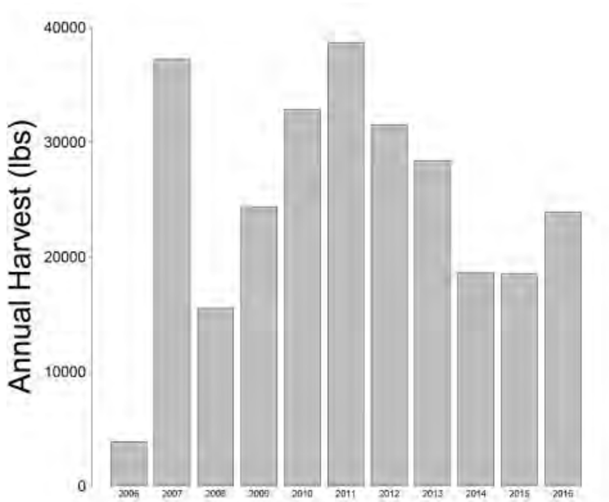

FIG. 7.5.4. Annual harvest (lbs) of Northern Pike in commercial fishery nets in Lake Ontario, including the Bay of Quinte, from 2006 -2016.

(<500 mm) are caught (Fig.7.5.3).

Annual harvest of Northern Pike in commercial fishery nets in Lake Ontario was higher in 2016 compared to the two previous years (Fig. 7.5.4). This trend is consistent with the CUE increase seen in the NSCIN trap nets in the Upper Bay of Quinte. As has been the case in previous years, the majority, 71.3%, of Northern Pike harvest was reported in the Bay of Quinte, with only 28.7% of the total harvest reported from all other areas in Lake Ontario (see Section 3.2).

7.6 Pelagic Prey Fish

J.P. Holden, M.J. Yuille, J.A. Hoyle Lake Ontario Management Unit
B.C. Weidel, *M.G. Walsh* Lake Ontario Biological Station, USGS
M.J. Connerton Cape Vincent Fisheries Station, NYSDEC

Alewife

Alewife are the dominant prey fish in Lake Ontario and are the primary prey item for important pelagic predators (e.g., Chinook Salmon, Rainbow Trout) as well as other recreationally important species such as Walleye and Lake Trout. It is important to monitor Alewife abundance because significant declines in their abundances in Lakes Huron and Michigan lead to concurrent declines in Alewife-dependent species, such as Chinook Salmon. However, having Alewife as the principal prey item can lead to a thiamine deficiency in fish that eat Alewife, which has been linked to undesirable outcomes like reproductive failure in Lake Trout as well as Early Mortality Syndrome (EMS).

The stock status of Alewife as it relates to predator-prey balance in Lake Ontario requires a whole-lake assessment. Acoustic estimates (Section 1.7) are used in conjunction with estimates derived from the New York State Department of Environmental Conservation (NYSDEC) and U.S. Geological Survey (USGS) spring bottom trawl program that included MNRF participation for the first time in 2016 (Section 1.11). Index values between acoustic and spring bottom trawls show differences in year over year trends. The acoustic index increased in 2016 whereas the bottom trawl index declined (Fig. 7.6.1). While comparisons of these two indices are ongoing, the difference between the trends in 2016 is most likely related to the sensitivity of each index to the abundance of age-1 fish. A more comprehensive analysis of the entire spring trawl time series is reported in the New York Annual Report.

Conducting spring trawls lake-wide in 2016 provided several new insights to Alewife assessment. In contrast to a more even distribution in the summer (see Section 1.5, Fig. 1.5.8), Alewife are distributed off-shore

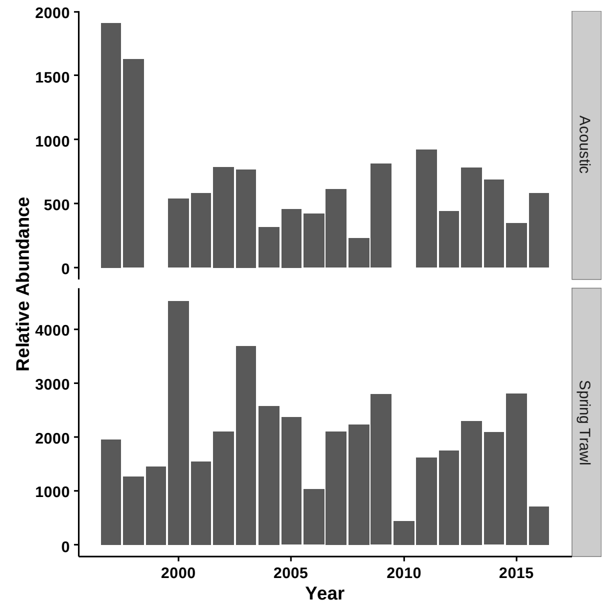

FIG. 7.6.1. Alewife abundance through time in the Spring Trawling Index (Age 2 and older Alewife per 10 min trawl) and the MNRF/ NYSDEC Acoustic survey (whole lake index of Age 1 and older Alewife, in millions). Acoustic estimates were not conducted in 1999 and 2010.

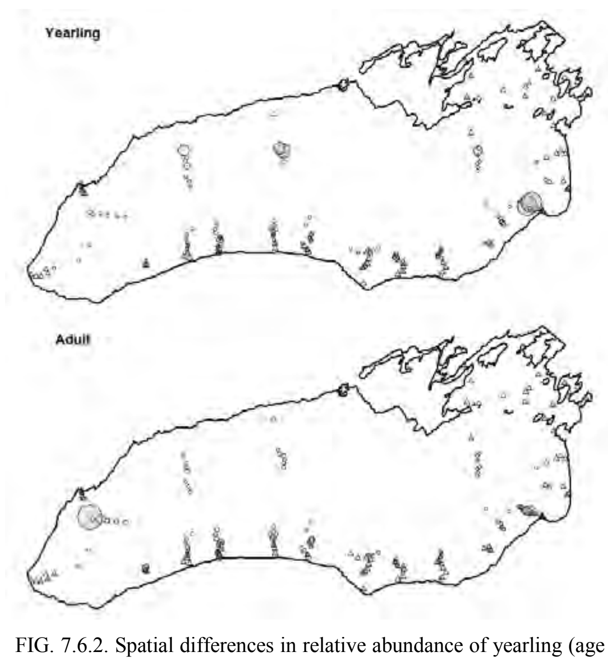

FIG. 7.6.2. Spatial differences in relative abundance of yearling (age -1) and adult (age-2+) caught in the spring trawl program (Section 1.11). Triangles indicate trawls that did not catch any Alewife. Circles are scaled relative to the number of Alewife in a 10 min trawl.

(generally depths > 70m) at the time bottom trawling was conducted (Fig. 7.6.2). Yearling (age-1) Alewife appear to have had a more patchy distribution in 2016 compared to adult Alewife. Of particular note was a single tow near Toronto that caught over 40,000 adult Alewife. The size distribution of Alewife throughout the lake however shows a similar pattern of low abundance of Alewife in the 100 to 150mm (TL) size range which represents the 2013 and 2014 cohorts (Fig. 7.6.3).

The Fish Community Index Gill Netting (Section 1.2) and Trawling programs (Section 1.3) provide localized trends but may not reflect whole lake abundance trends due to the relatively restricted geographical area of these surveys. A comparison of Acoustics, Trawling and Gill Netting shows little synchrony in abundance trends (Fig. 7.6.4) however neither Fish Community Index Gill Netting nor Trawling are specifically designed to index Alewife. Of note is the increasing trend observed in gill nets, which is not evident in the trawl programs. This trend is reflective of a change in Alewife size rather than absolute abundance. Index gill nets are limited in the size of mesh that effectively target small fish and are selective for only the largest Alewife, which make up small proportion of the total population. The trend, while not reflective of general lake wide abundance, does indicate an increase in abundance of the largest Alewife. This may indicate a change in growth or proportional size structure of the population.

Differences between geographic regions sampled in Fish Community Index trawling highlight how Alewife occupy these areas during the summer months. Data from the past five years (2011 to 2016) is presented in aggregate to increase sample size. Shallow depths have the highest catch numbers (fish/trawl) of Alewife (Fig. 7.6.5) but are generally sampling small, often young-of-year (age-0) Alewife (Fig. 7.6.6) and are generally confined to the Bay of Quinte (Fig. 7.6.7). Biomass (kg/trawl) is variable with depth (Fig. 7.6.8) but depths shallower than 50m tend to have the highest density.

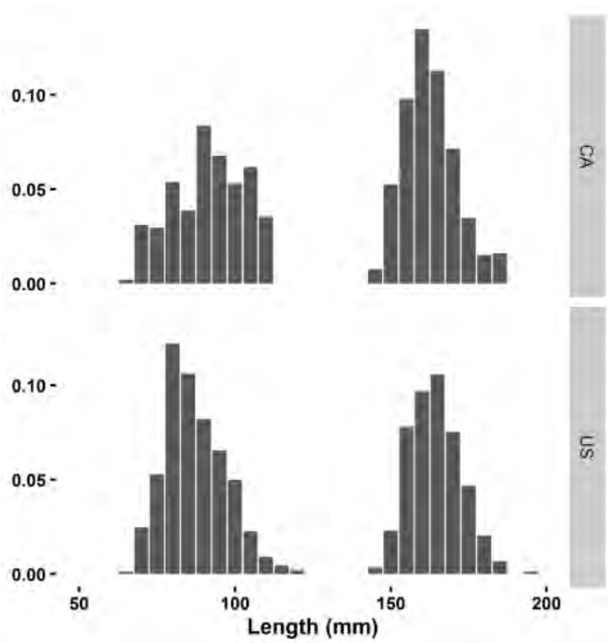

FIG. 7.6.3. Comparison of the size distribution (TL, mm) of Alewife captured in Spring Bottom trawling (Section 1.11) in Canadian (CA) and American (US) waters in 2016.

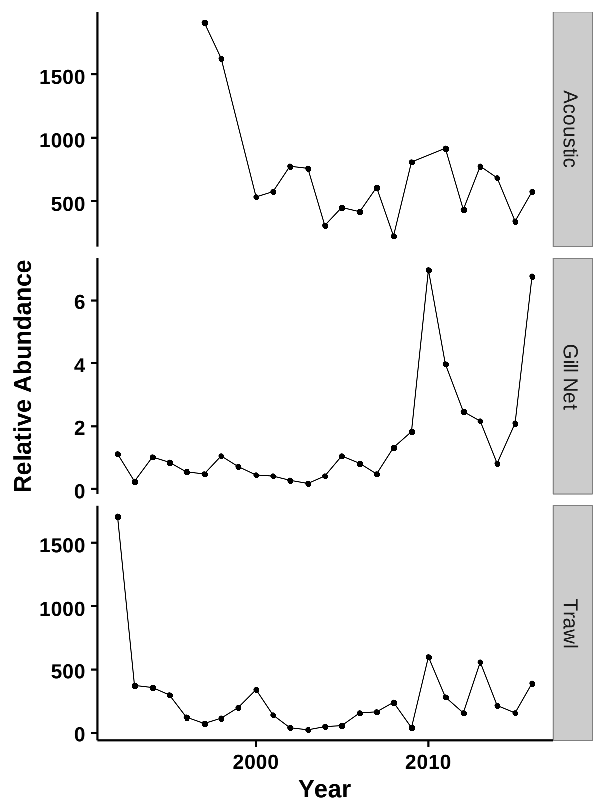

FIG. 7.6.4. Alewife trend in abundance between acoustic assessment (Section 1.5), gill nets (Section 1.2) and trawls (Section 1.3). Note that each program provides a relative index on a different scale. The acoustic index is an index of whole-lake population (in millions). Gill nets are indexed as kg per 24hr net set. Trawls are indexed as kg per 12 min. tow.

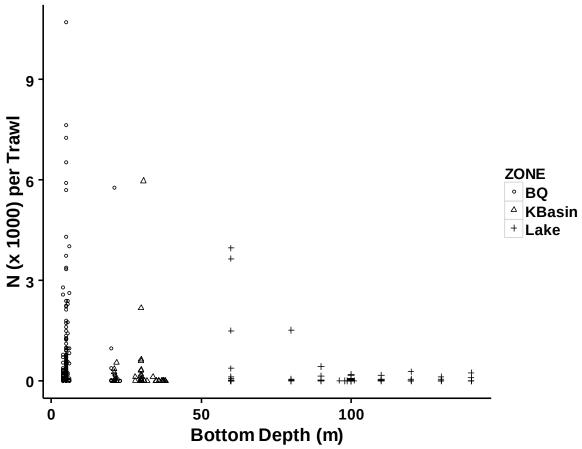

Fig. 7.6.5. Relative abundance (N/10 min tow) of Alewife for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the depth was sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

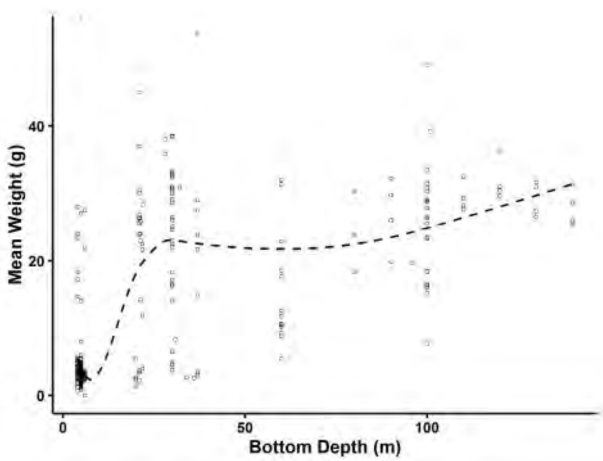

FIG. 7.6.6. Mean size of Alewife for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the depth was sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

Fish body condition quantifies on average how fat or thin individual fish are within a population. Changes in condition may indicate increased competition for food, reduced availability of food, changes in environmental conditions or a combination of these factors. Alewife condition is indexed as the predicted weight (based on a log-log regression) of a 137mm (TL) fish (Fig. 7.6.9). Recent years (since 2009) have shown greater variability in year to year changes in condition. The condition index for 2016 was the second highest of the time series and the four highest years have all occurred since 2009.

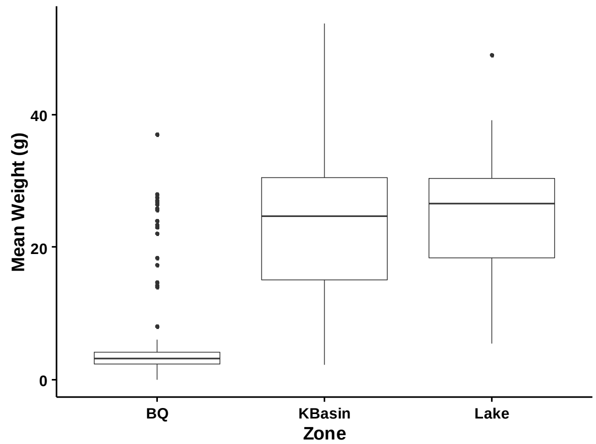

FIG. 7.6.7. Mean size of Alewife for each area sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin) in Fish Community Index Trawling (Section 1.3) from 2011 to 2016.

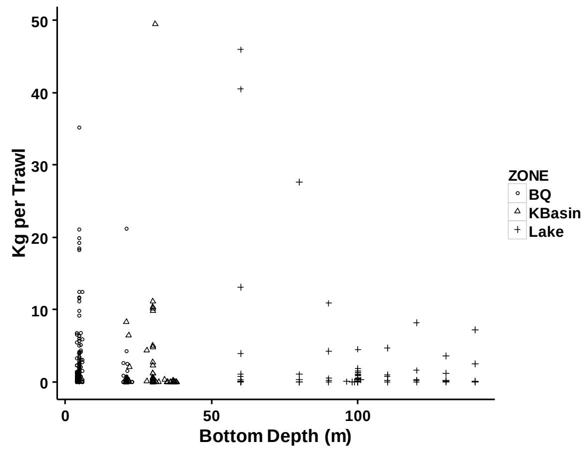

FIG. 7.6.8. Relative density (kg/12 min tow) of Alewife for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the depth was sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

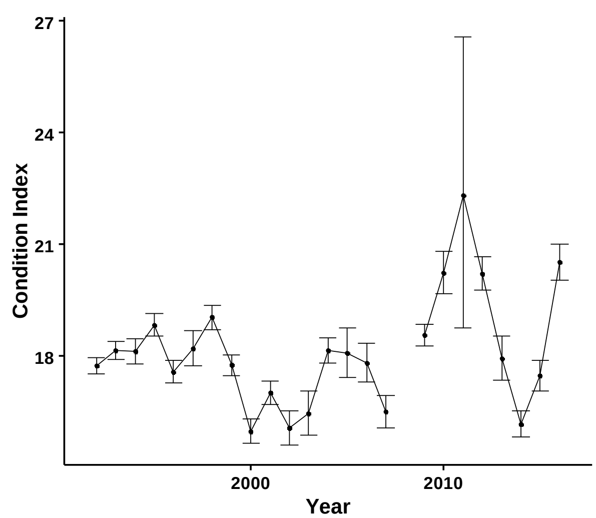

FIG. 7.6.9. Alewife condition, represented as the predicted weight (g, based on a log-log regression) of a 137 mm (total length) Alewife from the Fish Community Index trawls in the Kingston Basin only conducted in mid-summer.

Rainbow Smelt

Rainbow Smelt are the second most abundant pelagic prey species in Lake Ontario. Alewife however, contributes the majority of fish biomass in predator diets even during high periods of Rainbow Smelt abundance. High abundance of Rainbow Smelt has been thought to negatively impact native species. For example, the decline of the native Cisco population in the 1940s coincided with high abundance of Rainbow Smelt.

Following a dramatic decline of Rainbow Smelt in the 1990s, Rainbow Smelt populations have been variable but at a lower level (Fig. 7.6.10). Fish Community Index Trawling (Section 1.3) based estimates of Kingston Basin Rainbow Smelt density peaked at 1,982 fish/ha with an average density of 861 fish/ha between 1992 and 1997. The whole lake acoustic estimates of Rainbow Smelt from 1997 to present show a similar trend to the Kingston Basin trawls suggesting a lake wide decline. Similar to the acoustic survey (Section 1.5), summer trawl catches show Rainbow Smelt being confined to a relatively narrow depth range. Numbers (N/trawl, Fig. 7.6.11) and biomass (kg/trawl, Fig. 7.6.12) both peak in depths between 30 and 50m with large catches generally confined to Kingston Basin sites.

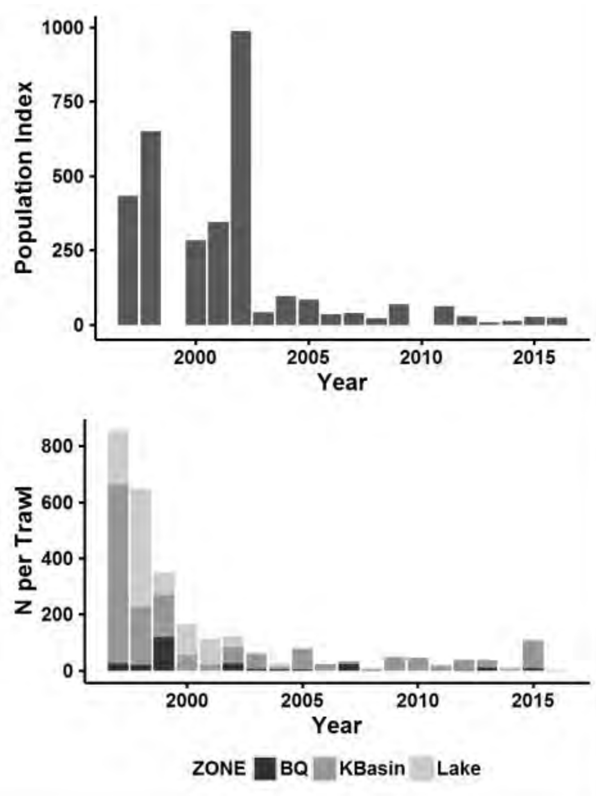

FIG. 7.6.10. Rainbow Smelt trend in abundance between acoustic assessment (Section 1.5) and trawls (Section 1.3). Note that each program provides a relative index on a different scale. The acoustic index is an index of whole-lake population (in millions). Trawls are indexed as kg per 12 min. tow with trawl regions indicated by grey shading (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

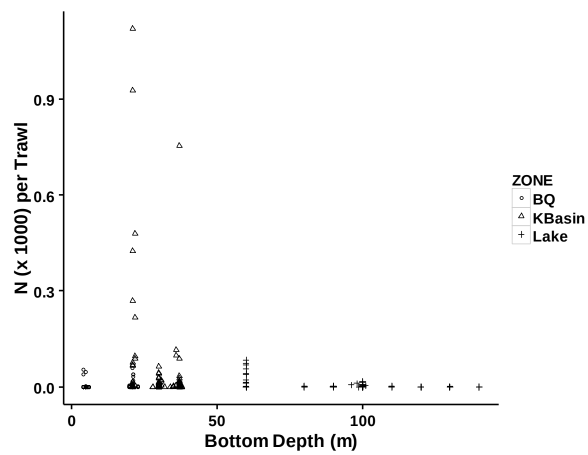

FIG. 7.6.11. Relative abundance (N/12 min tow) of Rainbow Smelt for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the depth was sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

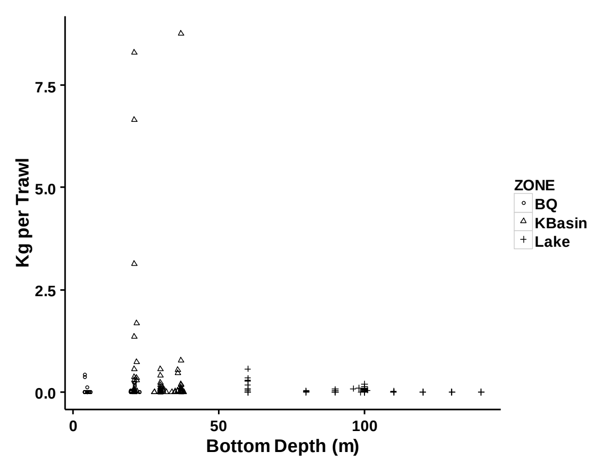

FIG. 7.6.12. Relative density (kg/12 min tow) of Rainbow Smelt for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the depth was sampled (BQ = Bay of Quinte, Lake = Main Lake Basin, KBasin = Kingston Basin).

7.7 Benthic Prey Fish

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

Round Goby

Round Goby were first documented in Lake Ontario in 1998 and have since become a dominant species in the nearshore and offshore benthic fish community. Round Goby are nearshore residents during summer, but migrate to depths up to 150 m during winter, where for half of the year, it also fills a major component of the offshore benthic fish community. Round Goby eat dreissenid mussels extensively, but their prey in offshore waters also includes freshwater shrimp (*Mysis diluviana*) and other invertebrates.

Since first detected in Fish Community Index Trawling in 2003 (Section 1.3) Round Goby abundance increased to peak levels in 2010 and has subsequently decreased (Fig. 7.7.1). Abundance in 2016 increased in both the Bay of Quinte (BQ) and Kingston Basin (KBasin) trawl sites. The addition of a fall trawl survey in 2015 (Section 1.11) and spring trawling in 2016 (Section 1.10) allows for a seasonal comparison of depth movement. Trawl gear (net and doors) and tow durations differ between programs, so only comparisons on relative distribution and general catch observations are appropriate at this time. There is a shift to deeper waters between summer and fall in trawl programs (Fig. 7.7.2). The most notable observation is that Round Goby were rarely caught during the spring survey. The trawl configuration we used catches Round Goby frequently when used in US waters. The sites used in the spring are also the same trawl sites used in the fall suggesting it is not purely a habitat issue. Shallow sites (<80 m) along the north shore of Lake Ontario have a large number of boulders and attempts to trawl many of these sites have resulted in snagged or torn nets. Also, Canadian trawl sites were sampled to maximum depth of 140 m. It is possible that Round Goby are occupying these areas where the trawl survey is not currently sampling. Future work to identify suitable trawl sites and alternative methods to sample boulder rich areas is ongoing.

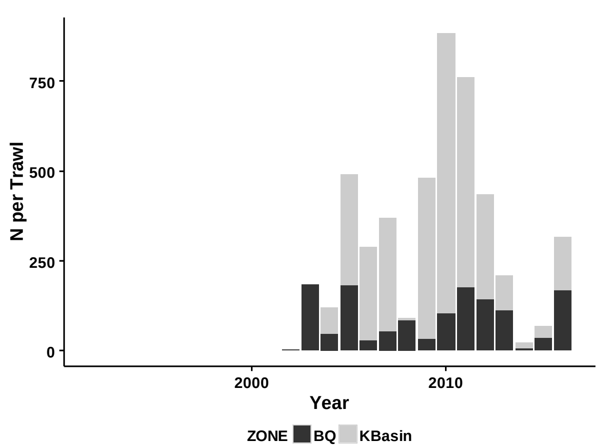

FIG. 7.7.1. Relative abundance (N/12 min tow) of Round Goby in Fish Community Index Trawling (Section 1.3) from 1992 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin).

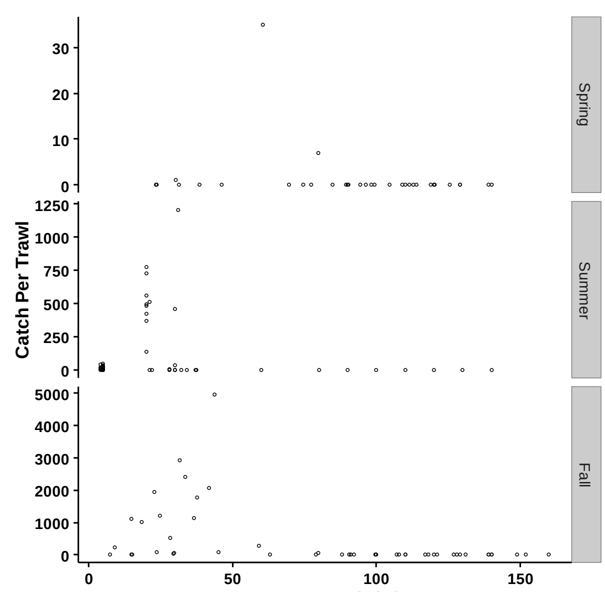

FIG. 7.7.2. Relative abundance (N/tow) of Round Goby for each depth sampled in Spring Prey Fish Trawling ('Spring', Section 1.11), Fish Community Index Trawling ('Summer', Section 1.3) and Fall Benthic Prey Fish Trawling ('Fall', Section 1.12) in 2016. Y-axis ranges vary due to differences in trawling gear and tow times.

When first detected, the mean size of Round Goby was quite large. As they became established, recruitment increased, predator species began to utilize them as prey and the mean size declined to relatively stable level since 2010 (Fig. 7.7.3). There is no clear difference in the size between the Bay of Quinte and the Kingston Basin suggesting similar recruitment, survival and predation in both areas. The mean size observed in both the Bay of Quinte and the Kingston Basin decreased in 2016 however the decrease was greater in Kingston Basin.

Slimy Sculpin

By the 1970s, the once diverse native prey base had largely collapsed with Slimy Sculpin being one of the last remaining offshore native prey species. Historically, Slimy Sculpin would have been the primary prey item for Lake Trout and even as recently as the mid-1990s this species was second only to Alewife as the most abundant prey item consumed by Lake Trout (Section 8.5, Fig. 8.5.10). The offshore depths that are the core habitat for Slimy Sculpin however have historically not been well represented in Fish Community Index Trawling (Section 1.3) and catches have typically been quite low (Fig. 7.7.4).

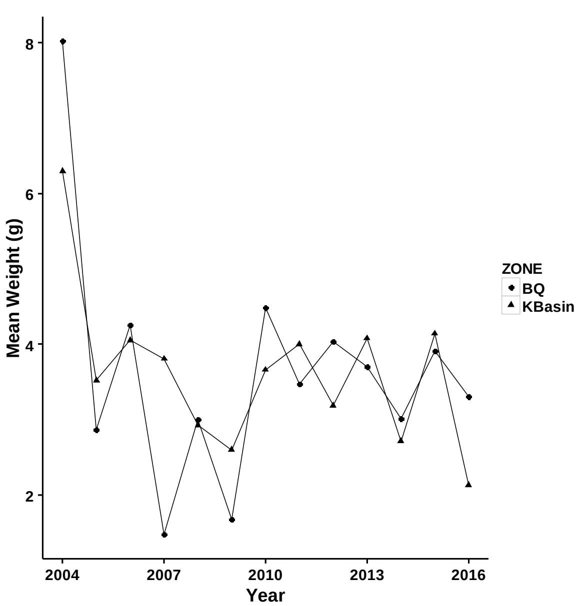

FIG. 7.7.3. Annual mean weight of Round Goby caught in Fish Community Index Trawling (Section 1.3) from 2004 to 2016. Bay of Quinte (BQ, circles) and Kingston Basin (KBasin, triangles) catches are reported separately.

Additional trawl programs in the spring (Section 1.11) and fall (Section 1.12) have an emphasis on the offshore habitats and provide greater insight to the abundance and distribution of the species. Slimy Sculpin catches in the 2016 fall trawl program show that the distribution is concentrated in offshore sites around the 100 m depth contour (Fig. 7.7.5).

The additional main lake trawl transects and depths added to Fish Community Index Trawling (Section 1.3) in 2014 show a similar trend with depth with additional observations at 60m (Fig. 7.7.6 and Fig. 7.7.7). The majority of the sites shallower than 60 m occur within the Kingston Basin and the Bay of Quinte; while the main basin sites shallower than 80 m are

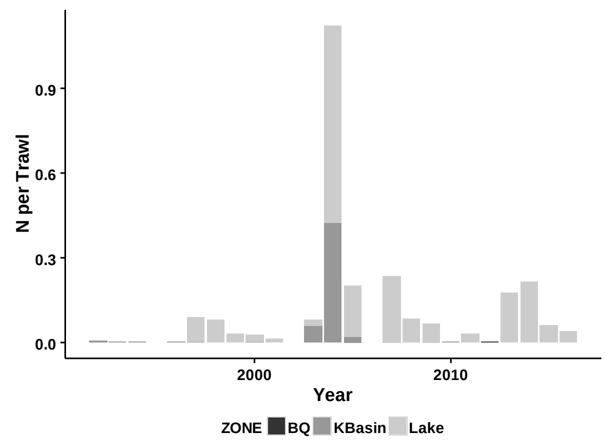

FIG. 7.7.4. Relative abundance (N/12 min tow) of Slimy Sculpin in Fish Community Index Trawling (Section 1.3) from 1992 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin, Lake = Main Basin).

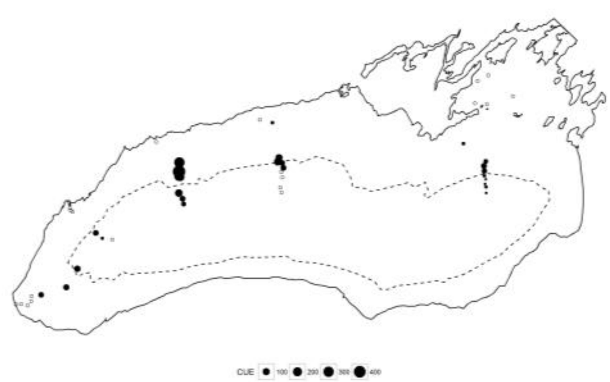

FIG. 7.7.5. Spatial differences in relative abundance in Slimy Sculpin caught in the Fall Benthic Prey Fish Trawl (Section 1.12) in 2016. Open circles indicate tows that caught zero Slimy Sculpin. Filled circles are scaled by catch per trawl. The dotted line indicates the 100

underrepresented in Canadian trawl programs. While the relative biomass peaks around 100m, individual fish size increases with depth (Fig. 7.7.8).

Deepwater Sculpin

Deepwater Sculpin were once abundant in the main basin of Lake Ontario. By the 1970s, Lake Ontario's native fish stocks, including Deepwater Sculpin, had been pushed to near extinction. After 1972, Deepwater Sculpin had not been detected in Lake Ontario until 1996, when one was caught in Fish Community Index Trawling (Fig. 7.7.9; Section 1.3).

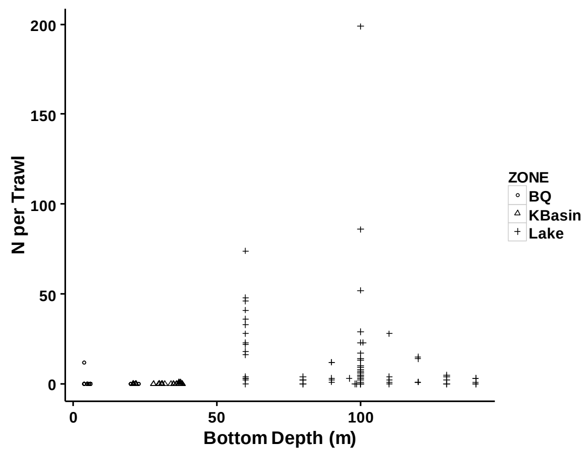

FIG. 7.7.6. Relative abundance (N/12 min tow) of Slimy Sculpin for each depth sampled in Fish Community Index Trawling ('Summer', Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin, Lake = Main Basin).

