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LAKE ONTARIO MANAGEMENT UNIT

1998 ANNUAL REPORT

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LAKE ONTARIO
MANAGEMENT UNIT

1998 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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Table of Contents

Introduction

I. Fish Community Indexing

1. **Pelagic Planktivores** 1.1
   - Overview
   - The Surveys
   - Total Numbers of Fish Targets and Species Composition
   - Alewife
   - Smelt
   - Other Species
   - References
2. **Pelagic Piscivores** 2.1
   - Overview
   - Stocking
   - Chinook Salmon Status
   - Rainbow Trout Status
   - Lake Trout Status
   - Atlantic Salmon Restoration
   - References
3. **Eastern Lake Ontario and Bay of Quinte** 3.1
   - Overview
   - Species Population Status
   - References
4. **St. Lawrence River** 4.1
   - Overview
   - Species Population Trends
   - References

II. Resource Use

5. **Commercial Fisheries** 5.1
   - Overview
   - Quota Management
   - Lake Ontario
   - References
6. **Recreational Fisheries** 6.1
   - Overview
   - Bay of Quinte Walleye Fishery
   - Western Lake Ontario Boat Fishery
   - Eastern Lake Ontario Boat Fishery
   - References
7. **Aboriginal Spear Fishery** 7.1
   - Overview
   - Spear Fishery Summary

III. Additional Topics

8. **Smallmouth Bass PopulationStatus** 8.1
   - Introduction
   - Methods
   - Result and Discussion
   - References

Appendices

Lake Ontario Management Unit
1998 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 1998 Annual Report documents result of LOMU fisheries assessment programs completed in 1998.

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Acknowledgements

The contributions of all Lake Ontario Management Unit staff are gratefully acknowledged. The U.S. Fish and Wildlife Restoration Act Funding, administered by the Great Lakes Fishery Commission, enhanced studies of smallmouth bass and lake whitefish (see Chapters 3, 6 and 8). Also, we would like to acknowledge the help and information provided by our many partners and volunteers.

1

Pelagic Planktivores

T. Schaner
B. F. Lantry[1]

Overview

Alewife (*Alosa pseudoharengus*) and rainbow smelt (*Osmerus mordax*) are the most abundant planktivorous fish in Lake Ontario. Both species are preyed upon by large salmonines, and the alewife are also an important item in the diet of walleye. The pelagic planktivore populations declined over the past two decades, 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, resulting in decreased productivity, and thus less plankton to support alewife and smelt. This effect was recently compounded by unintentional 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, salmon and trout are stocked annually in Lake Ontario, and they represent a substantial predatory demand. Alewife and smelt came to be squeezed between less plankton on which to feed, and predation by salmon and trout.

Concerns for declining numbers of prey fish were addressed by the Canadian and U.S. management agencies in 1993, when the numbers of salmonines stocked in the lake were reduced to a level that would bring the prey demand down to approximately a half. Since that time, however, the stocking levels were moderately increased again in 1997, following extensive public consultation on both sides of the border. In the same year we observed an increase in rate of natural production by the chinook salmon, and this was confirmed again in 1998. Thus the alewife and smelt populations continue to be under intense predatory pressure, and the population levels remain low compared to the 1980s and early 1990s.

Two additional species are becoming increasingly evident among the pelagic planktivores in the recent years - threespine stickleback (*Gasterosteus aculeatus*) and emerald shiner (*Notropis atherinoides*). Although they are less abundant than either alewife or smelt, the recent increase in abundance signals a change in the pelagic fish community.

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, an interruption occurred in the series in 1995 (a year for which we have no acoustic data), and in 1996 we updated the technology from a 420kHz dual-beam system to a 120kHz split-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.

The surveys were conducted three times a year, in the spring, summer and fall, until 1997, when the program was reduced to summer and fall surveys only. In 1998, due to bad weather we not able to conduct the fall survey, and therefore this report relies on the summer survey only for the latest assessment.

Total Numbers of Fish Targets and Species Composition

The estimated numbers of fish targets in summer of 1998 in Lake Ontario was 17.2 billion (Table). The highest number of targets was measured in the warm

[1] New York State Department of Environmental Conservation, P.O. Box 292, Cape Vincent, NY, 13618, U.S.A.

TABLE 1. Total fish target estimates for summer 1998. The initial division into 'large and 'small' targets is based on visual inspections of target strength distributions in the acoustic data, the further subdivision of 'large' targets by species is based on the composition of adult alewife and smelt in the midwater trawls.

Layer	Total number of targets (billions)	Percent 'large' targets	'Large' targets: Total number (billions)	'Large' targets: No. adult alewife (billions)	'Large' targets: No. adult smelt (billions)	Total no. 'small' targets (billions)
Warm water (epilimnion)	7.228	25%	1.807	1.807	0.000	5.421
Thermocline (metalimnion)	5.378	33%	1.775	0.877	0.897	3.603
Cold water (hypolimnion)	4.593	100%	4.593	0.223	4.370	0.000
All layers	17.199		8.175	2.908	5.267	9.024

layer (7.2 billion), followed by the thermocline layer (5.4 billion) - layers where adult alewife[1] constitute a high proportion of the trawl catches. The acoustic data from both layers, however were unusually high in small targets in the -52 to -61 dB range (Fig. 1), generally corresponding to fish in the range of YOY alewife and smelt, and threespine sticklebacks. The trawl catches in the epilimnion contained YOY alewife and threespine sticklebacks, but these small fish were caught in small numbers, compared to large fish (adult alewife) in the same layer. and therefore insufficient to explain the prominence of small targets in the acoustic data. The trawl catches in the metalimnion contained YOY alewife and smelt and significant numbers of threespine sticklebacks, but still not enough to account for the high proportion of acoustic targets in this layer. The trawl catches in the hypolimnion consisted largely of large fish (adult smelt). and the acoustic target strength distribution showed a corresponding peak in the -52 to -40 dB range.

The apparent conflict between the two sources of information is likely due to the catching characteristics of the midwater trawl used for ground-truthing. The trawl is optimized for capture of adult alewife and smelt, and its efficiency for smaller fish is marginal and probably highly size-dependent. It therefore poorly represents the overall numbers of small fish, and perhaps also the species composition among them.

Because the trawl catches do not represent the proportions of small and large fish, we used the acoustic data itself to estimate the proportions of the two groups. Only a rough estimate is possible, because the relationship between fish size and target strength is highly variable, resulting in a range of possible target strengths from any single fish. and an overlap in target strength distributions of the two size groups. The target strength distributions suggest that only approximately a quarter of the targets in the epilimnion correspond to large fish (modal target strength around -46 dB) and the remaining three quarters correspond to smaller fish. In the metalimnion the proportion of large targets is approximately one third. The targets in the hypolimnion were mostly in the adult fish range, any small targets were likely due to Mysis relicta, and therefore it was assumed that the layer contained large fish only.

The calculation of the numbers of large and small targets based on acoustic data only is shown in Table 1. The large fish targets are further divided, based on trawl results, into estimates of adult alewife and adult smelt. We hesitate to similarly divide the small target estimates into species, because we suspect that the catchabilities of the YOY alewife, YOY smelt and threespine sticklebacks are not comparable, and also because in the previous years we used fall rather than summer surveys to assess the status of the YOY fish.

[1] In the summer of 1998 there were virtually no yearling alewife or smelt present, and therefore an easy distinction could be made between YOY fish and 'adult' fish meaning two-years old and older fish.)

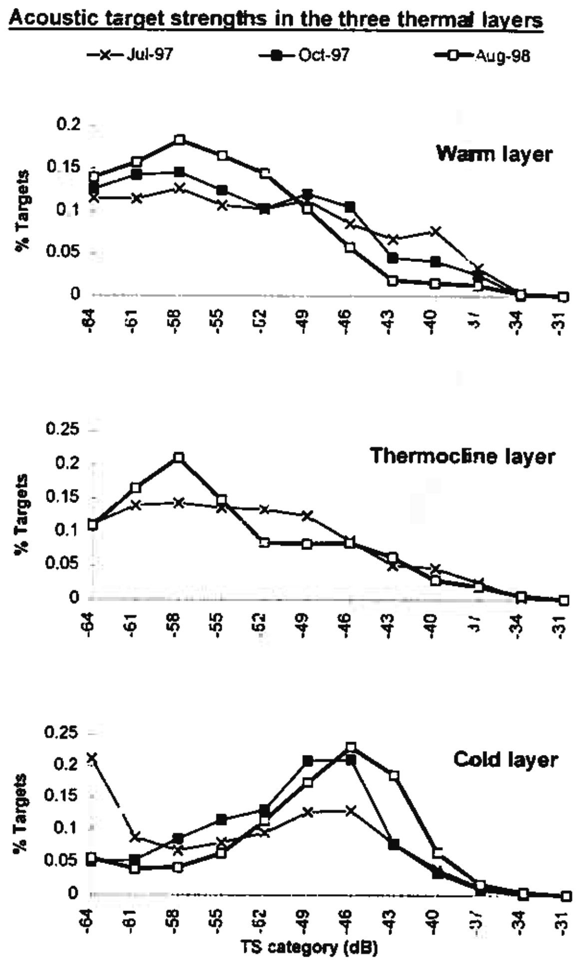

FIG. 1. Target strength distributions in the three thermal layers in the 1997 and 1998 surveys. The size of the fish is proportional to the target strength. The warm layer and thermocline target strength distributions in the 1998 summer survey show a higher proportion of small targets (left side of the graph) than the 1997 surveys. (Thermocline distribution for the 1997 fall survey is not shown, because a different horizontal stratification was used in the estimate.)

Alewife

The lake-wide estimate of the adult alewife population in the summer of 1998 was 2.9 billion fish. This is similar to the 1996 and 1997 summer and fall estimates (3.6 and 2.3 billion fish, although due to the different approaches in making the estimates, comparisons should be made with caution). The alewife populations levels remain low compared to levels observed in the early 1990s (Fig. 2), due largely to large gaps in year-class strength. The last large year-class of alewife was produced in 1995, and based on examination of the chronology of length frequency distributions (not shown) the adult population in 1998 consists almost entirely of these fish.

The strength of the 1998 year-class cannot be assessed based on the summer data only. We can, however fairly confidently predict that it will not be of the magnitude of the 1995 year-class, based on circumstantial evidence. In 1995 the strong year-class was already evident in the summer when we caught large numbers of YOY fish. The catches were high despite the inefficiency of the trawl gear for YOY fish, and it reflected the high numbers levels of these fish. In the summer of 1998 we also caught YOY alewife, but only small numbers, despite the fact that they were larger than those caught in 1995, and therefore presumably more vulnerable to the trawl. This suggests that at most a moderate year-class was produced in 1998.

Rainbow Smelt

The lake-wide estimate of adult smelt in the summer of 1998 was 5.3 billion fish. This is higher than the previous year's estimates (Fig. 3), although the chronology of length frequency distributions from in trawls indicates that there was no substantial recruitment due to the 1997 year-class. The smelt population in Lake Ontario exhibits an alternate-year recruitment pattern with good year-classes in even numbered years. In 1998 we caught YOY smelt in the summer survey, which is unusual (normally YOY smelt do not appear in trawl catches until the fall), and possibly a sign of a strong year-class to come.

Other species

Threespine sticklebacks started to appear in midwater trawl catches in 1993, and were caught in record numbers in the summer of 1996 (Fig. 4) . The catches in 1998 not as high, comparable to some of the recent years (1995, 1997). Unlike in previous years, however, the catches consisted largely of small fish in the 20-50mm range. These appear to be YOY fish, and due to their small size they were probably underrepresented in the trawls. They could account for a large portion of the "small fish" acoustic estimate (Table 1), implying that a very large year-class of threespine sticklebacks was produced in 1998.

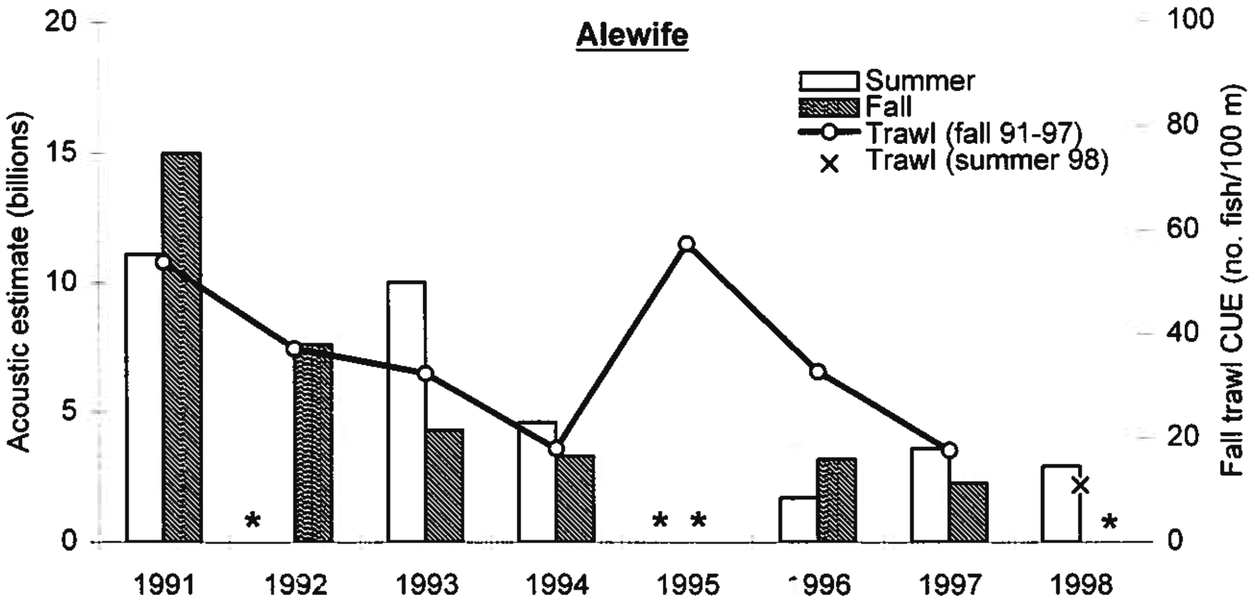

FIG. 2. Acoustic estimates of abundance, and midwater trawl indices of relative abundance (CUE) of alewife in Lake Ontario, 1991 to 1998. Asterisk indicates missing surveys.

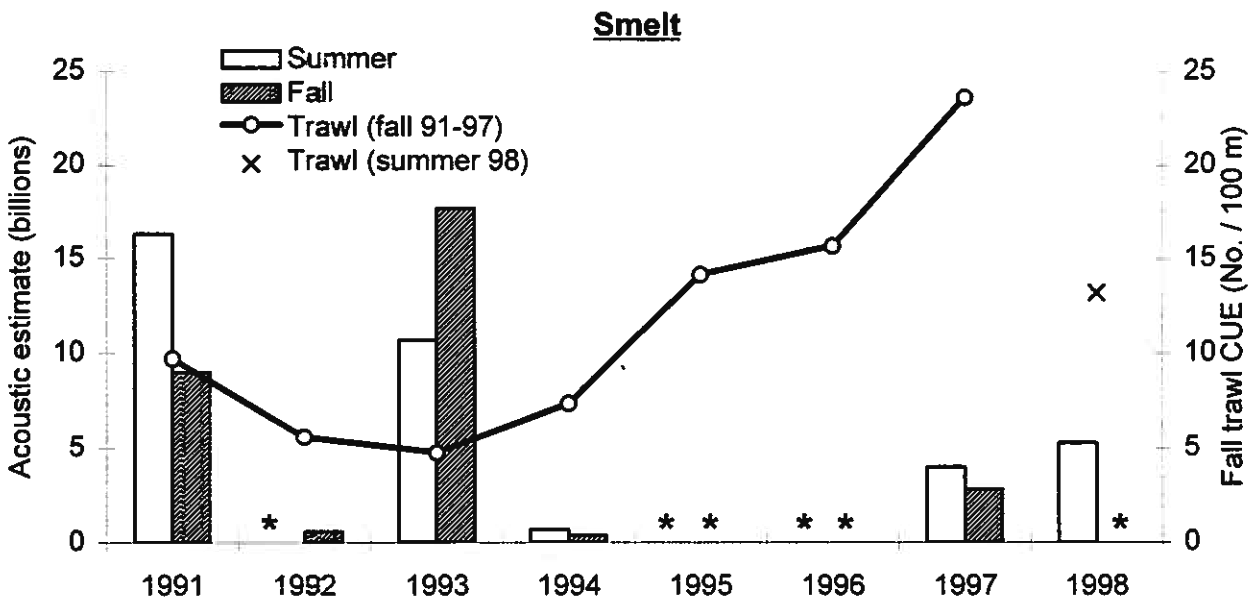

FIG. 3. Acoustic estimates of abundance, and midwater trawl indices of relative abundance (CUE) of smelt in Lake Ontario, 1991 to 1998. Asterisk indicates missing surveys, or analysis in progress (1996 surveys).

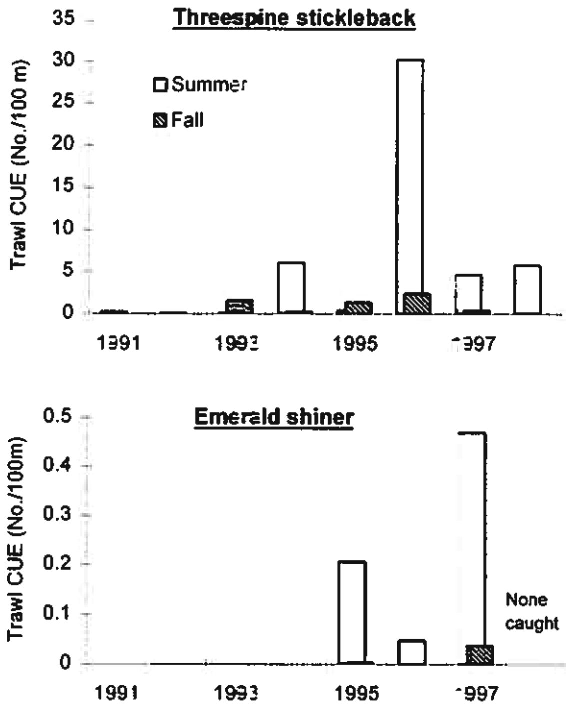

FIG. 4. Catch rates of threespine stickleback and emerald shiner in midwater trawls in Lake Ontario, 1991 to 1998.

Emerald shiner first appeared in the midwater trawl catches in 1995 and were caught with some regularity until 1997. No emerald shiner were caught the summer of 1998, perhaps signaling a downturn in the periodic fluctuation that seems to characterize the species (Scott and Crossman, 1973).

References

SCOTT, W. B., AND E. J. CROSSMAN. 1973. Freshwater Fishes of Canada. Bulletin 184, Fisheries Research Board of Canada.

2

Pelagic Piscivores

J. N. Bowlby, M. Daniels, T. Schaner, and 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 1991stocking levels by approximately 50% from 1993 to 1996. After extensive public consultation in 1996 and 1997, stocking was increased moderately in 1997.

Chinook salmon are the most abundant pelagic piscivore. Coincident with stocking cuts, chinook year-class strength increased, suggesting an increase in stocking survival and/or wild production. However, the 1997 year-class strength was reduced to a level predicted by stocking alone, despite observed increases in wild production.

Atlantic salmon fry stocking experiments continued to show positive results in 1998. Benchmarks for the survival of fry were achieved and exceeded at many experimental sites. Preliminary results suggest the most suitable have high rock cover, low fine sediments, and an absence of rainbow trout. We captured one young-of-the-year Atlantic salmon which may have been naturally reproduced.

Stocking

In 1998 OMNR stocked over 1.8 million salmon and trout into Lake Ontario (Table 1). Over 600,000 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 135,000 coho salmon fall fingerlings and spring yearlings were stocked into the

TABLE 1. Salmon and trout stocked into Province of Ontario waters of Lake Ontario, 1998 and target for 1999.

Species	Age	Number stocked in 1998	Target for 1999
Atlantic salmon	Early fry	92,775	80,000
	Advanced fry	58,074	80,000
	Yearling	500	
	Adult	157	
	Subtotal	151,506	160,000
Chinook salmon	Spring fingerling	616,710	540,000
Coho salmon	Fall fingerling	27,226	
	Yearling	108,220	150,000
	Subtotal	135,446	150,000
Lake trout	Yearling	438,364	440,000
	Adults	9	
	Subtotal	438,373	440,000
Rainbow trout	Eyed eggs	16,811	
	Fry	176,047	
	Yearling	142,384	140,000
	Adults	20	
	Subtotal	335,262	140,000
Brown trout	Spring fingerling	1,500	
	Yearling	162,980	165,000
	Subtotal	164,480	165,000
TOTAL		1,841,777	1,595,000

Credit River, as part of the recently re-instated coho program. We expect to begin a wild egg collection for coho salmon in the Credit River in the fall of 1999. In support of an ongoing research program to determine the feasibility of restoring Atlantic salmon, about 125,000 Atlantic salmon fry were stocked in Lake Ontario tributaries. The program is 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 150 pre-spawning adults, some with radio tags, were also released to study spawning success and substrate quality. Another 25,000 Atlantic salmon fry were raised by interest groups, under the Community Fisheries Involvement Program (CFIP). About 450,000 lake trout yearlings were stocked as part of a long-term rehabilitation program, focused in eastern Lake Ontario where most of the historic spawning shoals are found and where reproductive success has been well documented. About 142,000 rainbow trout yearlings were stocked by OMNR, and more than 200,000 fry fry were raised through CFIP. About 163,000 brown trout yearlings were stocked at various locations to provide shore and boat fishing opportunities.

Detailed information about 1998 OMNR stocking activities is found in Appendix A. The New York Department of Environmental Conservation (NYDEC) also stocked about 3.4 million salmon and trout into Lake Ontario in 1998 (Eckert 1999).

The targets for 1999 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 (Hoyle *et al.* 1999) and New York (Eckert 1998) for 1985 to 1998.

