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LAKE ONTARIO MANAGEMENT UNIT

1997 ANNUAL REPORT

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1997 ANNUAL REPORT

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Editor's Note: This report does not constitute publication. Many of the results are preliminary findings. The information and findings should not be quoted without the consent of the individual authors. Individual authors should be contacted prior to any application of the data herein.

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Lake Ontario Management Unit 1997 Annual Report

Introduction

The Lake Ontario Management Unit (LOMU), is part of the Fish & Wildlife Branch, Natural Resource Management Division of the Ontario Ministry of Natural Resources (OMNR). The LOMU is OMNR's lead administrative unit for fisheries management on Lake Ontario and the St. Lawrence River.

The 1997 Annual Report documents result of LOMU fisheries assessment programs completed in 1997.

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Acknowledgements

The contributions of all Lake Ontario Management Unit staff are gratefully acknowledged. Also, we would like to acknowledge the help and information provided by our partners including volunteer anglers, the commercial fish industry, Mohawks of the Bay of Quinte, Ontario Hydro, New York Power Authority, and the Ganaraska River volunteers.

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Pelagic Planktivores

T. Schaner
B. F. Lantry[1]

Overview

Alewife (*Alosa pseudoharengus*) and rainbow smelt (*Osmerus mordax*) are the most abundant plankton feeding fish in Lake Ontario. Both species are preyed upon by large salmonines, and alewife are also important in the diet of walleye. The populations of alewife and smelt declined over the past decade, due to two factors. Firstly, the nutrient loading into the lake decreased as a result of better sewage treatment and land use practices in the watershed, which resulted in decreased primary productivity, and less plankton to support alewife and smelt. More recently this effect was compounded by accidental introductions of zebra and quagga mussels, which tend to divert the energy flow to the benthic community, away from the pelagic-feeding alewife and smelt. Secondly, the stocking of large salmonine predators has been increasing until recently. Alewife and smelt became squeezed between less plankton on which to feed, and high predation by salmon and trout.

Concern for declining numbers of prey fish has prompted management agencies around the lake to cut down stocking of salmonines starting in 1993. The objective was to reduce predatory pressure on alewife and smelt by a half. The stocking levels were moderately increased in 1997 following public consultation, and in the same year the levels of wild production of chinook salmon in the Lake Ontario tributaries increased as well. The resulting fluctuations in prey demand, and their effect on the prey community will be felt in the next few years as the stocked and naturally produced predators grow to full size.

The Surveys

The information presented in this section is based on annual hydroacoustic surveys conducted by the Ontario Ministry of Natural Resources (OMNR) in cooperation with the New York State of Environmental Conservation (NYSDEC). The survey series was started in 1991 and continues until present. An interruption in the series occurred in 1995, a year for which we have no acoustic data. In 1996 we updated the acoustic technology to a dual-beam system capable of better target size discrimination. In all years the collection of acoustic data was accompanied by midwater trawling, designed to interpret the species and size composition of the acoustic estimates. The data collected in these trawls provide a measure of continuity throughout the series.

Alewife

The acoustic estimates in the summer and fall surveys were 3.6 and 2.3 billion fish (Fig. 1). This is similar to the level observed in the previous year, and down from the 5 to 15 billion levels observed in the early 1990s. Applying size composition from the trawls, these numbers translate into biomass estimates of 60,000 and 22,400 metric tonnes respectively. The yearly predator demand in Lake Ontario was anticipated to stabilize around 20,000 metric tonnes after the 1993 stocking reductions (Anonymous 1994). Much of the difference between summer and fall estimates of alewife biomass in 1997 could therefore be attributed to predation. More significant may be the observation that the fall estimate of alewife biomass is approximately the same as the yearly estimated predator demand, suggesting that we are near the capacity of the system to sustain large predators.

The catches of young-of-the-year alewife (YOY) in the fall midwater trawls were low to moderate (Fig. 2). In years of peak YOY production trawl catches in the fall are dominated by these young fish. The last time this occurred was in 1995, and before that in 1991. In

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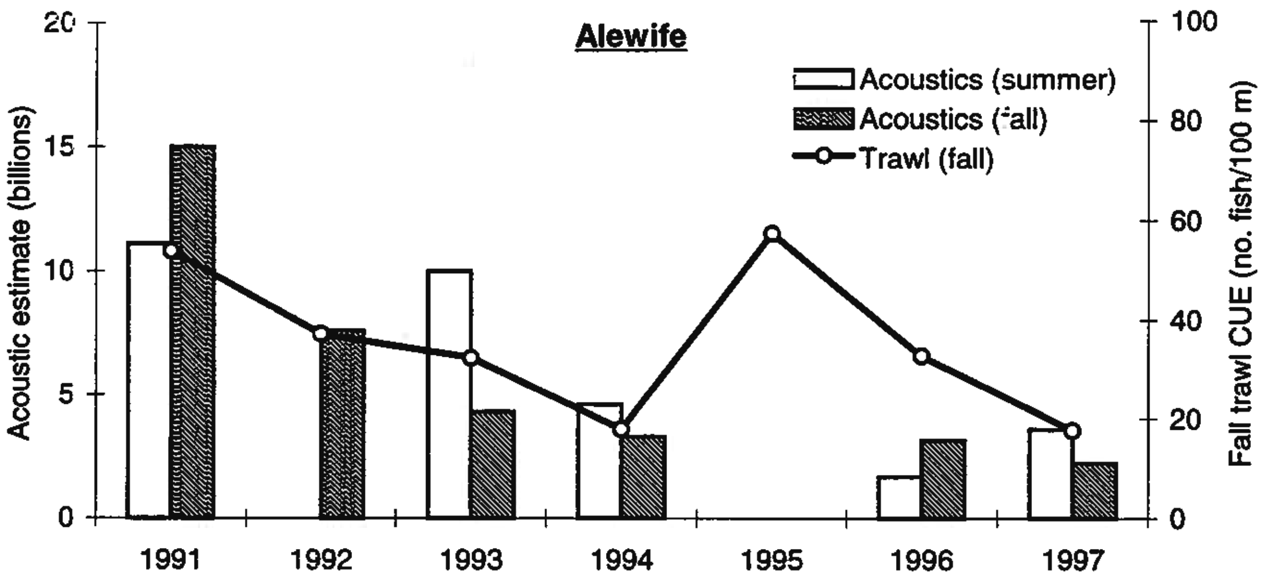


FIG. 1. Acoustic estimates of abundance, and midwater trawl indices of relative abundance (CUE) of alewife in Lake Ontario, 1991 to 1997. Acoustic estimates for summer 1992, and summer and fall 1995 are not available.

the intervening years the overall numbers of alewife decline as these strong year-classes decline. According to the acoustic data the current cycle, which is dominated by the 1995 year-class, is characterized by a lower population levels than the previous cycle, which was dominated by the 1991 year-class. This suggests an overall downward trend. The YOY alewife were not abundant in 1997, and therefore we can expect a further decrease in population size in 1998, as the dominant 1995 year-class further declines.

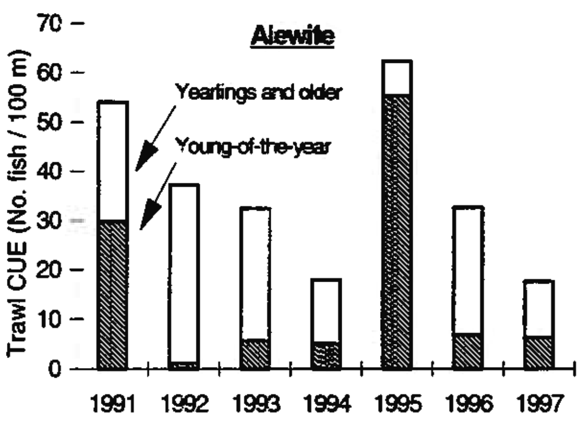


FIG. 2. Relative abundance (CUE) of young-of-the-year and older alewife in the fall in Lake Ontario, 1991 to 1997.

Spring bottom trawling surveys conducted independently by the U.S. Geological Survey (USGS) and NYSDEC since the late 1970s also indicate that there has been a decline since the peak alewife levels in the 1980s (O'Gorman *et al.* 1997). Since neither the acoustic data nor the USGS/NYSDEC spring bottom trawling suggest that the population levels are stabilizing, the concern for the alewife population and for the balance between salmonine predator demand and available prey continues.

Smelt

The 1997 estimates of smelt abundance were 4.0 billion fish in the summer survey and 2.8 billion fish in the fall (Fig. 3). Using size composition observed in midwater trawls, these population levels can be translated into biomass estimates of 13,300 and 12,000 metric tonnes respectively. The size composition of smelt in the midwater trawls made during both summer

[1] The midwater trawling program was designed to measure size and species distribution of the fish rather than their abundance. The pattern of increase, however, can still be observed when the trawl catches are stratified by temperature, which removes the major source of inconsistency.

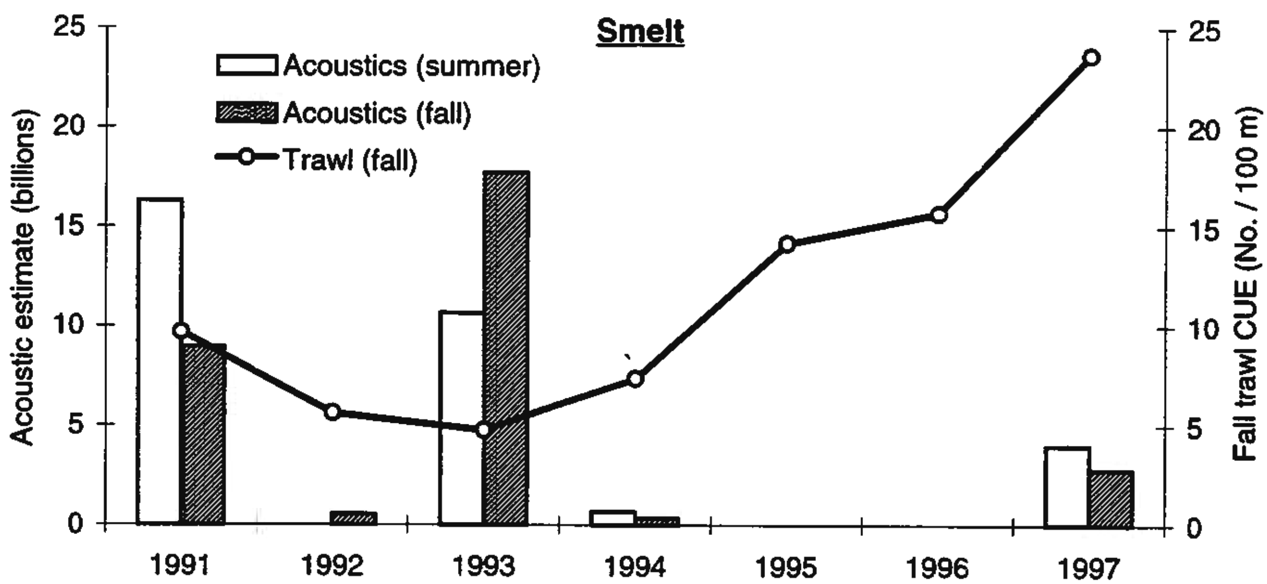


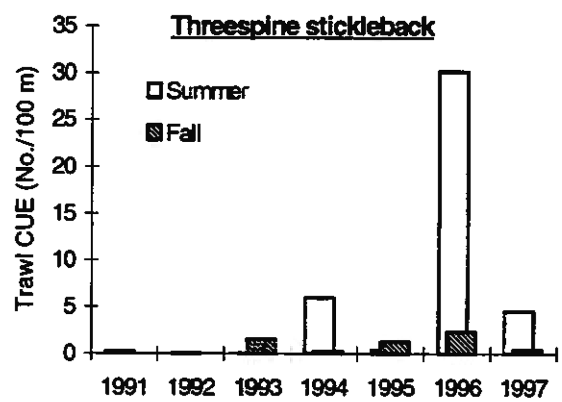
FIG. 3. Acoustic estimates of abundance, and midwater trawl indices of relative abundance (CUE) of smelt in Lake Ontario, 1991 to1997. Acoustic estimates for summer 1992, and summer and fall 1995 are not available, and estimates for 1996 are not completed.

and fall surveys indicates that the smelt population consists mostly of yearling fish (1996 year-class).

The 1997 acoustic estimates of smelt numbers lie within the range of widely fluctuating estimates for the years 1991 to 1994. The catch rates in the midwater trawls, however, show a pattern of steady increase since 1993 (Fig. 3)[1]. We think that the acoustic estimates from years 1991 to 1994 suffered from our inability to distinguish between smelt and the planktonic *Mysis relicta*, a problem that became less serious since we switched to new acoustic technology in 1996. It therefore appears reasonable to assume, based on the trawling results, that the smelt population has not declined since the early 1990s, and possibly even increased during this period.

Other species

Two other pelagic species, threespine stickleback (*Gasterosteus aculeatus*) and emerald shiner (*Notropis atherinoides*), have become increasingly abundant in the midwater trawls since the start of the hydroacoustic surveys in 1991 (Fig. 4). The trawl catches of the threespine stickleback started increasing in 1993 as we started to come upon occasional large aggregations. In 1996 we encountered at least one aggreagation that was large enough to be identified in the acoustic signal. In



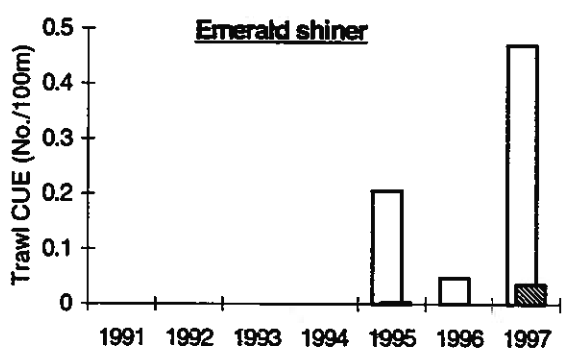


FIG. 4. Catch rates of threespine stickleback and emerald shiner in midwater trawls in Lake Ontario, 1991 to 1997.

1997 the catches of sticklebacks decreased again. Trawl catches of emerald shiner began to increase in 1995. It is not clear whether this increase represents a fundamental change in abundance, or only a periodic fluctuation in population numbers which seems to characterize the species (Scott and Crossman, 1973).

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Pelagic Piscivores

J. N. Bowlby T. Schaner
M. Daniels L. W. Stanfield

Overview

Salmon and trout are the most abundant pelagic piscivores in Lake Ontario. In response to declining prey populations (i.e., alewife and smelt) the Ontario Ministry of Natural Resources (OMNR) and New York Department of Environmental Conservation (NYDEC) reduced 1991 stocking levels by approximately 50% from 1993 to 1996. After public consultation in 1996 and 1997, stocking was increased moderately in 1997.

Stocking

In 1997 OMNR stocked about 2 million salmon and trout into Lake Ontario (Table 1). Over 612,000 chinook salmon spring fingerlings were stocked at various locations, mainly in the western end of the lake, to provide put-grow-and-take fishing opportunities. About 10,000 coho salmon fall fingerlings were stocked into the Credit River, the first installment of the newly re-instated coho program. In studies to determine the feasibility of Atlantic salmon rehabilitation, about 121,000 Atlantic salmon fry were stocked in Lake Ontario tributaries. These studies were designed to evaluate growth and survival of Atlantic salmon fry in various habitat types in Lake Ontario streams, and the ability of juvenile Atlantic salmon to compete with rainbow trout. About 50 pre-spawning adults, some with radio tags, were stocked to study spawning success and substrate quality. Another 17,000 Atlantic salmon fry were raised by the Credit River Anglers Association, under the Community Fisheries Involvement Program (CFIP). About 450,000 lake trout yearlings were stocked as part of a long-term rehabilitation program, concentrated in eastern Lake Ontario where most of the historic spawning shoals are found, and where reproductive success has been well documented. About 530,000 rainbow trout were stocked, including almost 288,000 fry that were raised by the Credit River Anglers Association and the Metro East Anglers Association.

TABLE 1. Salmon and trout stocked into Province of Ontario waters of Lake Ontario, 1997, and target for 1998.

Species	Age	Number stocked in 1997	Target for 1998
Atlantic salmon	Early fry	78,198	80,000
	Advanced fry	59,367	80,000
	Fall yearlings	454	
	Adult	68	
	Subtotal	138,087	160,000
Chinook salmon	Spring fingerling	612,120	600,000
Coho salmon	Fall fingerling	9,986	
	Yearling		26,200
Lake trout	Yearling	459,649	440,000
Rainbow trout *	Fry	287,500	
	Fall fingerling	125,900	
	Yearling	119,004	140,000
	Subtotal	532,404	140,000
Brown trout	Fall fingerling	66,267	
	Yearling	179,787	165,000
	Subtotal	246,054	165,000
TOTAL		1,998,300	1,531,200

** an additional 360,000 yearlings escaped from a private cage culture operation.*

An additional 360,000 rainbow yearlings escaped into Prince Edward Bay from a privately owned cage culture operation. About 246,000 brown trout were stocked at various locations to provide shore and boat fishing opportunities.

Detailed information about 1997 OMNR stocking numbers and locations is found in Appendix A. The New York Department of Environmental Conservation (NYDEC) also stocked about 3.7 million salmon and trout into Lake Ontario in 1997 (Schneider and Eckert 1998).

The targets for 1998 reflect the decision to moderately increase stocking levels (and predator demand) as a result of public consultation done in the fall of 1996 and the winter of 1997.

Chinook Salmon Status

Abundance Trends

Year-class strength of chinook salmon in Lake Ontario was calculated as the least-square mean (Littell *et al.* 1991) angling harvest rate by year-class. Angling survey data were from Ontario (Chapter 6 in this report) and New York (Eckert 1998) for 1985 to 1997.