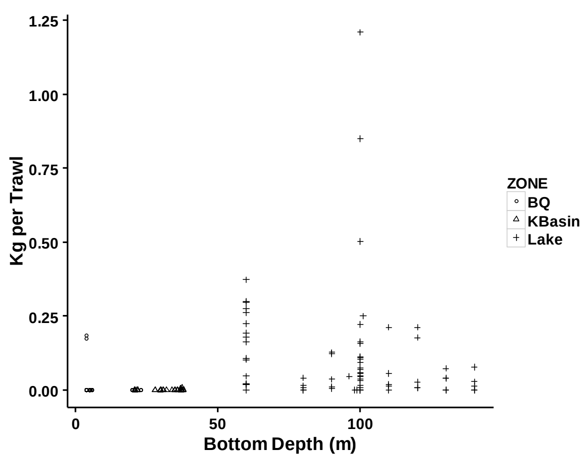

FIG. 7.7.7. Relative biomass (kg/12 min tow) of Slimy Sculpin for each depth sampled in Fish Community Index Trawling ('Summer', Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin, Lake = Main Basin).

Since 1996, no Deepwater Sculpin were collected in Fish Community Index programs until 2005, when they were collected in the trawls at Rocky Point. As recently as 2013, catches

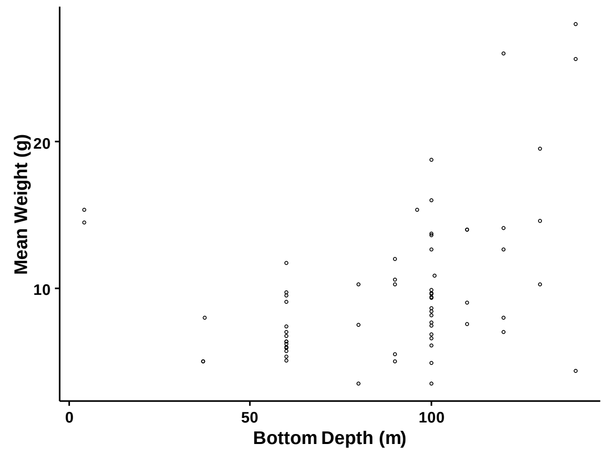

FIG. 7.7.8. Mean size of Slimy Sculpin for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016.

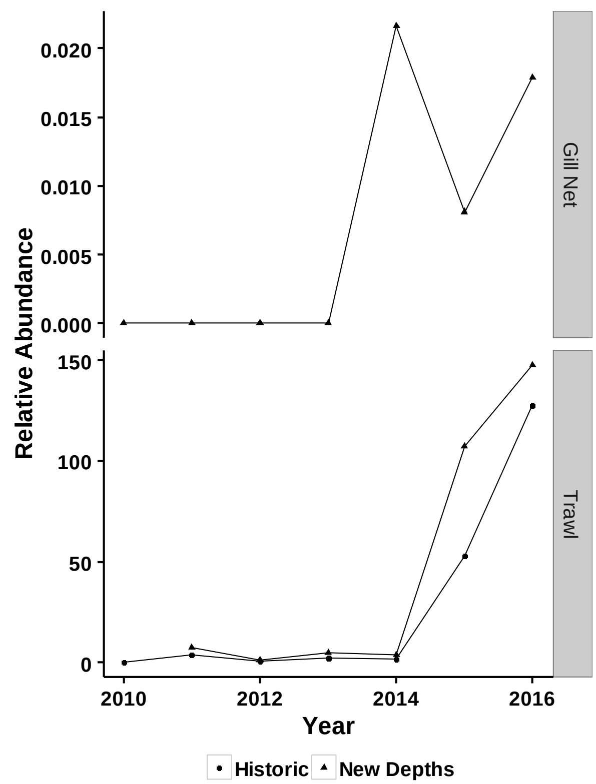

FIG. 7.7.9. Relative abundance (N/12 min tow) of Deepwater Sculpin in Fish Community Index Gill Nets (top panel, Section 1.2) and Trawling (bottom panel, Section 1.3) from 2010 to 2016. Gill net relative abundance is reported as fish per net set and Trawl relative abundance is fish per 12 min tow. Symbols on trawl plot indicate whether the relative abundance uses only the historic sampling sites (circles, Rocky Point 60 and 100 m and EB sites) or includes all the sites in recently modified to the sampling protocol (triangles, see Section 1.3 for details).

remained relatively low in index gillnets and trawls. Catches increased first in gillnets in 2013 followed by increased catchs in trawls during 2015. Main lake assessment sites were expanded in 2014 to include offshore sites at Cobourg and Port Credit. Subsequently in 2015, the offshore trawl protocol reduced sampling at the 60 and 100 m sites in favour of adding additional trawl sites at 10 m depth increments out to 140 m. This approach parallels the approach utilized in the fall trawl program (added in 2016, Section 1.12) and the spring trawl program (added in 2016, Section 1.11). The addition of these sites has increased the index of abundance for the time series, however, the increasing trend is still evident when restricted to the traditional 60 and 100 m Rocky Points sites (Fig. 7.7.9, bottom panel).

The additional depths sampled beyond 100 m have increased our understanding of the abundance, distribution and population demographics of Lake Ontario Deepwater Sculpin. Deepwater Sculpin are occasionally caught in Kingston Basin but the core of Deepwater Sculpin habitat is in depths greater than 100m (Fig. 7.7.10). The historic 100 m Rocky Point site is on the shallow edge of the depths that Deepwater Sculpin inhabit with abundance and biomass increasing with depth (Fig. 7.7.11 and Fig. 7.7.12). Both total biomass and mean size increase with depth (Fig. 7.7.13).

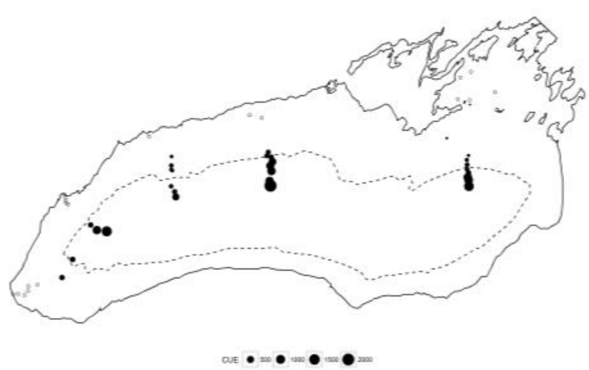

FIG. 7.7.10. Spatial differences in relative abundance in Deepwater Sculpin caught in the Fall Benthic Prey Fish Trawl (Section 1.12) in 2016. Open circles indicate tows that caught zero Slimy Sculpin. Filled circles are scaled by catch per trawl. The dotted line indicates the 100m bathymetric contour.

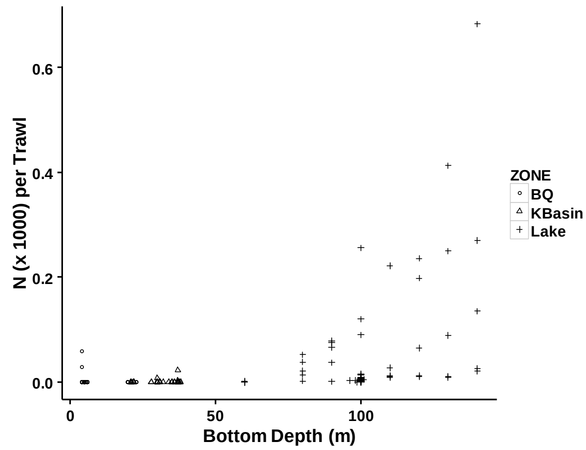

FIG. 7.7.11. Relative abundance (N/12 min tow) of Deepwater Sculpin for each depth sampled in Fish Community Index Trawling (‘Summer’, Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin, Lake = Main Basin).

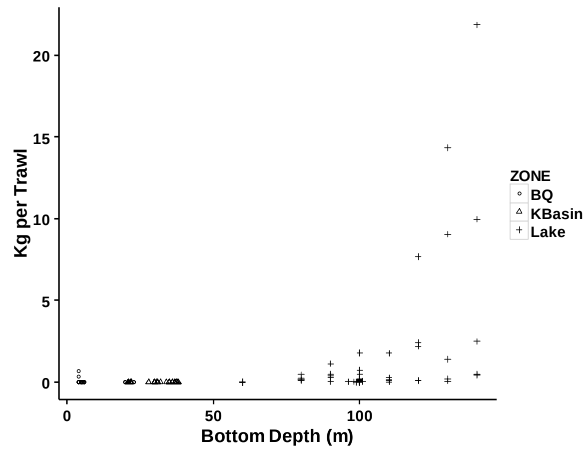

FIG. 7.7.12. Relative biomass (kg/12 min tow) of Deepwater Sculpin for each depth sampled in Fish Community Index Trawling (‘Summer’, Section 1.3) from 2011 to 2016. Symbols indicate the geographic area of the survey where the trawls were conducted (BQ = Bay of Quinte, KBasin = Kingston Basin, Lake = Main Basin).

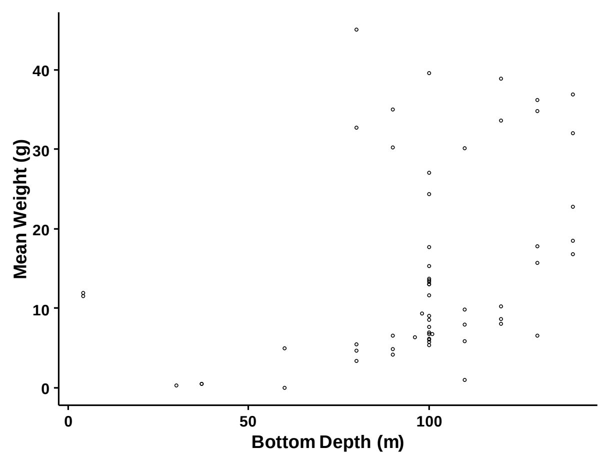

FIG. 7.7.13. Mean size of Slimy Sculpin for each depth sampled in Fish Community Index Trawling (Section 1.3) from 2011 to 2016.

8. Species Rehabilitation

8.1 Introduction

A. Mathers, Lake Ontario Management Unit

OMNRF works with many partners—government agencies, non-government organizations and interested individuals at local, provincial and national levels—to monitor, protect and restore the biological diversity of fish species in the Lake Ontario basin (including the lower Niagara River and the St. Lawrence River downstream to the Quebec-Ontario border). Native species restoration is the center piece of LOMU's efforts to restore the biodiversity of Lake Ontario.

The sections following describe the planning and efforts to restore Atlantic Salmon, American Eel, Bloater, Lake Trout, Walleye, Round Whitefish and Lake Sturgeon. Some of these species have been extirpated while others were once common but are now considered rare, at least in some locations in the lake. Successful restoration of these native species would be a significant milestone in improving Ontario's biodiversity and help to address Ontario's commitments under the GLFC's Fish Community Objectives and commitments identified in the Great Lakes Water Quality Agreement.

8.2 Atlantic Salmon Restoration

M.D. Desjardins, Lake Ontario Management Unit

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

Originating as a small stocking program in 1987, the Lake Ontario Atlantic Salmon Restoration Program has developed into a significant partnership combining the efforts of the Ministry of Natural Resources and Forestry (MNRF), the Ontario Federation of Anglers and Hunters (OFAH), and many corporate and community partners. Since 2006, significant progress has been made through enhancements in fish production, community involvement, research and assessment, and habitat enhancement. However, progress toward some program benchmarks has not kept pace. Specifically, the program has failed to generate sufficient numbers of returning adult fish to achieve program goals.

In 2015, the program steering committee developed a revised five-year plan (2016-2020) with new priorities and performance measures to accelerate restoration with emphasis on improving adult returns. Plan priorities include: enhancing program delivery and review, optimizing fish culture practices, prioritizing habitat issues, developing fish passage strategies (e.g., Cobourg Creek); and creating a recreation tributary fishery in the Ganaraska River.

Highlights of progress made in 2016, include the formation of watershed specific habitat teams. Habitat issues have been prioritized and strategies drafted for each "best-bet" watershed. Barrier mitigation options are being investigated on Cobourg Brook and fish way efficiency studies are being considered on other tributaries. The Ganaraska River was stocked with yearling Atlantic Salmon (Section 6.3) to create a future recreational fishery and a new "state of the art" fish counter /camera has been installed in the fish way on Corbett's Dam. This new technology will vastly improve our ability to monitor returning adult salmon (Section 9.9). Scoping for the placement of an additional counter /camera is underway for the Streetsville Dam on the Credit River.

8.3 American Eel Restoration

M. Hanley and A. Mathers, Lake Ontario Management Unit

Background

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

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

Indices of Eel Abundance

Moses Saunders Eel Ladder Operation

The largest barriers to both upstream and downstream migration of American Eels are power dams in the St. Lawrence River. One of these dams, the Moses Saunders Dam, is located on the upper St. Lawrence River between Cornwall, Ontario and Massena, New York. In 1974, an eel ladder was put in place on the Ontario portion of the dam (R.H. Saunders Hydroelectric Dam) in order to aid in the upstream passage of American Eel. The maintenance and operation of the ladder has been maintained and upgraded through collaborations between OMNRF and Ontario Power Generation (OPG) in the years since, and OPG took full responsibility of the operation and maintenance of the ladder in 2007.

In 2016, the Saunders eel ladder was in operation 24 hours a day from June 15 to October 15. Over the course of these four months, passive integrated transponder (PIT) tag readers and an electronic fish counter were used to monitor the use of the ladder and quantify the number of eels passing upstream. The PIT tag reader and counter operated 98-100% of the time and when they were not in operation, any eels passing through were kept in a collection tank and were manually counted in order to collect all data. In 2016, a total of 6,192 eels successfully passed through the OPG eel ladder (Fig. 8.3.1). This number represents the lowest recorded number of eels passed in the last six years. The majority of eels passed through the ladder during a six week period from early July to late August and most (96.9%) moved through during hours of darkness from 22:00 to 06:00.

The number of eels passed through the OPG ladder was approximately equal to the number of eels that passed through a second eel ladder on the New York portion of the Moses Saunders Dam (Moses Ladder) ,where 6,262 eels successfully exited the Moses Ladder. The Moses Ladder has been in operation since 2006 and has been maintained by the New York Power Authority (NYPA). Historically, the NYPA ladder passed more eels than the OPG ladder with approximately 3,500 more eels travelling through the Moses Ladder in 2015.

The combined number of eels that passed through both ladders (12,454 eels) was the lowest since 2004 when only the OPG ladder was in operation, but overall combined eel numbers exiting both ladders have increased since 2001. However, the number of eels ascending the ladders in 2016 is less than 2% of the level of recruitment identified as a long-term indicator in the Lake Ontario Fish Community Objectives for American Eel (FCO 1.3; at least one million eels ascending the ladders annually).

A sub-sample of eels was collected from the OPG ladder and biological characteristics were measured during 2016. The average length (403.2 ± 74.9 mm, n=559, range: 221-630 mm) and average weight (94.9g ± 56.2 g, n=559, range: 11-307 g) was similar for what has been observed in recent years with a trend for slightly larger fish in the last three years. These values are also similar to the average length (428.9 mm, n=515) and weight (117.2 g, n=515) recorded from the NYPA ladder.

Lake Ontario and Upper St. Lawrence River Assessment programs

In 2016, the abundance of larger "yellow" eels in the LO-SLR was measured with several assessment programs. Bottom trawling in the Bay of Quinte has been conducted since 1972 as part of the fish community index program. The average catch of American Eel in 511 trawls conducted (June-September at sites upstream of Glenora) between 1972 and 1996 was 2.0 eels per trawl. No eels were captured in the 360 trawls conducted between 2003 and 2011 and either zero or one eel was captured during the bottom trawls conducted annually between 2012 and 2016.

Nearshore trap netting was conducted using the NSCIN fish community index protocol (see Section 1.4). During 2016, one eel was captured in 24 nets set in Hamilton Harbor, one eel was captured in 24 nets set in Toronto Harbor, and three eels were captured in 36 nets set in the Upper Bay of Quinte.

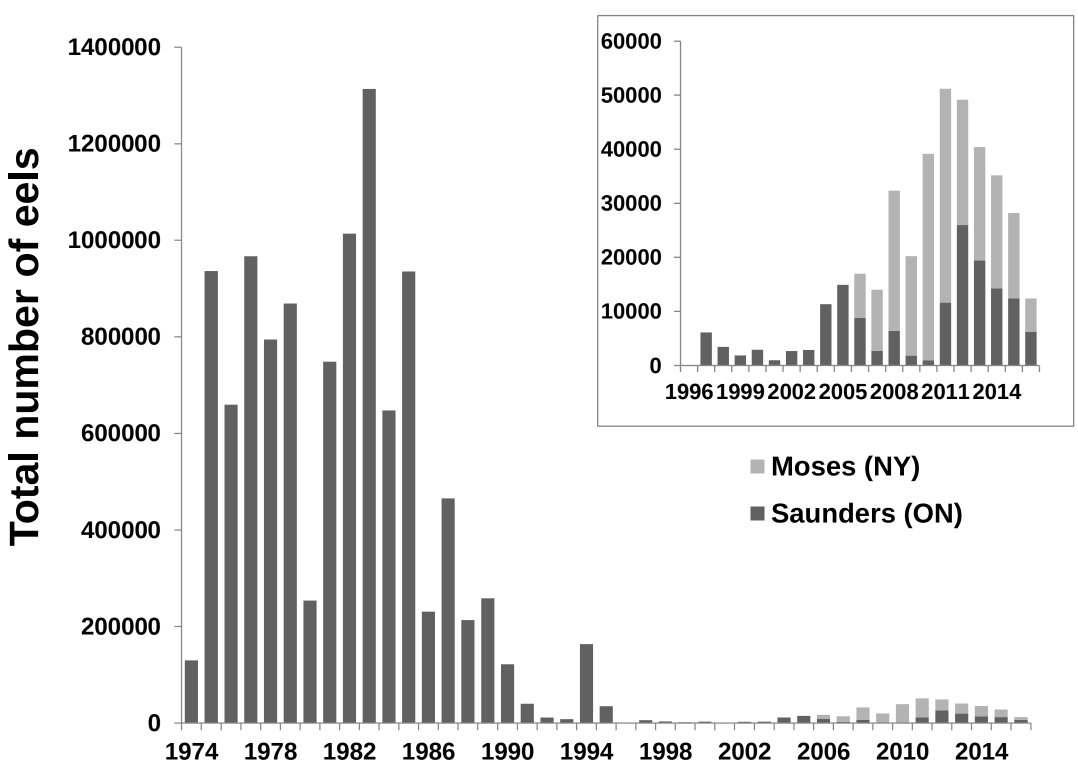

FIG. 8.3.1. Total number of eels ascending the eel ladders at the Moses-Saunders Dam, Cornwall, Ontario from 1974-2015. During 1996, the ladder operated however no counts were made.

Tail Water Survey

In 2016, surveys were conducted by OPG to collect dead eels in the Canadian water from the tailwater of the Moses-Saunders Dam. The surveys followed standardized routes, which extended approximately 10 km downstream of the dam along the Canadian shoreline. Tailwater surveys were conducted twice a week on each Tuesday and Friday from June 3 to September 30, 2016. Investigators working in a boat searched the specified area for dead and injured American Eels that were floating or submerged along or near the shoreline. In 2016, a total of 64 eels were collected during 35 surveys. OPG observed an average of 2.0 eels per day while NYPA observed 1.1 eels per day (Fig. 8.3.2). The average length of whole eels (n=19) collected by OPG was 845 ± 135 mm (mean ± SD) (Fig. 8.3.3). American Eels were observed during 27 of the 35 survey days and 72% of the collections in 2016 occurred in August and September. Most eels (92%) were collected when water temperatures were greater than or equal to 20°C.

Restoration Efforts

Effectiveness Monitoring of Stocked Eels

In one component of the OPG Action Plan for Offsetting Turbine Mortality of American Eel, over 4 million glass eels were stocked into the LO-SLR between 2006 and 2010. All stocked eels were purchased from commercial fisheries in Nova Scotia and were marked with oxytetracycline to distinguish them from eels that migrated naturally. Prior to stocking, health screening for a wide variety of fish pathogens (including *Anguillicolodes crassus*) was conducted at the Atlantic Veterinary College. As prescribed in the current Action Plan, eels have not been stocked since 2010.

DFO and OPG have collaborated to monitor the effectiveness of American Eel stocking through the electrofishing of pre-established transects in the St. Lawrence River (Jones Creek, Grenadier Island, and Rockport) and the Bay of Quinte (Deseronto, Big Bay, and Hay Bay). In the spring of 2016, 160 transects were sampled in these areas and a total of 326 eels were enumerated. Of the 326 American Eels observed or netted, 102 were captured, 31 were measured and weighed before being released, and 71 were sacrificed for age, growth, and origin assessment.

Density estimates have fallen approximately 50% in the St. Lawrence River and 25% in the Bay of Quinte since the peak density in 2013 (Fig. 8.3.4). In 2016, density estimates remained similar to 2015 in both the St. Lawrence River (79.3 ± 12.3 eels/ha) and the Bay of Quinte (96.0 ± 18.3 eels/ha). The decline in overall density is not surprising as natural recruitment remains low, stocking has not occurred since 2010, and the number of eels out-migrating is increasing. Biomass estimates have increased for the Bay of Quinte (51.1 ± 8.4 kg/ha), but

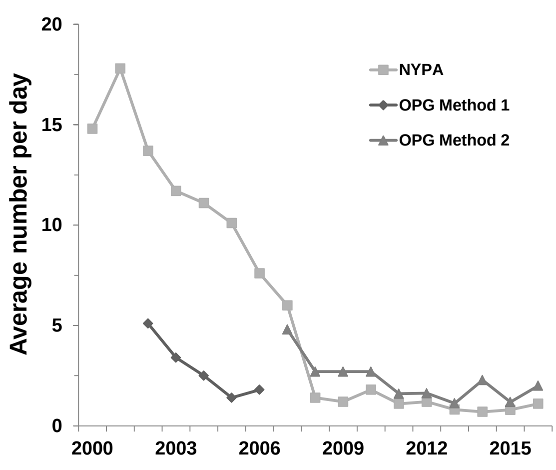

FIG. 8.3.2. Average number of eels observed per day in the tail-waters of the Moses-Saunders Dam 2000-2016. Note that the OPG sampling methodology and route changed in 2007.

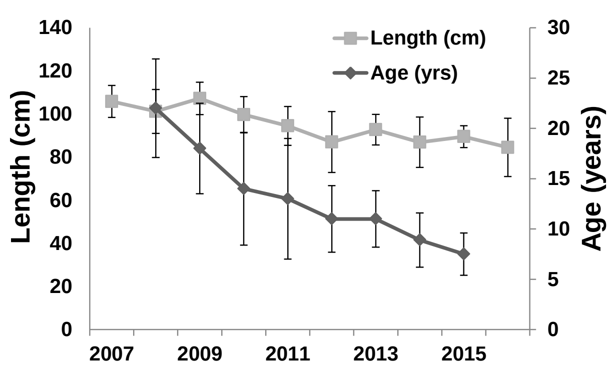

FIG. 8.3.3. Length (mean ± standard deviation) and age (mean ± standard deviation) of eels collected in the tail-waters of the Moses-Saunders Dam 2007-2016

decreased for the St. Lawrence River (34.2 ± 5.1 kg/ha) (Fig. 8.3.5). Mean capture length was similar in all areas again in 2016. Mean length has increase in the upper St. Lawrence River by 30 mm in the past three years. An increase of 180 mm in mean length has been observed in the Bay of Quinte over the same time period. The large increase in mean length in the Bay of Quinte has brought the size of eels in this area to that of the St. Lawrence River. The absence of new recruits (either through stocking or natural recruitment) is notable in the relatively high mean capture lengths.

Of the 71 eels that were sacrificed, ages were obtained from 70 (32 from the St. Lawrence River and 38 from the Bay of Quinte). For the first time, no eels from the 2007 stocked year-class were captured, and for the fourth year in a row no eels from the 2006 stocking event were collected. Given the current growth rates, it is estimated that the majority of stocked eels will out-migrate within the next five years.

Trap and Transport

Safe downstream passage past hydro turbines during the eel's spawning migration is an obstacle to restoration of eel that is identified in the OPG Action Plan. "Trap and Transport" (T&T) of large yellow eels was initiated in 2008 as an OPG pilot project to investigate this alternative for mitigating mortality of eels in the turbines at the Saunders Hydroelectric Dam. The project also involved local commercial fishers and the Québec Ministère des Forêts, de la Faune et des Parcs (MFFP). LOMU staff assisted OPG in the collection of eels captured in local commercial fisheries and transport of these fish from LO-SLR to Lac St. Louis (a section of the St. Lawrence River below all barriers to downstream migration). During 2008-2014, only eels collected during the spring commercial fishery were included in T&T. In 2015 and 2016, eels collected during the fall commercial fishery in areas upstream of the dam were also included in the T&T project in an effort to increase the numbers of eels transported.

A total of 2,211 large yellow eels (583 and 105 from Lake St. Francis in the spring and fall respectively, and 527 and 996 from above the Moses-Saunders Dam during the spring and fall respectively) were released into Lac St. Louis immediately downstream of the Beauharnois Hydroelectric Dam as part of the T&T program (Fig. 8.3.6). During release, all T&T eels were observed to be in good health and swam away from the release site and down towards the substrate. The mortality of large yellow eels during the spring capture phase of the program has been low with only three eels dying in 2016. During the fall T&T, the mortality was high during the first week with 44 mortalities. However, this was attributed to high water temperatures and only four additional eels died during the remaining three weeks once the water temperature cooled.

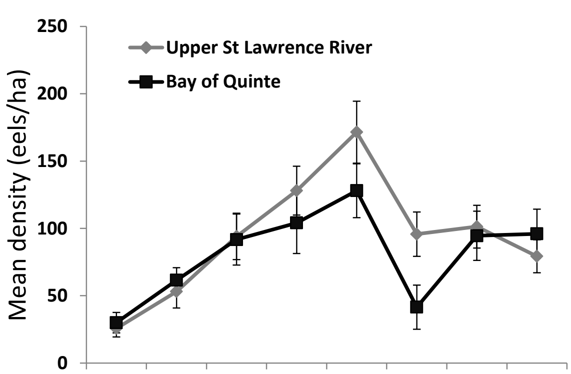

FIG. 8.3.4. Mean eels per hectare ± standard error of stocked American eel enumerated in spring transects, by study area.

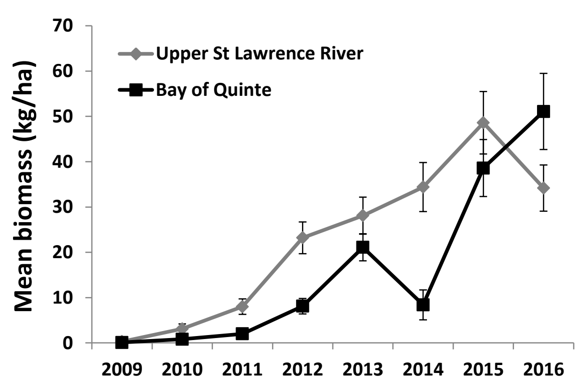

FIG. 8.3.5. Mean biomass (mean kg per hectare ± standard error) of eels captured in the Upper St. Lawrence River and the Bay of Quinte using electrofishing from 2009-2016. Sampling took place in the spring and fall from 2009-2011 and only in the spring from 2012-2016.

MFFP Silver Eel Fishery Monitoring

To monitor the long-term survival, condition, maturation, and migration of the transported yellow eels, staff from MFFP attempted to recover eels tagged during previous years' T&T in the silver eel fishery in the St. Lawrence River estuary. MFFP staff sampled 11, 017 eels (89.9% of the total harvest) from the silver eel fishery during the fall of 2016. A total of 26 PIT tagged eels were detected from this sample. Two of these originated from T&T operations in the St. Lawrence watershed and were both transferred in 2011. It should be noted that T&T eels have not been PIT tagged since 2012 with the exception of the eels that also received an acoustic tag (see below).

Results of this survey suggest that after four years, over 75% of the transported eels have migrated towards the spawning ground. The T&T project continued to demonstrate that, where abundant, large yellow eels can be caught, held for brief periods, and transported successfully with limited mortality and no behavioural or physical consequence.

Acoustic Telemetry to Track Movement

In the fall of 2015 and the spring and fall of 2016, 92 eels collected in the T&T program were implanted with acoustic tags and released into the Bay of Quinte. Acoustic tags are small, sound-emitting devices that are used to track fish movement. The tag is identified by a submerged, stationary receiver when the fish swims past it.

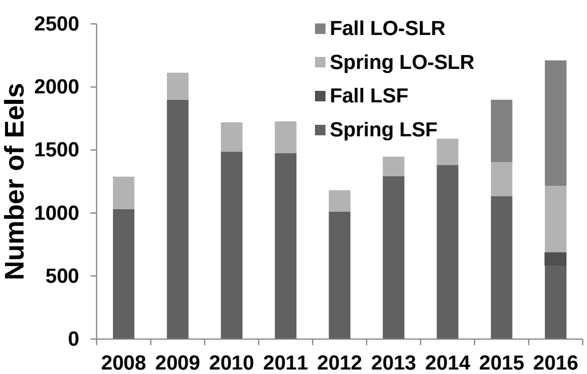

FIG. 8.3.6. Total number of eels collected in the Trap and Transport program from 2008-2016. Each total is divided into the locations at which the eels were captured in commercial fishery nets.

Acoustic tags were surgically implanted into the abdominal cavity of the eels with 13 eels tagged in the fall of 2015, 39 eels tagged in the spring of 2016, and 40 eels tagged in the fall of 2016. In the Bay of Quinte, 43 receivers have been placed in 14 arrays throughout the Bay and into the Eastern Basin of Lake Ontario in order to track movements. Additional receivers were placed above the Iroquois Dam and in Quebec at the Beauharnois Hydro Dam to detect eels moving downstream.

To date, all eels have been detected, but it is presumed that three eels have died (Table 8.3.1). Of the 92 eels tagged, 70 have left the Bay of Quinte, 31 have been identified at the Iroquois Dam, and seven have been identified at Beauharnois (Table 8.3.1). In addition, four of the 12 eels from the 2015 fall tagging session that left the Bay of Quinte were detected by receivers in the estuary of the St. Lawrence River. Eels that are tagged and released in the fall leave the Bay of Quinte much more quickly than those tagged in the spring and make their way to Iroquois in half the time. Eels that were released in the spring took an average of 11 ± 7.3 weeks (mean ± SD) to leave the Bay of Quinte, while eels tagged in the fall left the bay in an average of 2 ± 1.6 weeks (mean ± SD). Eels released in the spring took an average of 56 ± 30.1 days (mean ± SD) to reach Iroquois after leaving the Bay of Quinte, while those released in the fall reached Iroquois an average of 24 ± 15.2 days (mean ± SD) after leaving the Bay. Additionally, movement seems to take place predominantly at night, where 68% of detections were collected in darkness, defined as the time between one hour after sunset and one hour before sunrise.

Future work in this area is focused on VEMCO Positioning Information at the Iroquois Dam. If there is a particular path through the dam that the eels tend to favor, this information could be used to aid their passage. Preliminary analysis shows that GPS locations were identified for 26 of the 31 detected. Twenty-two eels had multiple locations (up to 9) determined. Twenty of these eels moved at night and only 2 of the eels were headed towards the eastern third of the dam (Fig. 8.3.7). Additionally, it is of interest to gather

TABLE 8.3.1. Fate of tags implanted in American Eels.

Fate	Fall 2015	Spring 2016	Fall 2016	Total
# Tags	13	39	40	92
Dead Eels	0	2	1	3
Still in BQ	1	9	9	19
Left BQ	12	28	30	70
Iroquois Detection	-	12	19	31
Quebec Detection	7	-	-	7

estimates on the survival of eels during their passage through the dam and so these estimates will be part of the work planned for 2017.

Eel Passage Research Center

Since 2013, the Eel Passage Research Center (EPRC) has conducted research to evaluate potential techniques to concentrate out-migrating eels for downstream transport around turbines at Moses-Saunders and Beauharnois Hydroelectric Dams to mitigate mortality in turbines. EPRC is coordinated by Electric Power Research Institute and primary funders of the research include OPG, Hydro Quebec, and the United States Fish and Wildlife Service (through a funding arrangement from NYPA). Four research projects were undertaken or completed during 2016:

FIG. 8.3.7. Image of Iroquois Water Control Structure in the upper St. Lawrence River. Lines represent the track of tagged eels (as detected by acoustic receivers) during September to December 2016. Locations of the eels were calculated from receiver data by VPS (https://vemco.com/products/vps/).

- laboratory studies of eel behavior in response to various behavioral cues
- recent research on the effect of light on out-migrating eels and recent advancements in lighting technology
- computational fluid dynamics model development for Iroquois control dam and Beauharnois approach channel
- Assessment of three sonar technologies to study downstream migrating American Eel approach and behavior at Iroquois Dam and Beauharnois Power Canal.

Future Work

In 2017, many of the projects described above will continue. The OPG and DFO monitoring of the effectiveness of American Eel stocking will be undertaken again in the spring of 2017. The OPG and OMNRF trap and transport program is scheduled again for spring and fall 2017. At the Moses-Saunders Dam, the tailwater surveys and the operation of the eel ladder will also occur again in 2017.

