# LAKE ONTARIO FISHERIES UNIT

# 1993 ANNUAL REPORT

Ministry of Natural Resources
Ministère des Richesses naturelles
Ontario

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# 1993 ANNUAL REPORT

*Prepared for the*
*Lake Ontario Committee Meeting*
*Great Lakes Fishery Commission*
*Niagara Falls, Ontario*
*March 29-30, 1994*

*Copies of this report are available from*
*Lake Ontario Fisheries Unit*
*Ontario Ministry of Natural Resources*
*R.R. #4, Picton, Ontario*
*K0K 2T0*

*Report ISSN0838-5653*

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# LAKE ONTARIO FISHERIES UNIT
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## Introduction

The Lake Ontario Fisheries Unit 1993 Annual Report summarizes the results of fisheries surveillance programs completed in 1993. The report was produced by the Assessment group of the Lake Ontario Management Unit[1]. The Assessment group has two main functions in support of Lake Ontario fisheries management The group plays a lead role to develop and maintain Ontario Ministry of Natural Resources (OMNR) fisheries surveillance programs on Lake Ontario. The Assessment group also shares a responsibility with Lake Ontario's broader scientific community to transfer science to fisheries management policy. Many of the Assessment group's surveillance activities are done in partnership with New York State Department of Environmental Conservation (NYSDEC), and the United States National Biological Survey (NBS, formerly the USFWS). In addition, several programs are integrated with research and synthesis activities conducted by the Lake Ontario Research group (LOR), the Great Lakes Salmonid Unit (GLSR), and the Provincial Warmwater Fisheries Specialist, all located at Glenora.

This introduction gives a brief of the annual report and the Assessment group's approach to Lake Ontario fisheries suveillance, including links to Research programs. Significant management initiatives of 1993 are also described. Included in Appendix A are lists of Assessment and Research project titles, LOMU staff, and Glenora associates. Results of the St. Lawrence River surveillance programs are reported in a separate report (Ontario Ministry of Natural Resources and New York State Department of Environmental Conservation 1994).

### *Overview of Surveillance Programs and Related Activities*

Lake Ontario surveillance activities reported in the seven chapters that follow are organized into three major sections: Fish Community Indexing, Resource Use Monitoring, and Additional Topics. The results reported are of a summary nature. The first two sections emphasize 1993 updates of selected fish population, biological, and fishery indices and statistics. Some preliminary results from ongoing data synthesis are reported. In the final section we report on zebra mussels related studies and aquatic habitat.

The 1993 Annual Report organization reflects our approach to Lake Ontario fisheries surveillance. The highest priority for LOMU Assessment is to develop and maintain indices of fish population abundance and biological attributes, and thereby detect long-term fish community changes. Also, we provide stock-specific information for species requiring rehabilitation such as lake trout, and economically important species such as walleye, whitefish, and yellow perch. Programs that are designed with this intent are grouped under Section I ( Fish Community Indexing) and include programs to monitor pelagic planktivores (Chapter 1), pelagic piscivores (Chapter 2), and eastern Lake Ontario fish communities (Chapter 3) Sampling is designed to obtain reliable indices of abundance and secondary biological information (age, sex, weight, diet, maturity).

Lake Ontario pelagic planktivore abundance (Chapter 1) is determined by a hydroacoustic and

[1] A reorganization of OMNR in 1992 established the Great Lakes Branch with a Management Unit for each of the Great Lakes. The Assessment group including staff located at Glenora, Maple, and Brockville, and the Operations group also located at Glenora, are part of the Lake Ontario Management Unit (LOMU). The Unit also includes a Management group and Compliance staff. The Lake Manager, management biologists, and Compliance Supervisor have their offices in Napanee.

mid-water trawling program done in partnership with NYSDEC. This program is supplemented by bottom trawling done in partnership with NBS, and index gillnetting and trawling programs in eastern Lake Ontario. Pelagic piscivore abundance (Chapter 2) is determined by a fall index gillnetting program targeting lake trout, sport fish harvest rates for rainbow trout, catch-at-age analysis of sport fishing harvest for chinook salmon, and stocking records for all salmon and trout. Also, counts of spawning rainbow trout at the Ganaraska River provide direct enumeration of the size of this stock. Growth and condition of chinook salmon and rainbow trout are monitored at selected spawning runs. Wild salmonid recruitment and year-class strength is determined from stream electrofishing surveys.

Fish community indexing is more intensive in eastern Lake Ontario (Chapter 3). Depth-stratified gillnet and bottom trawling surveys are done during the summer when there is a tendency for stable water temperature regimes and some separation of cold and warmwater fish assemblages. Three major geographic regions are recognized: northeastern Lake Ontario, the Outlet Basin, and the Bay of Quinte. Walleye abundance is also determined from catch-at-age analysis of angler harvest data and periodic mark-recapture studies.

The other principal activity of the LOMU Assessment group is to monitor fisheries resource use. Grouped under Section II (Resource Use Monitoring) are programs which monitor commercial (Chapter 4) and recreational fisheries (Chapter 5). Commercial fish harvest sampling provides data to manage quota allocations. Commercial harvest sampling also has the potential to provide an independent index of abundance of commercial stocks. The collection of biological data from commercial catches will, in time, allow us to fully develop this approach. Recreational fisheries monitoring concentrates on the Bay of Quinte walleye fishery and the boat fishery for salmon and trout in western Lake Ontario. Other fishery components are surveyed in some years.

Fishing effort statistics are important for gauging public participation in recreational fishing and provide feedback to managers on the success of stocking programs. Changes in catch and harvest rates reveal temporal and regional differences in fish population abundances and angler preferences. Catch-at-age analysis of the Bay of Quinte walleye angling data used to refine trend-through-time estimates of the walleye population size (Chapter 3). Similar analyses of the recreational harvest of chinook in Ontario and New York have resulted in preliminary estimates of chinook abundance over time (Chapter 2). This information, along with the associated estimates of mortality and angling selectivity will be used to update the SIMPLE model (see Research Links below).

The final section of the annual report is titled Additional Topics. In this section we summarize information from programs designed to enhance our understanding of zebra mussel impacts (Chapter 6) and fish habitat (Chapter 7). The zebra mussel program indexes the distribution and abundance of zebra and quagga mussel, and thereby documents a case history of their invasion. We also report on early life-history studies designed to better detect and understand the impacts of mussel invasion on lake whitefish. In Chapter 7, we report on fish habitat work, supported by RAP, in the Bay of Quinte.

### Research Links

The LOMU Assessment group shares facilities at Glenora with the Lake Ontario Research group (LOR), under the direction of Dr. John Casselman, and the Great Lakes Salmonid Research group (GLSU), under the direction of Dr. Michael Jones. Many research projects (Appendix 1) are integrated with those of the Assessment group.

Before 1992, the LOR was responsible for fish community indexing programs in the Bay of Quinte and Outlet Basin. The Lake Ontario Research group retains responsibility for the management of the historic data, and conducts studies to maintain the continuity of the historic data series and augment knowledge of fish community dynamics.

In 1993, studies were continued comparing multi-filament and mono-filament gillnets. These studies will allow direct comparison of current and historical indices of abundance. A seasonal fish community indexing program to provide information on fish migration and growth was also initiated in 1993.

The LOR group also has an age and growth research program. Of particular relevance to the Assessment group is the development and maintenance of the CSAGES computer software that allows for the capture, archival, and analysis of digitized scale and otolith age interpretation data. Work on discriminating stocks of lake whitefish based on scale and otolith growth characteristics will enhance our surveillance and management programs specific to the Bay of Quinte and Lake Ontario stocks. Studies of rainbow trout calcified tissue are being used to discriminate fish of hatchery origin from those that are produced naturally. These studies will help refine estimates of natural production, and allow us to better understand fish community changes and adjust stocking programs.

Lake trout research conducted by LOR is important to understanding factors impeding lake trout rehabilitation in Lake Ontario. Research includes assessment of spawning activity at the Yorkshire Bar historical site, in-situ bioassays to better understand early-life history, and studies to identify naturally produced yearling lake trout by examination of their calcified tissue.

The GLSU group has several programs integrated with LOMU surveillance programs. Studies at Wilmot creek, examining salmonid early life history, and competition between Atlantic salmon and resident salmonids is useful to evaluate Atlantic salmon restoration efforts. The GLSU developed a rapid assessment technique for measuring salmonid densities in streams. The Assessment group applied the technique to estimate rainbow trout smolt production in Ontario streams (Chapter 2). Studies examining the growth and population dynamics of spawning run rainbow trout in the Ganaraska River augment the fishway surveillance program. The studies provide insights into factors influencing the composition of the spawning run and the response of rainbow trout populations to ecosystem change. The SIMPLE project, co-chaired by Dr. Michael Jones and Dr. Joe Koonce (Case Western University) and supported by the Great Lakes Fishery Commission (GLFC), was completed in 1993 with a technical transfer workshop in Cleveland, Ohio. LOMU staff and Great Lakes partners were trained in the application and modification of the SIMPLE model. The model was a valuable tool for consulting the public concerning Lake Ontario predator and prey. Transfer of the technology will allow for timely updates of the model using the latest surveillance information.

In 1993, many LOMU staff, OMNR research staff and Great Lakes colleagues participated in two major data synthesis activities. The first culminated in the RESTORE conference, sponsored by the GLFC, in early January of 1994. This synthesis reviewed our knowledge regarding the progress of lake trout rehabilitation throughout the Great Lakes. The conference proceedings will be published in the Journal of Great Lakes Research in 1994. In addition, LOMU staff participated in the OMNR provincial walleye synthesis, coordinated by Cheryl Lewis. LOMU staff contributions and Lake Ontario surveillance data featured prominently in both syntheses.

Working with a number of Great Lakes scientists, LOMU and NYSDEC developed an ecosystem status report entitled "Ecosystem Watch: Status of the Lake Ontario Ecosystem." The synoptic report is intended to give the interested public up to date knowledge concerning the state of the Lake Ontario ecosystem. The report links nutrients, zooplankton, and water quality surveillance programs of the Department of Fisheries and Oceans to the fisheries surveillance programs of LOMU assessment and their partners.

## Management Initiatives

All fisheries management activities concerning Lake Ontario and the St. Lawrence River are coordinated from the office of the Lake Manager in Napanee. The management initiatives described below are those that were of particular significance in 1993.

### Predator-prey Deliberations

In the summer 1992 a comprehensive review of available scientific information (Anonymous 1992) concluded that the levels of salmon and trout stocking were higher than could be support by the available prey (alewife and smelt). This led to an extensive public consultation process and a bi-national decision to reduce stocking in 1993 and again in 1994 (see Chapter 2). The goal was to reduce demand on prey fish by approximately 45 to 50 percent in an attempt to restore the balance of predator and prey.

### Commercial Fishery Management

The general approach to commercial fisheries management is to support and assist the commercial fishery while conserving and rehabilitating fish stocks. Quota management is an essential component of the commercial fishery program. In 1993, significant increases in quotas for lake whitefish reflected substantial recovery of this species in eastern Lake Ontario. Continued concern about the status of eel and yellow perch stocks resulted in reduced 1993 quotas for these species. Besides stock conservation, licence conditions attempt to reduce problems of incidental catch and minimize conflicts with other resource users. In 1993, some expansion of gillnet seasons for lake whitefish was permitted through cooperative programs with the local industry. A more detailed account of commercial fish management, a summary of 1993 harvest, and biological characteristics of the harvest can be found in Chapter 4.

### *Compliance Programs*

Conservation officers conduct a wide range of compliance activities associated with fish harvest licensing and regulations. In the commercial fishery, ensuring compliance with licence conditions, quota management, and resolving conflicts with other resource users are high priorities. In 1993, lake whitefish over-quota and illegal marketing of eels with elevated contaminant levels were important areas of enforcement. The open-lake salmon and trout fishery and the Bay of Quinte walleye fishery continue to be high priorities for enforcement of sport fishing regulations. Compliance programs dealing with shore angling and seasonal spawning runs were accomplished through liaison and cooperation with OMNR District and Area teams.

### *Review of Eastern Lake Ontario Walleye Regulations*

At the request of resource users, LOMU has initiated a review of walleye harvest regulations for eastern Lake Ontario. The principal focus will be an evaluation of angling regulations for the Bay of Quinte. Consultation with those having a direct interest in the walleye fishery will include an examination of existing fisheries surveillance data (see Chapter 3 and 5), and an exploration of alternate regulatory scenarios.

### *Remedial Action Plans (RAPs)*

The Unit is responsible for coordinating OMNR's participation in remedial action plans for the Niagara River, Hamilton Harbour, Metro Toronto, the Bay of Quinte and the St. Lawrence River. OMNR's role in the RAP process continues to concentrate on restoration of degraded habitat, with special emphasis on protection and enhancement of fish habitat and the associated fish community. Surveillance programs, in support of the Bay of Quinte RAP, are integrated with LOMU's assessment program (Chapters 3 and 7). For most RAPs, OMNR District and Area Offices are directly involved in fish community and habitat monitoring, habitat rehabilitation projects and partnerships with other government agencies, non-government organizations, and the public.

### *Liaison with First Nations*

The Unit has been extensively involved in programs associated with Tyendinaga and Akwesasne First Nations. The principal role has been to provide fish stock status and resource use information to aboriginal liaison specialists of OMNR's Tweed and Kemptville Districts. In 1993, LOMU staff were directly involved with First Nations in information exchange, training, advice and assistance with aquaculture and research projects, a fisheries workshop, and cooperative RAP projects. The Unit was also consulted in deliberations regarding the conservation implications of aboriginal harvest.

### *Lake Trout Rehabilitation*

Lake trout rehabilitation continues to be guided by the "Joint Plan for the Rehabilitation of Lake Trout in Lake Ontario." An updated version of the plan, prepared by OMNR, NYSDEC and the NBS, is currently under review. These agencies participate in a cooperative annual sampling program, collecting data on abundance, survival, and population structure of lake trout and determining sea lamprey impacts (Chapter 2). Sport fishing harvest of lake trout was monitored during angler surveys (Chapter 5).

### *Review of Atlantic Salmon Restoration*

Atlantic salmon were very abundant in Lake Ontario in the early 1800's but were extinct by 1900. Restoration attempts have been made in the past. The current program by OMNR has consisted of stocking Atlantic salmon at two sites, Credit River and Wilmot Creek, since 1987. Adult returns to these sites have been limited to date. A working group consisting of OMNR staff from assessment, research, management and fish culture has been formed. They will review the existing program, determine the feasibility of restoration, and provide recommendations about the future of Atlantic salmon restoration efforts and supporting surveillance programs. In November, a workshop was held with staff from several agencies and universities to evaluate the ecological feasibility of Atlantic salmon restoration for Lake Ontario. The over-all conclusion from the workshop was that although there are several potential constraints from an ecological perspective, restoration is feasible. Consultation with client representatives about the future of the program is planned before the working group prepares a final report.

## Acknowledgements

The authors gratefully acknowledge the support provided by several individuals and groups that made this report possible. Many studies would not have been complete without the support of our Great Lakes partner agencies. The Operations group at Glenora provided the necessary administrative and technical support required to complete field programs, enter data, move the mail, and keep the facilities funcitioning. Many anglers and commercial fishermen provided information and fish samples. Of particular help were Mr. George Cooper, Mr. and Mrs. Roy Cooke and Mr. David Angas and his son Christopher. Funding for a number of projects was provided by the Canada-Ontario Agreement.

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# 1

# Pelagic Planktivores

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C. P. Schneider[1]

## Overview

The principal prey species in Lake Ontario are alewife and rainbow smelt. Both are pelagic species found in all parts of the lake, but neither species is native to the lake. Former major prey species, ciscoes (*Coregonus spp.*) and deepwater sculpin (*Myoxocephalus quadricornis*) have diminished in importance or disappeared from the lake altogether over the last 50 years.

Alewife and smelt support a variety of predators. They are the principal food for salmonines, and they also form an important part of the diet of warmwater predators such as walleye. Over the last decade we have witnessed a reduction in nutrient loading into the lake, leading to reduced production of plankton, the principal food of alewife and smelt. Concerns that the levels of salmon and trout stocking were higher than could be supported by the declining prey populations prompted the management agencies to reduce stocking in 1993 and 1994. It remains to be seen if these reductions were sufficient to allow the alewife and smelt populations to sustain themselves. Monitoring the state of the prey community is therefore becoming more critical than ever.

The most extensive long-term prey monitoring program on Lake Ontario is conducted cooperatively by the National Biological Survey (NBS, formerly U.S. Fish and Wildlife Service) and the New York State Department of Environmental Conservation (NYSDEC) (O'Gorman et al., 1992). The surveys cover the U.S. waters of the lake, but the smelt survey also extends into the western Canadian waters (Mathers 1992), and the 1993 results are discussed in this chapter. The gear used in the surveys is bottom trawl, with timing designed to take advantage of the period in spring and early summer, when alewife and smelt are concentrated in shallower water near shore.

The bottom along much of the north shore of Lake Ontario is rocky and irregular, making bottom trawling impractical. Rather than extending the alewife and smelt bottom trawling programs into Canadian waters (as was the case with lake trout gillnet surveys), we found an alternative method in hydroacoustics. In 1991 MNR and NYSDEC initiated a cooperative program of hydroacoustic surveys that is intended to provide long term monitoring or prey fish. Results from this program are the basis for much of the discussion in this chapter.

Additional information on the status of alewife and smelt comes from MNR's nearshore fish community index gillnetting program that includes stations in the Eastern Outlet basin, and in the northeastern part of the main lake (Chapter 3 in this report).

## Hydroacoustic Surveys

For three years now the MNR and NYSDEC have conducted spring, summer, and fall hydroacoustic surveys covering the entire lake. Each survey consists

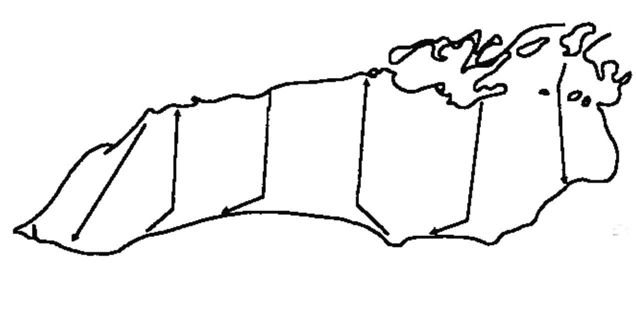

FIG. 1. Transects sampled in hydroacoustic surveys.

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of six cross-lake transects (Fig. 1), during which we collect continuous acoustic data, midwater trawl samples of prey fish, and temperature profiles.

The acoustic data are collected at night, starting at the 10m depth at one shore, and continuing across the lake until the 10m depth is reached at the other shore. The instruments are set to process signal down to 100m depth, although few fish are generally found deeper than 50m. With the present configuration we measure fish from 1 metre off the bottom to within few metres of the surface. At night when the sampling is done, the bulk of the prey fish population is found in the water column, and therefore the lack of coverage near bottom does not present a problem. Our current inability to sample near-surface, however, may lead to an underestimate, and deserves further investigation.

A trawler boat accompanies the hydroacoustic boat, sampling fish from scattering layers revealed by the acoustic data. The catches from the midwater trawls are used to establish species and size composition of the prey fish. As a further aid in interpreting the acoustic data, we also measure temperature profiles, because both alewife and smelt often exhibit strong temperature preferences.

In the first two years of the program we used a variety of older hydroacoustic equipment, until in 1993 we acquired replacements. Our experience with the new equipment has revealed a calibration problem which prompted re-processing of the 1993 fall survey (the corrected data are presented here), and also pointed out the need to re-process the spring and summer 1993 data (this still remains to be done). Furthermore, we think that data collected with the old equipment in previous years should also be examined. The discussion here is therefore brief, and limited to points that we feel will remain valid after re-evaluation of past data.

### Acoustic Estimates

The hydroacoustic estimate of prey fish numbers in October of 1993 is 8.6 billion fish (Fig. 2). This number may have been inflated by large numbers of very small targets, probably *Mysis*, encountered in the southwestern portion of the lake. The number is is in the same range as the 1992 estimate of 6.5 billion, but it is well below the 1991 estimate of 43.8 billion. The 1991 and 1992 figures will change when the data are re-processed, but we do not expect the

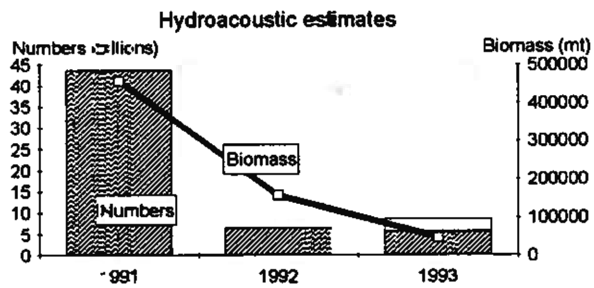


FIG. 2. Fall hydroacoustic estimates of numbers and biomass of prey fish in Lake Ontario. Blank bar in 1993 indicates 3 billion acoustic targets that are probably *Mysis* rather than fish.

overall time trend and relative magnitudes to change substantially.

The biomass estimated for October 1993 is 47,000 metric tonnes, much lower then the 1991 and 1992 October estimates of 457,000 mt and 157,000 mt respectively. The estimates were derived by converting average acoustic target strengths to average weights, and therefore the 1991 and 1992 figures will change when the data are re-processed. However, we believe that the low biomass estimate for 1993 is realistic, resulting not only from low fish numbers, but also from low average weights of individual fish. This is consistent with the evidence from trawls, which indicates absence of large alewife, and unusually small size of YOY alewife (see below).

### Alewife

There were very few yearling alewife in 1993 (Fig. 3). The failure of this year-class was first suspected in October of the previous year, when we caught very few YOYs in midwater trawls. The suspicion was confirmed in 1993 by the absence of yearlings in all three hydroacoustic surveys, and also in spring bottom trawls in the U.S. waters (R.O'Gorman, NBS Oswego, pers.comm.).

It appears that in 1993 nearly half the adult alewife were lost between July and October. In July the trawl catches consisted of two size groups, with modal fork lengths at 110 mm (likely corresponding to 2 yr old fish), and at 130 mm (3 yr old and older fish). In October, however, we found that there were very few fish larger than 125 mm, and the larger size

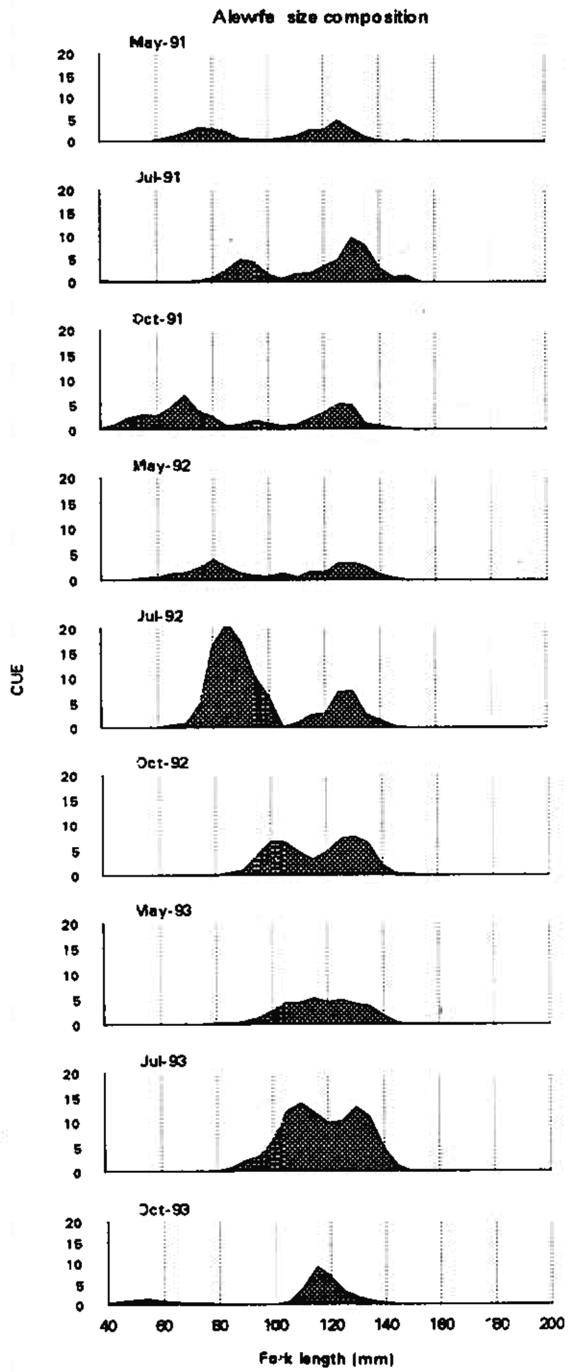


FIG. 3. Fork length frequency distributions of alewife from midwater trawls made during hydroacoustic surveys. In 1993, the absence of fish below 100mm in May and July indicates absence of yearlings. The YOY alewife were much smaller in October 1993 (40-60 mm) than in October 1991 (40-80 mm).

group that we saw in July was missing. The difference between July and October was also evident in the acoustic target strength distributions. It is likely that the large alewife were consumed by predators.