Year-class strength increased surprisingly in 1995 and 1996 (Fig. 1). The 1995 year-class was the strongest ever recorded and despite stocking reductions, the 1996 year-class was in the mid-range compared with previous values. These two year classes were higher than would be expected from stocking since stocking was reduced greatly in these years (Fig. 2). Higher year-class strength in 1995 and 1996 must have resulted from increased survival of stocked fish and/or significant increases in natural reproduction of chinook salmon. The survival of stocked fish may have been enhanced by the reductions in predators through stocking reductions beginning in 1993. As well, young-of-the-year alewife abundance was high in 1995 (Schaner and Schneider 1997), and likely provided a major source of food for young-of-the-year chinook salmon which, in turn may have enhanced survival. Although juvenile salmonid surveys conducted in Ontario in summer 1995 failed to detect any wild chinook salmon in Lake Ontario tributaries (Bowlby *et al.* 1996), unsurveyed tributaries in New York, in particular, the Salmon River, and Niagara River, and in Ontario, the lower Credit River may have contributed large numbers of wild chinook salmon. A limited survey targeting juvenile chinook salmon in Ontario tributaries during spring 1996 caught a small number of wild chinook salmon.

Catch rates of chinook salmon in the western Lake Ontario launch daily boat fishery are our best index of chinook salmon abundance for the Ontario portion of Lake Ontario. In 1997 the catch rate increased by 37% from 1995 to moderately high level (Fig. 3). The

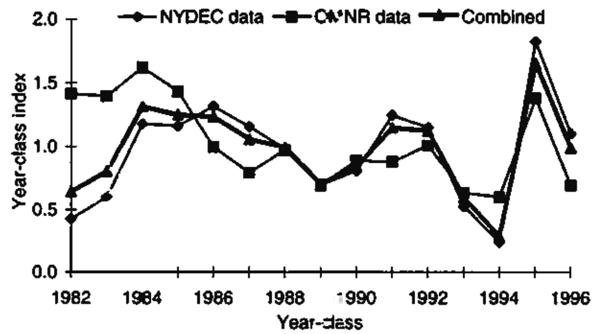

FIG. 1. Trends in year-class strength of chinook salmon in Lake Ontario, based on angler harvest rates from OMNR and NYDEC surveys. The combined index is based on the least-square mean of the OMNR and NYDEC harvest rates by year-class. Results were standardized to a common scale by dividing by the mean year-class index value for the time series.

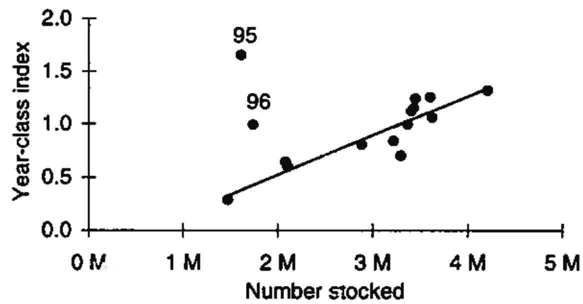

FIG. 2. Relationship between year class strength of chinook salmon in Lake Ontario and the number stocked. The line indicates the fit for the 1982-94 year classes.

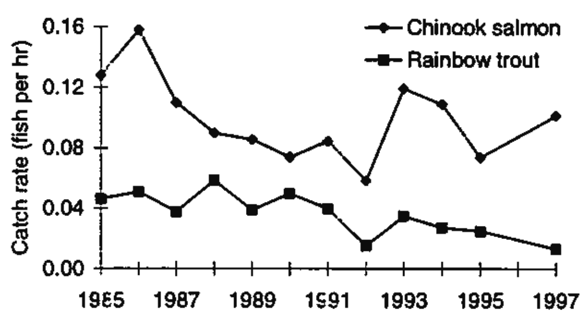

FIG. 3. The catch rate of chinook salmon and rainbow trout in the western Lake Ontario launch daily salmonid boat fishery (Ontario portion) from 1985 to 1997

strong 1995 and 1996 year-classes accounted for this increase. The chinook population in Lake Ontario is much higher than expected from stocking cuts from 1993 to 1996. As discussed above, either natural reproduction of chinook salmon has increased significantly, or the population has responded to the stocking cuts in a density-dependent manner and stocking survival has increased. Whatever the cause for this increase, the bottom line is that with a higher chinook salmon population than expected, their impact on prey populations, particularly alewife, will be higher than expected, as well.

Wild Production

During spring 1997 an electrofishing survey of 32 randomly selected sites across Ontario tributaries that produce rainbow trout was conducted to enumerate chinook salmon smolt production. This was conducted before chinook salmon smolt out to Lake Ontario during late June and July (OMNR, Salmonid Ecology Unit, unpublished data). Wild chinook fingerlings could be easily separated by size from stocked chinook fingerlings. These sites were surveyed again during summer 1997 to enumerate rainbow trout but some chinook salmon were caught, as well. In addition, 16 randomly selected sites on Wilmot Creek were surveyed during spring 1997 to more precisely estimate chinook smolt production for comparison with previous estimates from Wilmot Creek (OMNR, Salmonid Ecology Unit, unpublished data).

During the spring survey we observed 333 chinook salmon fingerlings in 9 different streams (Table 2). From this number we estimated a total of 403,411 chinook fingerlings in Ontario tributaries of Lake Ontario. Certainly, there was some mortality among these fish before they reached Lake Ontario. However, the same is true for stocked chinook salmon, and so this number may be comparable to chinook smolt stocking numbers. In addition we observed another 455 chinook fingerlings in another 14 sites on Wilmot Creek. We estimated a total of 75,786 chinook fingerlings in Wilmot Creek in 1997. Previously, chinook smolt estimates from weir counts peaked at about 20,000 in 1995 (OMNR, Salmonid Ecology Unit, unpublished data). During the summer 1997 survey we observed 29 chinook salmon in 9 different streams (Table 2). In previous surveys from 1993 to 1995 we observed one chinook salmon.

The natural reproduction of chinook salmon in Ontario tributaries of Lake Ontario during 1997 appears to have been greater and more widespread than in previous years. Wild juvenile chinook salmon have been seen occasionally in Lake Ontario tributary surveys since the mid 1980s but numbers have never been large (OMNR unpublished data). However, the number of adult chinook salmon returning to the Ganaraska River has not been estimated but is thought to be 2,000 to 5,000 fish. Since the Ganaraska River is

TABLE 2. Catch of chinook salmon fingerlings in Ontario tributaries of Lake Ontario during 1997.

		Number of chinook observed	
Stream	Number of sites	Spring	Summer
Spencer Cr. (Sulphur/Ancaster)	1	0	0
Bronte Cr. (incl. Limestone Cr.)	1	0	0
Oakville Cr.	1	13	0
Credit R. (main branch)	4	14	0
Duffins Cr.	3	1	7
Lynde Cr.	2	0	0
Oshawa Cr.	1	0	-
Farewell Cr.	1	0	0
Bowmanville Cr.	2	79	2
Soper Cr.	1	39	6
Wilmot Cr.*	2	172	7
Graham Cr.	2	1	1
Port Britain Cr.	1	0	0
Ganaraska R.	4	8	2
Gage Cr.	1	0	0
Cobourg Cr.	2	0	1
Barnumhouse Cr.	1	0	0
Shelter Valley Cr.	2	6	1
Colborne Cr.	1	0	0
Butler Cr.	1	0	2
Smithfield Cr.	1	0	0
Total	35	333	29

** another 455 chinook fingerlings were observed at another 14 sites during spring survey* not stocked, there must be significant natural reproduction, since straying alone cannot account for the high return. As well, the Napanee River is not stocked but an angler survey in 1992 indicated a catch of over 1,300 chinook (OMNR unpublished data), again suggesting significant natural reproduction. We now have an estimate of total wild chinook production that is very close to what we stocked in 1996. We must determine whether the level of wild chinook production in 1997 was an anomaly or a harbinger of a changing Lake Ontario ecosystem.

Finally, it should be noted that natural reproduction of chinook salmon has occurred in the "warmwater" sections of some Lake Ontario tributaries. In this study we observed wild chinook salmon in the Credit River below Streetsville. An angler has given us a chinook salmon fry collected from the Moira River, and the chinook production from the Napanee River has been discussed above. Chinook salmon move downstream to Lake Ontario before the stream temperatures get too warm. Thus, we must re-think our designation of suitable habitat in some of these warmwater streams to consider the seasonal use of the habitat for natural reproduction of chinook salmon.

Growth Trends

The spawning run of chinook salmon was monitored in the Credit River at the Reid Milling dam in Streetsville. The length of male and female chinook salmon was measured for those fish selected by Ringwood Fish Culture station for spawn collection. The length of male and female 3-yr-old chinook salmon declined sharply in 1994, followed by successive increases in 1995, 1996, and 1997 (Fig. 4). The decline in growth in 1994 was consistent with declines in alewife and smelt populations. The subsequent increases in growth were consistent with the stocking reductions from 1993 to 1996. Apparently, the stocking reductions resulted in a better predator-prey balance and prevented further reductions in chinook salmon growth rates.

Rainbow Trout Status

Abundance Trends

Counts of spawning rainbow trout at the Ganaraska River fishway are used to index rainbow trout abundance trends. In 1997, the estimated spring "run" past the fishway count decreased slightly to 8,768 fish (Fig. 5). This run has been relatively constant since 1993. The spring run of rainbow trout peaked in 1989 when more than 18,000 returned to spawn. The recent decline in the number of rainbow trout passing the fishway may be related to an increase in the size and age of first spawning, and the mortality associated with spending one more year in Lake Ontario before spawning. Apparently, channel improvements in the Ganaraska River during the early 1980s may have favoured larger fish. The total spring run of rainbow trout into the Ganaraska may have exceeded 10,000 fish since some fish spawned below the fishway and others were harvested by anglers. For instance, during spring 1992, we estimated that 1,267 rainbow were harvested from the Ganaraska River, in the harbour at Port Hope.

Catch rates of rainbow trout in the western Lake Ontario launch daily salmonid boat fishery are our best index of rainbow trout abundance for the Ontario portion of Lake Ontario. In 1997 the catch rate declined by 47% from 1995 to the lowest level since before 1985 (Fig. 3). This decline and the more general decline in rainbow trout catch rate since 1988 has created some concern. These declines were likely due to: i) the survival of rainbow trout stocked by NYDEC in the Salmon River has declined (Bishop 1997), ii) during the 1990s Ontario reduced yearling

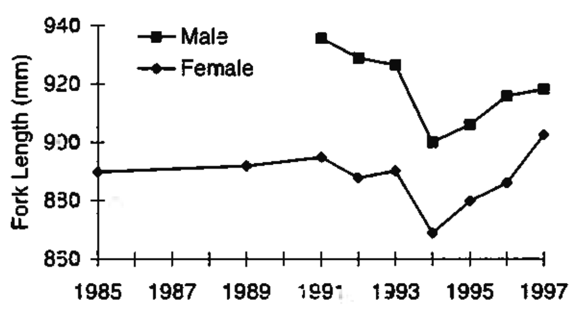

FIG. 4. Fork length of 3-year-old chinook salmon in the Credit River during spawning run in September and October.

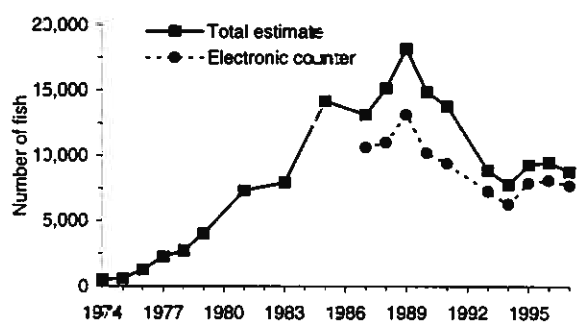

FIG. 5. Number of rainbow trout counted during April and May at the Ganaraska River fishway at Port Hope, Ontario.

stocking in favour of fall fingerlings which may have lower survival than yearlings, and iii) a series of poor wild rainbow trout year-classes in Ontario tributaries (Bowlby *et al.* 1996).

Condition Trends

Body condition of adult rainbow trout in the Ganaraska River was determined as the least-square mean (Littell *et al.* 1991) weight after adjusting for length using analysis of covariance. In 1997, body condition was significantly lower for both female and male rainbow trout than 1996 (Fig. 6). As stated above the chinook salmon population has increased, and so body condition of rainbow trout was consistent with past observations by Bowlby *et al.* (1994) that condition of salmon and trout in Lake Ontario is inversely related to chinook salmon numbers.

Lake Trout

Population trends

In 1996 OMNR discontinued dedicated surveys for lake trout, and incorporated their assessment into the fish community index netting conducted annually in eastern Lake Ontario. Considerable overlap between the two survey programs over the past several years, allows comparison between the two data series, and a shift to the general survey as a means of monitoring the lake trout population. Trends in lake trout populations in eastern Lake Ontario are reported in Chapter 3 of this report. Schneider *et al.* (1998) report on the status of lake trout rehabilitation and population trends in Lake Ontario in 1997.

Natural Reproduction

The occurrence of natural reproduction by lake

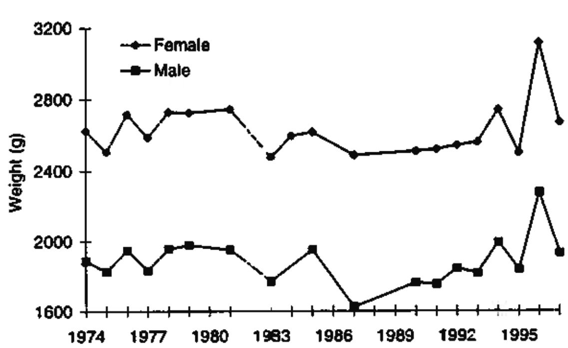

FIG. 6. Condition (mean weight, adjusted for length) of rainbow trout in April at the Ganaraska River fishway, in Port Hope, Ontario.

trout has been documented in Lake Ontario since the late 1980s. However, in 1994 young wild lake trout began to show up in bottom trawl catches, indicating that successful reproduction and survival beyond the larval and fry stages were occurring. The catches of wild juvenile lake trout continued in 1997 with 24 fish caught lake-wide, bringing the four-year total to 137 fish (Table 3). Most of the wild lake trout were caught in the U.S. waters, where a variety of bottom trawling surveys provide more opportunities for capture.

Atlantic Salmon Restoration

In 1995 OMNR prepared "An Atlantic Salmon Restoration Plan for Lake Ontario" (Anonymous 1995) with a review of the past Atlantic salmon program by technical experts and with public input from representatives of the major stakeholders. Technical experts indicated that Atlantic salmon restoration in Lake Ontario was feasible, but there were three concerns about Lake Ontario streams that warranted further research into potential limitations of restoration. These three concerns were: i) the ability of juvenile Atlantic salmon to use woody cover (which predominates in Lake Ontario streams) versus boulders, ii) abundance of fine sediments, and iii) competition with rainbow trout. Public input suggested a research approach using fry stocking to evaluate these concerns, specific benchmarks for years 5, 10, 15, and 20, and 5-year reviews of the program to determine if the targets were met. We have finished the third year of the program with review scheduled after the 1999 field season.

The Restoration Plan has a year-5 minimum benchmark density of 5 Atlantic salmon fall fingerlings per 100m^2 in areas stocked. Survival was poor for swim-up fry in 1995 and 1996 (below benchmark in all experimental categories). Poorer survival in these years may have resulted from hatchery effects. Swim-up fry stocking was delayed and they may have starved in these years. Accordingly, in 1997 swim-up fry were fed briefly before stocking (not enough to affect size), and mean survival exceeded the bench mark in all types of habitat where rainbow trout were absent, and in areas with boulder cover and low amounts of fine sediments (traditionally considered the best Atlantic salmon habitat) where rainbow trout were present.

In 1995, the advanced fry densities exceeded the benchmark in the same experimental categories as for swim-up fry in 1997. In 1996, advanced fry densities exceeded the benchmark only in areas with boulder

TABLE 3. Catches of naturally produced lake trout in Lake Ontario in index programs of the USNBS, NYDEC, and OMNR.

	1994		1995		1996		1997	
Age	U.S.	Can.	U.S.	Can.	U.S.	Can.	U.S.	Can.
0	3	-	28	-	2	-	-	-
1	5	3	28	1	9	-	-	1
2	-	-	2	1	26	1	2	-
3	-	-	-	-	-	4	14	-
4	-	-	-	-	-	-	4	3
Total	8	3	58	2	37	5	20	4

cover, low amounts of fine sediments, and rainbow trout absent. In 1997, the advanced fry densities exceeded the benchmark in all experimental categories except areas with wood cover, high amounts of fine sediments, and rainbow trout present.

Although it is too early to make conclusions, these initial results are encouraging.

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3

Eastern Lake Ontario and Bay of Quinte

J. A. Hoyle

Overview

The eastern Lake Ontario and Bay of Quinte region of Lake Ontario (Fig. 1) is significant because it supports several important recreational, commercial and aboriginal fisheries (see Part II, Resource Use, in this report), and because it has historically produced the largest fish yields of the entire lake (Christie *et al.* 1987). The fish community in the region consists of a diverse assemblage of cold- and warm-water fish species, and has been closely monitored by index gillnetting and trawling programs based out of the Glenora Fisheries Station for nearly forty years (Hoyle 1997).

The fish community of eastern Lake Ontario and Bay of Quinte region has undergone tremendous change during these past forty years. During the degraded water quality conditions of the 1960s and 1970s, the fish community was dominated by small, pelagic species—alewife, smelt, white perch and yellow perch. Formerly, prominent species such as lake trout, lake whitefish, lake herring, burbot, lake sturgeon, walleye, and northern pike were either much reduced in their abundance or in the case of lake trout extirpated from the lake.

Improvements to water quality, large-scale salmonid stocking, sea lamprey control, and commercial harvest control—all initiated during the 1970s—have led to recovery of some species. Walleye and lake whitefish recovered during the 1980s, and large recreational (walleye) and commercial (lake whitefish) fisheries developed based on these species. The small, pelagic species became less dominant.