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

8.4 Deepwater Cisco Restoration

C. Lake and M. Hanley, Lake Ontario Management Unit

Prior to the mid-1950s, Lake Ontario was home to a very diverse assemblage of deepwater ciscoes including Bloater (Coregonus *hoyi*), Kiyi (*C. kiyi*), and Shortnose Cisco (*C. reighardi*). Currently, only the Lake Herring (*C. artedi*) remains in Lake Ontario. Re-establishing self-sustaining populations of Bloater in Lake Ontario is the focus of a cooperative, international effort between the Ontario Ministry of Natural Resources and Forestry (OMNRF), the New York State Department of Environmental Conservation (NYSDEC), the U.S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey (USGS) and the Great Lakes Fishery Commission (GLFC). The Lake Ontario Committee has set a goal to establish a self-sustaining population of Bloater in Lake Ontario within 25 years. The objectives and strategies for the establishment of Bloater are specified in a draft strategic plan, which is currently under review. The plan addresses: sources of gametes, culture facilities, culture capacity, stocking, detection of wild fish, increasing our understanding of ecological consequences, research needs, and public education.

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

In November 2016, the OMNRF successfully released 161,680 Bloater (90,305 sub -adults and 71,375 fall yearlings) into the eastern basin of Lake Ontario. The stocked fish were released near Main Duck Island in the St. Lawrence Channel. This location was chosen based on assumed habitat suitability as well as to support the Aquatic Research and Monitoring Section's (ARMS) acoustic telemetry project. A large acoustic array has been assembled and maintained in this area by ARMS in order to track the movements of Bloater (see Section 9.1).

OMNRF sampled 155 individual Bloaters from the stocking event. Length, weight, and sex were recorded for each individual. Of the 155 fish, 47.7% were male (74 individuals) and 52.3% were female (81 individuals). The average fork length of the Bloaters sampled was 151.83 mm and there was no statistical difference in length between males and females (ANOVA, $F(1) = 0.33$, $p=0.57$). The average weight of fish was 37.09 g, and again no statistical difference was found between the average weight of males and females (ANOVA, $F(1) = 1.20$, $p=0.27$). The length-weight relationship for these Bloater is found in Fig. 8.4.1.

The re-introduction of Bloater to Lake Ontario is consistent with bi-national commitments to diversify the offshore prey fish community, increase and restore native fish biodiversity, and restore historical ecosystem structure and function. Continued collection of eggs from the wild and development of a cultured brood stock will result in more fish being stocked in future years. A key restoration goal with this program is to be able to stock 500,000 fish per year. To help achieve this goal, broodstock development continues at White Lake Fish Culture Station.

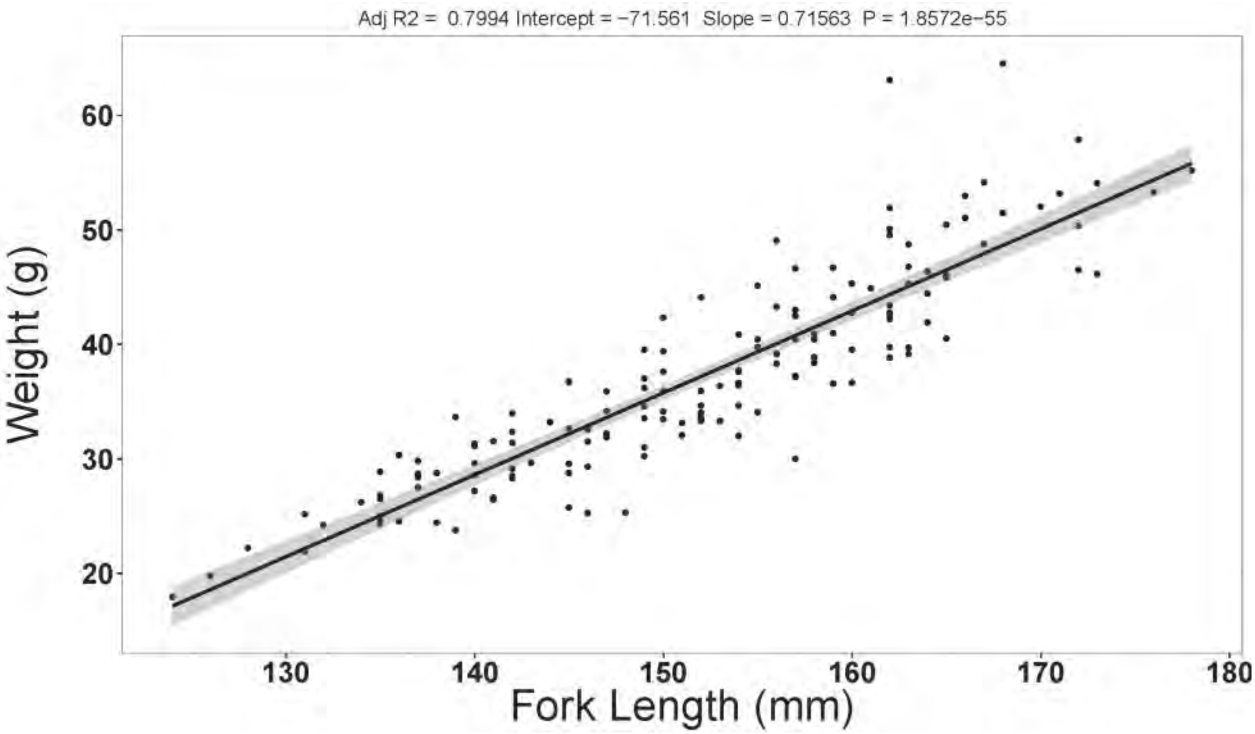

FIG. 8.4.1. Length-weight relationship of the Bloater that were sampled by OMNRF during the 2016 stocking event (n=155). Average length and weight of the fish was 151.83 mm and 37.09 g respectively.

8.5 Lake Trout Restoration

J. P. Holden and M. J. Yuille, Lake Ontario Management Unit
B. Metcalfe, Aquatic Research and Monitoring Section

Lake Trout were extirpated in Lake Ontario in the 1950s. The loss of this top predator and valued commercial species caused both ecological and economic damage. Rehabilitation of Lake Trout in Lake Ontario began in the 1970s with Sea Lamprey control and stocking of hatchery fish. The first joint Canada/U.S. plan outlining the objectives and strategies for the rehabilitation efforts was formulated in 1983 (referred to henceforth as 'the strategy'), and revisions in 1990, 1998, and most recently in 2014 were made to evaluate the methodology and the progress of rehabilitation. The two objectives of the strategy are: 1) increase abundance of stocked adult Lake Trout to a level allowing for significant natural reproduction and 2) improve production of wild offspring and their recruitment to adult stock.

Prior to 1996, Lake Trout were monitored with a targeted bi-national Lake Trout netting program. Since 1996, in Canadian waters of Lake Ontario the Lake Trout targets have been evaluated based on catches in a subsample of sites in the Fish Community Index Gill Netting (Section 1.2). Relative abundance is tracked across three areas of the survey: Kingston Basin (Grape Island, Melville Shoal, EB02, EB06, and Flatt Point), Main Lake (Rocky Point, Brighton and Wellington), and Deep Main Lake (Rocky Point deep sites) at sites where the water temperature on lake bottom is below 12°C. Pre-1996 indices back to 1992 from the Fish Community Index Gill Netting (Section 1.2) have been added to the current status report.

Lake Trout abundance experienced a significant period of decline that began in the early 1990s and reached a low point in 2005 (Fig. 8.5.1). Since 2005, there has been a gradual increase in the relative abundance of adult Lake Trout, although catches are still well below those seen in the 1990s. During 2016, abundance marginally decreased in the Kingston Basin and Main Lake, while the abundance in the Deep Main Lake increased from 2015 catches. Overall, there is still an increasing trend in catch. The strategy specifically identifies the abundance of female Lake Trout greater than 4,000 g as an important indicator of the health of the spawning stock. The current catch per unit effort (CUE, number per 24 hr gill net set) is on an increasing trend since 2005; however, it has been relatively stable since 2013 and decreased in Kingston Basin sites (Lake Deep Excluded Index) (Fig. 8.5.2).

Survival of juvenile Lake Trout was identified as one factor contributing to the decline in abundance. Catches of age-3 fish per half million fish stocked is used as an index of juvenile survival. Survival to age-3 of the 2013 cohort (sampled in 2016) is well below the target of 1.5 identified in the strategy (Fig. 8.5.3). This index has become increasingly variable in recent years.

As a measure of improved production of wild offspring and recruitment to the adult life stage, the strategy sets a target of wild fish to levels greater than observed between 1994 and 2011 (Ontario target = 13.6 wild fish per 100 standard gill net sets). The occurrence of wild Lake Trout is measured through catches of fish that do not bear hatchery fin clips (i.e., unclipped). Stable isotope analysis suggested that more than 90% of unclipped fish were of wild origin. Catches of wild Lake Trout decreased in 2016 and

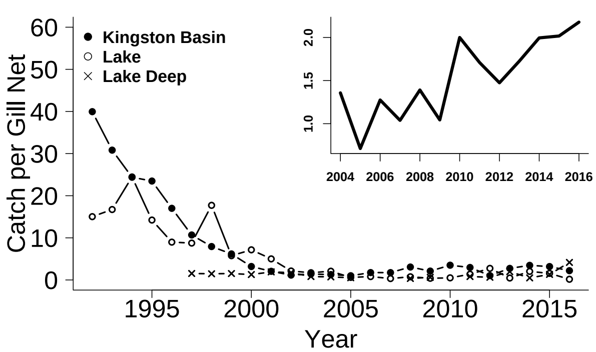

FIG. 8.5.1. Catch per unit effort of mature Lake Trout by area. Inset shows mean trend of the three areas combined since 2005.

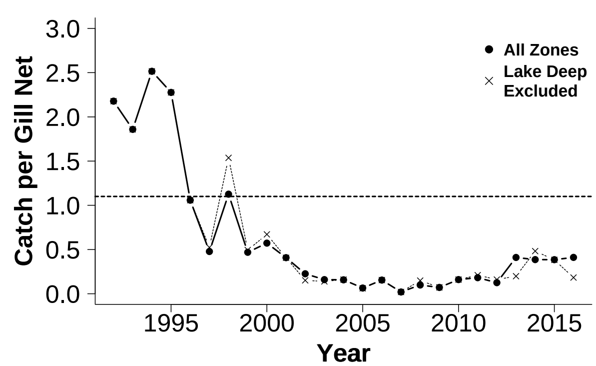

FIG. 8.5.2. Relative abundance of mature female Lake Trout greater than 4000 g. Trend is present with and without Lake Deep sites as they were not conducted in all years.

remains below target (Fig. 8.5.4). Ages of unclipped Lake Trout captured between 2005 and 2016 were interpreted through examination of otoliths and determined that several cohorts were present. Year class strength was assessed based on multiple years of catches and showed several strong year classes between 1998 and 2003 (Fig. 8.5.5).

Catches of small Lake Trout in the Fish Community Index Trawling (Section 1.3) are generally low but can provide some additional insight on wild recruitment. Small numbers of wild young-of-year (YOY) fish have been occurring more frequently in recent years and 2016 is the highest combined catch of wild age-0 and age-1 fish in the time series (Fig. 8.5.6).

The effectiveness of Sea Lamprey control is monitored through the number of A1 wounds (fresh with no healing) observed on Lake Trout. The strategy sets a target of less than two A1 wounds per 100 Lake Trout. The target has been consistently met since 1996 with the exception of 2012 (Fig. 8.5.7).

The strategy also calls for Ontario to continue stocking 500,000 Lake Trout yearlings annually to increase adult biomass to levels that would facilitate natural reproduction. Ontario stocks three strains of Lake Trout to maximize genetic diversity and develop a strain that is well adapted to present conditions in Lake Ontario. In 2016, a total of 502,249 Lake Trout yearlings were stocked in addition to 173,208 fall fingerlings spread across all basins of the lake. A breakdown of Lake Trout stocking numbers, locations and strains is included in Table 6.1.2.

Since 1998, Lake Trout stocked by MNRF have been clipped with multiple fin clips (an adipose clip and one other), and contain no coded wire tags (CWT). US stocked fish have continued to use only adipose clips paired with CWT. This difference in marking allows for an evaluation of fish straying. In 2016, of the 519 Lake Trout sampled in the Fish Community Index Gill Netting (Section 1.2), 183 Lake Trout were caught with only an adipose clip, and of these, 121 had a CWT recovered. This suggests that at least 23%, but as much as 35% of Lake Trout caught in Ontario waters originated from New York stocking. Catch location and stocking origin sites are mapped in Fig. 8.5.8. Of particular note, one Lake Trout captured near Amherst Island had been stocked in Lake Erie.

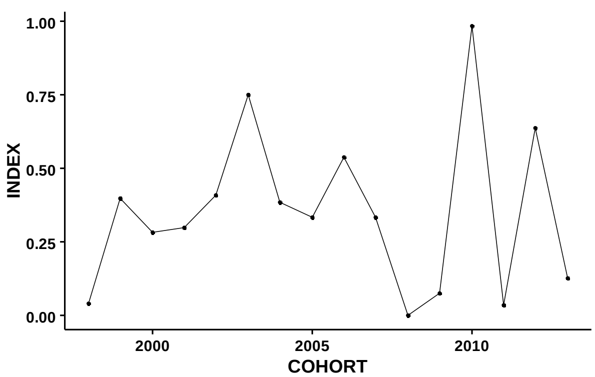

FIG. 8.5.3. Catch per unit effort (CUE) of age-3 Lake Trout standardized to 500,000 stocked. The Lake Trout Management Strategy target has established a target CUE = 1.5.

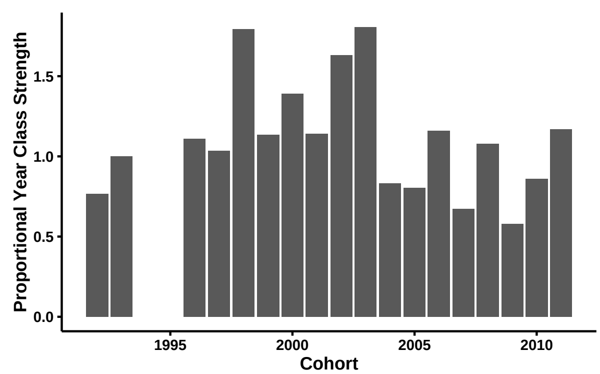

FIG. 8.5.5. Proportional year class strength of unclipped Lake Trout captured in the Fish Community Index Gill Netting (Section 1.2) caught between 2005 and 2016.

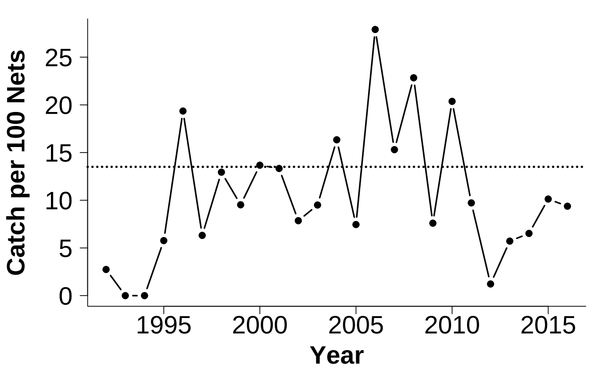

FIG. 8.5.4. Catch of unclipped Lake Trout per 100 standardized nets. Dotted line indicates Lake Trout Management Strategy target of 13.7 fish per 100 standardized nets.

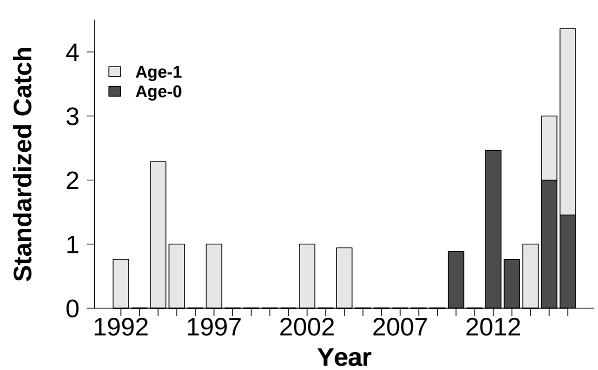

FIG. 8.5.6. Catches of age-0 and age-1 Lake Trout in the Fish Community Index Trawling (Section 1.3). Catches are standardized to a 32 trawl program.

The body condition of Lake Trout is reported as the predicted weight, based on a log-log regression, of a 680 mm (fork length) Lake Trout. While below the peak condition index observed in 2011 and 2013, Lake Trout condition in 2016 remains above the average for the time series (1992-2016; Fig. 8.5.9). A long term analysis of diet items from adult lake trout (>450mm TL) shows that Alewife are the most consumed diet item by weight (Fig 8.5.10). Since their establishment in Lake Ontario, Round Goby have displaced Slimy Sculpin in Lake Trout diets. Rainbow Smelt are commonly consumed but their importance varies among years. Other prey such as darter and shiner species are consumed in relatively small proportion compared to Alewife, Rainbow Smelt, Round Goby and historically Slimy Sculpin.

Catch and harvest of Lake Trout in the recreational fishery is assessed through the Western Lake Ontario Boat Angling Survey (Section 2.2). The estimated recreational catch of Lake Trout in the Ontario waters of Lake Ontario was 6,814 fish in 2016; a significant decline (47%) from the previous 2013 catch estimate (Fig. 8.5.11). Harvest in 2016 (12% of catch) was higher than 2013 (4% of catch), but remains just below the average harvest rate since 2000 (15% of catch; Fig. 8.5.12). Of the salmon and trout species targeted in Lake Ontario, Lake Trout was the third most frequently caught species behind Chinook Salmon and Rainbow Trout, although the majority of the catch in 2016 (99%) was isolated in the western end of Lake Ontario (Niagara and Hamilton Areas; Fig. 2.3.2). Of the Lake Trout sampled by creel technicians, it was determined that the majority of fish were of hatchery origin (89%) and 78% were stocked in U.S. waters (based on clip data). An angler survey was last conducted in the Kingston Basin in 1992 and suggested that Lake Trout catches were 3.5 times higher in the Kingston Basin compared to catches observed in the Western Lake Ontario Boat Angling Survey. Scaling the 2016 western basin harvest to account for Kingston Basin harvest results in 3,667 Lake Trout per year being harvested, which is below the strategy's maximum recommended harvest of 5,000 fish from Ontario waters.

The Lake Ontario Volunteer Angler Diary Program (Section 2.3) provides additional information

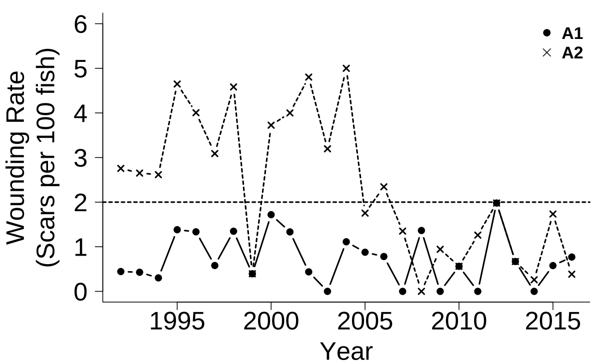

FIG. 8.5.7. Sea Lamprey scarring rate. Dotted line indicates the Lake Trout Management Strategy target of a maximum of two A1 wounds (fresh with no healing) per 100 Lake Trout.

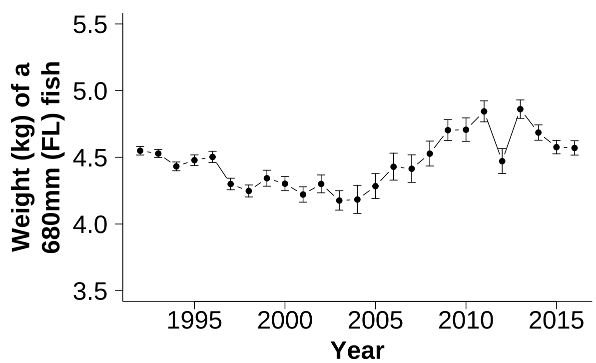

FIG. 8.5.9. Lake Trout Condition Index is the predicted weight of a 680 mm (fork length) Lake Trout. Error bar indicate the 95% confidence intervals.

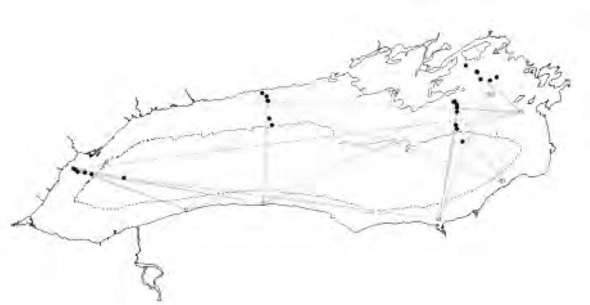

FIG. 8.5.8. Catch and generalized origin location of US stocked Lake Trout captured in Fish Community Index Gill Netting (Section 1.2) gill net sets. Black circles indicate the catch location. Open circles indicate the generalized stocking area. The single grey triangle indicates a Lake Trout captured that was initially stocked in Lake Erie.

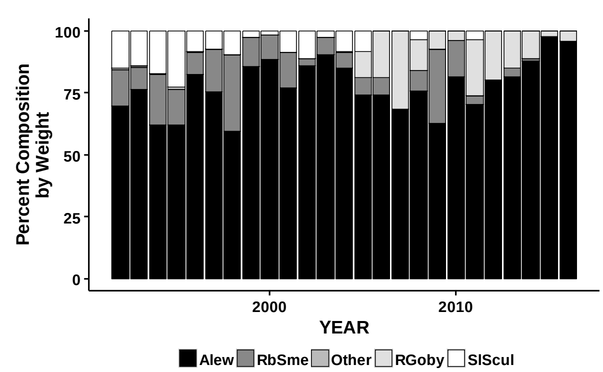

FIG. 8.5.10. Diet composition (percent composition by weight) of Lake Trout captured in Fish Community Index Gill Netting (Section 1.2) gill net sets.

on the recreational fishery for Lake Trout. Diaries were submitted from 15 anglers in 2016. A total of 286 trips were recorded and 40 (14%) were reported as targeting Lake Trout. Trips that targeted Lake Trout occurred in all Sectors but 29 (73%) of the trips occurred in the Hamilton and Niagara Sectors. Anglers reported catching 74 Lake Trout, which was the fourth most abundant species after Chinook Salmon, Rainbow Trout and Coho Salmon in the 2016 catch. Consistent with the Western Lake Ontario Boat Angling Survey, diary anglers reported releasing a large proportion (81%) of the Lake Trout caught.

There is no commercial harvest of Lake Trout in Lake Ontario; however, some fisheries (primarily the gill net fishery) do capture Lake Trout as by-catch (non-target captures). Commercial fishers are required to report by-catch on their Daily Catch Record. A total of 5,141 lbs (2,332 kg) of Lake Trout were reported as by-catch in 2016 (Fig. 8.5.13) and is the highest within the time series (2004-2016). Quota Zone 1-2 (see Section 3.2 for description of Quota Zones) makes up the largest proportion of the reported by-catch. Data on the size of the Lake Trout caught as by-catch is not available. However, using the mean weight of Lake Trout in the Fish Community Index Gill Netting (Section 1.2), by-catch in the commercial fishery was estimated at approximately 660 Lake Trout in 2016.

The expanded transects and depths in the Fish Community Index Gill Netting (Sections 1.2) provide an opportunity to contrast new sites with the established index sites. Overall, the size distribution of Lake Trout captured at western gill net sites was similar to the traditional index sites (Fig. 8.5.14). Gill net catch per standard set (standardized to 24 hrs) was variable within zones (Fig 8.5.15) but the general trend is that Conway and Kingston Basin sites had a slightly higher mean catch than the main lake sites (Fig. 8.5.16). Noteworthy, however, is that comparisons of CUE among Zones is complicated by unbalanced sampling, and how CUE is influenced by depth (Fig. 8.5.17) and bottom temperature (Fig. 8.5.18).

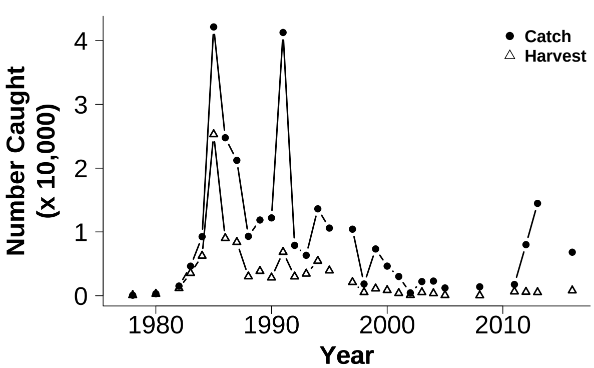

FIG. 8.5.11. Estimated catch and harvest of Lake Trout in the Western Lake Ontario Boat Angling Fishery survey.

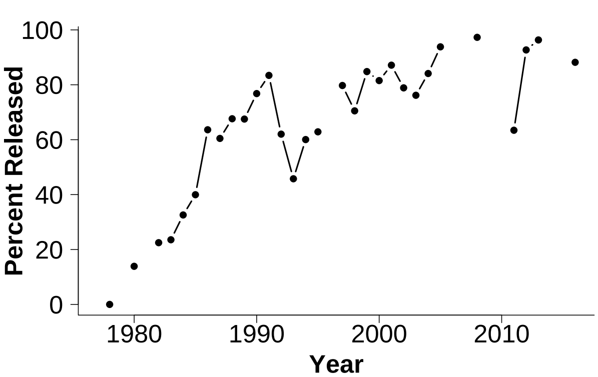

FIG. 8.5.12. Percentage of Lake Trout released in the Western Lake Ontario Boat Angling Fishery.

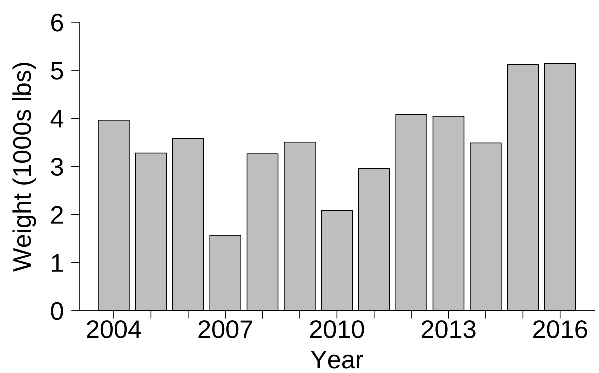

FIG. 8.5.13. By-catch of Lake Trout in the gill net fishery reported by commercial fishers on Daily Catch Records.

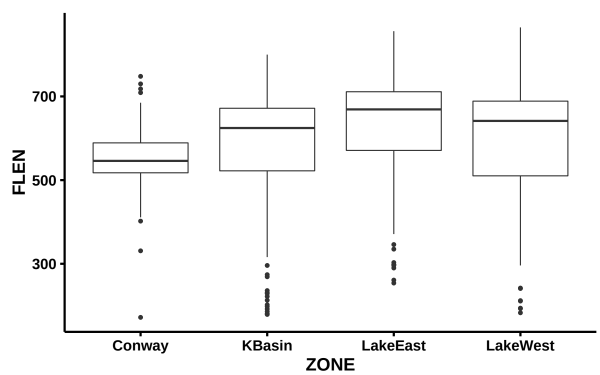

FIG. 8.5.14. Comparison of size distribution across Lake Ontario of Lake Trout captured in Fish Community Index Gill Netting (Section 1.2). Median value is indicated by the solid line. Boxes and whiskers capture 50% and 95%, respectively, of the values. Values beyond the 95% quantile are represented individually as solid circles. Specific transects have been assigned to broader groups (LakeWest = Port Credit, Cobourg, Brighton and Wellington; LakeEast = Rocky Point; KBasin= EB sites, Flatt Point, Grape Island and Melville Shoal; Conway = Conway).

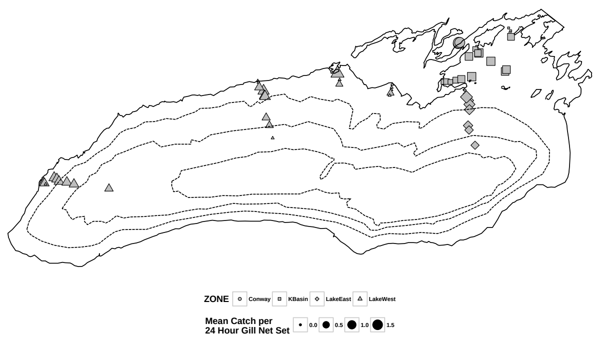

FIG. 8.5.15. Spatial distribution of Lake Trout catch per standardize 24 hr gill net set in the Fish Community Index Gill Netting Program (Section 1.2). Point shape indicates Zone. Point size is scaled to CUE.

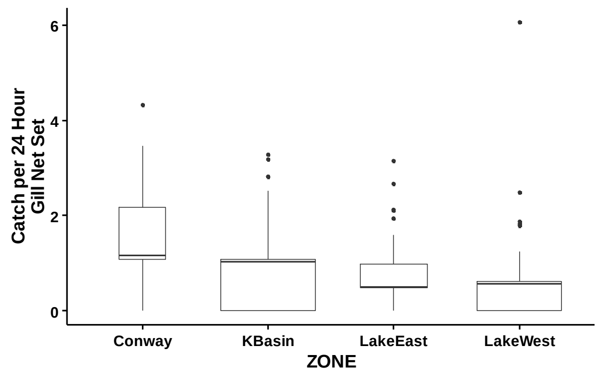

FIG. 8.5.16. Comparison of catches of Lake Trout per standardized 24hr set time Lake Ontario captured in Fish Community Index Gill Netting (Section 1.2) . Median value is indicated by the solid line. Boxes and whiskers capture 50% and 95%, respectively, of the values. Values beyond the 95% quantile are represented individually as solid circles. Specific transects have been assigned to broader groups (LakeWest = Port Credit, Cobourg, Brighton and Wellington; LakeEast = Rocky Point; KBasin= EB sites, Flatt Point, Grape Island and Melville Shoal; Conway = Conway).

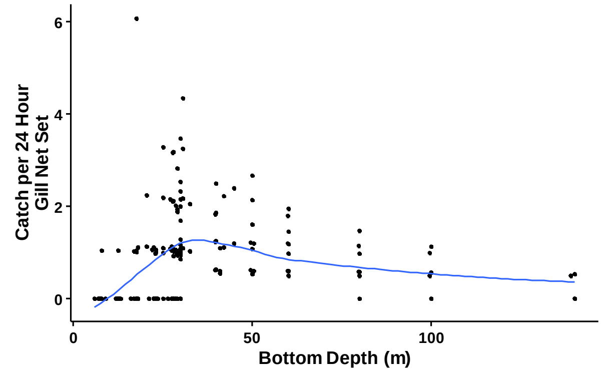

FIG. 8.5.17. Relationship between net depth of bottom set gill nets and Lake Trout catch per standardized 24 hr gill net set combined for all sites in Fish Community Index Gill Netting (Section 1.2). The trend line has been fitted with a non-linear loess fit.

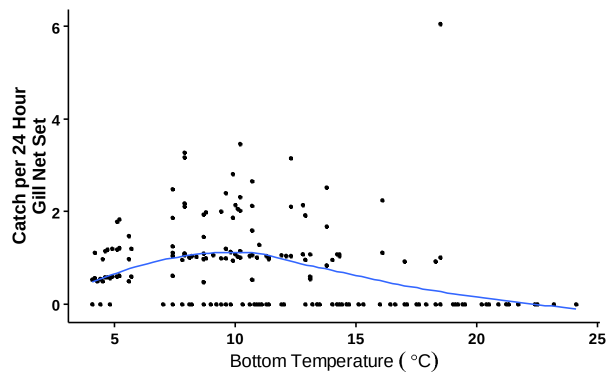

FIG. 8.5.18. Relationship between water temperature at net depth of bottom set gill nets and Lake Trout catch per standardized 24 hr gill net set combined for all sites in Fish Community Index Gill Netting (Section 1.2). The trend line has been fitted with a non-linear loess fit.