The young-of-the-year (YOY) alewife were small in 1993. The modal length of the YOY class, as seen in our October midwater trawl catches, was around 55 mm fork length, which is almost a third smaller than the 75 mm modal length seen in October 1991. We also suspect that our midwater trawl is less efficient for small fish because they can escape through the meshes in the forward sections of the net. This would bias the comparison with 1991 in two ways: the abundance of the 1993 YOY class may be higher than it appears, but their average size may be even smaller.

### *Smelt*

The expectations of a weak class of yearling smelt in 1993 proved wrong, and we did catch yearlings in all three 1993 surveys. The prediction was based on on the absence of YOY smelt in October 1992, together with the experience from 1991, when a similar absence did result in a missing year class. It appears, therefore, that catches of YOY smelt in the fall survey may not be a good indicator of yearclass strength. There is nothing to suggest problems in year-class production in 1993, since in the fall we caught some YOY smelt in all parts of the lake.

The yearling smelt caught in July 1993 (Fig. 4) were small, having modal fork length of approximately 77 mm. Our only available reference point with good sample size of yearlings is the July 1991 survey, when the modal fork length of yearlings was approximately 90 mm.

## Index Netting Program

Alewife and smelt are commonly caught in the index netting program conducted by MNR in the northeastern part of the lake. In 1992 the standard gillnet used in this program was changed from multifilament to monofilament, and the results of comparison fishing indicated that the monofilament was less efficient in capturing both alewife and smelt. This probably accounts for the general decrease in catches from 1991 to 1992 (Fig. 5). The results from 1992 and 1993, however, are comparable, and they show that the catch rates for alewife and smelt have

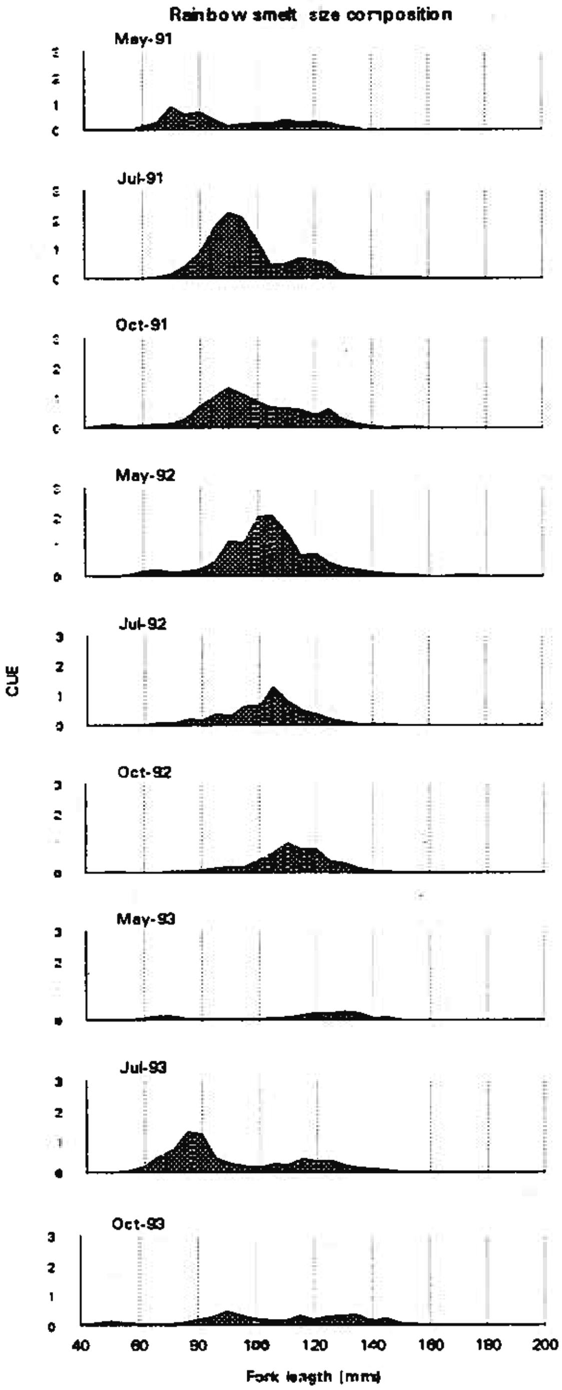


FIG. 4. Fork length frequency distributions of smelt from midwater trawls made during hydroacoustic surveys. Despite low catches of YOY smelt in October 1992 (fish less than 60 mm), yearling smelt were detected in large numbers following year (July 1993, peak around 80 mm); they were, however noticeably smaller than the 1991 yearlings (July 1993, peak around 90 mm).

decreased both in the northeastern portion of the main lake, and in the Outlet Basin. The catches of alewife have decreased to nearly a half, and in the Outlet Basin this represents more than two standard deviations, making the difference significant. The catches of smelt have decreased by an even greater factor, but the difference was not statistically significant.

## Spring Bottom Trawls

The spring bottom trawling survey of smelt conducted by the National Biological Survey has traditionally been extended into Canadian waters, with three transects between Niagara and Toronto. This represents only a small portion of the lake, but the results over the past three years showed some of the same patterns that we saw in the hydroacoustic surveys. Yearling smelt were caught in moderate numbers in 1991 and 1993, but not in 1992 (Fig. 6). The average size of the yearlings has decreased precipitously in 1992, and has remained low in 1993. The population estimate for adults in 1993 has dropped to the lowest level since 1985.

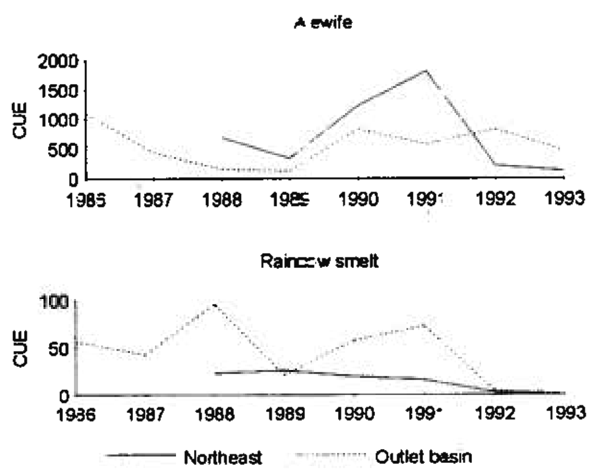


FIG. 5. Catches of alewife and smelt in the MNR index netting program. The sharp drop from 1991 to 1992 is due to changes in gear standards. Catches with new gear in 1991-92 show declines in 1992 in both species at both locations.

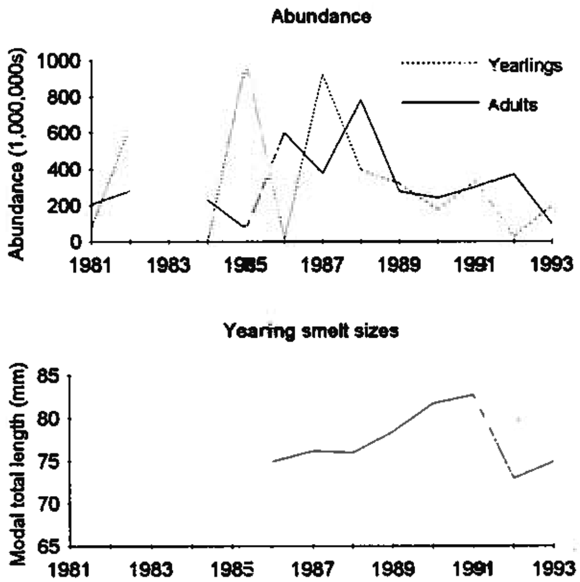


FIG. 6. Trends observed in spring bottom trawls in western Lake Ontario.

## *Discussion*

The abundance of prey fish was low in 1993, and due to small average size of alewife, the biomass was unusually low. The strongest evidence for this comes from the hydroacoustic surveys, and although we are currently re-evaluating some of the past hydroacoustic estimates, we expect that the corrections will be minor. According to hydroacoustic estimates the numbers of prey fish in 1993 were down to one fifth of the 1991 level, and prey biomass was down to one tenth of the 1991 level. Information from other sources indicates a less drastic a decline, nonetheless, the following observations were made in 1993: a) bottom trawling surveys indicated the lowest number of yearling alewife since late 1970s (R. O'Gorman, NBS Oswego, pers. comm.), b) bottom trawling in the Canadian western portion of the lake showed the lowest level of adult smelt since 1985, and c) index gillnet catches of alewife and smelt in the Canadian western portion of the lake have fallen from 1992. There are reasons to believe that prey abundance is at a low point.

A recent task group (Anon. 1992) concluded that changes in Lake Ontario ecosystem have had a significant impact on the prey community. Since the early 1980s the production of plankton has decreased, and predator biomass has increased, exerting pressure on the prey community from both directions. Observations from 1993 indicate that the pressure continues. At the time of writing we do not have data to comment on the availability of plankton to alewife and smelt, other than the general observation that the plankton productivity in 1993 has remained low (O.Johansson, DFO Burlington, pers. comm.), and the indirect observation that YOY alewife and yearling smelt were small in 1993. The impact of predation by salmonines on the other hand was demonstrated clearly by the near-disappearance of large mature alewife. If there was a shortage of suitable large prey in 1993, size selective cropping of larger individuals in the younger age-classes may have occurred, providing an alternative explanation for the small size of young prey fish.

The alewife population going into the winter of 1993-94 consisted largely of a group of YOY and a group of two year olds. The winter was severe, possibly leading to a high mortality of the young fish. Initial observations indicate that this has been the case (R.O'Gorman, NBS Oswego, pers.comm.), although spring surveys in 1994 will provide better information. Even if the overwinter survival of the YOY proves to be good, the alewife population in 1994 will consist of yearlings and three year old fish. In the absence of older individuals, the three year olds will be solely responsible for reproduction in 1994, and in the absence of two year old fish, they will also bear a major portion of predator pressure. Thus, even with the recent reductions in stocking of salmonines, concerns with the state of prey populations in the lake continue

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# 2

# Pelagic Piscivores

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Sandra Orsatti
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Ted Schaner

## Overview

This chapter describes the status of the pelagic piscivore community in Lake Ontario. This community is composed of primarily salmonids. In this chapter we concentrate on the status of the most abundant salmonids: lake trout, rainbow trout and chinook salmon. Although walleye are part of this community, mostly in eastern Lake Ontario, these fish are migrants from the Bay of Quinte, and walleye status is described in Chapter 3.

Most of the salmonids in Lake Ontario are stocked. Thus, stocking numbers provide a good indicator of recruitment to the pelagic piscivore community in Lake Ontario. In 1993 stocking of salmonines in Lake Ontario was reduced substantially by New York State and the province of Ontario. These actions were taken in response to declines in zooplankton and planktivorous fish over the past decade. Zooplankton declined as a result of a successful phosphorus control program in all the Great Lakes states and Ontario. These stocking reductions were expected to induce a 45-50% decline in future consumption of smelt and alewife. We have summarized the annual stocking and marking report (Orsatti and LeTendre 1994) here.

Lake trout populations were monitored to document the progress of the rehabilitation effort based on the Joint Plan for Rehabilitation of Lake Trout in Lake Ontario (Schneider et al. 1983). We have summarized the annual progress report (Schneider et al. 1994) here. Of particular significance in 1993 were the observations of highest lake trout survival and lowest lamprey predation yet recorded. Moreover, this was the first year the rehabilitation objective for lake trout survival has been met.

For salmonid species other than lake trout, we have traditionally used angler harvest rates from the boat fishery to index salmonid populations in the lake, because OMNR has no salmonid community index netting programs on Lake Ontario. This fishery is driven by a series of derbies which results in the fishery targeting chinook salmon and rainbow trout. The use of angler harvest rates from the Canadian portion of the Lake Ontario fishery should be limited to these two species. To improve our ability to index populations with harvest rates we have used catch-age analysis (CAGEAN; Deriso et al. 1985) with chinook salmon in the boat fishery. In 1993 we continued our CAGEAN analysis of chinook salmon by combining the New York DEC angler survey data with Ontario data. Preliminary population estimates have been presented below. More important was the indication of a declining trend in recruitment of chinook to age 1 relative to the number of fish stocked.

The harvest rate of rainbow trout in the boat angling fishery in 1993 was 62% of the average for 1985 to 1991. Nonetheless, harvest rates had increased in 1993 from 1992. However, harvest rates of rainbow trout in 1992 and 1993 in New York waters were the highest since 1985. Our only other source of population index information has come from counts of rainbow trout at the Ganaraska River fishway. Rainbow trout counts at the fishway in 1993 declined to 8860, which was 60% of the average count for 1985 to 1991.

In 1993 with the cooperation of the Great Lakes Salmonid Research unit (GLSR) we started a juvenile salmonid index program for migratory salmonids in

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streams. This program indexed year-class strength and recruitment for wild salmonid populations in the lake. Research by the GLSR may eventually use this data to provide estimates of the number of smolts entering the lake from these streams. We estimated 851,334 wild juvenile rainbow trout in Ontario streams. Juvenile coho and chinook salmon were observed as well.

We monitored growth and condition of lake trout, rainbow trout and chinook salmon to index the availability of their prey. Condition among piscivores in Lake Ontario declined through the 1980s until 1986 or 1987, and then increased. This increase in condition was surprising since stocking was relatively constant and alewife populations were declining. The trend in lake trout condition was negatively correlated with the chinook salmon population.

## Stocking

Changes in Lake Ontario over the past decade have resulted in a situation where the food consumption by salmon and trout likely exceeds the sustainable supply of their principal prey, alewife and smelt. In response to these changes OMNR and New York State Department of Environmental Conservation (NYSDEC) reduced salmon and trout stocking into Lake Ontario by 3 % in 1993. OMNR reduced stocking of lake trout, chinook salmon and brown trout, and NYSDEC reduced stocking of chinook salmon, coho salmon and lake trout relative to 1992 (Fig. 1 and 2) OMNR and NYSDEC together stocked 5,010,205 salmon and trout in 1993, which was less than the target of 5,133,000 . Chinook salmon continued to dominate stocking in 1993, followed by lake trout, rainbow trout, and brown trout (Fig. 3). Detailed information about stocking in 1993 is in Appendix B.

In 1993 OMNR stocked only the anadromous LeHave strain of Atlantic salmon. In addition to normal yearling stocking, fry were stocked in Wilmot Creek on an experimental basis. OMNR is currently reviewing its Atlantic salmon program for Lake Ontario. This review may result in changes in locations or numbers of Atlantic salmon stocked in Ontario. NYSDEC stocked Atlantic salmon yearlings and fingerlings of the landlocked Clear Lake strain. As a result of not reaching its yearling target of 200,000, NYSDEC stocked 30,000

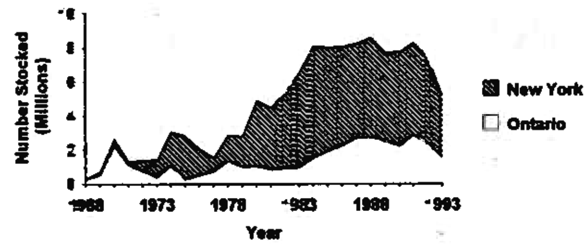


FIG. 1. Lake Ontario stocking trends for Ontario and New York.

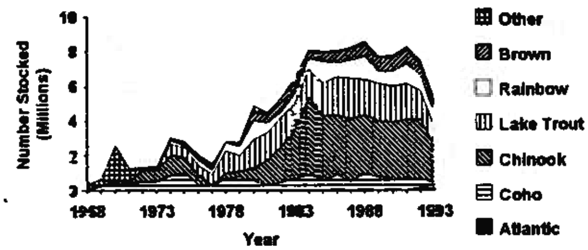


FIG. 2. Lake Ontario stocking trends by species.

fingerlings.

Brown trout stocking reductions by OMNR in 1993 were mainly east of Toronto where the returns to the sport fishery have been relatively poor compared to other areas of the lake Seeforellen strain has been stocked by NYSDEC since 1988 in an attempt to produce larger fish. They were stocked at two sites in 1993.

Although stocking of chinook salmon by OMNR was lower in 1993, stocking sites were similar to recent years. Since the late 1980's, NYSDEC has been reducing the number of chinook salmon stocked in eastern Lake Ontario in order to reducing straying to the St. Lawrence and Black Rivers

Coho salmon were not stocked in the Ontario waters of Lake Ontario. NYSDEC did not reach its target for coho salmon in 1993, because of hatchery production problems.

OMNR's lake trout stocking cuts in 1993 were mainly in eastern Lake Ontario. OMNR plans to consolidate most of its lake trout stocking efforts into eastern lake Ontario where much of the potential spawning habitat for lake trout is located, and natural reproduction has been documented. In 1993, two strains were stocked: Slate Island and Seneca Lake.

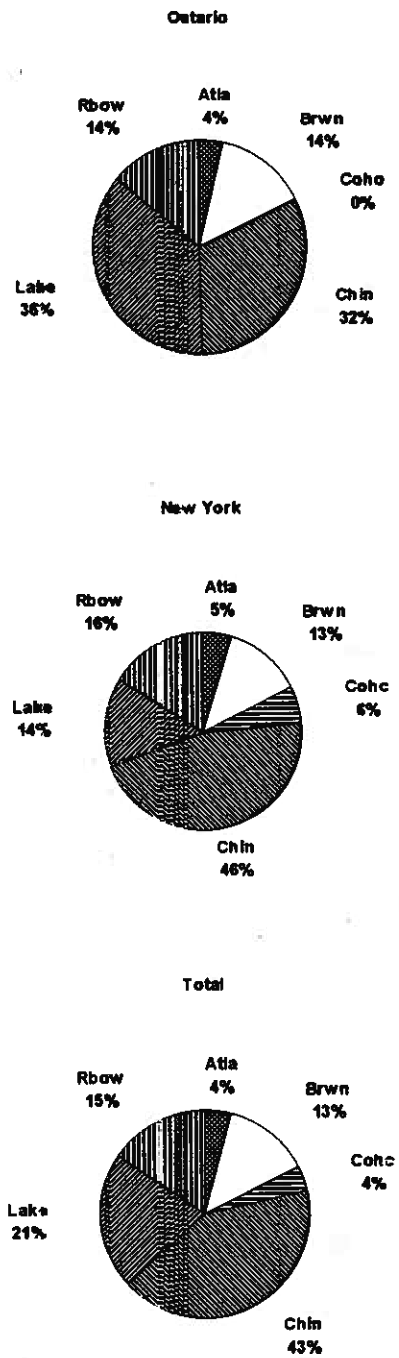


FIG. 3. Species mix of fish stocked into Lake Ontario during 1993.

The longer term target is to stock Seneca Lake strain, and three Lake Superior strains: Slate Island, Mishibishu Lake and Michipicoten Island. A Seneca brood stock is currently being developed by OMNR's fish culture system. It is anticipated that more Seneca, and Mishibishu, and Michipicoten strains will be available for stocking into Lake Ontario by 1996. In 1993, NYSDEC stocked Lewis Lake and Seneca Lake fish, and plans on continuing its emphasis Seneca Lake fish in future years. Despite a 60% reduction in lake trout stocking compared to rehabilitation targets set in the Joint Plan (Schneider et al. 1983), both agencies remain committed to lake trout rehabilitation in Lake Ontario.

OMNR stocked yearling and fingerling rainbow trout in 1993. The OMNR target for fingerlings was not met because of reduced fish culture production capabilities in 1993. Ontario stocking locations were primarily at the west end of the lake, and reflected sport fishing success and rehabilitation targets. Much of the rainbow trout fishery east of Toronto has been supported by naturally reproducing wild fish. NYSDEC stocked three strains of rainbow trout: domestic, Washington winter-run steelhead, and Skamania summer-run steelhead. The Skamania stocking by NYSDEC was done at four sites as an experiment to produce more near shore summer angling in New York waters.

Walleye were stocked in Ontario and New York waters of Lake Ontario. In Ontario waters, 185 adult walleye were transferred to Hamilton Harbour from the Bay of Quinte as part of the Hamilton Harbour RAP activities. Fingerlings were stocked in the Toronto area by a private hatchery on an experimental basis. In New York waters, fingerlings were stocked by private groups and by NYSDEC.

For 1994, stocking targets for salmon and trout have been lowered again. Stocking targets in 1993 and 1994 were part of a two year plan to reduce salmon and trout stocking in Lake Ontario in response to declining productivity at lower trophic levels.

## Lake Trout Status

Relative abundance of lake trout was estimated by calculating an average catch rate from fall gill net surveys. In 1993 we replaced our previous multifilament gill nets with new a monofilament standard. Since only catches of small lake trout are effected by our new gear, we should expect unbiased estimates of mature fish abundance and their survival. Although the abundance of mature lake trout in U.S. waters during 1993 was the highest observed (Fig. 4), there has been no significant trend (P>0.05) in the abundance from 1986 to 1993. In Canadian waters, the period of increasing adult abundance lasted throughout the 1980s and evidence of stability did not occur until 1990, four years later than U.S. waters (Fig 4). This time lag was consistent with lags between stocking by the two nations, where Canadian target levels were not reached until late 1980's. Abundance estimates since 1990 showed no significant trend (P>0.05).

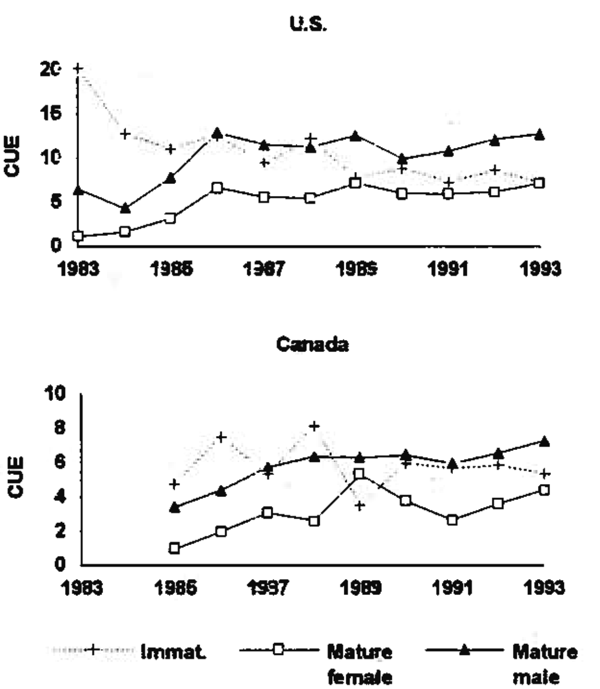


FIG. 4. Catch per standard gill net set during September in Lake Ontario.