Ontario data suggests lower strength for the 1997 year-class, than the previous estimate from combined New York and Ontario data (Fig. 1). Year-class strength had increased surprisingly in 1995 and 1996. 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 may have resulted from increased survival of stocked fish and/or significant increases in natural reproduction of chinook salmon. The 1997 year-class fits the relation between year-class strength and stocking from 1982 to 1994 (Fig. 2), despite increases in natural reproduction (Bowlby *et al.* 1998). It is possible that density dependent effects of the strong 1995 and 1996 year-classes reduced survival of the 1997 year-class.

Catch rates of chinook salmon in the western Lake

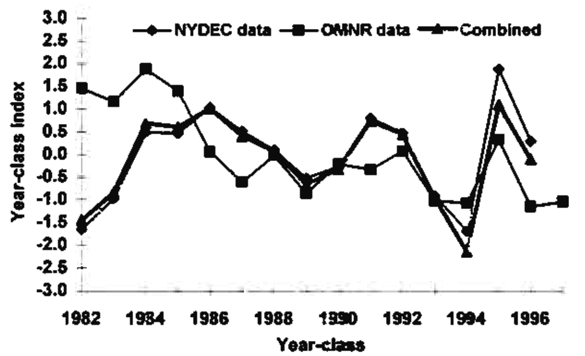

FIG. 1. Trends in year-class strength of chinook salmon in Lake Ontario, based on angler harvest rates from OMNR and NYDEC surveys. The combined index is based on the least-square mean of the OMNR and NYDEC harvest rates by year-class. Results were standardized to a mean of 0 and standard deviation of 1 for the time series.

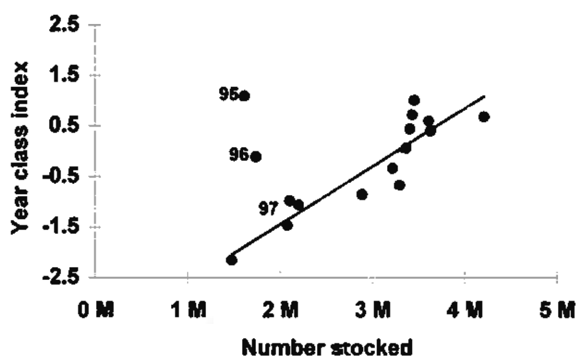

FIG. 2. Relationship between year-class strength of chinook salmon in Lake Ontario and the number stocked. Year-class strength is combined from NY and Ontario data, except 97 year class (Ont. only). The line indicates the fit for the 1982 to 94 year-classes. The 95 to 97 indicate year-classes are indicated.

Ontario launch daily salmonid boat fishery are our only available index of chinook salmon abundance for the Ontario portion of Lake Ontario. In 1998, the catch rate changed little from 1997, remaining moderately high (Fig. 3). The strong 1995 and 1996 year-classes helped to maintain the catch rate and populations of chinook salmon, accordingly.

Wild Production

During spring 1998 an electrofishing survey of Ontario tributaries to enumerate chinook salmon smolt production was started, but discontinued before completion because the chinooks began to smolt. These tributaries were surveyed again during summer 1998 to enumerate rainbow trout, but some chinook salmon were caught, as well.

The incomplete spring surveys showed significant natural reproduction of chinook salmon in Wilmot Creek, Cobourg Creek and the Ganaraska River. The summer survey confirmed the spring results and showed that there was a significant year-class of chinook salmon in Ontario tributaries, but similar in size to the 1997 year-class (Fig. 4). In addition, coho salmon increased in 1998 (Fig. 4). Coho were seen at more sites, but the greatest increase was in Bowmanville Creek. This increase of coho in Bowmanville Creek coincided with an absence of chinook from where they were abundant in 1997. The relationships between coho and chinook production remain unclear. Both species continue to adapt to the Lake Ontario ecosystem, and it remains to be seen just how successful they will become.

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 were collected for those fish selected by Ringwood Fish Culture station for spawn collection. The length of male and female 2 yr-old and 3 yr-old chinook salmon declined sharply in 1994, followed by increases from 1995 to 1998 (Fig. 5). The decline in growth in 1994 was consistent with declines in alewife and smelt populations, and high chinook abundance. 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. The increases in 1998 were not expected, but may have resulted from an extended growing season as a result of the early spring in 1998.

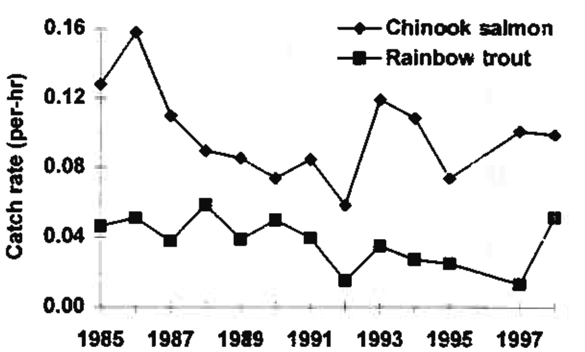

FIG. 3. The catch rate of chinook salmon and rainbow trout in the western Lake Ontario launch daily salmonid boat fishery (Ontario portion) from 1985 to 1998.

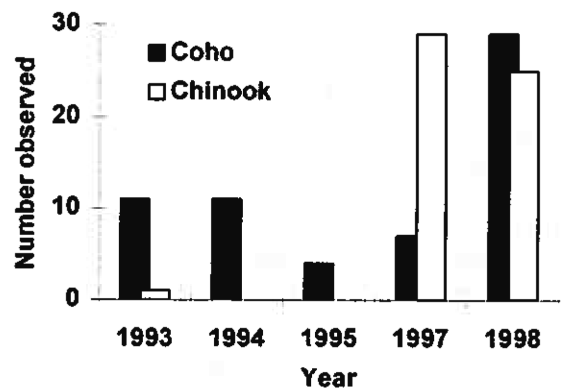

FIG. 4. Number of coho and chinook salmon observed during summer surveys of Lake Ontario tributaries in Ontario. No surveys were conducted in 1996.

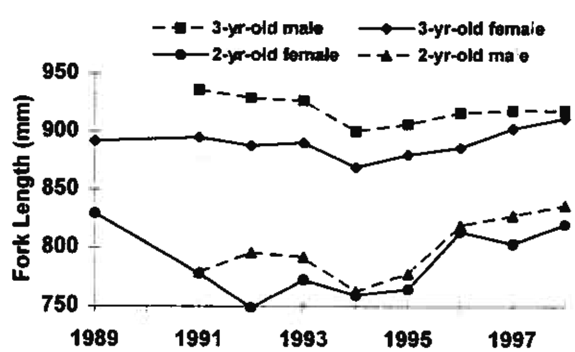

FIG. 5. Fork length of chinook salmon in the Credit River during spawning run in September and October.

Rainbow Trout Status

Abundance Trends

Counts of spawning rainbow trout at the Ganaraska River fishway have been used to index rainbow trout abundance trends. In 1998, complete counts at the fishway were not made because of power failures at the fishway.

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 1998, the catch rate increased by almost four times from 1997 to the highest level since 1988 (Fig. 3). A strong 1995 year-class of wild rainbow trout (see below) may be partly responsible for this increase, but cannot completely account for it. As well, the early spring may have lowered tributary harvest resulting in more fish available to the boat fishery. The early spring weather may have also increased the vulnerability of rainbow trout to boat angling.

Year-class Strength of Wild Rainbow Trout

Year-class strength of wild rainbow trout in Lake Ontario was calculated as the least-square mean (Littell *et al.* 1991) density of juvenile rainbow by year-class in Lake Ontario tributaries in Ontario. Rainbow trout were captured by electrofishing randomly selected sites established in 1993 in north shore Lake Ontario tributaries (Bowlby *et al.* 1994).

Rainbow trout year-class strength since 1991 was highest in 1995 and lowest in 1994 (Fig. 6). For the past three years (1996 to 1998) year-class strength has remained relatively constant. However, sampling was not conducted in 1996 (Fig 7), and this may have affected our 1994 to 1996 year-class strength estimates. Density of rainbow trout in these tributaries ranged from about 2500 to 5000 fish-per-km (Fig. 7). These densities are dominated by young-of-the-year, and thus, have a strong resemblance to year-class strength. Since wild rainbow trout peak in the boat angler harvest as 3 to 5 yr-olds, the strong 1995 year-class would have had its greatest impact on the boat anglers in 1998.

Repeat Spawner Index

The repeat spawner index (percentage of repeat spawners) is equal to the annual survival rate (Clarkson and Jones 1997). We have determined the repeat spawner index for rainbow trout captured at the Ganaraska fishway for most years from 1974 to 1998 (Fig. 8). From 1975 to 1991 the repeat spawner index for female rainbow trout in the Ganaraska River was 58 to 90% (Fig. 8). Using a 3-yr running average to reduce the effects of variable year-class strength, the repeat spawner index for females was generally between 70 and 80% (Fig. 8). For the same period the repeat spawner index for males was between 50 and 70% (Fig. 8). The repeat spawner index was lower for males because they are more vulnerable to stream anglers and have higher spawning mortality. Swanson (1985) determined angling exploitation of near 20% was associated with a 50% repeat spawner index on female rainbow trout. Our relatively high proportion of repeat spawners suggests that angling exploitation was quite low over this period.

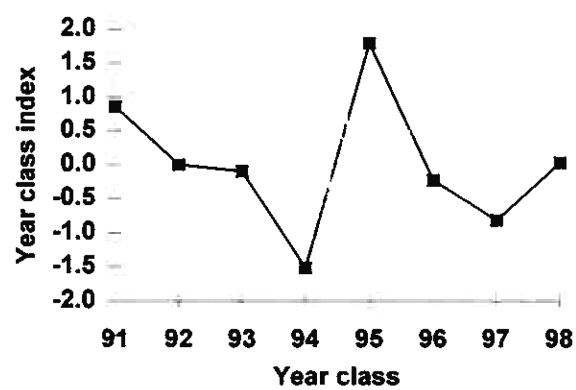

FIG. 6. Year-class strength of rainbow trout in Lake Ontario tributaries. The index is standardized to a mean of 0 and standard deviation of 1.

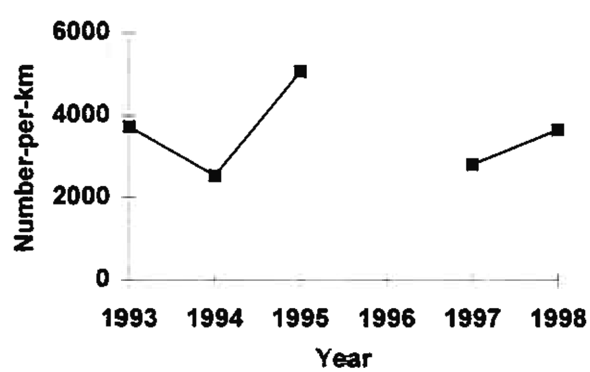

FIG. 7. Density of juvenile rainbow trout in north shore Lake Ontario tributaries suitable for rainbow trout.

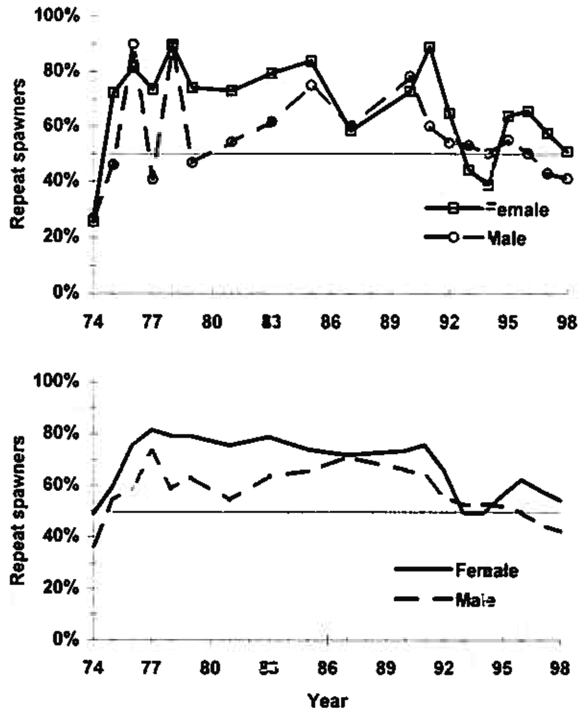

FIG. 8. The repeat spawner rate of rainbow trout in April at the Ganaraska River fishway, in Port Hope, Ontario. Upper panel, yearly values, and lower panel, three-year running averages.

In 1993 and 1994 the repeat spawner index for females dropped to close to 40%, below that of males (Fig. 8). From 1995 to 1998 the index for females increased to the 50 to 65% range. The large drop in repeat spawner index for females from 1992 to 1993 indicated a decline in their survival in 1992. At the same time the drop in survival of males was minor. This may be the product of late springs in 1992 and 1997 leading to later runs of spawning fish and potentially higher vulnerability to being harvested once the fishing season opened. In 1997, there was another late spring, and the repeat spawner rate fell more for females than males.

Currently the Ganaraska rainbow trout repeat spawner index is close to 50%, suggesting a continuation of the post-1992 higher levels of mortality and exploitation.

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

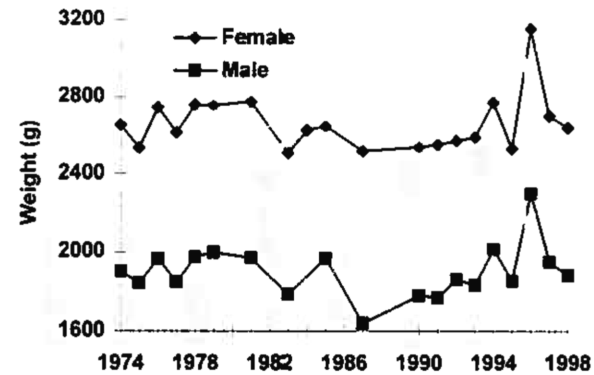

FIG. 9. Condition (mean weight, adjusted for length) of rainbow trout in April at the Ganaraska River fishway, in Port Hope, Ontario, 1974 to 1998

length using analysis of covariance. In 1998, body condition was slightly lower for both female and male rainbow trout than 1997 (Fig. 9). 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 abundance.

Lake Trout Status

Abundance Trends

The abundance of lake trout declined over the 1990s (Fig. 10). This is largely due to stocking reductions implemented in 1993 in order to decrease the predatory pressure on alewife and smelt. The number of lake trout stocked in the lake by Canadian and U.S. agencies was reduced from approximately two million yearlings per year in the late 1980s to less than a million after 1993. This reduction is obviously responsible for the strong and immediate decline of young fish (Fig. 10 fish under 600 mm). Simultaneously, however, there was also a decline in the numbers of older fish (Fig. 10, fish over 600 mm), which occurred too soon after the stocking reductions to be attributed to that factor. The decline appears to be consistent with a decrease in post-stocking survival observed over the 1980s (Elrod *et al.* 1995). This resulted in a gradual decrease in effective stocking levels, even as the actual levels remained constant over the period when these older fish were stocked (mid to late-1980s). In the U.S. waters there was no corresponding decrease in abundance of older fish in the 1990s (Lantry *et al.* 1997) despite nearly identical levels and pattern of stocking. This difference could

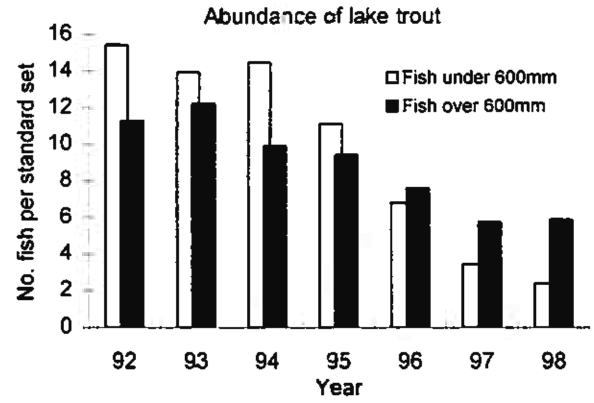

FIG. 10. Catch-per-unit-effort of lake trout in Canadian waters between Brighton and Kingston, as measured in OMNR's index gillnets. Only sets in water colder than 12°C were used in the calculation. The division at 600 mm approximates the division between immature and mature fish.

be attributed to earlier and greater reliance on the Seneca strain which exhibits less susceptibility to lamprey attacks resulting in higher survival rates. OMNR started stocking Senecas in 1992, and by 1998 this strain made up more than half of the stocked fish. They are just starting to enter the mature segment of the population, and therefore the decline in abundance of mature fish should cease.

Condition Trends

The condition of the lake trout did not decline in the 1990s (Fig. 11) despite concurrent declines in prey fish stocks. In the U.S. waters lake trout condition actually increased over the same period, although this increase is not being attributed to trophic effects (Lantry *et al.* 1997).

Natural Reproduction

Natural production of lake trout has been document in Lake Ontario since the late 1980s, and in 1994 young wild lake trout began to show up in the bottom trawls, indicating that there was not only successful reproduction, but survival beyond the larval and fry stages as well. In 1998, we caught one naturally produced YOY lake trout. Aditionally, we caught seven unmarked fish in the 430 to 590 mm total length range, which are likely to be naturally produced lake trout of the 1993 year-class. The U.S. agencies caught 12 naturally produced lake trout including one YOY and three yearlings (Lantry *et al.* 1999). Fish of all year-classes starting with 1993 have been caught so far with fair regularity, although it appears that the 1993

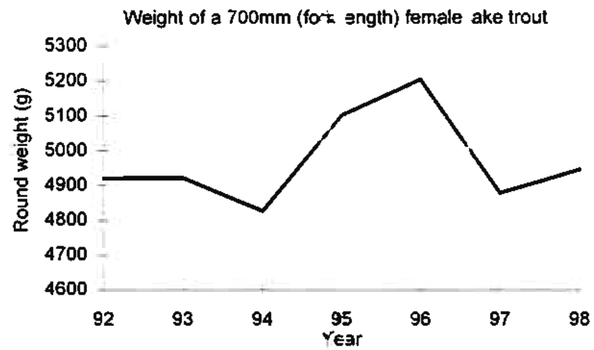

FIG. 11. Condition of mature lake trout, expressed as the weight of a 700 mm (fork length) female predicted from weight-length regressions.

year-class is the most frequently encountered in the Canadian waters, while the 1994 year-class is prominent in the U.S. waters. Documented survival of fish beyond the larval stage demonstrates the feasibility of lake trout rehabilitation in Lake Ontario, but higher reproductive rates will need to be achieved for the rehabilitation to succeed.

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 fourth year of the program with review scheduled after the 1999 field season.

The Restoration Plan has a yr-5 benchmark density of five Atlantic salmon fall fingerlings per 100 m^2 in areas stocked. In 1998, survival was better in almost all categories than previous years. Moreover, fall fingerling densities continued to exceed benchmarks in most of the experimental categories. The only experimental category where Atlantic salmon did not exceed the benchmark was swim-up fry stocked in the presence of woody cover, high fine sediments, and rainbow trout. In addition, preliminary statistical analyses suggested significantly higher Atlantic salmon survival in habitat with i) high rock cover, ii) low fine sediment, and iii) absence of rainbow trout (Stanfield 1998).

In addition, one young-of-the-year Atlantic salmon was captured in electrofishing surveys at Norval in the Credit River in 1998. Although there were Atlantic salmon fry stocked about 8 km upstream, this fish was unlikely one of these since stocked young-of-the-year Atlantic salmon rarely move more than 100 m from the stocking site during the first summer. At least four Atlantic salmon were observed jumping over the Streetsville dam in 1997 and would have had access up to Norval. Accordingly, this may be the first recent record of wild Atlantic salmon from lake-run fish on the Ontario side of Lake Ontario.

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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 forty years (Hoyle 1998).

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) developed based on these species. The small, pelagic species became less dominant.

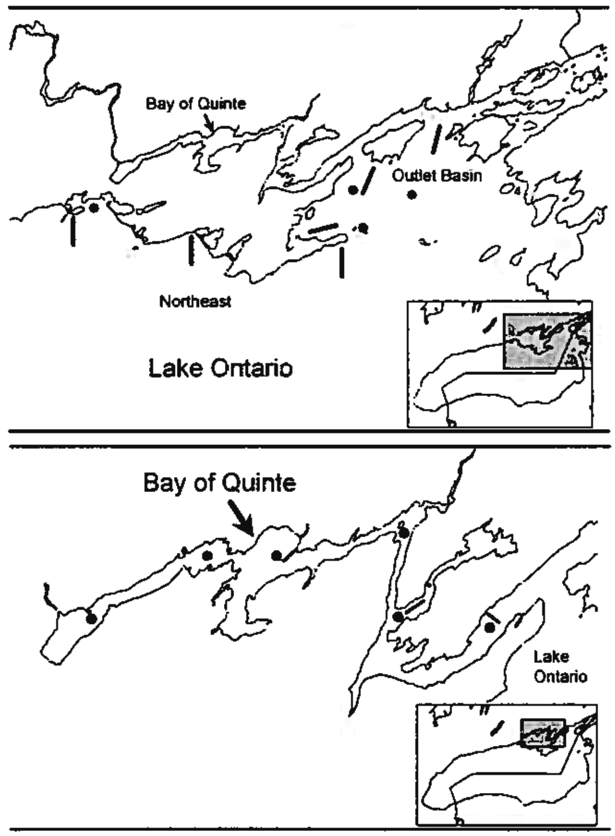

FIG. 1. Maps of eastern Lake Ontario (upper panel) and the Bay of Quinte (lower panel) showing fish community index gillnetting and trawling locations. Depth-stratified gillnetting locations are shown as bars; single depth gillnetting and trawling locations are represented by circles.

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 an increasing 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 1996 index trawling program

At the same time, however, Dreissenid mussels invaded this area (Schaner 1998), and appear to be significantly impacting the fish community. The water is now much clearer and less productive, and the food-web is changing. Recently, we have observed signs of stress in previously recovered walleye and lake whitefish populations, and signs of increase in populations favoured under these conditions (e.g., yellow perch; Hoyle 1998).

This chapter updates the status of 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 updated, 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 1998, organized by broad geographic area (Northeast, Outlet Basin and Bay of Quinte) and season (Bay of Quinte), see Appendix B.