Now, in the 1990s other species have shown early signs of recovery. A large lake trout population, built-up by large-scale stocking through the 1980s and 1990s, produced notable numbers of 'wild' fish starting with the 1993 year-class. Lake herring showed an increase in recruitment of young-of-the-year fish in 1990, and a trend toward increasing an adult population—at least in isolated areas. Significant numbers of young lake sturgeon have been reported by local commercial fishermen beginning in 1996. And finally, three deepwater sculpin, a species thought to be extirpated from Lake Ontario, were captured in our

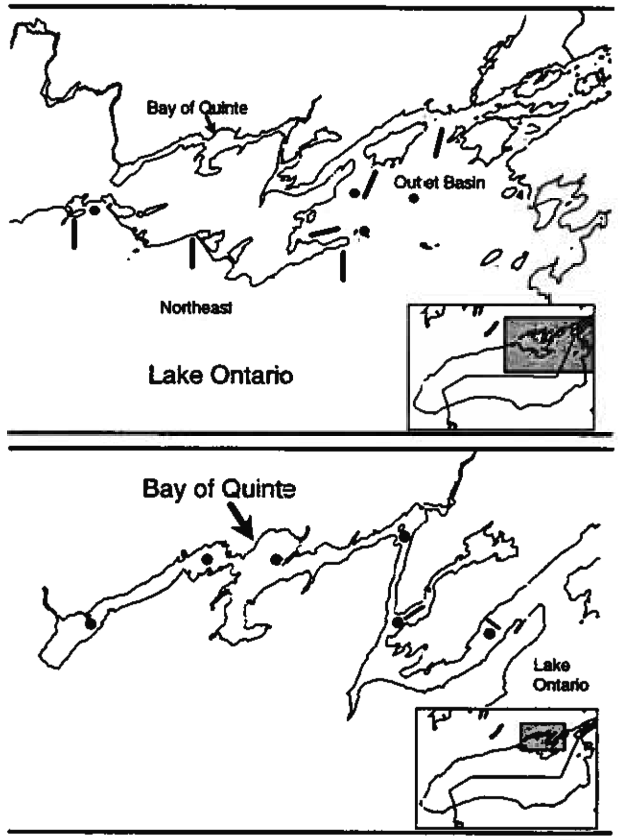

FIG. 1. Maps of eastern Lake Ontario (upper panel) and the Bay of Quinte (lower panel) showing fish community index gillnetting and trawling locations. Depth-stratified gillnetting locations are shown as bars; single depth gillnetting and trawling locations are represented by circles.

1996 index trawling program.

At the same time, however, *Dreissenid* mussels have invaded this area, and appear to be significantly impacting the fish community. The water is now much clearer and less productive, and the food-web is changing. We are now watching for signs of stress in the previously recovered walleye and lake whitefish populations, and for signs of increase in populations which will be favoured under these conditions (e.g., yellow perch).

This chapter updates the status of lake trout, lake whitefish, smallmouth bass, yellow perch, and walleye, as well as that of several species which have recently shown early signs of recovery—lake herring, lake sturgeon and deepwater sculpin. Lake trout population status is also dealt with, in the context of the entire lake, in Chapter 2 of this report. For a summary of standardized gillnet/trawl catch-per-unit-effort for 1997, organized by broad geographic area (Northeast, Outlet Basin and Bay of Quinte), see Appendix B.

Species Population Status

Lake Trout

Lake trout support a locally significant recreational fishery in the Northeast (e.g., Wellington) and the Outlet Basin (e.g., Kingston) areas of eastern Lake Ontario. The lake trout numbers were built up by large-scale stocking efforts during the 1980s and 1990s, and some production of 'wild' fish beginning with the 1993 year-class subsequently occurred. For a stocking summary and an update on 'wild' lake trout production, see Chapter 2. Lake trout abundance trends are presented here.

Lake trout abundance indices were summarized here for two geographic areas, the Northeast (represented by three netting locations between Brighton and Long Point), and the Outlet Basin. The Outlet Basin is further divided into a 'deep' area (2 netting locations) and a 'nearshore' area (3 netting locations) with somewhat different sampling histories (Fig. 2).

Lake trout abundance increased in all areas during the 1980s, peaked in the early 1990s, and has declined in recent years—most precipitously in the deep waters of the Outlet Basin (Fig. 2).

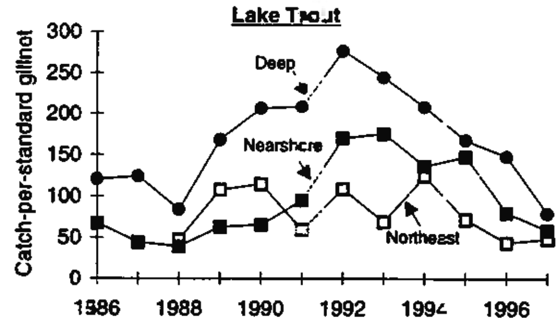

Fig. 2. Lake trout catch-per standard gillnet (sum of catch adjusted to 100 m of each mesh size) in the Northeast and the Outlet Basin of Lake Ontario at 'deep' sites (30 m) and 'nearshore' sites (mean of 22.5 and 27.5 m depths), 1986 to 1997.

Lake Whitefish

Eastern Lake Ontario and Bay of Quinte lake whitefish stocks recovered during the 1980s and early 1990s (Casselman *et al.* 1996). By 1996, the two stocks supported over 50% of the total Lake Ontario commercial fish industry for all species.

Abundance Trends

Having peaked in 1993, lake whitefish abundance now appears to be in decline (Fig. 3). Of particular concern is that, whereas large numbers of young recruits were present in 1993 index gillnets (i.e., 1990, 1991, and 1992 year-classes), much smaller numbers of young fish are now caught. This is of concern because index trawl catches of young-of-the-year (YOY) fish indicated that large year-classes were produced in 1994 and 1995 (Fig. 3) but these failed to contribute to the adult population. Therefore, survival appears to have declined, and to top it off, small year-classes were produced in 1996 and 1997.

In 1997, five lake whitefish carcasses—the first observed in nearly 40 years of index netting activity—were observed in our trawls and 5 dead/dying fish were caught in gillnets. The cause of death was not determined. The fish ranged in size from 250 to 350 mm total length and represent young, immature fish of 2 to 3 years of age.

Condition Trends

Lake whitefish body condition has declined significantly since 1993 in both major spawning stocks (Fig. 3). These two stocks reside for much of the year in the Outlet Basin of Lake Ontario and the lower Bay of Quinte. Examination of amphipod abundance in these areas (R. Dermott, Department of Fisheries and Oceans, Burlington, Ontario, unpublished data) indicate that this primary food source of the whitefish

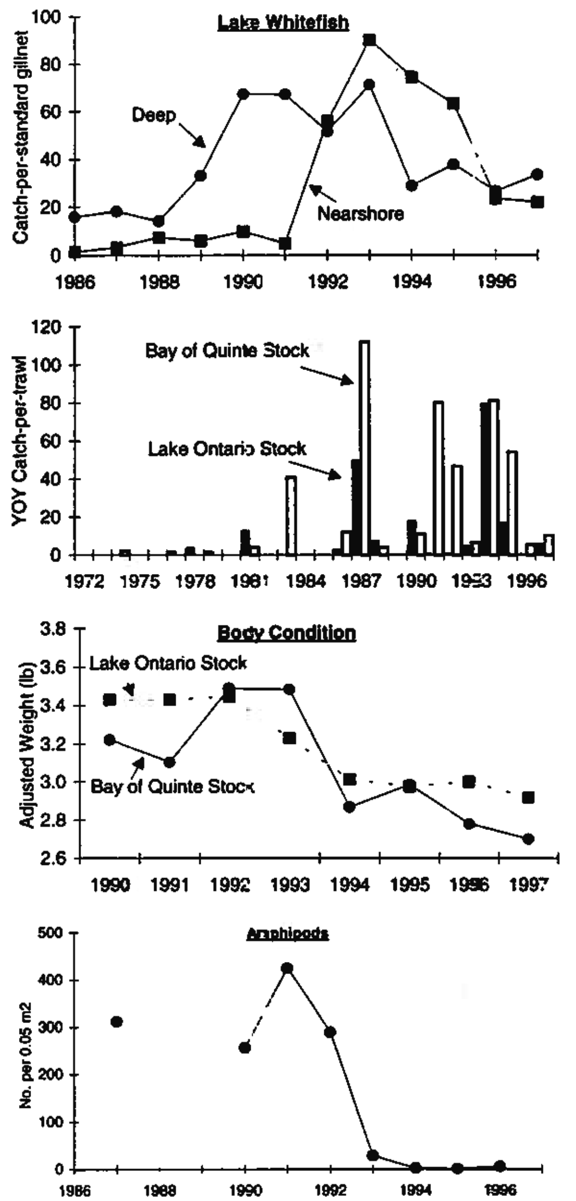

FIG. 3. Upper panel, lake whitefish catch-per standard gillnet (sum of catch adjusted to 100 m of each mesh size) in the Outlet Basin of Lake Ontario at 'deep' sites (30 m) and 'nearshore' sites (mean of 22.5 and 27.5 m depths), 1986 to 1997. Second panel, lake whitefish year-class strength for Lake Ontario (Timber Island) and Bay of Quinte (Conway) stocks as represented by young-of-the-year (YOY) catch-per-trawl (adjusted to 12 min duration), 1972 to 1997 (no trawling in 1989). Third panel, lake whitefish body condition in samples collected during fall spawning runs for Lake Ontario and Bay of Quinte stocks as represented by mean weight adjusted for differences in length among years (1990 to 1997). Lower panel, amphipod abundance (number per 0.05 m2) averaged for two lower Bay of Quinte/Outlet Basin sites, 1986 to 1996 (R. Dermott, Department of Fisheries and Oceans, Burlington, Ontario, unpublished data).

(Ihssen et al. 1981) has also declined dramatically (Fig. 3). Amphipods declined by 90% in 1993 compared with the 1990 to 1992 average at two sites, and further declined to negligible numbers thereafter. Therefore, the decline in lake whitefish condition may be related to the decline in amphipod abundance.

Dermot (1997) suggested that the decline in amphipod abundance may be due to: 1) lake whitefish predation, or 2) zebra mussel impacts (e.g., direct competition for phytoplankton). The relative importance of these two factors may be difficult to determine. Lake whitefish abundance peaked in 1993 (see above) and impacts due to *Dreissenid* mussels occurred as early as 1993 in the Outlet Basin, and at least by 1995 in the Bay of Quinte.

Colonies of *Dreissenid* mussels were first observed in the Bay of Quinte in 1993, and the mussels were fully colonized by 1994. However, significant impacts on water quality (phosphorus, chl a, water clarity) and phytoplankton communities were not observed until 1995 (Nichols and Heintsch 1997, Millard and Miles 1997). Dreissenid mussels had impacted water quality in the Outlet Basin by 1993 (e.g., water clarity, E. S. Millard and O. E. Johannsson, Department of Fisheries and Oceans, Burlington, Ontario,unpublished data) because the mussels colonized this area sooner than the Bay of Quinte (Schaner and Stewart 1995), and because of the influence of the Lake Erie water supply on this area of the lake.

Smallmouth Bass

Abundance Trends

Smallmouth bass populations, along with lake trout, provide an important recreational fishery in the Outlet Basin of Lake Ontario. Their abundance in index gillnets is dramatically lower for the 1992 to 1997 time period compared to that from 1986 to 1991(Fig. 4).

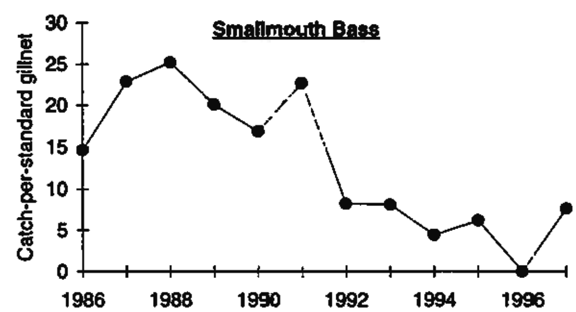

FIG. 4. Smallmouth bass catch-per-standard gillnet in the Outlet Basin of Lake Ontario ('nearshore' sites, mean of 7.5 and 12.5 m depths), 1986 to 1997.

The reason for the decline is not clear.

Smallmouth bass populations in New York waters of eastern Lake Ontario have not shown the same dramatic decline (Ekert 1997) but concerns have been raised about potential impacts of Double-crested cormorant predation on eastern Lake Ontario smallmouth bass (Schneider *et al.* 1997)

Yellow Perch

Yellow perch are common throughout eastern Lake Ontario and the Bay of Quinte. Yellow perch abundance peaked in the early 1980s, at which time they largely supported the Lake Ontario commercial fishery. Their populations declined dramatically in the years following.

Abundance Trends

In the Northeast, yellow perch abundance has been monitored in gillnets for many years at Middle Ground, and since 1988 at several additional sites (Fig. 5). Commercially marketable-sized yellow perch (>7.5 inches total length) are particularly scarce, even though large numbers of small fish have been observed in some years. Remarkably, no marketable-sized yellow perch have been captured in the Middle Ground gillnets since 1995.

Gillnet catches in the Outlet Basin have been low for the last four years, compared to the 1986 to 1993 time period, especially for small fish.

Largest catches of yellow perch now come from the Bay of Quinte (Fig. 5), and recruitment of YOY yellow perch has increased markedly in recent years (Fig. 5). In addition, Bay of Quinte walleye anglers reported catching large numbers of small yellow perch in the spring of 1997 (Chapter 6 in this report).

Walleye

Bay of Quinte walleye are the target of one of Lake Ontario's largest recreational fisheries (see Chapter 6 in this report). Walleye also supplement the Lake Ontario commercial fishery which is largely otherwise supported by lake whitefish, yellow perch and eel (see Chapter 5 in this report), and provide a spring aboriginal spear fishery in the rivers of the Bay of Quinte (see Chapter 7 in this report). Adult walleye migrate to Lake Ontario immediately following spawning in the Bay of Quinte, and then move back into the bay in the fall to over-winter.

Abundance Trends

Walleye population size increased sharply in 1980,

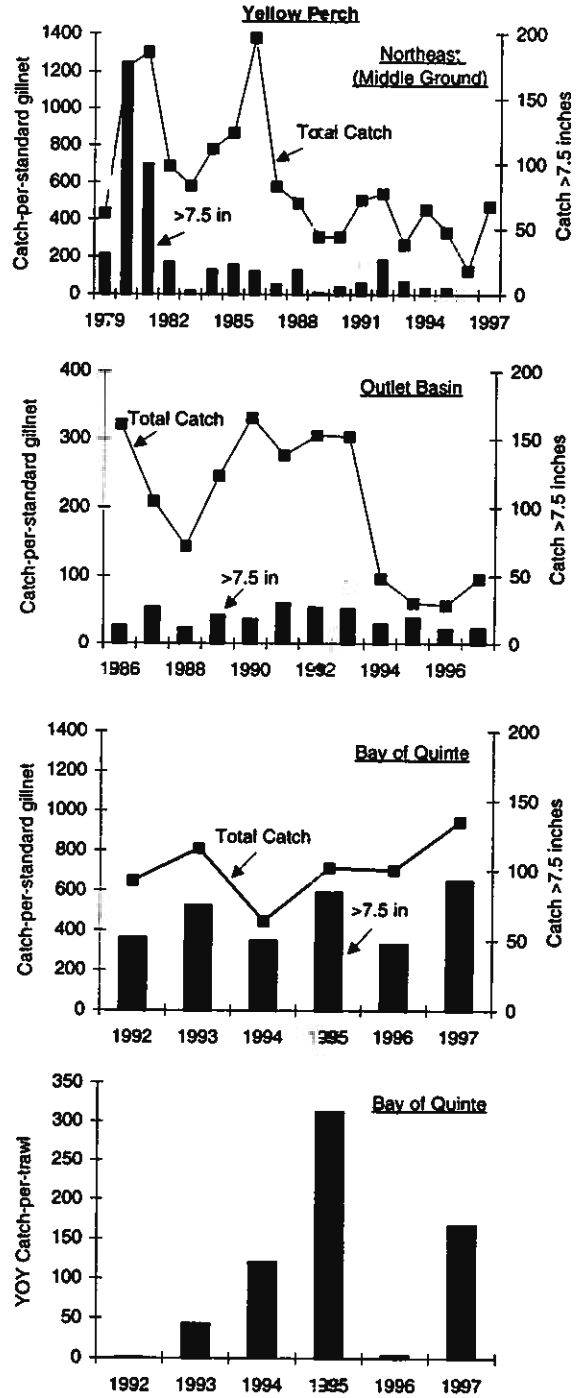

FIG. 5. Yellow perch catch-per-standard gillnet, including for fish greater than 7.5 inches total length—representing commercially marketable-sized fish—in Northeast Lake Ontario (Middle Ground, 1979 to 1997), the Outlet Basin (1986 to 1997), and the Bay of Quinte (1992 to 1997). Lower panel, yellow perch year-class strength in the Bay of Quinte as represented by young-of-the-year (YOY) catch-per-trawl (6

with recruitment of the 1978 year-class, and remained relatively stable since the mid-1980s at about 1.5 million 2-yr-old and older fish. Our ability to estimate population size using catch-at-age analysis (i.e., CAGEAN, Deriso et al. 1985) has been temporarily compromised since 1995 due to changes in walleye distribution patterns in the face of major ecosystem changes—including increased water clarity—in the Bay of Quinte.

Young-of-the-year abundance in bottom trawls for 1995, 1996 and 1997 was the lowest observed since 1984 (Fig. 6). The open-water walleye fishery has been in decline since 1991 (Chapter 6 in this report), and will likely be further impacted in years ahead due to lower walleye recruitment to the fishery.

Recovering Native Species

In recent years, several species—once prominent in the Lake Ontario fish community—have shown early signs of recovery (see Chapter 2 for an update of 'wild' lake trout production).

Lake Herring

Historically, lake herring supported an important commercial fishery in Lake Ontario but this fishery collapsed during the 1940s. We anticipated that lake herring, like lake whitefish, would increase in abundance following declines in alewife and smelt in the late 1970s. This did not happened. Prior to 1990, lake herring had not been observed in our index bottom trawls. Small numbers were observed in 1990, 1991 and 1993 at the Conway site in the lower Bay of Quinte (Fig. 7). In 1994, relatively large numbers of YOY lake herring were caught—along with large numbers of YOY lake whitefish—at the same Bay of Quinte site.