Density of lake trout carcasses killed by sea lamprey, and the average A1 wounds are used to monitor the effect of sea lamprey on lake trout in Lake Ontario. A1 wounding rates have remained low on both sides of the border since the mid-1980's. In Canadian waters in 1993 the average A1 wounds on lake trout over 433 mm was 1.8 per 100 fish, virtually unchanged from 1991 (Fig. 5). In U.S. waters A1 wounds declined to the lowest level observed, 1.1 wounds per 100 fish. Since 1991, wounding has decreased 62 percent. Lake trout carcass densities have been measured in U.S. waters in fall bottom trawling surveys since 1982, and provide a direct measure of lake trout mortality due to lamprey attacks. In 1993, density of lake trout killed by sea lamprey was 0.055 ha$^{-1}$, which is amongst the lowest density observed (Fig. 5).

Adult lake trout survival was monitored by comparing the catches from fall gill net surveys. The best estimates of survival were limited to U.S. waters due to the long-term use of coded wire tags, which permit accurate aging of lake trout. Survival of lake trout aged 7 to 9 was 66% in 1993. This is the highest survival observed, and represents the first year that survival met the objective of 60% outlined in the rehabilitation plan. Data from a small group of fish stocked with coded wire tags in Canada in 1983 suggest that the survival rate over the period of 1987-91 was around 40% per year. This is at the lower end of the range of survival rates reported by Elrod et al. (1994). However, this particular group of fish was released, and tend to stay as adults, in the Outlet Basin, where lake trout are subject to a much higher

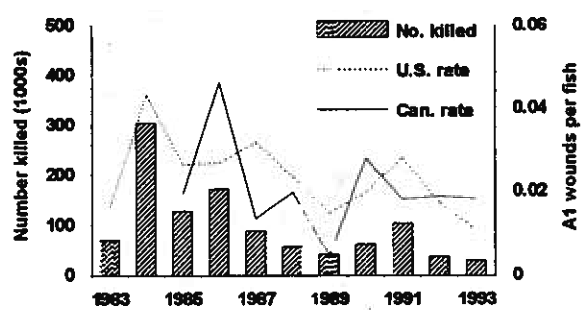


FIG. 5. Number of A1 lamprey wounds per lake trout captured during September gill net surveys in Lake Ontario and density of lake trout killed by sea lamprey in U.S. waters.

fishing pressure than in the rest of Canadian Lake Ontario. On the other hand, since the largest (and presumably the oldest) fish are routinely caught in Canadian waters, survival in Canadian waters may have been higher.

## Population trends of chinook salmon and rainbow trout

### Chinook Salmon

Chinook salmon populations were estimated with CAGEAN for 1984-1992. These estimates were based on age-specific harvest and effort in 1984-1992 in the New York (NYSDEC 1984, Eckert 1993) and Ontario boat angler fisheries (Savoie and Bowlby 1993).

We must emphasize caution on the use of these results since we are still reanalyzing some of the historic Ontario data. As well, CAGEAN requires an independent estimate of natural mortality, for which we could only make assumptions of the actual value. We used age-specific natural mortality estimates derived from Jones et al. (1993). An incorrect value for natural mortality would change the magnitude of the population estimates but should not severely affect the pattern across years.

From 1984 to 1986 the chinook salmon population increased (Fig. 6) as a result of stocking increases in the early 1980s. However, the population declined from 1987 to 1991 despite relatively constant stocking and harvest rates. We believe a vast majority of these fish were stocked. If so, then survival from stocking to age 1 declined through the 1980s (Fig. 7). Most of the variation in survival from stocking to age 2 or 3 was due to the variation in survival to age 1 (Fig. 7). This decline in stocking survival parallels declines in alewife, smelt, and zooplankton (Anonymous 1992). The most reasonable hypotheses for this decline in survival of stocked chinook salmon are: 1) with reductions in smelt and alewife, piscivores may eat more young-of-the-year (YOY) chinook salmon, or 2) reductions in food (zooplankton or invertebrates) has reduced survival of YOY chinook salmon.

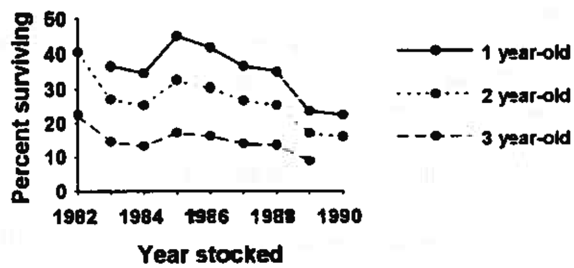


FIG. 7. Percent of chinook salmon surviving from time of stocking in Lake Ontario.

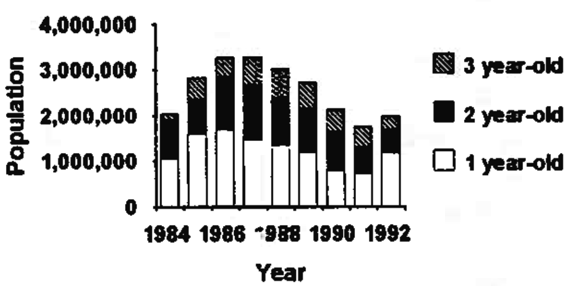


FIG. 6. Population of chinook salmon in Lake Ontario based on catch-age analysis of harvest data from boat angling fisheries in New York and Ontario.

### Rainbow Trout

Harvest rates of rainbow trout in the boat angling fishery declined in 1992 and 1993 compared to previous years (Fig. 8). In 1993 the harvest rate of rainbow trout was 62% of the average for 1985 to 1991. However, harvest rates for rainbow trout in New York waters of Lake Ontario increased

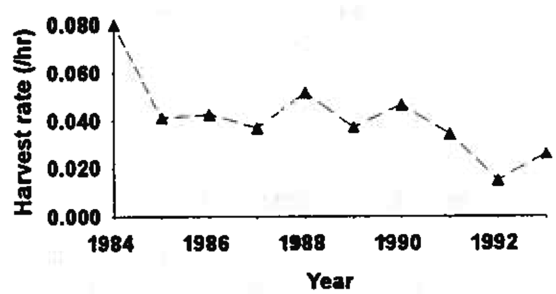


FIG. 8. Harvest rate of rainbow trout in total boat angling fishery in the Ontario waters of of Lake Ontario.

substantially in 1992 and 1993, and in 1993 the harvest rate of rainbow trout was 182% of the average for 1985 to 1991 (Eckert 1994). Apparently, rainbow trout distribution in Lake Ontario during 1992 and 1993 changed from previous years. These corresponding changes in harvest rates between Ontario and New York waters demonstrate the need for whole lake surveys to understand changes in the pelagic fish community.

Our only other source of rainbow trout population information has come from counts of rainbow trout at the Ganaraska River fishway. In 1993 these counts declined to 8860 (Fig. 9), 60% of the average count for 1985 to 1991. Clarkson and Jones (1994) found that the age of first spawning and the average age of spawning of rainbow trout at the Ganaraska fishway had increased one to two years from 1974 to 1991. Assuming that the average age for first spawning has increased by one year, and that the total annual mortality for the relevant age groups is 30-40%, this alone could explain the decline. Alternatively, a series of warm dry summers in the late 1980s may have reduced numbers of juvenile rainbow trout produced in the river before entering the lake.

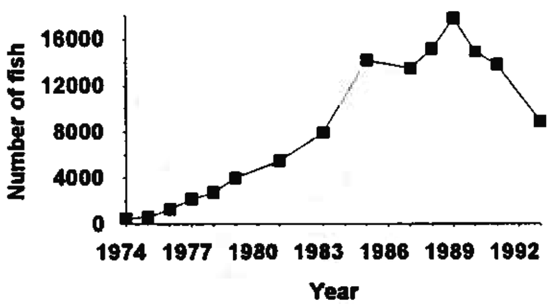


FIG. 9. Number of rainbow trout passing through the fishway on the Ganaraska River during April and May.

## Stream Recruitment Index

In 1993 we sampled 40 sites in on streams in Ontario (Table 1). These sites were randomly selected from all of the salmonid stream habitat accessible to salmonids from Lake Ontario. Each site was about 50 m in length, and was electrofished with a single pass between July 27 and August 26, 1994. For detailed sampling design see Bowlby (1993). Predictions of density from a single pass were based on a previously established regression (Jones and Stockwell unpublished). A mean density for all sites was calculated, and then the total numbers were estimated based on 369.9 km of salmonid stream habitat in Ontario accessible to salmonids from Lake

TABLE 1 Lake Ontario salmonid streams in Ontario and number of sites sampled for juvenile salmonids.

| Stream | Length of accessible salmonid habitat (km) | Number of sample sites |
|---|---|---|
| Spencer Creek | 9.7 | 1 |
| Grindstone Creek | 3.5 | 0 |
| Bronte Creek | 9.2 | 1 |
| Oakville Creek | 5.3 | 1 |
| Credit River | 57.1 | 6 |
| Duffins Creek | 31.7 | 3 |
| Lynde Creek | 19.3 | 2 |
| Oshawa Creek | 14.2 | 2 |
| Farwell Creek | 11.8 | 1 |
| Bowmanville Creek | 23.9 | 3 |
| Soper Creek | 10.3 | 1 |
| Wilmot Creek | 21.8 | 2 |
| Graham Creek | 17.3 | 2 |
| Newtonville Creek | 1.1 | 0 |
| Port Granby Creek | 1.8 | 0 |
| Port Britain Creek | 8.6 | 1 |
| Ganaraska River | 38.7 | 4 |
| Gage Creek | 9.9 | 1 |
| Cobourg Creek | 25.2 | 3 |
| Lucas Point Creek | 0.9 | 0 |
| Barnumhouse Creek | 5.3 | 1 |
| Shelter Valley Creek | 17.4 | 2 |
| Colborne Creek | 11.7 | 1 |
| Salem Creek | 1.9 | 0 |
| Butler Creek | 5.1 | 1 |
| Smithfield Creek | 3.9 | 1 |
| Waring Creek | 3.5 | 0 |
| Total | 369.9 | 40 |

Ontario.

We estimated wild juvenile migratory salmonids in Ontario streams as follows: 851,334 rainbow trout, 2468 coho salmon, and 238 chinook salmon. Most of the rainbow trout were young-of-the year (Fig. 10). Wild rainbow trout were found at almost all sites except four in the Credit River watershed. Of these four sites, stocked rainbow trout were found at two sites, and stocked Atlantic salmon were found at one site. The presence of fish stocked as fall fingerlings at two sites suggests that habitat was suitable during summer and winter but rainbow trout had not yet

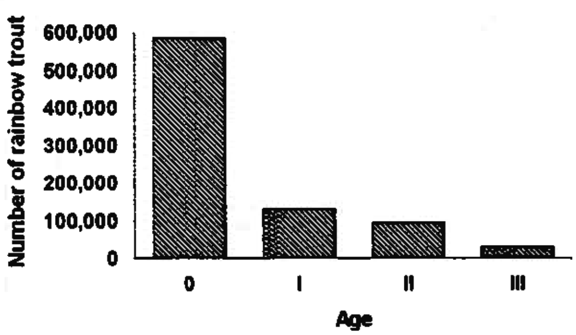


FIG. 10. Number of rainbow trout by age estimated in Lake Ontario streams in Ontario.

invaded the sites. Stocked rainbow trout were found at one other site on the Credit River, and a stocked Atlantic salmon was found in Sopers Creek.

Coho salmon were found in the Ganaraska River, Limestone Creek, Shelter Valley Creek, and Bowmanville Creek. No coho salmon were seen at either of two sites on Wilmot Creek, despite a GLSR smolt weir and more extensive electrofishing by GLSR that indicated substantial numbers of juvenile coho salmon. Coho salmon are habitat specialists, and apparently their distribution is more patchy than rainbow trout. Based on the intensive estimates from Wilmot Creek the rainbow trout estimates were in the expected range, but the coho estimates may be low. Nevertheless, the coho estimates on a basin wide basis are probably in the right order of magnitude relative to rainbow trout. These estimates of coho salmon cast some doubt on previously made natural reproduction estimates of coho in the angling fishery (Bowlby 1991). Wild coho salmon in Lake Ontario are likely less abundant than previously thought

One chinook salmon was observed. It was in Duffins Creek which was not stocked. Chinook salmon are thought to smolt in June or July, and so we expected to see a few more, especially at the beginning of the survey. To adequately assess chinook salmon we will have to survey earlier in the year.

## *Growth and Condition*

We monitor growth and condition of lake trout, rainbow trout and chinook salmon in an attempt to index the availability of their prey. Lake trout condition was monitored in the combined U.S and Canadian fall index gill net surveys (Schneider et al. 1994). To assess the condition of lake trout we use the weight of a typical 700 mm (27.5 in) fish, calculated from a length-weight regression. The condition of large fish decreased from the late 1970s to 1986. Since that time, however, condition has generally improved (Fig. 11). Condition declined significantly in 1993, but over the last eleven years was still only exceeded by values in 1992 and 1983.

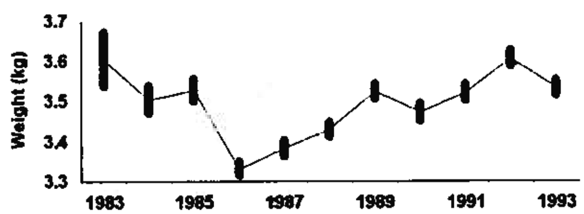


FIG. 11. Predicted weight (± 95% CI) of a 700mm (total length) lake trout during September in Lake Ontario.

Body condition of male and female rainbow trout was monitored in the spawning migration at the Ganaraska River fishway. Body condition was determined as the mean weight after adjusting for length using analysis of covariance as outlined by Dimond and Bowlby (1992). Since 1987 condition has increased significantly for both sexes of rainbow trout (Fig. 12), in a pattern remarkably similar to lake trout. In 1993 condition did not differ significantly from 1992 for males or females.

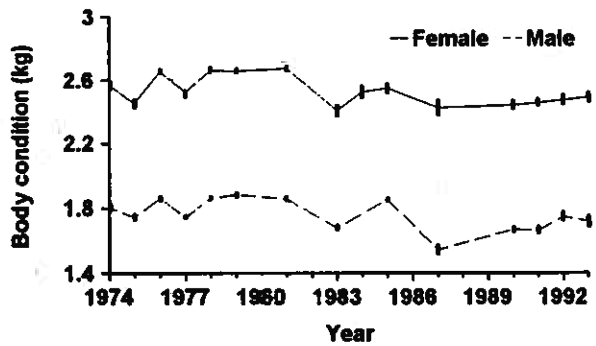


FIG. 12. Body condition (mean ± 2 SE) of rainbow trout during spring spawning run in the Ganaraska River. Body condition was determined as the mean weight after adjusting for differences in length.

Body condition of male and female chinook salmon was monitored in the spawning migration at the Credit River at Streetsville during the Ringwood Fish Culture Station egg collection. Body condition was determined as for rainbow trout. Condition was highest in the early 1980s and then declined to a relatively stable level from 1989 to present (Fig.13). Unfortunately, there were no samples taken from 1986 to 1988 when condition declined the most in lake trout and rainbow trout. In 1993 condition did not differ significantly from 1992 for males but it increased significantly for females.

Rainbow trout, lake trout, chinook salmon, and coho salmon (Bowlby et al. 1993) show remarkable similarity in the pattern of body condition through the 1980s to present. The drop in condition around 1986

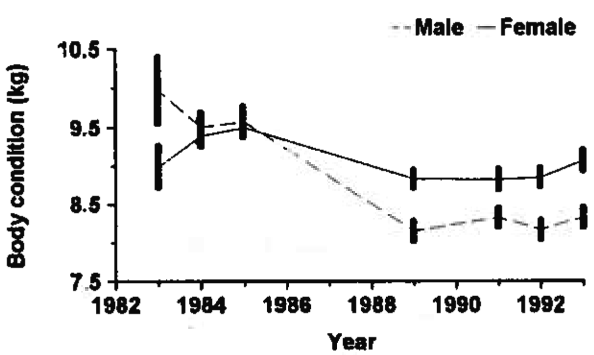


FIG 13. Body condition (mean ± 2 SE) of chinook salmon during fall spawning run in the Credit River. Body condition was determined as the mean weight after adjusting for differences in length.

was predictable based on the increased stocking through the early 1980s. However, the increase in condition in more recent years was unexpected. Stocking levelled off after 1983, but declines in lake productivity, and sustained predation lead to reductions in alewife and smelt. Accordingly, we had expected further declines in body condition after 1986. An explanation for increases in condition may involve recent declines in piscivore populations. The body condition of lake trout was negatively correlated with the population of chinook salmon over the period 1984 to 1992 ($r=0.74$, $p=0.02$). As the population of chinook salmon declined body condition increased in lake trout, rainbow trout and coho salmon. (For chinook salmon this relationship is less clear due to an absence of data for 1986 to 1988.) Also, Elrod et al. (1993) showed 50% decline in the survival of stocked spring yearling lake trout and 90% decline in survival of stocked fall fingerlings from 1980 to 1990. The increases in body condition in several salmonid species may have been related to declines in piscivore populations, particularly chinook salmon which dominates the piscivore community in numbers and impact on planktivorous fish.

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# 3

# Eastern Lake Ontario

Jim Hoyle
Mike Rawson

## *Overview*

The Lake Ontario Fisheries Unit uses annual summer index gillnetting and bottom trawling programs to detect long-term changes in the eastern Lake Ontario and Bay of Quinte fish communities (Fig. 1). By providing trend-through-time indices of species abundance, these programs have also routinely delivered timely, stock-specific information to fisheries managers. For the deep-waters of Lake Ontario's Outlet Basin and the Bay of Quinte, these programs have run for over 30 years in the case of gillnetting and for over 20 years in the case of trawling (Casselman and Scott 1992; Hurley 1992). More recently, gillnetting operations were begun in the nearshore waters of eastern Lake Ontario as far west as Brighton. The latter studies initially focused on yellow perch, an important commercial species, but expanded in 1986 to a wide range of depths, and thereby sampled a diverse assemblage of warm and cold-water species (Hoyle 1992).

In 1992, fish community studies on eastern lake Ontario underwent a major program overhaul to facilitate gear standardization, improved experimental design, elimination of sampling redundancies, and better program coordination, while preserving the continuity and integrity of the historic data series (Hoyle 1992; Casselman and Scott 1992). Also in 1992, multifilament gillnets were replaced with monofilament nets. Comparative netting studies have been completed but gear conversion factors have not been finalized. Hence, the trend-through-time gillnet results presented have not been adjusted to reflect this gear change and must be interpreted accordingly.

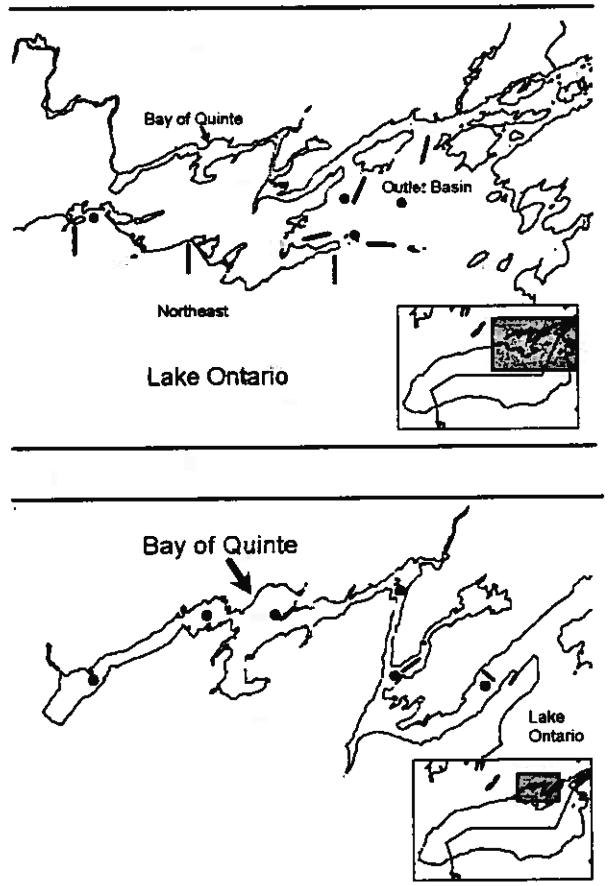


FIG. 1. Maps of Lake Ontario (upper panel) and Bay of Quinte (lower panel) showing fish community index gillnetting and trawling locations. Depth-stratified gillnetting locations are shown as lines while single-depth gillnetting and/or trawling sites are represented by circles.

For a summary of standardized gillnet/trawl catch-per-unit-effort (CUE) for the first two years of the new program (1992 and 1993), organized by geographic area (northeast, outlet basin, and the Bay of Quinte) see Appendix C. Here we report trend-through-time abundance indices for several fish species of management interest and which together account for over 95% of the catch in our fish community studies.

In addition to determination of relative fish abundance for the many species captured in our fish

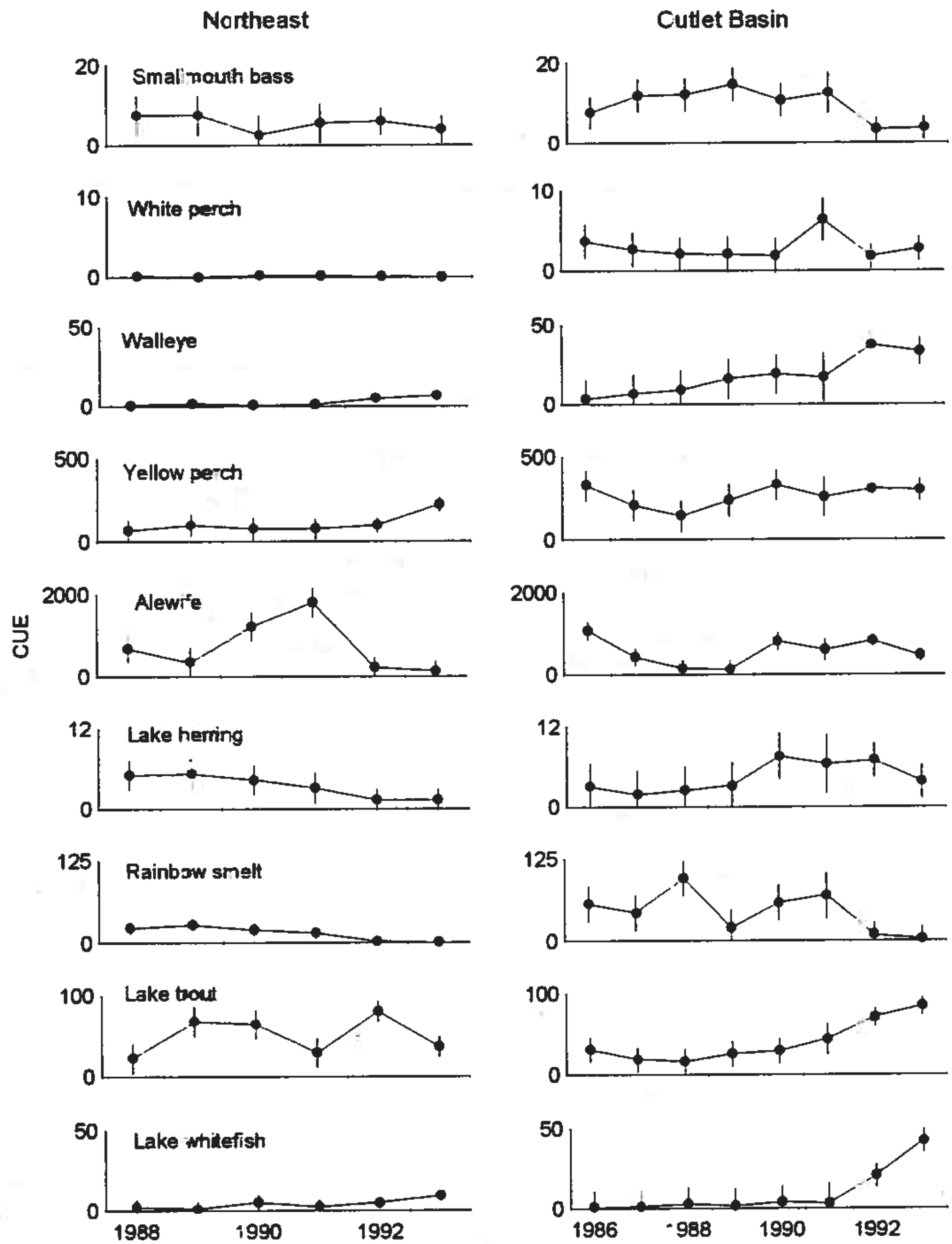


FIG. 2. Catch-per-standard-gillnet lift (CUE) for nine fish species from northeastern and Outlet Basin, Lake Ontario. Each of the two major geographic regions is represented by three depth-stratified gillnetting locations. The CUE was calculated as the sum of the catch of eight gillnet panels (1.5 to 5 in) each adjusted to represent 100 m of net. Multifilament gillnets were replaced with monofilament gillnets starting in 1992. Error bars represent two standard errors

community index gillnetting and trawling programs described above, we have also estimated absolute abundance for walleye. Initially we conducted a walleye mark/recapture program. The mark/recapture program provided direct walleye population estimates to ground-truth the index netting results. We also employed a young-of-the-year walleye index of abundance, based on Bay of Quinte bottom trawling, to project walleye population estimates into the future (Mathers 1993). Recently, we have supplemented this approach to walleye management with a catch-at-age model (CAGEAN, Deriso et al. 1985) which calculates walleye population estimates using Bay of Quinte angler harvest data. Although the CAGEAN model has been calibrated to the walleye mark/recapture results, CAGEAN has the advantage that it can be updated on an annual basis with only angler harvest data. Here we report CAGEAN estimates of walleye population size from 1979 to 1993, and a projected estimate for 1994 based on our young-of-the-year walleye index of abundance in Bay of Quinte bottom trawling.