Species Population Status

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. 2). The peak catches in 1992 and 1993 contained large numbers of young fish from the 1990, 1991 and 1992 year-classes (Hoyle 1999) but in more recent years fewer young fish were caught. This may be of concern because index trawl catches of young-of-the-year (YOY) fish indicated that large year-classes were also produced in 1994 and 1995 (Fig. 2) but these appear to have failed to contribute strongly as 1 or 2 yr-old fish. Similarly, the 1991 year-class has dominated the commercial harvest from age 3 through 7 yrs-old, while subsequent year-classes have not contributed strongly to the fishery (see Chapter 5 in this report).

Therefore, survival of young fish appears to have declined. Most recently, small year-classes were

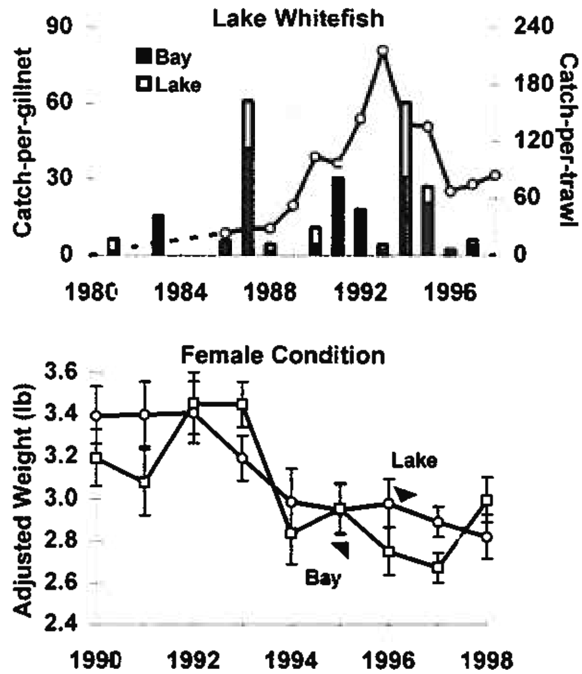

FIG. 2. Upper panel, lake whitefish catch-per-gillnet (sum of catch adjusted to 100 m of each mesh size) in the Outlet Basin of Lake 1986 to 1998, and year-class strength for Lake Ontario (Timber Island) and Bay of Quinte (Conway) stocks (stacked bars) as represented by young-of-the-year (YOY) catch-per-trawl (adjusted to 12 min duration), 1972 to 1998 (no trawling in 1989). Lower 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 1998.

produced in 1996, 1997 and 1998—the 1998 year-class being the smallest since 1985.

In 1997, five lake whitefish carcasses—the first observed in 40 years of index netting activity—were observed in Outlet Basin bottom trawls and three dead/dying fish were caught in gillnets (Hoyle 1998). The cause of death was not determined but the fish ranged in size from 250 to 350 mm total length and represent young, immature fish of 1 to 3 yrs of age. In 1998, seven carcasses—similar in size to those of 1997—were observed in bottom trawls.

Condition Trends

Lake whitefish body condition declined significantly after 1993 in both major spawning stocks (Fig. 2). The decline in lake whitefish body condition was related to a corresponding, and dramatic decline in deepwater amphipod (*Diporeia hoyi*) abundance (Hoyle 1993)—formerly the most important prey item in the diet (Ihssen *et al.* 1981). Body condition did rebound somewhat in 1998 for the Bay of Quinte stock compared to 1997, nonetheless, body condition remains poor compared to the early 1990s. Also, a detailed diet study conducted in 1998 indicated that *Dreissenid* mussels now dominate the lake whitefish diet in the Outlet Basin of Lake Ontario (Table 1).

Smallmouth Bass

Abundance Trends

Smallmouth bass populations, along with lake trout, provide an important recreational fishery in the Outlet Basin of Lake Ontario. Smallmouth bass abundance in index gillnets was high in the late 1970s and early 1980s, declined during the mid-1980s, increased somewhat to 1991 then declined dramatically from 1991 to 1996. Abundance increased somewhat in 1997 and again in 1998 (Fig.3). Similar trends in smallmouth bass abundance were reported for New York waters of eastern Lake Ontario (Chrisman and Eckert 1998). A detailed assessment of smallmouth bass population dynamics can be found in Chapter 8 in this report.

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 until the mid-1990s when their abundance began to increase.

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. 4). Commercially marketable-sized yellow perch (>7.5 inches total length) have been particularly scarce since 1982, even though large numbers of small fish have been observed in some years, including 1998. No marketable-sized yellow perch have been captured in the Middle Ground gillnets in 1996 and 1997. Small catches of marketable-sized fish were observed in 1998. This population will be watched closely in the coming year to see if the increase observed in 1998 will continue.

Gillnet catches in the Outlet Basin were low from 1994 to 1997, compared to the 1986 to 1993 time period, especially for small fish. Increased abundance in 1998 index gillnets, and reports of increased harvest from the commercial fishery (see Chapter 5 in this report) show promise for yellow perch in this area.

Largest catches of yellow perch occurred in the Bay of Quinte—particularly in the Upper Bay (Fig. 4 and 5), and recruitment of YOY yellow perch has increased markedly in recent years, particularly in 1995 and 1997. In addition, Bay of Quinte walleye anglers reported catching large numbers of small yellow perch in 1997 and 1998 (Chapter 5 in this report).

TABLE 1. Frequency of occurrence of items in the diet of lake whitefish in the Outlet Basin of Lake Ontario, 1998.

Taxon			Number of Fish	Frequency of Occurrence
Crustacea	Decapoda		1	1%
Insecta	Diptera		14	10%
	Trichoptera		7	5%
Mollusca	Gastropoda		7	5%
	Pelecypoda	Dreissena	128	90%
	Pelecypoda	Other[1]	34	24%
Number food items			5,814	
Number of non-empty stomachs			142	
Number of fish examined			169	

[1] *includes mainly Pisidium and Sphaerium (fingernail clams)*

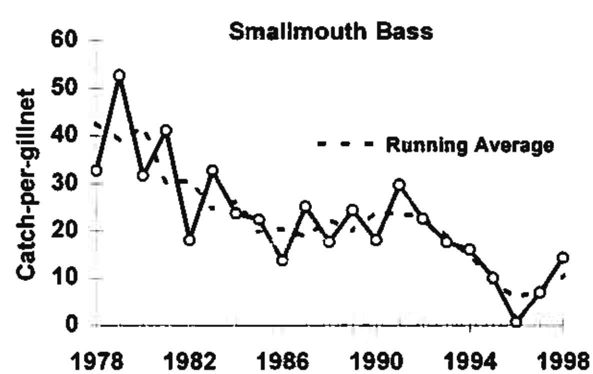

FIG. 3. Smallmouth bass catch-per-gillnet in the Outlet Basin of Lake Ontario (Simcoe Island site from 1978 to 1985 and Melville Shoal, Grape Island, and Rocky Point sites from 1986 to 1998).

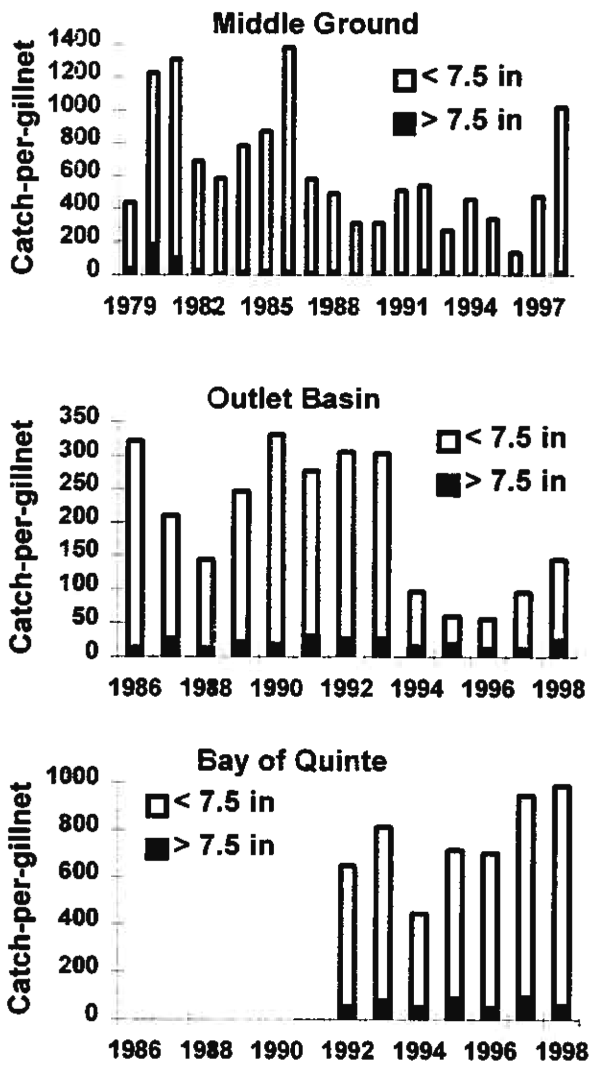

FIG. 4. Yellow perch catch-per-gillnet, including for fish greater than 7.5 inches total length—representing commercially marketable-sized fish—in Northeast Lake Ontario (Middle Ground, 1979 to 1998, upper panel), the Outlet Basin (1986 to 1998, second panel), and the Bay of Quinte (1992 to 1998, lower panel).

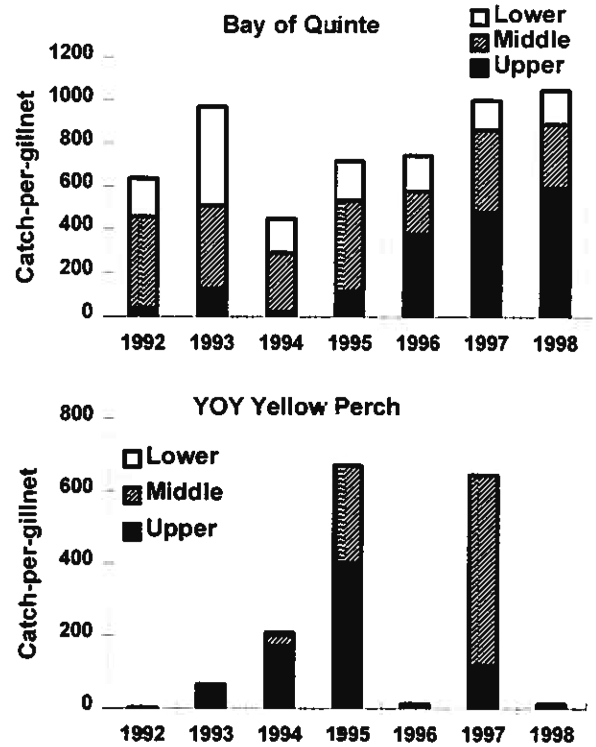

FIG. 5. Yellow perch catch-per-gillnet, including for fish greater than 7.5 inches total length—representing commercially marketable-sized fish—in the Bay of Quinte (1992 to 1998) in the Upper, Middle and Lower Bay. Lower panel, yellow perch year-class strength in the Bay of Quinte as represented by YOY catch-per-trawl (6 min duration), 1992 to 1998.

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 are allocated to 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 abundance was monitored at Big Bay (Bay of Quinte) and Melville Shoal (Outlet Basin of Lake Ontario). Walleye age-class composition at the two sites reflected the age-specific distribution pattern of walleye during mid-summer; young fish at Big Bay (e.g., mainly 1 to 5 yrs-old) and older fish at Melville Shoal (e.g., mainly greater than 5 yrs-old but also some younger fish). Walleye abundance increased, beginning in the early 1980s at Big Bay and in the mid- to latter 1980s at Melville Shoal, following production of the 1978 year-class (Fig. 6). Walleye abundance peaked in the early 1990s (Big Bay 1990, Melville Shoal 1992) and then declined markedly in Big Bay

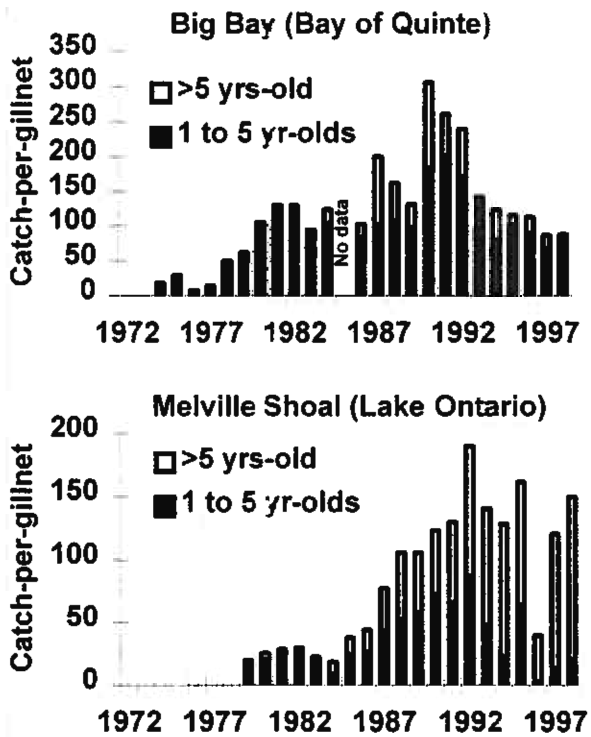

FIG. 6. Walleye catch-per-gillnet, for age-classes 1 to 5 yrs-old and >5 yrs-old, in the Bay of Quinte (Big Bay, 1972 to 1998, upper panel) and the Outlet Basin (Melville Shoal, 1977 to 1998, lower panel) in mid-summer.

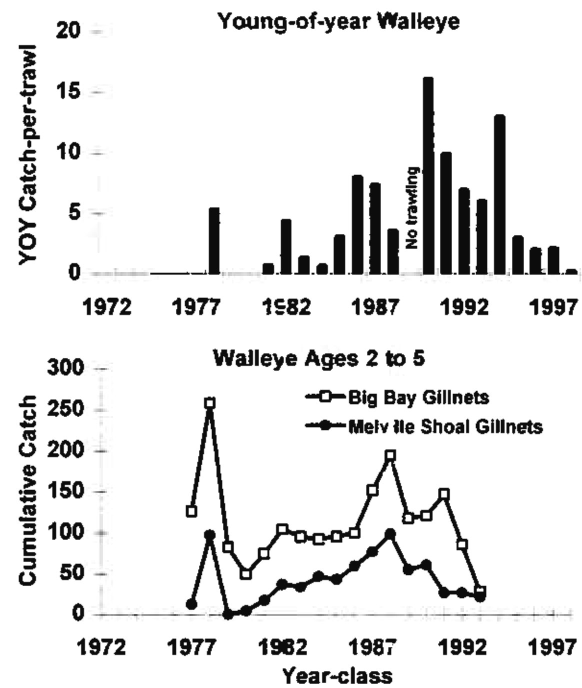

FIG. 7. Walleye year-class strength; measured as young-of-the-year (YOY) catch-per-trawl in the Bay of Quinte (6 min duration), 1970 to 1998 (no trawling in 1989), and as cumulative catch-per-gillnet of each year-class measured at ages 2 to 5 yrs-old for the 1977 to 1993 year-classes in the Bay of Quinte (Big Bay) and the Outlet Basin of Lake Ontario (Melville Shoal).

but only slightly at Melville Shoal. The most recent trends in abundance were age-specific. Young fish (1 to 5 yrs-old) declined at both sites while older fish (>5 yrs-old) declined at Big Bay but increased or remained steady at Melville Shoal. The latter observation may have resulted from increased movement of older walleye from the Bay of Quinte to eastern Lake Ontario for the summer months.

Walleye year-class was measured two ways (Fig. 7). Young-of-the-year walleye were measured in August bottom trawls at three Bay of Quinte sites, Big Bay, Hay Bay and Conway. In addition, a measure of year-class strength was determined by tracking year-class specific gillnet catches over time for ages 2 to 5 yrs-old (i.e., cumulative catch-per-gillnet) at Big Bay and Melville Shoal. Catches of YOY walleye indicated virtually no reproduction of walleye prior to 1978, a large 1978 year-class, a general pattern of increasing production from 1981 to 1990, and finally a decline—with the exception of 1994—to very low levels in 1998. Tracking year-class over time for walleye aged 2 to 5 yrs showed the very large 1978 year-class, a steady increase in year-class strength from 1979 to 1988, then a general decline.

The open-water walleye fishery in the Bay of Quinte 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.

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. 8). 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. 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 and 1997. A single individual was caught in 1998.

Lake herring gillnet catches in the Bay of Quinte (Hay Bay index site) increased dramatically in 1996 and 1997. The 1998 catch was similar to 1997. By way of contrast, lake herring catches in the Outlet Basin (Flatt Point index site), having increased to moderate levels in the late 1980 and early 1990s, have declined to zero in 1997 and 1998.

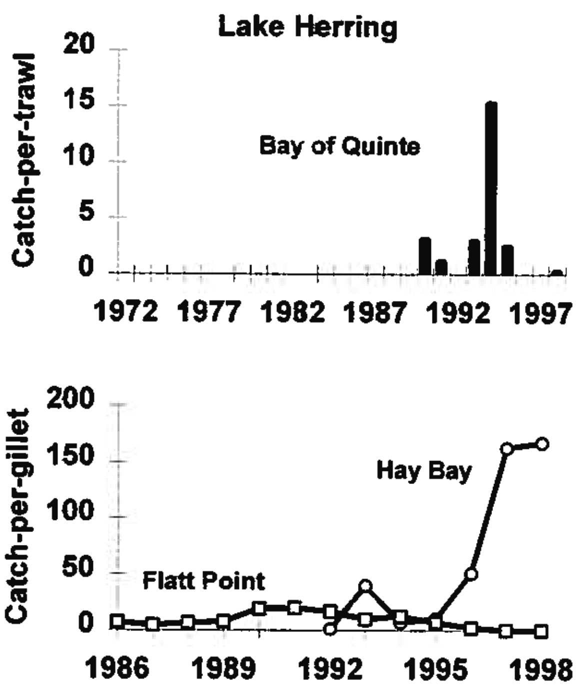

FIG. 8. Top panel, lake herring year-class strength in the lower Bay of Quinte (Conway) as represented by YOY catch-per-trawl (adjusted to 12 min duration), 1972 to 1998 (no trawling in 1989). Lake herring catch-per standard gillnet in the Outlet Basin (Flatt Point) and the Bay of Quinte, (Hay Bay), 1992 to 1998.

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. In 1996 and again in 1997, encouraging numbers of small sturgeon were captured by commercial fishermen in gear primarily set for yellow perch. In 1997, two small sturgeon were caught for the first time in our index netting program (Hoyle 1998). In 1998, five small lake sturgeon were caught (Table 1) continuing the encouraging signs of recovery of this species. The five fish were caught in a wide variety of depths (5 to 30 m), water temperatures (10.6 to 22.2 oC) and geographic areas (Upper, Middle and Lower Bay of Quinte and in the Outlet Basin) from June 23 to October 21.

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. No specimens were caught in 1998, however, New York State reported a single deepwater sculpin captured in US water of western Lake Ontario. 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.

Table 1. Statistics for five lake sturgeon captured during index gillnetting, in the Outlet Basin (EB06) and Bay of Quinte (all other sites) 1998.

Site	Date	Depth (m)	Water Temp. (oC)	Mesh Size (mm)	Total Length (mm)	Weight (g)
BB05	23-Jun	5.0	20.9	102	531	609
HB13	25-Jun	12.5	13.5	152	547	925
EB06	30-Jun	30.0	10.6	114	552	1017
CO13	13-Aug	12.5	22.2	089	473	516
BB05	21-Oct	5.0	13.0	114	741	1386

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4

St. Lawrence River

A. Mathers, T. J. Stewart, and A. Bendig[1]

Overview

The St. Lawrence River fisheries management program includes standardized fall gillnetting programs, creel surveys and monitoring the eels migrating over the fish-way 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 communities and has been established in four distinct sections of the river; Lake St. Francis, Middle Corridor, Lake St. Lawrence, and the Thousand Islands. 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 1986 and 1995 gillnet assessment programs on the Ontario portion of the River were conducted in each section every second year. The 1998 netting in Lake St. Francis (conducted using methods as described by Bendig 1995) added to the database established in 1984 and represented the seventh netting program in this section of the St. Lawrence River.

American eel spawn in the Sargasso Sea and a portion of the juvenile female population eventually migrates 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 for a 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 migration of the eel upstream of the dam. Annual counts and a new index of recruitment, based on mean daily counts, was reported for the years 1974 to 1995 (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 1998.

Species Population Trends

This chapter provides updated trends in abundance for five fish species of local management interest. Yellow perch, walleye, smallmouth bass, and northern pike provide an important recreational fishery in the Lake St. Francis area (Bendig 1995). In addition, the yellow perch and American eel contribute to a commercial fishery (Hoyle 1999). The overall catch during 39 gillnet sets in the 1998 Lake St. Francis project included 590 fish of 13 species (a complete summary of standardized gillnet catch-per-unit-effort is listed in Appendix C) The average number of fish captured per net during 1998 (15.7 fish per net) was very similar to 1994, however, there has been a gradual decline in the number of fish caught per net from the start of the program in 1984 (Fig. 1).