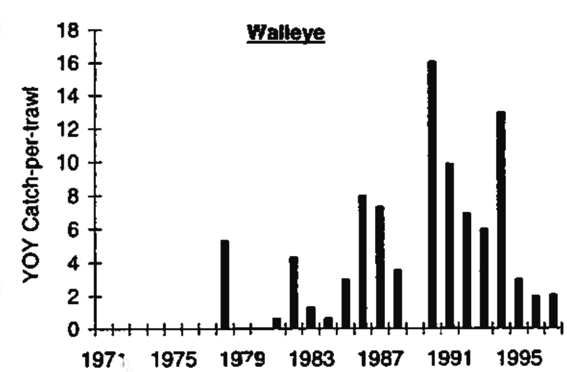

FIG. 6. Walleye year-class strength in the Bay of Quinte as represented by young-of-the-year (YOY) catch-per-trawl (6 min duration), 1971 to 1997 (no trawling in 1989).

The 1995 year-class was small but similar in size to the 1990 and 1993 year-classes. No YOY lake herring were caught in 1996 or 1997.

It appears that a year-class of lake herring was produced in 1987 (Hoyle and Bowlby 1995) although it did not show up in bottom trawling in the Outlet Basin. Following recruitment of the 1987 year-class to the gillnets in 1990, lake herring catches declined in the Outlet Basin (Fig. 7). However, lake herring gillnet catches in the Bay of Quinte (Hay Bay index site) have now increased dramatically in the last two years, likely due to recruitment of the year-classes produced in the bay beginning in 1990.

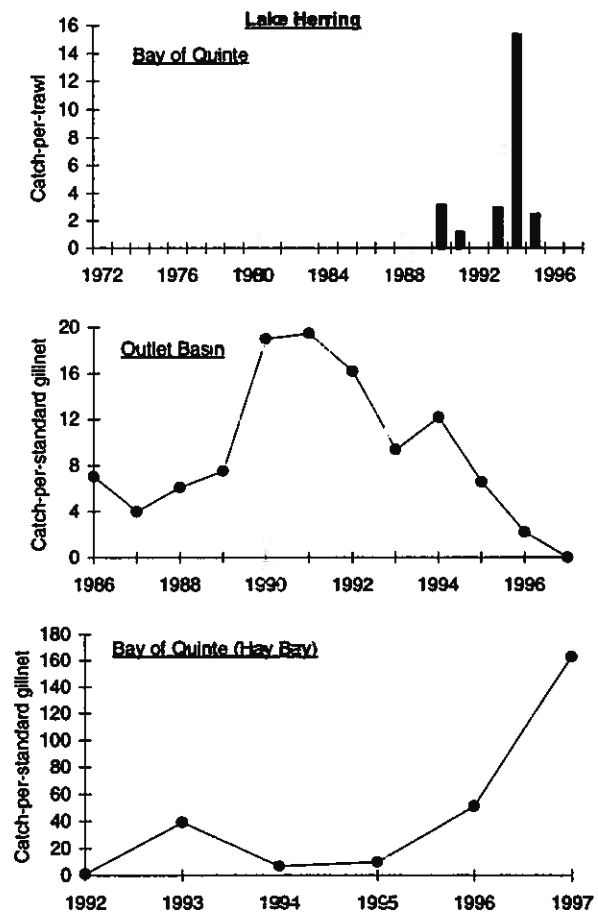

FIG. 7. Top panel, lake herring year-class strength in the lower Bay of Quinte (Conway) as represented by YOY catch-per-trawl (adjusted to 12 min duration), 1972 to 1997 (no trawling in 1989). Lake herring catch-per standard gillnet in the Outlet Basin, second panel ('deep' sites), 1986 to 1997, and the Bay of Quinte, third panel (Hay Bay site, 12.5 m depth), 1992 to 1997.

Lake Sturgeon

Lake sturgeon provided an important commercial fishery in Lake Ontario prior to the turn of the century but by 1900 they were all but wiped out. Occasional reports of capture have occurred over the years, indicating that the species persisted at very low levels. During 1997, at least 29 young sturgeon (less than 24 in total length) were caught by local commercial fishermen while fishing for yellow perch and lake whitefish. Also in 1997, two young sturgeon were caught for the first time in our fish community index gillnetting program (Table 1). These observations, along with reports by commercial fishermen during 1996, provide encouraging signs for the recovery of lake sturgeon.

Deepwater Sculpin

Deepwater sculpin were formally abundant in the deep waters of lake Ontario, and were an integral part of the Lake Ontario benthic food web, including as a food source for lake trout. Three individuals of this species were caught in the 1996 index netting program but none were observed in 1997. Deepwater sculpin were thought to be extirpated from Lake Ontario since they had not been observed seen since 1972, and had not been abundant for over 50 years.

River Redhorse

River redhorse are listed by the Committee on the Status of Endangered Species as a vulnerable species. A single river redhorse was captured in the Bay of Quinte in our 1997 index trawling program. This is the first confirmed siting of this species locally.

Future Outlook

The eastern Lake Ontario and Bay of Quinte fish community is undergoing a dramatic period of restructuring in an environment of high predator demand (e.g., large lake whitefish population) but declining ecosystem productivity (e.g., zebra mussel impacts). We have observed negative impacts on the previously recovered lake whitefish and walleye populations, and lake trout populations have declined. At the same time, several other historically abundant species (e.g., lake trout, lake herring, lake sturgeon, and deepwater sculpin) have shown encouraging signs of recovery.

What the future will bring is impossible to predict—but more of the same should be expected. For example, lake whitefish and walleye abundance will likely decline; smallmouth bass and yellow perch abundance will increase in the Bay of Quinte but remain at low to moderate levels in Lake Ontario proper; and finally lake herring and lake sturgeon abundance will likely increase.

Table 1. Statistics for two lake sturgeon captured during index gillnetting, in the Outlet Basin (EB02) and lower Bay of Quinte (CO30), 1997.

Site	Date	Depth (m)	Water Temp (°C)	Mesh Size (mm)	Total Length (mm)	Weight (g)
EB02	26-Aug	30.0	11.8	152	500	549
CO30	08-Oct	30.0	12.2	140	570	932

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4

St. Lawrence River

R. Cholmondeley[1] T. J. Stewart
A. Mathers L. A. Marcogliese

Overview

The St. Lawrence River fisheries management program includes standardized fall gillnetting programs, creel surveys, and monitoring eels ascending the fishway at the R. H. Saunders Hydroelectric Dam in Cornwall. The fall gillnetting program in the St. Lawrence River is designed to detect long-term changes in the fish community and has been established in four distinct sections of the river: Thousand Islands, Middle Corridor, Lake St. Lawrence, and Lake St. Francis. These programs have been coordinated with the New York State Department of Environmental Conservation (NYSDEC) assessment programs to provide 'river-wide' coverage of fisheries resources. Between 1987 and 1995 gillnet assessment programs on the Ontario portion of the River were conducted in each section, every second year. The 1997 netting in the Thousands Islands (conducted between Kingston and Brockville, as described by Bendig 1996) continued the database established in 1987, and represented the seventh netting program in the Thousand Islands section of the St. Lawrence River.

American eel spawn in the Sargasso Sea and a portion of the juvenile female population migrate up the St. Lawrence River into Lake Ontario. The eels reside in Lake Ontario for several years before migrating back to sea. While in Lake Ontario the eels provide a highly valued commercial fishery (Stewart *et al.* 1997). An eel ladder was installed at the R.H. Saunders Hydroelectric Dam in Cornwall in 1974 to assist with the upstream migration of eel. Annual eel counts and a new index of recruitment, based on mean daily counts, was reported for the years 1974 to 1995 by Casselman *et al.* (1997a). In this report, we provide estimates for the total number of eels ascending the ladder and update the recruitment index for 1997.

Species Population Trends

This chapter provides updated trends in abundance for four fish species of local management interest. Yellow perch, smallmouth bass, and northern pike provide an important recreational fishery in the Thousand Islands area (Bendig 1995). In addition, the yellow perch and American eel support an important commercial fishery (Hoyle 1998).

Yellow Perch

The overall catch during 48 gillnet sets in the 1997 Thousand Islands project included 1,141 fish of 19 species (for a summary of standardized gillnet catch-per-unit-effort, see Appendix C). Yellow perch continued to be the most abundant fish captured in the Thousand Islands gillnet program The catches of yellow perch during 1995 and 1997 were good relative to the period between 1989 and 1993 (Fig. 1). A

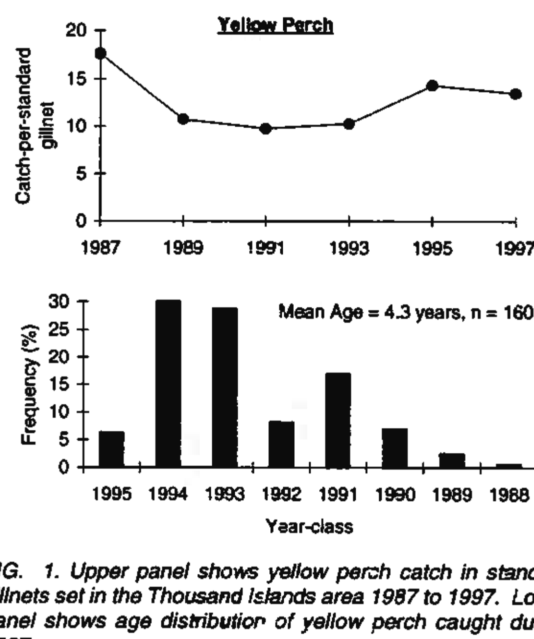

FIG. 1. Upper panel shows yellow perch catch in standard gillnets set in the Thousand Islands area 1987 to 1997. Lower panel shows age distribution of yellow perch caught during 1997.

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similar trend was reported by McCullough and Klindt (1997) for the catches of yellow perch in the New York waters of the Thousand Islands. Catches of yellow perch in the Eastern Basin of Lake Ontario have declined over the same time period (Hoyle 1998). Age distributions of the catch indicate that the 1993 and 1994 year classes (age 4 and 3 respectively) made up 69% of the total catch.

Smallmouth Bass

Smallmouth bass abundance in gillnets has declined dramatically since 1989 (Fig. 2). Similar declines in smallmouth bass catches have been reported over the same time period in the New York waters of the Thousand Islands (McCullough and Klindt 1997) and in the Eastern Basin of Lake Ontario (Hoyle 1998). Fish from the 1991 and 1993 year classes (6 and 4 years old, respectively) made up over 50% of the catch (Fig. 2). The low catches of fish from the 1996, 1995 and 1994 year-classes suggest that the smallmouth bass populations will remain at low abundance for the next few years.

Northern Pike

Northern pike catches have declined throughout the 1990's (Fig. 3). A similar decline in northern pike catches has been reported over the same time period in the New York waters of the Thousand Islands (McCullough and Klindt 1997). Fish aged 2, 3 and 4 made up 74% of the total catch (Fig. 3). No large year -classes appear to be entering the fishery.

Other Species

Pumpkinseed and rock bass are also monitored by this program and are commercially harvested on the St. Lawrence River. Pumpkinseed populations appear to have followed a similar trend as the smallmouth bass, peaking in 1989 and gradually declining over the next 8 years (Appendix C). Catches of pumpkinseed have declined by slightly more than half since 1989. Rock bass appear to be the only species which has increased in abundance since the inception of the netting program (Appendix C).

American Eel

In 1997, the eel ladder was opened on June 23 and closed on October 24 (124 days), and counts were obtained for 111 days (Stewart and Marcogliese 1998). The total count of eels was 6,116--the lowest number recorded since the installation of the ladder. The recruitment index (Casselman *et al.* 1997a) was 144 eels per day, based on the 31-day peak migration period occurring from July 5 to Aug 4, and was also the lowest value ever observed (Fig. 4). The recruitment index was correlated with commercial catches of eels 8 years later in Lake Ontario (Casselman *et al.* 1997b). Therefore, low indices of recruitment over the last

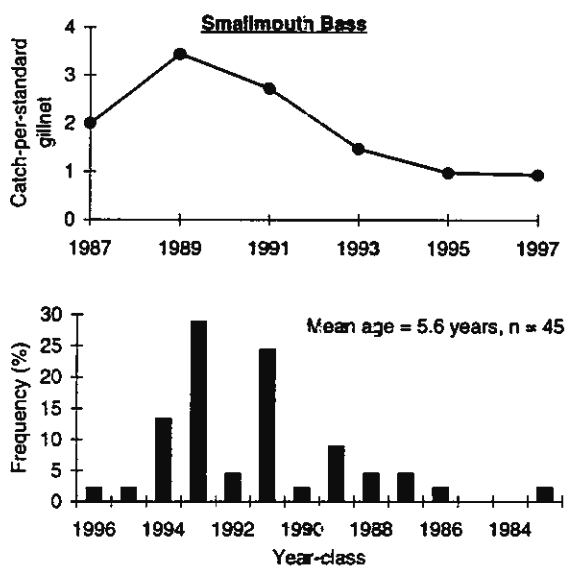

FIG. 2. Upper panel shows smallmouth bass catch in standard gillnets set in the Thousand Islands area, St. Lawrence River, 1987 to 1997. Lower panel shows age distribution of smallmouth bass caught during 1997.

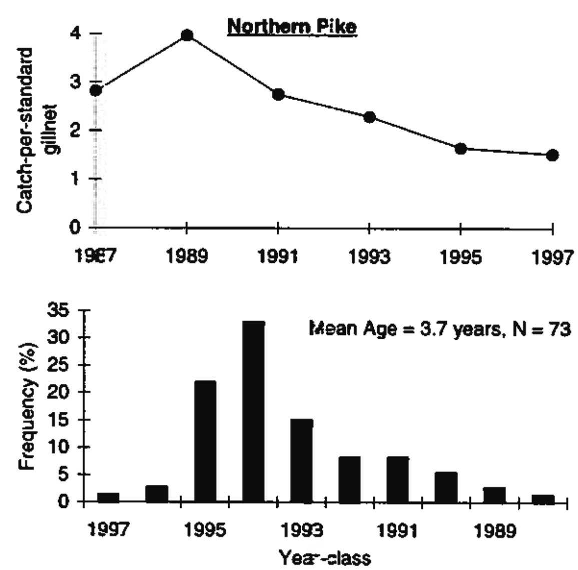

FIG. 3. Upper panel shows northern pike catch in standard gillnets set in the Thousand Islands area, St. Lawrence River, 1987 to 1997. Lower panel shows age distribution of northern pike caught during 1997.

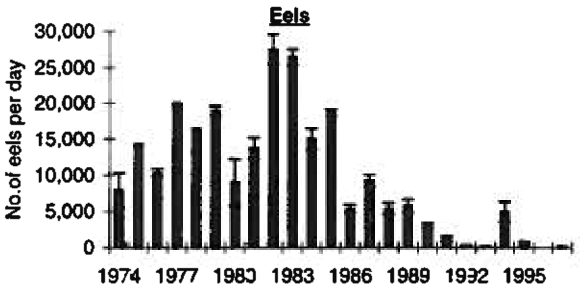

FIG. 4. Mean number of eels ascending the eel ladder per day at the R. H Saunders Hydroelectric Dam, Cornwall, Ontario during the 31-day peak migration period for the years 1974 to 1997. Vertical bars indicated the 95% confidence intervals. No counts were available for 1996. (Data from 1974 to 1995 re-drawn from data provide in Table 1, Casselman et al. 1997a).

decade (Fig 4) do not bode well for the future of the commercial eel fishery in Lake Ontario.

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5

Commercial Fisheries

J. A. Hoyle
R. Harvey

Overview

Lake Ontario supports a relatively small but locally significant commercial fish industry. The commercial harvest comes primarily from the Canadian waters of eastern Lake Ontario and the Bay of Quinte. In 1996, 1.3 million lb of fish valued at nearly $1.5 million were harvested from Canadian waters (Hoyle and Harvey 1997) compared to about 70,000 lb valued at $70,000 for New York waters of Lake Ontario (Cluett 1997).

The Canadian waters of the St. Lawrence River also supports a commercial fish harvest; 450,000 lb valued at $400,000 were harvested in 1996.

This chapter updates the 1997 commercial harvest for the Canadian waters of Lake Ontario and the St. Lawrence River.

Quota Management

The overall direction of commercial fish management on Lake Ontario is to support and assist the commercial fishing industry where consistent with the conservation and rehabilitation of fish stocks. In addition to protection of fish stocks, licence conditions attempt to reduce problems of incidental catch, and minimize conflicts with other resource users.