## Trend-through-time Analysis

Trend-through-time abundance indices for several fish species of management interest are presented below.

### Northeastern Lake Ontario

Catches of smallmouth bass, white perch, walleye, yellow perch, alewife, lake herring, rainbow smelt, lake trout, and lake whitefish at three depth-stratified gillnetting locations in northeastern Lake Ontario (Brighton, Wellington, Rocky Point - 1988 to 1993) are summarized in Fig. 2. This graphical presentation is organized by species-specific water temperature preferences; warm-water species at the top, cold-water species at the bottom and species caught at a wide variety of water temperatures (yellow perch and alewife) in the middle.

Cold-water species are much more common than warm-water species in this area of Lake Ontario.

Walleye and lake whitefish catches increased over the time period of netting operations. Yellow perch were stable from 1988 to 1992 but increased in 1993. Smallmouth bass, lake herring and rainbow smelt catches declined. The switch to monofilament gillnets in 1992 meant that rainbow smelt were no longer vulnerable to our index gillnets. White perch are scarce in this area of Lake Ontario. Alewife and lake trout catches were highly variable, although alewife were of very low abundance in 1992 and 1993.

A longer-term index of yellow perch abundance at the single depth site, Middle Ground, is presented in Fig. 3. When viewed over the longer term, yellow perch populations in this area, especially for large, marketable-sized fish (>7.5 in), are very low. Factors influencing yellow perch abundance in this area were reviewed by Hoyle (1993).

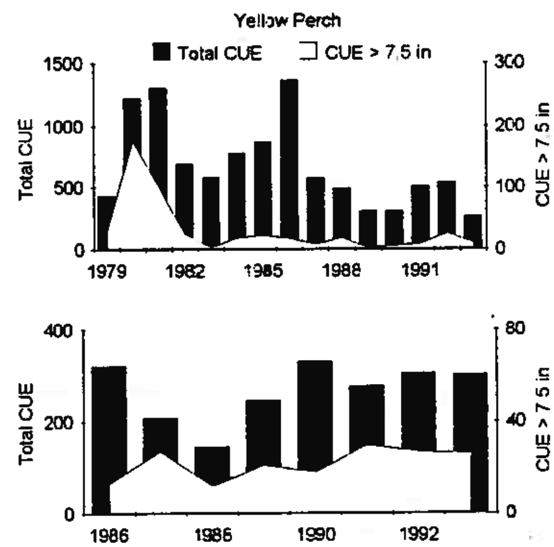


FIG. 3. Catch-per-standard-gillnet lift (CUE) for yellow perch from the Middle Ground index gillnetting location in northeastern Lake Ontario (top panel), and three depth-stratified gillnetting locations in the Outlet Basin (lower panel). The CUE was calculated as the sum of the catch of four gillnet panels (1.5 to 3 in) each adjusted to represent 100 m of net. Multifilament gillnets were replaced with monofilament gillnets starting in 1992. Both total CUE (solid bars) and CUE for those yellow perch greater than 7.5 in total length, representing commercially marketable-sized fish (open area), are shown.

### Outlet Basin Lake Ontario

Catches of smallmouth bass, white perch, walleye, yellow perch, alewife, lake herring, rainbow smelt, lake trout, and lake whitefish at three depth-stratified gillnetting locations in the Outlet Basin of Lake Ontario (Flatt Point, Grape Island, Melville Shoal - 1986 to 1993) are also summarized Fig. 2. Warm-water species are more common in the Outlet Basin than in northeastern Lake Ontario.

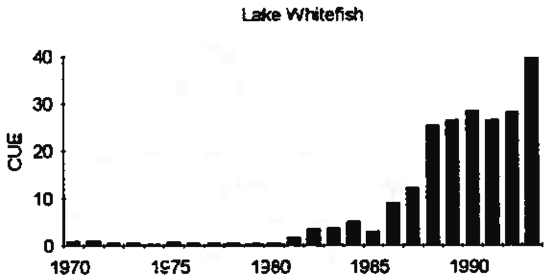


FIG. 4. Catch-per-standard-gillnet lift (CUE) for lake whitefish from two deep-water gillnetting locations in the Outlet Basin, Lake Ontario. The CUE was calculated as the sum of the catch of eight gillnet panels (1.5 to 5 in) each of which were 50 ft in length. Multifilament gillnets were replaced with monofilament gillnets starting in 1992.

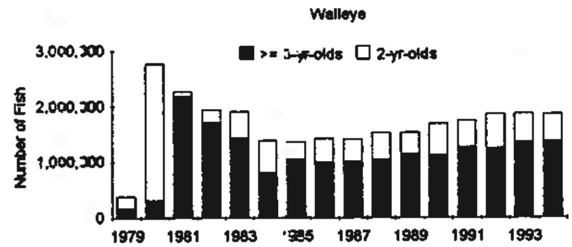


FIG. 6. Bay of Quinte walleye population estimates for 2-yr-olds, representing fish about to recruit to the angling fishery, and for 3-yr-old and older fish, representing the fishable population.

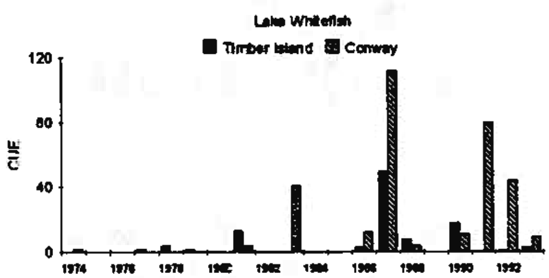


FIG. 5. Year-class strength of Lake Ontario and Bay of Quinte lake whitefish stocks as represented by young-of-the-year (YOY) catch in 12 min bottom trawls, at Timber Island and Conway, respectively, 1974 to 1993. No trawling was conducted in 1989.

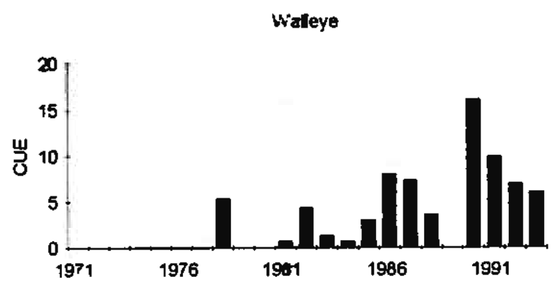


FIG. 7. Year-class strength of Bay of Quinte walleye as represented by young-of-the-year (YOY) catch in 6 min bottom trawls, at six sites 1971 to 1993. No trawling was conducted in 1989.

Walleye, lake trout and lake whitefish have increased in abundance since 1986. Yellow perch catches, including catches of marketable-sized fish (> 7.5 in, Fig. 3) remained stable in the last several years. Smallmouth catches were down the last two years. White perch showed an unusual increase in abundance in 1991 that was attributed to a migration from the Bay of Quinte where catches were low that year (Hoyle 1992). Alewife and smelt catches were highly variable. Lake herring increased in abundance through 1991 but then declined the last two years.

A longer term index of lake whitefish abundance at only the deep-water gillnetting sites in the Outlet Basin is presented in Fig. 4. Lake whitefish abundance has increased tremendously since the early 1980s. These high population levels should be maintained thanks to continued good, although highly variable, young-of-the-year recruitment, as measured by bottom trawls (Fig. 5).

### Bay of Quinte

Estimates of walleye population size from 1979, including a projected estimate for 1994 are presented in Fig. 6. Population size increased sharply in 1980 with recruitment of the 1978 year-class. Abundance has remained very stable, with a slightly increasing trend, at just over 1 million 3-yr-old and older fish from 1985 to present. Recruitment too has been relatively stable at about 0.5 million 2-yr-old fish annually. Using young-of-the-year walleye abundance in Bay of Quinte bottom trawls (Fig. 7), we project that walleye population abundance in 1994 will be 1.4 million 3-yr-old and older fish, with an expected recruitment of 0.5 million 2-yr-old fish. Total annual mortality for Bay of Quinte walleye averaged 32% over the last ten years and included annual exploitation rates of about 10% and 1% for the open-water and ice-fisheries respectively.

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# 4

# Commercial Fishery

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Phil Smith
Sandra Orsatti

## Overview

The commercial fish industry on the Canadian waters of Lake Ontario harvests about $1,000,000 worth of fish annually, small relative to the other Great Lakes, but locally significant since it is confined mainly to the northeast corner of the lake. Records of commercial fish harvest on Lake Ontario date back to 1867 (Baldwin et. al 1979). The provincial commercial fisheries modernization program was introduced in 1984; the principle feature of this program, as it affected the Lake Ontario commercial fishery, was individual species harvest quotas.

This chapter on Lake Ontario's commercial fishery deals with three areas: i) an overview of our approach to commercial fish management and licensing; ii) a species-specific summary of the 1993 commercial harvest by quota zone; and iii) a more detailed summary of lake whitefish, yellow perch, and walleye harvest in 1993, including biological characteristics.

Our approach to commercial fish management and licensing during the last decade on Lake Ontario, including quota setting, fishing seasons, gear restrictions, size limits, and harvest reporting, has not previously been formally documented. Consequently, this area of the report will receive more attention than is planned in future annual reports, which will focus on regulation changes in the commercial fishery pertinent to that year.

Recent annual reports have reported a table summarizing commercial harvest of each species for the whole lake. This year we report harvest by quota zone to give a geographic perspective to this information.

Collection and reporting of biological characteristics of the commercial harvest has been sporadic. Our current objective in this area is to obtain and report age distribution of the harvest for the major commercial species, and in the case of lake whitefish, by stock, on an annual basis. Here we present size and age distributions where available for lake whitefish, yellow perch, and walleye.

## Management and Licensing

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

### Quota Management

Decisions on commercial allocation for each species are made on a 'quota zone' basis (Fig. 1). Fish species for which direct harvest controls are deemed necessary are placed under quota management (Table 1). These species include 'premium' species (e.g. yellow perch, eels, crappies), species with large allocations to other users (e.g. walleye), and species at low levels of abundance or requiring rehabilitation (e.g. lake herring). In 1993, bullhead and sunfish were deleted from their former designation as quota species for Lake Ontario, except for the Prince Edward County lakes and embayments: East Lake, West Lake, Consecon Lake, Weller's Bay, North Bay and Pleasant Bay).

A 'Quota Transfer Form' was implemented in 1993 to facilitate transfer of quota between commercial license holders. Quota transfer can be permanent or within-year only (i.e. reverts back to original license holder in the following calendar year). Quota transfers are generally approved only within a quota zone and between similar types of fishing gear.

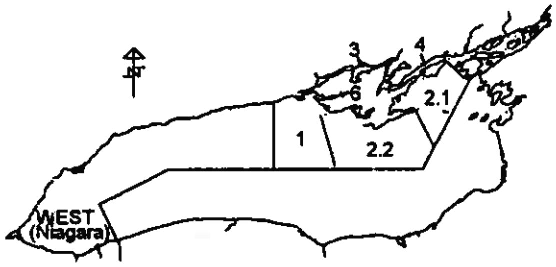


FIG. 1. Commercial fish harvest quota zones on the Canadian waters of Lake Ontario.

### Fishing Seasons

Season restrictions on the commercial fishery are applied primarily on gear rather than on fish species. In 1993, only walleye had designated closed seasons (for both gillnet and impoundment gear fisheries).

Gillnets

For gillnet licences, fishing seasons are generally established to minimize incidental catch of non-target species, game fish, and immature walleye. Prohibitions on gillnetting related to incidental catch are based on reports from commercial operators, our assessment results, and negotiation with the industry. Seasonal restrictions on gillnetting are established according to mesh size (Table 2).

During 1993, incidental harvest of walleye from gillnets was permitted only during the fall and winter whitefish season in the open waters of eastern Lake Ontario, in Quota Zones 1, 2 and 4.

Large mesh carp net (min 8 in) is generally permitted year-round in the open waters of Lake Ontario, with a summer prohibition in Prince Edward County lakes and embayments, and the Bay of Quinte. Season restrictions on carp netting relate to high summer water temperatures and potential gear conflicts with other resource users.

In response to frequent industry requests for expanded gillnetting seasons, some 'test fishing' (usually involving OMNR observers) has been conducted by license holders as suggested by the commercial fish industry. For example, in 1993, in the eastern portion of Quota Zone 2, an industry representative experimented with daylight only sets for yellow perch during a portion of the closed season (last two weeks of June). As a result of previous test fishing, several licence holders have been licensed for daylight sets only, during the last two weeks of June, in the western portion (e.g. west of Salmon Point) of Quota Zone 2.

Where unusual weather conditions result in the delay or advance of 'normal seasons' and associated fish movement patterns, some within-year adjustments to fishing seasons have been considered at the request of the industry. In 1993, the closing date for small-mesh gillnet in Quota Zone 4 was extended from May 6 to May 20 for those license holders requesting an extension.

Impounding Gear

There are no season restrictions on the trapnet season for the open waters of Lake Ontario, although the harvest of walleye from trapnets in 1993 was limited to May, June and July (Table 3). This season ensures that all walleye harvested are in a post-spawning condition (primarily Bay of Quinte fish returning to Lake Ontario), and minimizes enforcement problems related to illegal walleye taken from other gear in other seasons.

Hooklines and Seines

There are no season restrictions on hooklines for eel, brown bullhead, channel catfish and freshwater drum. While a few licences include authorization to use a 100 m seine net (usually for eels or carp), seines are used by very few fishermen and there are no season restrictions on their use.

### Gear Restrictions

Generally, no additional gear is being licensed on Lake Ontario, unless it is part of a larger restructuring (e.g. conversion of gillnet to trapnets) of the licence. Where a license holder wishes to try new or experimental gear, the new gear generally replaces currently licensed gear. For example, in 1993, a fisherman test fishing with electrofishing gear under a temporary licence, surrendered a total of 900 hooks from licensed hooklines during the experimental fishing period.

Gillnets

Each gillnet licence carries a maximum length (m) which can be fished. Additional gillnet licences or gillnet length will not be approved. This is consistent

TABLE 1. Commercial harvest quotas (lb) for the Canadian waters of Lake Ontario, 1993. For Quota Zone 1, eel and black crappie include quota from Consecon Lake, Quota Zone 5. See Fig. 1 for map of quota zones.

| | Quota Zone | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | West | Total |
| Lake whitefish | 31,500 | 320,300 | 85,280 | 74,900 | 800 | 512,780 |
| Lake herring | 9,660 | 10,900 | 4,300 | 3,500 | 0 | 28,360 |
| Eel | 45,720 | 271,190 | 77,910 | 44,250 | 4,000 | 443,070 |
| Black crappie | 4,140 | 15,810 | 10,510 | 800 | 2,400 | 33,660 |
| Yellow perch | 49,500 | 171,740 | 110,100 | 72,840 | 11,500 | 415,680 |
| Walleye | 5,400 | 37,200 | 0 | 4,700 | 0 | 47,300 |

TABLE 2. Commercial harvest fishing seasons for gillnet licences on the Canadian waters of Lake Ontario, 1993.

| Mesh Size mm (in) Minimum | Maximum | Time period | Fish species |
|---|---|---|---|
| *Quota Zone 1:* | | | |
| 57 (2 1/4) | 66 (2 5/8) | Aug 1 to Aug 31 | Any species for which the license is valid other than lake whitefish, lake herring, walleye and carp. |
| 76 (3) | 83 (3 1/4) | Dec 1 to Dec 22 | Any species for which the license is valid other than walleye. |
| 114 (4 1/2) | 114 (4 1/2) | Nov 1 to Nov 30 | Any species for which the license is valid |
| 203 (8) | unlimited | Jan 1 to Dec 31 except Weller's Bay | Carp |
| *Quota Zone 2:* | | | |
| 57 (2 1/4) | 83 (3 1/4) | Jan 1 to Apr 30 and Jul 1 to Dec 31 | Any species for which the license is valid other than lake whitefish, walleye and carp. |
| 114 (4 1/2) | 127 (5) | Nov 1 to Dec 10 | Any species for which the license is valid other than lake whitefish, walleye and carp. |
| 203 (8) | unlimited | Jan 1 to Dec 31 except West Lake | Carp |
| *Quota Zone 4:* | | | |
| 57 (2 1/4) | 66 (2 5/8) | Jan 6 to May 6 | Any species for which the license is valid other than lake whitefish, lake herring, walleye and carp (season extended to May 20 for 1993 only). |
| 76 (3) | 83 (3 1/4) | Jan 1to Mar 20 and Dec 1 to Dec 31 | Any species for which the license is valid. |
| | | Mar 21 to Apr 30 | Any species for which the license is valid other than walleye. |
| 114 (4 1/2) | 114 (4 1/2) | Jan 1 to Mar 20 and Dec 1 to Dec 31 | Any species for which the license is valid. |
| | | Sep 10 to Sep 20 | Any species for which the license is valid other than walleye. |
| 203 (8) | unlimited | Jan 1 to Dec 31 | Carp |
| *Western Lake Ontario:* | | | |
| 66 (2 5/8) | 83 (3 1/4) | Jan 1 to Sep 30 and Nov 1 to Dec 31 | Any species for which the license is valid. |

with the management direction established in the two gillnet buy-out programs implemented in eastern Lake Ontario in the 1980s.

In 1990 the minimum mesh size for small mesh gillnet in eastern Lake Ontario was changed from 2 5/8 to 2 ¼ in on the condition that the industry maintains a high compliance with the 7 ½ in min size for yellow perch.

The designated mesh size for the fall/winter whitefish fishery is 4 ½ in. Beginning in the fall of 1992, for Quota Zone 2 only, at the request of the industry, the mesh size was changed to 4 ½ to 5 in, to allow the industry to harvest a higher proportion of larger, older whitefish, for which there is a stronger market.

Impounding Gear

The trapnet and hoopnet licences in Quota Zones 2, 3 and 4 are generally assigned area-specific fishing grounds, to encourage local stewardship by license holders, and to minimize competition and conflict over prime netting sites. In Quota Zone 1 fishing grounds are licensed by general location only; for example, several hoopnet fishermen share Presqu'ile and Weller's Bay fishing grounds.

In the impounding gear fishery, it is sometimes to the licensees' advantage to fish larger trapnets rather than hoopnets (e.g. during fall whitefish runs in Bay of Quinte). In 1993 exchange of hoopnets for trapnets on a licence was permitted at a ratio of 3:1. This exchange could be implemented seasonally, as a condition of the licence.

Other Gear

For many years, only eels could be legally harvested from hooklines. At the industry's suggestion, brown bullhead, channel catfish, and freshwater drum were added to hookline licences as 'unlimited' species in 1993.

One operator has been authorized to harvest eels with electrofishing gear for several years. Although the industry has expressed opposition to this fishing method in the past, the local association did support an additional small-scale electrofishing experiment by one licence holder in Quota Zone 2 in 1993.

### *Size Limits*

Size limits are placed on some fish species for reasons relating to protection of fish stocks, contaminant levels or allocation among user groups. All size limit restrictions on licences are expressed as 'total length'.

The min size limit of 7 ½ in for yellow perch is directed at stock conservation by ensuring that most perch have the opportunity to spawn before becoming vulnerable to harvest.

The 1993 max size limits of 18 in for channel catfish and 24 in for walleye were based on recommendations from Department of Fisheries and Oceans Fish Inspection staff relating to elevated contaminant levels. The 1993 min size for walleye was 16 inches in the trapnet fishery and 17 inches in the incidental gillnet fishery. The trapnet limit protects the smaller walleye comprising the majority of the sport fish harvest. Incidentally caught walleye taken in 4 1/2 in gillnet set for whitefish are rarely smaller than 17 in; this min size limit for gillnetted walleye discourages the illegal targeting of walleye in mesh under 4 1/2 in.

### *Commercial Harvest Reporting*

All commercial license holders on Lake Ontario are required to report their commercial harvest on 'CF1' forms. For the 1993 walleye trapnet fishery only (May 1 to July 31), licensees were also required to document harvests on a 'daily harvest form' to facilitate enforcement efforts.

## *Harvest Summary*

The 1993 commercial fishing season was a difficult one for the industry. The total commercial harvest of all species exceeded 1.1 million lb (Table 4), similar to the 1992 harvest (OMNR 1993). However, the total landed value of the harvest declined by 28% to $746,829.28, the lowest in many years.

Markets were generally weaker and prices lower for most species in 1993. The most dramatic decline in prices occurred in the premium species including eel and yellow perch. The low prices combined with significant declines in harvest, accounted for a drop in value of over $300,000 for these two species.

For the first time in several decades on Lake Ontario, lake whitefish became the most important commercial species, both in terms of harvest weight

TABLE 3. Commercial harvest fishing seasons for impoundment gear licences on the Canadian waters of Lake Ontario, 1993. These regulations apply for all species for which the licence is valid except for walleye which can only be harvested in May, June, and July in Quota Zones 1 and 2 (open waters of Lake Ontario only).

| Location | Time period |
|---|---|
| *Quota Zone 1:* | |
| Presqu'ile Bay (hoopnets) | Closed 2nd Sat in Jun to Sep 15 |
| Weller's Bay (trapnets and hoopnets) | |
| Pleasant/North Bay Consecon Lake (hoopnets) | Closed Fri preceding Victoria Day in May to Sep 20 |
| *Quota Zone 2:* | |
| Open-water Lake Ontario | No restrictions |
| South Bay | Closed 2nd Sat in Jun to Sep 15 |
| East and West Lakes | Closed Fri preceding Victoria Day in May to Sep 20 |
| *Quota Zone 3:* | |
| Upstream from Glenora Ferry | Closed Jun 1 to first Sun in Sep |
| *Quota Zone 4:* | |
| Trapnets | No restrictions except must be set in 2 m water depth from Jun 1 to Sep 5 |
| Hoopnets | Closed 2nd Sat in May to Sep 5 |
| *Western Lake Ontario.* | |
| | Closed Jun 1 to Sep 4 |

and value. This was due in part to an increased harvest of over 25% since price remained largely unchanged from 1992.