Yellow Perch

Yellow perch continued to be the most abundant fish captured in the Lake St. Francis gillnet program making up 47% of the total catch of all species. The catches of yellow perch during 1998 showed a continuation of the trend of declining catch which

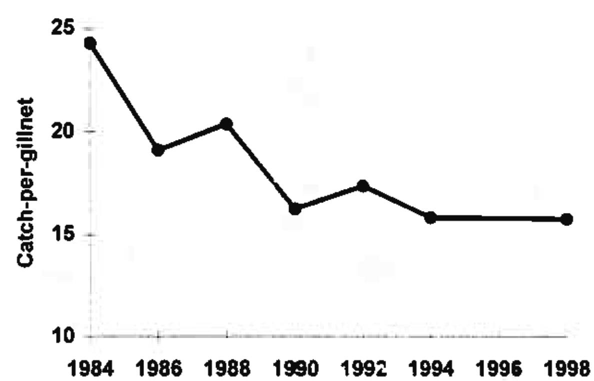

FIG. 1. Catch of all species of fish in standard gillnets set in the Lake St. Francis area 1984 to 1998

[1] Ontario Ministry of Natural Resources, P.O. Box 2002, Concession Road, Kemptville, Ontario, K0G 1J0.

started in 1990 (Fig. 2). Catches of yellow perch in the Thousand Islands area (McCullough and Klindt 1998, Cholmondeley et al. 1998) and eastern Lake Ontario (Hoyle 1999) have shown slight improvement in recent years while yellow perch catches in Lake St. Lawrence (Lapan and Klindt 1998) have remained relatively stable. The catch rate of large yellow perch (greater than 220 mm total length) increased slightly in 1998 relative to the catch in 1994 (Fig. 2). Age distributions of the catch indicate that the 1995 year-class (currently aged 3 yrs-old) is relatively strong, making up 57% of the total catch (Fig. 2).

Smallmouth Bass

Smallmouth bass abundance in gillnets set in Lake St. Francis suggest a trend of increasing abundance since 1990 (Fig. 3). Smallmouth bass catches have declined in the Thousand Islands (McCullough and Klindt 1998, Cholmondeley *et al.* 1998), Lake St. Lawrence (Lapan and Klindt 1998), and in the Eastern Basin of Lake Ontario (Hoyle 1999). Fish from the 1991 year-class (7 yrs-old) made up over 26% of the catch (Fig. 3). The catches of younger fish suggest there will not be strong year-classes entering the fishery over the next few years.

Northern Pike

Northern pike catches have stayed relatively stable throughout the time period surveyed, although catches of small pike have declined slightly (Fig. 4). A decline in northern pike catches has been reported over the same time period in the Thousand Islands area (McCullough and Klindt 1998, Cholmondeley *et al.* 1998), while pike catches in Lake St. Lawrence have increased recently (Lapan and Klindt 1998). Fish aged 5 and 6 yrs-old made up 45% of the total catch, suggesting that the 1992 and 1993 year-classes were relatively strong (Fig. 4). The catch rates for young pike were not particularly large relative to previous years (Bendig 1995) however, the presence of young of the year fish in the catch is encouraging.

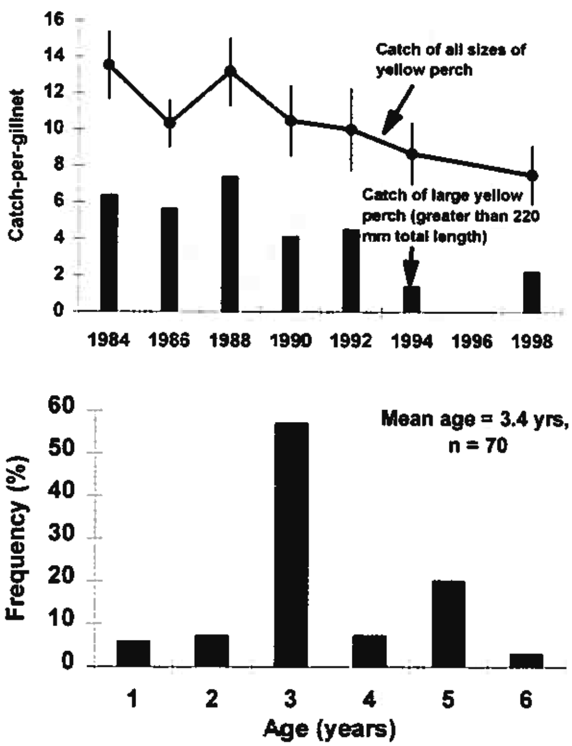

FIG. 2. Upper panel shows both the catches of large yellow perch (bars) and all sizes of yellow perch (line) in standard gillnets set in the Lake St. Francis area 1984 to 1998. Lower panel shows age distribution of yellow perch caught during 1998.

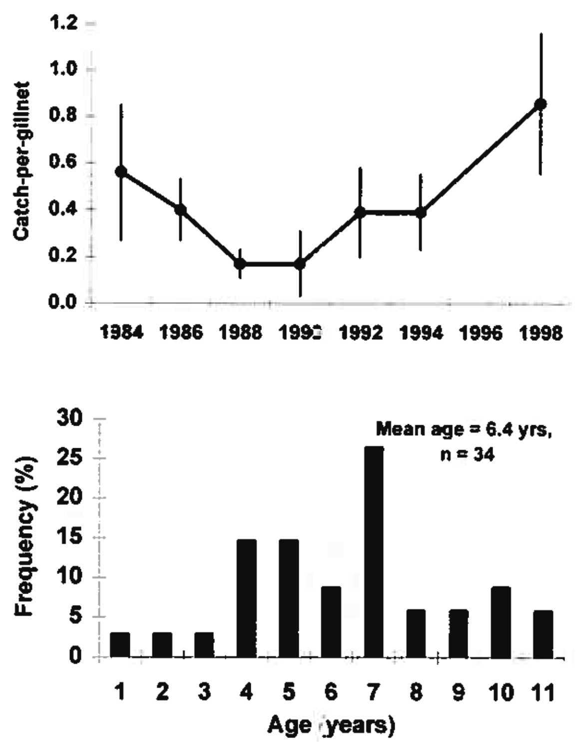

FIG. 3. Upper panel shows smallmouth bass catch in standard gillnets set in the Lake St. Francis 1984 to 1998. Lower panel shows age distribution of smallmouth bass caught during 1998.

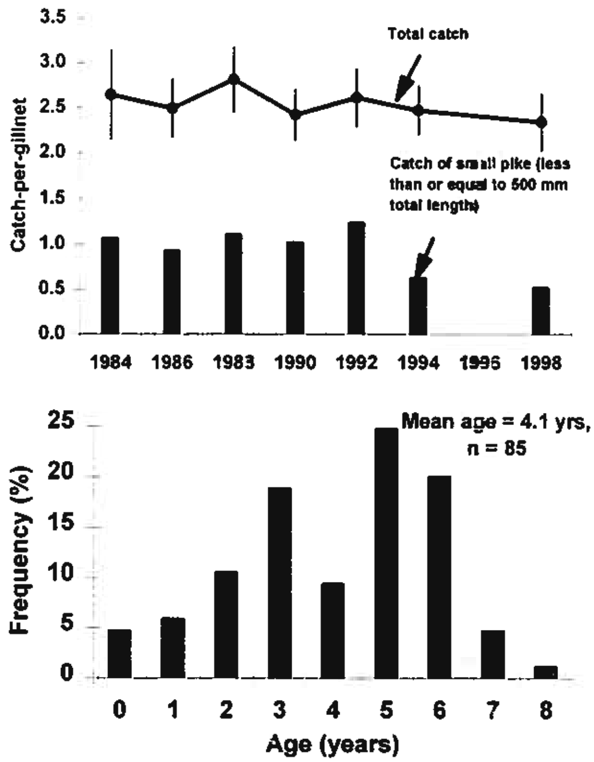

FIG. 4. Upper panel shows the catch of small northern pike (bars) and catch of all pike in standard gillnets set in the Lake St. Francis, 1984 to 1998. Lower panel shows age distribution of northern pike caught during 1998.

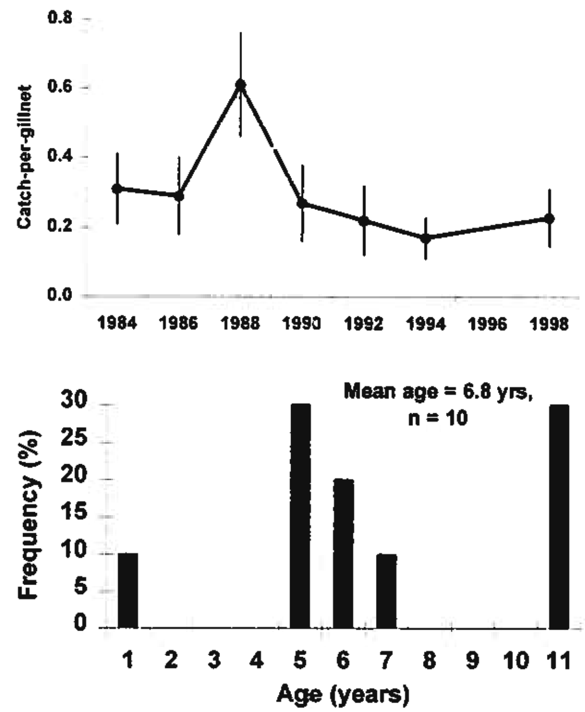

FIG. 5. Upper panel shows walleye catch in standard gillnets set in the Lake St. Francis area , St. Lawrence River, 1984 to 1998. Lower panel shows age distribution of walleye caught during 1998.

Walleye

Walleye catches in Lake St. Francis have stayed relatively low and stable in recent years (Fig. 5). Relatively high walleye catches have been reported in Lake St. Lawrence recently (Lapan and Klindt 1998).

Other Species

Pumpkinseed, brown bullhead and rock bass are also monitored by this program and are commercially harvested in Lake St. Francis. Catches of these three species appear to have been relatively stable over the last ten yrs (Appendix C).

American Eel

The eel ladder was opened on June 24 and closed on October 19 (113 days) and counts were made manually on 34 days. The total number of eels using the ladder was estimated to be 3,432, the lowest recorded since the installation of the ladder. The recruitment index (Casselman *et al.* 1997a) was calculated to be 57.2 eels/day (Fig. 6), based on the

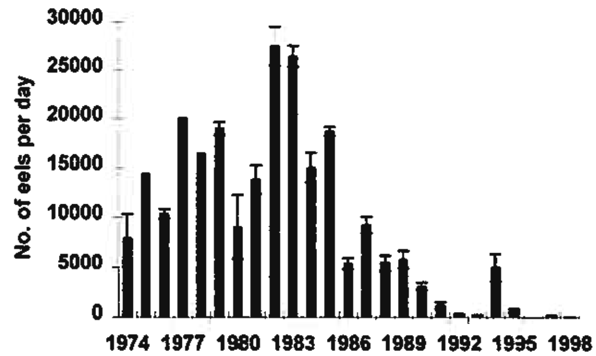

FIG. 6. Mean number of eels ascending the eel ladder per day at the R. H. Saunders Hydroelectric Dam, Cornwall, Ontario during a 31-day peak migration period for 1974 to 1998. Vertical bars indicated the 95% confidence intervals. No counts were available for 1996. (Data from 1974 to 1995 redrawn from data provide in Table 1, Casselman et al. 1997a).

31-day peak migration period occurring from July 2 to August 1, and was also the lowest value estimated. The recruitment index was correlated with commercial catches of eels 8 yrs later in Lake Ontario (Casselman *et al.* 1997b). Therefore, low indices of recruitment for the last decade (Fig. 6) 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 1997, about 1million lb of fish valued at nearly $1million were harvested from Canadian waters (Hoyle and Harvey 1998).

The Canadian waters of the St. Lawrence River also supports a commercial fish harvest; 350,000 lb valued at $400,000 were harvested in 1997.

This chapter updates the 1998 commercial fisheries for the Canadian waters of Lake Ontario and the St. Lawrence River.

Quota Management

The overall direction of commercial fish management 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

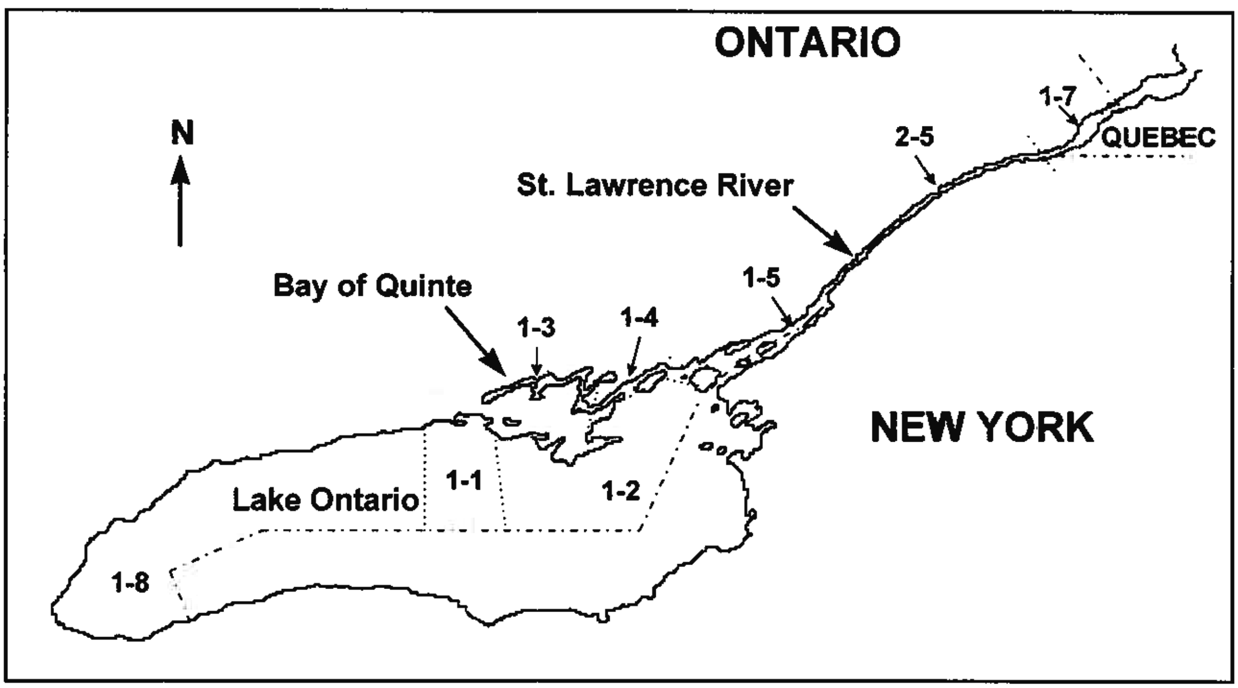

FIG. 1. Commercial fish quota zones on the Canadian waters of Lake Ontario and the St. Lawrence River.

TABLE 1. Commercial harvest quotas (lb) for the Canadian waters of Lake Ontario, 1998. 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.

Species	Quota (lb) by Quota Zone					
	1-1	1-2	1-3	1-4	1-8	Total
Lake whitefish	39,310	407,100	107,027	125,259	800	679,496
Lake herring	15,690	18,900	7,250	7,350	-	49,190
Round whitefish	10,000	-	-	-	-	10,000
Eel	41,830	254,655	66,130	34,035	3,600	400,250
Black crappie	3,940	15,650	12,530	400	2,400	34,920
Yellow perch	31,870	116,560	78,690	75,235	11,500	313,855
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, 1998. See Fig. 1 for a map of the quota zones. Quota for species such as bullheads and sunfish are not given here.

Species	Quota (lb) by Quota Zone			
	Napanee (1-5)	Cornwall (1-7)	Brockville (2-5)	Total
Eel	30,690	50,186	23,070	103,946
Black crappie	20,590	5,940	22,140	48,670
Yellow perch	52,860	5,760	66,517	125,137

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 1998 included minor adjustments to quota; compare Table 1 in this report to Table 1 in Hoyle and Harvey (1998).

Lake Ontario

Commercial Harvest Summary

Commercial harvest statistics were not available at the time of printing. The Ontario Ministry of Natural Resources is currently reviewing the 1998 commercial harvest data, and until that is complete we are not in a position to report on 1998 landings and value. The 1998 statistics will be published next year along with the 1999 harvest statistics.

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 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 (Casselman *et al.* 1996).

The length and age distributions of lake whitefish in the fall commercial fisheries for Quota Zones 2 and 3 are shown in Fig. 2 and Fig. 3. Mean length and age in Quota Zone 2, representing the Lake Ontario whitefish stock, were 472 mm and 8.0 yrs-old, respectively. The 1991 and 1992 year-classes contributed to nearly 50% of the harvest. In the Bay of Quinte (Quota Zone 3), the mean length and age were 445 mm and 8.2 yrs-old, respectively. For the fifth year in succession, the 1991 year-class dominated the harvest. The 1994 year-class was strong as measured as young-of-the-year in bottom trawls, and was expected to show strongly in this year's fishery (4 yrs-old). This did not occur, and is in direct contrast to the

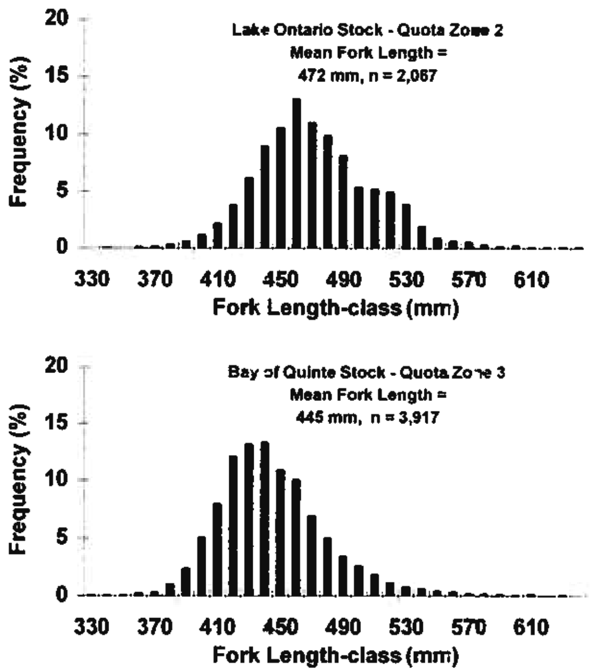

Fig. 2. Fork length (mm) distribution of lake whitefish in Quota Zone 2 (upper panel) and 3 (lower panel) in the 1998 commercial harvest.

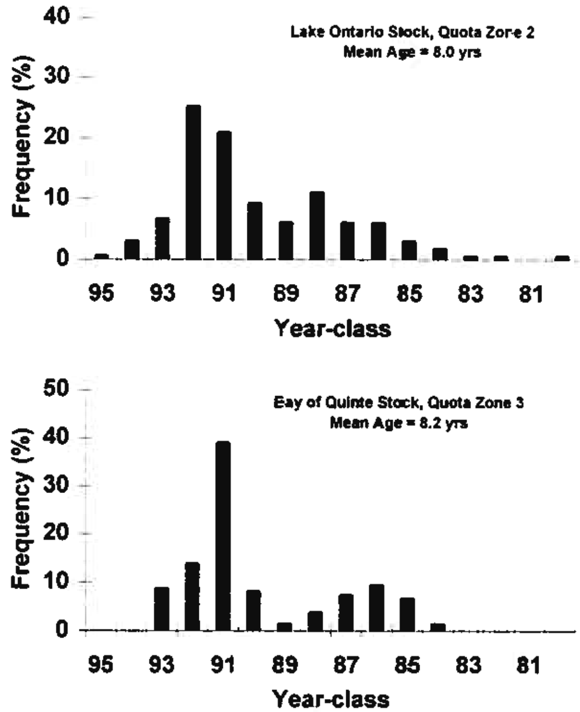

Fig. 2. Age distribution of lake whitefish in Quota Zone 2 (upper panel) and 3 (lower panel) in the 1998 commercial harvest.

1991 year-class which was the most abundant year-class in the 1994 commercial fishery at age 3.

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6

Recreational Fisheries

J. A. Hoyle, J. N. Bowlby, and A. Smith

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 1998 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 control phosphorus input, declines in alewife abundance, and the recent invasion of zebra mussels are some of the primary factors causing Bay of Quinte ecosystem changes.

The salmon and trout fishery in Western Lake Ontario was monitored again in 1998. Only the portion of the fishery that launches boats from ramps was monitored. This is consistent with our surveys from 1982 to 1995, and 1997. Marina based boats were surveyed in 1989 and 1995 (Hoyle *et al.* 1996) to give

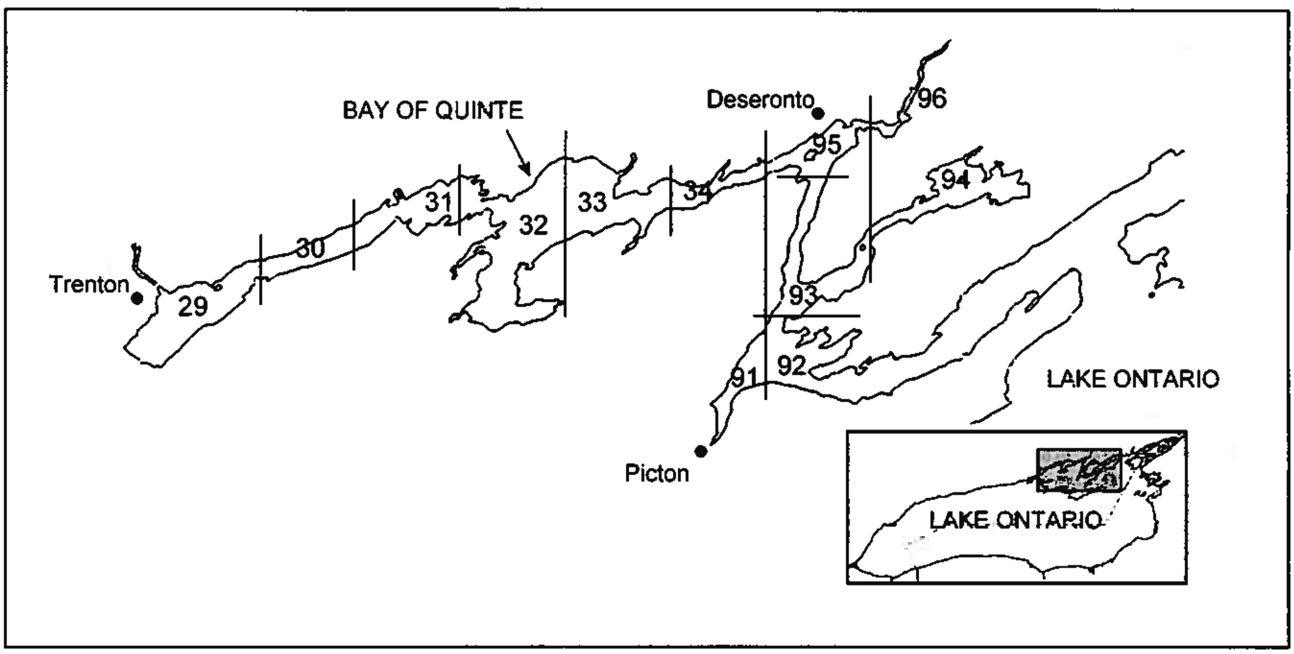

Fig. 1. Map of Bay of Quinte, eastern Lake Ontario, showing creel survey areas.

a more complete picture of the boat fishery, but this fishery was not surveyed in 1997 or 1998. However, the boat angler fishery in the Ontario portion of eastern Lake Ontario was surveyed for the first time since 1992.