Decisions on commercial allocation are made on a *quota zone* basis (Fig. 1). Fish species for which direct harvest controls are necessary to meet fisheries management objectives are placed under quota management (Tables 1 and 2). These species include premium commercial species (e.g., lake whitefish, eel, black crappie, yellow perch), species with large

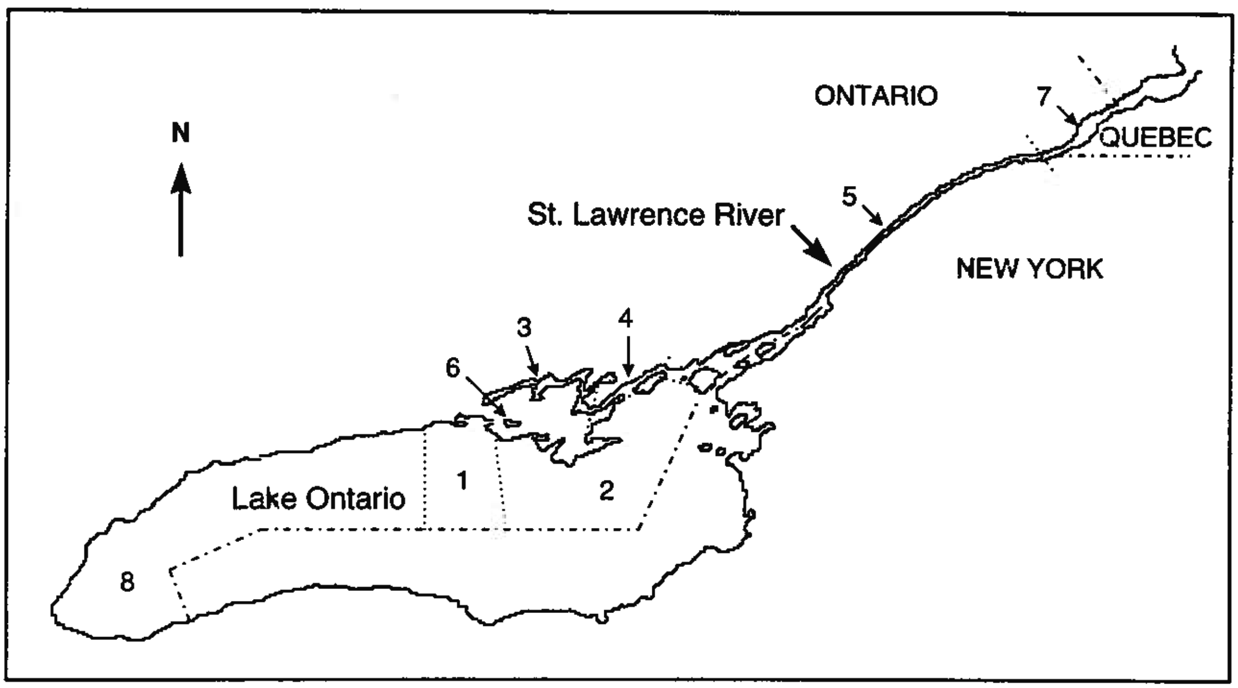

FIG. 1. Commercial fish quota zones on the Canadian waters of Lake Ontario and the St. Lawrence River. Quota Zone 5 is further divided into two areas, Napanee and Brockville portions of the St. Lawrence River, for reporting purposes.

TABLE 1. Commercial harvest quotas (lb) for the Canadian waters of Lake Ontario, 1997. For Quota Zone 1, eel and black crappie include quota from Consecon Lake, Quota Zone 6. See Fig. 1 for a map of the quota zones. Quota for species such as bullheads and sunfish in Lake Ontario embayments (e.g., East Lake, West Lake, Wellers Bay) are not given here but their 1997 harvest totals are included in Table 3.

	Quota (lb) by Quota Zone					
Species	1-1	1-2	1-3	1-4	1-8	Total
Lake whitefish	46,306	485,452	117,852	132,786	800	783,196
Lake herring	15,690	18,900	8,350	7,650	-	50,590
Round whitefish	10,000	-	-	-	-	10,000
Eel	41,830	246,130	63,309	34,883	3,600	389,752
Black crappie	3,940	15,700	11,250	800	2,850	34,540
Yellow perch	34,340	106,220	79,862	59,340	11,500	291,262
Walleye	6,131	48,637	-	11,231	600	66,599

TABLE 2. Commercial harvest quotas (lb) for the Canadian waters of the St. Lawrence River, 1997. See Fig. 1 for a map of the quota zones. Quota for species such as bullheads and sunfish are not given here but their 1997 harvest totals are included in Table 4.

	Quota (lb) by Quota Zone			
Species	Napanee (1-5)	Cornwall (1-7)	Brockville (2-5)	Total
Eel	31,190	48,420	26,940	106,550
Black crappie	20,628	5,940	14,052	40,620
Yellow perch	60,540	6,720	61,560	128,820

allocations to other users (e.g., walleye), and species at low levels of abundance or requiring rehabilitation (e.g., lake herring). In addition, some species traditionally thought of as coarse fish, have harvest controls for only some areas within a quota zone (e.g., bullheads, sunfish, carp and channel catfish in embayments of Lake Ontario or the St. Lawrence River).

Changes to commercial fish licensing conditions in 1997 included minor adjustments to quota; compare Table 1 in this report to Table 1 in Hoyle and Harvey (1997).

Lake Ontario

Commercial Harvest Summary

Fifty-five fishers held 129 commercial fishing licences in 1997. The total harvest of all species was just over 1 million lb in 1997 (Table 3). The total landed value was $1 million, down by one-third compared to 1996. The primary difference between the 1997 and 1996 commercial harvest was a much reduced lake whitefish harvest (down 30% to 452,184 lb) and value (down 60%, to $267,958).

Yellow perch harvest rebounded somewhat in 1997, having declined over the past number of years, showing a 13% increase in harvest (167,890 lb) compared to 1996. Yellow perch were the most important species in terms of value in 1997 ($343,729). Eel harvest continued its decline of recent years (64,311 lb) but, due to high prices, was still the third most valuable species ($137,730).

Biological Characteristics of the Harvest

Lake whitefish were monitored for biological characteristics. Sampling activities focused on the fall (October/November) trapnet fishery in the Bay of

TABLE 3. Commercial fish harvest (lb) and value ($) for fish species in the Canadian waters of Lake Ontario, 1997.

	Harvest by Quota Zone (lb)								
Species	1-1	1-2	1-3	1-4	1-6	1-8	Total	Price per lb	Value
Bowfin	3,126	1,597	2,966	-	159	-	7,348	$ 0.28	$ 2,222.09
Gizzard Shad	-	1	-	-	-	-	1	$ 0.10	$ 0.11
Lake whitefish	24,172	295,531	101,961	30,520	-	-	452,184	$ 0.59	$ 267,957.88
Lake herring	523	1,791	4,278	1,578	-	-	8,170	$ 0.43	$ 3,501.61
Mooneye	-	-	-	4	-	-	4		$ -
Suckers	410	2,807	4,067	53	-	25	7,362	$ 0.12	$ 881.14
Common carp	1,908	325	16,099	8	-	105	18,445	$ 0.16	$ 3,016.59
Brown bullhead	29,599	16,485	108,502	7,013	608	2,927	165,134	$ 0.37	$ 61,045.22
Channel catfish	26	1,482	536	134	-	1,787	3,965	$ 0.26	$ 1,026.08
Eel	6,366	36,950	14,869	3,247	37	2,842	64,311	$ 2.14	$ 137,730.38
Burbot	-	-	37	-	-	-	37	$ 0.10	$ 3.70
White perch	251	1,391	5,473	684	-	721	8,520	$ 0.82	$ 6,976.84
White bass	-	13	45	550	-	38	647	$ 1.07	$ 589.20
Rock bass	2,369	5,233	2,325	247	343	1,886	12,402	$ 0.37	$ 4,558.77
Black crappie	871	9,554	6,060	28	27	1,091	17,630	$ 2.27	$ 39,998.56
Sunfish	3,366	25,246	23,673	379	3,389	301	56,354	$ 0.79	$ 44,700.23
Yellow perch	3,903	61,795	51,056	45,168	-	5,968	167,890	$ 2.05	$ 343,729.04
Walleye	4,874	28,179	-	7,754	-	537	41,344	$ 1.73	$ 71,717.24
Freshwater drum	864	16,762	19,020	9,396	-	-	46,042	$ 0.14	$ 6,632.10
Total	82,630	505,143	360,966	106,761	4,563	18,229	1,078,292		$ 996,386.79

Quinte (Quota Zone 3), and the November gillnet fishery on the south shore of Prince Edward County (Quota Zone 2). As such, our survey covered the largest components of the total annual harvest for lake whitefish.

Lake whitefish harvest peaked in the early 1920s. From 1930 to the early 1960s the harvest was sustained at about 420,000 lb annually prior to crashing to insignificance in the 1970s (Christie 1973). Lake whitefish populations recovered during the 1980s and early 1990s thanks to good recruitment of both major spawning stocks—Lake Ontario and Bay of Quinte spawning stocks (Casselman *et al.* 1996).

The 1997 lake whitefish harvest was 452,184 lb, representing 60% of the 733,196 lb quota. Over 50% of the total lake whitefish harvest comes from Quota Zone 2 during the lake whitefish spawning run in November and December. The main gear type used in this fishery is 4 1/2 inch gillnets. Although this gear results in a highly selective harvest, some observations on year-class strength are apparent (Fig. 2). The 1987 and 1990 year-classes were the largest observed as young-of-the-year in bottom trawls, prior to 1994 (Lake Ontario stock, see Chapter 3 in this report), and provided 40% of the 1997 Quota Zone 2 commercial harvest (Fig. 2). The 1994 year-class is thought to be strong, and should enter this fishery in 1998.

The Quota Zone 3 fishery (October/November) is

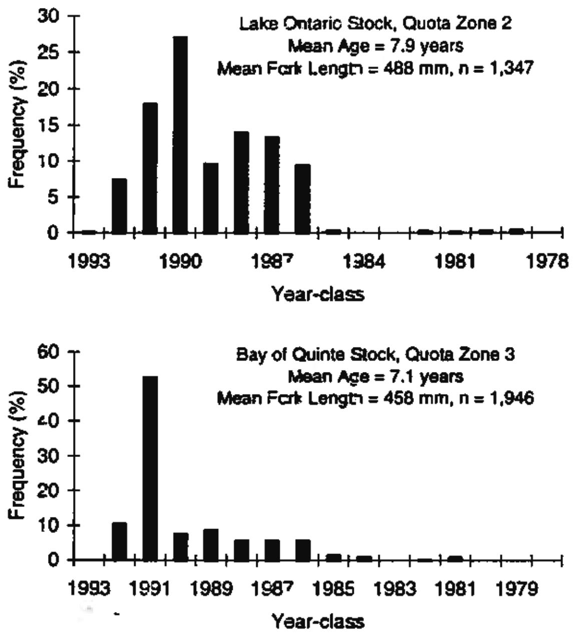

FIG. 2. Lake whitefish age distributions of the 1997 commercial harvest from Quota Zones 2(top panel) and 3 (lower panel).

primarily a trapnet fishery and generally harvests both smaller fish and wider size range of fish than the Quota Zone 2 gillnet fishery. The 1997 harvest was dominated by the 1991 year-class (Fig. 2). This year-class was the most abundant age-group in the commercial harvest for the past four years. The 1994 year-class of fish was also strong as measured by young-of-the-year but did not show up as 3-yr-olds in the 1997 commercial fishery. This is in direct contrast to the 1991 year-class which was the most abundant year-class in the 1994 commercial fishery at age 3.

St. Lawrence River

Commercial Harvest Summary

Twenty fishers held 33 commercial fishing licences in 1997. The total harvest of all species was 353,838 lb (Table 4). The total landed value of the harvest was $397,494.

Brown bullhead (112,331 lb), yellow perch (99,798 lb), and sunfish (62,536 lb) accounted for nearly 80% of the total harvest. The most important species in terms of value were yellow perch ($198,674) and eel ($68,007).

TABLE 4. Commercial fish harvest (lb) and value ($) for fish species in the Canadian waters of the St. Lawrence River, 1997.

Species	Harvest by Quota Zone (lb) Napanee (1-5)	Cornwall (1-7)	Brockville (2-5)	Total	Price per lb	Value
Bowfin	3,236	-	-	3,236	$ 0.33	$ 1,066.89
Lake whitefish	2	-	-	2	$ 1.00	$ 1.98
Suckers	1,154	6,369	-	7,523	$ 0.10	$ 755.55
Common carp	9,531	607	6,008	16,145	$ 0.17	$ 2,680.65
Brown bullhead	51,061	45,788	15,482	112,331	$ 0.44	$ 48,952.43
Channel catfish	516	112	-	628	$ 0.28	$ 173.27
Eel	5,796	20,342	5,949	32,087	$ 2.12	$ 68,007.24
White perch	3,355	200	-	3,555	$ 0.92	$ 3,266.12
White bass	6	-	-	6	$ 0.58	$ 3.60
Rock bass	665	-	1,024	1,689	$ 0.32	$ 535.08
Black crappie	12,121	579	1,506	14,207	$ 1.87	$ 26,525.90
Sunfish	28,206	16,194	18,136	62,536	$ 0.75	$ 46,838.85
Yellow perch	49,392	5,012	45,394	99,798	$ 1.99	$ 198,673.55
Freshwater drum	94	-	-	94	$ 0.14	$ 13.10
Total	165,135	95,203	93,500	353,838		$ 397,494.21

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6

Recreational Fisheries

J. A. Hoyle
J. N. Bowlby

Overview

The two largest recreational fisheries in Canadian waters of Lake Ontario are the Bay of Quinte walleye fishery, and the lake and tributary salmon and trout fishery.

Angler surveys have been conducted on the Bay of Quinte periodically since 1957 (Fig. 1). There is an ice fishery (from "ice-on" in December or January to the end of February) and an open-water (first Saturday in May to "ice-on". Traditionally, walleye have made up the bulk of the angling harvest. Fishing pressure was minimal on the Bay of Quinte when walleye populations were very low in the late 1960s and 1970s, and no angling surveys were conducted at that time. With the resurgence of walleye since 1978, a large sport fishery developed. Results of the 1997 angler surveys on the Bay of Quinte indicate that significant changes in the Bay of Quinte walleye fishery have now occurred over the last several years. Efforts to reduce pollution and the recent invasion of zebra mussels are likely the primary factors for Bay of Quinte ecosystem changes.

The salmon and trout fishery in Western Lake Ontario was monitored again in 1997 after one year of absence. Only the portion of the fishery that launches boats from ramps was monitored. This is consistent with our surveys from 1982 to 1995. Marina based boats were surveyed in 1989 and 1995 (Hoyle et al. 1996) to give a more complete picture of the boat

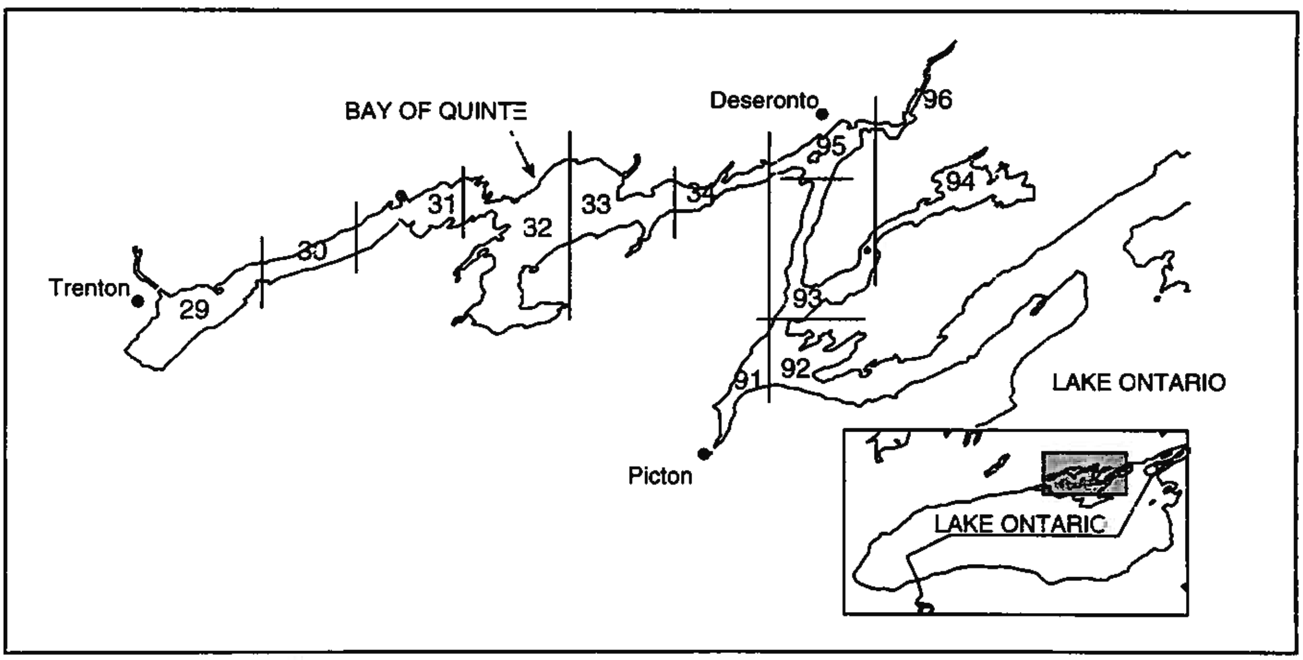

Fig. 1. Map of Bay of Quinte, eastern Lake Ontario, showing creel survey areas.

fishery, but this fishery was not surveyed in 1997.

In 1997, angling effort in the boat fishery was similar to that in 1995. Chinook salmon harvest increased compared to that in 1995 while rainbow trout harvest declined.

Bay of Quinte Walleye Fishery

Bay of Quinte recreational angling surveys are conducted annually during the walleye angling season (January 1 to February 28 and first Saturday in May to December 31). Angling effort is measured using aerial counts during ice fishing surveys, and a combination of aerial counts and on-water counts during open-water surveys. On-ice and on-water angler interviews provide information on catch/harvest rates and biological characteristics of the harvest. Detailed survey designs are reported by Hoyle (1996, 1997) for on-ice and on-water surveys, respectively.

Ice Fishery

Ice angling effort was estimated to be 264,315 rod-hours (Table 1). This fishing pressure was down over 40% from last year due to poor ice conditions and the resulting late start to the fishing season (Fig. 2). An estimated 42,315 walleye were caught of which 22,631 were harvested. Despite the short fishing season, the number of walleye harvested was up 10% from last year. Fishing success was the highest observed in 5 years with a harvest-per-unit-effort (HUE) of 0.086 walleye-per-rod-hour (Fig. 3 and Fig. 4). The average walleye harvested during the ice fishery was 484 mm fork length and weighed 1.5 kg.

Open-water fishery

Open-water fishing effort was estimated to be 508,221 rod-hours (Table 1, Fig. 2). Walleye catch was estimated at 129,709 fish of which 80,063 were harvested. The number of walleye harvested was down 30% from last year and down 37% compared to the average of the previous five years. Walleye angling success (0.158 walleye harvested-per-rod-hour in 1997) has been declining since 1991. The average walleye harvested during the open-water fishery was 395 mm fork length and weighed 0.75 kg.