8.6 Round Whitefish Spawning Population Study

J. Wood, C. Wilson, Aquatic Research and Monitoring Section
J. A. Hoyle, Lake Ontario Management Unit

The genetic stock structure of Round Whitefish (*Prosopium cylindraceum*) in Lake Ontario was assessed to test for the potential presence of cryptic stocks in Ontario waters. Historical and contemporary samples collected from Round Whitefish from three locations in Lake Ontario (Darlington, Pickering, and Peter Rock, Fig. 8.6.1) during fall spawning were analyzed using microsatellite DNA markers. Individual-based analyses of multilocus genotypes failed to identify significant genetic differences or discrete genetic populations among Round Whitefish from the different sampling locations. Results of this study will help inform ongoing management of this native coregonid species. A final report on this work is available online at: http://www.ontla.on.ca/library/repository/mon/30010/337012.pdf

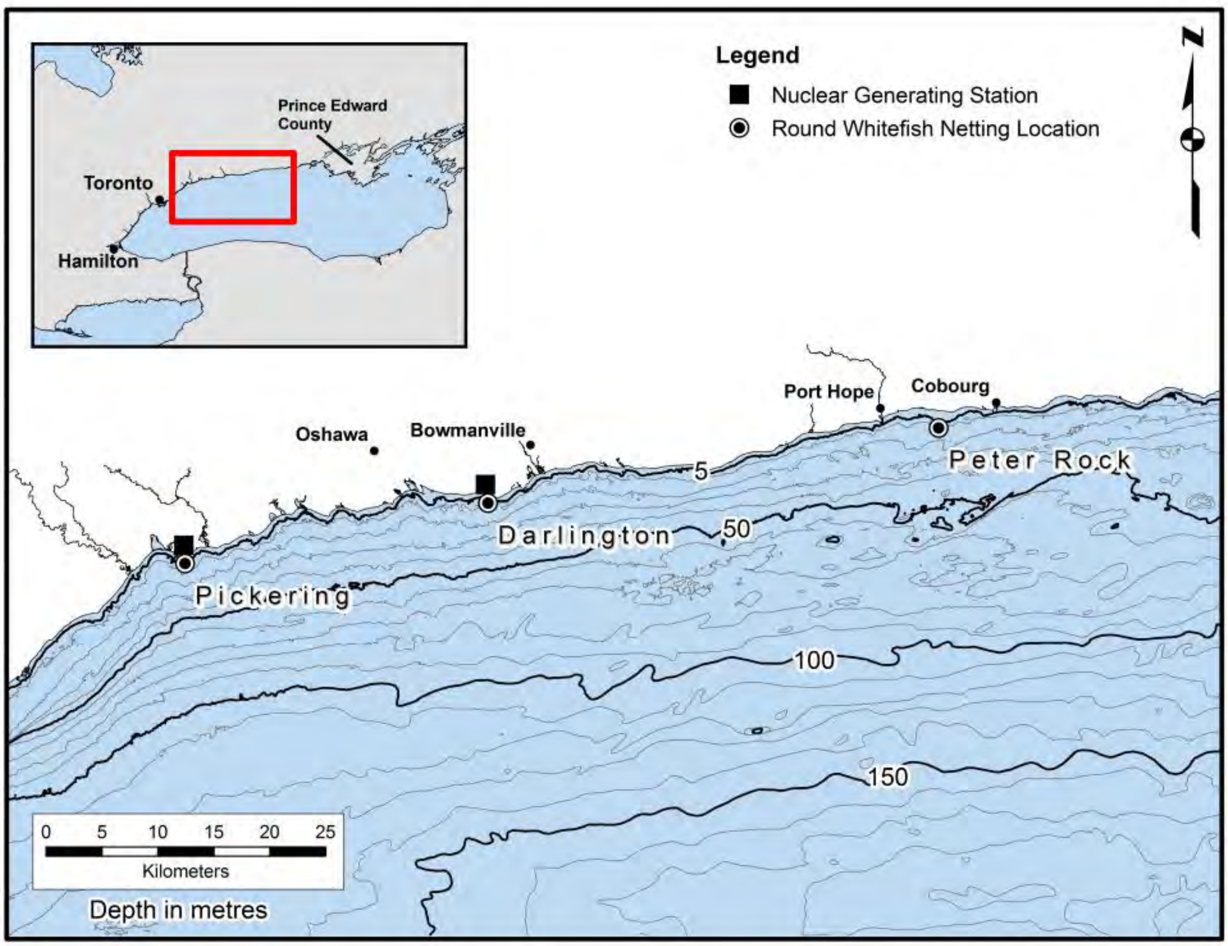

FIG. 8.6.1. Map of Lake Ontario showing locations (Pickering, Darlington, and Peter Rock) of Round Whitefish tissue sample collections.

8.7 Hamilton Harbour Walleye Reintroduction

J. A. Hoyle, Lake Ontario Management Unit
J. L. Brooks, Carleton University, Ottawa
D. T. Reddick, Fisheries & Oceans Canada, CCIW, Burlington

Past Restoration Efforts

Walleye declined in Hamilton Harbour in the early 1900s and were not observed in various fish surveys conducted during the mid-1900s. Walleye were reintroduced in Hamilton Harbour through adult transfer and spring fingerling stocking of Bay of Quinte strain in the 1990s (Table 8.7.1). This initial stocking effort was part of the local Remedial Action Plan (RAP) objective to increase top predators in the Hamilton Harbour fish community. All Walleye subsequently caught in trap net assessments during 2006 and 2008 had DNA showing Bay of Quinte origin, consistent with the 1990s stocking program. Walleye abundance declined and disappeared from the trap net surveys between 2006 and 2012 (Fig. 8.7.1).

Current Restoration Efforts

Since 2012, Walleye stocking has been conducted annually and included a variety Walleye life-stages (Table 8.7.1). In 2016, 100,000 1-month (stocked on May 25) old fry and 115,722 summer fingerlings (June 30) were stocked.

Monitoring and Assessment

Nearshore Fish Community Index Trap Netting (NSCIN)

NSCIN was conducted on Hamilton Harbour in August 2016 (see Section 1.4). A mean catch of 4.6 Walleye per trap net was observed (Fig. 8.7.1). This exceeds the

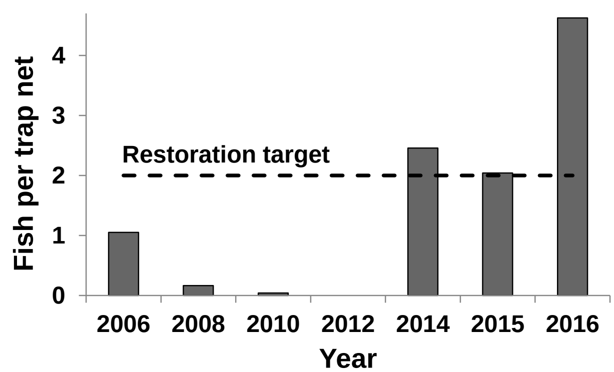

FIG. 8.7.1. Walleye catch (number of fish per trap net lift) for years indicated.

TABLE 8.7.1. Walleye stocked into Hamilton Harbour, 1993-2015 and target for 2016*.

Year	Month	Life-Stage	Mean weight (g)	Number of fish	Source
1993	October	adult	600	185	transferred from Bay of Quinte
1994	October	adult	1,500	129	transferred from Bay of Quinte
1997	October	adult	900	130	transferred from Bay of Quinte
1998	September	adult	1,364	120	transferred from Bay of Quinte
1999	July	3-months	0.5	6,000	White Lake FCS (Bay of Quinte strain)
2012	July	3-months	1.0	100,000	White Lake FCS (Bay of Quinte strain)
2012	November	adult	1,500	74	White Lake FCS (Bay of Quinte strain)
2013	July	3-months	0.5	10,000	White Lake FCS (Bay of Quinte strain)
2014	June	Swim-up fry	n/a	950,000	White Lake FCS (Bay of Quinte strain)
2015	May	Swim-up fry	n/a	1,017,625	White Lake FCS (Bay of Quinte strain)
2015	July	3-months	0.3	52,963	White Lake FCS (Bay of Quinte strain)
2016	May	Swim-up fry	n/a	168,000	White Lake FCS (Bay of Quinte strain)
2016	June	3-months	0.45	115,722	White Lake FCS (Bay of Quinte strain)

restoration target of 2 fish per net established prior to commencement of the 2012 Walleye stocking initiative. The mean catch of 4.6 fish per net also compares favourably to that from other Lake Ontario and St. Lawrence River nearshore areas (see Section 1.4 and Section 7.4). Fourteen of the 24 trap net sets in Hamilton Harbour caught at least one Walleye (Fig. 8.7.2). Walleye were captured throughout Hamilton Harbour where suitable trap net sampling locations were located. Largest catches occurred at a trap net in the extreme west end of the harbour (n=59) and in two nets set at an extreme east end location (n=17 and 9).

FIG. 8.7.2. Map of Hamilton Harbour showing number of Walleye caught, in August 2016, at each trap net location. A total of 111 Walleye were captured. Map courtesy of Google Earth.

Age was interpreted (otoliths) for a random sample of 31 of the 111 Walleye caught. These 31 fish ranged in length from 474 to 571 mm fork length. All were age-4 and likely from the 2012 stocking event. Walleye caught ranged in size from 470-610 mm fork length (mean 534 mm; Fig. 8.7.3). Comparing the size of the 4-year-old fish with the length distribution of all 111 fish caught suggested that all but one of the Walleye were age-4. A single larger, presumably older, Walleye (fork length 610 mm) was also caught. Results of the 2012 Walleye stocking continue to be very successful. Subsequent stocking events have been less successful to date.

Seventeen of 22 males and eight of nine female Walleye were judged to be mature in August 2016 and capable of spawning in spring 2017. As in 2015, some of the Walleye caught in 2016 were provided to Fisheries and Oceans staff for an acoustic tagging study.

Spawning Assessment

In April 2016, Fisheries and Oceans (DFO) completed the first walleye spawning assessment in Hamilton Harbour to determine if the stocked walleye population would be attempting to spawn, as a successful cohort was approaching the appropriate age and size to reproduce. Electrofishing was used to sample along the shoreline in 1-3 m water depth, beginning a half-hour after dark until 01:00am EST. Water clarity prevented visual observation for walleye congregations, so 1000 second transects were used to locate congregations of walleye. Due to time constraints, sampling was focused on the eastern shoreline south of Indian Creek along Eastport Drive to the Port Authority cells, along the western shore south of the Desjardin Canal to Bayfront Park boat ramp, and along the south shore from the Bayfront boat ramp to Macassa Bay, and within the Ottawa street slip. Water temperatures ranged from 6.8 and 11.1 ^{o}C at all locations except the Ottawa Street slip which was 15 ^{o}C, due to the warm water outflow from the steel mill.

Walleye were captured along all shorelines. A total of 56 walleye were observed, 49 of which were captured for non-lethal sampling purposes (Table 8.7.2). Of the 49 fish captured, 2 were ripe females, and 48 were ripe males. Despite differing weather conditions and variable water temperatures, walleye congregations were located at the same general sites, both nights of sampling along the eastern shoreline, suggesting spawning behaviour. These fish ranged in length from 420 to 620 mm fork length (Fig. 8.7.3). One large male walleye above the size range expected was captured along the western shore with a total length of 650 mm and a weight of 3960 g.

Acoustic Tagging Study

Acoustic biotelemetry allows continual, year-round, monitoring of fish locations. Beginning in summer 2015, 50 sexually mature

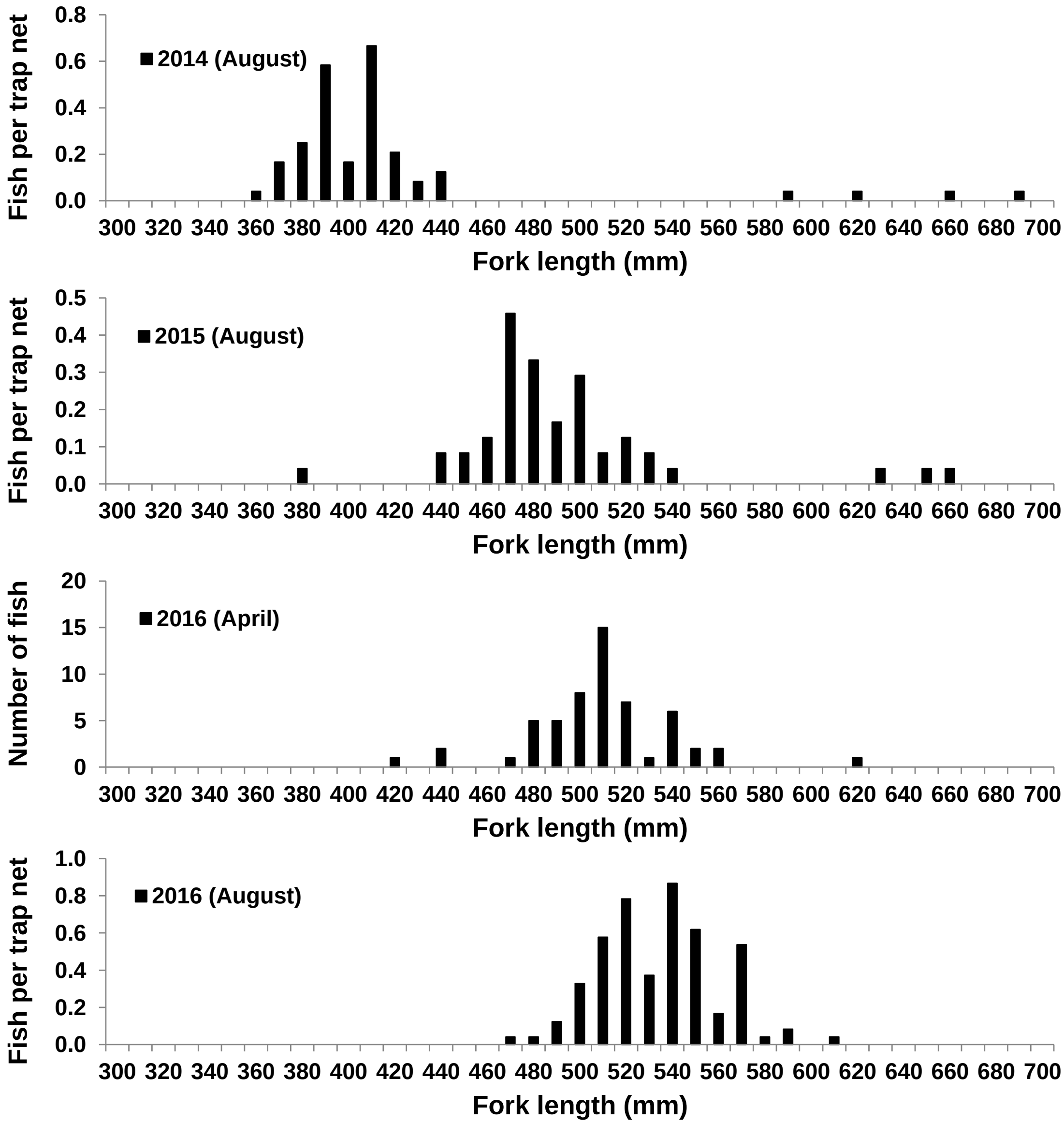

FIG. 8.7.3. Size distribution of Walleye caught during NSCIN trap net surveys conducted in Hamilton Harbour in August of 2014, 2015 and 2016, and during the Walleye spawning assessment in April 2016.

Walleye have been captured during the OMNRF's trap netting and DFO's electro-fishing efforts and internally tagged with acoustic transmitters (V13 transmitters, 13 mm diameter, 48 mm length, 3-year battery, Vemco ™, Halifax, NS). Fixed acoustic biotelemetry receivers (Fig. 8.7.4) have been placed throughout and adjacent to the Harbour to determine seasonal residency patterns of Walleye, with a particular focus on identifying aggregation areas during the spawning season.

Receivers were downloaded in October 2016 and have shown some interesting preliminary results. Of the first 25 tags deployed in 2015, 17 survived the tagging process and 16 of these remained within the boundaries of Hamilton Harbour throughout the spring (2016) spawning period. Six of these individuals had exited the Harbour, east through the canal, towards the end of September (2016). Hamilton Harbour experiences hypoxia and anoxia issues, particularly during the stratification period during the summer, therefore we suspect this may have 'pushed' the Walleye out of the area. Of the 25 Walleye tagged in the summer of 2016, 23 survived, and eight of these also exited the harbour in late August, potentially for the same reason. The receiver download in April, 2017 will

TABLE 8.7.2. Electrofishing sampling summary for the April 2016 Walleye spawning assessment in Hamilton Harbour.

Location	Sampling period	Fish observed	Fish captured	Total sampling time
Eastern shore	Night 1	11	9	4027 seconds
	Night 2	26	23	4129 seconds
Western shore	Night 1	Not Sampled	Not Sampled	Not Sampled
	Night 2	9	7	3018 seconds
Southern shore	Night 1	1	1	1963 seconds
	Night 2	9	9	2034 seconds
Total	All Nights	56	49	15171

determine if these Walleye had returned after the fall breakdown of the harbour's thermal stratification. Fig. 8.7.1 shows the interpolated hourly points for the initial 17 walleye (deployed in 2015) movements from fall 2015 to summer 2016.

Concluding Remarks

An adequate level of top fish predators, such as Walleye, helps to achieve a balanced trophic structure in the fish community, and also complements local remedial action to improve water quality and restore fish habitat in Hamilton Harbour. All indications to date are that the 2012 Walleye stocking effort in Hamilton Harbour was highly successful in terms of survival and growth rates. An ongoing plan is in place to monitor contaminant levels for the Hamilton Harbour Walleye. To help further evaluate stocking success, local anglers are encouraged to report on any Walleye caught in Hamilton Harbour. The next trap net survey is planned for 2018. Spawning assessment and acoustic biotelemetry studies are on-going. Of particular interest, moving forward, is identification of Walleye survival "bottlenecks" during early life history stages.

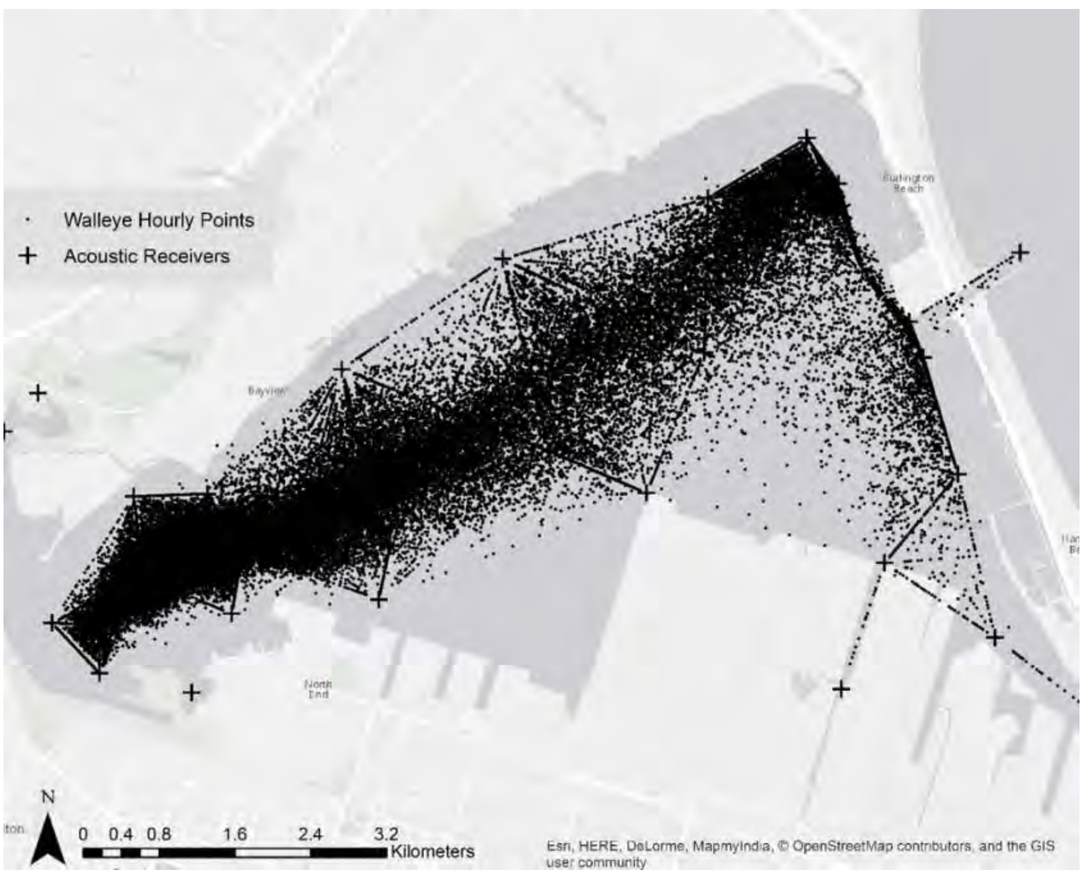

FIG. 8.7.4. Interpolated points of 17 walleye (*Sander vitreus*) positions per hour between October 2015 and October 2016. Crosses illustrate acoustic receiver locations. It is important to note that tagged walleye may be using the coastal areas on the outside of this array perimeter, however, the type of interpolation we have used repositions their location within this outer boundary.

8.8 Lake Sturgeon

C. Lake and M. Hanley, Lake Ontario Management Unit

Lake Sturgeon (*Acipenser fulvescens*) were a key component of the fish community in Lake Ontario and the Upper St. Lawrence River in the past, but are now listed as threatened under the Endangered Species Act (ESA) in this area. As is outlined in the recovery strategy (RS) for Lake Sturgeon "the recovery goal for Lake Sturgeon in Ontario is to maintain existing Lake Sturgeon populations throughout their current range and where feasible, to restore, rehabilitate or re-establish, self-sustaining Lake Sturgeon populations which are viable in the long term within their current habitat and/or within habitats they have historically occupied, in a manner consistent with maintaining ecosystem integrity and function." For more information on the RS of Lake Sturgeon, please visit http://files.ontario.ca/environment-and-energy/species-at-risk/stdprod_086034.pdf.

In order to achieve the goals set out in the RS for Lake Sturgeon, more information is needed related to the current distribution and abundance. LOMU aims to add to this knowledge through tagging and tracking adult Lake Sturgeon. Through the use of acoustic tags, information on movement and habitat use of Lake Sturgeon in the Bay of Quinte will be collected, which will help to address key knowledge gaps identified in the RS and will contribute to the continued rehabilitation of this species.

Queen's University, with MNRF assistance, deployed 16 acoustic receiver arrays in the Bay of Quinte and Eastern Lake Ontario during early summer 2015. Arrays were installed to monitor movements of Smallmouth and Largemouth Bass, however, they also allow monitoring of any species fitted with a compatible tag. Information on movements of Lake Sturgeon (as they are highly migratory) would address knowledge gaps identified in ESA RS's and assists in the development of actions that will promote their recovery. A better understanding of how Lake Sturgeon fit into the existing fish community in the Bay of Quinte, would help evaluate the potential use of stocking to reintroduce sturgeon into others areas and help identify important habitats to inform restoration efforts. Acoustic tagging has significant advantages over traditional techniques in addressing these knowledge gaps for Lake Sturgeon. Monitoring the movements of adult Lake Sturgeon could contribute to the knowledge needed to properly identify areas that are suitable for the restoration of Lake Sturgeon in waters they have formerly occupied and are capable of providing habitat requirements for all life history stages.

From May 16 to May 27, 2016, hook lines were deployed in the Trent River in order to capture adult Lake Sturgeon for implantation of acoustic tags. Hook-lines were set downstream of the dam in the Trent River over a distance of approximately 1.3 kilometers (Fig. 8.8.1). Circle hooks were attached to each main line at approximately 1 m intervals and were baited with salted or unsalted alewife or chicken hearts. Each main line had between 13-36 individual hooks (average = 20), adjusted as required by site. The hook lines were anchored at each end with chain anchors and were left for approximately 24 hours. In addition to the use of hook lines, electrofishing was done throughout the survey area in an effort to capture Lake Sturgeon. During the survey period, electrofishing was conducted on six days for a total of 164.7 minutes (avg. 27.46 min/day).

Unfortunately over the course of the two week field season, no Lake Sturgeon were captured. The hook-lines had very little non-target species by-catch; only 1 Freshwater Drum was captured on this gear. While electrofishing, a number of species were captured. The most predominantly captured species included various Redhorse species, Longnose Gar, Common Carp, American Eel, and various sunfishes. Muskellunge, Walleye, and Smallmouth Bass were also captured, but in lower incidences than the other species listed above.

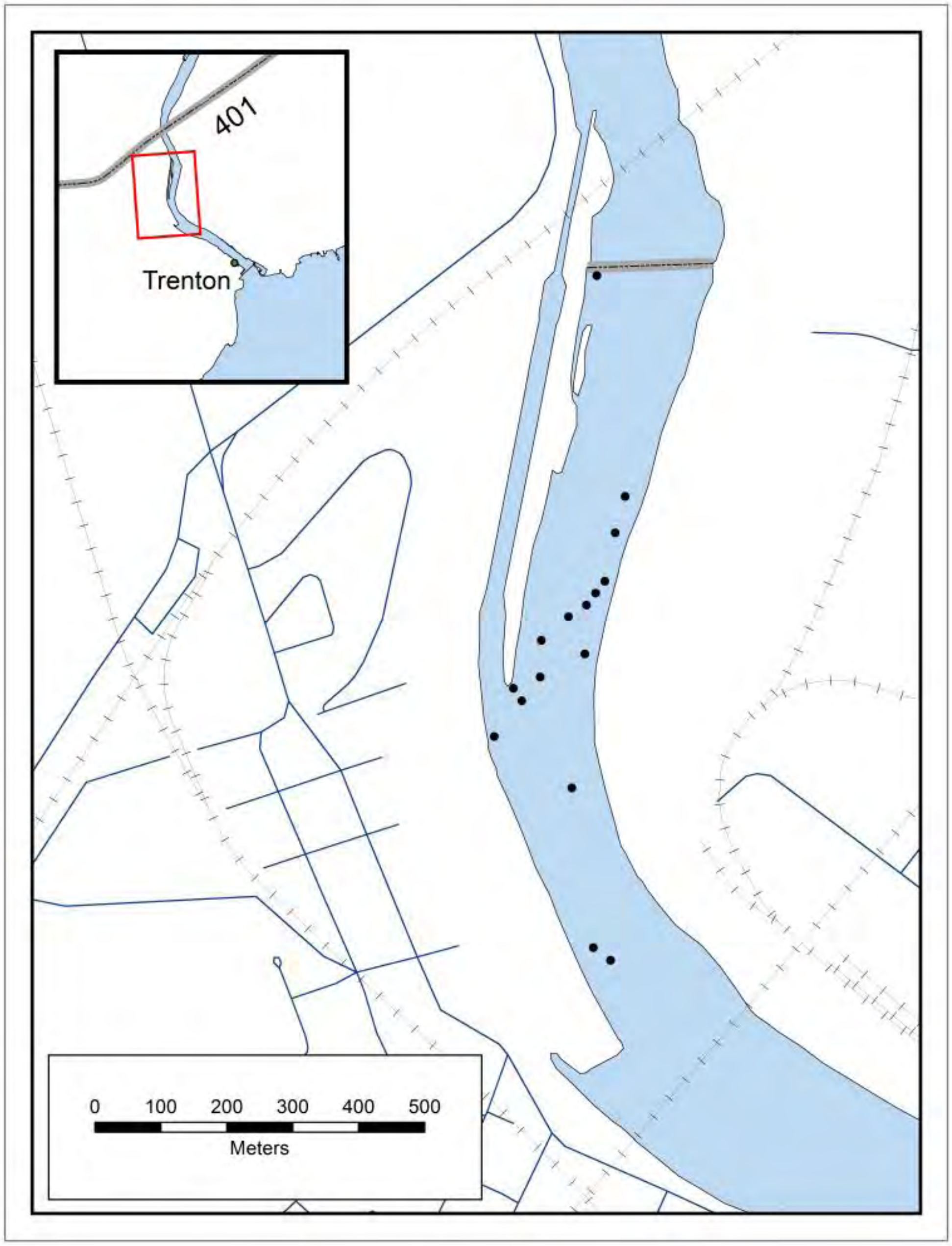

FIG. 8.8.1. Locations of hook-lines deployed in the Trent River in 2016

9. Research Activities

9.1 Bloater Restoration: Using Acoustic Telemetry to Understand Post-stocking Behaviour

Project leads: Tim Johnson (OMNRF-ARMS), Aaron Fisk, Scott Colborne (Great Lakes Institute for Environmental Research, University of Windsor), Eddie Halfyard (The Nova Scotia Salmon Association)
Collaborators: Lake Ontario Management Unit, New York State Department of Environmental Conservation
Funding: Great Lakes Protection Act / Canada-Ontario Agreement, Great Lakes Fish and Wildlife Restoration Act, Great Lakes Fisheries Commission

Historically, a diverse assemblage of Deepwater Ciscoes (5 species), including Bloater (*Coregonus hoyi*), inhabited Lake Ontario. Since that time, only the shallow water form (*C. artedi*) remains. OMNRF and New York State Department of Environmental Conservation have jointly developed a plan to re-establish a self-sustaining Deepwater Cisco population with a target to stock 500,000 juvenile Bloater annually (see Section 8.4). One question requiring investigation is what will happen to the stocked fish after introduction. Do hatchery fish survive in the wild? How does survival change over time? Do they quickly disperse or do they stay close to their stocking site? Do they school closely together and move as a group? What is their seasonal habitat use and occupied depth and temperature? Answering these questions using acoustic telemetry is the focus of this research. This update provides initial analyses of data obtained between November 2015 and May 2016; the next scheduled download of the receivers is in May 2017.

In November of 2015 we tagged 70 yearling Bloater (mean length 174 mm) with either Vemco V7- or V9-69 kHz tags, and released those fish, along with ~1,700 untagged yearlings and ~38,000 untagged fingerlings into the centre of a pre-established acoustic array in eastern Lake Ontario (Fig. 9.1.1). The receiver array (n=80 Vemco VR2W 69 kHz receivers) detected 68 of the 70 tagged Bloater, amounting to 577,361 detections over the 6 ½ months. November, the month of release, had the highest number of detections, followed by May (the month of recovery) with lower numbers of detections during the winter months (Fig. 9.1.2).

Initially, the highest number of detections was near the point of release, but within 1.2 days Bloater were detected in the northern portion of the St. Lawrence channel, representing the maximum extent of the array (linear distance 13.6 km from point of release). We estimate that 55%

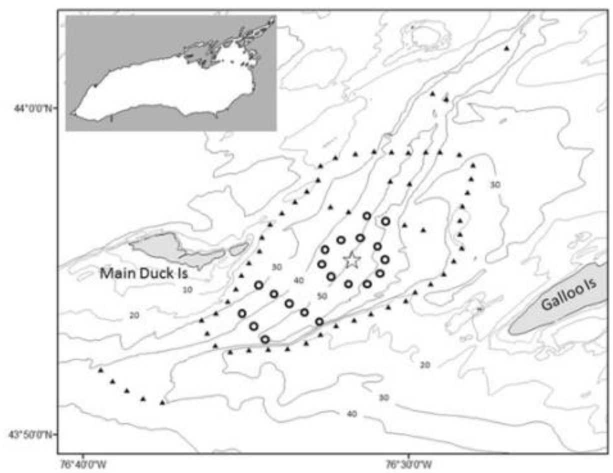

FIG. 9.1.1. Acoustic receiver layout in the St Lawrence Channel of eastern Lake Ontario used to assess post-stocking behaviour and survival of Bloater, *Coregonus hoyi*. The array consists of eighty 69 kHz receivers. The star indicates the point of release, while the circles indicate receivers that were downloaded in May 2016 to assess initial post-stocking behaviour.

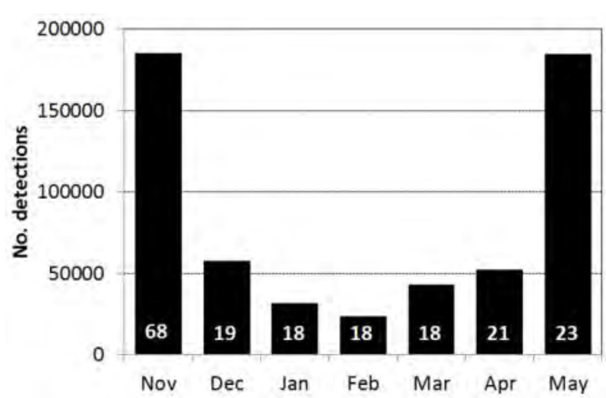

FIG. 9.1.2. Monthly sum of detections (bars) and number of unique Bloaters detected per month (numbers within bars).

of the tagged Bloater emigrated from the array (average 12.9 ± 31.8 days post release, range 0.4 to 189.9 d). Bloater appear to have largely emigrated along the long-axis of the channel, with about half of the fish moving toward the Lake Ontario main basin. Preliminary analyses suggest the stocked Bloater were more likely to occur where other Bloater were detected , suggestive of a schooling behaviour characteristic of wild populations. At the time that the array was downloaded (6 ½ months post-release), eight tags (12%) were actively moving within the array. If we exclude the individuals that emigrated from the array (for which we are unable to assign fate), six-month survival would be estimated at 26% (8/31). More unique tags were detected in May (n=23) than in any month other than November when the Bloater were released, suggesting that some fish returned to the array in May – further substantiating our interpretation that some of the Bloater survived beyond the 6 ½ month study period.

All receivers downloaded in May were re-deployed, along with 23 additional receivers to continue to track the behaviour and survival of stocked Bloater. In November 2016, 161,680 Bloater (see Section 8.4) were stocked by MNRF including 24 tagged fish. Half of these tagged Bloater contained V9 detection tags used in 2015, while the other half contained V9-pt tags which report on the depth and temperature of the fish as it moves through the array. This information will further our understanding of factors influencing the behaviour and distribution of Bloater. Additional funding from the Great Lakes Fishery Commission will enable us to tag additional Bloater in 2017 and 2018, while also collecting *in situ* environmental and biological data further informing our knowledge of Bloater ecology and their potential to re-establish in Lake Ontario.

With support from Ontario's Great Lakes Protection Act and NYSDEC, we tagged 30 adult Lake Trout on spawning shoals in the vicinity of our array, with the hope that we will learn more about the interaction between Bloater and Lake Trout; a predator that historically preyed upon Bloater in Lake Ontario. We expect to tag more Lake Trout and sub-adult Chinook Salmon in 2017 and will report on all three species in future Annual Reports.