In addition to declines in eel and yellow perch harvest and value, possibly associated with declining stocks, seasonal incidental catch problems and limitations imposed by high contaminant levels for some fish species contributed to the hardship experienced by the Lake Ontario commercial fish industry in 1993.

## Biological Characteristics of the Harvest

The 1993 commercial harvest of lake whitefish, yellow perch, and walleye is shown, by quota zone (Quota Zone 1 to 4) and gear type (trapnet/hoopnets and gillnets), in Table 5. The table highlights (harvest values underlined) those areas where we focused our collections of biological attribute data. The historical harvest trends of the three species are presented in Fig. 2.

### 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 (Fig. 2). Lake whitefish have resurged in recent years thanks to good recruitment of both major spawning stocks (see Chapter 3).

The 1993 lake whitefish harvest was 390,000 lb, representing 76% of the 512,000 lb quota. Most of the harvest occurs at spawning time. Thus lake whitefish harvest from Quota Zones 1 and 2 represents the Lake Ontario spawning stock proper while Quota Zones 3 and 4 harvest mainly Bay of Quinte spawning stock.

The large gillnet fishery of Quota Zone 2 (nearly 50% of the total harvest) harvests a narrower size range due to a high degree of gear selectivity

TABLE 4. Commercial fish harvest (lb) and value ($) for the Canadian waters of Lake Ontario, 1993. Note the highlighted values which indicate species and quota zones where collection of biological data occurred.

| Species | Harvest (lb) by Quota Zone | | | | | | | Price | Value |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 6 | West | Total | per lb | |
| Bowfin | 5,205 | 4,400 | 2,220 | 132 | 248 | 0 | 12,205 | 0.21 | $2,563.05 |
| Brown bullhead | 45,102 | 27,127 | 92,163 | 9,352 | 2,366 | 298 | 177,408 | 0.35 | $62,092.80 |
| Burbot | 26 | 0 | 0 | 0 | 0 | 0 | 26 | 0.19 | $4.94 |
| Carp | 4,286 | 2,193 | 18,733 | 591 | 0 | 5,292 | 31,095 | 0.30 | $9,328.50 |
| Channel catfish | 56 | 354 | 3,422 | 234 | 0 | 67 | 4,133 | 0.39 | $1,611.87 |
| Black crappie | 796 | 10,877 | 5,826 | 27 | 0 | 1 | 17,527 | 1.40 | $24,537.80 |
| Eel | 17,045 | 133,137 | 27,569 | 17,129 | 59 | 112 | 195,051 | 0.99 | $193,100.49 |
| Freshwater drum | 820 | 2,848 | 8,176 | 3,326 | 0 | 52 | 15,222 | 0.12 | $1,826.64 |
| Lake herring | 4,666 | 3,896 | 1,510 | 2,127 | 0 | 0 | 12,199 | 0.51 | $6,221.49 |
| **Lake whitefish** | 12,829 | **222,044** | **66,137** | **90,268** | 0 | 5 | 391,283 | 0.67 | $262,159.61 |
| Rock bass | 3,864 | 7,260 | 2,019 | 18 | 216 | 445 | 13,822 | 0.33 | $4,561.26 |
| Suckers sp | 1,044 | 18 | 5,681 | 1,231 | 0 | 185 | 8,159 | 0.11 | $897.49 |
| Sunfish sp | 12,433 | 14,943 | 9,164 | 223 | 4,343 | 0 | 41,106 | 0.36 | $14,798.16 |
| White bass | 605 | 39 | 0 | 1,953 | 0 | 96 | 2,693 | 0.59 | $1,588.87 |
| White perch | 5,335 | 6,521 | 9,277 | 7,830 | 0 | 10,228 | 39,191 | 0.43 | $16,852.13 |
| **Yellow perch** | 7,443 | **41,190** | 26,256 | **31,690** | 0 | 1,515 | 108,094 | 1.01 | $109,174.94 |
| **Walleye** | **4,108** | **29,825** | 0 | 1,286 | 0 | 0 | 35,219 | 1.01 | $35,571.19 |
| Industrial | 0 | 0 | 15 | 0 | 0 | 0 | 15 | 0.07 | $1.05 |
| Totals: | | | | | | | 1,104,448 | | $746,892.28 |

TABLE 5. Commercial harvest (lb) of lake whitefish, yellow perch, and walleye taken from the Canadian waters of Lake Ontario, 1993. Note the highlighted values which indicate species and quota zones where collection of biological data occurred.

| Quota Zone | Gear | % Harvest by species | | |
|---|---|---|---|---|
| | | Lake whitefish | Yellow perch | Walleye |
| 1 | Trapnet/Hoopnet | 1 | 6 | **10** |
| | Gillnet | 3 | 1 | 1 |
| 2 | Trapnet/Hoopnet | 9 | 6 | **72** |
| | Gillnet | **48** | **31** | 13 |
| 3 | Trapnet/Hoopnet | **17** | 25 | 0 |
| 4 | Trapnet/Hoopnet | 0 | 2 | 0 |
| | Gillnet | **23** | **28** | 4 |
| | Harvest (lb) | 391,278 | 106,579 | 35,219 |
| | Quota (lb) | 511,980 | 404,180 | 47,300 |
| | % | 76 | 26 | 74 |

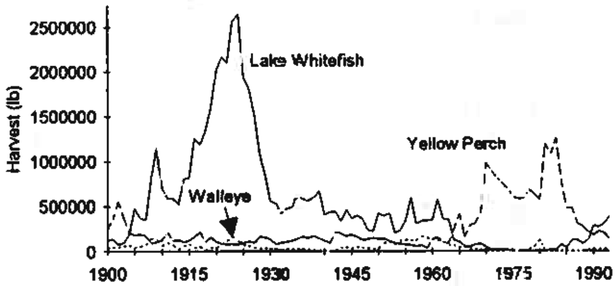


FIG. 2. Historic trends in the commercial harvest of lake whitefish, yellow perch, and walleye from the Canadian waters of Lake Ontario from 1900 to 1993.

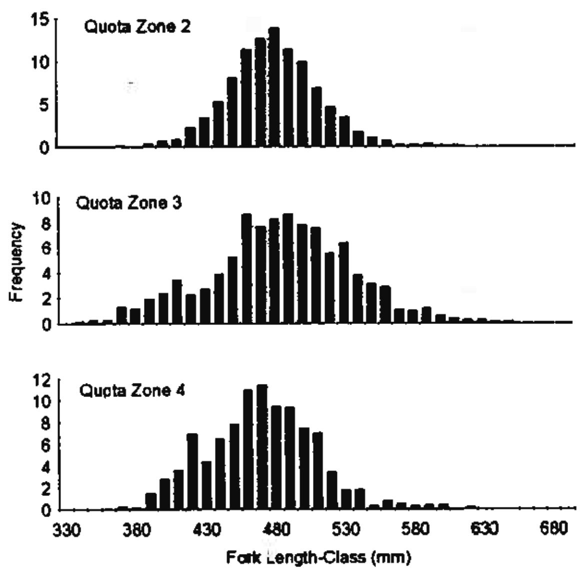


FIG. 3. Size distribution of lake whitefish harvested by the 1993 commercial fishery from Quota Zones 2, 3, and 4.

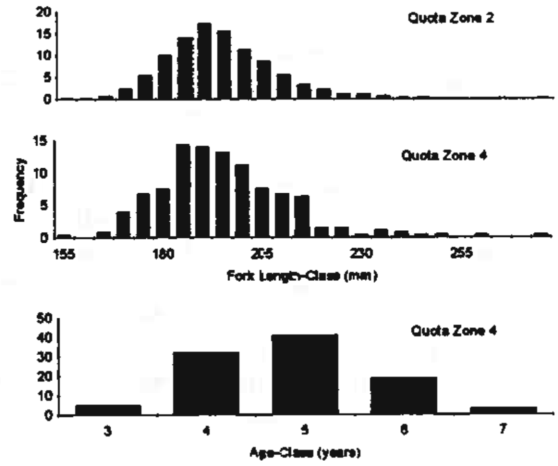


FIG. 4. Size distribution of yellow perch harvested by the 1993 commercial fishery from Quota Zones 2 and 4, and the age distribution from Quota Zone 4 only.

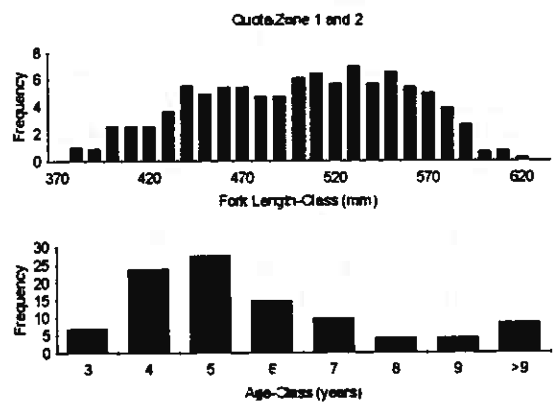


FIG. 5. Size and age distributions of walleye harvested by the 1993 commercial fishery from Quota Zones 1 and 2.

compared to the trapnet/hoopnet fishery of Quota Zone 3. The post-spawning winter gillnet fishery in Quota Zone 4 harvests smaller fish than the other quota zones (Fig. 3). Although the latter fishery is likely comprised mainly of Bay of Quinte stock, we plan to verify the stock composition using stock discrimination techniques (Brown and Casselman 1992).

### Yellow Perch

Historical trends in yellow perch commercial harvest were recently described by Hoyle (1993). Briefly, yellow perch commercial harvest fluctuated around 125,000 lb from the early 1900s to the mid-

1960s when a tremendous increase in harvest occurred, and which was sustained until the early 1980s. Yellow perch harvest declined through the mid-1980s and now rests at less than 110,000 lb as of 1993, and represent only 26% of available quota for this species.

Yellow perch harvest is especially low in Quota Zone 1 relative to quota. Although yellow perch harvest was highest in Quota Zone 2, the highest harvest relative to quota occurs in Quota Zone 4 (44%). The size structures of the yellow perch harvest are similar for Quota Zones 2 and 4 with most (92%) of the yellow perch commercial harvest in Quota Zone 4 being comprised of 4, 5, and 6-yr-old fish (Fig 4).

### Walleye

Like lake whitefish, walleye commercial harvest declined during the 1960s. The annual harvest remained very low until their resurgence beginning in 1978 (Fig. 2). Tight commercial harvest controls were introduced in 1981, with a complete ban for the years 1984 to 1988 inclusive. A small walleye commercial harvest was re-instituted in 1989.

In 1993, the harvest was 35,000 lb, 74% of the available quota, and was taken mainly by the trapnet/hoopnet fishery in Quota Zones 1 and 2 with a small incidental catch allowance taken during the various lake whitefish gillnet fisheries (Table 5). As in 1992 (Mathers 1993), nearly 70% of the harvest was comprised of 4, 5, and 6-yr-old fish. About 5% of the trapnet/hoopnet harvest was comprised of fish outside the 'slot size' limit of 16 to 24 in (Fig. 5).

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# 5

# Recreational Fisheries

Paul J. Savoie
Alastair Mathers

## Overview

Surveys of recreational fisheries are used to monitor trends in fishing effort and catch. They also provide demographic, socioeconomic, and behavioral information. Fisheries managers use recreational fishing surveys to describe fish distribution and abundance and species mix, and thereby monitor both stocked fish returns and levels of natural fish production.

There are two major recreational fisheries in Canadian waters of Lake Ontario: the Bay of Quinte walleye fishery, and the lake and tributary salmonine (salmon and trout) fishery.

Angler surveys have been conducted on the Bay of Quinte periodically since 1957 (Fig. 1). The ice fishery in the Bay of Quinte has been monitored biennially from 1982 to 1988 and annually since 1988. The open-water fishery has been monitored annually since 1979. Traditionally, walleye make 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 has developed.

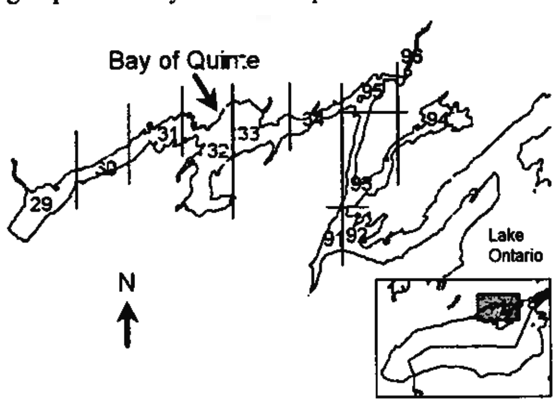


FIG. 1. Geographic areas covered by the Bay of Quinte angler surveys in 1993 (see Table 1).

Monitoring of the lake salmonine fishery is centred around western Lake Ontario, launch daily, boat angler surveys (Fig. 2). These surveys began in 1977, and are restricted to anglers using boat launch ramps. Early surveys were confined to specific fishing derbies and regions. Annual surveys (April to September, inclusive) were first implemented in 1987. This launch daily boat fishery represents approximately 25% of the salmonine angling effort in Canadian waters of Lake Ontario and the lower reaches of its tributaries. Other components of Lake Ontario's shore and marina based fisheries, including the outlet basin, are scheduled to be sampled on a five year rotation and are not reported.

A summary of 1993 survey results for the Bay of Quinte walleye and the western Lake Ontario salmonine boat fisheries is presented here.

## Bay of Quinte Walleye

Survey designs are framed around the walleye angling season. Angling effort is measured using aerial counts during the ice fishing survey, and both aerial and on-water counts, during the open-water season. On-ice and on-water interviews with anglers provide information on catch rates and biological characteristics of the catch. In recent years, less intensive surveys have been used to assess the open-water and ice fisheries. In 1993 however, complete surveys were conducted for both fisheries. Detailed survey protocols were reported by Mathers (1993a, 1993b).

### Ice Fishery

Ice angling effort was estimated to be 321,510 rod-hours representing 48,325 angling trips (Table 1). This level of effort was the second highest observed, and the trend over the past decade suggests that the ice fishery continues to grow (Fig. 3). The average angling effort during the previous five years was 243,210 rod-hours.

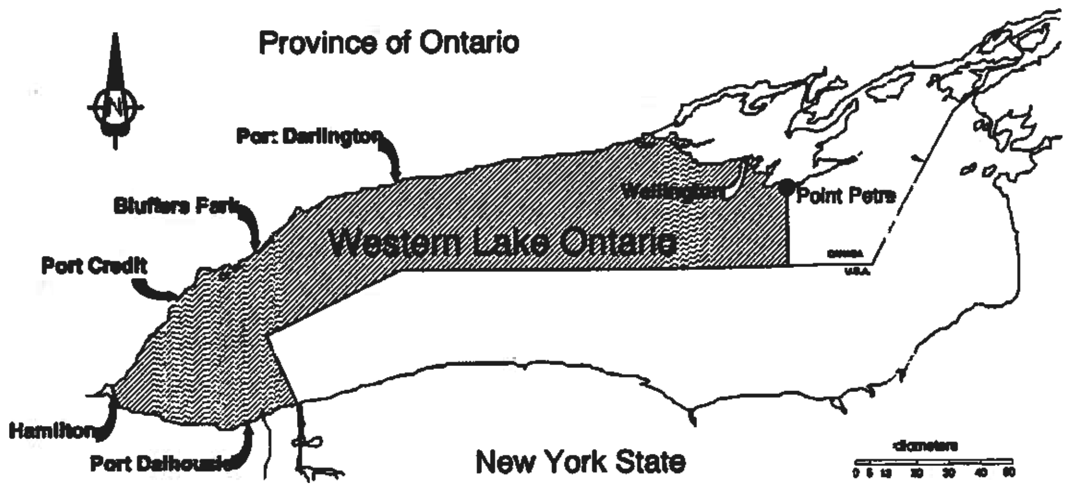


FIG. 2. Geographic area covered by the 1993 western Lake Ontario launch daily boat angler survey.

TABLE 1. The geographic distribution of the estimated walleye catch, harvest and effort, for the 1993 recreational ice fishery on the Bay of Quinte. See Fig. 1 for map of survey areas.

| Area | Catch (# fish) | Harvest (# fish) | Effort (rod-hours) |
|---|---|---|---|
| Trenton (29) | 3,278 | 1,041 | 61,348 |
| Makatewis Is. (30) | 2,432 | 1,648 | 38,488 |
| Belleville (31) | 542 | 177 | 42,769 |
| Pt. Anne (32) | 4,009 | 3,572 | 29,286 |
| Trident Pt. (33) | 3,189 | 3,144 | 28,997 |
| Telegraph Nr. (34) | 1,584 | 1,389 | 10,456 |
| Deseronto (95) | 1,138 | 596 | 31,298 |
| Long Reach (93) | 4,222 | 2,537 | 68,641 |
| Hay Bay (94) | 234 | 20 | 2,982 |
| Bygotts Bay (92) | 672 | 672 | 7,064 |
| Picton Bay (91) | 28 | 20 | 182 |
| Total | 21,328 | 14,816 | 321,511 |

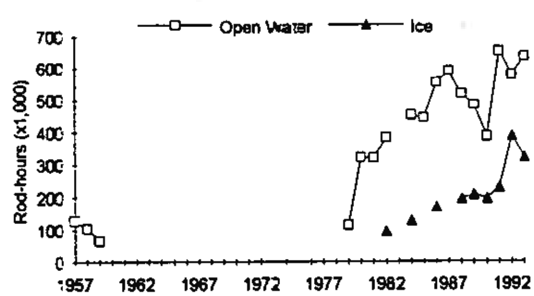


FIG. 3. Angling effort during the Bay of Quinte ice and open-water recreational fisheries from 1957 to 1993.

An estimated 21,326 walleye were caught of which 14,816 were harvested (Table 1). This level of harvest is lower than the previous 5-year average of 25,504 fish, however no clear trend in harvest is evident (Fig. 4). The harvest per unit effort of 0.046 walleye per rod-hour, is lower than the average of 0.095 fish per rod-hour for the previous 5-years (Fig. 5). In 1993, the average walleye harvested during the ice fishery was 47 cm in fork length, weighed 1.6 kg and was 5.9 years-old. Other species caught included yellow perch (36,897 fish) and northern pike (1,125 fish).

### *Open-water Fishery*

The open-water survey included the entire season from the opening weekend (first weekend in May) to the end of November. Angling effort was estimated at 635,713 rod-hours (Table 2), representing 120,561 angling trips, the second highest effort ever observed. This level of effort was higher than the previous 5-year average of 523,336 rod-hours, and the trend suggests that the open-water fishery continues to grow (Fig. 3).

Walleye catch was estimated at 265,941 fish, of which 144,949 were harvested (Table 2). The 1993 level of harvest was above the previous 5-year average of 131,868 walleye suggesting a gradually increasing trend (Fig. 4). The harvest per unit effort was 0.228 walleye per rod-hour, slightly lower than the 5-year average of 0.251 fish per rod-hour (Fig. 5). The 1993 open-water walleye harvest rate was almost five times that of the ice fishery. In 1993, the average walleye harvested during the open-water season, was 40 cm in fork length, weighed 0.9 kg and was 3.7 years old. Other species of fish harvested include yellow perch (8,142 fish), northern pike (2,265 fish), freshwater drum (2,177 fish), rock bass (1,608 fish), and smallmouth bass (1,198 fish).

## *Western Lake Ontario Salmonine Boat Fishery*

The 1993 survey of the salmonine recreational fishery focused on the launch daily boat fishery in Canadian waters of western Lake Ontario. The 1993 survey was based on completed trip angler interviews from April to September at six boat launching ramps: Port Dalhousie, Hamilton, Port Credit, Bluffers Park,

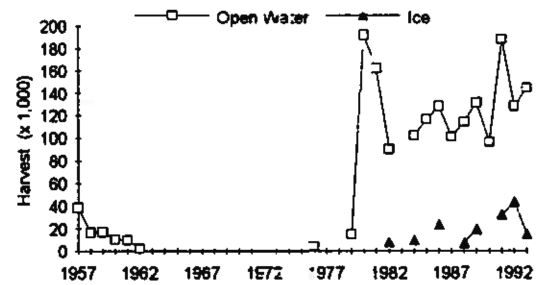


FIG. 4. Walleye harvest during the Bay of Quinte ice and open-water recreational fisheries from 1957 to 1993.

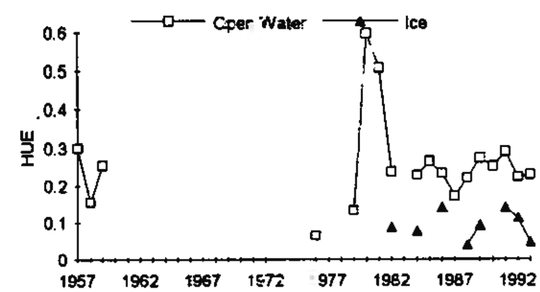


FIG. 5. Walleye harvest, per rod-hour of angling effort (HUE), during the Bay of Quinte ice and open-water recreational fisheries from 1957 to 1993.

TABLE 2. The temporal distribution of the estimated walleye catch, harvest and effort, for the 1993 recreational open-water fishery on the Bay of Quinte.

| Season | Catch (# fish) | Harvest (# fish) | Effort (rod-hours) |
|---|---|---|---|
| Opening weekend | 22,377 | 16,272 | 87,406 |
| May | 155,802 | 79,082 | 278,314 |
| June | 31,006 | 16,399 | 90,639 |
| July | 21,565 | 10,641 | 44,479 |
| August | 28,156 | 19,763 | 82,465 |
| Fall | 7,035 | 2,793 | 52,410 |
| Open-water total | 265,941 | 144,950 | 635,713 |

Port Darlington and Wellington (Fig. 2). Counts of parked boat trailers at the six surveyed ramps, and an additional thirty-four ramps, from Queenston (Niagara River) to Wellington (Prince Edward County), were used to determine the distribution of fishing effort for western Lake Ontario. Detailed survey protocols were reported by Savoie (1993a, 1993b).

The 1993 western Lake Ontario launch daily boat angling effort was estimated at 527,050 rod-hours (Table 3). This level of angling effort was the lowest observed in nine years, and represents a decline of almost 13% compared to 1992, and a 25% decline compared to the previous 5-year average (Fig. 6, Table 3). Effort increased dramatically from the early 1980s to 1986 (coincident with increased stocking of salmon and trout), peaked in 1989, and has declined since then. Lake-wide stocking levels have hovered around 8.2 million (+/- 5%) fish from 1984 to 1992 (see Chapter 2). Recent declines in angling effort may be due to increasing concern over contaminants in fish and a general decline in the economy. With the announced cancellation of the Toronto Star Great Salmon Hunt and given the past emphasis on derby fishing, we expect a further decline in angling effort for 1994.