Significant changes in the Bay of Quinte walleye fishery have now occurred over the last several years. For example, walleye fishing success during May has been declining steadily since 1991, as walleye movement and distribution patterns changed in response to ecosystem changes in the Bay, particularly

*TABLE 1. The seasonal distribution of angling effort and walleye catch and harvest for Bay of Quinte ice and open-water recreational fisheries, 1997. *Ice fishing walleye catch and harvest totals represent extrapolations from a partial geographic on-ice survey to the whole Bay of Quinte (note that aerial counts to determine fishing effort encompassed the whole Bay of Quinte), and are based on the geographic distribution of fishing success observed in 1993. **Open-water fishing effort and walleye catch and harvest for the fall season represent an extrapolation based on the seasonal pattern of fishing effort and success observed in 1993 and 1995 (August only).*

Season	Effort (rod-hours)	Catch	Harvest
Ice Fishery:			
Ice fishing total*	264,315	42,315	22,631
Open-water fishery:			
Opening weekend	59,693	8,139	6,267
May	182,231	36,388	23,776
June	99,200	44,97[illegible]	26,699
July	64,667	25,399	12,972
August**	60,526	11,380	8,807
Fall**	41,905	3,432	1,543
Open-water total	508,221	129,709	80,063
Annual total	772,536	172,024	102,694

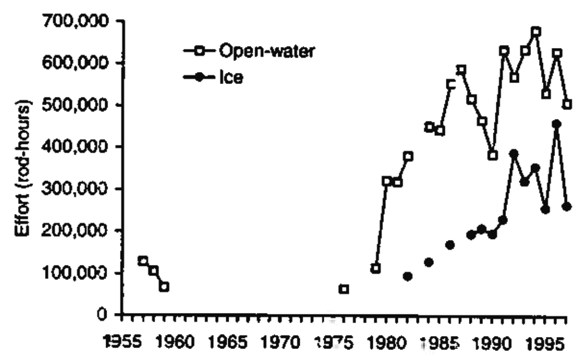

FIG. 2. Angling effort during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1997.

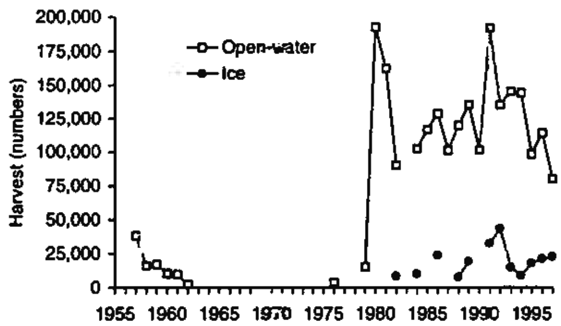

FIG. 3. Walleye harvest during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1997.

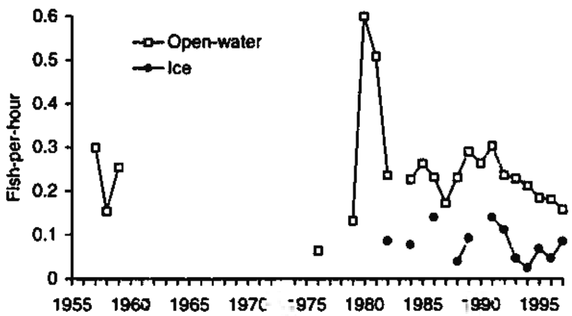

FIG. 4. Walleye harvest-per-unit-effort (HUE) during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1997.

clearer water. In 1997, anglers in May also reported catching large numbers of small yellow perch.

By way of contrast, walleye fishing success during June has been improving during recent years and has more than doubled since 1988. This result may be related to a decline in the numbers of alewife, the walleye's primary food source. In the past, anglers had difficulty catching walleye when large numbers of alewife migrated into the Bay of Quinte from Lake Ontario to spawn each June. Efforts to reduce pollution and the recent invasion of zebra mussels are likely the primary factors for Bay of Quinte ecosystem changes.

Western Lake Ontario Boat Fishery

The salmon and trout fishery in Western Lake Ontario was monitored again in 1997, after one year of absence. Only the portion of the fishery that launches boats from ramps was monitored. This is consistent with our surveys from 1982 to 1995. Marina based boats were surveyed in 1989 and 1995 (Hoyle et al. 1996) to give a more complete picture of the boat fishery, but this fishery was not surveyed in 1997.

The survey design in 1997 was consistent with past surveys of the 'launch daily' boat fishery. The design was based on seasonal stratification by month from April to September, and spatial stratification into 6 sectors from the Niagara River to Wellington (Hoyle et al. 1996: FIG. 1). Anglers were interviewed after fishing was completed at four launch ramps: St. Catharines Game and Fish, Fisherman's Wharf, Port Credit, and Bluffers Park, each representing catch and harvest statistics for a sector. Anglers were not surveyed at the two remaining sectors (Whitby to Wellington). Rather, the catch and harvest distribution from 1995, scaled to the 1997 results at the surveyed ramps, was assumed for Whitby to Wellington. Boat trailers were counted to index effort at all ramps from the Niagara River to Wellington (Table 2), and these counts were used to scale up effort, catch, and harvest, accordingly. Interviews were conducted at each of the four ramps (above) on 4 weekdays and 4 weekend days each month to cover all time periods of the day. Estimates for the total fishery were made using the ratio of effort, catch, and harvest between launch daily and marina based fisheries in 1995.

Effort

The effort in the western Lake Ontario boat fishery was unchanged in 1997 compared with 1995 (Fig. 5). In the western Lake Ontario boat fishery during 1997, the effort of launch daily anglers was estimated at 333,317 angler-hours, and the effort of all boat anglers was estimated at 531,072 angler-hours. Most of this effort occurred in July and August (Table 2) during the Toronto Star Great Salmon Hunt which may have helped to turn the downward trend in effort during recent years. The West and Northwest sectors which encompass the Toronto waterfront accounted for almost half the effort (Table 2).

Catch

Chinook salmon comprised about two-thirds of the catch and three-quarters of the harvest of salmonines in the launch daily fishery (Table 3). Lake trout and rainbow trout, together comprised about one-quarter of the catch. However, this is the only year that lake trout catch exceeded rainbow trout since 1985 (Fig. 5).

The chinook salmon catch in 1997 increased by 40% from 1995 (Fig. 5), and coho salmon catches more than doubled. The survival of stocked chinook may

TABLE 2. Mean trailer count on weekend days, 1000-1400 hours, at western Lake Ontario launch ramps (Ontario portion).

Sector	Ramp	Apr	May	Jun	Jul	Aug	Sep	Total
Southwest	Old Boat Works	0.8	0.0	0.0	0.0	0.0	0.0	0.8
	Queenston Sand Docks	4.8	5.3	5.0	3.3	7.5	12.0	37.8
	St.Catharines Game and Fish	15.3	11.3	7.3	11.5	10.3	13.0	68.5
	Beacon Motor Inn	3.3	1.8	2.3	3.3	6.5	4.5	21.5
	Sector total	24.0	18.3	14.5	18.0	24.3	29.5	128.5
West	Grimsby Municipal Ramp	0.5	1.8	1.3	0.5	2.0	0.3	6.3
	Foran's Marine	5.5	2.5	2.8	3.8	3.8	2.5	20.8
	Lakecourt Marina	2.3	0.3	0.0	1.0	0.3	0.5	4.3
	HRCA 50 Pt. Ramp	14.3	10.3	10.3	11.3	14.5	5.5	66.0
	Fisherman's Wharf	15.8	17.3	19.8	17.8	33.5	14.5	118.5
	Bronte Beach	2.0	5.3	14.8	16.5	25.5	5.5	69.5
	Shipyard Park	0.0	0.5	5.5	8.3	8.5	1.8	24.5
	Busby Park	1.3	0.3	1.3	0.8	0.5	0.3	4.3
	Sector total	41.5	38.0	55.5	59.8	88.5	30.8	314.0
Northwest	*Port Credit Ramp*	3.3	2.5	11.3	14.5	51.8	21.8	105.0
	Lakefront Promenade Park	2.8	3.0	13.0	20.8	58.0	19.8	117.3
	Marie-Curtis Park	0.3	0.0	1.0	2.3	4.3	0.5	8.3
	Humber Bay West	1.8	3.3	22.5	26.8	32.3	11.3	97.8
	Sector total	8.0	8.8	47.8	64.3	146.3	53.3	328.3
West Central	Ashbridges Bay	0.3	0.3	6.5	21.5	21.3	4.0	53.8
	Bluffers Park	0.5	1.3	15.3	56.0	62.0	8.8	143.8
	Frenchman's Bay West	2.5	1.5	2.8	5.3	7.5	0.5	20.0
	Frenchman's Bay East	0.0	0.0	0.0	0.0	1.3	0.8	2.0
	Duffin Creek	0.0	0.0	0.0	1.8	0.8	0.3	2.8
	Sector total	3.3	3.0	24.5	84.5	92.8	14.3	222.3
Central	Port Whitby Marina	0.0	0.0	0.0	1.4	0.7	0.7	2.8
	Whitby Gov't Ramp	0.7	0.0	2.1	14.7	21.1	1.4	40.0
	Port Oshawa Marina	0.0	0.0	2.1	11.2	19.0	2.1	34.4
	CLOCA P. Darlington Ramp	1.4	0.0	1.4	26.0	20.4	2.1	51.3
	Port Newcastle	0.0	0.0	1.4	4.2	4.9	0.7	11.2
	Port Hope Marina	4.9	0.0	0.0	14.0	11.9	1.4	32.3
	Cobourg Yacht Club	0.7	0.0	0.7	5.6	7.7	0.0	14.7
	Sector total	7.7	0.0	7.7	77.2	85.7	8.4	186.8
East Central	Ontario Street Ramp	0.0	4.2	2.8	16.2	15.4	2.1	40.7
	Brighton Marina	0.0	0.0	0.7	0.0	1.4	0.7	2.8
	Gosport Gov't Ramp	0.0	0.0	0.0	0.7	2.8	0.0	3.5
	Camp Barcovan	0.0	0.0	0.0	0.7	2.8	0.0	3.5
	McSaddens Marina	0.0	0.0	2.1	4.2	4.2	0.0	10.5
	Wellers Bay Marina	0.0	0.0	0.7	10.5	7.7	0.0	19.0
	North Shore Park	0.0	0.0	0.7	1.4	0.7	0.7	3.5
	Wellington Beach	5.6	4.2	2.1	23.9	23.9	1.4	61.1
	Wellington Gov't Ramp	1.4	0.0	2.1	17.6	14.0	0.7	35.8
	Sector total	7.0	8.4	11.2	75.1	73.0	5.6	180.5
Total		91.5	76.4	161.2	378.9	510.5	141.8	1360.3
Ramps with Anger Interviews		34.8	32.3	53.5	99.8	157.5	58.0	435.8
		(38%)	(42%)	(33%)	(26%)	(31%)	(41%)	(32%)

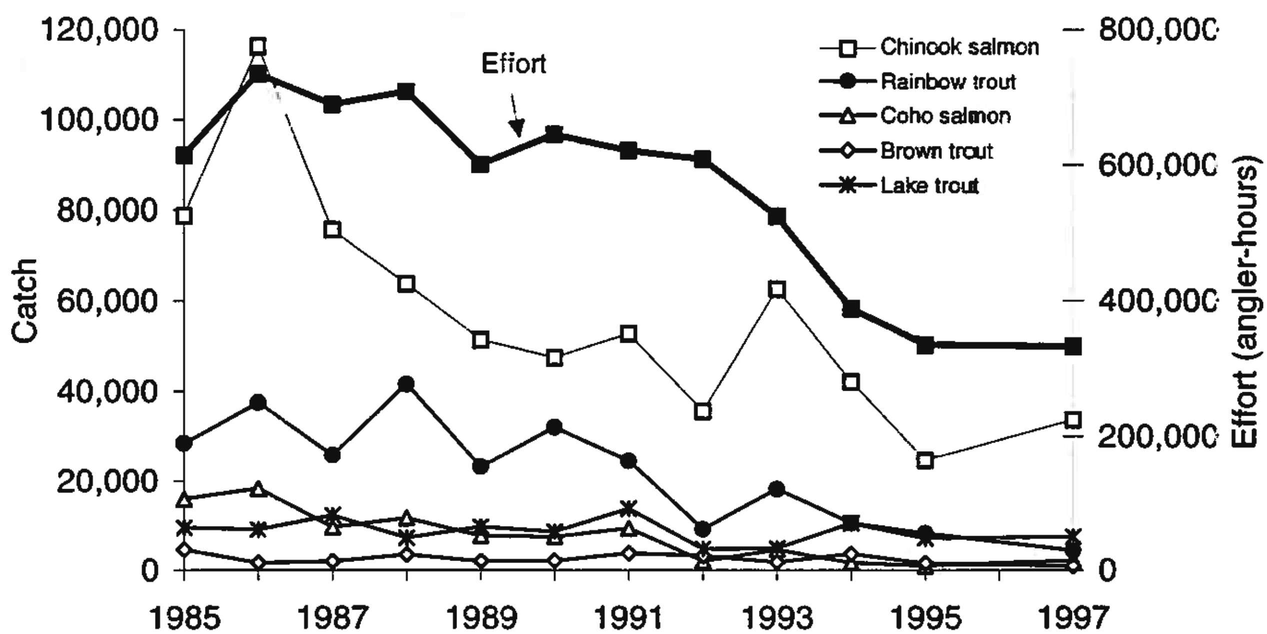

FIG. 5. Catch and effort in western Lake Ontario launch daily salmonid boat fishery (Ontario portion) from 1985 to 1997 (no sampling in 1996).

TABLE 3. Angling statistics for salmonid boat fisheries in western Lake Ontario (Ontario portion) during April to September 1997 (Catch and harvest rates are no. of fish per angler-hour).

Species	Launch Daily Anglers					All Boat Anglers				
	Catch	Harvest	Catch rate	Harvest rate	Release rate (%)	Catch	Harvest	Catch rate	Harvest rate	Release rate (%)
Chinook salmon	33,714	17,967	0.1011	0.0539	47	43,032	23,655	0.1291	0.0710	45
Rainbow trout	4,413	2,280	0.0132	0.0068	48	7,011	3,985	0.0210	0.0120	43
Coho salmon	2,194	1,206	0.0066	0.0036	45	2,620	1,474	0.0079	0.0044	44
Brown trout	955	575	0.0029	0.0017	40	1,820	1,035	0.0055	0.0031	43
Lake trout	7,575	2,014	0.0227	0.0060	73	17,075	2,322	0.0512	0.0070	86
Atlantic salmon	34	19	0.0001	0.0001	45	34	19	0.0001	0.0001	45
Unidentified salmonine	224	65	0.0007	0.0002	71	224	65	0.0007	0.0002	71
Total salmonines	49,110	24,125	0.1473	0.0724	51	71,816	32,555	0.2155	0.0977	55

have been quite good in 1995 and 1996, and increased natural reproduction may have contributed to these numbers, as well (see Chapter 2 in this report). Rainbow trout catch in 1997 declined by about one-half from 1995 to the lowest level since 1985 (Fig. 5). This decline, and the more general decline in rainbow trout catch since the late 1980s, has created some concern. These declines were likely due to: i) the survival of rainbow trout stocked by NYDEC in the Salmon River has declined (Bishop 1997); ii) during the 1990s Ontario reduced yearling stocking in favour of fall fingerlings which may have lower survival than yearlings; and iii) a series of poor wild rainbow trout year classes in Ontario tributaries (Bowlby *et al.* 1996). The brown trout catch in 1997 also declined by 38% from 1995 and this is the lowest since 1985 (Fig. 5). This is likely the result of stocking reductions in recent years by Ontario and also stocking a greater proportion of fall fingerling brown trout which may have lower survival than yearlings.

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7

Aboriginal Fisheries

A. Mathers
T. Northardt[1]

Overview

This survey monitors trends in fishing effort and harvest for aboriginal spear fisheries in the Bay of Quinte. By measuring changes in the harvest rates and biological characteristics of the fish harvested, these surveys provide information on the status of the fish populations which are useful to fisheries managers in their attempts to provide a healthy resource. Aboriginal fisheries in the Canadian waters of Lake Ontario include major aboriginal spear fisheries for walleye conducted during the spring at the mouths of the Napanee, Moira and Salmon Rivers. Surveys of the Napanee and Moira River fisheries have been conducted cooperatively by the Mohawks of the Bay of Quinte and the Ontario Ministry of Natural Resources since 1994 (Fig. 1).

Spear Fishery Summary

The spear fishery survey was conducted during the spring walleye run between April 14 and May 2, 1997 on the Napanee and Moira Rivers. Fishing effort was measured on randomly selected days using hourly counts of spearing activity on the rivers between 5 pm and 12 pm. Interviews with fishers provided information on catch rates and biological information on the fish harvested. The information collected during these samples was then expanded to estimate the fishing effort and harvest for the entire survey period.

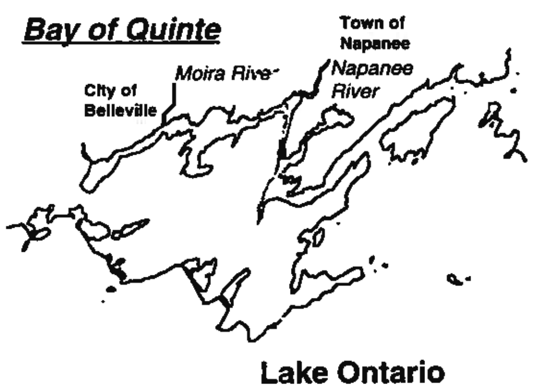

FIG. 1. Map of Bay of Quinte showing locations of Napanee and Moira Rivers.

Fishing effort was estimated to be 188 and 357 hours for the Napanee and Moira Rivers, respectively, during the 1997 survey period (Fig. 2). The combined fishing effort for the two rivers has increased over the four years surveyed. An estimated 3,405 walleye were harvested in the Napanee River which was double the 1996 estimate for this river (Fig. 3). The estimate for the Moira River was 6,467 walleye harvested which was a 30% increase compared to 1996. The fork length of the walleye harvested ranged between 320 mm and 770 mm (Fig. 4). Fish in the Napanee River averaged 628 mm in length while those harvested in the Moira River averaged 576 mm. Previous years' surveys have also shown larger fish being captured in the Napanee River. Female fish from both rivers combined averaged 635 mm, while males averaged 522 mm in length. The larger size of female fish has also been observed in previous surveys.