9.2 Understanding Depth and Temperature Preference of Lake Ontario Salmonids Using Novel Pop-off Data Storage Tags

Project leads: Tim Johnson (OMNRF-ARMS), Aaron Fisk, Graham Raby, Tom Stewart (Great Lakes Institute for Environmental Research, University of Windsor)
Collaborators: New York State Department of Environmental Conservation
Funding: Great Lakes Protection Plan / Canada-Ontario Agreement, Great Lakes Fisheries Commission

Lake Ontario contains six salmonid species, with potential for inter-species competition for food resources. Recreational fisheries for Chinook Salmon (*Oncorhynchus tshawytscha*) and Rainbow Trout (*Oncorhynchus mykiss*) are sometimes perceived to be in conflict with efforts to rehabilitate Atlantic Salmon (*Salmo salar*) and Lake Trout (*Salvelinus namaycush*), owing to concerns about competition for food and spawning habitat. Understanding the movement, behaviour, and habitat preferences of these species in a large and ever-changing ecosystem like Lake Ontario is not an easy task. Pop-off data storage tags (pDST) became available for freshwater fish for the first time in 2013 and provide an opportunity to collect new and unprecedented information on depth and temperature of fishes in the wild. These pDST record data at specified time intervals and then release from the fish on a programmed date, floating to the surface where they can be recovered.

In the first year of the study, 2014, we attached 22 pDSTs to trout and salmon in Lake Ontario, with the tags programmed to record depth and temperature every 70 s before popping off the fish after one year. Recovery of these tags has relied on tags being found and returned by the public – a $100 reward has been offered as an incentive. Among the 22 fish tagged in 2014, six tags were recovered (27%) – among these six, the longest interval between tagging and tag recapture was 466 days. Among 56 fish we tagged in 2015 (scheduled pop off in summer or fall 2016), 15 have thus far been returned to us (27%), although we expect a few more of these tags to be found in the spring and/or summer of 2017. In our final year of tagging (2016), we deployed an additional 40 tags, which are not scheduled to pop off until July 2017. In total, we have tagged 118 fish with 33 tags recovered at the time of writing (Table 9.2.1). The tags recovered in each year have been a mixture of: a) fish caught by anglers with tags still attached (n=7), b) tags found on shore, popped-off as scheduled (n=11), c) tags found on shore, popped/broken off prematurely (n=2), and d) tags found on shore with the bridle still attached, indicating the fish likely died at some point after release (n=13, all hatchery fish) (Fig 9.2.1).

The most obvious trend that appears when visually examining the data for each fish is a remarkable variation within and among individuals in vertical distribution and behaviour (Fig. 9.2.2). For instance, some individuals will exhibit strong diel (day-night) vertical movement patterns while other individuals show little or no diel behaviour (Fig. 9.2.2).

TABLE. 9.2.1. Number of fish tagged and tags recovered, by species in Lake Ontario between 2014 and 2016. Days elapsed is the range of days between when then fish was released and the tag recovered. Linear distance is the straight line distance from the point of release of the tagged fish and the reported location where the tag was found, and should not be viewed as an indicator of fish movement.

	Number tagged	Number recovered	Days elapsed	Linear distance (km)
Chinook	32	9	60 - 437	23 - 260
Lake Trout – wild	40	6	102 - 580	Apr-66
Lake Trout – hatchery	10	4	---	---
Atlantic – wild	1	0	---	---
Atlantic – hatchery	20	9	---	---
Rainbow Trout	10	3	24 - 46	108 - 278
Brown Trout	5	2	67 - 467	Oct-45

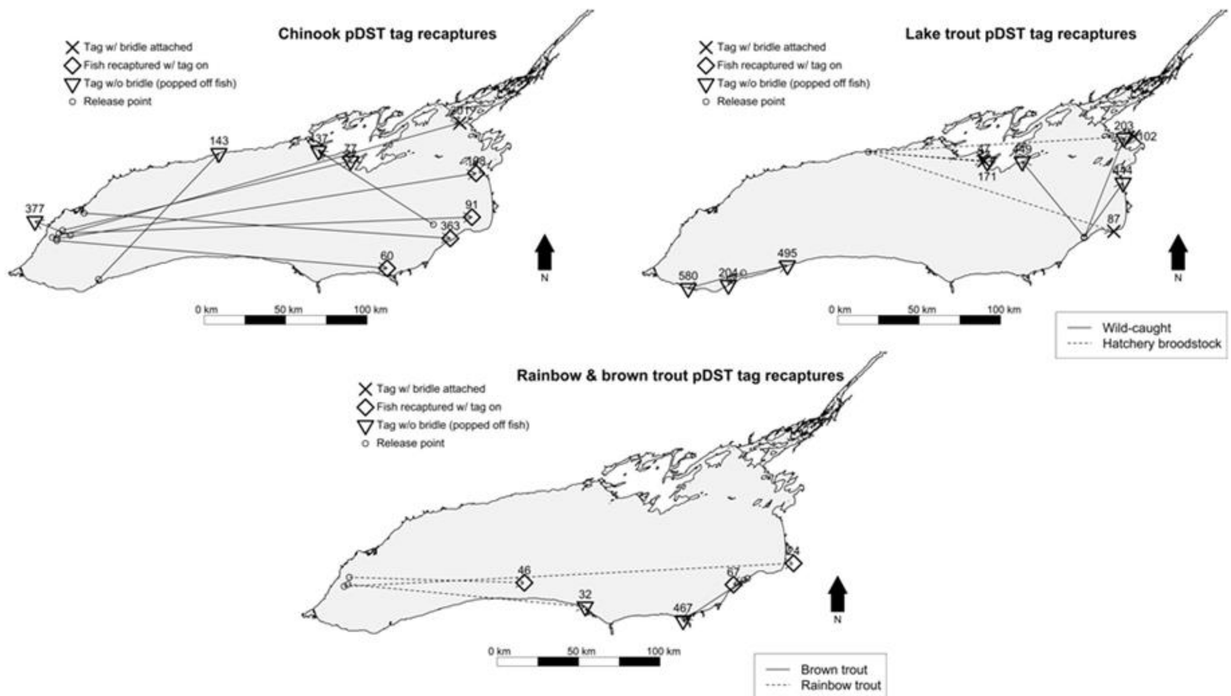

FIG. 9.2.1. Maps of release and recapture locations for pDSTs for Chinook Salmon (upper left), Lake Trout (upper right) and Rainbow and Brown Trout (combined, lower) in Lake Ontario 2014-16. The numbers shown above (or adjacent to) each recapture point (the large symbols) indicates the number of days between release and recapture of the tag/fish. "Bridle" refers to the plastic components used to externally attach to the fish via plastic monofilament lines running through the dorsal musculature.

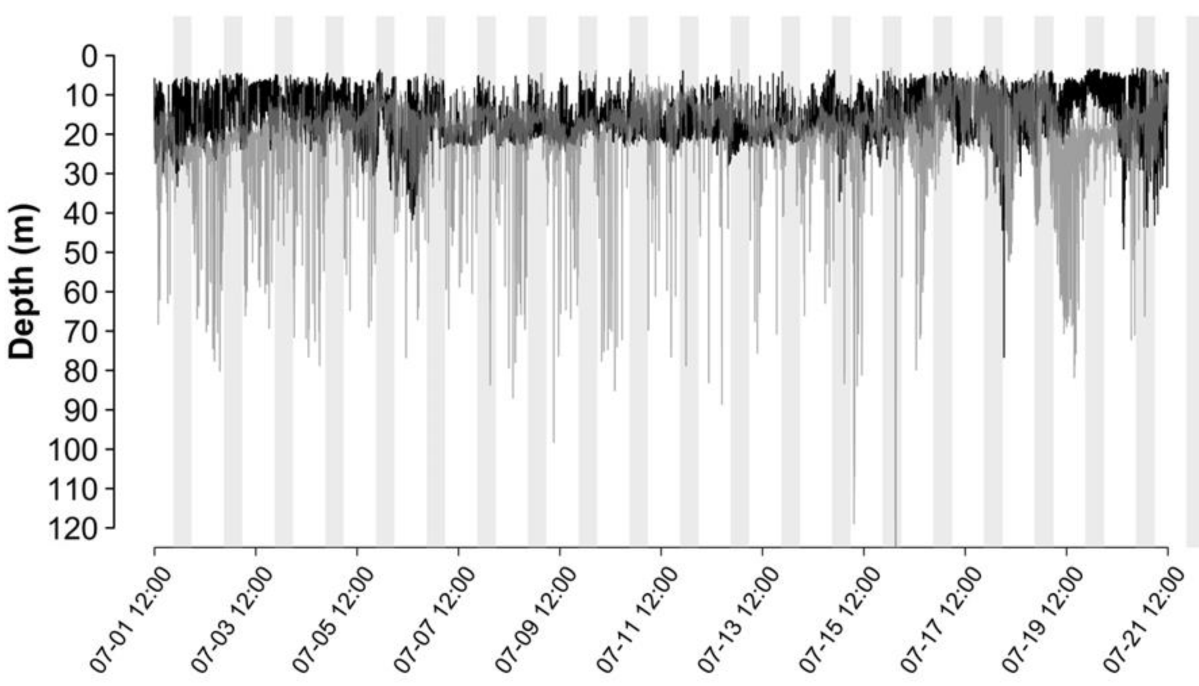

FIG. 9.2.2. Depth distribution for two different Chinook Salmon during the month of July 2015. The dark bands represent nighttime, while the white bands represent daytime.

As expected, some differences among species emerge (Fig. 9.2.3). The two species for which we have the greatest number of returned tags are Chinook and Lake Trout (nine and six respectively, among Charter-caught fish). These show clear differentiation in thermal and vertical habitat use at most times of the year. In general, Lake Trout seem to be much less active than Chinook in terms of vertical movements, often staying within 1-2 m of the same depth for an entire day, whereas Chinook frequently undergo vertical movements of 10-20 m or more. Median depth for Chinook ranged between ~10-20 m during the summer fishing months (May through September), whereas the median depth for Lake Trout was ~20-40 m, although, there was some overlap in the depth distribution for the two species in most of these months (Fig. 9.2.3a). As expected, Rainbow Trout and especially Brown Trout appear to be more surface oriented than either Chinook Salmon or Lake Trout, but we have very few tags on which to base these generalizations at this point (Fig. 9.2.3a). One between-species difference that is very clear from the tags we have been able to retrieve so far is the enormous divergence in vertical behaviour and thermal experience between Chinook Salmon and Lake Trout during the winter (Fig. 9.2.3a and b). Chinook Salmon primarily occupied waters in the 4-5 °C range, while Lake Trout were mostly confined to the 0-4 °C range. More interestingly, Chinook appear to forage very actively in the winter and in the deeper parts of the lake, based on the enormous depth ranges (Fig. 9.2.3a) exhibited by fish on a monthly, daily, and even hourly basis (for an example of this behaviour see Fig. 9.2.4).

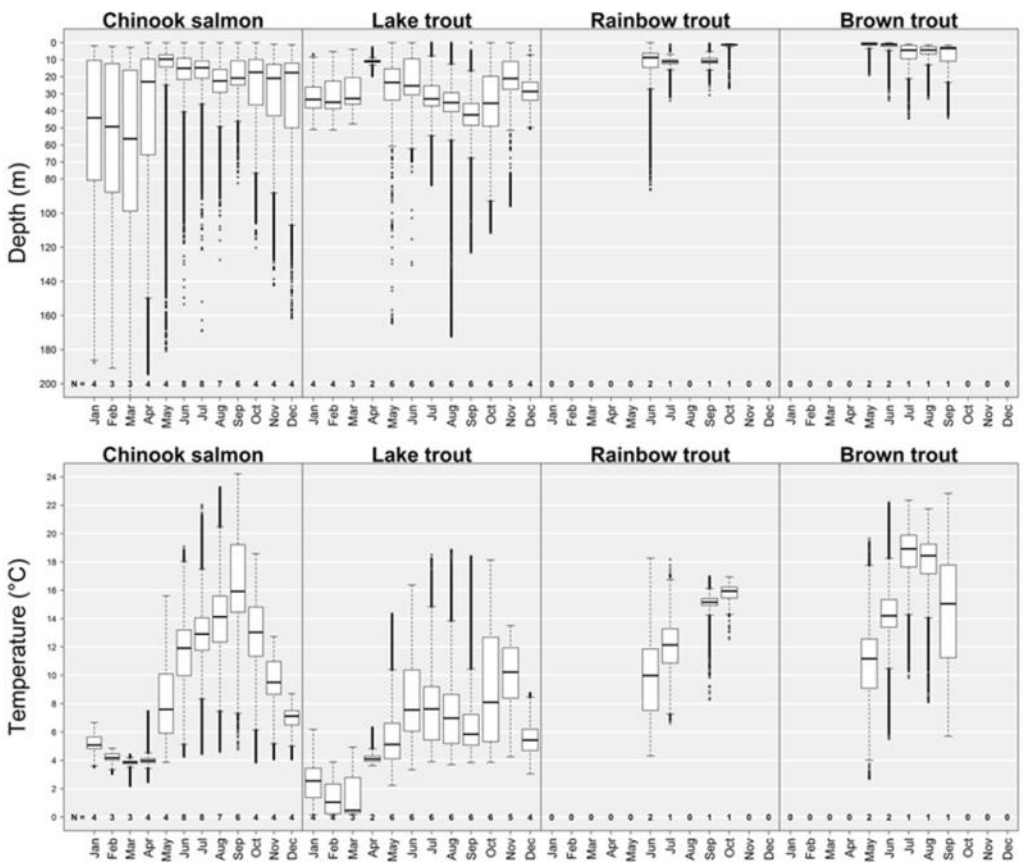

FIG. 9.2.3.Species comparison of depth (upper) and temperature (lower) distributions by month. The numbers along the bottom of each plot indicate the number of unique fish represented in the dataset for each month. The centre-line in the boxplots shows the median value, the upper and lower ends of each box represent the 75th and 25th percentiles, respectively, and the whiskers show either the maximum/minimum value or 1.5 times the inter-quartile range (the length of the box), whichever is closer to the median. In most cases, additional values are shown beyond the whiskers (i.e., beyond 1.5× the inter-quartile range). Traces for each tag were manually inspected and data removed after the tag released from the fish or after the time the fish was caught. Likewise, the first 10 days of each tag's data was trimmed off to allow the fish a 'recovery' period following capture and tagging.

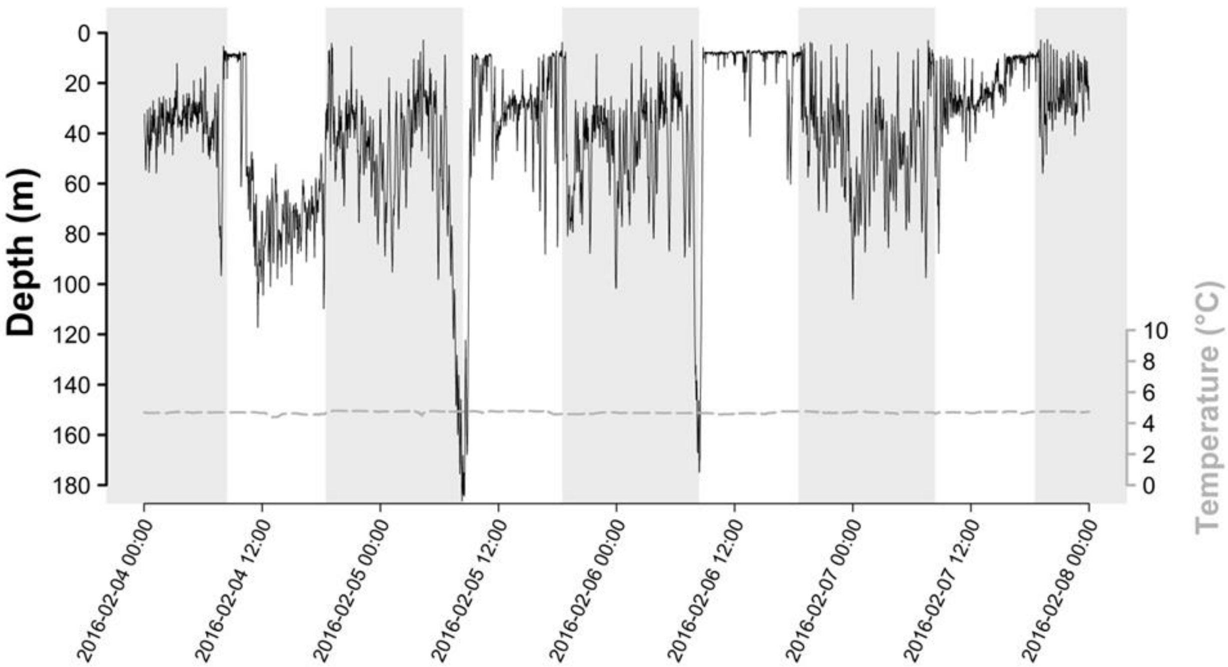

FIG. 9.2.4.4 Depth and temperature data for one week in February 2016 for a Chinook salmon in Lake Ontario. The top line corresponds to the left axis (depth), while the (virtually-flat) bottom line corresponds to temperature (right axis). Daytime is marked by white vertical bands, while nighttime is marked with grey bands. Date (year-month-day) and time are shown on the x-axis.

Given that 28 more tags are scheduled to release from fish in 2017 and that a few more already-released tags may be found and returned throughout 2017, analyses of these data aimed at quantifying interspecific, seasonal, and diel differences in depth and temperature will not be finalized until early 2018. The data collected through this study will be used to provide never before seen detail of the temperature and behaviour of these trout and salmon species in Lake Ontario. Such information can be used to drive bioenergetic models to understand growth rate potential and food consumption rates, as well as an improved understanding of the potential resource overlap among multiple species. Modelled results will help us better understand the interaction amongst predators and between predators and their food, as well as how species may respond to climatic and other environmental changes.

9.3 An Interactive Tool for Assessing the Energetic Demand of Stocked Predators in Lake Ontario

Project Leads: Jeff Buckley & Tim Johnson (OMNRF-ARMS)
Partners: Lake Ontario Management Unit, New York State Department of Environmental Conservation, United States Geological Survey.
Funding: OMNRF-ARMS base

Lake Ontario and its tributaries provide world-class angling opportunities and fuel a multi-million dollar recreational fishery. Alewife, the most abundant prey fish species in Lake Ontario, is a major prey item for these salmon and trout species; however, each salmon and trout species utilizes this prey resource differently throughout their life histories. As changes to stocking levels occur and the effectiveness of net pen stocking is better understood, the Lake Ontario Committee expressed interest in developing a tool, modeling the effects of different stocking scenarios on prey availability. In response, an interactive tool was developed to visualize how different stocking scenarios (total numbers stocked and which species) could affect the total consumption of prey species (specifically Alewife). The outputs from these models will aid lake managers in stocking decisions with the ultimate goal of maintaining predator-prey balance in Lake Ontario.

The tool uses an underlying bioenergetics model based on the diet, physiology, and survival of predator species. The tool uses input stocking numbers for six predator species: Chinook Salmon (*Oncorhynchus tshawytscha*), Coho

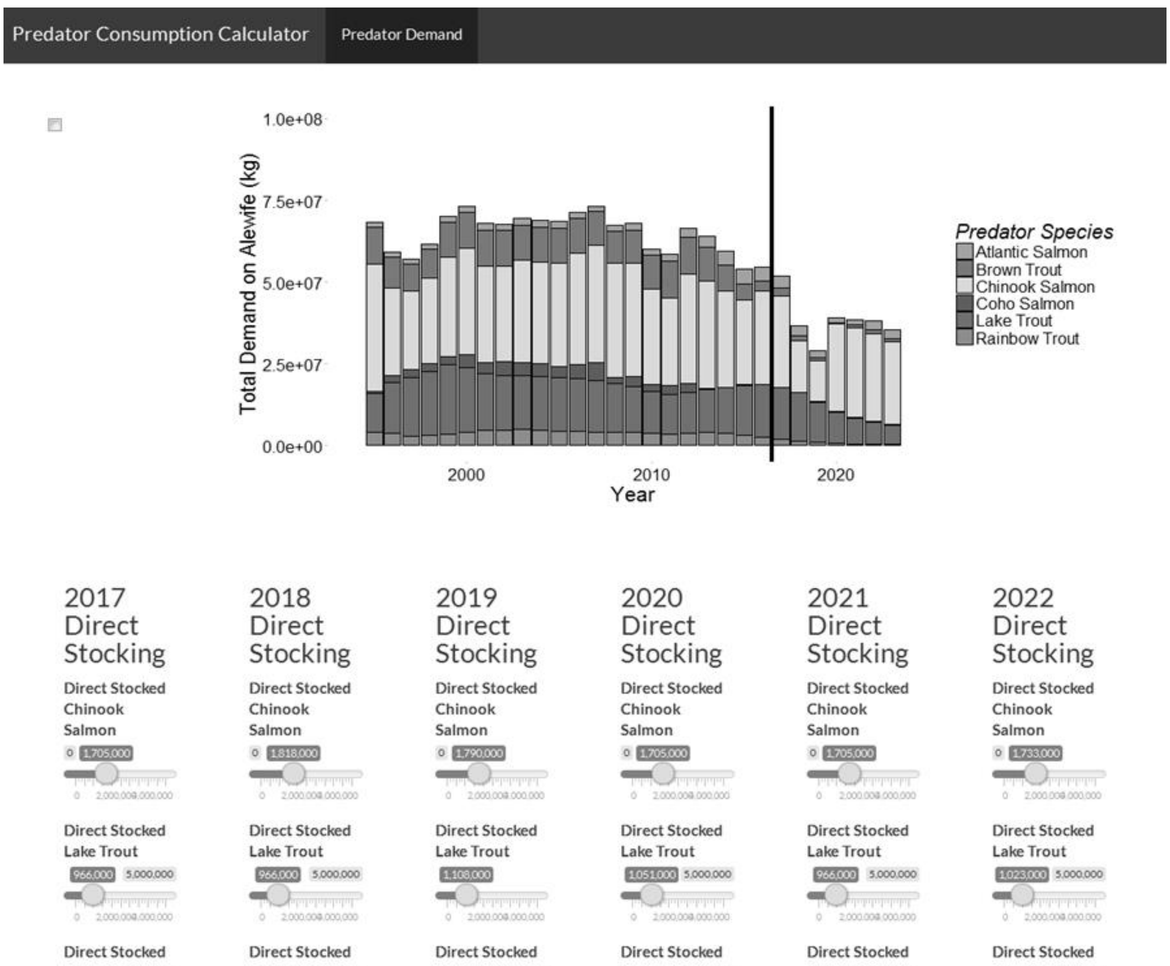

FIG. 9.3.1. User interface for the primary predator energy demand tool. Bar graph shows the total annual consumption by stocked predators. Past consumption is based on historic stocking data. Future consumption is updated in real time with slider inputs of stocking numbers for each species/year.

Salmon (*O. kisutch*), Atlantic Salmon (*Salmo salar*), Lake Trout (*Salvelinus namaycush*), Rainbow Trout (*O. mykiss*), and Brown Trout (*Salmo trutta*). With these data it calculates the total annual consumption for each predator. The tool requires no previous knowledge of bioenergetics models, but allows managers to easily use them to model effects of different predator stocking scenarios.

Fig. 9.3.1 shows the primary user interface of the tool. Users can set individual stocking levels for each predator up to five years into the future. The bioenergetics model output is translated into a simple timeline showing the expected predator demand, which includes past consumption based on historic stocking data, and expected consumption up to 10 years into the future.

The tool also contains a secondary interface that allows the user to visualize the change in consumption for a predator species given different long-term, consistent, stocking levels. For example, Fig. 9.3.2a shows the reduction in consumption by stocked Chinook Salmon when a 25% reduction from current stocking numbers is applied for the next five years. Fig. 9.3.2b shows how the same decrease in Lake Trout stocking over the next five years would affect consumption. Despite a decrease in stocking by an equal proportion of fish in both scenarios, a decrease in Chinook is expected to result in a substantially larger decrease in prey consumption as individual Chinook Salmon eat a significantly larger amount of prey than Lake Trout over their lifetime.

(a)

(b)

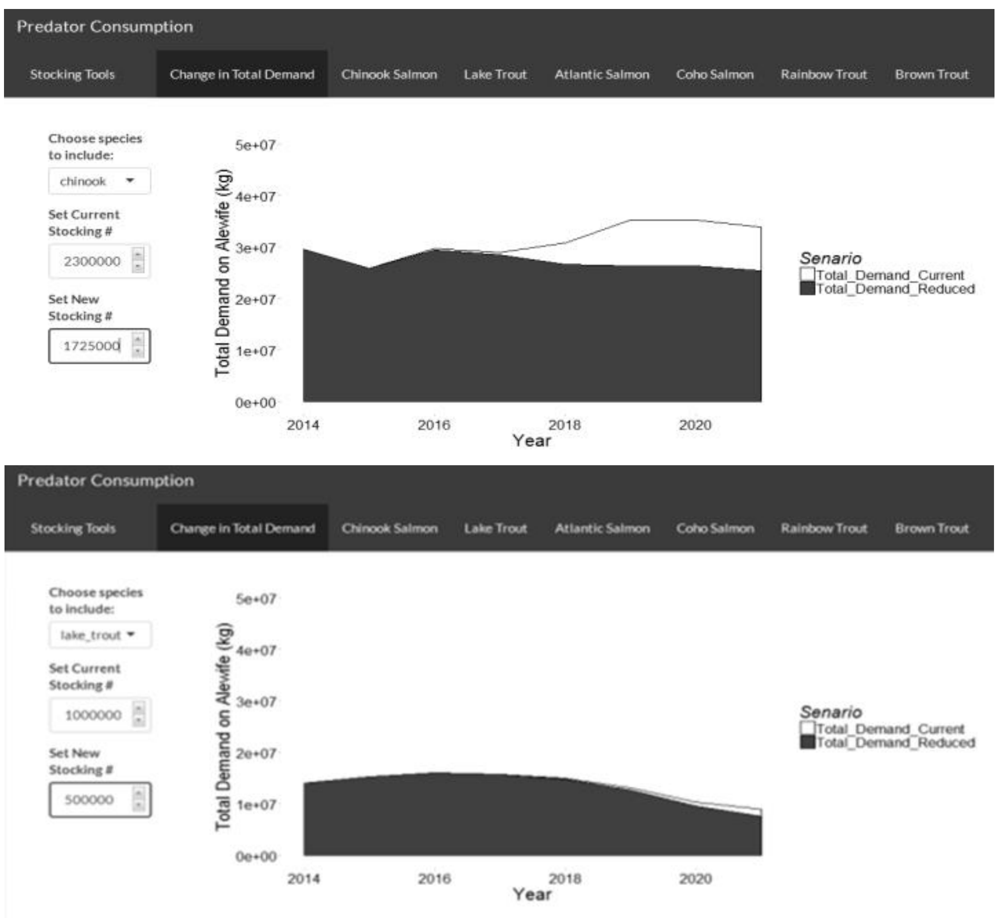

FIG. 9.3.2. Secondary user interface for the predator energy demand tool. Graph shows total consumption by Chinook salmon (a) and Lake Trout (b). User selects a species and inputs two stocking scenarios. Output figure shows predicted change in consumption for each scenario (white and black area graphs) over the following decade given a consistent use of input stocking numbers.

9.4 Comparative Ecology of Juvenile Salmonids in Lake Ontario

Project leads: Changhai Zhu & Tim Johnson (OMNRF-ARMS)
Collaborators: Lake Ontario Management Unit, Toronto and Region Conservation Authority, New York State Department of Environmental Conservation
Funding: Great Lakes Protection Act / Canada-Ontario Agreement

Lake Ontario contains two native (Atlantic Salmon (*Salmo salar*) and Lake Trout (*Salvelinus namaycush*)) and four introduced salmonid species (Chinook Salmon (*Oncohynchus tshawytscha*), Coho Salmon (*O. kisutch*), Brown Trout (*Salmo trutta*), and Rainbow Trout (*O. mykiss*)). These fish species are important both ecologically and economically. Adult salmonids function as top predators in the Lake Ontario fish community and support a large recreational fishery. While the stream dwelling juvenile life stage and lake dwelling adult life stage have both been well studied, very little is known about the ecology of these fish at the juvenile life stage when they first exit natal streams and begin their lake dwelling phase. This transition from lotic to lentic habitats likely bring with it new challenges (e.g., possibly different food resources, fish community inhabitants, and fish community interactions) that may influence their success later in life. Improved understanding of this life stage could provide valuable insight into the ecology of these species and improve our knowledge of fish production. To address this knowledge gap we collected diet and stable isotope samples from lake dwelling juvenile fish throughout the course of three summers (2012-2014) largely from Canadian waters of Lake Ontario. With these data we explored ecological differences in morphology, feeding, and trophic position amongst juvenile salmonid species during the first year of their residency in Lake Ontario. We utilized a variety of metrics to build a cohesive ecological story. Length/weight relationships and body size were used to approximate growth rates. Stomach contents and stable isotopes were used to examine variation in diet composition as well as niche space occupancy and overlap among juvenile salmonids. Additionally, energy density was used as a measure of overall well-being. By using this suite of metrics, our interpretation of inter- and intra-specific differences in growth and diet was robust, and provided greater confidence in ascribing differences to intrinsic and environmental variability in the nearshore of Lake Ontario.

Between May 2012 and October 2014, a total of 1,881 salmonids were collected from over 30 different locations across Lake Ontario (Fig. 9.4.1). Multiple sampling gears (e.g., small-mesh gillnets, beach seines, electrofishing) were used to target juvenile salmonids. Using break-point analysis on our entire catch we determined that

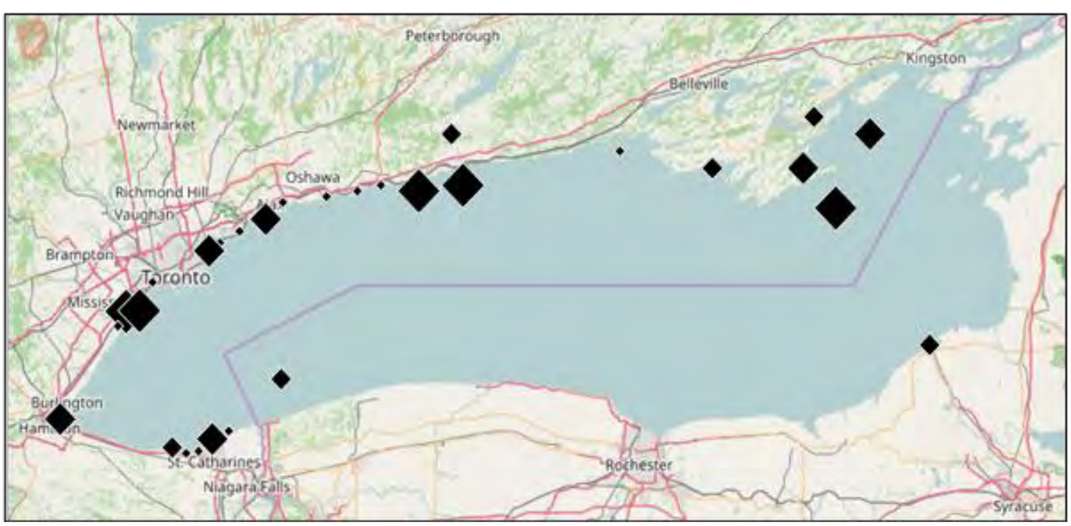

FIG. 9.4.1. Map of Lake Ontario and sampling sites. Size of diamonds are related to the number of fish sampled at each location. Very small: < 20, small: 20-49, medium: 50 – 99, large: > 100.

the transition to piscivory (a diet composed entirely of prey fish) was essentially complete in fish >320mm in length. Thus, we termed fish <320 mm "juveniles" and limited our analysis to these 449 individual fish. We further subdivided the juveniles into three size groups based on the level of piscivory that was observed. Fish less than 100 mm consumed no fish and were classified as *small*. Fish between 100-200 mm showed some evidence of piscivory and were classified as *medium*. Fish larger than 200 mm exhibited a high degree of piscivory and were classified as *large*.

While all salmonid species generally exhibited isometric growth (weight increased as the cube of length), Lake Trout and Brown Trout were slightly heavier at a given length than the other species. Diet compositions suggested this may be due to their tendency to shift to a diet dominated by prey fish at a smaller size compared to the other salmonid species.

Stomach contents were fairly uniform and similar amongst species within the small size category (Fig. 9.4.2). All salmonid species underwent a diet shift from predominantly aquatic insects when they were small to predominantly fish as they grew larger. As a species, Rainbow Trout has the most diverse diets, with invertebrates continuing to contribute prominently in all size categories.

Energy density ($J \cdot g^{-1}$ body mass) increased throughout the year (even after controlling for increases in fish size). From an ecological perspective, this suggested that prey availability was likely not limiting in terms of quality or quantity since fish were able to exceed the caloric intake necessary to support basic metabolic functions. Amongst the five species, Brown Trout had higher energy densities than all others (except for Atlantic Salmon, which were assumed to be of recent hatchery origin based on isotopic signatures). The high proportion of prey fish in Brown Trout diets likely contributed to their elevated energy densities.

Overlap of isotopically derived niche space was high and generally indicated that the juvenile salmonids occupied a similar trophic level and that they derived their energy from similar sources (Fig. 9.4.3). That said, Lake Trout and Brown Trout had the most unique isotopic niches although the differences were not statistically significant. In the case of Lake Trout this could have been due to their unique life history at this age (i.e., juvenile Lake Trout do not have a stream dwelling life stage, and occupy habitats further offshore than the other species). In the case of Brown Trout the uniqueness of the niche is more difficult to explain and may simply be a spurious result of the inclusion of some fish of suspected recent hatchery origin.