The 1993 salmonine catch was estimated at 94,597 fish with a catch rate of 0.180 fish per rod-hour of effort (Table 4), for an increase of 73% and 67% respectively, compared to 1992. The 1993 salmonine harvest was estimated at 45,764 fish with a harvest rate of 0.087 fish per rod-hour of effort (Table 4), for an increase of 46% and 67% respectively, compared to 1992. The increase in harvest from 1992 to 1993 was associated with lower fishing effort but increased harvest rate. No substantial change in the proportion of fish released was observed. A cold spring and record high water levels, which flooded many ramps and marinas, resulted in a poor first half to the 1993 fishing season, with catch and harvest rates comparable to 1992. The second half of the 1993 fishing season was twice as productive as the same period in 1992. This improvement was likely influenced by a very strong thermocline, which concentrated the fish in a narrow band, making them easier to target. In 1993 there was also a significant summer alewife die-off, which may have improved angling efficiency. Chinook salmon dominated the fishery, representing 70% of the harvest, followed by rainbow trout at 16%, then coho salmon, lake trout, brown trout and finally a few Atlantic salmon (Table 4). In 1993 there were also 378 non-salmonines harvested, mostly walleye, channel catfish and brown bullhead.

TABLE 3. Yearly effort and harvest comparisons of the western Lake Ontario launch daily boat angler fishery.

| | Yearly Comparisons | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1988 | 1989 | 1990 | 1991 | 1992 | Average* | 1993 |
| Effort (rod-hours) | 678,747 | 784,965 | 768,700 | 675,454 | 603,506 | 702,274 | 527,050 |
| Harvest rate | 0.099 | 0.093 | 0.082 | 0.105 | 0.052 | 0.087 | 0.087 |
| *Fish harvested:* | | | | | | | |
| Unknown salmonine | 191 | 1,029 | 359 | 1,297 | 0 | 575 | 110 |
| Coho salmon | 6,955 | 5,290 | 4,896 | 7,105 | 1,166 | 5,082 | 2,439 |
| Chinook salmon | 35,913 | 45,558 | 30,057 | 41,400 | 21,696 | 34,925 | 32,128 |
| Rainbow trout | 19,151 | 16,075 | 19,563 | 12,644 | 4,979 | 14,482 | 7,478 |
| Atlantic salmon | 113 | 248 | 150 | 65 | 309 | 177 | 223 |
| Brown trout | 2,446 | 1,261 | 1,077 | 2,966 | 1,447 | 1,839 | 1,081 |
| Lake trout | 2,252 | 3,185 | 6,660 | 5,700 | 1,715 | 3,902 | 2,305 |
| Total salmonine | 67,021 | 72,646 | 62,762 | 71,177 | 31,312 | 60,982 | 45,764 |

* Average for the years 1988 to 1992 inclusive.

The coho salmon harvest has more than doubled from 1992 to 1993, but was still 52% below the previous 5-year average (Table 3). Chinook salmon harvest increased by 48% from 1992 to 1993, and was 8% below the previous 5-year average. The 1993 rainbow trout harvest increased by 50% from the previous year but was still 48% below the 5-year average. There were too few Atlantic salmon observed in the harvest to infer any significant trend. The brown trout harvest declined by 25% from 1992 to 1993, and was 41% below the 5-year average. The 1993 lake trout harvest increased by 34% compared to 1992 and was 41% below the previous 5-year average.

Overall, the 1993 salmonine harvest per unit effort was 0.087 fish per rod-hour, a 67% increase from 1992 but equal to the previous 5-year average (Table 3). There is mounting evidence that the declining trend in harvest rate since 1984 (Fig. 7) reflects declining salmonine abundance (see Chapter 2), suggesting a decline in stocked fish survival. Predation, cannibalism, reduced food production for young fish, and hatchery effects are possible explanations for reduced survival of stocked salmon and trout.

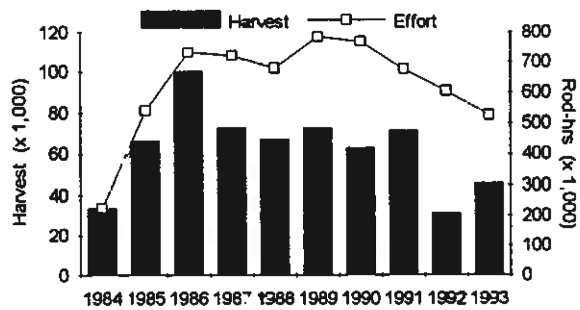


FIG. 6. Western Lake Ontario launch daily boat angler effort and salmonine harvest from 1984 to 1993.

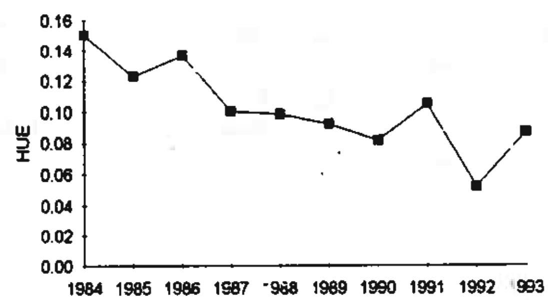


FIG. 7. Salmonine harvest, per rod-hour of angling effort (HUE), for the western Lake Ontario launch daily boat fishery from 1984 to 1993.

TABLE 4. Western Lake Ontario launch daily boat angler statistics for 1993.

| | Catch | Harvest | CUE | HUE |
|---|---|---|---|---|
| Unknown salmonine | 1,042 | 110 | 0.0020 | 0.0002 |
| Pink Salmon | 13 | 0 | 0.0000 | n/a |
| Coho salmon | 4,566 | 2,439 | 0.0087 | 0.0046 |
| Chinook salmon | 64,587 | 32,128 | 0.1225 | 0.0610 |
| Rainbow trout | 17,548 | 7,478 | 0.0333 | 0.0142 |
| Atlantic salmon | 464 | 223 | 0.0009 | 0.0004 |
| Brown trout | 1,713 | 1,081 | 0.0033 | 0.0021 |
| Lake trout | 4,664 | 2,305 | 0.0088 | 0.0044 |
| Total salmonine | 94,597 | 45,764 | 0.1795 | 0.0868 |
| Total non-salmonine | 2,067 | 378 | 0.0039 | 0.0007 |

* Boat angler effort was estimated at 527,050 rod-hours, based on 1,975 completed trip interviews. Catch and harvest rate are reported as number of fish caught or harvested per rod-hour of fishing effort.

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# 6

# Zebra Mussel Studies

Tom Stewart
Jim Hoyle
Ted Schaner

## Overview

Lake Ontario fisheries surveillance programs are designed to detect changes in fish communities and associated fisheries over time, including those that may result from the invasion of zebra and quagga mussels. To increase our ability to relate potential changes to the effects of zebra mussel, further studies were implemented. First, we established biannual surveys of mussel density to document a quantitative case history of the invasion. Second, we supplement existing fisheries surveillance information with studies of the early life history of lake whitefish. The decision to focus on lake whitefish was based on the strength of existing research and surveillance programs, the opportunity to contrast the response of Bay of Quinte whitefish stocks to those of Lake Ontario and the fact that whitefish are a species of provincial significance that are not being extensively studied outside of Lake Ontario. The studies examine hatch dates, larval fish diets relative to zooplankton community structure, and growth. Also, dive surveys measure the density of whitefish eggs and mussels on selected spawning sites. A summary of 1993 results is provided here.

## Mussel Density Surveys

A dive survey to estimate zebra mussel densities was conducted in the Canadian waters of western Lake Ontario in the summer of 1991 (Schaner et al. 1992). The survey was repeated in 1993, with the addition of transects in Canadian waters of central and eastern Lake Ontario, and included the identification of quagga mussels The surveys were stratified by depth and substrate type.

In 1993, mussel densities were highest in western Lake Ontario (Fig. 1). In north-central Lake Ontario densities were very low and increased to moderate

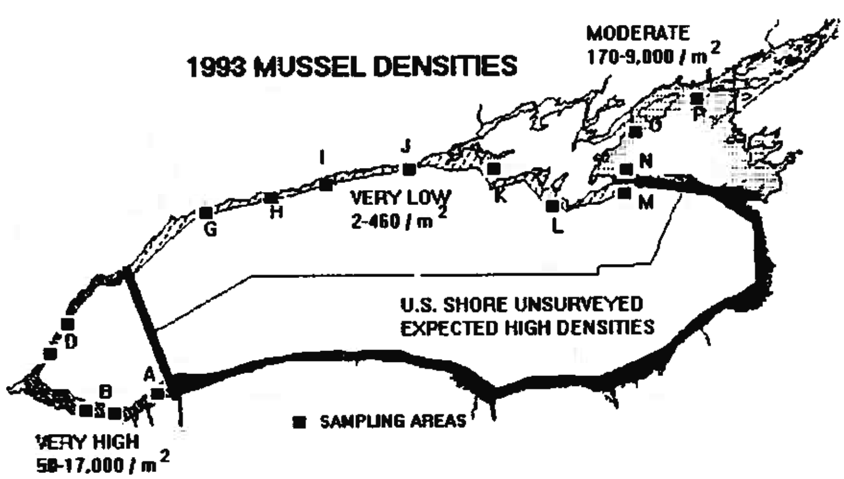


FIG. 1. Map of sites surveyed for zebra mussel, and range of densities observed in 1993.

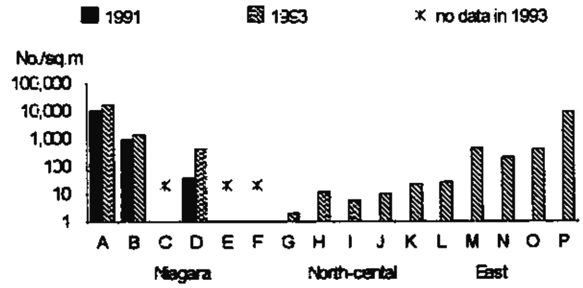


FIG. 2. Densities of zebra mussel observed in 1991 and 1993. The letters refer to the sites or areas shown in Figure 1. Sites with astericks were judged to have substrate unsuitable for zebra mussel colonization in 1991, and were not resurveyed in 1993.

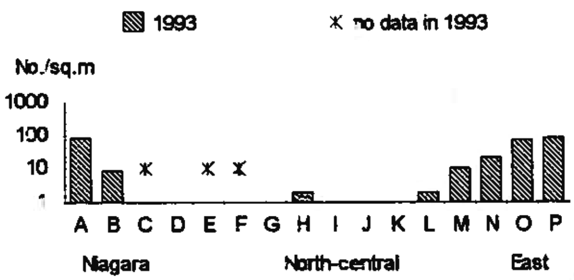


FIG. 3. Densities of quagga mussel observed in 1991 and 1993. The letters refer to the sites or areas shown in Figure 1. Sites with astericks were judged to have substrate unsuitable for zebra mussel colonization in 1991, and were not resurveyed in 1993.

levels as you moved eastward (Fig. 1 and Fig. 2). Quagga mussel densities were very low in all areas, but were highest in the western and eastern Lake Ontario (Fig. 3).

Densities increased in all resurveyed areas from 1991 to 1993. Area D, which includes transects near Bronte and Port Credit, increased by a factor of 10 (Fig. 1). Area G, near Whitby was surveyed in 1991 but no mussel were found. In 1993, densities were also very low in this area. The failure of the mussels to extensively colonize north central Lake Ontario may be due to prevailing currents that prevent dispersal to this area or cooler temperatures (Stewart and Robertson 1991).

## *Whitefish Early Life History Studies*

### *Larval Fish Sampling*

Larval lake whitefish sampling on the Bay of Quinte and eastern Lake Ontario has been conducted annually since 1991 (Hoyle 1992, 1993a). These studies continued in 1993 (Hoyle 1993b). The spring of 1993 was cool. Water temperatures remained below 4 °C until mid-April (Fig. 4). Lake whitefish hatched over a two week period beginning about April 14. Because of the relatively late hatch date and slow growth rate, the larval fish were much smaller in 1993 than in two previous years on comparable

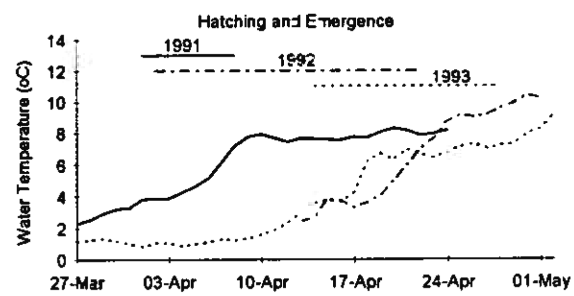


FIG. 4. Changes in water temperature at Trident Point, Bay of Quinte, 1991 to 1993. Periods of lake whitefish hatching and emergence are indicated.

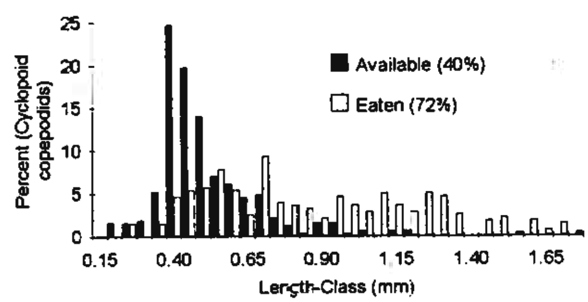


FIG. 5. Percent composition by number of cyclopoid copepodids length-classes in the stomach contents of larval lake whitefish and in zooplankton samples taken in the vicinity of larval fish samples, 1993. Percentages shown in the legend indicate the composition of cyclopoid copepodids in the zooplankton community (available) and in the stomach contents (eaten).

dates. As in previous years, cyclopoid copepodids were the most numerous prey in larval lake whitefish stomachs (72% by number, comared to 40% available), with the larval fish selecting the largest individuals of this prey type available (Fig. 5).

### Spawning Shoal Dive Survey

Lake whitefish spawning shoal dive surveys have been conducted on the Bay of Quinte and eastern Lake Ontario annually since 1990, exclusive of 1991 (Hoyle and Melkic 1991, Hoyle 1993a). Results for 1992 and 1993 dive surveys are summarized in Table 1. Zebra mussel presence was confirmed for the first time on a Lake Ontario lake whitefish spawning shoal in 1992 (Petticoat Point), and for the first time on a Bay of Quinte shoal in 1993 (Makatewis Island). Zebra mussels have not been observed at the Trident Point site to date.

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# 7

# Habitat

Alastair Mathers
Andy Smith

## Overview

Nearshore aquatic habitat of lakes provides reproductive, nursery and/or feeding habitat which is essential for most Great Lakes fish. Human construction activities along the shoreline and upland areas have profoundly changed aquatic habitats along parts of Lake Ontario. It is generally accepted that large changes to aquatic habitats will affect the production of organisms which exist there.

The management of aquatic habitat in Lake Ontario, as in all of the Great Lakes, is a developing field. Progress has been hindered by problems of scale, classification methodology, the difficulties of effectively processing information (Busch and Sly 1992), and a lack of a complete understanding of the relationships between habitat and the production of aquatic organisms. Development of a defensible nearshore habitat classification system which can be used to guide human construction activities along the shoreline of Lake Ontario is an important step towards protecting the lake's aquatic environment. To develop such a system it is critical to both a) describe the habitat and b) quantify the habitat's importance to aquatic organisms.

There have been several initiatives to describe components of the aquatic habitat in Lake Ontario. Rukavina (1969 and 1970) and Balesic (1979) described the nearshore substrate of Lake Ontario. Stewart and Robertson (1991) described the thermal habitat of the pelagic and nearshore waters of Lake Ontario. Environment Canada has published maps of the nearshore substrate of Lake Ontario which ranked the environmental sensitivity of these substrates based on a subjective scale. These reports described the habitat but did not quantify habitat use by aquatic organisms. Few examples of quantification exist. One example is Minns et al (1993), who reported the use of an 'index of biotic integrity' (IBI) based on electrofishing catches to evaluate the use of aquatic habitats by fish in three areas including the Bay of Quinte (Lake Ontario).

Here we report efforts to describe the nearshore physical habitat of the Bay of Quinte and to evaluate its use by fish. This project was initiated as part of the Quinte Remedial Action Plan (RAP). This classification system is in the preliminary stages of development at this time, however, if it is successful for the Bay of Quinte it could be of value in other areas of Lake Ontario.

## Bay of Quinte Nearshore Habitat Mapping

In 1985, the Bay of Quinte was identified by the International Joint Commission as an 'Area of Concern'. As a result, the Quinte RAP was developed and several impaired beneficial uses were identified in the Bay of Quinte, one of which was the degradation of fish populations and the loss of their habitats, particularly in the nearshore areas. Specifically, submergent and emergent aquatic vegetation has been lost due to changes in water quality, shoreline alterations and intense shoreline development pressures from urbanization. Almost two thirds of wetlands within 3.2 kilometres of the Bay's shoreline have been lost (RAP Coordinating Committee 1990).

A study to inventory fish and wildlife habitat in the nearshore zone of the Bay was initiated in 1991. Contributors to the project included the Great Lakes Cleanup Fund, Department of Fisheries and Oceans Canada, Ontario Ministry of Environment and Energy, local Conservation Authorities, Mohawks of the Bay of Quinte, and the Ontario Ministry of Natural Resources. The objectives of this project were to create a habitat map of the nearshore zone in the Bay, examine fish communities within the littoral zone, and to identify critical fish and wildlife habitat. This information will be used to develop a nearshore habitat management and restoration plan for the Bay of Quinte. The field study consisted of mapping the nearshore zone (including some terrestrial features), and seine netting littoral fish communities as described by Sawers and Smith (1992). The following is a summary of the results of work done between 1991 and 1993.

Approximately 395 kilometres of Bay of Quinte shoreline was mapped between the Murray Canal and Glenora during the 1991-93 field seasons (Smith 1993). A total of 155 1:2,000 scale Flood Damage Reduction Program, 16 1:5,000 floodplain and 8 1:10,000 Ontario Base Map maps were completed. These data are being entered into an electronic data base to allow quantification of the habitat features, to allow easy updating of the information, and to facilitate the production of maps of the aquatic habitat. Data for the 'Upper Bay' (Trenton to Telegraph Narrows) have been entered into an AUTOCAD system and we anticipate completion of the data entry for the remaining areas of the Bay next year.

The habitat data collected include information on substrate, aquatic vegetation, terrestrial vegetation, land use and biological features. An example of a map is shown in Figure 1. A detailed analysis of the habitat maps has been on a relatively small portion of the dataset at this time, however, some general observations can be made.

### Aquatic Vegetation and Substrate Mapping

The greatest density and variety of aquatic macrophytes were found growing in muck and silt substrates associated with wetlands. These wetlands are relatively scarce and long stretches of shoreline exist where virtually no aquatic vegetation remains. Plant density increased through the summer usually peaking near the end of the field season (late August-early September). Cattail (*Typha* spp.) was by far the dominant emergent plant observed, often forming dense mats covering several hectares. Submergents

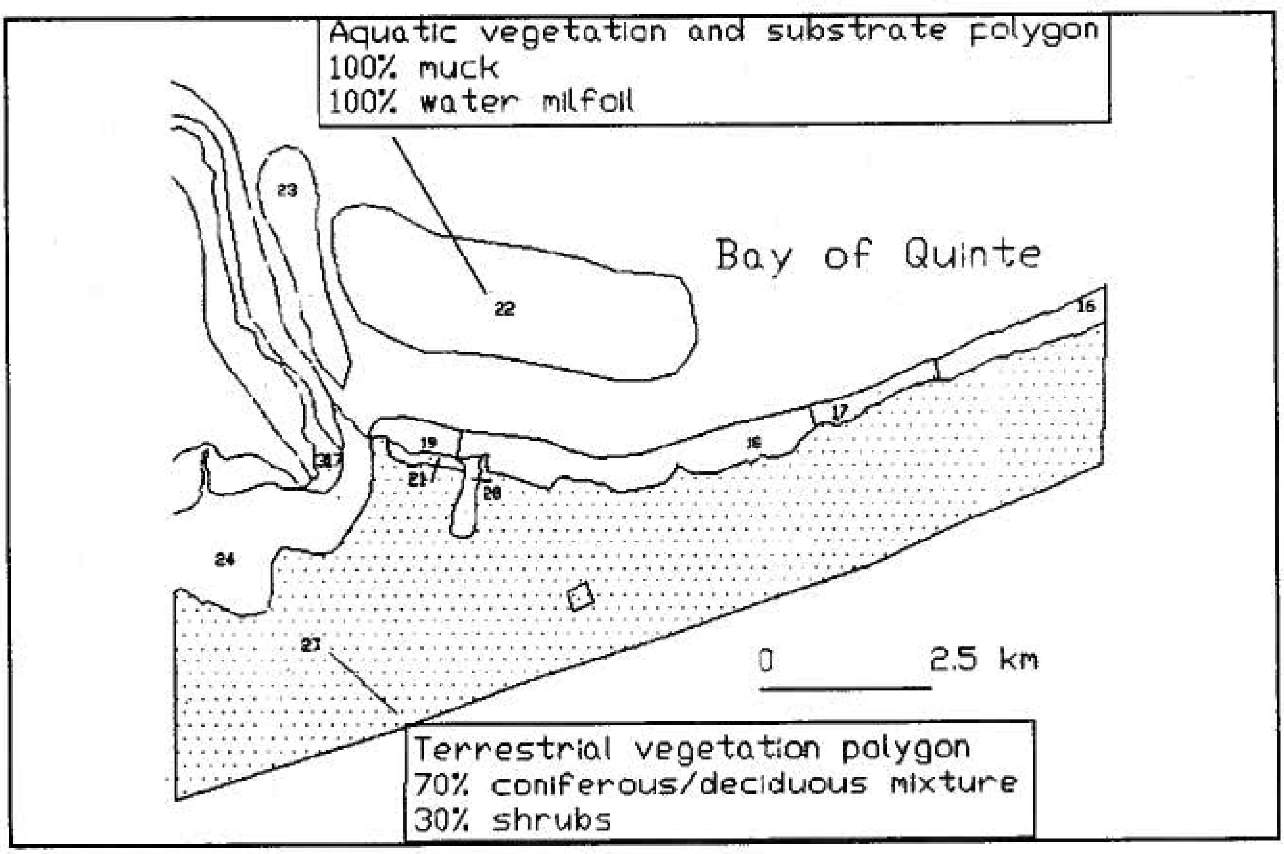


FIG. 1. An example of the maps created during the 1991 to 1993 nearshore mapping project in the Bay of Quinte. The habitat data collected include information on substrate, aquatic vegetation, terrestrial vegetation, land use and biological features.

commonly recorded in the marshes include pondweed (*Potomegeton* spp.), wild celery (*Vallisnaria americana*) and coontail (*Ceratophyllum demersum*). Water milfoil (*Myriophyllum* spp.) was also frequently observed and regularly dominated beds in deeper water.

A mixture of rubble and gravel was the most common substrate type recorded in the nearshore zone. Bedrock and boulder was only seen occasionally and usually mixed with rubble or gravel. Muck and silt was commonly seen in marshes, sheltered bays, and in deeper water off the shoreline. Sand and clay was periodically recorded, often mixed with other substrates such as silt. Detritus was rarely observed and marl was never recorded.

Sand and clay substrates supported very sparse to dense beds of macrophytes consisting of a variety of species. Water plantain (*Alisma* spp.), water milfoil and pondweed were plants commonly found growing on rubble and gravel bottom types. These substrates, however, rarely sustained greater than moderate densities of macrophytes.

### *Terrestrial Vegetation, Slope and Land Use Mapping*

Forested areas on the Bay of Quinte were dominated by deciduous trees. Few stands of solid coniferous vegetation were found but shrub growth was relatively common. Black willow (*Salix nigra*) was often observed overhanging the water, particularly along undeveloped shorelines. The terrain surrounding the Bay could be best described as rolling or hilly, but flat areas were occasionally recorded. The only continuous stretch of 'mountainous' topography was found on Long Reach and the west shore of Picton Bay. Much of the Bay of Quinte shoreline has been developed for residential and recreational property. In many cases the native vegetation has been removed and replaced by lawns. Various types of docks are common and over 1,000 erosion control structures were recorded (Smith 1993). Shoreline alteration was frequent along developed stretches and found to be particularly intensive around heavily populated areas. Agricultural crops and pasture are the dominant land use in several areas. Sites of cattle access and barnyard runoff to the Bay were identified.