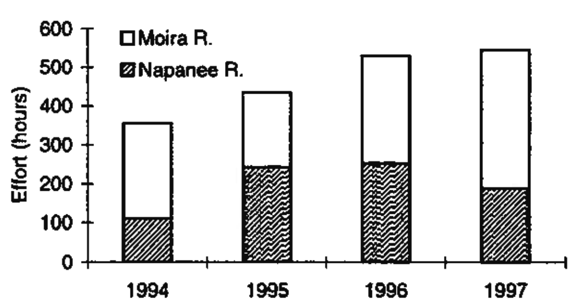

FIG. 2. Spear fishing effort in the Napanee and Moira Rivers, 1994 to 1997.

[1] Mohawks of the Bay of Quinte, R. R. #1, Deseronto, Ontario, K0K 1X0.

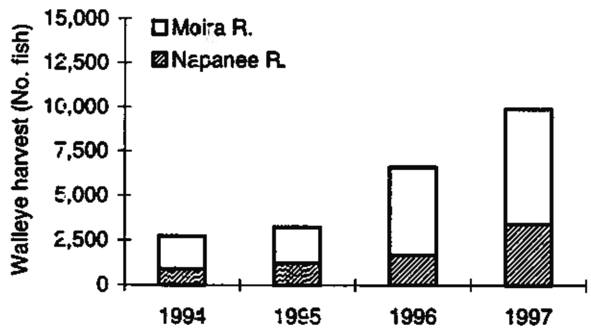

FIG. 3. Walleye harvest during spring spear fisheries in the Napanee and Moira Rivers, 1994 to 1997.

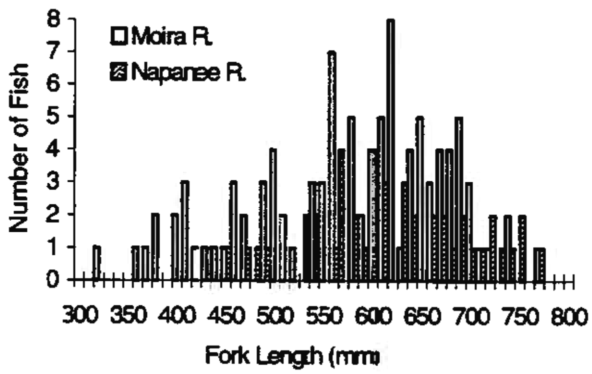

FIG. 4. Fork length of walleye harvested during spring spear fisheries in the Napanee and Moira Rivers during 1997.

8

Zebra and Quagga Mussels

T. Schaner

Overview

Zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*) are two related bivalve species introduced to North America in ballast water in the late 1980s. They are morphologically and functionally quite similar, and therefore the presence of two species, rather than a single one, was not noted until several years after the initial sighting (May and Marsden, 1992). The functional difference between the two *Dreissena* species lies mainly in their habitat preferences, with the quagga mussel being able to tolerate colder, deeper waters. There is considerable overlap in distributions of the two species in Lake Ontario.

The mussels can have a great impact on the ecosystem which they colonize. They are filter feeders, and they are usually characterized by high population densities. As a result, they are capable of consuming a significant portion of the plankton production of a lake, depressing the plankton abundance, and affecting the overall structure of the plankton community. The mussels also modify the bottom habitat, both structurally, and through excretion of waste products. These effects cascade through the ecosystem, resulting in readily observed changes, such as increase in water clarity, abundance and distribution of macrophytes, and shifts in the fish community.

Dreissena mussels arrived in Lake Ontario at a time when decreasing nutrient inputs (due to improving watershed management practices), and food demands of the stocked salmon and trout were starting to cause concerns for the ability of the lake to sustain fish harvests. The newly arrived mussels were anticipated to have an effect similar to that of decreasing nutrient levels, and this was one of the factors contributing to the decision to cut fish stocking levels in 1992. To monitor the spread of *Dreissena* in Lake Ontario, the Ontario Ministry of Natural Resources started a series of surveys in 1990. The initial surveys in 1990 and 1991 concentrated on detection of the free-floating *Dreissena* larvae (veligers), but starting in 1991 we began to measure densities of settled mussels. The surveys varied in sampling intensity and geographical coverage, starting with a survey in the western end of the lake, and moving east as the mussels colonized new areas. The most recent surveys in 1994, 1995 and 1997 concentrated on the Bay of Quinte.

The Main Lake

The western end of Lake Ontario was the first area to be colonized by *Dreissena*. This is where the first sighting was reported in 1989, and where a survey in 1991 detected the highest concentrations of veliger larvae (Schaner 1991). The highest concentrations of settled mussels were found in the south-eastern portion of the lake, between Niagara and Hamilton, where density estimates from the diving survey exceeded 10,000 individuals per square meter (Table 1). A repeated survey in 1993 showed somewhat higher densities, up to 17,000 individuals per square meter.

The spread of *Dreissena* proceeded along the south shore of the lake and probably reached the east end of the lake as early as 1991, when veligers were observed in several plankton samples from this area. The diving survey in 1993 revealed mussels at all surveyed locations in eastern Lake Ontario and the Kingston Basin, with densities on the order of hundreds to thousands of individuals per square meter (maximum detected density was $9{,}218 \cdot m^{-2}$, Table 1). More recent estimates from the Kingston Basin are not available, but densities in the adjoining areas reached tens of thousands of individuals per meter square (1994, Parrots Bay, $44{,}500 \cdot m^{-2}$; 1997, Conway, $81{,}700 \cdot m^{-2}$).

The central-north shore was colonized more slowly. Although some settled mussels were detected at all surveyed locations in the 1993 diving survey, the

Table 1. Estimates of Dreissena densities (individuals·m^{-2}, pooled species) from diving surveys in Lake Ontario. The estimates are based on extrapolations from counts of collected samples, except those marked as (a) which are based on divers' observations.

	Dreissena (zebra+quagga) density (individuals· m^2)					
	1991	1992	1993	1994	1995	1997
Western L.Ontario - Niagara to Hamilton	126 - 10,805		558 - 17,528			
Western L.Ontario - Hamilton to Toronto	26 - 148		52 - 840			
Petticoat Pt. (eastern L.Ontario)		50 (a)	950 (a)	3,672		
Kingston Basin			214 - 9,218			
Upper Bay of Quinte				445 - 389,448		26,312 - 82,580
- Makatewis Is. only (upper Bay)		0 (a)	2,580 (a)	389,448	40,477	82,580
- Trident Pt. only (upper Bay)		0(a)	0 (a)	141,980	121,728	39,750
Middle Bay of Quinte				967 - 46,552		28,032 - 31,684
Lower Bay of Quinte				9 - 2,086		8,270 - 120,615

(a) estimates based on divers' visual estimates (all other estimates are based on counts of collected *Dreissena*)

numbers were low, less than 30 individuals per square meter at any of the locations. We have no recent data from this portion of the lake, but it appears that the mussel populations here have been slow to build up, and it was not until 1997 for example, that settling *Dreissena* began to pose a problem at the water intakes of Pickering and Darlington nuclear generating station (R. Claudi, Ontario Hydro, pers. comm.).

The Bay of Quinte

Dreissena started colonizing the Bay of Quinte in 1993. Our surveys of whitefish spawning shoals (Makatewis Is. and Trident Pt. in 1992, Table 1) as well as a survey of navigational buoys (Wormington *et al.* 1993) suggest that there were no *Dreissena* in the bay in 1992. The first major concentration of mussels was detected in 1993 near Makatewis Island in the upper bay. In 1994, in an extensive diving survey we found *Dreissena* in most areas of the bay. The densities reached hundreds of thousands of individuals per square meter, exceeding those documented in the main lake (Table 1), and comparable to densities reported from Lake Erie (Griffith *et al.* 1991). A pattern of densities became apparent, with the highest numbers seen in the upper bay, and the numbers decreasing in the middle and lower bay. This is consistent with the 1993 and 1994 observations from navigational buoys (Wormington 1995), and it suggests that *Dreissena* first established themselves in the upper bay and proceeded to colonize downstream, carried by the water flow.

Up until now, the Bay of Quinte has been colonized by zebra mussels only. No quagga mussels were found in the upper and middle bay in any of the diving surveys so far. In the lower bay, quaggas were found only at sites immediately adjoining the Kingston Basin in 1993, and further up the bay at Glenora in 1997. It is not clear whether the absence of quaggas in the upper and middle bay is due to their preference for deeper waters or only a fortuitous and temporary delay.

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Appendices

Atlantic salmon stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
ATLANTIC SALMON - EARLY FRY									
Barnum House Cr.	Barn401	5	1996	White Lake	LeHave/Normandale	5	0.2	None	4,100
Credit R.	Black (Limehouse)	5	1996	White Lake	LeHave/Normandale	5	0.2	None	12,500
	Black17th	5	1996	White Lake	LeHave/Normandale	5	0.2	None	7,000
	W. Credit	5	1996	White Lake	LeHave/Normandale	5	0.2	None	10,000
CREDIT R. TOTAL									29,500
Duffin Cr.	DuHwy7	5	1996	White Lake	LeHave/Normandale	5	0.2	None	3,300
Ganaraska R.	CaCascades	5	1996	White Lake	LeHave/Normandale	5	0.2	None	4,100
	CaNomansl	5	1996	White Lake	LeHave/Normandale	5	0.2	None	4,000
GANARASKA R. TOTAL									8,100
Wilmot Cr.	Wm35/115	5	1996	White Lake	LeHave/Normandale	5	0.2	None	8,000
	Wm5thCon	5	1996	White Lake	LeHave/Normandale	5	0.2	None	3,700
	WmNursbr	5	1996	White Lake	LeHave/Normandale	5	0.2	None	4,500
WILMOT CR. TOTAL									16,200
Black Cr.	Stewarttown	5	1996	Credit River Anglers Association	LeHave/Normandale			None	16,998
ATLANTIC SALMON - ADVANCED FRY									
Bronte Cr.	BronteLow	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	8,802
	CedarSp.	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	7,190
BRONTE CR. TOTAL									15,992
Cobourg Cr.	CobCr74	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	7,301
Credit R.	BlTrib	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	8,377
	Silver Cr.	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	6,500
CREDIT R. TOTAL									14,877
Duffin Cr.	Du6thCon	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	4,500
Ganaraska R.	CaHydro	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	3,400
Proctors Cr.	ProcLake	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	523
Shelter Valley Cr.	SVChannel	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	5,175
	SVPark	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	2,700
SHELTER VALLEY CR. TOTAL									7,875
Wilmot Cr.	WmPisany	4	1996	Ringwood	LeHave/Normandale	4	1.0	None	4,899
ATLANTIC SALMON - FALL YEARLINGS									
Credit R.	Norval	11	1995	University of Guelph	LeHave/Normandale	23	250.0	None	197
		11	1995	University of Guelph	LeHave/Normandale	23	250.0	None	257
CREDIT R. TOTAL									454
ATLANTIC SALMON - ADULTS									
Credit R.	Whillans	10	1993	Codrington	LeHave/Normandale	46	1300.0	Tags/Radiotags	20
	Maletta	10	1993	Codrington	LeHave/Normandale	46	1300.0	Tags/Radiotags	20
	Forks	10	1993	Codrington	LeHave/Normandale	46	1300.0	Tags/Radiotags	13
	Norval	11	1994	University of Guelph	LeHave/Normandale	35	2000.0	None	5
CREDIT R. TOTAL									58
TOTAL ATLANTIC SALMON - EARLY FRY									78,198
TOTAL ATLANTIC SALMON - ADVANCED FRY									59,367
TOTAL ATLANTIC SALMON - FALL YEARLINGS									454
TOTAL ATLANTIC SALMON - ADULTS									58
TOTAL ATLANTIC SALMON									**138,077**

Brown trout stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
BROWN TROUT - FALL FINGERLINGS									
Lake Ontario	Bluffer's Park	10	1996	Harwood	Ganaraska/Normandale	11	19.6	Ad	12,601
		10	1996	Harwood	Ganaraska/Normandale	11	15.6	Ad	19,705
		10	1996	Harwood	Ganaraska/Normandale	11	15.6	Ad	17,354
		10	1996	Harwood	Ganaraska/Normandale	11	19.6	Ad	16,607
LAKE ONTARIO TOTAL									66,267
BROWN TROUT - YEARLINGS									
Bronte Cr.	Bronte Beach Park	3	1995	Ringwood	Ganaraska/Normandale	15	32.0	RV	7,550
		3	1995	Ringwood	Ganaraska/Normandale	15	30.4	RV	7,517
BRONTE CR. TOTAL									15,067
Duffins Cr.	Rotary Park Ramp	4	1995	White Lake	Ganaraska/Normandale	15	16.0	RV	9,123
Lake Ontario	Ashbridge's Bay	3	1995	Ringwood	Ganaraska/Normandale	15	28.9	RV	7,504
		3	1995	Ringwood	Ganaraska/Normandale	15	28.3	RV	7,544
	Bluffer's Park	5	1995	Harwood	Ganaraska/Normandale	18	45.9	AdRV	5,423
	Burlington Canal	4	1995	Harwood	Ganaraska/Normandale	17	36.3	RV	16,536
	Fifty Point CA	4	1995	Harwood	Ganaraska/Normandale	17	35.6	RV	17,020
	Jordan Harbour	3	1995	Normandale	Ganaraska/Normandale	14	30.8	RV	6,490
		3	1995	Normandale	Ganaraska/Normandale	14	30.8	RV	6,490
		4	1995	Normandale	Ganaraska/Normandale	15	30.7	RV	5,407
	Lakefront Promenade	3	1995	Ringwood	Ganaraska/Normandale	15	30.2	RV	7,550
		3	1995	Ringwood	Ganaraska/Normandale	15	30.5	RV	7,522
	Lakeport	4	1995	White Lake	Ganaraska/Normandale	15	16.0	RV	12,932
	Millhaven Wharf	4	1995	White Lake	Ganaraska/Normandale	15	16.0	RV	15,909
	Oshawa Harbour	4	1995	White Lake	Ganaraska/Normandale	15	16.0	RV	9,625
	Port Dalhousie East	3	1995	Normandale	Ganaraska/Normandale	14	36.1	RV	5,540
		3	1995	Normandale	Ganaraska/Normandale	14	30.7	RV	6,510
		4	1995	Normandale	Ganaraska/Normandale	15	34.1	RV	17,595
LAKE ONTARIO TOTAL									155,597
TOTAL BROWN TROUT FALL FINGERLINGS									66,267
TOTAL BROWN TROUT YEARLINGS									179,787
TOTAL BROWN TROUT									**246,054**

Chinook salmon stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
CHINOOK SALMON - SPRING FINGERLINGS									
Bowmanville Cr.	CLOCA Ramp	4	1996	Ringwood	Lake Ontario	4	5.3	None	25,323
Bronte Cr.	2nd Side Rd Bridge	5	1996	Ringwood	Lake Ontario	5	4.7	None	25,274
	5th Side Rd Bridge	5	1996	Ringwood	Lake Ontario	5	4.7	None	25,274
BRONTE CR. TOTAL									50,548
Cobourg Cr	South of King St.	4	1996	Ringwood	Lake Ontario	4	5.3	None	25,324
		4	1996	Sir Sandford Fleming College	Lake Ontario	5	3.9	None	3,495
COBOURG CR. TOTAL									28,819
Credit R.	Eldorado Park	4	1996	Ringwood	Lake Ontario	4	5.0	None	50,700
		5	1996	Ringwood	Lake Ontario	5	4.4	None	12,655
	Norval	4	1996	Ringwood	Lake Ontario	4	4.5	None	51,053
		5	1996	Ringwood	Lake Ontario	5	4.4	None	12,654
CREDIT R. TOTAL									127,062
Lake Ontario	Ashbridge's Bay Ramp	4	1996	Ringwood	Lake Ontario	4	4.2	None	25,547
	Barcovan Beach	4	1996	Ringwood	Lake Ontario	4	4.6	None	25,277
	Bluffer's Park	4	1996	Ringwood	Lake Ontario	4	4.2	None	25,548
		5	1996	Ringwood	Lake Ontario	5	4.6	None	50,700
	Burlington Canal	5	1996	Ringwood	Lake Ontario	5	4.5	None	50,560
	Jordan Harbour	5	1996	Ringwood	Lake Ontario	5	4.4	None	25,309
	Oshawa Harbour	4	1996	Ringwood	Lake Ontario	4	4.5	None	25,281
	Port Dalhousie East	4	1996	Ringwood	Lake Ontario	4	4.4	None	50,540
		4	1996	Ringwood	Lake Ontario	4	4.3	None	51,048
	Wellington Channel	4	1996	Ringwood	Lake Ontario	4	4.6	None	25,278
	Whitby Harbour	4	1996	Ringwood	Lake Ontario	4	4.5	None	25,280
LAKE ONTARIO TOTAL									380,368
TOTAL CHINOOK SALMON									**612,120**

Coho salmon stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
Credit R.	Norval	10	1996	Ringwood	Salmon River	8	23.6	AdRV	9,986
TOTAL COHO SALMON									**9,986**