Overall, the five salmonid species appear to have similar growth rates, condition, diets, and utilize similar resources. The differences that were observed tended to be in individual metrics (e.g., diet composition) rather than across all traits for a given species suggesting that none of the salmonid species greatly differed from the others in terms of diets, resources consumed, energy

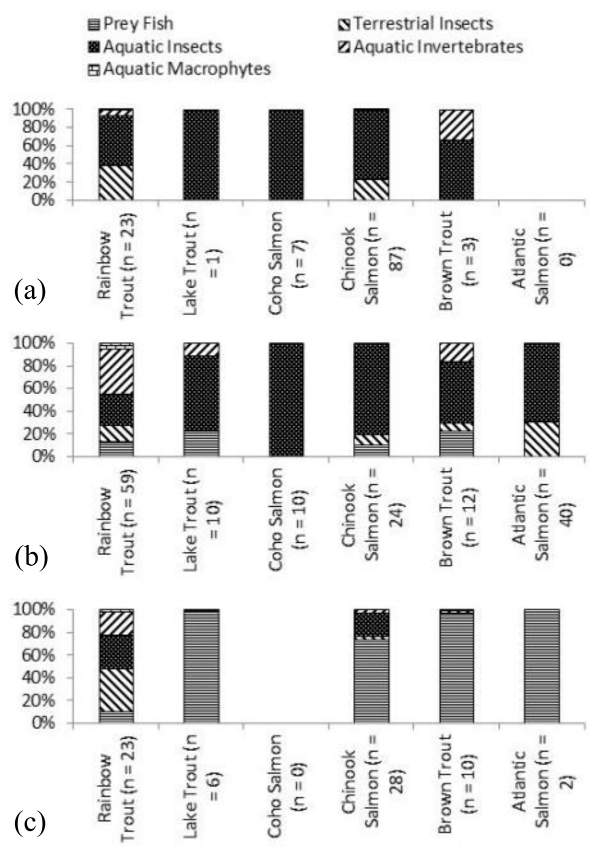

FIG. 9.4.2. Proportion by volume of prey items found in stomachs of juvenile salmonids in three size classes: a) <100 mm fork length, b) 100-200 mm fork length, and c) 200-320 mm fork length.

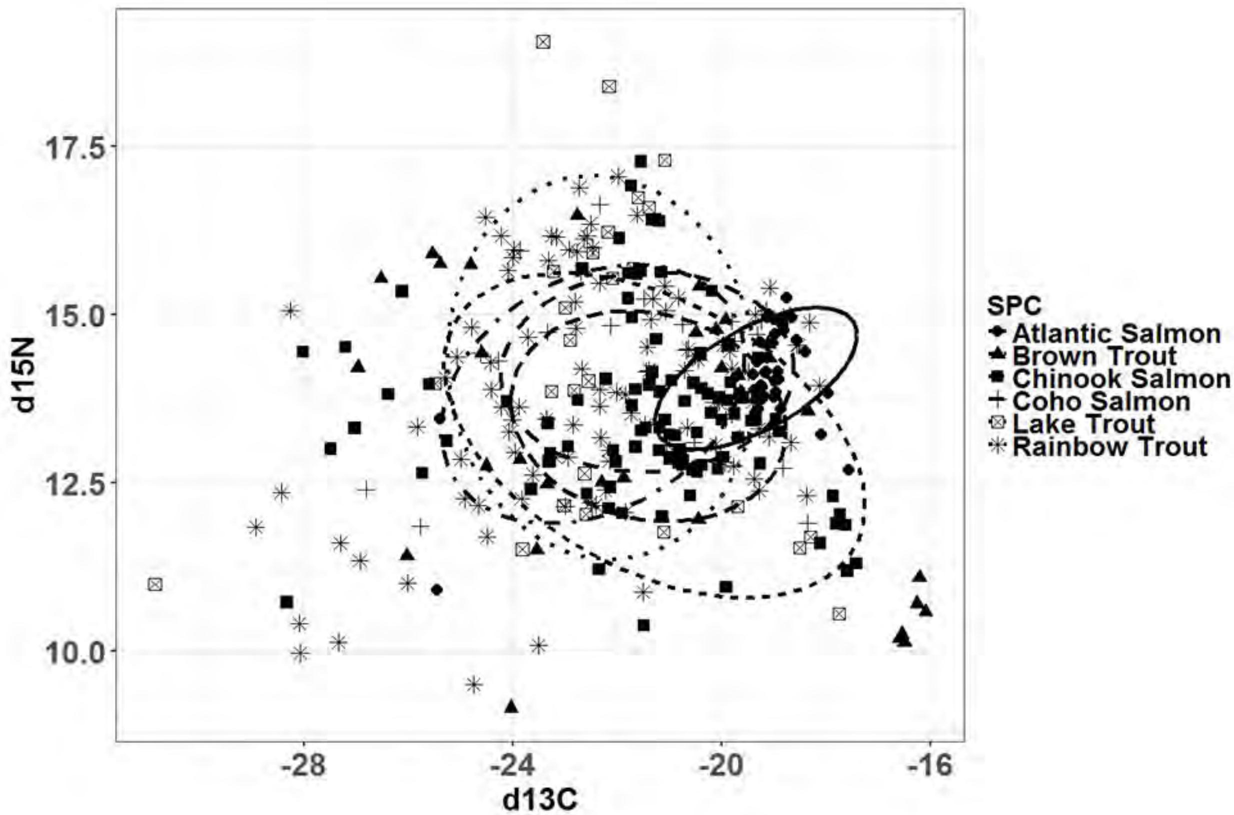

FIG. 9.4.3. 50% probability ellipses for juvenile salmonid stable isotope signatures.

stores, or growth and development. These results suggest that at this life stage, all of the salmonid species present in Lake Ontario have the potential to use and consume similar resources.

9.5 Station 81: Long-term Monitoring at the Base of Lake Ontario's Food Web

Project leads: Carolina Taraborelli & Jeff Buckley (OMNRF-ARMS)
Collaborators: Lake Ontario Management Unit, Fisheries and Oceans Canada
Funding: OMNRF-ARMS base, Great Lakes Protection Act / Canada-Ontario Agreement

Lower trophic levels, including algae and zooplankton, fill an essential role in the Lake Ontario food web. These biological communities are the primary source of food to many important prey fish species. Therefore, an understanding of the lower trophic levels aids in the management of larger piscivorous species.

Long-term monitoring is an important tool in understanding how changes in the physical and chemical condition of a lake affect the food web. Beginning in 1981, Fisheries and Oceans Canada (DFO) began reporting on the lower trophic levels, as well as physical and chemical condition of Lake Ontario at Station 81 (Fig. 9.5.1). Sampling continued each summer until 1995 when the program was cancelled. Data collected through this monitoring program culminated in a report that demonstrated the response of lower trophic levels to the large decrease in phosphorous loadings in the lake and the initial establishment of dreissenid mussels (Johannsson et al. 1998).

In 2007, OMNRF's Aquatic Research and Monitoring Section reinstated the long-term monitoring program at Station 81 in collaboration with the Lake Ontario Management Unit and DFO.

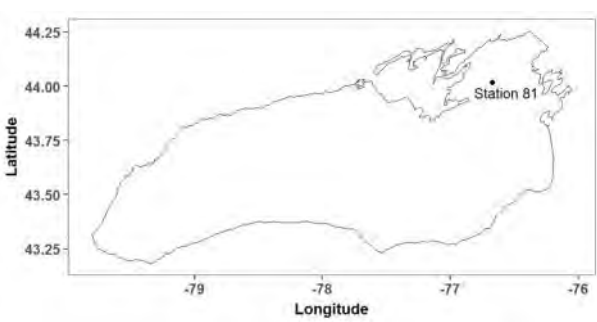

FIG. 9.5.1. Map of Lake Ontario showing location of Station 81.

Station 81 is located in the centre of the eastern basin of Lake Ontario (44º 01.02' N, 76º 40.23' W; Fig. 9.5.1). In 2016, samples were collected bi-weekly from May 10th to October 19th. Data collected included profiles of temperature, dissolved oxygen, chlorophyll-a (an index of the amount of algae), Secchi depth (transparency), water samples for nutrient analysis, and samples describing the phytoplankton and zooplankton communities.

In 2016, stratification of the water column was first observed on June 14th and was last observed on October 3rd. Secchi depth varied between 5 m and 18.5 m, with a mean of 8.7 m. Mean daily water temperature ranged from 6.1˚ C to 23.2˚ C, with the highest average temperature observed on August 8. Nutrient, phytoplankton, and zooplankton samples are currently being analysed.

Since 1981, an overall trend of increasing mean annual water temperature has been observed at Station 81 (Fig. 9.5.2). The lowest mean annual temperature was in 1982 (12.5˚ C), while the highest annual temperature was observed in 2012 (16.2˚ C).

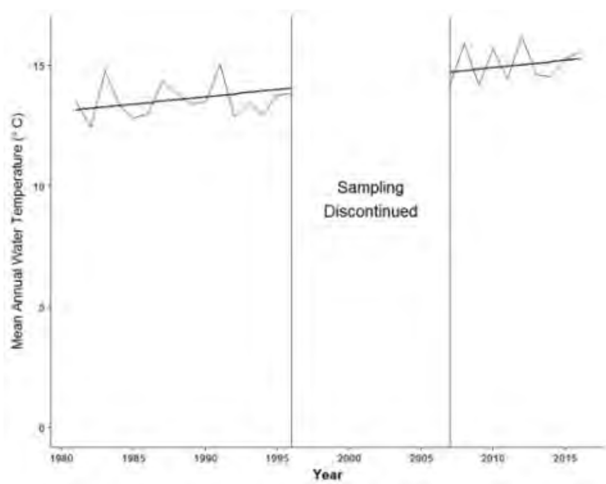

FIG. 9.5.2. Mean annual epilimnetic water temperature from 1981 to 2016. Daily water temperature was calculated as the mean temperature of the water column from the surface to the thermocline, or to 20 m depth if no thermocline existed. Annual means were seasonally weighted between April 1 and October 31. Trend line is the least-squares linear regression of water temperature over time.

Finally, long-term monitoring of the lake's tiniest biota can give us insight into how the lake's chemical and physical conditions influence the lake's biotic communities. Average annual chlorophyll a levels and average annual primary productivity levels (estimates of the lake's capacity to produce "fish food") have declined since the 1970s in response to reduced nutrient levels in the lake. Both have, however, been relatively constant over the past decade (Fig. 9.5.3).

Johannsson, O. E., Millard, E. S., Ralph, K. M., Myles, D. D., Graham, D. M., Taylor, W. D., Allen, R. E. The changing pelagia of Lake Ontario (1981 to 1995): A report of the DFO long-term biomonitoring (bioindex) program. Can. Tech. Rep. Fish. Aquat. Sci. No. 2243: i-ix+278pp.

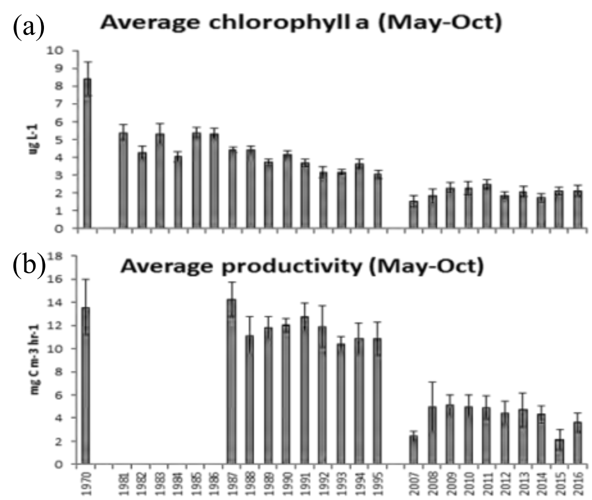

FIG. 9.5.3. a) Average annual chlorophyll a levels; and, b) average annual Primary Productivity levels measured at Station 81 (May - Oct.). Bars represent means with standard errors.

9.6 Understanding the Vulnerability of the Great Lakes and Ontario's Inland Lakes to Invasive Species Spread and Establishment

Project leads: Jeff Buckley, Graham Mushet & Tim Johnson (MNRF-ARMS), Len Hunt & Allison Bannister (MNRF-CNFER), Andrew Drake (DFO)
Funding: Great Lakes Protection Act / Canada-Ontario Agreement, Natural Heritage Policy Section

Invasive species pose a threat to the function and diversity of aquatic communities. Over 200 species of fish, plants, and invertebrates are currently listed as potential aquatic invaders of Ontario and neighbouring jurisdictions in Canada and the U.S. Here we report on our continued progress to undertake on a vulnerability assessment of Ontario and the Great Lakes to the spread and establishment of aquatic invasive species.

This project investigates both human facilitation of the introduction and spread of invasive species, as well as the environmental factors that mediate their survival and establishment. Previous work focusing on human dimensions examines how metrics of attraction and accessibility of lakes can define likely pathways of invasive species spread. For example, the size and location of towns and the quality and locations of destination lakes can influence the likelihood of aquatic invasive species arrival through recreational boating. More recent research has focused on assessing how the thermal habitat of inland lakes will change over time due to climate change as well as determining habitat suitability for invasive species in the Great Lakes.

Climate change will affect the habitat of aquatic species as rising temperatures and changes in precipitation may increase access to new habitat for warm water species, while reducing or shifting habitat northward for cool and cold water species. Previously, Minns and Shuter (2012) developed a seasonal temperature model (STM) to determine temperature characteristics of inland lakes in Ontario. The STM is used to estimate the volume of discrete thermal bins (i.e. 8-12°C) present in a lake given local climatic conditions and morphological characteristics of the lake. We applied the STM to lakes sampled through Ontario's Broad-Scale Monitoring program using climate projection data from three climate scenarios and three time periods.

Lakes will see a significant decrease in cold water habitat (8-20°C), and complementary increases in warm water habitat (>25°C), with longer-term and more severe scenarios resulting in the greatest amount of change (Fig. 9.6.1). Modification of the STM was required to accommodate high temperatures predicted for the long-term (2071-2100) time period and in the minimal climate change mitigation scenario (rcp85).

For the Great Lakes, habitat data for fish, invertebrates, and plants have been collected in the form of basin-wide geospatial layers (e.g., depth, temperature, relative exposure, light attenuation), and preliminary habitat suitability models have been developed to identify areas in the Great Lakes that provide optimal habitat for potential invasive species.

An initial grouping of species and subsequent habitat suitability analysis has been generated for invasive fish. Taxa were first divided into thermal guilds (cold, cool, warm) (Fig. 9.6.2a). These thermal guilds were then further divided into predominantly offshore or predominantly nearshore species. Wind and wave exposure were applied as a third criterion as they are also important determinants of fish habitat, and because they tend to correlate with other important variables such as substrate and submerged aquatic vegetation cover. Suitability scores were determined by computing the geometric mean of suitability scores representing habitat preference assigned to ranges of the environmental variables.

An example habitat suitability analysis for a warm-water, nearshore fish that prefers low-energy environments indicated that Lake Erie,

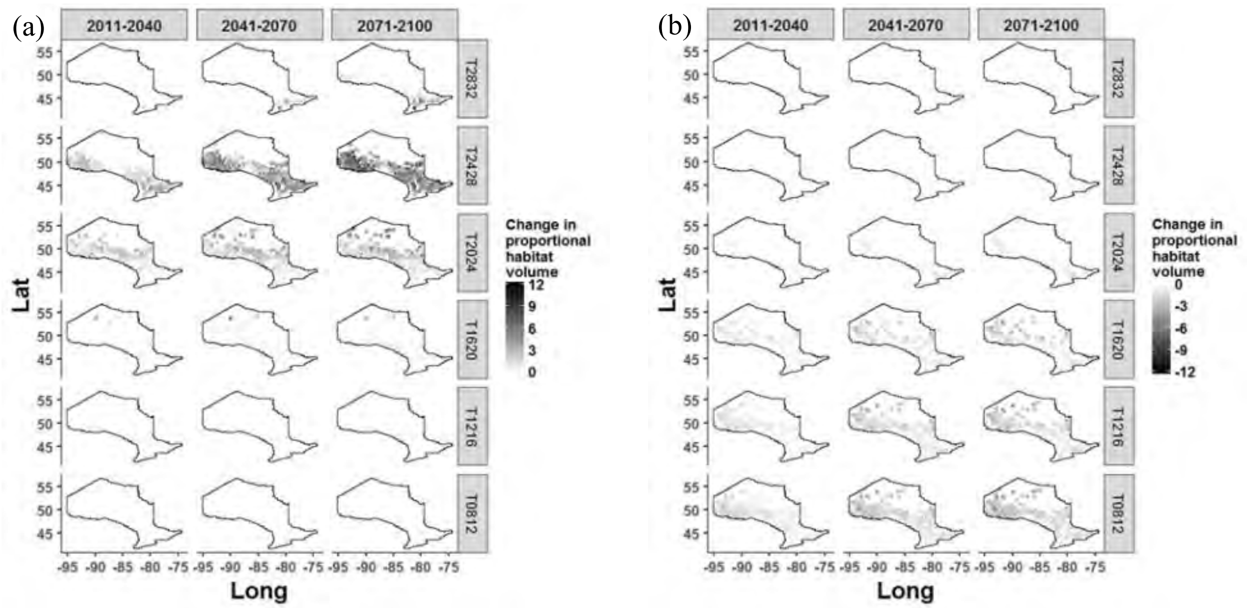

FIG. 9.6.1. Gains (a) and losses (b) of thermal habitat Relative to current (2007-2015) habitat. Thermal habitat is measured in mean annual proportional volume of a given temperature range. Temperature projections are based on the medium climate mitigation scenario (rcp45).

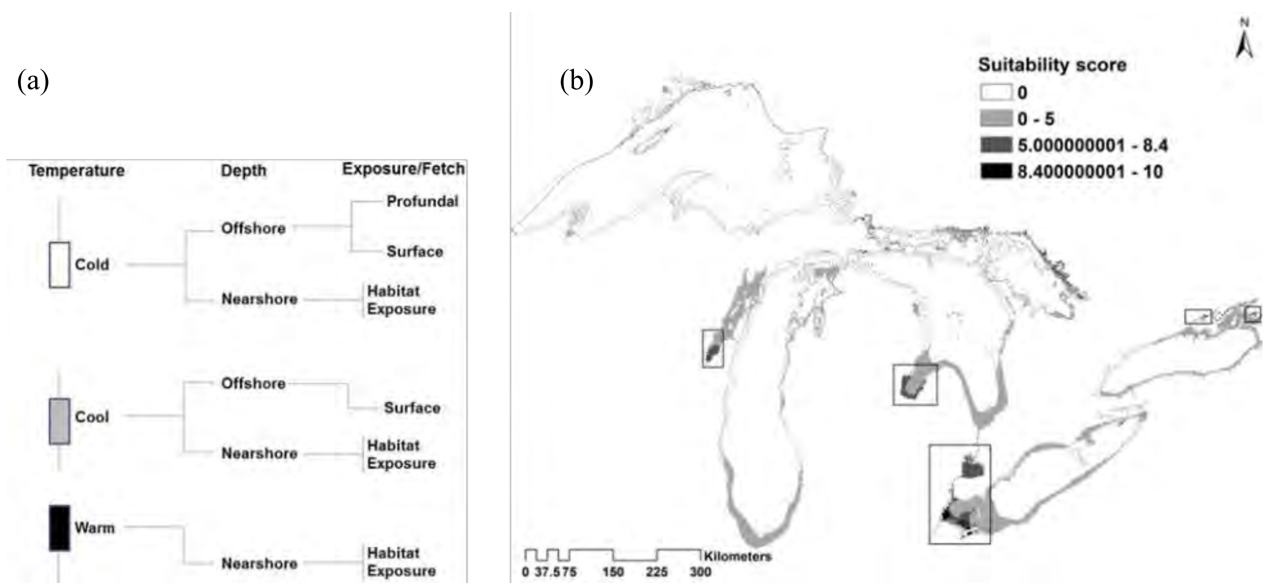

FIG. 9.6.2. a) fish species classification scheme b) results from a habitat suitability analysis in the Great Lakes for a warm-water, nearshore fish that prefers protected environments (i.e. low relative exposure). Areas with high suitability are indicated by the black boxes (Green Bay in Lake Michigan, Saginaw Bay in Lake Huron, Lake Erie west basin, and the Bay of Quinte in Lake Ontario).

Lake Ontario, Lake Huron, and Lake Michigan provide low-quality habitat in the majority of their nearshore zones, whereas Lake Superior provides little-to-no habitat for a fish species of this type (Fig. 9.6.2b). Areas of higher habitat suitability tended to be in large embayments in Lake Michigan, Lake Huron, and Lake Ontario, as well as in Lake St. Clair and the western basin of Lake Erie.

9.7 Development of New Fishway Counting Technology

N.J. Jakobi and 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 (e.g., Chinook Salmon, Coho Salmon, Rainbow Trout and Brown Trout). In addition, LOMU is working to restore Atlantic Salmon to Lake Ontario. Understanding migration timings 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 the lake proper.

In the spring of 2016, LOMU acquired the Riverwatcher Fish Counting system by VAKI (Fig. 9.7.1) to assist in identifying adult Atlantic Salmon returning to spawn in the Ganaraska River. The new counter will augment the current resistivity counter that has been traditionally used on the Ganaraska fishway (Corbett Dam, Port Hope, Ontario) for enumerating the spring Rainbow Trout spawning run (see Section 1.1.1). The Riverwatcher Fish Counting system 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 (Fig. 9.7.2). These features enable the user to identify species, sex, size and presence/absence of fin clips. The system also records water temperatures and estimates the total length of each fish from the silhouette image. The ability to identify the species of each fish passing through the Ganaraska Fishway will allow LOMU staff to determine whether any of the recently stocked Atlantic Salmon (see Section 6.1 and 8.2) have returned to spawn.

With the assistance of the Ganaraska River fishway volunteer group and OMNRF

FIG. 9.7.1. The VAKI Riverwatcher fish counter.

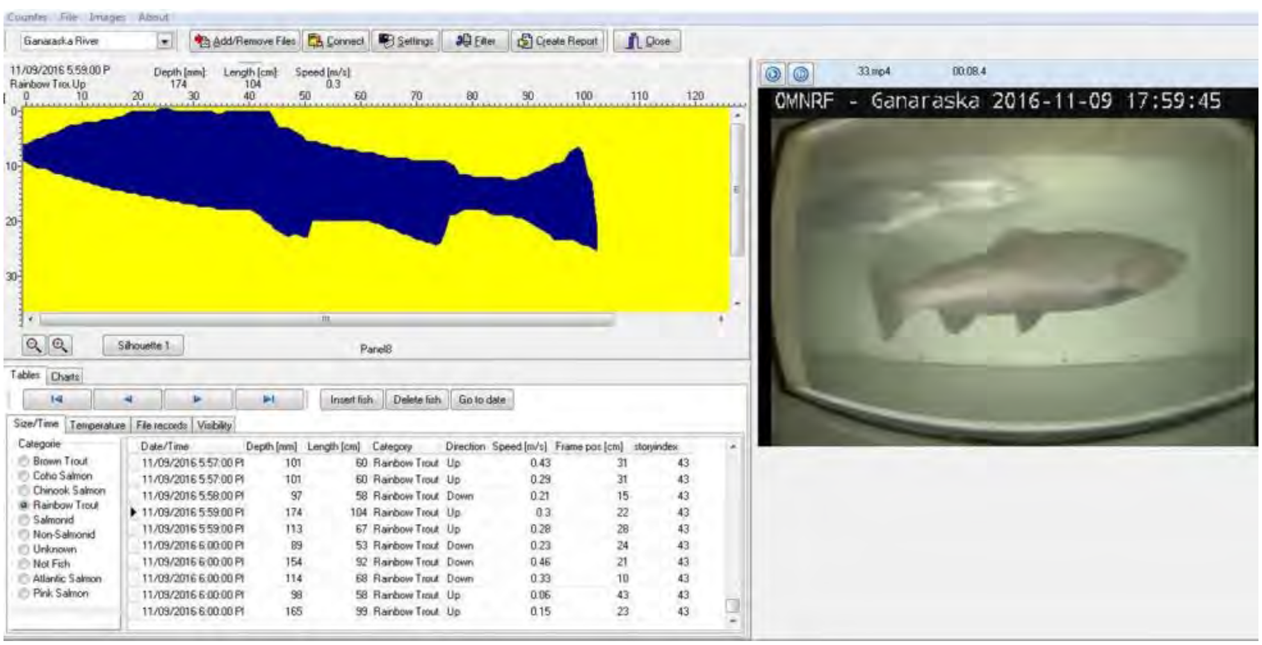

FIG. 9.7.2. Silhouette and video image collected by the Riverwatcher fish counter to assist with species identification and length.

Peterborough district staff, LOMU completed the on-site installation of the Riverwatcher in September, 2016 (Fig. 9.7.3). LOMU staff field tested the new fish counter system during the 2016 fall salmon and trout spawning run (Fig. 9.7.4). These tests showed the fish counter successfully counted fish over a wide range of sizes (estimated length range 90 to 1270 mm), allowed the user to accurately identify each passing fish to species and recorded water temperature simultaneously. Data collected by Riverwatcher in the fall of 2016 has confirmed that multiple salmon and trout species – including Chinook Salmon, Coho Salmon, Rainbow Trout, Brown Trout and Pink Salmon – utilize the Ganaraska Fishway to navigate upstream of the Corbett Dam to access spawning habitat.

The data collected by the Riverwatcher Fish Counter system will be able to determine whether adult Atlantic Salmon are returning to the tributaries to spawn and to understanding species specific run timings and patterns. In the spring of 2017, the Riverwatcher system will be calibrated to allow for comparison to the historical data series (see Section 1.1.1). The Riverwatcher system on the Ganaraska River will be fully operational by the fall of 2017. LOMU is exploring the feasibility of installing and operating the Riverwatcher Fish Counter system in the Streetsville Fishway on the Credit River, Mississauga, Ontario. The Credit River was selected as a priority river for Atlantic Salmon restoration (see Section 8.2) and the use of this fish counter technology on that river will help evaluate the success of restoration efforts.

FIG. 9.7.3. VAKI Riverwatcher fish counter and frame designed for the Ganaraska Fishway.

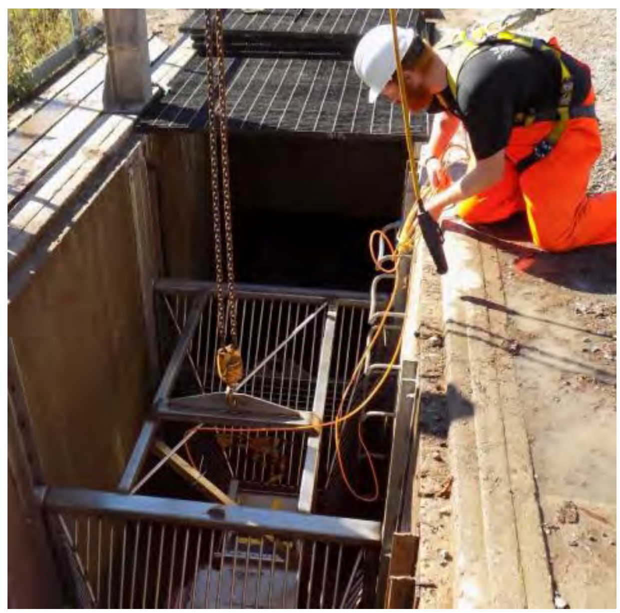

FIG. 9.7.4. VAKI Riverwatch fish counter in the Ganaraska Fishway.

10. Partnerships

10.1 Walleye Spawn Collection

J.A. Hoyle, Lake Ontario Management Unit

In April 2016 the Lake Ontario Management Unit (LOMU) worked in conjunction with MNRF's White Lake Fish Culture Station (FCS) to collect Bay of Quinte Walleye gametes. Similar projects were conducted in spring 2013-2015. In 2016, trap nets were set at six sites (Fig. 10.1.1, Table 10.1.1): Sherman's Point, Trumpour Point, three locations on the "high shore" Prince Edward County, and Indian Point. The trap nets were set beginning on April 5 in shoreline areas thought to be inhabited by Walleye that were staging to spawn. Netting took place from April 5-19. Water temperature ranged from 3.4-7.9 ^{o}C over this time period. Walleye, in spawning condition, were brought by boat to the Glenora Fisheries Station. White Lake FCS staff collected gametes from 19 Walleye families. Approximately three million eggs were collected and transferred to the White Lake FCS.

Walleye gametes collected in 2016 will be used to supply walleye fingerlings for stocking in inland lakes. The 2016 spawn collection will also provide wild gametes for restoration Walleye stocking in Hamilton Harbour.

Twenty-one species and a total of 839 fish including 78 Walleye were caught in 2016 (Table 10.1.2). Other commonly caught species included: Cisco (223), Yellow Perch (122), White Sucker (107), Northern Pike (52), Largemouth Bass (51), Black Crappie (45), Pumpkinseed (43), Bluegill (39), and Brown Bullhead (33). Catches

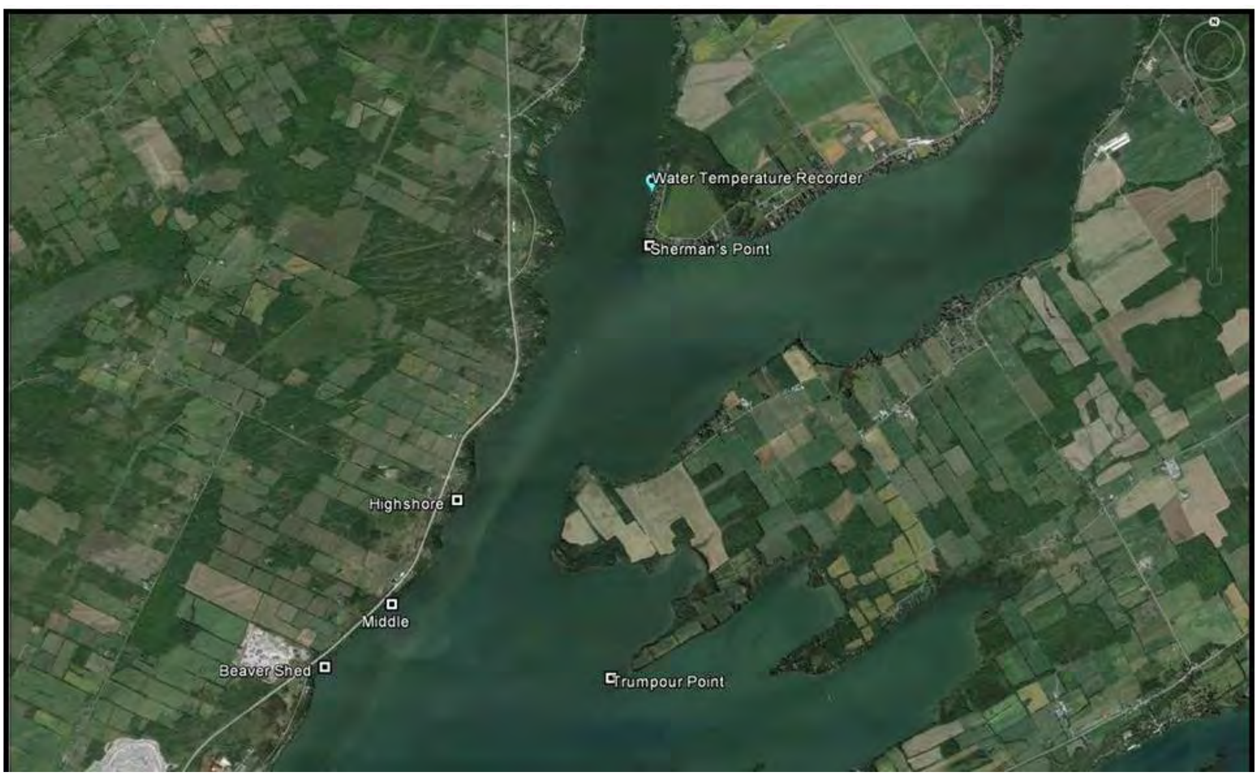

FIG. 10.1.1. Map of Bay of Quinte showing trap net locations for the 2016 Walleye spawn collection. Also shown is the location of a water temperature logger. Map courtesy of Google Earth.

TABLE 10.1.1. Location and sampling information for the Bay of Quinte Walleye egg collection program, 2016.

Attribute	Sherman's Point	Trumpour Point	Highshore: Beaver Shed	Highshore: Middle	Highshore: Highshore	Indian Point
Latitude (deg decmin)	44 06.27	44 03.96	44 04.03	44 04.37	44 04.92	44 06.87
Longitude (deg decmin)	77 04.03	77 04.33	77 06.45	77 05.95	77 05.47	76 50.96
Site depth (m)	3.0	3.2	3.2	3.2	3.0	3.5
Trap net size (ft)	8	12	6	8	6	10
First set date	08-Apr-16	05-Apr-16	05-Apr-16	15-Apr-16	08-Apr-16	18-Apr-16
Final lift date	15-Apr-16	19-Apr-16	19-Apr-16	19-Apr-16	19-Apr-16	19-Apr-16
Number of days fished	7	14	14	4	11	1
Number of lifts	3	9	8	3	6	1
Water temperature range (^{o}C)	3.4 to 4.8	3.4 to 7.9	3.6 to 7.8	6.9 to 7.8	3.4 to 7.6	6.6
Number of Walleye caught	3	28	20	4	19	4

TABLE 10.1.2. Summary of fish captured (21 species) at six locations during the Bay of Quinte Walleye egg collection program, 2016.