In 1998, angling effort in the western Lake Ontario boat fishery was down slightly form 1997. Chinook salmon harvest was similar to that in 1997, while rainbow trout harvest increased. In the eastern Lake Ontario boat fishery, catches of lake trout were higher than in the 1992 survey but smallmouth bass catch and catch rate were down.

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 (1997, 1998) for on-ice and on-water surveys, respectively.

Ice Fishery

Ice angling effort was estimated to be 148,178 rod-hours (Table 1). The fishing pressure was down 55% from the previous 5-yr average (Fig. 2). The low fishing pressure was at least partly related to extremely poor ice conditions. An estimated 11,167 walleye were caught of which 6,089 were harvested. The number of walleye harvested was the lowest ever recorded (Fig. 3), while fish success rate was the second lowest in 10 years (Fig. 4). The average walleye harvested during the ice fishery was 561 mm fork length and weighed 2.3 kg.

Open-water fishery

Open-water fishing effort was estimated to be 443,104 rod-hours (Table 1, Fig. 2). Walleye catch was estimated at 67,786 fish of which 51,118 were harvested. The number of walleye harvested was down 35% from last year and down 56% compared to the average of the previous five years (Fig. 3). Walleye angling success (0.115 walleye harvested-per-rod-hour in 1997) has been declining since 1991 (Fig. 4). The average walleye harvested during the open-

*TABLE 1. The seasonal distribution of angling effort and walleye catch and harvest for Bay of Quinte ice and open-water recreational fisheries, 1998. *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
<u>Ice Fishery:</u>			
Ice fishing total*	148,178	11,167	6,089
<u>Open-water fishery:</u>			
Opening weekend	74,000	5,512	4,172
May	171,195	26,178	20,448
June	56,183	12,532	9,302
July	52,418	15,823	10,588
August**	52,771	5,947	5,623
Fall**	36,536	1,793	985
Open-water total	443,104	67,786	51,118
Annual total	591,282	78,953	57,207

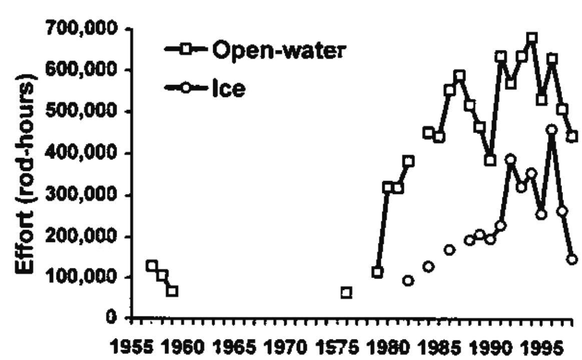

FIG. 2. Angling effort during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1998.

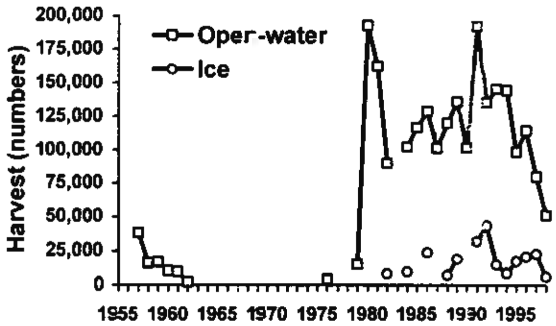

FIG. 3. Walleye harvest during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1998.

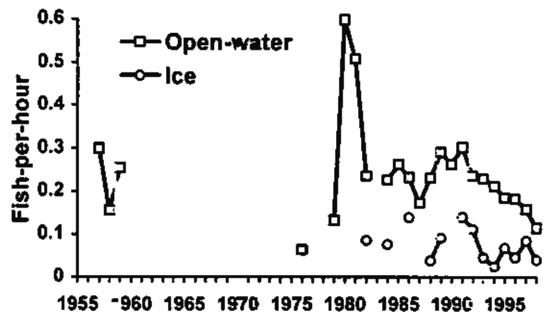

FIG. 4. Walleye harvest-per-unit-effort (HUE) during the Bay of Quinte ice and open-water recreational fisheries, 1957 to 1998.

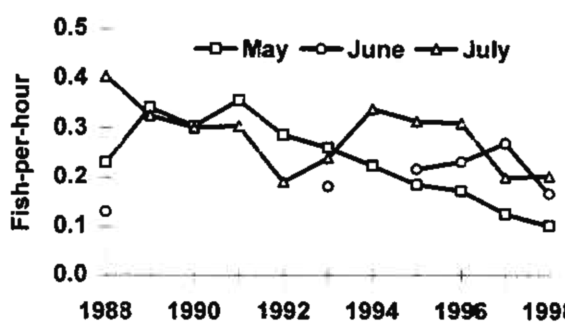

FIG. 5. Walleye harvest-per-unit-effort (HUE) during the Bay of Quinte open-water recreational fishery in May, June and July, 1988 to 1998.

water fishery was 381 mm fork length and weighed 0.67 kg.

Significant changes in the Bay of Quinte walleye fishery have now occurred over the last several years as the Bay of Quinte ecosystem changes in response to efforts to reduce pollution (e.g., phosphorus control) and the invasion of zebra mussels. For example, walleye fishing success during May has been declining steadily since 1991 (Fig 5), as walleye movement and distribution patterns have likely changed in response to ecosystem changes in the Bay, particularly clearer water. By way of contrast, walleye fishing success during June had been improving during recent years and had more than doubled from 1988 to 1997. The latter result was likely related to a decline in the numbers of alewife, the walleye's primary food source (Hoyle 1998). 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. The trend was reversed in 1998 when June fishing success was poor.

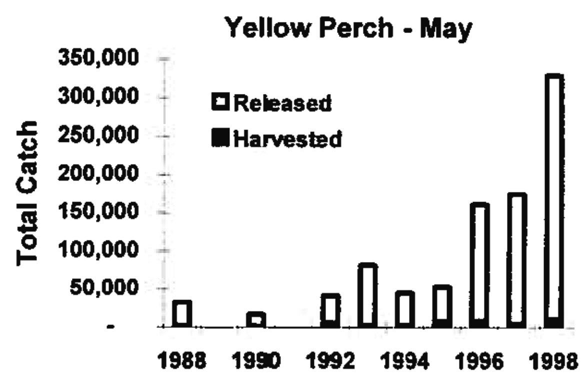

FIG. 6. Yellow perch catch (released and harvested) during May of the Bay of Quinte open-water recreational fishery, 1988 to 1998.

Another indication of ecosystem change is the large increase in yellow perch abundance in recent years (see Chapter 2 in this report). The increase in yellow perch abundance is also reflected in the anglers catch (Fig. 6).

Western Lake Ontario Boat Fishery

The portion of the salmon and trout fishery in Western Lake Ontario that launches boats from ramps was monitored in 1998. This is consistent with our surveys from 1982 to 1997. Marina based boats were not surveyed in 1998.

The survey design in 1998 was consistent with past surveys of the "launch daily" boat fishery. The design

TABLE 2. Average daily trailer count on weekend days in 1998 during 1000 - 1400 hrs at launch ramps along western Lake Ontario (Ontario portion)

Sector	Ramp	Apr	May	Jun	Jul	Aug	Sep	Average
Southwest	Queenston Sand Docks	10.5	6.5	7.3	5.0	8.5	11.0	8.1
	St.Catharines Game and Fish	16.5	11.3	4.0	7.5	15.5	14.8	11.6
	Beacon Motor Inn	5.5	5.8	8.3	5.3	6.0	5.0	6.0
	Sector total	32.5	23.5	19.5	17.8	30.0	30.8	25.7
West	Grimsby Municipal Ramp	4.3	1.8	0.0	1.5	2.3	1.5	1.9
	Foran's Marine	9.0	2.3	1.3	3.8	3.8	1.0	3.5
	Lakecourt Marina	2.8	0.8	0.0	0.3	0.0	0.0	0.6
	HRCA 50 Pt. Ramp	24.0	17.3	12.8	19.8	16.5	8.3	16.4
	Fisherman's Wharf	21.8	16.8	14.0	28.5	32.5	19.0	22.1
	Bronte Beach	7.8	8.5	7.0	33.3	14.8	21.8	15.5
	Shipyard Park	0.0	3.0	2.8	11.3	3.5	6.3	4.5
	Busby Park	1.3	0.5	1.3	1.3	0.0	0.5	0.8
	Sector total	70.8	50.8	39.0	99.5	73.3	58.3	65.3
Northwest	*Port Credit Ramp*	2.8	8.5	10.8	32.8	46.8	15.8	19.5
	Lakefront Promenade Park	1.5	6.5	11.3	28.8	35.0	13.3	16.0
	Marie-Curtis Park	0.0	0.8	1.0	4.8	8.3	1.0	2.6
	Humber Bay West	0.8	14.3	11.0	44.0	31.3	11.5	18.8
	Sector total	5.0	30.0	34.0	110.3	121.3	41.5	57.0
West Central	Ashbridges Bay	0.8	3.0	5.0	25.0	19.8	5.3	9.8
	Bluffers Park	2.0	6.3	10.5	70.8	47.5	9.3	24.4
	Frenchman's Bay West	2.5	3.3	1.0	6.0	4.8	1.0	3.1
	Frenchman's Bay East	1.3	1.3	1.5	2.0	0.8	0.3	1.2
	Duffin Creek	0.8	0.8	0.0	0.0	0.5	0.0	0.3
	Sector total	7.3	14.5	18.0	103.8	73.3	15.8	38.8
Central	Port Whitby Marina	0.0	0.5	0.5	0.5	1.3	2.8	0.9
	Whitby Gov't Ramp	0.0	0.0	0.0	7.5	10.3	2.5	3.4
	Port Oshawa Marina	0.0	1.5	1.8	10.5	8.0	2.3	4.0
	CLOCA P. Darlington Ramp	2.3	1.5	4.0	19.5	15.8	3.0	7.7
	Port Newcastle	0.5	1.5	1.3	3.3	1.8	0.0	1.4
	Port Hope Marina	0.5	0.0	0.5	7.0	9.8	0.5	3.0
	Cobourg Yacht Club	0.5	2.0	1.8	4.0	3.8	0.3	2.0
	Sector total	3.8	7.0	9.8	52.3	50.5	11.3	22.4
East Central	Ontario Street Ramp	1.0	12.0	4.8	16.8	7.5	2.5	7.4
	Brighton Marina	0.0	0.5	0.3	0.5	0.0	0.0	0.2
	Gosport Gov't Ramp	0.3	4.8	1.5	1.3	1.0	0.5	1.5
	Camp Barcovan	0.0	0.5	3.3	2.3	2.0	0.0	1.3
	McSaddens Marina	0.0	0.8	3.8	7.0	2.0	0.8	2.4
	Wellers Bay Marina	0.5	6.3	3.3	5.5	5.3	4.0	4.1
	North Shore Park	0.0	0.0	0.3	1.5	0.8	0.3	0.5
	Wellington Beach	3.0	10.3	9.0	35.5	16.5	2.0	12.7
	Wellington Gov't Ramp	0.5	1.0	3.5	12.5	6.0	1.3	4.1
	Sector total	5.3	36.0	29.5	82.8	41.0	11.3	34.3
Total		124.5	161.8	149.8	466.3	389.3	168.8	243.4
Ramps with Anger Interviews		10.5	27.5	37.8	171.0	132.5	31.3	68.4
		(8%)	(17%)	(25%)	(37%)	(34%)	(19%)	(28%)

was based on seasonal stratification by month from April to September, and spatial stratification into 6 sectors from the Niagara River to Wellington (Table 2). Anglers were interviewed after fishing was completed at four launch ramp locations Port Credit, Bluffers Park, Port Darlington, and Wellington, each representing catch and harvest statistics for a sector. Anglers were not surveyed at the two remaining sectors (St. Catharines Game and Fish, Fisherman's Wharf). Rather, the catch and harvest distribution from 1995, scaled to the 1998 results at the surveyed ramps, was assumed for Niagara to Oakville. 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 time periods from 0900 to 2100. 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 declined slightly in 1998 compared with 1997 (Fig. 7). During 1998, the effort of launch daily anglers and all boat anglers was estimated at 297,330 and 473,843 angler-hrs, respectively. 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 half of the effort (Table 2). A regulation change allowing 2 rods-per-angler in Lake Ontario came into effect during summer 1998. This resulted in effort in rod-hrs exceeding angler-hrs by 11% during August and September. Previously, the angler-hrs and rod-hrs estimates of effort were almost identical. Across the whole survey period the rod-hr estimate exceeded the angler-hr estimate by 6%.

Catch

Chinook salmon and rainbow trout accounted for about 90% of the salmonine catch and harvest in the western Lake Ontario boat fishery (Table 3).

The chinook salmon catch and harvest in 1998 was similar to 1997 (Fig. 7). Rainbow trout catch in 1998

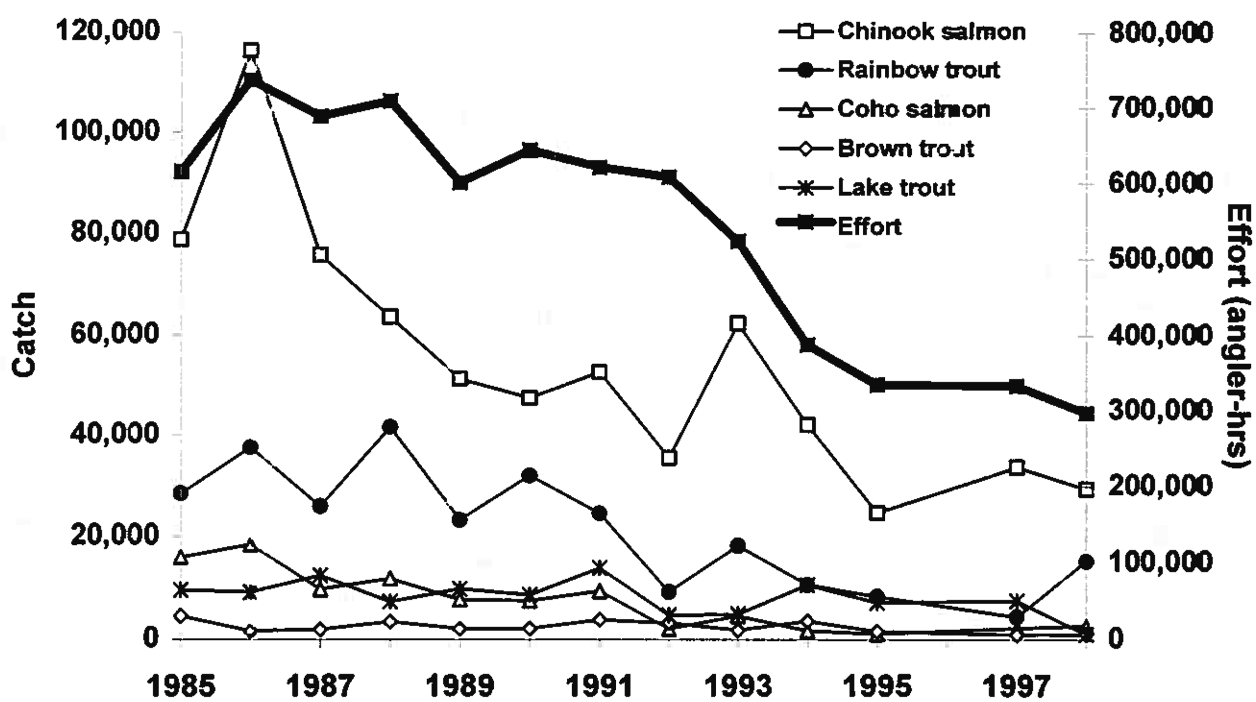

FIG. 7. Catch and effort in western Lake Ontario launch daily salmonid boat fishery (Ontario portion) from 1985 to 1998.

TABLE 3. Angling statistics for salmonid boat fisheries in western Lake Ontario (Ontario portion) during April to September 1998. Catch and harvest rates are number of fish per angler-hr.

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	29,432	17,115	0.0990	0.0576	42	38,845	23,363	0.0820	0.0493	40
Rainbow trout	15,236	8,461	0.0512	0.0285	44	26,815	16,976	0.0566	0.0358	37
Coho salmon	2,598	1,345	0.0087	0.0045	48	3,173	1,682	0.0067	0.0036	47
Brown trout	1,090	496	0.0037	0.0017	55	1,561	829	0.0033	0.0018	47
Lake trout	1,051	480	0.0035	0.0016	54	1,712	667	0.0036	0.0014	61
Atlantic salmon	480	316	0.0016	0.0011	34	885	559	0.0019	0.0012	37
Pink salmon	54	42	0.0002	0.0001	22	54	42	0.0001	0.0001	22
Unidentified salmonine	550	80	0.0019	0.0003	86	697	126	0.0015	0.0003	82
Total salmonines	50,492	28,333	0.1698	0.0953	44	73,742	44,245	0.1556	0.0934	40

increased 3.7 times over 1997 (Fig. 7). This increase counters the more general decline in rainbow trout catch since the late 1980s. The reasons for this increase are not clearly linked to stocking. As well, there was a strong year-class of wild rainbow trout in 1995, but it cannot fully account for this increase in catch. Rather, the unusual weather patterns in 1998 may have made rainbow trout more vulnerable to anglers. An early spring in 1998 likely resulted in lower harvest by river anglers during spawning runs, leaving more fish available for boat anglers. Lake trout catches declined drastically in 1998; this was also more likely related to the unusually early spring. The greatest harvest of lake trout in this fishery usually occurs during spring at Wellington, but few lake trout were caught there in 1998. The brown trout catch in 1998 remained at low levels similar to 1997 (Fig. 7). Atlantic salmon catches increased in 1998 and the harvest level was similar in magnitude to brown trout and lake trout. The low release rate for Atlantic salmon (Table 3) despite a 25-in minimum size limit, are consistent with the difficulties anglers have in identifying Atlantic salmon. The reported catch of Atlantic salmon is likely about half the actual catch and is consistent with the catch of higher numbers of unidentified salmon and trout (Table 3).

Eastern Lake Ontario Boat Fishery

The boat angler fishery in the Ontario portion of eastern Lake Ontario was surveyed for the first time since 1992 (Bowlby and Mathers 1993). Eastern Lake Ontario refers to the Bay of Quinte, east of Glenora Ferry, and Lake Ontario, east of Point Petre. This survey was designed to cover the major portion of the smallmouth bass season because of concerns with declines in smallmouth bass populations (see Chapter 8 in this report).

The survey began on the opening of smallmouth bass season (June 27) and estimates were made until the end of September, 1998. Launch daily and marina based anglers were interviewed at Collins Bay and Olympic Harbour to obtain catch and effort information. These two sites accounted for 34% of the effort from public boat access sites in 1992 (Bowlby and Mathers 1993). Interviews were conducted in a similar manner and with similar daily and weekly stratification as the survey of western Lake Ontario anglers (above). Fishing boats were counted from the air on one weekday and one weekend day each week to expand angling effort for the whole of eastern Lake Ontario. Aerial counts were expanded to counts for the whole day with the use of daily activity patterns developed from the interview data.

Effort

During the smallmouth bass season in 1998, the effort in the eastern Lake Ontario boat fishery was estimated at 49,751 angler-hrs. As a result of the regulation change allowing 2 rods-per-angler in Lake Ontario, effort in rod-hrs exceeded angler-hours by 8% during August and September and 7% for the whole survey period. Effort was directed primarily towards lake trout (53%) and smallmouth bass (38%).

Comparisons with previous surveys in 1992 and 1987 are difficult due to differences in the design of the surveys. Nevertheless, in 1992 about 54,000 angler-hrs of fishing occurred from July to September in eastern Lake Ontario (OMNR unpublished). The summer fishery may have declined slightly. The majority of effort in the summer of 1992 was directed towards smallmouth bass, and so this decline appears to be in the smallmouth bass fishery.

Catch

The salmonid fishery in eastern Lake Ontario differs greatly in character from the boat fishery in western Lake Ontario. This fishery to a large extent targets lake trout, with other species such as chinook salmon and brown trout being incidental to lake trout catches (Table 4). As well, almost all of the salmonids caught in this fishery are kept.

The catch and harvest of lake trout during summer 1998 approached the 1992 totals for the entire season. The total 1998 harvest of lake trout likely exceeded 1992. Lake trout catch rates were very high compared to other salmon and trout species in the eastern and western launch daily fisheries (Tables 3 and 4). Unclipped fish accounted for 17% of the lake trout harvest. The size range of these unclipped fish suggests that most may have been hatchery fish with regenerated fins. However, the presence of so many potentially wild fish in anglers catches, along with the relatively low release rate, suggests that it may be appropriate to encourage the release of unclipped lake trout to support rehabilitation efforts.

TABLE 4. Angling statistics for salmonid boat fisheries in eastern Lake Ontario (Ontario portion) during June 27 to September 1998. Targeted catch and harvest rates are number of fish per angler-hr.