Lake trout stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
LAKE TROUT - YEARLINGS									
Lake Ontario	Bluffer's Park	4	1995	Harwood	Slate Islands/Hills Lake	17	18.0	Ad	28,353
	Cobourg HB Pier	4	1995	Harwood	Slate Islands/Hills Lake	17	17.3	Ad	20,859
		4	1995	Harwood	Slate Islands/Hills Lake	17	17.8	Ad	19,156
	COBOURG TOTAL								40,015
	Fifty Point CA	4	1995	Harwood	Seneca Lake/Harwood	16	16.8	Ad	28,252
		4	1995	Harwood	Slate Island/Hills Lake	17	20.4	Ad	11,546
	FIFTY POINT TOTAL								39,798
	N of Main Duck Sill	4	1995	Harwood	Seneca Lake/Harwood	16	16.0	Ad	18,187
		4	1995	Harwood	Seneca Lake/Harwood	16	16.6	Ad	17,001
		4	1995	Harwood	Seneca Lake/Harwood	16	17.0	Ad	18,905
		4	1995	Harwood	Seneca Lake/Harwood	16	15.9	Ad	20,297
		4	1995	Harwood	Seneca Lake/Harwood	16	16.5	Ad	5,590
		4	1995	Harwood	Michipicoten Island/Dorion	17	29.2	Ad	10,981
		4	1995	Harwood	Michipicoten Island/Dorion	17	29.4	Ad	5,586
		4	1995	Harwood	Michipicoten Island/Dorion	17	28.9	Ad	7,902
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.2	Ad	5,534
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.9	Ad	11,083
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.0	Ad	10,057
	MAIN DUCK SILL TOTAL								131,123
	S of Long Point	4	1995	Harwood	Seneca Lake/Harwood	16	15.9	Ad	17,045
		4	1995	Harwood	Seneca Lake/Harwood	16	16.5	Ad	16,958
		4	1995	Harwood	Seneca Lake/Harwood	16	16.5	Ad	19,410
		4	1995	Harwood	Seneca Lake/Harwood	16	16.6	Ad	19,380
		4	1995	Harwood	Seneca Lake/Harwood	16	16.3	Ad	7,181
		4	1995	Harwood	Michipicoten Island/Dorion	17	29.2	Ad	4,481
		4	1995	Harwood	Michipicoten Island/Dorion	17	28.9	Ad	7,056
		4	1995	Harwood	Michipicoten Island/Dorion	17	29.0	Ad	11,069
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.2	Ad	6,737
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.4	Ad	11,299
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	28.6	Ad	9,259
	LONG POINT TOTAL								129,875
	Scotch Bonnet Shoal	4	1995	Harwood	Seneca Lake/Harwood	16	19.3	Ad	4,366
		4	1995	Harwood	Seneca Lake/Harwood	16	19.5	Ad	15,415
		4	1995	Harwood	Seneca Lake/Harwood	16	21.2	Ad	21,536
		4	1995	Harwood	Michipicoten Island/Dorion	17	31.9	Ad	220
		4	1995	Harwood	Michipicoten Island/Dorion	17	31.8	Ad	6,762
		4	1995	Harwood	Michipicoten Island/Dorion	17	31.8	Ad	9,442
		4	1995	Harwood	Michipicoten Island/Dorion	17	31.8	Ad	6,773
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	27.4	Ad	10,972
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	25.7	Ad	3,310
		4	1995	Harwood	Mishibishu Lakes/Tarentorus	17	25.7	Ad	11,689
	SCOTCH BONNET SHOAL TOTAL								90,485
TOTAL LAKE TROUT YEARLINGS									459,649

Appendix A

Rainbow trout stocked in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
RAINBOW TROUT - FRY									
Credit R.	Black Cr.	5	1997	Credit River Anglers Association	Credit R.-wild egg collection			None	25,000
	Papermill Dam to Norval	5	1997	Credit River Anglers Association	Credit R.-wild egg collection			None	130,000
	Silver Cr.	5	1997	Credit River Anglers Association	Credit R.-wild egg collection			None	90,000
CREDIT R. TOTAL									245,000
Don R.	East Don R.	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	5,000
		6	1997	Metro East Anglers Association	Unknown	0	0.2	None	5,000
DON R. TOTAL									10,000
Highland Cr.	Centennial Cr.	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	5,000
Rouge R.	Berczy Cr.	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	2,500
	Burndenette Cr.	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	2,500
	Leno Park	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	10,000
	Morningside Cr.	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	5,000
		6	1997	Metro East Anglers Association	Unknown	0	0.2	None	5,000
	Robinson Cr	6	1997	Metro East Anglers Association	Unknown	0	0.2	None	2,500
ROUGE R. TOTAL									27,500
RAINBOW TROUT - FALL FINGERLINGS									
Bronte Cr.	5th Side Rd Bridge	11	1997	Normandale	Ganaraska/Normandale	7	8.4	Ad	12,510
	Lowville Park	11	1997	Normandale	Ganaraska/Normandale	7	8.4	Ad	12,510
BRONTE CR. TOTAL									25,020
Credit R.	Huttonville	11	1997	Normandale	Ganaraska/Normandale	7	7.3	Ad	12,553
	Norval	11	1997	Normandale	Ganaraska/Normandale	7	8.4	Ad	10,662
		11	1997	Normandale	Ganaraska/Normandale	7	7.3	Ad	1,888
CREDIT R. TOTAL									25,103
Humber R.	E Branch Mill Road	11	1997	Normandale	Ganaraska	6	3.8	Ad	12,570
	E Humber R Kirby Road	11	1997	Normandale	Ganaraska	6	3.8	Ad	11,904
		11	1997	Normandale	Ganaraska	6	3.9	Ad	667
HUMBER R. TOTAL									25,141
Lake Ontario	Port Dalhousie East	11	1997	Normandale	Ganaraska	6	3.6	Ad	1,404
		11	1997	Normandale	Ganaraska/Normandale	7	7.3	Ad	24,069
LAKE ONTARIO TOTAL									25,473
Rouge R.	Berczy Cr.	11	1997	Normandale	Ganaraska	6	3.8	Ad	8,387
	Bruce Cr.	11	1997	Normandale	Ganaraska	6	3.8	Ad	8,387
	Silver Spring Farms	11	1997	Normandale	Ganaraska	6	3.9	Ad	8,389
ROUGE R. TOTAL									25,163
RAINBOW TROUT - YEARLINGS									
Bronte Cr.	5th Side Rd Bridge	4	1996	Normandale	Ganaraska/Normandale	12	10.9	RV	10,000
	Lowville Park	4	1996	Normandale	Ganaraska/Normandale	12	10.9	RV	10,090
BRONTE CR. TOTAL									20,090
Credit R.	Huttonville	4	1996	Normandale	Ganaraska/Normandale	11	8.0	RV	10,000
	Norval	4	1996	Normandale	Ganaraska/Normandale	11	8.0	RV	10,000
CREDIT R. TOTAL									20,000
Humber R.	E Branch Mill Road	5	1996	Normandale	Ganaraska/Normandale	13	11.5	RV	5,210
	E Humber R Kirby Road	4	1996	Normandale	Ganaraska/Normandale	12	10.9	RV	10,089
		5	1996	Normandale	Ganaraska/Normandale	12	11.5	RV	4,780
HUMBER R. TOTAL									20,079
Lake Ontario	Glenora	4	1996	Normandale	Ganaraska/Normandale	11	10.8	RP	11,110
	Jordan Harbour	4	1996	Normandale	Ganaraska/Normandale	11	7.6	RV	21,700
	Long Point Pier	4	1996	Normandale	Ganaraska/Normandale	11	10.8	RP	5,555
	Millhaven Wharf	4	1996	Normandale	Ganaraska/Normandale	11	10.8	RP	5,555
LAKE ONTARIO TOTAL									43,920
Rouge R.	Bruce Cr.	6	1996	Normandale	Ganaraska/Normandale	13	15.1	RV	9,875
	Silver Spring Farms	5	1996	Normandale	Ganaraska/Normandale	12	11.5	RV	5,040
ROUGE R. TOTAL									14,915
TOTAL RAINBOW TROUT FRY									287,500
TOTAL RAINBOW TROUT FALL FINGERLINGS									125,900
TOTAL RAINBOW TROUT YEARLINGS*									119,004
TOTAL RAINBOW TROUT									532,404

*an additional 360,000 rainbow trout yearlings escaped from a privately owned cage culture operation into Prince Edward Bay, Lake Ontario.

Walleye transferred in the Province of Ontario waters of Lake Ontario, 1997.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Transferred
Hamilton Harbour*	Waterfront Park	10			Bay of Quinte		900	None	130
TOTAL WALLEYE									**130**

* Transfer of wild fish from Bay of Quinte to Hamilton Harbour as part of Remedial Action Plan objective to increase predators in the harbour.

Species-specific catch-per-standard gillnet lift, Northeast Lake Ontario, 1997.

	Brighton					Middle Ground	Rocky Point									Wellington				
Species / Depth (m)	8	13	18	23	28	5	8	13	18	23	28	60	80	100	140	8	13	18	23	28
Sea lamprey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake sturgeon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alewife	98	228	213	766	79	11	460	641	199	420	1543	39	63	3	11	54	33	43	159	123
Gizzard shad	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	3
Brown trout	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	3	0	3	0
Brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	3	0	26	59	72	26	33	33	53	56	76	72	48	14	4	0	0	0	7	20
Lake whitefish	0	0	0	3	10	0	0	0	14	13	10	0	0	0	0	0	0	0	0	0
Lake herring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Round whitefish	0	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smelt	0	0	0	0	0	0	0	0	0	0	0	5	5	3	2	0	0	0	0	0
Northern pike	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Mooneye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White Sucker	7	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silver redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carp	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spottail shiner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Channel catfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	0	3	0	3	0	0	0	0	3	0	3	0	0	2	0	0	0	3	3
White perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	0	0	0	3	14	0	0	0	0	0	0	0	0	0	11	0	0	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow perch	425	228	0	0	0	282	0	0	0	0	0	0	0	0	0	309	115	0	64	3
Walleye	0	0	0	0	0	3	26	0	0	0	0	0	0	0	0	0	0	0	0	0
Freshwater drum	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	14	3	0	0	0

Species-specific catch-per-standard gillnet lift, Outlet Basin Lake Ontario, 1997.

	Eastern Basin		Flatt Point					Grape Island					Melville Shoal				
Species / Depth (m)	30 (02)	30 (06)	8	13	18	23	28	8	13	18	23	28	8	13	18	23	28
Sea lamprey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake sturgeon	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alewife	15	25	558	110	11	666	272	713	319	1594	311	0	188	112	152	98	0
Gizzard shad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown trout	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	83	75	10	10	13	33	92	0	0	23	30	105	0	0	3	23	69
Lake whitefish	56	11	0	0	10	16	16	3	0	7	26	59	0	0	0	7	7
Lake herring	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Round whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smelt	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern pike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mooneye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White Sucker	0	0	0	0	0	0	10	0	3	0	0	0	0	0	0	0	0
Silver redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Carp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Spottail shiner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Channel catfish	0	0	0	0	0	0	0	0	0	0	0	0	11	0	3	0	0
Eel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burbot	1	1	0	0	0	0	0	0	0	7	7	0	0	0	3	3	3
White perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	0	3	0	0	3	22	32	0	0	0	21	46	27	0	0
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bluegill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	11	0	0	0	0	3	25	0	0	0	7	0	0	0	0
Yellow perch	1	0	35	292	94	7	55	32	95	24	0	0	87	59	489	132	17
Walleye	1	0	0	0	0	0	0	20	16	0	3	0	168	72	23	3	0
Freshwater drum	0	0	0	0	0	0	0	13	0	0	0	0	0	3	0	0	0

Species-specific catch-per-standard gillnet lift, Bay of Quinte, 1997.

	Big Bay			Conway			Hay Bay	
Species / Depth (m)	05	08	13	20	30	45	08	13
Sea lamprey	0	0	0	0	0	0	0	0
Lake sturgeon	0	0	0	0	0	0	0	0
Longnose gar	12	0	0	0	0	0	0	0
Alewife	26	192	477	655	23	0	46	51
Gizzard shad	0	0	0	0	0	0	10	0
Chinook salmon	0	0	0	0	0	0	0	0
Brown trout	0	0	0	7	0	0	0	0
Brook trout	0	0	0	0	0	0	0	0
Lake trout	0	0	0	7	37	30	0	0
Lake whitefish	0	0	0	0	13	2	0	2
Lake herring	0	0	0	0	2	0	8	163
Round whitefish	0	0	0	0	0	0	0	0
Coregonus	0	0	0	0	0	0	2	3
Smelt	0	0	0	0	0	3	0	2
Northern pike	2	2	0	0	0	0	3	3
Mooneye	3	0	0	0	0	0	0	0
White Sucker	54	15	16	7	2	0	56	87
Silver redhorse	0	0	0	0	0	0	0	0
Redhorse	3	2	0	0	0	0	0	0
Carp	7	3	0	0	0	0	0	0
Spottail shiner	0	0	0	0	0	0	0	0
Brown bullhead	31	0	2	0	0	0	2	0
Channel catfish	2	2	0	0	2	0	0	0
Eel	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	2	0	0	0
White perch	306	5	3	0	0	0	72	10
Rock bass	12	46	13	0	0	0	0	0
Pumpkinseed	21	0	0	0	0	0	3	0
Bluegill	7	0	0	0	0	0	0	0
Smallmouth bass	49	8	2	0	0	0	0	0
Yellow perch	1433	503	465	271	25	0	1362	939
Walleye	86	71	43	3	0	0	54	7
Freshwater drum	120	12	12	0	0	0	10	3

Species-specific catch-per-trawl, Bay of Quinte and Lake Ontario, 1997.

	Bay of Quinte						Lake Ontario				
Species	Trenton	Belleville	Big Bay	Deseronto	Hay Bay	Conway	EB02	EB03	EB06	Rocky Point	Cobourg
Alewife	6	0	1	6	21	245	77	313	0	14	18
Gizzard shad	114	77	4	1	0	0	0	0	0	0	0
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0
Lake trout	0	0	0	0	0	0	0	0	0	0	0
Lake whitefish	0	0	0	0	0	6	5	11	0	0	0
Lake herring	0	0	0	0	0	0	0	0	0	0	0
Rainbow smelt	0	0	1	0	0	47	283	1730	265	438	629
Northern pike	0	0	0	0	0	0	0	0	0	0	0
White sucker	1	2	2	0	3	1	0	0	0	0	0
Redhorse sucker	0	0	0	0	0	0	0	0	0	0	0
Carp	0	0	0	0	0	0	0	0	0	0	0
Spottail shiner	164	22	11	14	13	0	0	0	0	0	0
Brown bullhead	61	9	17	13	2	0	0	0	0	0	0
Channel catfish	1	0	0	0	0	0	0	0	0	0	0
Eel	0	0	0	0	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0	0	0
Brook stickleback	0	0	0	0	0	0	0	0	0	0	0
Threespine stickleback	0	0	0	0	0	0	5	144	0	0	0
Trout-perch	21	25	7	0	20	254	1	191	1	0	0
White perch	1458	659	851	249	298	1	0	0	0	0	0
White bass	1	8	7	1	0	0	0	0	0	0	0
Rock bass	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed sunfish	90	38	20	19	3	0	0	0	0	0	0
Bluegill sunfish	0	0	5	0	0	0	0	0	0	0	0
Smallmouth bass	2	1	0	0	0	0	0	0	0	0	0
Largemouth bass	8	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	1	0	0	0	0	0	0	0	0
Yellow perch	523	64	80	172	561	14	0	0	0	0	0
Walleye	5	12	10	3	3	0	0	0	0	0	0
Johnny darter	3	2	0	0	0	1	0	0	0	0	0
Logperch	8	0	0	0	0	0	0	0	0	0	0
Frehwater drum	4	18	12	7	2	0	0	0	0	0	0
Mottled sculpin	0	0	0	0	0	0	0	0	0	0	0
Slimy sculpin	0	0	0	0	0	0	1	1	1	19	448

Species-specific catch-per-standard-gillnet lift, Thousand Islands area, St. Lawrence River, 1997.

	1987	1989	1989	1991	1993	1995	1997
Longnose gar	0.00	0.00	0.00	0.02	0.00	0.00	0.02
Bowfin	0.05	0.08	0.06	0.00	0.04	0.02	0.04
Alewife	0.31	0.00	0.00	0.06	0.02	0.02	0.00
Gizzard shad	0.00	0.26	0.23	0.29	0.00	0.00	0.00
Chinook salmon	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Brown trout	0.00	0.03	0.02	0.00	0.00	0.00	0.00
Rainbow trout	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Lake trout	0.00	0.08	0.10	0.00	0.10	0.08	0.08
Lake herring	0.00	0.00	0.02	0.00	0.00	0.04	0.00
Northern pike	2.82	4.26	3.96	2.75	2.29	1.65	1.52
Muskellunge	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Esocidae hybrids	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Mooneye	0.03	0.00	0.00	0.00	0.00	0.00	0.00
White sucker	0.69	1.33	1.29	0.88	0.94	0.87	0.79
Moxostoma sp.	0.00	0.05	0.08	0.04	0.08	0.21	0.00
Common carp	0.03	0.08	0.06	0.06	0.02	0.06	0.23
Chub	0.00	0.03	0.02	0.00	0.00	0.00	0.00
Golden shiner	0.03	0.03	0.02	0.00	0.04	0.02	0.00
Brown bullhead	1.62	1.13	1.13	1.56	0.67	0.60	1.21
Channel catfish	0.51	0.05	0.08	0.35	0.10	0.19	0.19
White perch	0.05	0.00	0.00	0.23	0.02	0.04	0.00
White bass	0.03	0.38	0.46	0.27	0.15	0.00	0.04
Rock bass	2.62	2.82	3.08	3.44	3.02	3.52	3.08
Pumpkinseed	2.92	3.92	3.67	3.68	2.46	1.77	1.52
Bluegill	0.41	0.56	0.48	0.27	0.04	0.00	0.10
Smallmouth bass	2.00	3.59	3.44	2.73	1.48	0.98	0.94
Largemouth bass	0.08	0.23	0.25	0.08	0.10	0.10	0.02
White crappie	0.00	0.00	0.04	0.00	0.00	0.00	0.00
Black crappie	0.08	0.10	0.08	0.06	0.04	0.02	0.02
Yellow perch	17.59	11.15	10.77	9.75	10.27	14.35	13.50
Walleye	0.13	0.38	0.35	0.21	0.21	0.17	0.38
Freshwater drum	0.00	0.00	0.02	0.06	0.00	0.02	0.06
Total Catch	32.00	30.54	29.71	26.83	22.09	24.75	23.77

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(0.8 k P.R., 98 03 20)
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