Species	Sherman's Point	Trumpour Point	Highshore: Beaver Shed	Highshore: Middle	Highshore: Highshore	Indian Point	Total
Longnose Gar	-	1	-	-	-	-	1
Bowfin	-	6	1	2	-	-	9
Gizard Shad	-	2	-	-	-	-	2
Rainbow Trout	-	1	2	-	2	-	5
Lake Whitefish	1	4	-	-	-	-	5
Cisco	2	199	3	-	1	18	223
Northern Pike	5	38	1	2	3	3	52
White Sucker	28	67	3	7	1	1	107
Common Carp	-	2	-	-	-	-	2
Golden Shiner	-	1	2	-	-	-	3
Brown Bullhead	-	32	-	-	-	1	33
Channel Catfish	-	1	-	-	-	-	1
Amercian Eel	-	-	1	-	-	-	1
Rock Bass	4	-	3	-	7	-	14
Pumpkinseed	-	34	4	-	5	-	43
Bluegill	2	26	2	3	6	-	39
Largemouth Bass	-	42	1	8	-	-	51
Black Crappie	3	39	-	3	-	-	45
Yellow Perch	45	59	6	8	4	-	122
Walleye	3	28	20	4	19	4	78
Freshwater Drum	-	-	1	-	1	1	3
Total	93	582	50	37	49	28	839

in 2016 are compared with those in 2014 and 2015 in Table 10.1.3. A total of 23 species was caught in the last three years.

The size distribution of 94 Walleye measured for fork length is shown in Fig. 10.1.2. Walleye sex (male, female, immature) and state of maturity information is shown in Table 10.1.4.

Water temperature was recorded continuously at a Long Reach shoreline site near Sherman's Point (Fig. 10.1.1). Water temperature increased to about 6 °C in late March then declined and remained lower for a period of time before increasing again after mid-April (Fig. 10.1.3).

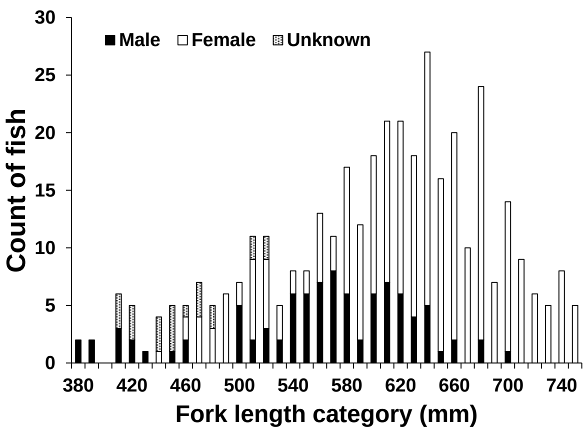

FIG. 10.1.2. Size distribution of (10 mm fork length categories) of 94 Walleye caught and measured during the egg collection program, April 2016. Totals: 41 males, 41 females and 12 unknown sex.

TABLE 10.1.4. Sex and gonad classification (based on external characteristics) for 94 Walleye caught and sampled during the 2016 Walleye egg collection program.

Gonad condition	Sex Male	Female	Unknown	Total
Immature		1		1
Green	6	9		15
Ripe	35	26		61
Spent		5		5
Unknown			12	12
Total	41	41	12	94

TABLE 10.1.3. Summary of fish captured (23 species) during the Walleye egg collection program , April 2014, 2015 and 2016.

Species	2014	2015	2016
Longnose Gar	6	-	1
Bowfin	8	4	9
Gizzard Shad	-	-	2
Rainbow Trout	1	2	5
Lake Whitefish	24	14	5
Lake Herring	36	26	223
Northern Pike	26	52	52
White Sucker	183	53	107
Common Carp	-	-	2
Golden Shiner	-	-	3
Brown Bullhead	22	29	33
Channel Catfish	19	2	1
American Eel	1	1	1
White Perch	48	-	-
Rock Bass	7	17	14
Pumpkinseed	3	2	43
Bluegill	-	1	39
Smallmouth Bass	-	2	-
Largemouth Bass	6	2	51
Black Crappie	8	70	45
Yellow Perch	93	4	122
Walleye	601	464	78
Freshwater Drum	35	21	3
Total catch	1,127	766	839

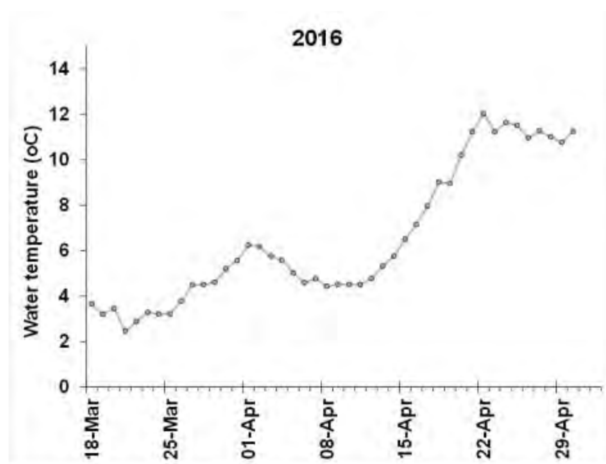

FIG. 10.1.3. Mean daily water temperature (recorded at 1 hour intervals) at 1 m depth, east side of Long Reach near Sherman's Point, March 18-April 30, 2016.

10.2 Observations of Aquatic Invasive Species in Lake Ontario

M. Hanley, Lake Ontario Management Unit

The Lake Ontario Management Unit continues to monitor both Lake Ontario and the Bay of Quinte for invading aquatic species. In 2016, eDNA sampling was completed as a means to monitor the area for Asian Carp. In addition a report of a Tench (*Tinca tinca*) was received from the St. Lawrence River.

Continued monitoring of Lake Ontario for Asian Carp through eDNA sampling

Asian carps are a collection of carp native to China and Southern Russia which includes Grass, Bighead, Silver, and Black Carp. Asian carps were introduced in the United States in the 1960s and 1970s in an effort to control algae and zooplankton in aquaculture ponds. They have since become established in the Mississippi River Basin and throughout the eastern United States. In parts of the Mississippi River, they have been successful in replacing native species. There is concern that these species may become established in the Great Lakes due to their affinity for cool to moderate water temperatures. The nearshore Great Lakes region is similar to their native range and has been identified as suitable Asian carp habitat through risk assessment.

Asian carp pose a threat to the Great Lakes due to their large size, their high fecundity, and their ability to consume large amounts of aquatic plants, algae, and plankton. These factors have led to concerns for the impacts of Asian carp on native species in Lake Ontario. Asian carps weight two to four kg but can weigh up to 40 kg and grow to more than a metre in length They are able to grow more than 25 cm in their first year alone. Asian carp are able to eat 20% of their body weight in plankton each day and reproduce very rapidly. For these reasons, there is concern that Asian carps could compete with native fish species in Lake Ontario if they were to become established. Bighead and Silver carp consume zooplankton and phytoplankton respectively while Grass carp eat aquatic plants and Black carp eat freshwater snails and mussels. Grass carp are able to eliminate large areas of aquatic plants that are important as fish food and as spawning and nursery habitats. Black carp could reduce the abundance of native snails and mussels as well as other invertebrates. Bighead and Silver carp could consume large amounts of the plankton biomass available as food for native fish species. All Asian carps can also compete directly with native fish for space and habitat.

Fisheries and Oceans Canada (DFO), under its Asian Carp Program, conducts early detection surveillance activities to detect Asian carps in the Canadian waters of the Great Lakes basin as soon as possible after potential arrival and before a population could establish. A co-ordinated response system to evaluate any observations of Asian carp has also been established between DFO and MNRF. Conservation Authorities have also participated in these response activities. All these agencies conduct fisheries assessment and sampling activities in Lake Ontario. This type of lake-wide assessment, along with commercial fishers, also contribute to our ability to detect this invasive species.

Although eight Grass Carp were captured in Lake Ontario in 2015, in 2016 no Asian carp were detected through netting methods completed by DFO in the Canadian Waters of Lake Ontario. In addition to the Asian carp targeted netting efforts of DFO and OMNRF electrofishing and netting methods, OMNRF monitors Lake Ontario and the Bay of Quinte for Asian carps using environmental DNA (eDNA). eDNA sampling detects DNA shed from fish species and uses various genetic markers to identify which fish species left behind the DNA sample. In this monitoring program, the water samples collected in each area are assessed for the presence of the genetic markers of each of the four species of Asian carps listed above. In aquatic environments, eDNA is diluted and distributed by currents and other hydrological processes, lasting about 7–21 days, depending on environmental conditions. LOMU staff collected water samples during the weeks of August 29 to September 2 and September 5 to September 9, 2016 following MNRF's eDNA monitoring and surveillance standard operating procedures (Wilson et al., 2014). During these two weeks, 17 sites were sampled; locations within West Lake, East Lake, Presqu'ile Bay, Weller's Bay, Trenton, Salmon River, Muscote Bay, and Marysville Creek were all surveyed (FIG. 10.2.1). The number of locations where a water sample was collected within each site is outlined in TABLE 10.2.1. Water samples were filtered at OMNRF Aquatic Research and Monitoring Section Genetics Laboratory or at the Lake Ontario Management Unit. No genetic markers from any of the four species of Asian carps were detected at any of the sampled sites.

Wilson, C., J. Bronnenhuber, M.Boothroyd, C.Smith, and K. Wozney. 2014. Environmental DNA
(eDNA) monitoring and surveillance: field and laboratory standard operating procedures. OMNRF Aquatic Research Series 2014-05.

FIG. 10.2.1. Locations of Asian Carp eDNA sampling in 2016.

TABE 10.2.1. The number of locations within a site where water samples were collected, and the location of filtering.

Site	Number of locations sampled within the site	Location of filtering
West Lake	3	ARMS
East Lake	3	ARMS
Presqu'ile Bay	3	LOMU
Weller's Bay	2	LOMU
Trenton	3	LOMU
Salmon River	1	LOMU
Muscote Bay	1	LOMU
Marysville Creek	1	LOMU

Capture of Tench in the St. Lawrence River

On September 23, 2016, the Lake Ontario Management Unit (LOMU) received a report of a possible Tench (*Tinca tinca*), an invasive fish, that was caught in Lake St. Francis near Bainsville, Ontario by a commercial fisher (FIG. 10.2.2). Using a photograph, the fish was identified as a Tench by MNRF (FIG. 10.2.3). The identity was confirmed by a professor at the University of Toronto that is conducting research on Tench. The fish was frozen and shipped to LOMU for further identification and biological sampling and the stomach will be given to McGill University for further study. The Tench was male, 395 mm long and weighed 1,111 g.

Tench are a member of the Cyprinidae (carps and minnows) family and are usually 20-25 cm long and can reach a maximum size of 70 cm. They are dark olive to pale golden tan with a white to bronze belly and reddish-orange eyes. Their fins are dark and rounded with no bony spines and the scales are small and embedded in thick skin. The mouth is narrow and there is a small barbel at each corner. Male Tench are easily identifiable by a thick, fleshy, and flattened second ray on their pelvic fins where females do not possess a thickened second ray.

Tench are native to Europe and Western Asia. To date, a wild population of Tench is not known to occur in any Ontario waters. A population of Tench was found in an isolated farm pond near Orangeville, Ontario in 2014. This population was eradicated through actions taken by MNRF and the landowner in fall 2014 and spring 2015. Monitoring activities in the pond and adjacent streams have continued in 2016 to ensure that the project was a success. In Canada the fish is found only in the Columbia watershed in British Columbia and the Richelieu River in Quebec. It is well established in the United States, particularly in the Mississippi River watershed. The

FIG. 10.2.2. Location of the Trap net in Lake St. Francis that captured the Tench.

FIG. 10.2.3. Photograph of the Tench that was captured in Lake St. Francis by a commercial fisherman in 2016.

population in Quebec is believed to be the result of an illegal fish stocking event in the mid-1980's whereby the fish escaped into the Richelieu River. Tench have expanded their range in the area of the St. Lawrence River around Montreal. The province of Quebec has discovered Tench in baitfish buckets alongside other fish species. Tench are a competitor with native minnows, bullheads and suckers for food. By consuming large quantities of aquatic snails which feed on algae, Tench may contribute to nuisance algal blooms. They are known to increase turbidity through their foraging activities, similar to Common Carp, when populations are high.

Along with the 46 nets used by the commercial fisher who captured the Tench, LOMU community index netting in the Lake St. Francis area using 36 gill net sets and did not detect any Tench. Crews electrofished the area during the week of September 26, 2016 in response to this report and found no Tench. The St. Lawrence River Institute of Environmental Studies has been conducting a minnow survey to evaluate fish community health in Lake St. Francis for the last year. Information sheets and signs have been prepared by the OMNRF and OFAH in order to provide Tench identification characteristics to commercial bait harvesters and anglers so as to avoid dispersal through baitfish buckets. In order to increase monitoring efforts in the future, MNRF Aquatic Research and Monitoring Section and Natural Heritage Section are collaborating to develop techniques to test for the eDNA of Tench.

11. Environmental Indicators

11.1 Water Temperature

J.P. Holden and J.A. Hoyle, Lake Ontario Management Unit

Winter Severity Index

Winter severity is often correlated with year-class strength in temperate fish species. A long-term (1944-2016) winter severity index is present in Fig. 11.1.1. The winter of 2016 was much less severe than the long term average. Thirteen of the last 20 years have been less severe than the long term average.

Mid-summer Water Temperature

Summer water temperatures can impact fish distribution and influence growth and survival of young of the year fish.

Bay of Quinte

A long-term (1944-2016) mid-summer water temperature index is presented in Fig. 11.1.2. Water temperature in the summer of 2016 was well above the long term average. Sixteen of last twenty 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 northeast of Rochester, NY, 43.621 N 77.406 W) . Mean summer water temperatures in 2016 returned to above average for the time series (2002 to 2016) following two cold summers in 2014 and 2015. 2016 is the third highest mean summer temperature behind 2012 and 2005 (Fig. 1.11.3).

Coldwater Habitat

Native coldwater species such as Lake Trout, Lake Whitefish and Lake Herring (Cisco) depend on access to suitable temperatures. Temperature profiles are collected at each Fish Community Index Gill Net and Trawl site (Section 1.2 and 1.3). Gill net site EB06 is an

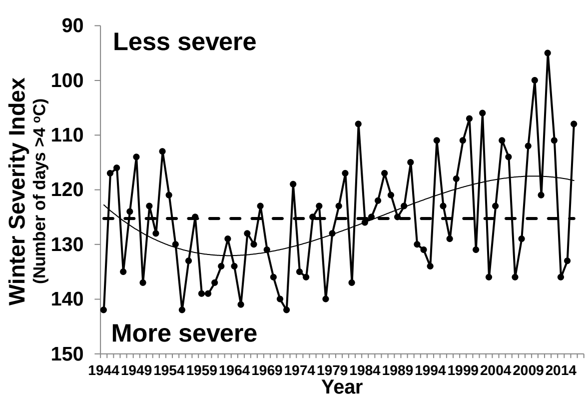

FIG. 11.1.1. Winter severity index, 1944-2016. Winter severity is measured as the number of days in December through April with a mean water temperature less than 4°C. By way of example, the 2016 data point includes the mean daily surface water temperature from Dec 1, 2015 to April 30, 2016. The long-term average index is depicted with a dashed line, and a third order polynomial fit to the data is shown as a thin solid line. Mean daily surface water temperature data was obtained from the Belleville (Bay of Quinte) Water Treatment Facility.

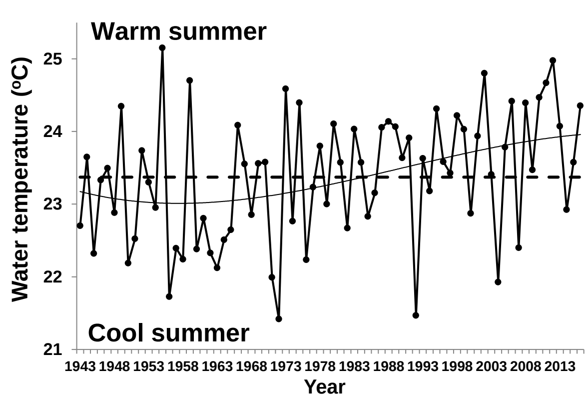

FIG. 11.1.2. Mean mid-summer water temperature (July and August; mean of 62 days) at the Belleville Water Treatment Facility, 1943-2016. The long-term average index is depicted with a dashed line, and a third order polynomial fit to the data is shown as a thin solid line. Mean daily surface water temperature data was obtained from the Belleville (Bay of Quinte) Water Treatment Facility.

offshore site in the Kingston Basin (for a map, see map 1.2.1) that can provide a representative index of available thermal habitat in summer months within the Kingston Basin through time. Profiles collected in July and September at EB06 (Fig. 11.1.4) show the seasonal warming (warmer water deeper) of the Kingston Basin but do not capture the daily variability influenced by thermal mixing due to wind events. The water depth at which water temperature are below 15°C provides an index of the amount of coldwater habitat available among years. A shallower depth of 15 °C would indicate more coldwater habitat available. The index shows a range of annual variability within the Kingston Basin (Fig. 11.1.5) with recent years have more coldwater habitat (shallower 15°C depth) than the period between

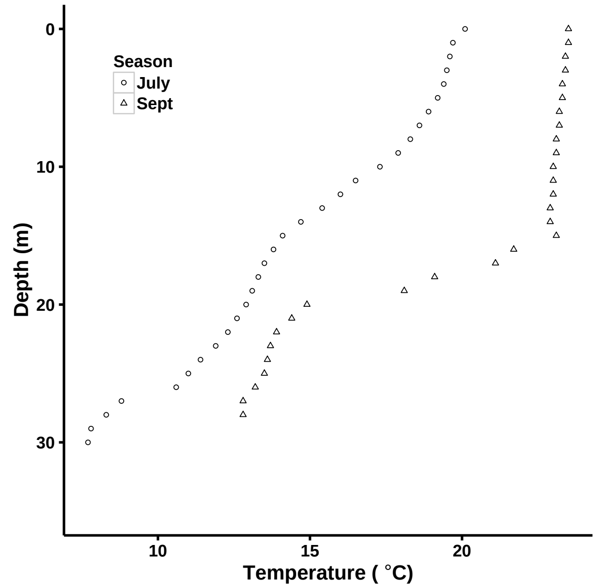

FIG. 11.1.4. Temperature profiles collected in July and August at Fish Community Index Gill Net (Section 1.2) site EB06.

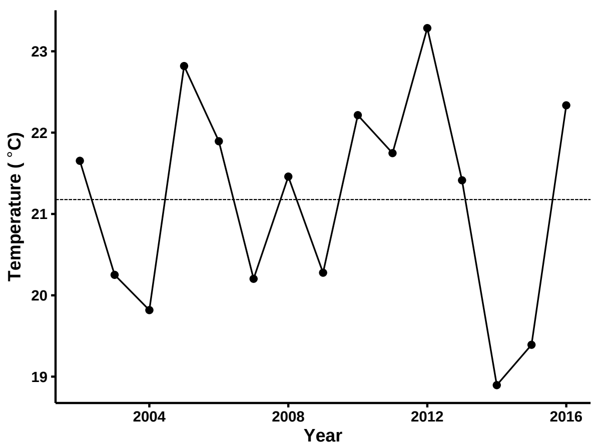

FIG. 11.1.3. Mean annual water temperatures in July and August collected at the National Oceanic and Atmospheric Administration's Station 45012 (East Lake Ontario – 20 nautical miles north of Rochester, NY). Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

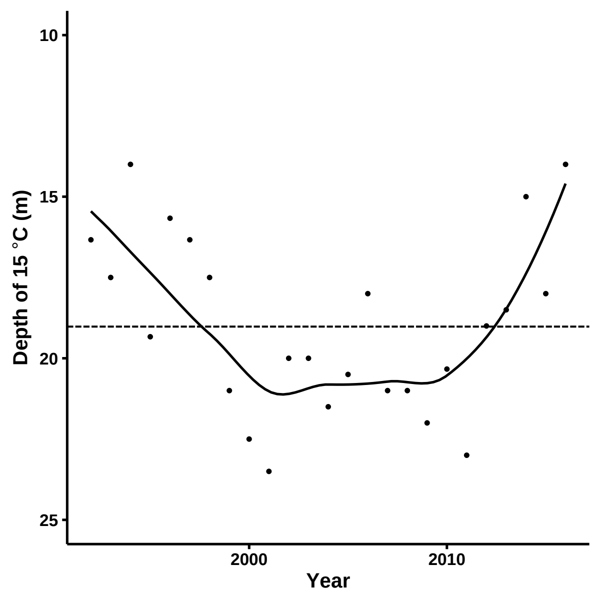

FIG. 11.1.5. Index of coldwater habitat in the Kingston Basin determined by July and August temperature profiles collected at Fish Community Index Gill Net (Section 1.2) site EB06. The solid line is the trend through time (loess fit) and the dotted line is the average depth of 15°C throughout the time-series (1992-2016).

11.2 Wind

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

National Oceanic and Atmospheric Administration (NOAA) records multiple weather variables using a variety of weather buoys deployed throughout Lake Ontario. Buoy data are available through the National Data Buoy Center webpage hosted by NOAA (http://www.ndbc.noaa.gov/). The Rochester weather buoy (Station 45012, East Lake Ontario, 20 nautical miles north northeast of Rochester, NY, 43.621 N 77.406 W) records several environmental variables, including wind direction and velocity (m·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 – 2016 (Fig. 11.2.1). 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 since 2007, the years 2010, 2011 and 2014 had higher than average small craft warnings (Fig. 11.2.1a). The number of small craft warning hours increased from 2015 to 2016, but the total number of hours in July and August remained below the long-term average (Fig. 11.2.1a). A second index, the East Wind Index, was calculated to determine the total number of hours between July 1st and August 31st, each year, that an eastern wind predominated (Fig. 11.2.1b). This index shows that 2016 had the highest incidences of east winds since 2007; well above the long-term average (Fig. 11.2.2).

Lastly, wind direction and velocity have been summarized for the months of July and August from 2014 – 2016 (Fig. 11.2.2). These analyses show the seasonal and annual variability in wind patterns on Lake Ontario. While, southwestern winds generally predominate through July and August (Fig. 11.2.2), the variability that exists may impact the Lake Ontario ecosystem as well as the recreational fishery.

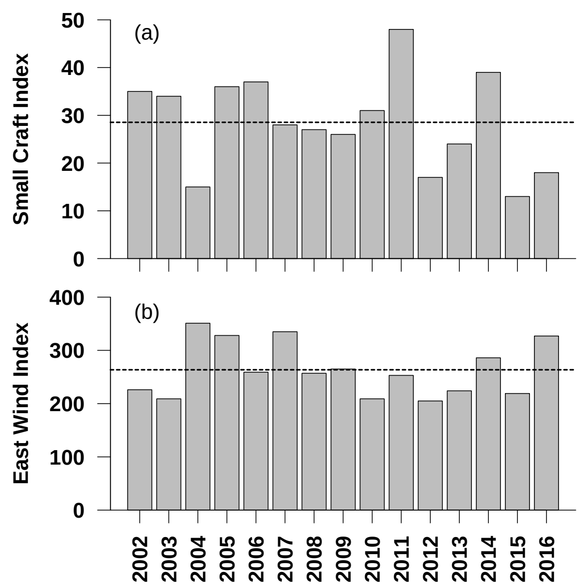

FIG. 11.2.1. : Lake Ontario wind as characterized by the Small Craft Index (a) and East Wind Index (b). The Small Craft Index represents the total number of hours from July 1 to August 31 each year where the wind velocity was ≥ 20 knots. The East Wind Index represents the number of hours from July 1st to August 31st each year that an eastern wind predominated. Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

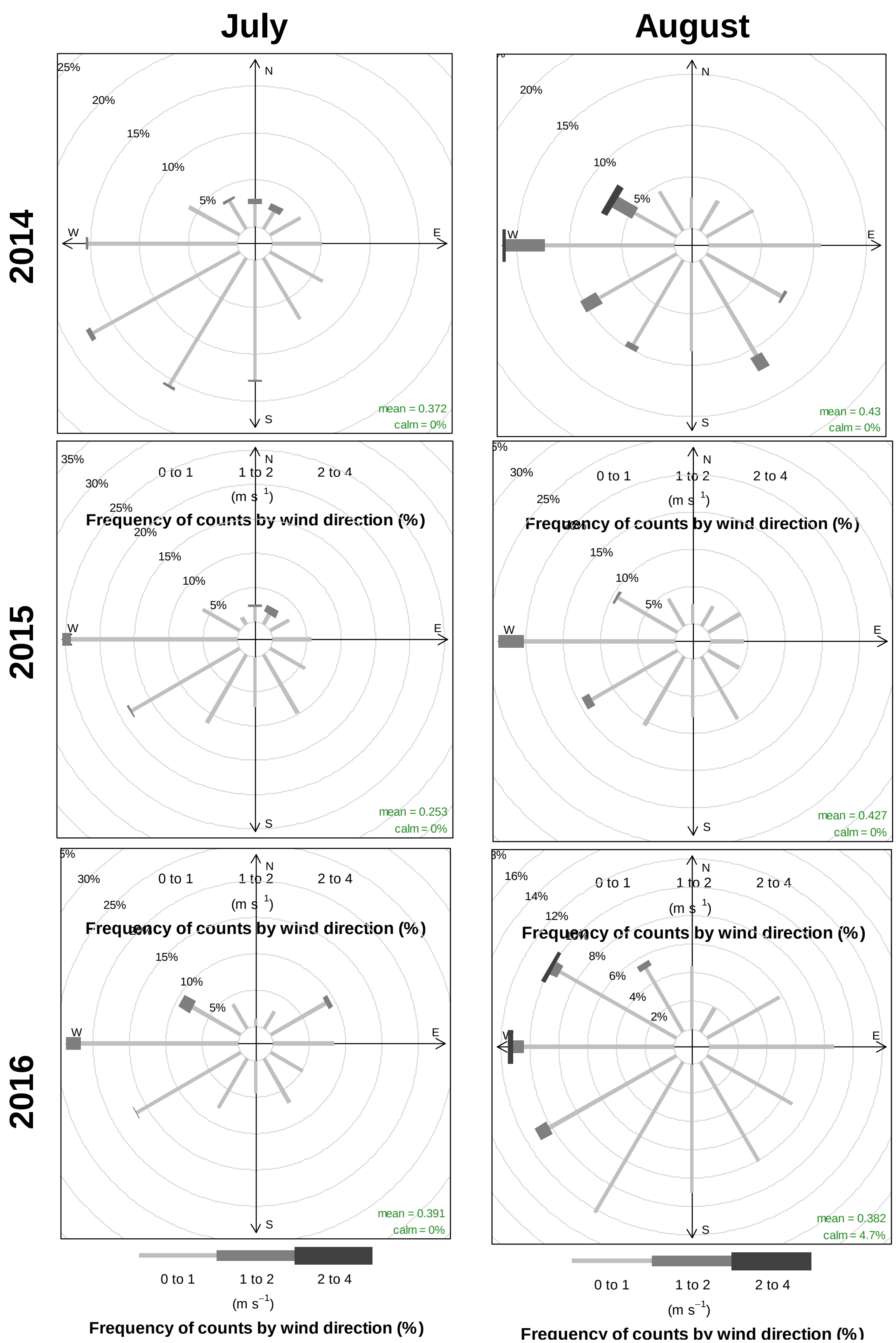

FIG. 11.2.2. Wind direction and velocity represented as a proportional frequency of occurrence for July and August in 2014 – 2016. Wind velocities of 0 – 1 knots are light grey, 1 – 2 knots are medium grey and > 2 knots are dark grey. Data provided by National Data Buoy Center, NOAA (http://www.ndbc.noaa.gov/).

11.3 Water Clarity

J.P. Holden, Lake Ontario Management Unit

Summer Water Transparency

Water clarity is measured using a Secchi disk at each Fish Community Index Gill Netting site. The maximum depth the Secchi disk can be observed is an index of water clarity. Mean annual water clarity varies between the Bay of Quinte, Kingston Basin and the eastern portion of Lake Ontario (measured at Rocky Point gill net sites). Bay of Quinte Secchi depths are generally lower (less clear) than main lake sites and have been stable since the early 2000s. Mean Secchi depth in the Bay of Quinte was deeper in 2016 (2.1 m) compared to 2015 (1.5 m) but within the expected range for the time series. Kingston Basin and Rocky Point had a mean Secchi depth shallower in 2016 (KB = 7.0 m, RP = 7.6) than in 2015 (KB=8.1 m, RP = 9.8 m). The 2016 values are more consistent with the long term trend compared to the low values observed in 2014 and 2015.

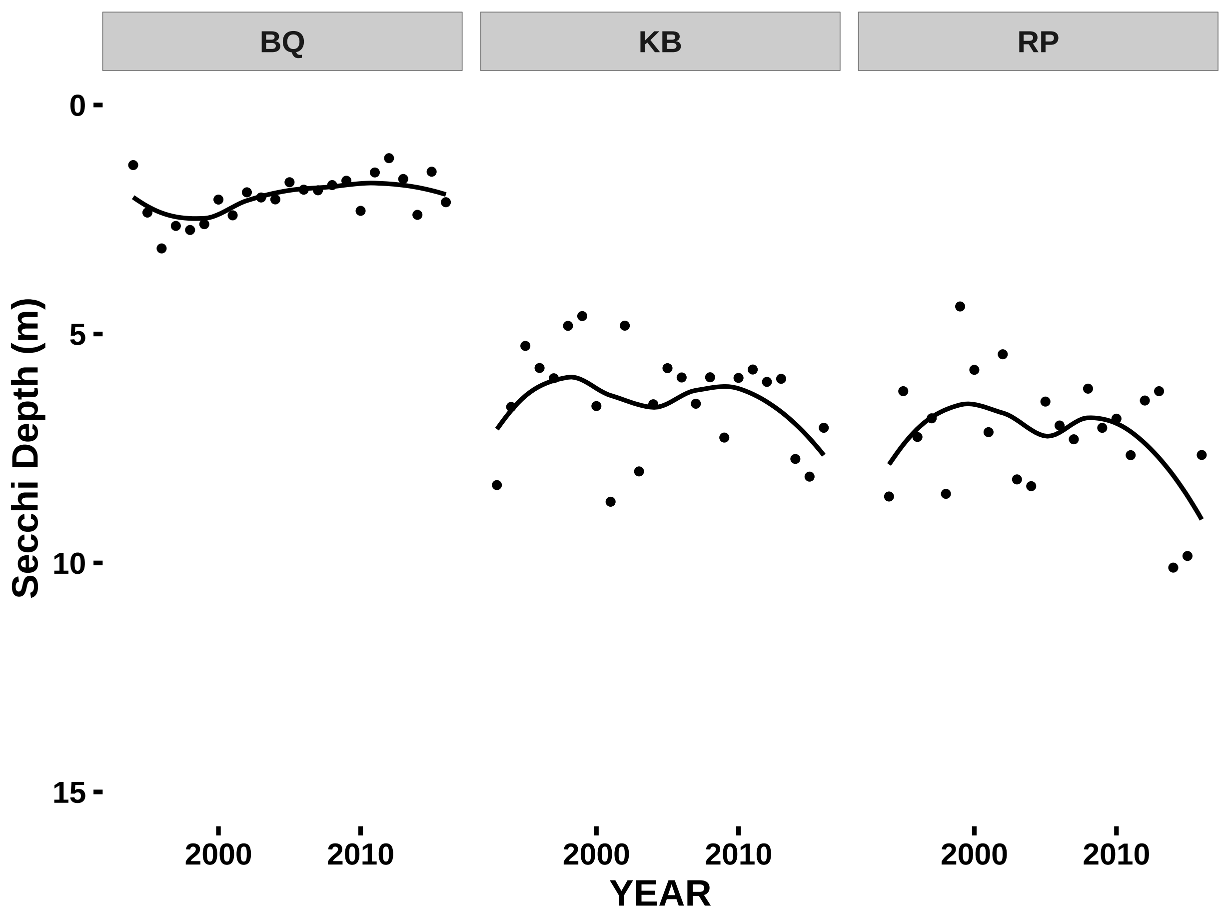

FIG. 11.3.1. Mean annual water clarity determined by Secchi disk readings collected at Fish Community Index Gill Net sites in June, July and August.

11.4 Tributary Water Flow

T. Peat, Lake Ontario Management Unit

Stream flow is defined as the rate at which a specific volume of water travels through a specific point in a stream. Stream flow is typically influenced by a number of different natural (e.g., runoff from rain and snow melt, ground-water discharge, sedimentation, etc.) and human-induced factors (e.g., river flow restrictions, water withdrawals, construction, land use changes, etc.), which cause many rivers to exhibit unpredictable and large variations in flow dynamics throughout a given year. The Water Survey of Canada (WSC) operates in partnership with the provincial governments, territories, and other agencies, to provide standardized hydrometric data on stream flow for over 2,800 active hydrometric gauges across Canada. Data from these hydrometric gauges are available online through the Water office webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html). For the purposes of this report, we used discharge data (m3/s) from the following stations: Streetsville Dam, Credit River, Mississauga; Ganaraska River above Dale, Port Hope; Moira River, Foxboro; Salmon River, Shannonville Ontario (see Table 11.4.1).