Species	Catch	Harvest	Catch rate	Harvest rate	Release Rate (%)
Chinook salmon	826	826	0.079	0.079	0
Brown trout	39	39	0.061	0.061	0
Lake trout	9,106	8,677	0.348	0.331	5
Unidentified salmonine	21	21	0.030	0.030	0
Total salmonines	9,992	9,562	0.381	0.365	4
Northern pike	1,019	20	0.330	0.041	98
Muskellunge	20	-	-	-	100
Brown bullhead	20	20	-	-	0
Rock bass	88	-	-	-	100
Pumpkinseed	293	-	-	-	100
Bluegill	380	-	1.000	-	100
Smallmouth bass	5,078	1,356	0.265	0.068	73
Largemouth bass	344	74	0.231	0.056	78
Yellow perch	8,553	472	1.469	0.137	94
Walleye	359	167	0.118	0.046	53
Freshwater drum	86	-	-	-	100

Chinook salmon catches almost quadrupled from 1992. Since most chinook in eastern Lake Ontario are caught during summer, the values reported here (Table

4) likely reflect a majority of the 1998 catch. Anglers that targeted chinook salmon had success just slightly lower than western Lake Ontario.

Brown trout catches declined to less than 20% of summer 1992 catches. This is consistent with reductions in brown trout stocking in eastern Lake Ontario, since 1992, and further emphasizes the poor returns of brown trout stocked in the North Channel (Bowlby and Mathers 1993).

Rainbow trout stocking by Ontario began in 1997 in eastern Lake Ontario. As well, in 1997 about 360,000 rainbow trout escaped from pens of a private fish culture operation in the Outlet Basin. Based on our observations of stocked rainbow trout in western Lake Ontario, we expected to see some of the aquaculture fish in 1998. However, we had no reports of rainbow trout in this survey. Often, catches peak two years after stocking, and we may yet see some of the aquaculture fish caught. It is not clear whether the absence of these fish thus far, is associated with poor survival, or is because eastern Lake Ontario fishermen have not begun to target rainbow trout.

The warmwater fishery in eastern lake Ontario was dominated by smallmouth bass, but also included largemouth bass, yellow perch, walleye, and a few other species (Table 4). Smallmouth bass catches in 1998 were lower than 1992 (Table 4). This resulted from a combination of decreased effort and decreased catch rates (Fig. 8). These catch rates reflect recent declines in the population of smallmouth bass in eastern Lake Ontario (see Chapter 8 in this report).

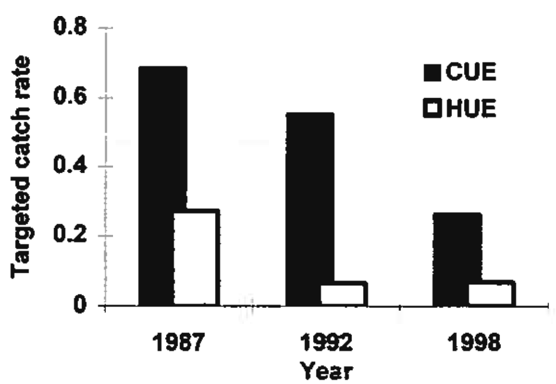

FIG. 8. Targeted catch rate of smallmouth bass in the eastern Lake Ontario launch daily boat fishery (Ontario portion) from 1987 to 1998.

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7

Aboriginal Spear Fishery

A. Mathers, T. Northardt[1] and J. Brant[1]

Overview

This survey monitors trends in fishing effort and harvest of aboriginal spear fisheries in the Bay of Quinte, and measures changes in harvest rate and biological characteristics of the fish harvested. The information is used to help assess walleye status and support fisheries management. Aboriginal fisheries in the Canadian waters of Lake Ontario include aboriginal spear fisheries for walleye conducted during the spring at the mouths of the Napanee, Moira, and Salmon Rivers (Fig. 1). 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. A census of the spear fishery on the Salmon River is conducted by the Mohawks of the Bays of Quinte.

Spear Fishery Summary

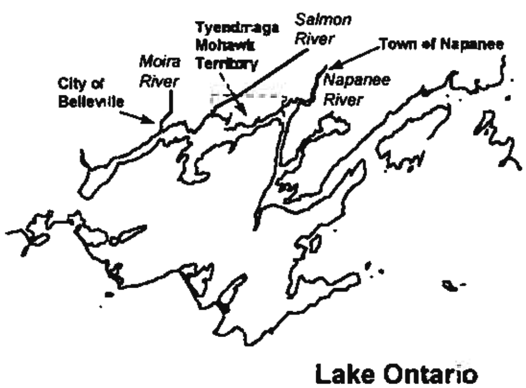

FIG. 1. Map of Bay of Quinte showing locations of Napanee, Salmon and Moira Rivers.

The spear fishery survey was conducted during the spring walleye run between March 31 and May 1, 1998 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 random samples was then expanded to estimate the fishing effort and harvest for the entire survey period.

A count of all walleye harvested by spear fishers was conducted on the Salmon River daily between April 1 and May 1, 1998. All people fishing were interviewed and their harvest was counted.

Fishing effort was estimated to be 294 hours and 558 hrs for the Napanee and Moira Rivers respectively during the 1998 survey period (Fig. 2). The combined fishing effort for the two rivers has increased over the five years surveyed. Fishing effort was not evaluated during the census on the Salmon River.

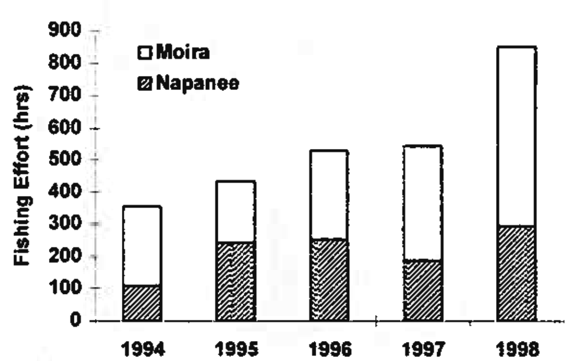

FIG. 2. Spear fishing effort in the Napanee and Moira Rivers for 1994 to 1998.

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

An estimated 848 walleye were harvested in the Napanee River which was only one quarter of the 1997 estimate for this river (Fig. 3) The estimate for the Moira River was 7,000 walleye harvested which is similar to the estimate for 1997. In the Salmon River, 4,679 walleye were harvested, which is similar to previous estimates.

The fork length of the walleye harvested ranged between 310 mm and 770 mm (Fig. 4). Fish in the Napanee River averaged 613 mm in length while those harvested in the Moira River averaged 581 mm. Previous year's surveys have also shown larger fish being captured in the Napanee River. Female fish from both rivers combined averaged 603 mm while males averaged 545 mm in length. The larger size of female fish has also been observed in previous surveys. Length of walleye harvested in the Salmon River was not measured.

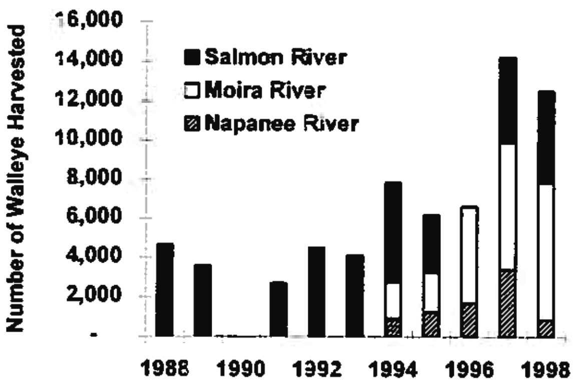

FIG. 3. Walleye harvest during spring spear fisheries in the Salmon, Napanee and Moira Rivers for 1988 to 1998. Note that no surveys were conducted in the Napanee and Moira Rivers prior to 1994. No surveys were conducted in the Salmon River during 1990 and 1996.

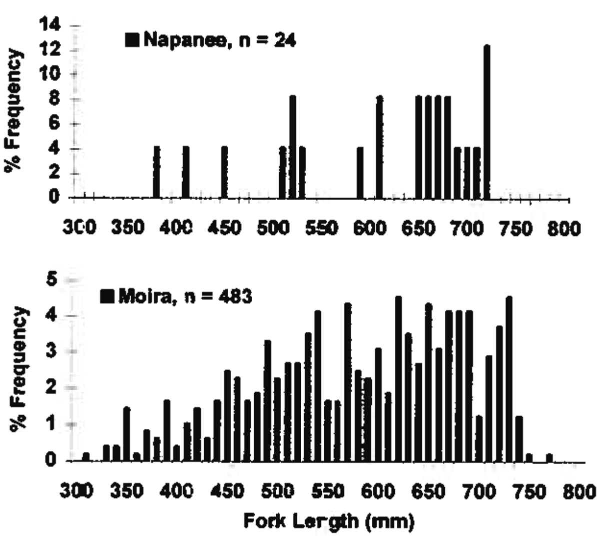

FIG. 4. Fork length of walleye harvested during spring spear fisheries in the Napanee (upper panel) and Moira (lower panel) Rivers during 1998.

8

Smallmouth Bass (*Micropterus dolomieui*) Population Status in Eastern Lake Ontario, 1978 to 1998

J. A. Hoyle, J. M. Casselman and T. Schaner

Introduction

Smallmouth bass (*Micropterus dolomieui*) are a prominent member of the eastern Lake Ontario (Fig. 1) fish community. Since 1978, smallmouth bass have consistently been one of the most abundant species caught in fish community index netting programs conducted during mid-summer in eastern Lake Ontario by the Ontario Ministry of Natural Resources (OMNR). In early years, smallmouth bass were the most abundant top predator but in more recent years (i.e., late 1980s) were surpassed in abundance by walleye and lake trout. Smallmouth bass, along with lake trout, also support the largest recreational fisheries in eastern Lake Ontario.

In recent years, smallmouth bass abundance has declined in OMNR index gillnets (Hoyle 1998) and in the recreational fishery (see Chapter 6 in this report). New York State has observed similar trends (Chrisman and Eckert 1998). Here, we document smallmouth bass status in the Canadian waters of eastern Lake Ontario from 1978 to 1998. The objective of this report is to provide background information to help determine the factors controlling smallmouth bass population dynamics in the eastern basin of Lake Ontario.

Methods

Smallmouth bass abundance was monitored using gillnets, consisting of a variety of mesh sizes from 1½ in to 6 in stretched mesh, set at fixed sampling locations in the eastern basin of Lake Ontario from 1978 to 1998 (Fig. 1). Catches were adjusted to represent 100 m of each mesh size, and summed across mesh sizes (CUE). Correction factors were applied to

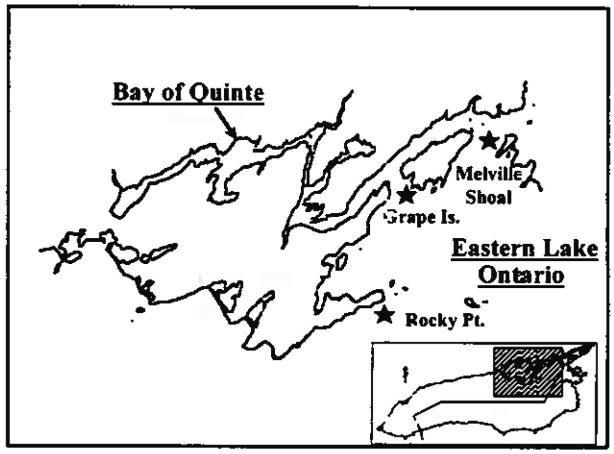

Fig. 1. Map of eastern Lake Ontario. Shown are three index gillnetting sites, Melville Shoal, Grape Island, and Rocky Point, sampled from 1986 to 1998. Not shown is Simcoe Island, located just east of Melville Shoal, sampled from 1978 to 1985.

the catches due to changes in gillnet material from multi to monofilament and to changes in annual dates of sampling from seasonal sampling to July only (i.e., 1992).

All smallmouth bass caught were sampled for biological attributes including fork length, weight, sex, and stomach contents. Age was interpreted from scales, and validated by the seasonal record on the scale edge and by modal progression of strong year-classes.

Smallmouth bass annual survival rate was estimated by the Chapman-Robson estimator (Robson and Chapman 1961), by year-class, for fish aged 6 to 10 yrs-old. Mean age was also reported.

Fork length-at-age was back-calculated to the beginning of the growing season in the year in which each fish was caught using the following fork length-scale radius (measured as mm) relationship (geometric regression):

$$\text{Fork Length} = 62.247(\text{Scale Radius}) + 51.087$$

$$N = 1{,}475 \quad r = .919$$

Differences in natural log transformed back-calculated fork length-at-age among year-classes were examined using analysis of covariance (heterogeneity of slopes, SAS System for Linear Models, 1991).

Smallmouth bass stomach contents were identified and counted. Diet was expressed as the frequency of occurrence of each prey type for three time periods: 1980 to 1984, 1989 to 1993, and 1994 to 1998 (no data available for 1985 to 1988).

Smallmouth bass year-class strength was estimated by two methods. Age-specific CUEs were summed for fish aged 2, 3 and 4 yrs-old by year-class. This method provided complete year-class strength information for 17 year-classes from 1973 to 1994. Year-class strength was also estimated for ages 2 to 11, using proportional year-class strength. Proportional year-class strength for 23 year-classes from 1973 to 1995 was calculated, determining the relative abundance of each year-class in each year of sampling, estimating their proportion by age and averaging this proportion over the ages vulnerable to the sampling gear.

Year-class strength estimates were then correlated with July/August water temperature data. Two water temperature databases were used. The first database was from the Lake Ontario Biomonitoring Program (Johannsson et al. 1998) for the years 1981 to 1995, and was used to represent the water temperatures to which smallmouth bass were exposed during their first summer of life in eastern Lake Ontario. This water database was used to correlate water temperature with the log-cumulative year-class strength estimate for ages 2 to 4 yrs. The second water temperature database came from the Belleville pumping station in the upper Bay of Quinte. It is an ongoing, consistent index of shallow, inshore water temperature, and was highly correlated with the eastern Lake Ontario water temperature database ($r = .97$, $N = 14$). This latter water temperature database allowed us to predict year-class strength for more recent year-classes (i.e., 1996 to 1998) using the relationship between water temperature and log-proportional year-class strength estimates for ages 2 to 11 yrs.

Results and Discussion

Abundance

Smallmouth bass abundance in eastern Lake Ontario was high in the late 1970s, declined through the early and mid-1980s, then remained steady or increased slightly to the early 1990s. After 1992, abundance declined rapidly to 1996 then increased slightly over the last two years to 1998 (Fig. 2). Trends in abundance were age-specific. Young bass (i.e., 2 to 5 yrs-old) showed a cyclical pattern of abundance with peaks during the years 1983 to 1985 and 1991 to 1993, and low points during 1981, 1986 to 1990, and 1994 to 1997 (Fig. 3). Older bass (>5 yrs-old) showed a marked decrease throughout the 21-yr study period (1978 to 1998). These age-specific trends in abundance were also reflected in trends for mean age of the catch (Fig. 4). Mean age declined markedly after 1988.

Survival

Smallmouth bass annual survival rates for the 1973 to 1988 year-classes, from ages 6 to 10 yrs-old (7 to 10 yrs-old for the 1973 year-class), averaged 0.62 (Fig. 5). The 1973 to 1982 year-classes had an average survival rate of 0.65 (n = 10), while the 1983 to 1988 year-classes had an average survival rate of 0.57 (n = 6), although the lower survival rates for the more recent year-classes were not significantly different than for those of earlier year-classes (Fig. 5). Also, strong year-classes tended to have lower survival rates (0.54, n = 5) compared to weak year-classes (0.67, n = 10).

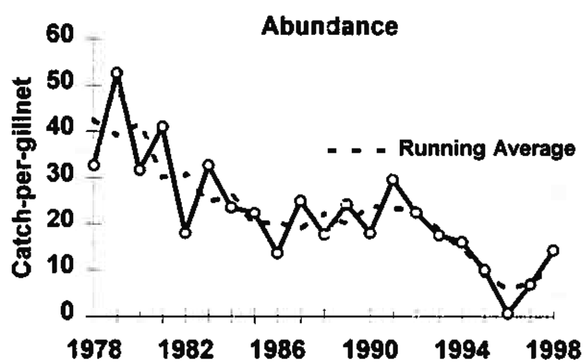

Fig. 2. Trends in smallmouth bass abundance in eastern Lake Ontario index gillnets during mid-summer, 1978 to 1998 (solid line). One site (Simcoe Island) was sampled for the years 1978 to 1985, while three sites (Melville Shoal, Grape Island, and Rocky Point) were sampled from 1986 to 1998. Also shown is the 3-yr running average (dotted line).

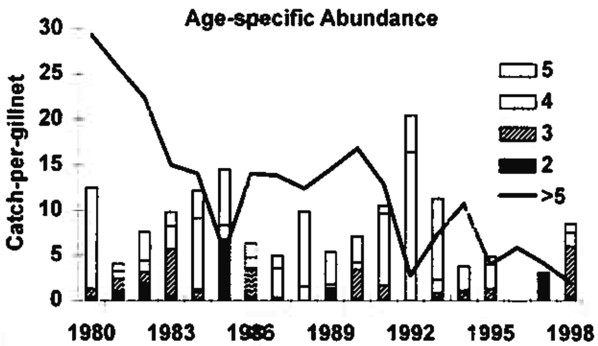

Fig. 3. Smallmouth bass age-specific abundance trends for ages 2, 3, 4, 5 (stacked bars) and >5 yrs-old (solid line) in eastern Lake Ontario index gillnets during mid-summer, 1980 to 1998.

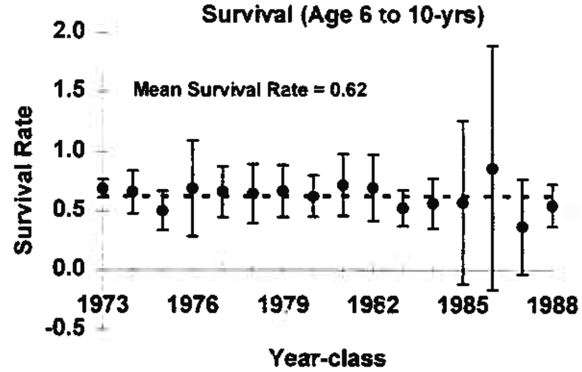

Fig. 5. Smallmouth bass annual survival rate for the 1973 to 1988 year-classes from age 6 to 10 yrs-old (error bars are 95% C.I.)

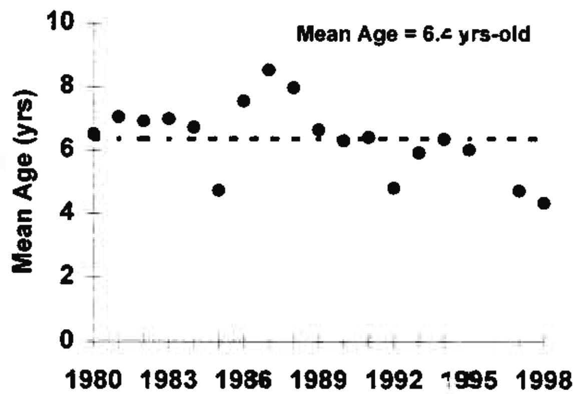

Fig. 4. Mean age of smallmouth bass in eastern Lake Ontario index gillnets during mid-summer, 1980 to 1998. Also shown is the mean age across all years (dotted line).

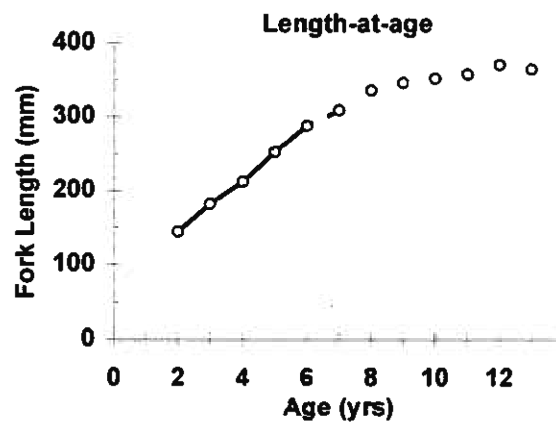

Fig. 6. Smallmouth bass fork length-at-age.

Length-at-age

Smallmouth bass fork length-at-age increased linearly for fish aged 2 to 6 yrs-old (Fig. 6). The rate of increase in length gradually declined to a plateau after about age 10. The was no significant differences in the rate of increase in length among year-classes for ages 2 to 6 yrs-old (p = .39) or for ages 6 to 10 (p=.30).

Diet

Smallmouth bass consumed a variety of prey species (Table 1). Crayfish and fish dominated the diet. Fish species commonly taken included alewife, sculpin, yellow perch, darters, smelt and trout-perch. Crayfish increased in frequency in the smallmouth bass diet over the study period while alewife decreased.

Table 1. Frequency of occurrence of prey items found in the stomachs of smallmouth bass, 1980 to 1998 (no data for years 1985 to 1988). "Other" includes other fish and other invertebrate species.

	Frequency of Occurrence			
Prey Type	1980-84	1989-93	1994-98	All years
Crayfish	0.35	0.50	0.63	0.48
Alewife	0.15	0.13	0.08	0.12
Smelt	0.01	0.02	0.00	0.01
Trout-perch	0.00	0.02	0.00	0.01
Yellow perch	0.02	0.03	0.00	0.02
Darter	0.01	0.05	0.00	0.02
Sculpin	0.01	0.06	0.01	0.03
Unid. fish	0.49	0.38	0.42	0.43
Other	0.05	0.02	0.02	0.03

Year-class Strength

Trends in year-class strength revealed that the eastern Lake Ontario smallmouth bass population is characterized by periodic strong year-classes, and intervening years of weak year-classes (Fig. 7). Cumulative gillnet CUEs for ages 2 to 4 yrs showed strong year-classes in 1980, 1983, 1987, 1988 and 1995 (note that only ages 2 and 3 yrs were observed for the 1995 year-class). Proportional year-class strength estimates for ages 2 to 11 inclusive indicated that 1973 and 1975 were also strong year-classes. The 1973 year-class was the strongest over the 23-yr period from 1973 to 1995. It was approximately three-times stronger than the next strongest year-classes (Fig. 7). Only extremely weak year-classes were produced through the 6-yr period from 1989 to 1994. The strongest year-class during this period, 1991, was only of moderate strength. Direct estimates of year-class strength were not possible beyond 1995. However, smallmouth bass year-class strength in eastern Lake Ontario was positively correlated with July/August water temperatures during the first year of life (Fig. 8). With the possible exception of 1991, water temperature results alone can explain the lack of strong year-classes from 1988 to 1995. The 1991 year-class, while of moderate size, was smaller than predicted by water temperature. The 1995 year-class has, to date, only been observed at ages 2 and 3 but is at least as large as that predicted by water temperature (Fig. 8).