### *Biological Features Mapping*

Thirteen provincially or regionally significant bird species were observed at 103 different locations on the Bay during the 1991-93 field seasons (Table 1). No mammal, reptile or amphibian species on the significant species list were recorded. Several fish nursery areas were located resulting from the seine net catches and field observations. Few spawning sites or migration routes were found due to the timing of the field season (June-September). Surveys to document fish spawning locations are planned for the spring of 1994.

### *Seine Netting and Evaluation of Habitat Use*

A total of 303 sites were seined on the Bay as part of this project. An average of 65 fish were caught in each seine haul. Over the course of the study 29 of the 65 species (RAP coordinating Committee 1990) known to frequent the Bay were captured. Yellow perch was the species most frequently caught, followed by logperch, pumpkinseed, and bluntnose minnows (Figure 2, complete listing in Smith 1993). For those species sorted by age group, over 74% of the fish were young-of-the-year or juveniles. Top predator species (longnose gar, bowfin, northern pike, smallmouth and largemouth bass, and walleye) composed 3.2% of the catch while 31% of the catch consisted of forage fish (Cyprinids, gizzard shad, alewife, banded killifish, logperch and brook silverside).

The high percentage of young-of-year, juvenile and forage fish in the seining results illustrates the importance of the nearshore zone as a nursery and food producing area. Remedial actions that increase water clarity and submergent macrophytes have been predicted to result in increased abundances of Centarchid and Esocid fishes (RAP coordinating Committee 1993). Seining the identical sites after remedial actions should provide an indicator of changes to the nearshore fish communities.

To evaluate the use of the various nearshore habitat classes by fish, indices of biotic integrity (IBI's) were calculated for each seine site, following the methods of Minns et al. (1993). The IBI was developed as a measure of fish community "health" (Karr 1981) and we have assumed that it provides a measure of the relative value of habitats with the most valued habitat receiving an IBI score of 1.00

TABLE 1. Provincially significant (P) and regionally significant (R) bird species observed during the near shore habitat inventory on the Bay of Quinte between 1991 and 1993.

| Common Name | Scientific Name |
|---|---|
| Common Loon (R) | *Gavia immer* |
| Pied-billed Grebe (P) | *Podilymbus podiceps* |
| Double-crested Cormorant (P) | *Phalacrocorax auritus* |
| Green Heron (P) | *Butorides viresens* |
| Least Bittern (P) | *Ixobrychus exilis* |
| Northern Pintail (P) | *Anas acuta* |
| Northern Harrier (P) | *Circus cyaneus* |
| Osprey (R) | *Pandion haliaetus* |
| Little Gull (P) | *Larus minutus* |
| Caspian Tern (P) | *Sterna caspia* |
| Common Tern (P) | *Sterna hirundo* |
| Black Tern (P) | *Chlidonias niger* |
| Marsh Wren (P) | *Cistothorus palustris* |

and the least valued habitat receiving an IBI score of 0.00. A detailed description the calculations can be found in MacLeod et al. (in prep). IBI's for each seine catch were compared to habitat features at the seine site and summaries were generated by habitat feature. Preliminary analysis showed that there were few significant differences in the IBI scores across detailed vegetation densities, vegetation types, and substrate types. Therefore, the habitat classes were generalized until significant differences in IBI scores were observed. Substrate classes were lumped into hard (boulder, rubble, gravel) and soft (sand, muck, silt, detritus) groups Vegetation type and density were divided into three groups: dense vegetation (areas with submergent and floating aquatic plants at densities exceeding 50% cover), sparse vegetation (areas with submergent and floating aquatic plants at densities less than 50% cover) or no vegetation (areas with no submergent or floating aquatic vegetation).

The IBI scores indicated that soft substrates which had dense vegetation (average IBI=0.40) were the most highly valued while hard substrates which had no vegetation (average IBI=0.23) were the least highly valued (Figure 3). Statistically significant differences were detected in the seine catches conducted at sites with different substrate and vegetation groupings (MacLeod et al. in prep). This evaluation of habitat use, based on seine net catches, has been combined with two other indices of fish use to provide a map which provides a preliminary ranking of fish habitat (MacLeod et al. in prep). One of the other indices used was the IBI based on fish catches during an electrofishing survey conducted in the Bay of Quinte (Minns et al. 1993). The third index evaluated the suitability of habitat for fish spawning based in the work of Christie (1982). The map combining these indices has only been prepared for a relatively small area of the Bay of Quinte and future investigations will allow for habitat evaluation on a larger study area.

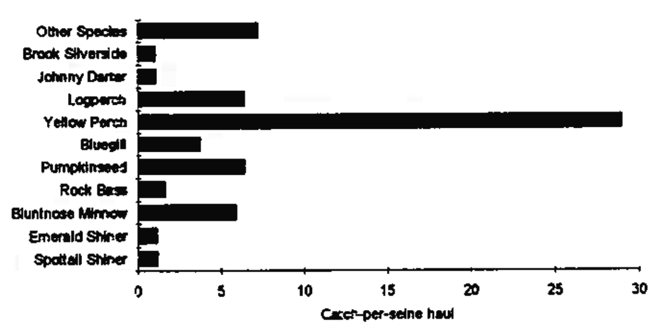


FIG. 2. Average catch per seine net haul by fish species for netting conducted during the 1991 to 1993 nearshore mapping project in the Bay of Quinte.

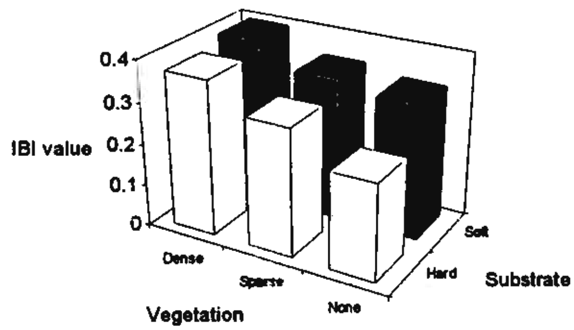


FIG. 3. Average IBI values for the six categories of aquatic vegetation and substrate. IBI values were determined from seine net catches and are assumed to represent fish community 'health'.

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# Appendices

APPENDIX A1. Programs conducted by the Lake Ontario Fisheries Unit between April 1, 1993 and April 1, 1994

## Assessment Programs

Western basin smelt bottom trawling (NBS/OMNR)
Project Leader: Paul Savoie

Hydroacoustics and trawling survey (NYSDEC/OMNR)
Project Leader: Ted Schaner

Eastern Lake Ontario fish community index netting
Project Leader: Jim Hoyle

Cooperative lake trout gillnetting (NYSDEC/OMNR/NBS)
Project Leader: Ted Schaner

Salmonid recruitment index
Project Leader: Jim Bowlby

Salmonid boat angler survey
Project Leader: Paul Savoie

Charter boat survey
Project Leader: Paul Savoie

Credit River coho/chinook monitoring
Project Leader: Jim Bowlby

Ganaraska River rainbow trout monitoring
Project Leader: Jim Bowlby

Lake whitefish early life history studies
Project Leader: Jim Hoyle

Bay of Quinte creel surveys
Project Leader: Alastair Mathers

Commercial harvest sampling
Project Leader: Jim Hoyle

Zebra mussel density index
Project Leader: Paul Savoie

Sport fish contaminant sampling program
Project Leader: Alastair Mathers

### St. Lawrence River Projects

St. Lawrence River fish community indexing
Project Leader: Anne Bendig

St. Lawrence River muskellunge nursery and spawning habitat assessment
Project Leader: Anne Bendig

Cornwall eel ladder monitoring
Project Leader: Anne Bendig

St. Lawrence River boat fishing effort survey
Project Leader: Anne Bendig

Lake St. Francis creel survey
Project Leader: Anne Bendig

*Special Projects*

Walleye catch-at-age analysis
Project Leader: Mike Rawson

Chinook sport fishery data synthesis
Project Leader: Tom Stewart

## Research Programs

Seasonal fish community dynamics of eastern Lake Ontario
Project Leader: Dr. John Casselman

Age, year-class strength and 45-year growth chronology of freshwater drum of the Bay of Quinte and Lake Ontario
Project Leader: David Brown

Lake trout rehabilitation studies
Project Leader: Dr. John Casselman

Comparison of monofilament and multifilament gillnets- conversions for long-term data sets
Project Leader: Dr. John Casselman

Lake whitefish stock discrimination studies
Project Leader: Dr. John Casselman

Discrimination between hatchery and native rainbow trout
Project Leader: Dr. John Casselman

Development of a calcified structure age and growth data extraction system (CSAGES)
Project Leader: Dr. John Casselman

Modelling predator-prey interactions among Lake Ontario offshore pelagic fish species
Project Leader: Dr. Michael L. Jones

Evaluating constraints to the restoration of Atlantic salmon populations in Lake Ontario
Project Leader: Dr. Michael Jones

Development and testing of reliable methods for the determination of stream salmonid biomass and abundance
Project Leader: Dr. Michael L. Jones

Investigations of life history variations in naturalized steelhead populations in the Great Lakes
Project Leader: Dr. Michael L. Jones

Development of models relating stream habitat and watershed characteristics to production of stream salmonids
Project Leader: Dr. Michael L. Jones

APPENDIX A2. LOMU staff and Glenora associates in 1993.

### Management and Compliance Staff at Napanee

Phil Smith, Lake Manager
Dave Jones, Compliance Supervisor
Rick Todd, Conservation Officer
Mike MacDonald, Conservation Officer
Bruce Chenier, Conservation Officer
Sandra Orsatti, Management Biologist
Alastair Mathers, Management and Planning Biologist
Andy Smith, Biologist

### Other Compliance Staff

Brad Labadie, Conservation Officer, Maple
Ken Forster, Conservation Officer, Cambridge

### Assessment Staff at Glenora

Tom Stewart, Assessment Supervisor
Jim Bowlby, Assessment Biologist
Jim Hoyle, Assessment Biologist
Ted Schaner, Assessment Biologist
Mike Rawson, Assessment Biologist

### Assessment and Operations Staff at Maple

Paul Savoie, Assessment Biologist
Sandra Malcic, Assessment Biologist
Rob Dalziel, Special Projects Technician

### Assessment and Operations Staff at Brockville (St. Lawrence River Fisheries Unit)

Anne Bendig, Assessment Biologist
Sean Bond, Technician

### Operations Staff at Glenora

David Jeffrey, Operations Supervisor
Linda Blake, Administrative Clerk
Carol Ward, Secretary/Administrative Support/Library
Ken Scott, Computer Systems and Database Manager
Kelly Sarley, Data Technician
Dawn Walsh, Senior Technician-Field Operations

Chuck Wood, Senior Technician-Marine Service
Wayne Miller, Senior Technician-Base Operations
Jeff Church, Age Interpretation Technician
Dale Dewey, Resource Technician III
Steve Lawrence, Resource Technician III
Tim Shannon, Resource Technician III
Steve Welham, Technician
Terry Cronin, Technician
Randy Gurnsey, Technician
Ambrose McCambridge, Technician
Tom Lawrence, Technician
Alan McIntosh, Boat Captain
Elaine Lockwood, Technician
Lisa McWilliams, Technician
Sean Corrigan, Technician
Shane Lockwood, Technician
Vaughan Jamieson,Technician, Commercial Fish, Fish Culture

## Research staff at Glenora

Dr. John Casselman, Senior Research Scientist
David Brown, Research Project Biologist
Lucian Marcogliese, Graduate Student
Dr. Michael Jones, Research Scientist (Salmonid Unit)
Les Stanfield, Project Biologist (Salmonid Unit)
Mike Stoneman, Research Technician (Salmonid Unit)
Christine VanderDussen, Graduate Student (Salmonid Unit)
Janice Clarkson, Graduate Student (Salmonid Unit)

## Fisheries Policy Branch staff at Glenora

Cheryl Lewis, Warmwater Fisheries Specialist

APPENDIX B1. Salmon and trout stocked into Province of Ontario waters of Lake Ontario in 1991, 1992 and 1993. For 1994 target stocking numbers are presented.

| Species | Age | Number stocked 1991 | Number stocked 1992 | Number stocked 1993 | Target number 1994 |
|---|---|---|---|---|---|
| Atlantic | Yearling | 28,495 | 34,758 | 42,366 | |
| | Fry | 0 | 0 | 15,000 | |
| | Subtotal | 28,495 | 34,758 | 57,366 | 50,000 |
| Brown Trout | Yearling | 380,914 | 257,366 | 191,591 | |
| | Fall Fingerling | 145,039 | 0 | 25,000 | |
| | Spring Fingerling | 0 | 0 | 1,867 | |
| | Subtotal | 525,953 | 257,366 | 218,458 | 180,000 |
| Coho Salmon | Yearling | 148,006 | 0 | 0 | |
| | Fingerling | 2,950 | 0 | 0 | |
| | Fry | 275,511 | 0 | 0 | |
| | Subtotal | 426,467 | 0 | 0 | 0 |
| Chinook Salmon | Fingerling | 593,631 | 604,755 | 500,784 | 450,000 |
| Lake Trout | Yearling | 1,092,196 | 931,226 | 567,988 | |
| | Fingerling | 0 | 195,074 | 0 | |
| | Subtotal | 1,092,196 | 1,126,300 | 567,988 | 520,000 |
| Rainbow Trout | Yearling | 125,070 | 64,378 | 35,850 | |
| | Fall Fingerling | 62,249 | 226,286 | 179,839 | |
| | Subtotal | 187,319 | 290,664 | 215,689 | 330,000 |
| TOTAL | | 2,854,061 | 2,313,843 | 1,560,285 | 1,530,000 |

APPENDIX B2. Salmon and trout stocked into New York waters of Lake Ontario in 1991, 1992 and 1993. For 1994 target stocking numbers are presented.

| Species | Age | Number Stocked 1991 | Number Stocked 1992 | Number Stocked 1993 | Target Number 1994 |
|---|---|---|---|---|---|
| Atlantic | Yearling | 178,000 | 169,305 | 135,280 | |
| | Fingerling | 0 | 0 | 30,000 | |
| | Subtotal | 178,000 | 169,305 | 165,280 | 200,000 |
| Brown Trout | Yearling | 381,880 | 415,170 | 445,350 | |
| | Fall Fingerling | 0 | 0 | 0 | |
| | Subtotal | 381,880 | 415,170 | 445,350 | 425,000 |
| Coho Salmon | Yearling | 97,000 | 94,100 | 95,670 | |
| | Fingerling | 131,750 | 445,000 | 99,970 | |
| | Subtotal | 228,750 | 539,100 | 195,640 | 245,000 |
| Chinook Salmon | Fingerling | 2,835,000 | 2,798,215 | 1.603,300 | 1,000,000 |
| Lake Trout | Yearling | 818,090 | 507,580 | 498,400 | |
| | Fingerling | 160,000 | 0 | 0 | |
| | Subtotal | 978,090 | 507,580 | 498,400 | 500,000 |
| Rainbow Trout: | | | | | |
| Washington Steelhead | Yearling | 519,300 | 430,000 | 379,930 | |
| | Fingerling | 215,000 | 0 | 0 | |
| | Subtotal | 734,300 | 430,000 | 379,930 | |
| Domestic | Yearling | 81,550 | 84,850 | 88,020 | |
| | Fingerling | 28,900 | 0 | 0 | |
| | Subtotal | 110,450 | 84,850 | 88,020 | |
| Skamania | Yearling | 32,000 | 84,780 | 74,000 | |
| | Rainbow trout Subtotal | 876,750 | 599,630 | 541,950 | 613,000 |
| TOTAL | | 5,478,470 | 5,029,000 | 3.449,920 | 2,983,000 |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993.

| Waterbody Name | Site Name | Month Stocked | Year Spawned | Hatchery/ Source | Strain/Egg Source | Age Months | Mean Wt. (g) | Marks | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|
| ATLANTIC SALMON - FRY | | | | | | | | | |
| Wilmot Creek | Orono Cr Taunton Rd | 05 | 1992 | Glenora | Anadromous/LeHave, NS | 01 | 0.1 | None | 8,000 |
| Wilmot Creek | Conc 8 | 05 | 1992 | Glenora | Anadromous/LeHave, NS | 01 | 0.1 | None | 7,000 |
| WILMOT CREEK TOTAL | | | | | | | | | 15,000 |
| ATLANTIC SALMON - YEARLINGS | | | | | | | | | |
| Credit River | Silver Cr (E Branch) | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 44.6 | RV | 4,948 |
| Credit River | Rogers Creek 10th Line | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 44.4 | RV | 4,409 |
| Credit River | Black Cr Stewartown | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 44.4 | RV | 4,408 |
| Credit River | Black Cr Georgetown | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 42.4 | RV | 3,615 |
| Credit River | E Branch Hwy 10 | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 42.4 | RV | 1,179 |
| Credit River | E Branch 3rd Line | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 42.4 | RV | 1,768 |
| Credit River | Inglewood | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 48.5 | RV | 4,038 |
| Credit River | E Branch 5th Side Rd | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 48.5 | RV | 4,036 |
| Credit River | Silver Cr (E Branch) | 05 | 1991 | U of Guelph | Anadromous/LeHave, NS | 15 | 45.0 | RV | 3,200 |
| Credit River | E Branch 2nd Line | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 42.4 | RV | 589 |
| CREDIT RIVER TOTAL | | | | | | | | | 32,190 |
| Wilmot Creek | Taunton Rd | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 37.6 | RV | 2,389 |
| Wilmot Creek | Conc 5 | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 37.6 | RV | 2,390 |
| Wilmot Creek | Conc 3 | 03 | 1991 | Ringwood | Anadromous/LeHave, NS | 13 | 39.2 | RV | 5,397 |
| WILMOT CREEK TOTAL | | | | | | | | | 10,176 |
| **TOTAL ATLANTIC SALMON FRY** | | | | | | | | | **15,000** |
| **TOTAL ATLANTIC SALMON YEARLINGS** | | | | | | | | | **42,366** |
| **TOTAL ATLANTIC SALMON** | | | | | | | | | **57,366** |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993

| Waterbody Name | Site Name | Month Stocked | Year Spawned | Hatchery/ Source | Strain/Egg Source | Age Months | Mean Wt. (g) | Marks | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|
| **BROWN TROUT - FALL FINGERLINGS** | | | | | | | | | |
| Lake Ontario | Ashbridges Bay Ramp | 09 | 1992 | Normandale | Ganaraska/Normandale | 09 | 18.7 | Ad | 25,000 |
| **BROWN TROUT - SPRING FINGERLINGS** | | | | | | | | | |
| Wilmot Creek | Taunton Road | 05 | 1992 | Sir Sandford Fleming | Ganaraska/Normandale | 05 | 5.8 | None | 1,867 |
| **BROWN TROUT - YEARLINGS** | | | | | | | | | |
| Bronte Creek | Bronte Beach Park | 04 | 1991 | Chatsworth | Ganaraska/Normandale | 16 | 42.9 | RV | 15,049 |
| Duffins Creek | Rotary Park Ramp | 03 | 1991 | Ringwood | Ganaraska/Normandale | 14 | 56.4 | RV | 13,770 |
| Lake Ontario | Port Dalhousie East | 04 | 1991 | Normandale | Ganaraska/Normandale | 15 | 57.4 | RV | 30,574 |
| Lake Ontario | Bluffer's Park | 03 | 1991 | Ringwood | Ganaraska/Normandale | 14 | 53.5 | RV | 13,121 |
| Lake Ontario | Burlington Canal | 04 | 1991 | Chatsworth | Ganaraska/Normandale | 16 | 42.9 | RV | 5,017 |
| Lake Ontario | Burlington Canal | 04 | 1991 | Normandale | Ganaraska/Normandale | 15 | 59.0 | RV | 10,164 |
| Lake Ontario | Fifty Point CA | 04 | 1991 | Normandale | Ganaraska/Normandale | 15 | 61.4 | RV | 15,023 |
| Lake Ontario | Jordan Harbour | 04 | 1991 | Normandale | Ganaraska/Normandale | 15 | 58.6 | RV | 13,323 |
| Lake Ontario | Lakefront Promenade | 03 | 1991 | Ringwood | Ganaraska/Normandale | 14 | 56.1 | RV | 13,753 |
| Lake Ontario | Millhaven Wharf | 04 | 1991 | White Lake | Ganaraska/Normandale | 16 | 24.9 | RV | 28,054 |
| Lake Ontario | Collins Bay Wharf | 04 | 1991 | White Lake | Ganaraska/Normandale | 16 | 25.2 | RV | 19,978 |
| Mimico Creek | Humber Bay Park West | 03 | 1991 | Ringwood | Ganaraska/Normandale | 14 | 59.5 | RV | 13,765 |
| **TOTAL BROWN TROUT FALL FINGERLINGS** | | | | | | | | | **25,000** |
| **TOTAL BROWN TROUT SPRING FINGERLINGS** | | | | | | | | | **1,867** |
| **TOTAL BROWN TROUT YEARLINGS** | | | | | | | | | **191,591** |
| **TOTAL BROWN TROUT** | | | | | | | | | **218,458** |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993.

| 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 Creek | CLOCA Ramp | 04 | 1992 | Ringwood | Lake Ontario | 05 | 4.7 | None | 25,047 |
| Bronte Creek | 5th Side Rd Bridge | 05 | 1992 | Ringwood | Lake Ontario | 06 | 5.7 | None | 50,093 |
| Cobourg Creek | South Of King St | 04 | 1992 | Ringwood | Lake Ontario | 05 | 5.2 | None | 25,192 |
| Cobourg Creek | South Of King St | 02 | 1992 | Sir Sandford Fleming | Lake Ontario | 03 | 3.5 | None | 7,996 |
| Cobourg Creek | South Of King St | 04 | 1992 | Sir Sandford Fleming | Lake Ontario | 05 | 11.1 | None | 1,960 |
| COBOURG CREEK TOTAL | | | | | | | | | 35,148 |
| Credit River | Huttonville | 05 | 1992 | Ringwood | Lake Ontario | 06 | 5.4 | None | 45,332 |
| Credit River | Eldorado Park | 05 | 1992 | Ringwood | Lake Ontario | 06 | 4.5 | None | 40,155 |
| Credit River | Norval | 05 | 1992 | Ringwood | Lake Ontario | 06 | 5.3 | None | 44,543 |
| CREDIT RIVER TOTAL | | | | | | | | | 130,030 |
| Lake Ontario | Port Dalhousie East | 05 | 1992 | Ringwood | Lake Ontario | 06 | 4.6 | None | 100,153 |
| Lake Ontario | Burlington Canal | 05 | 1992 | Ringwood | Lake Ontario | 06 | 5.8 | None | 50,087 |
| Lake Ontario | Bluffer's Park | 05 | 1992 | Ringwood | Lake Ontario | 06 | 5.9 | None | 50,013 |
| Lake Ontario | Whitby Harbour | 04 | 1992 | Ringwood | Lake Ontario | 05 | 4.7 | None | 25,048 |
| Lake Ontario | Wellington Channel | 05 | 1992 | Ringwood | Lake Ontario | 06 | 4.8 | None | 35,165 |
| **TOTAL CHINOOK SALMON** | | | | | | | | | **500,784** |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993.