Migratory salmon and trout (e.g., Chinook Salmon and Rainbow Trout) utilize Lake Ontario tributaries to spawn and for critical nursery habitat. Spawning runs of these migratory fish are affected by changes in tributary discharge. Consequently, information on the flow regimes of major Lake Ontario tributaries is necessary to provide better insight as to when spawning runs of these migratory fish species occur. Here, we examined daily flow data and the central flow timing (i.e., the date at which half the annual discharge has been exceeded), to compare annual stream flow to historical averages.

The average annual discharge (7.11 $m^3 \cdot s^{-1}$) for the Credit River at Streetsville Dam in 2016 was well below the time-series average (Fig. 11.4.1). The central flow Julian day date in 2016 was 105 indicating that flows occurred early relative to the 10-year average (134). During 2016, spring flow was high during the middle of March at the Streetsville Dam and later peaked at the end of March and early April (Fig. 11.4.2). The fall flow regime in 2016 at the Streetsville Dam was lower and less variable than that observed in 2014 and 2015 (Fig. 11.4.2) with very little flow occurring for much of the season except slight peaks occurring during early September and early November.

The average annual discharge (3.05 $m^3 \cdot s^{-1}$) for the Ganaraska River above Dale in 2016 was below the time-series average (Fig. 11.4.3). The central flow Julian day date in 2016 was 117 indicating that flows occurred early relative to the 10-year average (135). During 2016, spring flow was lower and less variable than previous years with increased flows occurring at the start of April (Fig. 11.4.4). The fall flow regime in 2016 for the Ganaraska River was lower than that observed in 2014 and 2015 (Fig. 11.4.4) with very little flow occurring for the majority of the season.

TABLE 11.4.1. Geographic information of four Lake Ontario tributaries used in the stream flow analysis including river name, station ID, latitude and longitudes (Degrees Decimal Minutes), and the gross drainage area (km^2) for each tributary.

River	Station ID	Latitude	Longitude	Gross Drainage Area (km^2)
Credit	02HB029	44°34.933 N	79°42.517 W	774.24
Ganaraska	02HD012	43°59.450 N	78°16.683 W	241.87
Moira	02HL001	44°15.217 N	77°25.117 W	2594.93
Salmon	02HM003	44°12.433 N	77 °12.550 W	906.73

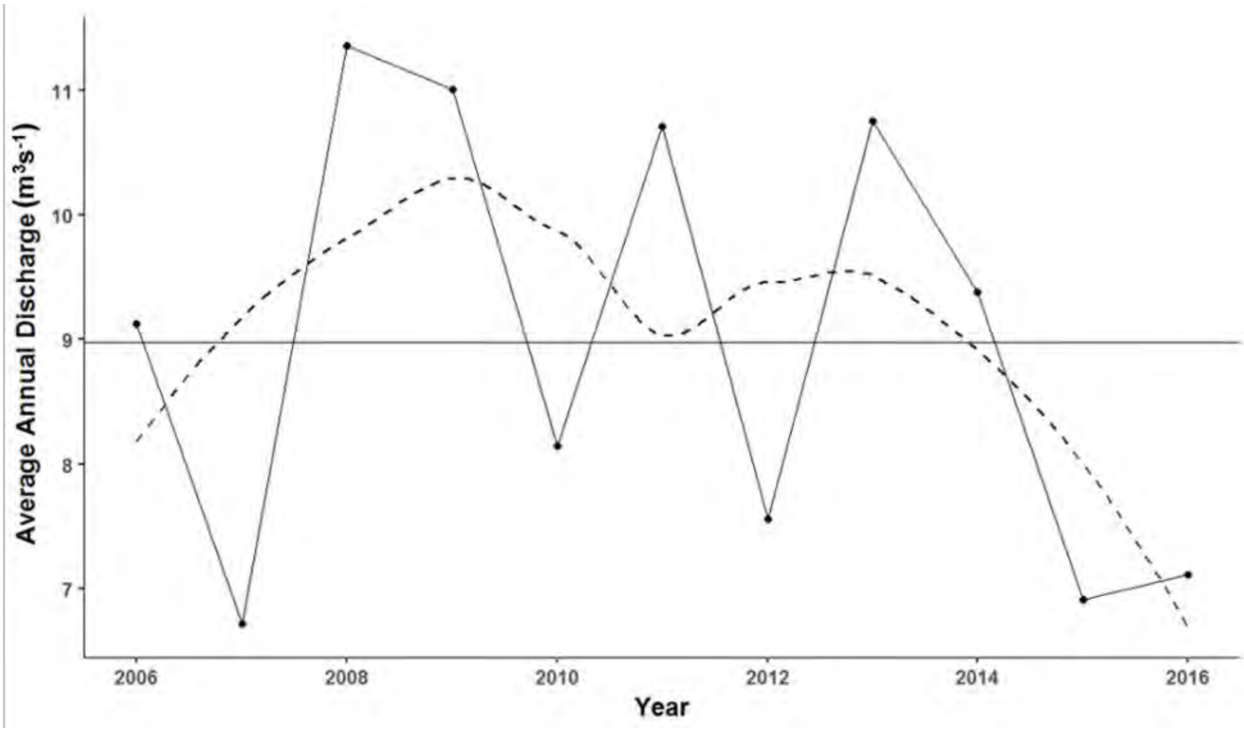

FIG. 11.4.1. Average annual discharge ($m^3 \cdot s^{-1}$) for the Credit River, Streetsville Dam, Ontario from 2006 to 2016. The horizontal line represents the historical average discharge. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

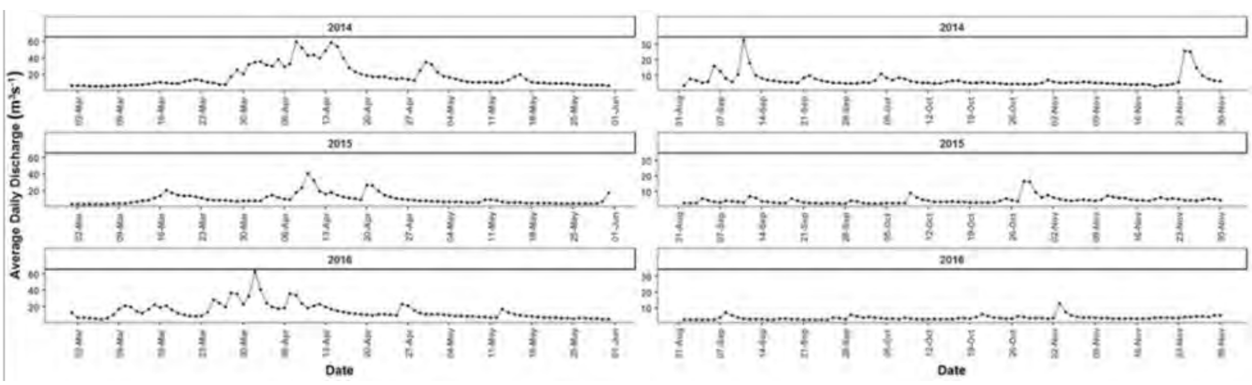

FIG. 11.4.2. Spring (left panel) and fall (right panel) discharge for the Credit River, Streetsville Dam, Ontario from 2014 to 2016. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

The average annual discharge (26.68 $m^3 \cdot s^{-1}$) for the Moira River near Foxboro, Ontario in 2016 was below the time series average (Fig. 11.4.5). The central flow Julian day date in 2016 was 83 indicating that flows occurred early relative to the 10-year average (106). High spring flow occurred earlier on in the season when compared to previous years (early March) and remained high until late April (Fig. 11.4.6). Similar to all the other tributaries we examined, fall flows were virtually absent for the entire fall season (Fig. 11.4.6).

Lastly, the average annual discharge (9.80 $m^3 \cdot s^{-1}$) for the Salmon River at Shannonville, Ontario in 2016 was well below the time series average (Fig. 11.4.7). The central flow Julian day date in 2016 was 79 indicating that flows occurred early relative to the 10-year average (106). High spring flow occurred earlier on in the season when compared to previous years and was highest during the start of April 2016 (Fig. 11.4.8). Unlike previous years, fall flows remained low with little to no flow occurring throughout the entire season (Fig. 11.4.8).

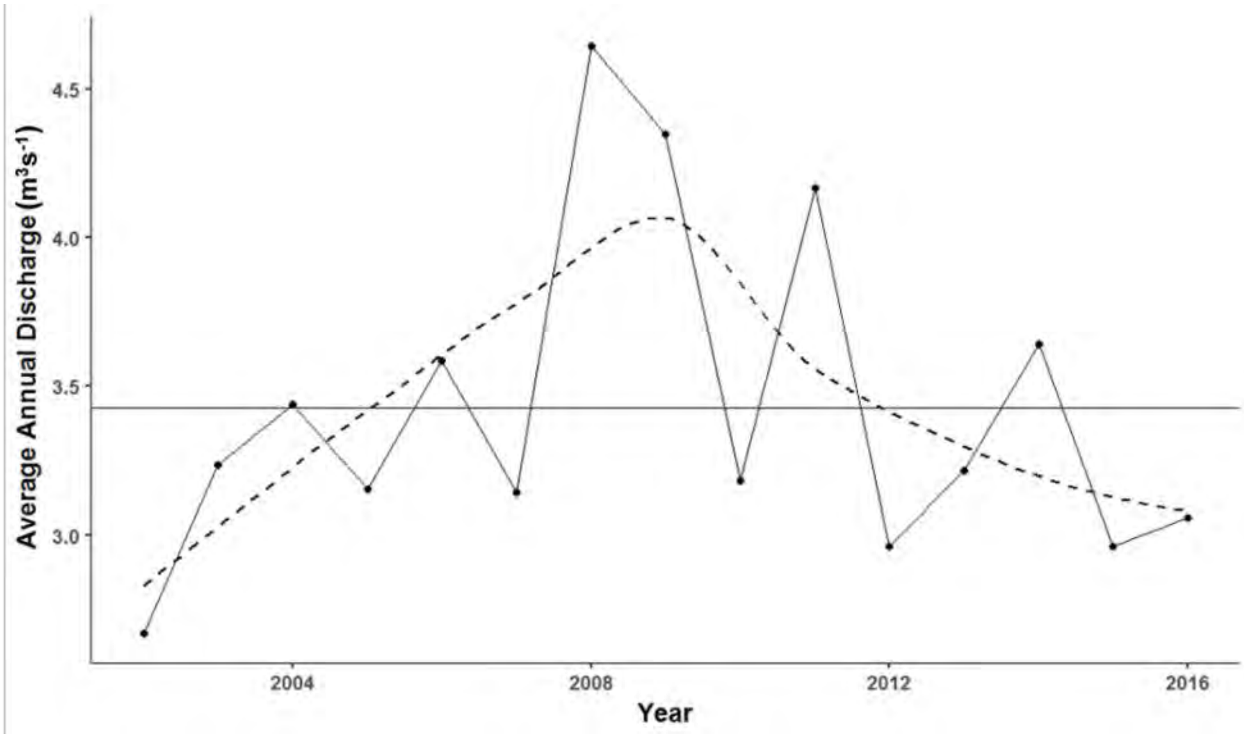

FIG. 11.4.3. Average annual discharge ($m^3 \cdot s^{-1}$) for the Ganaraska River, Dale, Ontario from 2003 to 2016. The horizontal line represents the historical average discharge. Data is available online through the Wateroffice webpage hosted by Environment Canada (http:// wateroffice.ec.gc.ca/index_e.html).

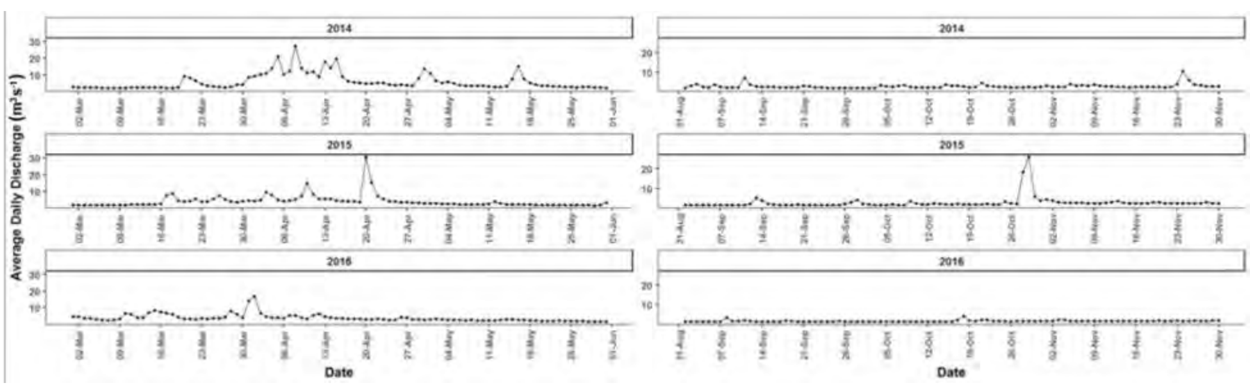

FIG. 11.4.4. Spring (left panel) and fall (right panel) discharge for the Ganaraska River, Dale, Ontario from 2014 to 2016. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

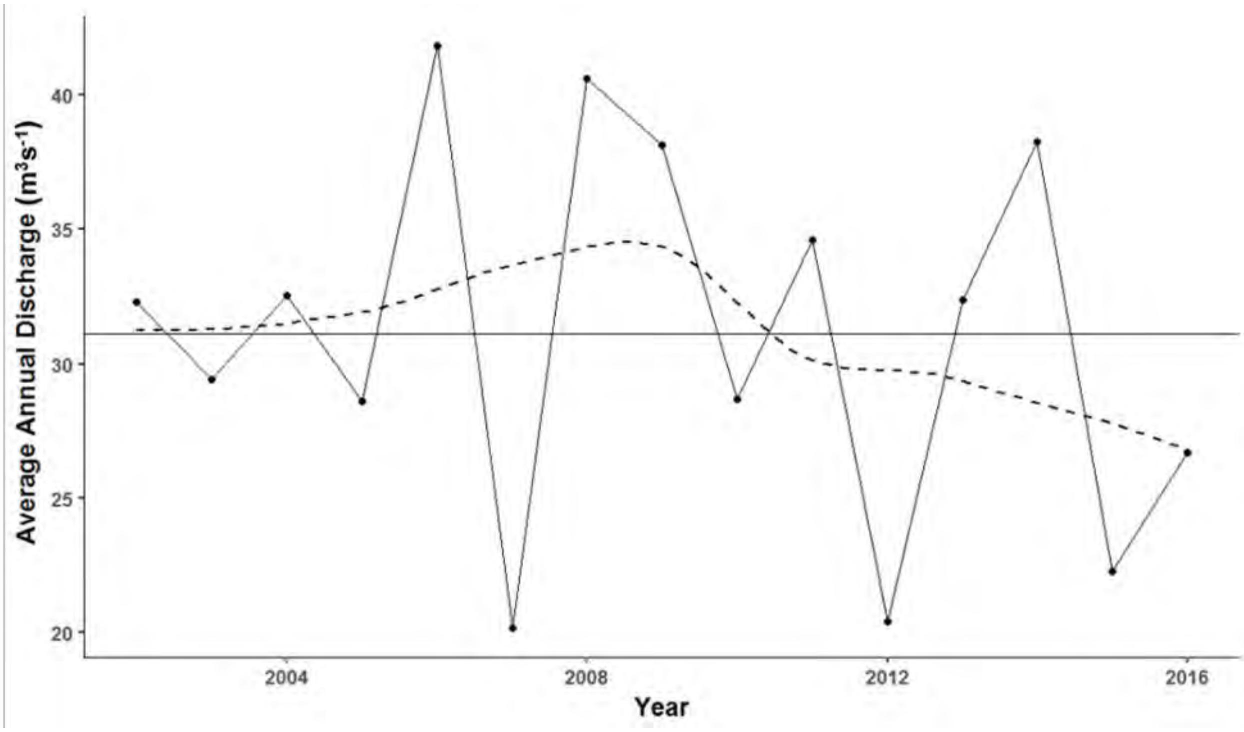

FIG. 11.4.5. Average annual flow ($m^3 \cdot s^{-1}$) for the Moira River, Foxboro, Ontario from 2003 to 2016. The horizontal line represents the historical average discharge. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

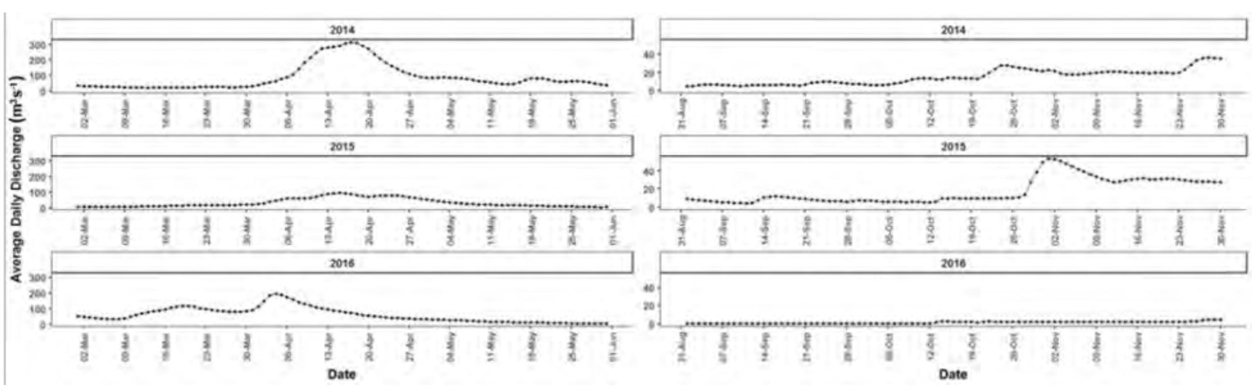

FIG. 11.4.6. Spring (left panel) and fall (right panel) discharge for the Moira River, Foxboro, Ontario from 2014 to 2016. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

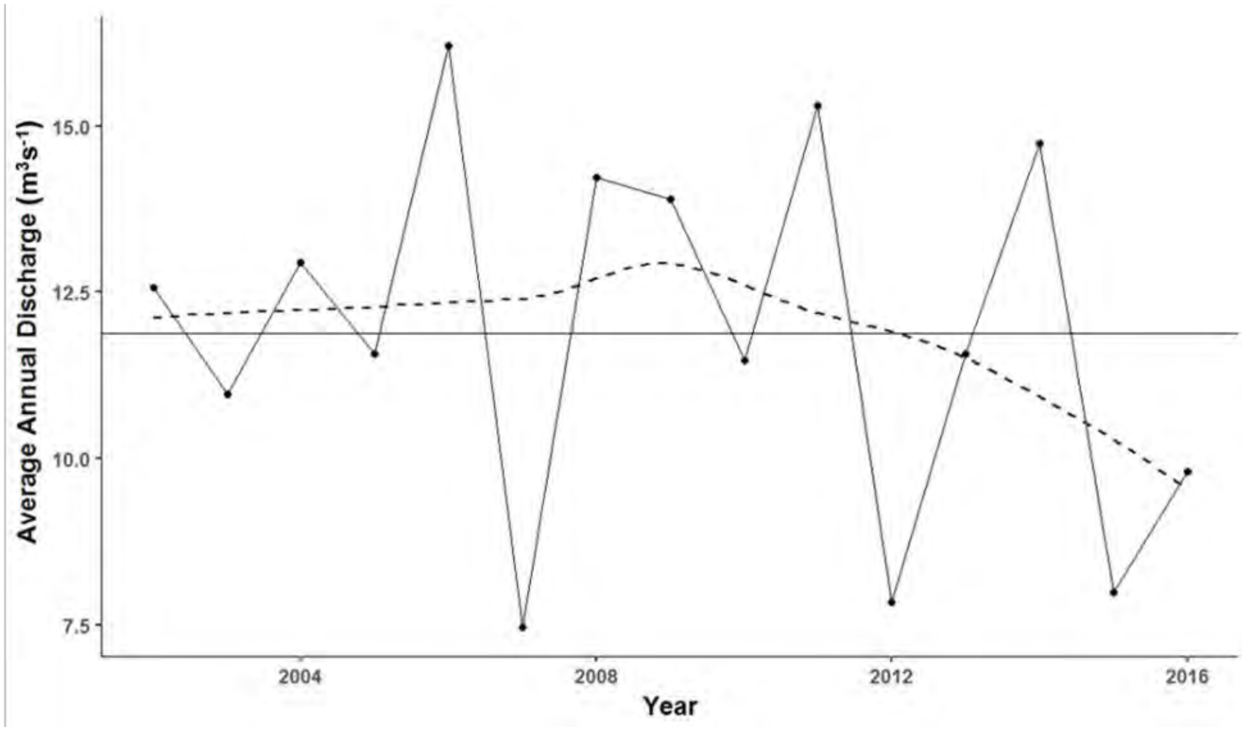

FIG. 11.4.7. Average annual flow ($m^3 \cdot s^{-1}$) for the Salmon River, Shannonville, Ontario 2003 to 2016. The horizontal line represents the historical average discharge. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

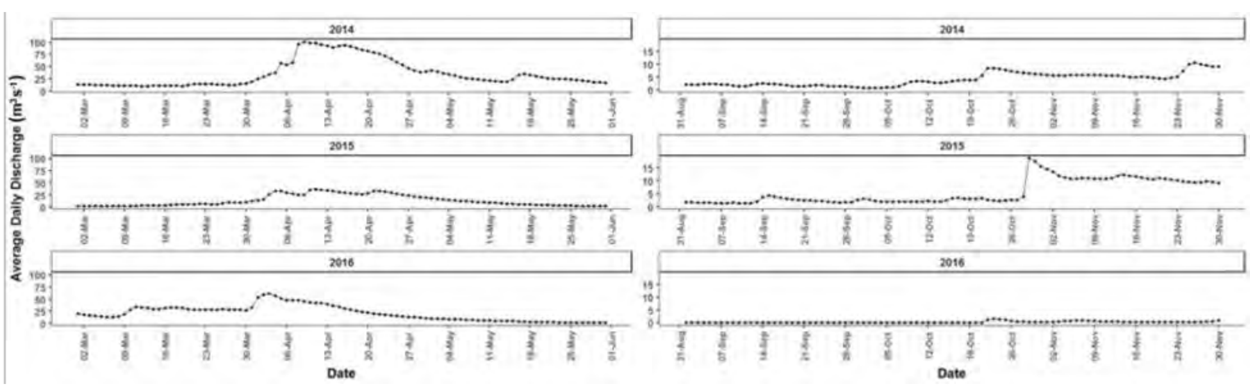

FIG. 11.4.8. Spring (left panel) and fall (right panel) discharge for the Salmon River, Shannonville, Ontario from 2014 to 2016. Data is available online through the Wateroffice webpage hosted by Environment Canada (http://wateroffice.ec.gc.ca/index_e.html).

12. Staff 2016

Glenora Fisheries Station, 41 Hatchery Lane, Picton, ON KOK 2TO
Tel: 613-476-2400 Fax: 613-476-7131

PROVINCIAL SERVICES DIVISION

Fish and Wildlife Service Branch
Lake Ontario Management Unit

Andy Todd Lake Manager
Dawn Young Administrative Assistant
Alastair Mathers Assessment Supervisor
Colin Lake Lead Management Biologist
Jake LaRose Lake Ontario COA Coordinator
Marc Desjardins Management Biologist
Jim Hoyle Assessment Biologist
Jeremy Holden Assessment Biologist
Mike Yuille Assessment Biologist
Mary Hanley Lake Ontario Aquatic Ecologist Intern
Changhai Zhu Project Support Biologist
Steve McNevin Operations Supervisor
Sonya Kranzl Operations Coordinator, Senior Base Operations Technician
Kelly Sarley Support Services/Data Technician
Jon Chicoine Vessel Master
Nina Jakobi Management Project Biologist, Great Lakes Technician
Ben Maynard Great Lakes Technician
Alan McIntosh Boat Captain
Tim Dale Great Lakes Fisheries Technician
Scott Brown Great Lakes Fisheries Technician
Steve Wingrove Great Lakes Fisheries Technician
Ron Green Great Lakes Fisheries Technician
Tyson Scholz Great Lakes Fisheries Technician
Daniel Jang Great Lakes Fisheries Technician
Tom Staton Great Lakes Fisheries Technician
Kody Adams Great Lakes Fisheries Technician
Tyler Peat Great Lakes Fisheries Technician
Daniel Hoyle Great Lakes Fisheries Technician
Aaron Law Great Lakes Fisheries Technician
Jake Gibson Great Lakes Fisheries Technician, Student Fisheries Technician
Camden Moir Student Fisheries Technician
Maeghan Brennan Student Fisheries Technician
Stacey Doyle Student Fisheries Technician
Alyssa Herron Student Fisheries Technician

Enforcement Branch

Jeff Fabian Conservation Officer
Victor Miller Enforcement Manager, Peterborough

Science and Research Branch
Aquatic Research and Monitoring Section

Dr. Tim Johnson Research Scientist
Brent Metcalfe Research Biologist
Carolina Taraborelli Project Biologist (Food Webs)
Jeff Buckley Research Intern, Project Biologist (Invasive Species)
Shannon Fera Project Biologist (Invasive Species)
Graham Mushet Project Biologist (Invasive Species)
Changhai Zhu Project Biologist (Juvenile Salmonids)
Megan Murphy Student Research Technician
Shelsey Taylor Co-op Intern
Tyson Scholz Research Technician

13. Operational Field and Lab Schedule, 2016

(SPA = Special Purpose Account; COA = Canada Ontario Agreement; TRCA = Toronto and Region Conservation Authority; OPG = Ontario Power Generation; GLFC = Great Lakes Fisheries Commission).

Field and Lab Projects	Dates	Species Assessed, Monitored or Stocked	Project Lead	Operational Lead	Funding Source
Bay of Quinte Ice Angling Survey	Dec-Feb	Walleye and Perch	Hoyle	McNevin	SPA
Public Outreach - Toronto Sportsmen's Show	Mar	Public Outreach/Education	McNevin	Kranzl	SPA
Ganaraska River Chinook Salmon Marking Program	Mar	Chinook Salmon	Lake	Kranzl	SPA
Ganaraska Fishway Rainbow Trout Assessment	Mar-Apr	Rainbow Trout	Yuille	Maynard	SPA
Public Outreach - Cottage Life Show	Apr	Public Outreach/Education	McNevin	Kranzl	SPA
Public Outreach - Lake Ontario Salmon Symposium	Apr	Public Outreach/Education	Todd	McNevin	SPA
Credit River Atlantic Salmon Smolt Survey (Rotary Screw Trap)	Mar-Jun	Atlantic Salmon	Desjardins	Clayton	COA
Walleye Egg Collection	Mar-Apr	Walleye	McNevin	Kranzl	SPA
Hamilton Harbour Walleye Spawning Surveillance	Mar-Apr	Walleye	Hoyle	Reddick	DFO
Chinook Salmon Tournament Sampling	Apr-Sept	Chinook Salmon	Yuille	Kranzl	SPA
Chinook Salmon Net Pens	Apr	Chinook Salmon	Lake	Jakobi	SPA
Lake Trout Tug Stocking	Apr	Juvenile Lake Trout	Lake	Chicoine	SPA
Lake Ontario Spring Prey fish Trawling Survey	Apr	Alewife/Smelt	Holden	Dale	CRF
Fish Contaminant Sampling	Apr-Dec	Sport Fish	McNevin	Kranzl	SPA
St 81- Offshore Benthos and Zooplankton Survey	May-Oct	Lower Food Web	Dr. Johnson	Taraborelli	SPA
Spring American Eel Trap and Transfer	Apr-Jun	American Eel	Mathers	Hanley	OPG
Deepwater Cisco Acoustic Telemetry Research Program Program	Jun	Deepwater Cisco	Johnson	Maynard	COA/SPA
Public Outreach - Belleville Cops for Kids Fishing Day	Jun	Public Outreach/Education	McNevin	Kranzl	SPA
Wastern Basin Salmon and Trout Creel	Apr-Sept	Salmonid Species	Yuille	Jakobi	SPA
Juvenile Chinook Salmon Assessment (Electrofishing)	May	Juvenile Chinook Salmon	Yuille	Jakobi	SPA
Trent River Lake Sturgeon Survey / Acoustic Tagging	May	Lake Sturgeon	Lake	Maynard	COA
Queens University - Bay of Quinte Acoustic Receiver Program	Jun-Oct	Largemouth / Smallmouth Bass	Tufts	McIntosh	SPA
Eastern Lake Ontario and Bay of Quinte Community Index Netting	Jun-Sep	Fish Community	Hoyle	Kranzl	SPA
Western Lake Ontario Community Index Netting	July	Fish Community	Hoyle	Kranzl	SPA
Eastern Lake Ontario and Bay of Quinte Index Trawling	Jun-Sep	Fish Community	Hoyle	Kranzl	SPA
Lake-wide Hydroacoustic Assessment of Prey fish	July	Prey Fish Community	Holden	Chicoine	COA
Asian Grass Carp Emergency Response	July-Sept	Grass Carp	McNevin	Kranzl	SPA
Public Outreach - Hamiton Harbour Kids Fishing Day	Aug	Public Outreach/Education	Todd	Jakobi	SPA

Continued on next page

13. Operational Field and Lab Schedule, 2016 *(continued from previous page)*

Hamilton Harbour Nearshore Community Index	Aug	Nearshore Fish Community	Hoyle	Maynard	COA
Toronto Harbour Nearshore Community Index	Sept	Nearshore Fish Community	Hoyle	Maynard	COA
Upper Bay Nearshore Community Index Netting	Sept	Nearshore Fish Community	Hoyle	Adams	COA
Boat Electrofishing - Bay of Quinte	Sept	Nearshore Fish Community	Hoyle	Kranzl	SPA
Lake St. Francis Community Index Netting	Sept	Fish Community	Yuille	Scholz	COA
eDNA Asian Grass Carp Surveillance	Sept	Grass Carp	McNevin	Hanley	SPA/COA
Ganaraska Chinook Salmon Assessment and Egg Collection	Sept	Chinook Salmon	Yuille	Maynard	SPA
Atlantic Salmon Marking Program	Sept	Atlantic Salmon	Lake	Kranzl	SPA
Fall American Eel Trap and Transfer	Sept-Oct	American Eel	Mathers	McNevin	OPG
Lake Ontario Fall Benthic Prey Fish Trawling Survey	Sept-Oct	Round Goby/Slimy Sculpin/Deepwater Sculpin	Holden	Chicoine	COA
Credit River Chinook Salmon Assessment and Egg Collection	Oct	Chinook Salmon	Yuille	Scholz	SPA
Credit River Juvenile Atlantic Salmon Electrofishing	Oct	Juvenile Atlantic Salmon	Desjardins	Jang	COA
Commercial Catch Sampling	Oct-Nov	Lake Whitefish	Hoyle	Brown	SPA
Age and Growth (Lab)	Year-Round	Multiple Species	Multiple	Kranzl	SPA
Deepwater Cisco Restoration Stocking	Nov	Deepwater Cisco	Lake	Chicoine	SPA
Deepwater Cisco Research Acoustic Telemetry Stocking	Nov	Deepwater Cisco	Johnson	Chicoine	COA/SPA

14. Primary Publications of Glenora Fisheries Station Staff[1] in 2016

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Bowlby, J.N., Hiriart-Baer, V.P., Blukacz-Richards, E.A., Yerubandi, R.R., Doka, S.E., Long, T.L., O'Connor, K.M. 2016. Evaluation of the Remedial Action Plan goal for dissolved oxygen in Hamilton Harbour: A goal based on habitat requirements for Cisco. Aquatic Ecosystem Health & Management 19:134-140.

Colborne, S.F., Rush, S.A., Paterson, G., **Johnson, T.B.,** Lantry, B.F., and Fisk, A.T. 2016. Estimates of lake trout (*Salvelinus namaycush*) diet in Lake Ontario using two and three isotope mixing models. Journal of Great Lakes Research 42: 695-702.

Greenhorn, J.E., Sadowski, C., **Holden, J.,** Bowman, J. 2016. Coastal Wetlands Connected to Lake Ontario Have Reduced Muskrat (*Ondatra zibethicus*) Abundance. Wetlands. doi:10.1007/s13157-016-0874-0

Hoyle, J.A., Yuille, M.J. 2016. Nearshore fish community assessment on Lake Ontario and the St. Lawrence River: A trap net-based index of biotic integrity, Journal of Great Lakes Research 42:687-694.

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Wood, J., **Hoyle, J.A.,** Wilson, C. 2016. Genetic analysis of round whitefish (*Prosopium cylindraceum*) stock structure in Lake Ontario. Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, Ontairo. Science and Research Technical Report TR-11 10p.

Zhang, H., Rutherford, E.S., Mason, D.M., Breck, J.T., Wittmann, M.E., Cooke, R.M., Lodge, D.M., Rothlisberger, J.D., Zhu, X., and **Johnson, T.B.** 2016. Forecasting impacts of silver and bighead carp on the Lake Erie food web. Transactions of the American Fisheries Society 145:136-162.

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

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