Year-class strength, as predicted by the relationship between log-proportional year-class strength and Bay of Quinte water temperatures, indicated that the 1998 year-class was probably high and above average. Year-classes from 1996 and 1997 were probably weak but stronger than during the period of very weak year-classes from 1989 to 1994 (Fig. 7).

Factors Regulating Smallmouth Bass Abundance

Year-class Strength vs. Water Temperature

The most apparent explanation for the recent decline in smallmouth bass abundance is the lack of strong year-classes from 1989 to 1994 in a population

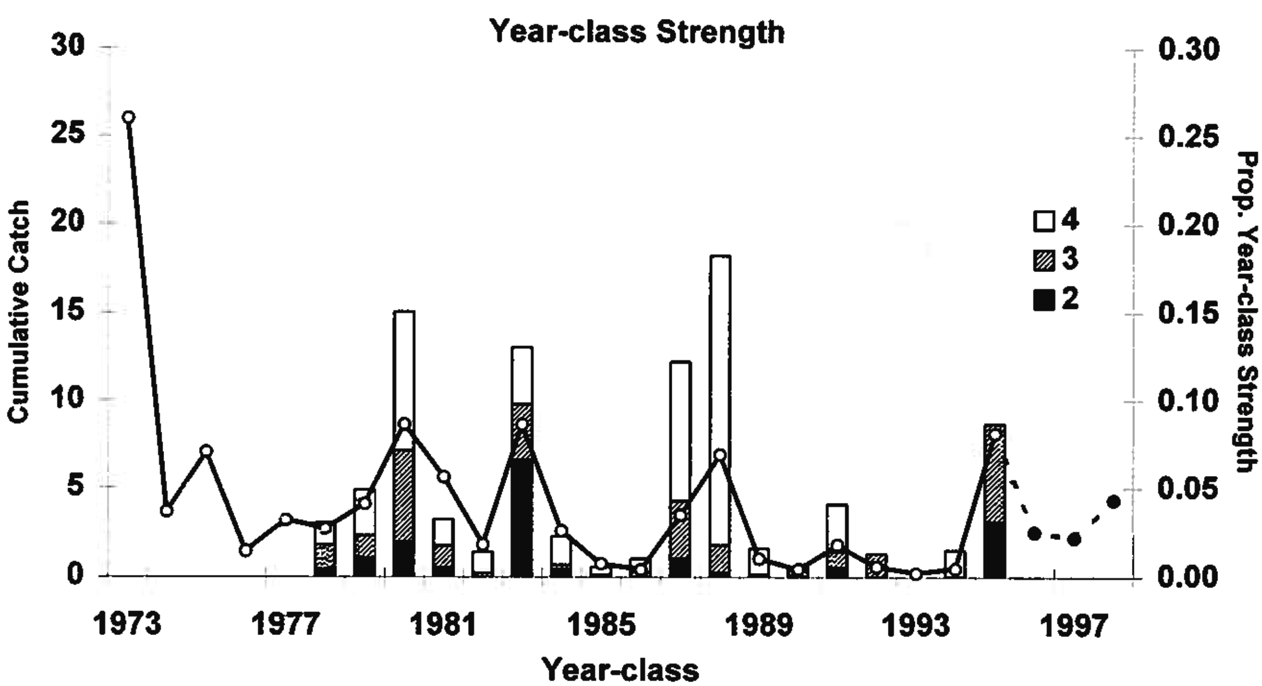

Fig. 7. Smallmouth bass year-class strength measured as the cumulative catch-per-gillnet of ages 2 to 4 yrs-old for the 1978 to 1995 year-classes (ages 2 to 3 yrs-old for 1995, stacked bars), and by proportional year-class strength for the 1973 to 1995 year-classes (solid line). Proportional year-class strength for the 1996, 1997 and 1998 year-classes was estimated based on the following water temperature vs. year-class strength relationship: Log10(CUE) = 0.373(Water Temperature) - 10.388, r = .54, p = .008, N = 23).*

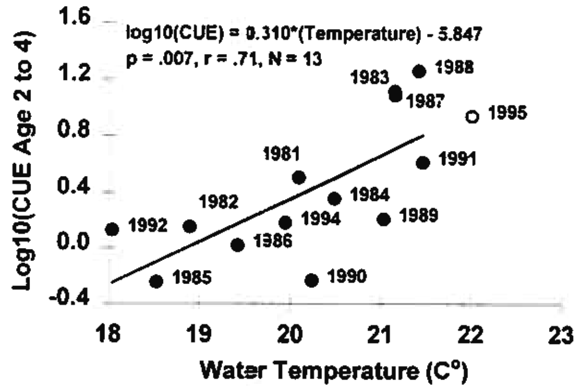

Fig. 8. Relationship between July/August water temperature (°C) and smallmouth bass year-class strength measured as the cumulative CUE for fish aged 2 to 4 yrs-old, for the 1981 to 1994 year-classes. The 1993 and 1995 year-classes were not used in the regression. The 1993 had insufficient data. The 1995 year-class is an observed value but only for fish aged 2 and 3 yrs-old.

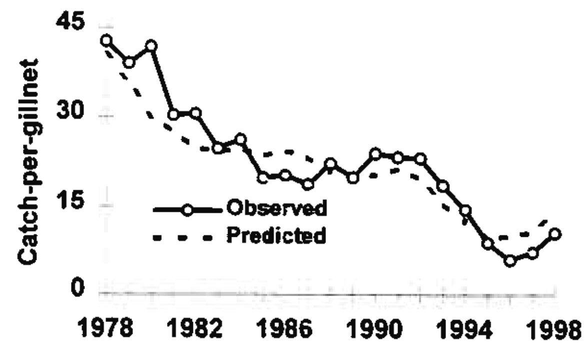

Fig. 9. Observed and predicted trends of smallmouth abundance in eastern Basin of Lake Ontario gillnets during mid-summer, 1978 to 1998. Predictions were made using the trends in smallmouth bass year-class strength as a recruitment index, subjecting each year-class to an annual mortality rate of 38% (see Fig. 5), and estimating an age-specific gillnet selectivity pattern (catchability = 0 for age 1, 0.09 for age 2, 0.19 for age 3, 0.51 for age 4, 0.78 for age 5, 0.87 for 6, and 1 for ages >6 yrs-old).

which had previously been characterized as having more frequent large year-classes (e.g., on average, every three years from 1972 to 1988). The results of a simple predictive model to illustrate the point is presented in Fig. 9. Using smallmouth bass year-class strength as a recruitment index, subjecting each year-class to an annual mortality rate of 38% (see Fig. 5), and estimating an age-specific gillnet selectivity pattern, predicts a reasonable approximation of observed gillnet catches including most of the decline between 1992 and 1996 (Kolmogorov-Smirnov Goodness of Fit Test, $p>.5$, Zar 1974). Given year-class strength estimates for the years 1995 to 1998, index gillnet catches should increase over the next few years.

Year-class strength, as influenced primarily by mid-summer water temperatures, appears to be the major factor determining the size of the smallmouth bass population in eastern Lake Ontario from 1978 to 1998. This result is consistent with other smallmouth bass populations at the northern limits of this species' range (Shuter *et al.* 1980).

Other Factors

Smallmouth bass, along with lake trout, support an important recreational fishery in eastern Lake Ontario. Smallmouth bass recruit to the recreational harvest about age 4 or 5 (mean age for 1998 = 6 yrs-old, LOMU unpublished data). The annual survival rate for smallmouth bass aged 6 to 10 yrs-old (mean = 0.62, Fig. 5) suggests that over-exploitation is not a problem. On the other hand, one explanation consistent with the observation that survival of strong year-classes (mean = 0.54) is lower than that for weak year-classes (0.67) may be that strong year-classes were "fished-up" (i.e., exploitation rates were highest in years when bass were most abundant).

Predation by cormorants has been implicated as influencing the survival of young smallmouth bass in New York waters of eastern Lake Ontario (Chrisman and Eckert 1998). If cormorants are a major source of smallmouth bass mortality in Ontario waters of eastern Lake Ontario, their impact has been too recent to distinguish it from expected population trends due to the recent history of summer water temperature and low year-class strength. The fate (i.e., survival rate over the next 2 to 3 years) of the initially strong 1995 smallmouth bass year-class may provide additional insight regarding the relative importance of cormorant predation.

Significant ecosystem changes in eastern Lake Ontario have occurred since the arrival of Dreissenid mussels in the early 1990s. The impact of changes such as increased water clarity and fundamental shifts in food-web interactions on smallmouth bass distribution and abundance is difficult to predict but some level of impact is certainly expected.

Another potential smallmouth bass predator is the walleye. Walleye abundance in eastern Lake Ontario increased dramatically through the late 1980s and early 1990s, however, not a single smallmouth has been observed over the 1986 to 1998 time period (number of walleye stomachs examined = 2,240; Lake Ontario Management Unit, unpublished data).

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Appendices

Atlantic salmon stocked in the Province of Ontario waters of Lake Ontario, 1998.

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.	Hwy 401	5	1997	White Lake	LaHave/Normandale	4	0.1	None	4,100
Bronte Cr.	Lowville	5	1997	White Lake	LaHave/Normandale	4	0.1	None	9,405
	Cedar Springs Pk.	5	1997	White Lake	LaHave/Normandale	4	0.1	None	7,214
BRONTE CR. TOTAL									16,619
Credit R.	Black Cr. Tributary	5	1997	White Lake	LaHave/Normandale	4	0.1	None	8,413
	Black Cr.	5	1997	Partnership	LaHave/Normandale	1	0.2	None	10,000
		5	1997	Partnership	LaHave/Normandale	2	0.2	None	60
	Cheltenham	5	1997	Partnership	LaHave/Normandale	2	0.2	None	60
	Forks of Credit Pk.	5	1997	Partnership	LaHave/Normandale	1	0.2	None	5,894
	Silver Cr. Branch - Ed. Centre	5	1997	White Lake	LaHave/Normandale	4	0.1	None	11,301
CREDIT R. TOTAL									35,728
Duffin Cr.	6th Conc.	5	1997	White Lake	LaHave/Normandale	4	0.1	None	4,500
Ganaraska R.	Canton Br. S. Hydro	5	1997	White Lake	LaHave/Normandale	4	0.1	None	3,400
Humber R.	Hopefull Cr.	5	1997	Partnership	LaHave/Normandale	0		None	978
Proctors Cr.	Proctors Cr.	5	1997	White Lake	LaHave/Normandale	4	0.1	None	2,350
Rouge R.	Little Rouge R.	4	1997	Partnership	LaHave/Normandale	1		None	10,000
	Leno Pk.	6	1997	Partnership	LaHave/Normandale	3	0.9	None	325
ROUGE R. TOTAL									10,325
Shelter Valley Cr.	Channel	5	1997	White Lake	LaHave/Normandale	4	0.1	None	7,175
	Shelter Valley Pk.	5	1997	White Lake	LaHave/Normandale	4	0.1	None	2,700
SHELTER VALLEY CR. TOTAL									9,875
Wilmot Cr.	Pisany Property	5	1997	White Lake	LaHave/Normandale	4	0.1	None	4,900
ATLANTIC SALMON - ADVANCED FRY									
Black Cr.	17th Line	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	6,000
	Limehouse	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	10,000
BLACK CR. TOTAL									16,000

Cobourg Br.	Dale Rd.	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	5,174
Credit R.	West Credit R.	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	9,300
Duffin Cr.	Hwy 7	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	3,300
Ganaraska R.	Canton Br. at Hydro	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	4,000
	Canton Cr. - Cascades	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	4,100
GANARASKA R. TOTAL									8,100
Wilmot Cr.	Hwy 35/115	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	8,000
	5th Conc.	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	2,700
		4	1997	Ringwood	LaHave/Normandale	4	0.7	None	1,000
	Nursery Bridge	4	1997	Ringwood	LaHave/Normandale	4	0.7	None	4,500
WILMOT CR. TOTAL									16,200
ATLANTIC SALMON - YEARLINGS									
Credit R.		6	1996	University of Guelph	LaHave/Normandale		50.0	None	250
		6	1996	University of Guelph	LaHave/Normandale		50.0	None	250
CREDIT R. TOTAL									500
ATLANTIC SALMON - ADULTS									
Credit R.	Silver Cr.	10	1993	Codrington	LaHave	60	2500.0	None	12
		10	1992	Codrington	LaHave	72	3700.0	None	18
	Meadow	10	1992	Codrington	LaHave	72	3700.0	None	21
		10	1992	Codrington	LaHave	60	2500.0	None	12
	Glen Williams	10	1993	Codrington	LaHave	60	2500.0	None	9
		10	1992	Codrington	LaHave	72	3700.0	None	22
	Maletta	10	1993	Codrington	LaHave	60	2500.0	None	9
		10	1992	Codrington	LaHave	72	3700.0	None	17
		10	1992	Codrington	LaHave	72	3700.0	None	6
	Whillans	10	1993	Codrington	LaHave	60	2500.0	None	9
		10	1992	Codrington	LaHave	72	3700.0	None	22
CREDIT R. TOTAL									157
TOTAL ATLANTIC SALMON - EARLY FRY									**92,775**
TOTAL ATLANTIC SALMON - ADVANCED FRY									**58,074**
TOTAL ATLANTIC SALMON - YEARLINGS									**500**
TOTAL ATLANTIC SALMON - ADULTS									**157**
TOTAL ATLANTIC SALMON									**151,506**

Brown trout stocked in the Province of Ontario waters of Lake Ontario, 1998.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
BROWN TROUT SPRING FINGERLINGS									
Rouge R.	Little Rouge R.	2	1997		Ganaraska/Normandale	3	0.2	None	1,000
		3	1997	Harwood	Ganaraska/Normandale	3	0.3	None	500
ROUGE R. TOTAL									1,500
BROWN TROUT - SPRING YEARLINGS									
Bronte Cr.	Bronte Beach Park	2	1996	Ringwood	Ganaraska/Normandale	14	32.2	RV	7,908
		2	1996	Ringwood	Ganaraska/Normandale	14	35.0	RV	7,915
BRONTE CR. TOTAL									15,823
Duffin Cr.	401 Bridge	5	1996	Harwood	Ganaraska/Normandale	18	48.7	RV	10,003
Lake Ontario	Ashbridge's Bay	2	1996	Ringwood	Ganaraska/Normandale	14	35.3	RV	7,848
		2	1996	Ringwood	Ganaraska/Normandale	14	35.2	RV	7,858
	Bluffer's Park	2	1996	Ringwood	Ganaraska/Normandale	14	31.1	RV	2,779
		2	1996	Ringwood	Ganaraska/Normandale	14	33.1	RV	7,903
	Burlington Canal	3	1996	Harwood	Ganaraska/Normandale	16	41.2	RV	8,499
		4	1996	Harwood	Ganaraska/Normandale	17	56.2	RV	5,814
	Fifty Point CA	3	1996	Normandale	Ganaraska/Normandale	15	41.5	RV	14,210
		3	1996	Harwood	Ganaraska/Normandale	16	41.7	RV	5,001
	Jordan Harbour	3	1996	Normandale	Ganaraska/Normandale	15	42.6	RV	5,283
		3	1996	Normandale	Ganaraska/Normandale	15	41.5	RV	4,721
	Lakeport	5	1996	Harwood	Ganaraska/Normandale	18	48.5	RV	9,943
	Millhaven Wharf	3	1996	Harwood	Ganaraska/Normandale	16	39.6	RV	8,500
		5	1996	Harwood	Ganaraska/Normandale	18	53.1	RV	5,543
	Oshawa Harbour	3	1996	Harwood	Ganaraska/Normandale	16	41.8	RV	7,702
		5	1996	Harwood	Ganaraska/Normandale	18	52.9	RV	2,300
	Port Dalhousie East	3	1996	Normandale	Ganaraska/Normandale	15	42.6	RV	4,860
		3	1996	Normandale	Ganaraska/Normandale	15	46.0	RV	15,885
		3	1996	Normandale	Ganaraska/Normandale	15	42.6	RV	2,348
LAKE ONTARIO TOTAL									126,997
Mimico Cr.	Humber Bay Park West	3	1996	Harwood	Ganaraska/Normandale	16	36.4	RV	7,707
		5	1996	Harwood	Ganaraska/Normandale	18	52.9	RV	2,300
MIMICO CR. TOTAL									10,007
Rouge R.	Little Rouge R.	2	1996		Ganaraska/Normandale	15	48.7		150
		3	1996	Harwood	Ganaraska/Normandale	16	58.7		150
ROUGE R. TOTAL									300
TOTAL BROWN TROUT - SPRING FINGERLINGS									**1,500**
TOTAL BROWN TROUT - YEARLINGS									**162,980**
TOTAL BROWN TROUT									**164,480**

Chinook salmon stocked in the Province of Ontario waters of Lake Ontario, 1998.

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	1997	Ringwood	Lake Ontario	4	4.2	None	25,588
Bronte Cr.	2nd Side Rd Bridge	4	1997	Ringwood	Lake Ontario	4	4.5	None	25,583
	5th Side Rd Bridge	4	1997	Ringwood	Lake Ontario	4	4.5	None	25,583
BRONTE CR. TOTAL									51,166
Cobourg Br.	South of King St.		1997	Partnership	Lake Ontario		4.4	None	2,925
		4	1997	Ringwood	Lake Ontario	4	4.2	None	25,588
COBOURG BR. TOTAL									28,513
Credit R.	Eldorado Pk	4	1997	Ringwood	Lake Ontario	4	4.5	None	25,430
	Huttonville	5	1997	Ringwood	Lake Ontario	5	4.4	None	51,076
	Norval	4	1997	Ringwood	Lake Ontario	4	4.3	None	51,122
CREDIT R. TOTAL									127,628
Lake Ontario	Ashbridge's Bay Ramp	4	1997	Ringwood	Lake Ontario	4	4.8	None	25,000
	Barcovan Beach	5	1997	Ringwood	Lake Ontario	5	4.9	None	25,551
	Beacon Inn	4	1997	Ringwood	Lake Ontario	4	4.5	None	25,431
	Bluffer's Park	4	1997	Ringwood	Lake Ontario	4	4.8	None	77,226
	Burlington Canal	5	1997	Ringwood	Lake Ontario	5	4.5	None	51,079
	Oshawa Harbour	4	1997	Ringwood	Lake Ontario	4	4.4	None	25,562
	Port Dalhousie East	5	1997	Ringwood	Lake Ontario	5	4.6	None	51,092
	Port Weller	4	1997	Ringwood	Lake Ontario	4	4.9	None	51,131
	Wellington Channel	5	1997	Ringwood	Lake Ontario	5	4.9	None	25,550
	Whitby Harbour	4	1997	Ringwood	Lake Ontario	4	4.4	None	25,563
LAKE ONTARIO TOTAL									383,185
Rouge R.	Little Rouge R.	3	1997	Ringwood	Lake Ontario	3	1.6	None	630
TOTAL CHINOOK SALMON									**616,710**

Coho salmon stocked in the Province of Ontario waters of Lake Ontario, 1998.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
COHO SALMON - FALL FINGERLINGS									
Credit R.	Eldorado Pk	2	1996	Ringwood	Wild - Blue Jay Cr.	11	18.7	RV	3,817
		2	1996	Ringwood	Wild - Salmon R.	13	21.4	RV	3,817
	Heritage Rd Bridge	2	1996	Ringwood	Wild - Blue Jay Cr.	11	18.7	RV	2,813
		2	1996	Ringwood	Wild - Salmon R.	13	21.4	RV	3,817
	Huttonville	2	1996	Ringwood	Wild - Salmon R.	13	23.0	RV	6,481
	Norval	2	1996	Ringwood	Wild - Salmon R.	13	23.0	RV	6,481
CREDIT R. TOTAL									27,226
COHO SALMON - SPRING YEARLINGS									
Credit R.	Norval	9	1997	Normandale	Wild - Salmon R.	10	15.0	AdRV	13,388
		10	1997	Normandale	Wild - Salmon R.	11	18.0	AdRV	10,512
		10	1997	Ringwood	Wild - Salmon R.	11	19.3	AdRV	11,189
	Eldorado Pk	10	1997	Normandale	Wild - Salmon R.	11	18.7	AdRV	10,355
		10	1997	Normandale	Wild - Salmon R.	11	15.3	AdRV	15,310
		10	1997	Ringwood	Wild - Salmon R.	11	19.3	AdRV	11,183
	Huttonville	10	1997	Normandale	Wild - Salmon R.	11	15.2	AdRV	16,434
		10	1997	Normandale	Wild - Salmon R.	11	17.8	AdRV	8,660
		10	1997	Ringwood	Wild - Salmon R.	11	19.3	AdRV	11,189
CREDIT R. TOTAL									108,220
TOTAL COHO SALMON - FALL FINGERLINGS									27,226
TOTAL COHO SALMON - SPRING YEARLINGS									108,220
TOTAL COHO SALMON									135,446

Lake trout stocked in the Province of Ontario waters of Lake Ontario, 1998.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
LAKE TROUT - SPRING YEARLINGS									
Lake Ontario	Cobourg HB Pier	3	1996	Harwood	Slate Islands/Hills Lake	17	29.3	Ad	10,728
		3	1996	Harwood	Slate Islands/Hills Lake	17	30.8	Ad	12,000
		3	1996	Harwood	Slate Islands/Hills Lake	17	29.8	Ad	12,000
	COBOURG TOTAL								34,728
	Fifty Point CA	3	1996	Harwood	Seneca Lake/Harwood	15	26.4	Ad	13,497
		3	1996	Harwood	Seneca Lake/Harwood	15	26.1	Ad	12,416
		3	1996	Harwood	Seneca Lake/Harwood	15	25.2	Ad	3,003
		3	1996	Harwood	Slate Islands/Hills Lake	17	31.9	Ad	10,995
		3	1996	Harwood	Slate Islands/Hills Lake	17	32.5	Ad	10,732
		3	1996	Harwood	Slate Islands/Hills Lake	17	33.3	Ad	11,846
	FIFTY POINT TOTAL								62,489
	N. of Main Duck Sill	4	1996	Harwood	Michipicoten Island/Dorion	18	36.4	Ad	9,464
		4	1996	Harwood	Michipicoten Island/Dorion	18	34.2	Ad	11,735
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	28.6	Ad	15,775
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	32.6	Ad	949
		4	1996	Harwood	Seneca Lake/Harwood	16	30.8	Ad	13,480
		4	1996	Harwood	Seneca Lake/Harwood	16	31.5	Ad	14,149
		4	1996	Harwood	Seneca Lake/Harwood	16	29.1	Ad	15,151
		4	1996	Harwood	Seneca Lake/Harwood	16	30.2	Ad	15,114
		4	1996	Harwood	Seneca Lake/Harwood	16	30.6	Ad	15,623
		4	1996	Harwood	Seneca Lake/Harwood	16	29.6	Ad	4,245
	MAIN DUCK SILL TOTAL								115,685
	S. of Long Point	4	1996	Harwood	Michipicoten Island/Dorion	18	35.6	Ad	9,364
		4	1996	Harwood	Michipicoten Island/Dorion	18	37.8	Ad	11,735
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	32.6	Ad	952
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	29.4	Ad	16,476
		4	1996	Harwood	Seneca Lake/Harwood	16	35.6	Ad	13,352
		4	1996	Harwood	Seneca Lake/Harwood	16	31.5	Ad	14,300
		4	1996	Harwood	Seneca Lake/Harwood	16	29.5	Ad	15,148
		4	1996	Harwood	Seneca Lake/Harwood	16	31.4	Ad	15,130
		4	1996	Harwood	Seneca Lake/Harwood	16	30.9	Ad	15,707
		4	1996	Harwood	Seneca Lake/Harwood	16	29.0	Ad	4,149

	LONG POINT TOTAL								116,313
	Scotch Bonnet Shoal	4	1996	Harwood	Michipicoten Island/Dorion	18	41.0	Ad	4,526
		5	1996	Harwood	Michipicoten Island/Dorion	18	41.0	Ad	10,327
		5	1996	Harwood	Michipicoten Island/Dorion	18	38.0	Ad	3,630
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	32.6	Ad	8,571
		4	1996	Harwood	Mishibishu Lakes/Tarentorus	17	32.6	Ad	9,348
		5	1996	Harwood	Mishibishu Lakes/Tarentorus	17	29.5	Ad	3,174
		4	1996	Harwood	Seneca Lake/Harwood	16	34.4	Ad	15,078
		4	1996	Harwood	Seneca Lake/Harwood	16	35.3	Ad	13,506
		4	1996	Harwood	Seneca Lake/Harwood	16	33.2	Ad	15,400
		4	1996	Harwood	Seneca Lake/Harwood	16	30.5	Ad	17,002
		4	1996	Harwood	Seneca Lake/Harwood	16	27.6	Ad	8,587
	SCOTCH BONNET SHOAL TOTAL								109,149
LAKE TROUT - ADULTS									
Lake Ontario	Rouge Beach Park	2	1990	Normandale	Seneca Lake	85	2776.8	None	5
		3	1986	Hills Lake	Killala Lake/Hills Lake	130	3550.0	None	4
	ROUGE BEACH PARK TOTAL								9
TOTAL LAKE TROUT - SPRING YEARLINGS									**438,364**
TOTAL LAKE TROUT - ADULTS									**9**
TOTAL LAKE TROUT									**438,373**

Rainbow trout stocked in the Province of Ontario waters of Lake Ontario, 1998

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Stocked
RAINBOW TROUT - EYED EGGS									
Rouge R.	Little Rouge R.	2	1998	Normandale	Ganaraska/Normandale				8,596
		3	1998	Normandale	Ganaraska/Normandale				8,215
ROUGE R. TOTAL									16,811
RAINBOW TROUT - FRY									
Don R.	East Don R.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	10,000
Highland Cr.	Centennial Cr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	5,000
Rouge R.	Leno Pk.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	10,000
	Barford Br.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	6,545
	Berczy Cr.	6	1998	Partnership	Wild - Rouge R.	1	0.2	None	9,500
		6	1998	Partnership	Wild - Rouge R.	0	0.2	None	20,000
	Bruce Cr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	30,000
	Burndenette Cr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	5,000
	Morningside Cr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	20,380
	Robinson Cr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	20,000
	Twyn River Dr.	6	1998	Partnership	Wild - Rouge R.	0	0.2	None	6,000
ROUGE R. TOTAL									127,425
RAINBOW TROUT - SPRING YEARLINGS									
Bronte Cr.	5th Side Rd Bridge	4	1997	Normandale	Ganaraska/Normandale	11	11.9	RV	1,205
	5th Side Rd Bridge	4	1997	Normandale	Ganaraska/Normandale	12	6.0	RV	10,812
	Lowville Park	4	1997	Normandale	Ganaraska/Normandale	12	6.0	RV	11,976
BRONTE CR. TOTAL									23,993
Credit R.	Huttonville	3	1997	Normandale	Ganaraska/Normandale	10	9.2	RV	11,984
	Norval	3	1997	Normandale	Ganaraska/Normandale	10	9.2	RV	11,984
CREDIT R. TOTAL									23,968
Humber R.	E. Branch Mill Road	3	1997	Normandale	Ganaraska/Normandale	10	7.6	RV	12,619
	King Vaughan Line	4	1997	Normandale	Ganaraska/Normandale	11	9.2	RV	12,091
HUMBER R. TOTAL									24,710
Lake Ontario	Adolphustown	5	1997	Normandale	Ganaraska/Normandale	12	9.4	RV	13,296

	Millhaven Ferry	5	1997	Normandale	Ganaraska/Normandale	12	9.4	RV	6,382
	Port Dalhousie East	3	1997	Normandale	Ganaraska/Normandale	10	7.6	RV	24,977
LAKE ONTARIO TOTAL									44,655
Rouge R.	Berczy Cr.	4	1997	Normandale	Ganaraska/Normandale	12	7.3	RV	5,184
		4	1997	Normandale	Ganaraska/Normandale	12	6.0	RV	3,327
	Bruce Cr.	4	1997	Normandale	Ganaraska/Normandale	12	7.3	RV	8,457
	Silver Spring Farms	4	1997	Normandale	Ganaraska/Normandale	11	9.2	RV	7,408
		4	1997	Normandale	Ganaraska/Normandale	12	7.3	RV	682
ROUGE R. TOTAL									25,058
RAINBOW TROUT - ADULTS									
Rouge R.	Little Rouge R.	2	1995	Normandale	Ganaraska/Normandale	35	6500.0		20
TOTAL RAINBOW TROUT - EYED EGGS									**16,811**
TOTAL RAINBOW TROUT - FRY									**176,047**
TOTAL RAINBOW TROUT - SPRING YEARLINGS									**147,384**
TOTAL RAINBOW TROUT - ADULTS									**20**
TOTAL RAINBOW TROUT									**335,262**

Walleye transferred in the Province of Ontario waters of Lake Ontario, 1998.

Waterbody Name	Site Name	Month Stocked	Year Spawned	Hatchery/Source	Strain/Egg Source	Age (Months)	Mean Wt. (g)	Marks	Number Transferred
Lake Ontario*	Hamilton Harbour	9		Bay of Quinte			1364	None	120
TOTAL WALLEYE									120

* Transfer of wild fish from the 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, 1998.

	Brighton					Cobourg				Middle Ground	Rocky Point									Wellington			
Species / Depth (m)	8	13	18	23	28	60	80	100	140	5	8	13	18	23	28	60	80	100	140	8	13	18	23
Lake sturgeon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alewife	54	53	46	716	104	86	26	910	104	0	2947	1092	3094	4107	1666	173	95	35	49	0	11	28	155
Gizzard shad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	0	0	0	3	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	3
Brown trout	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	0	0	0	0	53	0	2	15	7	0	0	0	0	11	3	77	35	23	3	46	69	92	72
Lake whitefish	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	33	2	0	0	0	0	0	0
Lake herring	0	0	0	0	0	0	2	0	2	0	0	3	7	0	0	0	3	2	3	0	0	0	0
Round whitefish	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coregonus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Smelt	0	0	0	0	0	0	0	3	10	0	0	0	0	0	0	0	8	5	0	0	0	0	0
Northern pike	0	0	0	0	0	0	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	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Greater Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake chub	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0
Common Carp	0	0	0	0	0	0	0	0	0	20	7	0	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	7	0	0	0	0	0	0	0	0	53	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	0	0	0
Burbot	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	3	7
White perch	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock bass	110	0	3	0	0	0	0	0	0	7	35	0	0	0	0	0	0	0	0	0	10	0	0
Pumpkinseed	0	0	0	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	0	0	0
Smallmouth bass	0	0	0	0	0	0	0	0	0	0	13	13	3	3	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow perch	237	0	0	0	0	0	0	0	0	1013	0	0	0	0	0	0	0	0	0	451	33	0	3
Walleye	10	10	0	3	0	0	0	0	0	0	13	0	0	3	0	0	0	0	0	3	10	0	0
Freshwater drum	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	7	0	0	0
Slimy sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	0

Appendix B

Species-specific catch-per-standard gillnet lift, Outlet Basin Lake Ontario, 1998.

	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
Lake sturgeon	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alewife	645	337	774	1139	401	768	1654	964	2001	2732	4036	2122	196	379	1493	1273	403
Gizzard shad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chinook salmon	1	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	3
Brown trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	41	62	0	14	39	49	89	0	0	0	13	20	0	0	0	0	13
Lake whitefish	25	24	0	0	0	99	115	0	0	0	3	0	0	0	0	0	13
Lake herring	0	0	0	0	0	0	0	3	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
Coregonus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smelt	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern pike	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
White Sucker	0	0	46	20	0	0	0	0	0	0	3	0	0	0	0	0	0
Greater Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Lake chub	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Carp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	0	0	13	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	7	0	0	0	0
Burbot	0	2	0	0	0	0	0	0	0	10	3	7	0	0	3	0	0
White perch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock bass	0	0	57	25	17	0	0	21	32	0	0	0	38	35	0	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	0	0	0	0	0	13	24	0	0	0	14	10	0	0	0
Largemouth bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow perch	0	0	614	338	23	0	0	32	87	183	17	0	133	212	244	235	14
Walleye	0	0	0	0	0	0	0	43	20	7	0	0	227	72	7	3	0
Freshwater drum	1	0	0	3	0	0	0	7	3	3	0	0	3	0	0	0	0
Slimy sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species-specific catch-per-standard gillnet lift, Bay of Quinte, 1998.

	Big Bay		Conway				Hay Bay	
Species / Depth (m)	05	08	13	20	30	45	08	13
Lake sturgeon	0	0	1	0	0	0	0	0
Alewife	8	235	266	357	8	7	3	31
Gizzard shad	8	2	0	2	0	0	2	0
Chinook salmon	0	0	0	2	2	0	0	0
Brown trout	0	0	0	2	0	0	0	0
Lake trout	0	0	0	0	28	20	0	0
Lake whitefish	0	0	0	5	49	0	0	0
Lake herring	0	0	0	0	7	0	0	168
Round whitefish	0	0	0	0	0	0	0	0
Coregonus	0	0	0	0	2	0	0	0
Smelt	0	0	0	0	12	0	0	2
Northern pike	2	0	0	0	0	0	2	3
White Sucker	54	5	7	26	2	0	21	39
Greater Redhorse	0	0	0	0	0	0	0	0
Lake chub	0	0	0	0	0	0	0	0
Common Carp	3	0	0	0	0	0	0	0
Brown bullhead	54	0	0	0	0	0	13	8
Channel catfish	5	0	0	0	0	0	0	0
Burbot	0	0	0	0	2	3	0	2
White perch	439	0	0	0	0	0	49	2
White bass	0	0	0	0	0	0	0	0
Rock bass	0	76	8	0	0	0	0	0
Pumpkinseed	122	0	0	0	0	0	38	0
Bluegill	16	0	0	0	0	0	0	0
Smallmouth bass	18	2	7	0	0	0	2	0
Largemouth bass	0	0	0	0	0	0	0	0
Black crappie	5	0	0	0	0	0	0	0
Yellow perch	1777	510	507	426	16	0	1209	559
Walleye	87	40	38	7	0	0	61	3
Freshwater drum	76	2	3	0	0	0	16	0
Slimy sculpin	0	0	0	0	0	0	0	0

Species-specific catch-per-standard gillnet lift, Bay of Quinte, 1998.

Species / Season	Big Bay Apr/May	Big Bay May/Jun	Big Bay Jun/Jul	Big Bay Summer	Big Bay Sep/Oct	Big Bay Oct/Nov	Conway Apr/May	Conway May/Jun	Conway Jun/Jul	Conway Summer	Conway Sep/Oct	Conway Oct/Nov	Hay Bay Apr/May	Hay Bay May/Jun	Hay Bay Jun/Jul	Hay Bay Summer	Hay Bay Sep/Oct	Hay Bay Oct/Nov
Lake sturgeon	0	0	3	0	0	3	0	0	0	0	0	0	0	0	2	0	0	0
Alewife	0	0	0	8	7	0	0	21	713	193	33	10	0	0	53	17	0	0
Gizzard shad	0	0	0	8	3	23	0	0	0	1	0	1	0	0	0	1	66	7
Chinook salmon	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
Brown trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake trout	0	0	0	0	0	0	4	7	14	8	45	20	0	3	0	0	0	0
Lake whitefish	3	0	0	0	0	7	1	26	14	12	4	3	0	0	3	0	12	2
Lake herring	0	0	0	0	0	20	0	0	1	1	1	1	2	0	18	84	0	8
Round whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coregonus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smelt	0	0	0	0	0	0	0	1	0	3	1	2	0	0	0	1	0	0
Northern pike	3	0	3	2	0	3	1	0	0	0	0	0	3	0	8	2	0	0
White Sucker	10	59	40	54	13	16	1	3	13	9	12	16	16	39	49	30	28	10
Greater Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake chub	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Carp	0	0	0	3	3	7	0	0	0	0	0	0	0	0	0	0	0	0
Brown bullhead	3	66	7	54	7	10	0	0	0	0	2	0	0	0	0	11	2	3
Channel catfish	7	3	0	5	0	3	0	0	0	0	0	0	0	0	0	0	8	8
Burbot	0	0	0	0	0	3	0	0	1	1	0	0	2	3	2	1	0	0
White perch	7	82	69	439	753	345	0	0	0	0	0	1	7	0	2	26	77	194
White bass	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	3	0
Rock bass	0	0	0	0	0	0	0	1	3	19	26	12	0	0	0	0	0	5
Pumpkinseed	0	3	3	122	0	0	0	0	0	0	0	0	0	0	0	19	0	2
Bluegill	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	0	18	7	3	0	0	0	2	4	0	0	0	0	1	0	5
Largemouth bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow perch	799	2776	3266	1777	59	171	193	443	351	324	175	91	350	1012	1342	884	141	370
Walleye	23	112	76	87	46	214	4	3	13	19	28	29	18	2	13	32	77	158
Freshwater drum	3	174	299	76	16	26	0	0	2	1	13	76	0	0	0	8	87	120
Slimy sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species-specific catch-per-trawl, Bay of Quinte and Lake Ontario, 1998.

	Bay of Quinte						Lake Ontario				
Species	Trenton	Belleville	Big Bay	Deseronto	Hay Bay	Conway	EB02	EB03	EB06	Rocky Point	Cobourg
Alewife	1	24	0	0	122	0	337	284	16	19	5
Gizzard shad	4	81	0	23	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	0	1	0	1	0	0
Lake herring	0	0	0	0	0	0	0	0	0	0	0
Rainbow smelt	0	1	0	0	0	60	11	98	472	865	844
Northern pike	0	0	0	0	0	0	0	0	0	0	0
White sucker	0	0	10	0	2	1	0	0	0	0	0
Common Carp	0	0	0	0	0	0	0	0	0	0	0
Spottail shiner	4	16	8	7	58	0	0	0	0	0	0
Brown bullhead	9	11	29	15	59	0	0	0	0	0	0
Channel catfish	0	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
Threespine stickleback	0	0	0	0	0	0	13	1	0	0	0
Trout-perch	2	2	23	15	2	27	18	57	1	0	0
White perch	21	45	400	74	7	0	0	0	0	0	0
White bass	0	0	0	0	0	0	0	0	0	0	0
Lepomis sp.	1	22	0	0	0	0	0	0	0	0	0
Rock bass	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed sunfish	56	5	40	13	5	0	0	0	0	0	0
Bluegill sunfish	0	0	4	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	0	0	0	0	0	0	0	0	0
Largemouth bass	1	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	0	0	0	0	0	0	0	0
Yellow perch	33	38	223	373	539	3	0	0	0	0	0
Walleye	1	4	10	3	2	1	0	0	0	0	0
Johnny darter	0	5	1	2	0	0	0	0	0	0	0
Logperch	8	0	0	0	0	0	0	0	0	0	0
Frehwater drum	5	70	24	6	1	0	0	0	0	0	0
Slimy sculpin	0	0	0	0	0	0	1	0	0	370	16

Species specific catch-per-trawl, Day of Quinte, 1998.

Species / Season	Big Bay Apr/May	Big Bay May/Jun	Big Bay Jun/Jul	Big Bay Summer	Big Bay Sep/Oct	Big Bay Oct/Nov	Conway Apr/May	Conway May/Jun	Conway Jun/Jul	Conway Summer	Conway Sep/Oct	Conway Oct/Nov	Hay Bay Apr/May	Hay Bay May/Jun	Hay Bay Jun/Jul	Hay Bay Summer	Hay Bay Sep/Oct	Hay Bay Oct/Nov
Alewife	0	0	0	0	32	9	0	1	10	0	76	0	0	0	1	177	77	7
Gizzard shad	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	12	5
Lake trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake whitefish	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Lake herring	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Rainbow smelt	0	0	0	0	0	1	0	0	0	60	1	3	0	2	3	0	0	0
Northern pike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White sucker	0	2	0	10	1	3	0	0	0	1	21	0	0	5	10	2	18	1
Common Carp	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Spottail shiner	0	1	3	8	51	5	0	0	0	0	0	0	0	25	16	58	21	64
Brown bullhead	1	9	3	29	37	31	0	0	0	0	0	0	0	0	1	59	78	17
Channel catfish	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	1	0	0	0	0	0	0	0
Burbot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Threespine stickleback	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Trout-perch	0	1	1	23	10	20	0	2	0	27	26	0	8	13	48	2	4	7
White perch	0	22	65	400	68	139	0	0	0	0	0	0	0	0	2	7	24	9
White bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Lepomis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10
Rock bass	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Pumpkinseed sunfish	0	2	20	40	5	0	0	0	0	0	0	0	0	3	0	5	1	1
Bluegill sunfish	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Largemouth bass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black crappie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Yellow perch	14	80	554	223	5	33	1	0	0	3	5	1	43	165	656	539	22	166
Walleye	3	13	14	10	6	9	1	0	0	1	4	0	1	1	1	2	14	4
Johnny darter	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Logperch	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Frehwater drum	0	7	5	24	42	68	0	0	0	0	3	1	0	1	0	1	39	3
Slimy sculpin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Species-specific catch-per-standard gillnet lift, Lake St. Francis area, St. Lawrence River, 1998.

Survey year	1984		1986		1988		1990		1992		1994		1998	
Number of Nets	36		35		36		36		36		36		35	
	CUE	SE	CUE	SE	CUE	SE	CUE	SE	CUE	SE	CUE	SE	CUE	SE
Yellow perch	13.53	1.85	10.31	1.28	13.19	1.86	10.47	1.92	10.00	2.25	8.67	1.67	7.51	1.60
Northern pike	2.64	0.49	2.49	0.32	2.81	0.36	2.42	0.28	2.61	0.32	2.47	0.27	2.34	0.31
Walleye	0.31	0.10	0.29	0.11	0.61	0.15	0.27	0.11	0.22	0.10	0.17	0.06	0.23	0.08
Smallmouth bass	0.56	0.29	0.40	0.13	0.17	0.06	0.17	0.14	0.39	0.19	0.39	0.16	0.86	0.30
Largemouth bass	0.03	0.03	0.00	-	0.06	0.04	0.06	0.04	0.00	-	0.03	0.03	0.06	0.04
Muskellunge	0.00	-	0.00	-	0.03	0.03	0.00	-	0.00	-	0.00	-	0.00	-
Rock bass	2.25	0.30	2.20	0.51	1.83	0.35	0.86	0.17	1.36	0.26	1.33	0.40	1.63	0.36
Pumpkinseed	3.14	0.99	1.09	0.34	0.53	0.13	0.47	0.19	0.94	0.26	1.11	0.25	0.97	0.29
Bluegill	0.00	-	0.00		0.00		0.00		0.00	-	0.00	-	0.03	0.03
Black crappie	0.03	0.08	0.06	0.06	0.03	0.05	0.06	0.06	0.06	0.04	0.08	0.05	0.00	
Brown bullhead	0.72	0.30	0.77	0.30	0.39	0.23	0.25	0.13	0.44	0.34	0.28	0.13	0.60	0.21
White sucker	1.08	0.21	1.37	0.24	0.64	0.17	1.06	0.19	0.89	0.18	1.06	0.18	1.26	0.31
Redhorse sucker	0.00	-	0.00	-	0.03	0.03	0.11	0.11	0.03	0.03	0.06	0.39	0.11	0.05
Fallfish	0.00	-	0.00	-	0.00	-	0.06	0.06	0.00	-	0.00	-	0.00	-
Creek chub	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.06	0.04
Longnose gar	0.00	-	0.14	0.09	0.06	0.03	0.00	-	0.42	0.28	0.17	0.07	0.09	0.05
Total	24.29		19.12		20.38		16.26		17.36		15.82		15.74	