| Waterbody Name | Site Name | Month Stocked | Year Spawned | Hatchery/ Source | Strain/Egg Source | Age Months | Mean Wt. (g) | Marks | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|
| **LAKE TROUT - YEARLINGS** | | | | | | | | | |
| Cobourg Creek | South Of King St | 03 | 1991 | Harwood | Slate Island/Dorion | 16 | 31.2 | AdCWT | 80,422 |
| Lake Ontario | Fifty Point CA | 03 | 1991 | Harwood | Slate Island/Dorion | 16 | 27.3 | AdCWT | 79,765 |
| Lake Ontario | Scotch Bonnet Shoal | 05 | 1991 | Harwood | Slate Island/Dorion | 18 | 26.7 | AdCWT | 80,281 |
| Lake Ontario | Scotch Bonnet Shoal | 05 | 1991 | Harwood | Seneca Lake/Normandale | 17 | 53.2 | AdCWT | 13,868 |
| Lake Ontario | Main Duck Island | 04 | 1991 | Harwood | Slate Island/Dorion | 17 | 32.9 | AdCWT | 97,007 |
| Lake Ontario | Main Duck Island | 04 | 1991 | Harwood | Seneca Lake/Normandale | 16 | 50.0 | AdCWT | 14,508 |
| Lake Ontario | N Of Main Duck Sill | 04 | 1991 | Harwood | Slate Island/Dorion | 17 | 34.6 | AdCWT | 89,047 |
| Lake Ontario | N Of Main Duck Sill | 05 | 1991 | Harwood | Slate Island/Dorion | 18 | 29.5 | AdCWT | 7,797 |
| Lake Ontario | N Of Main Duck Sill | 05 | 1991 | Harwood | Seneca Lake/Normandale | 17 | 54.0 | AdCWT | 14,516 |
| Lake Ontario | S Of Long Point | 04 | 1991 | White Lake | Slate Island/Dorion | 17 | 29.2 | AdCWT | 78,925 |
| Lake Ontario | S Of Long Point | 05 | 1991 | Harwood | Seneca Lake/Normandale | 17 | 57.8 | AdCWT | 11,852 |
| **TOTAL LAKE TROUT** | | | | | | | | | **567,988** |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993.

| Waterbody Name | Site Name | Month Stocked | Year Spawned | Hatchery/ Source | Strain/Egg Source | Age Months | Mean Wt. (g) | Marks | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|
| **RAINBOW TROUT - FALL FINGERLINGS** | | | | | | | | | |
| Bronte Creek | 5th Side Rd Bridge | 11 | 1993 | Normandale | Ganaraska/Normandale | 06 | 2.9 | Ad | 30,000 |
| Credit River | Huttonville | 11 | 1993 | Normandale | Ganaraska/Normandale | 06 | 2.5 | Ad | 40,000 |
| Humber River | E Branch Mill Road | 10 | 1993 | Normandale | Ganaraska/Normandale | 05 | 8.7 | AdRV | 39,889 |
| Lake Ontario | Port Dalhousie East | 10 | 1993 | Normandale | Ganaraska/Normandale | 05 | 8.0 | AdRV | 39,950 |
| Rouge River | Twyn River Drive | 11 | 1993 | Normandale | Ganaraska/Normandale | 06 | 8.4 | Ad | 30,000 |
| **RAINBOW TROUT - YEARLINGS** | | | | | | | | | |
| Bronte Creek | Lowville Park | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 13.7 | RV | 3,072 |
| Bronte Creek | 2nd Side Rd Bridge | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 13.7 | RV | 3,072 |
| Bronte Creek | 5th Side Rd Bridge | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 13.7 | RV | 3,072 |
| Bronte Creek | Qew Bridge | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 13.7 | RV | 3,074 |
| BRONTE CREEK TOTAL | | | | | | | | | 12,290 |
| Credit River | Norval | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 12.5 | RV | 5,680 |
| Credit River | Black Cr Georgetown | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 12.5 | RV | 5,680 |
| CREDIT RIVER TOTAL | | | | | | | | | 11,360 |
| Lake Ontario | Rouge Beach Bk | 04 | 1992 | Normandale | Ganaraska/Normandale | 11 | 14.1 | RV | 12,200 |
| **TOTAL RAINBOW TROUT FALL FINGERLINGS** | | | | | | | | | **179,839** |
| **TOTAL RAINBOW TROUT YEARLINGS** | | | | | | | | | **35,850** |
| **TOTAL RAINBOW TROUT** | | | | | | | | | **215,689** |

APPENDIX B3. Salmon, trout and walleye stocked in the Province of Ontario Waters of Lake Ontario in 1993.

| Waterbody Name | Site Name | Month Stocked | Year Spawned | Hatchery/ Source | Strain/Egg Source | Age Months | Mean Wt. (g) | Marks | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|
| **WALLEYE - ADULTS** | | | | | | | | | |
| Lake Ontario | Hamilton Harbour | 10 | | Bay of Quinte | Bay of Quinte | | 600.0 | None | 30 |
| Lake Ontario | Hamilton Harbour | 11 | | Bay of Quinte | Bay of Quinte | | 600.0 | None | 155 |
| HAMILTON HARBOUR TOTAL | | | | | | | | | 185 |
| **WALLEYE - FRY** | | | | | | | | | |
| Lake Ontario | Humber R Mouth | 08 | 1993 | Private | Unk. | 03 | 1.6 | None | 4,143 |
| Mimico Creek | Humber Bay Park West | 08 | 1993 | Private | Unk. | 03 | 12.6 | None | 20 |
| **TOTAL WALLEYE ADULTS** | | | | | | | | | **185** |
| **TOTAL WALLEYE FRY** | | | | | | | | | **4,163** |
| **TOTAL WALLEYE** | | | | | | | | | **4,348** |

**APPENDIX B4. Salmon, trout and walleye stocked in New York waters of Lake Ontario in 1993.**

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| ATLANTIC SALMON - YEARLINGS | | | | | | | | | | |
| Black River | Dexter | 0.19 | 6/11 | 1992 | Adirondack | Little Clear | 16 | 8.1 | Ad | 4,180 |
| Black River | Dexter | 0.19 | 6/11 | 1992 | Adirondack | Little Clear | 16 | 9.0 | None | 7,260 |
| Black River | Dexter | 0.19 | 4/28, 29 | 1992 | Adirondack | Little Clear | 14 | 9.7 | None | 52,800 |
| DEXTER TOTAL | | | | | | | | | | 64,240 |
| Lake Ontario | Oswego River | 721 | 5/3 | 1992 | Adirondack | Little Clear | 15 | 10.4 | None | 20,160 |
| Lake Ontario | Hamlin Beach | 713 | 5/10 | 1992 | Salmon R./Adirondack | Little Clear | 15 | 17.8 | None | 11,520 |
| Lake Ontario | Sodus Point | 819 | 5/7 | 1992 | Salmon R./Adirondack | Little Clear | 15 | 16.2 | None | 11,520 |
| Lake Ontario | Irondequoit | 815 | 5/7 | 1992 | Salmon R./Adirondack | Little Clear | 15 | 16.2 | None | 11,520 |
| Lower Niagara River | Lewiston Sand Docks | 0.158 | 5/10 | 1992 | Salmon R./Adirondack | Little Clear | 15 | 17.8 | None | 16,320 |
| ATLANTIC SALMON - FALL FINGERLINGS | | | | | | | | | | |
| Black River | Dexter | 0.19 | 10/18 | 1993 | Adirondack | Little Clear | 04 | 19.1 | LV | 30,000 |
| ATLANTIC SALMON YEARLINGS | | | | | | | | | | **135,280** |
| ATLANTIC SALMON FALL FINGERLINGS | | | | | | | | | | **30,000** |
| ATLANTIC SALMON TOTAL | | | | | | | | | | **165,280** |

APPENDIX B4. Salmon, trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| BROWN TROUT - YEARLINGS | | | | | | | | | | |
| Lake Ontario | Ray Bay | 523 | 5/3 | 1992 | Salmon River | Rome Lab | 18 | 4.4 | None | 17,900 |
| Lake Ontario | Hontario Point | 523 | 6/2 | 1992 | Salmon River | Rome Lab | 18 | 4.6 | None | 17,900 |
| Lake Ontario | Selkirk Shores | 623 | 6/3 | 1992 | Salmon River | Rome Lab | 18 | 4.7 | Ad V | 14,330 |
| Lake Ontario | Selkirk Shores | 623 | 6/3 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 8.6 | LV | 28,660 |
| Lake Ontario | Selkirk Shores | 623 | 6/24 | 1992 | Salmon River | Rome Lab | 18 | 3.8 | None | 6,700 |
| SELKIRK SHORES TOTAL | | | | | | | | | | 49,690 |
| Lake Ontario | Oswego | 721 | 5/3 | 1992 | Salmon River | Rome Lab | 18 | 4.5 | AdLV | 14,330 |
| Lake Ontario | Oswego | 721 | 6/7 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 7.4 | LV | 12,960 |
| Lake Ontario | Oswego | 721 | 6/3 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 9.6 | LV | 14,330 |
| OSWEGO TOTAL | | | | | | | | | | 41,620 |
| Lake Ontario | Fair Haven | 720 | 6/3 | 1992 | Salmon River | Rome Lab | 18 | 4.4 | AdLV | 14,330 |
| Lake Ontario | Fair Haven | 720 | 6/7 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 7.4 | LV | 5,570 |
| Lake Ontario | Fair Haven | 720 | 6/7 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 7.4 | LV | 8,350 |
| Lake Ontario | Fair Haven | 720 | 6/3 | 1992 | Caledonia | Seeforellen/Caledonia | 18 | 7.2 | LV | 14,330 |
| FAIR HAVEN TOTAL | | | | | | | | | | 42,580 |
| Lake Ontario | Sodus | 819 | 5/5 | 1992 | Salmon River | Rome Lab | 17 | 5.0 | None | 30,080 |
| Lake Ontario | Pultneyville | 817 | 5/28 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 4.0 | None | 11,280 |
| Lake Ontario | Pultneyville | 817 | 6/3 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.2 | None | 5,640 |
| Lake Ontario | Pultneyville | 817 | 6/11 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.0 | None | 5,640 |
| PULTNEYVILLE TOTAL | | | | | | | | | | 22,560 |
| Lake Ontario | Webster | 816 | 6/8 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.4 | None | 10,810 |
| Lake Ontario | Webster | 816 | 6/15 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.3 | None | 10,810 |
| WEBSTER TOTAL | | | | | | | | | | 21,620 |
| Lake Ontario | Irondequoit | 815 | 5/5 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 3.9 | None | 21,620 |
| Lake Ontario | Rochester | 815 | 5/13 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 3.6 | None | 28,200 |
| Lake Ontario | Braddock's Bay | 815 | 5/9 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.2 | None | 10,810 |
| Lake Ontario | Braddock's Bay | 815 | 5/16 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.4 | None | 10,810 |
| BRADDOCK'S BAY TOTAL | | | | | | | | | | 21,620 |
| Lake Ontario | Hamlin Beach | 713 | 6/25 | 1992 | Salmon River | Rome Lab | 18 | 3.5 | None | 6,700 |
| Lake Ontario | Hamlin Beach | 713 | 5/3 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 4.0 | None | 33,840 |
| HAMLIN BEACH TOTAL | | | | | | | | | | 40,540 |
| Lake Ontario | Point Breeze | 711 | 6/10 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.4 | None | 17,860 |
| Lake Ontario | Point Breeze | 711 | 6/11 | 1992 | Caledonia | Rome Lab/Randolph | 18 | 3.3 | None | 17,860 |
| POINT BREEZE TOTAL | | | | | | | | | | 35,720 |
| Lake Ontario | Olcott | 708 | 6/25 | 1992 | Salmon River | Rome Lab | 18 | 3.5 | None | 6,700 |
| Lake Ontario | Olcott | 708 | 5/10 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 3.7 | None | 23,500 |
| OLCOTT TOTAL | | | | | | | | | | 30,200 |
| Lake Ontario | Wilson | 707 | 5/6 | 1992 | Caledonia | Rome Lab/Randolph | 17 | 3.9 | None | 23,500 |
| **BROWN TROUT TOTAL** | | | | | | | | | | **445,350** |

APPENDIX B4. Salmon, trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| **CHINOOK SALMON FINGERLINGS** | | | | | | | | | | |
| Henderson Bay | Association Island Cut | 423 | 6/4 | 1993 | Salmon River | Salmon River | 06 | 118.0 | Ad | 40,000 |
| Henderson Bay | Association Island Cut | 423 | 6/4 | 1993 | Salmon River | Salmon River | 06 | 112.0 | RV | 40,000 |
| HENDERSON BAY TOTAL | | | | | | | | | | 80,000 |
| North Sandy Creek | NY Route 3 | 0.44 | 6/2 | 1993 | Salmon River | Salmon River | 06 | 91.0 | None | 56,500 |
| South Sandy Creek | NY Route 3 | 0.45 | 6/2 | 1993 | Salmon River | Salmon River | 06 | 91.0 | None | 56,500 |
| Beaverdam Brook | Salmon River Hatchery | 0.53-8 | 6/28 | 1993 | Salmon River | Salmon River | 06 | 75.0 | None | 270,000 |
| Salmon River | NY Route 3 | 0.53 | 6/11 | 1993 | Salmon River | Salmon River | 06 | 73.2 | None | 70,800 |
| Oswego River | Oswego Harbour | 0.66 | 6/7 | 1993 | Salmon River | Salmon River | 05 | 103.0 | None | 133,000 |
| Little Sodus Bay | State Park Boat Launch | 0.74 | 5/26 | 1993 | Salmon River | Salmon River | 04 | 120.6 | None | 106,500 |
| Sodus Bay | Outlet Channel | 0.84 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 118.3 | None | 106,500 |
| Genesee River | Naval Militia Boat Ramp | 0.117 | 6/8 | 1993 | Salmon River | Salmon River | 05 | 103.0 | None | 160,000 |
| Sandy Creek | DEC Boat Ramp | 0.130 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 118.3 | None | 106,500 |
| Oak Orchard Creek | Twin Bridges | 0.138 | 5/26 | 1993 | Salmon River | Salmon River | 04 | 118.3 | None | 160,000 |
| Eighteen Mile Creek | Olcott Harbour | 0.148 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 153.0 | RP | 30,000 |
| Eighteen Mile Creek | Olcott Harbour | 0.148 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 118.5 | None | 46,500 |
| Eighteen Mile Creek | Olcott Harbour | 0.148 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 100.0 | LP | 30,000 |
| EIGHTEEN MILE CREEK TOTAL | | | | | | | | | | 106,500 |
| Twelve Mile Creek | Wilson Harbour | 0.152 | 5/27 | 1993 | Salmon River | Salmon River | 04 | 118.5 | None | 36,500 |
| Niagara River | Lewiston Sand Docks | 0.158 | 5/28 | 1993 | Salmon River | Salmon River | 04 | 118.3 | None | 154,000 |
| **CHINOOK SALMON TOTAL** | | | | | | | | | | **1,603,300** |

APPENDIX B4. Salmon, trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| **COHO SALMON - YEARLINGS** | | | | | | | | | | |
| Beaverdam Brook | Smolt release pond | 0.53-8 | 4/1 | 1992 | Salmon River | Salmon River | 15.5 | 9.0 | None | 95,670 |
| **COHO SALMON - FALL FINGERLINGS** | | | | | | | | | | |
| Sodus Bay | West Pier | 0.84 | 10/01 | 1993 | Salmon River | Salmon River | 10 | 22.4 | None | 16,770 |
| Genesee River | Naval Militia Access Site | 0.117 | 10/01 | 1993 | Salmon River | Salmon River | 10 | 20.3 | None | 14,190 |
| Sandy Creek | Parkway Bridge | 0.130 | 9/30 | 1993 | Salmon River | Salmon River | 10 | 18.0 | None | 16,770 |
| Oak Orchard Creek | Twin Bridges | 0.138 | 9/29 | 1993 | Salmon River | Salmon River | 10 | 18.0 | None | 16,770 |
| Eighteen Mile Creek | Olcott Harbour | 0.148 | 9/30 | 1993 | Salmon River | Salmon River | 10 | 22.0 | None | 19,350 |
| Niagara River | Lewiston Sand Docks | 0.158 | 9/29 | 1993 | Salmon River | Salmon River | 10 | 18.0 | None | 16,120 |
| **COHO SALMON YEARLINGS** | | | | | | | | | | **95,670** |
| **COHO SALMON FALL FINGERLINGS** | | | | | | | | | | **99,970** |
| **COHO SALMON TOTAL** | | | | | | | | | | **195,640** |

APPENDIX B4. Salmon, trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| LAKE TROUT - YEARLINGS | | | | | | | | | | |
| Lake Ontario | Olcott | 708 | 5/18 | 1992 | Allegheny | Lewis Lake | 18 | 8.0 | 60-47-14 | 30,600 |
| Lake Ontario | Hamlin | 713 | 5/19 | 1992 | Allegheny | Lewis Lake | 18 | 9.2 | 60-47-13 | 40,000 |
| Lake Ontario | Hamlin | 713 | 5/19 | 1992 | Allegheny | Lewis Lake | 18 | 8.2 | 60-47-4 | 38,000 |
| Lake Ontario | Hamlin | 713 | 5/20 | 1992 | Allegheny | Ontario x Seneca | 18 | 13.0 | 60-47-12 | 40,000 |
| Lake Ontario | Hamlin | 713 | 5/20 | 1992 | Allegheny | Ontario x Seneca | 18 | 10.0 | 60-47-7 | 38,800 |
| HAMLIN TOTAL | | | | | | | | | | 156,800 |
| Lake Ontario | Sodus | 818 | 5/21 | 1992 | Allegheny | Lewis Lake | 18 | 6.4 | 60-47-3 | 38,000 |
| Lake Ontario | Sodus | 818 | 5/21 | 1992 | Allegheny | Lewis Lake | 18 | 6.8 | 60-47-2 | 38,000 |
| SODUS TOTAL | | | | | | | | | | 76,000 |
| Lake Ontario | Selkirk | 623 | 5/24 | 1992 | Allegheny | Lewis Lake | 18 | 10.0 | 60-47-6 | 40,000 |
| Lake Ontario | Selkirk | 623 | 5/1,2,3 | 1992 | Allegheny | Lewis Lake | 18 | 7.8 | 60-47-5 | 38,000 |
| SELKIRK TOTAL | | | | | | | | | | 78,000 |
| Lake Ontario | Stony | 422 | 5/25 | 1992 | Allegheny | Ontario x Seneca | 18 | 10.5 | 60-47-9 | 40,000 |
| Lake Ontario | Stony | 422 | 5/26 | 1992 | Allegheny | Seneca | 18 | 10.9 | 60-47-10 | 37,000 |
| Lake Ontario | Stony | 422 | 5/3, 6/4 | 1992 | Allegheny | Seneca | 18 | 13.0 | 60-47-11 | 40,000 |
| STONY TOTAL | | | | | | | | | | 117,000 |
| Lake Ontario | Stony Creek | 523 | 6/4 | 1992 | Allegheny | Ontario x Seneca | 18 | 12.0 | 60-47-8 | 40,000 |
| TOTAL LAKE TROUT | | | | | | | | | | 498,400 |

APPENDIX B4. Sal trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| RAINBOW TROUT - YEARLINGS | | | | | | | | | | |
| Lake Ontario | Selkirk Shores State Park | 623 | 6/18 | 1992 | Caledonia | Caledonia | 14 | 3.4 | None | 9,270 |
| Lake Ontario | Selkirk Shores State Park | 623 | 6/11 | 1992 | Caledonia | Caledonia | 14 | 3.9 | None | 11,250 |
| SELKIRK SHORES STATE PARK TOTAL | | | | | | | | | | 20,520 |
| Lake Ontario | Webster | 816 | 5/14 | 1992 | Caledonia | Caledonia | 13 | 4.0 | None | 9,000 |
| Lake Ontario | Sodus Point | 819 | 6/4 | 1992 | Caledonia | Caledonia | 14 | 3.5 | None | 18,000 |
| Lake Ontario | Hamlin Beach State Park | 713 | 5/4 | 1992 | Caledonia | Caledonia | 13 | 4.9 | None | 18,000 |
| Lake Ontario | Olcott Harbour | 708 | 5/11 | 1992 | Caledonia | Caledonia | 13 | 5.2 | None | 11,250 |
| Lake Ontario | Wilson Harbour | 707 | 5/7 | 1992 | Caledonia | Caledonia | 13 | 4.7 | None | 11,250 |
| RAINBOW TROUT TOTAL | | | | | | | | | | 88,020 |

APPENDIX B4. Sal trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | No. fish/ Pound | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| STEELHEAD YEARLINGS | | | | | | | | | | |
| Black River | Dexter Boat Launch | 0.19 | 3/29 | 1992 | Caledonia | Skamania | 11 | 11.4 | AdLV | 16,240 |
| Black River | Dexter Boat Launch | 0.19 | 3/29 | 1992 | Salmon River | Washington/Salmon R. | 11 | 10.8 | None | 23,285 |
| Black River | Dexter Boat Launch | 0.19 | 3/30 | 1992 | Salmon River | Washington/Salmon R. | 11 | 10.8 | None | 21,200 |
| Black River | Dexter Boat Launch | 0.19 | 4/20 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.0 | None | 1,515 |
| BLACK RIVER TOTAL | | | | | | | | | | 62,240 |
| Stony Creek | State Park Boat Launch | 0.40 | 4/16 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.2 | None | 17,650 |
| South Sandy Creek | NY Route 3 | 0.45 | 4/16 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.0 | None | 24,500 |
| Beaverdam Brook | Salmon River Hatchery | 0.53-8 | 4/13 | 1992 | Salmon River | Washington/Salmon R. | 12 | 12.1 | LV | 60,000 |
| Beaverdam Brook | Salmon River Hatchery | 0.53-8 | 3/25 | 1992 | Caledonia | Skamania | 11 | 11.4 | AdLP | 25,280 |
| BEAVERDAM BROOK TOTAL | | | | | | | | | | 85,280 |
| Orwell Brook | Tubbs Road | 0.53-6 | 4/14 | 1992 | Salmon River | Washington/Salmon R. | 12 | 10.3 | LV | 9,100 |
| Orwell Brook | Tubbs Road | 0.53-6 | 4/15 | 1992 | Salmon River | Washington/Salmon R. | 12 | 12.5 | LV | 5,000 |
| Orwell Brook | Tubbs Road | 0.53-6 | 4/20 | 1992 | Salmon River | Washington/Salmon R. | 12 | 12.7 | LV | 5,700 |
| Orwell Brook | Tubbs Road | 0.53-6 | 4/23 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | LV | 200 |
| ORWELL BROOK TOTAL | | | | | | | | | | 20,000 |
| Trout Brook | Mattison Rd & Co. Rt. 22 | 0.53/5 | 4/19 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.6 | LV | 3,370 |
| Trout Brook | Mattison Rd & Co. Rt. 22 | 0.53/5 | 4/21 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.0 | LV | 10,000 |
| Trout Brook | Mattison Rd & Co. Rt. 22 | 0.53/5 | 4/23 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | LV | 6,630 |
| TROUT BROOK TOTAL | | | | | | | | | | 20,000 |
| Spring Brook | Reservoir | 0.53-2-P.6 | 4/9 | 1992 | Salmon River | Washington/Salmon R. | 12 | 10.6 | LV | 7,500 |
| Spring Brook | Reservoir | 0.53-2-P.6 | 4/20 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.0 | LV | 2,500 |
| Spring Brook | Reservoir | 0.53-2-P.6 | 4/26 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | LV | 10,000 |
| SPRING BROOK TOTAL | | | | | | | | | | 20,000 |
| SALMON RIVER SYSTEM TOTAL | | | | | | | | | | 60,000 |
| Oswego River | Below Route 104 | 0.66 | 4/16 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.2 | None | 14,700 |
| Sterling Creek | Fair Haven Beach St. Pk. | 0.73 | 5/27 | 1992 | Salmon River | Washington/Salmon R. | 13 | 9.8 | None | 5,000 |
| Maxwell Creek | Mouth to Trib. 2 | 0.85 | 4/8 | 1992 | Caledonia | Skamania | 11 | 13.4 | AdLP | 16,240 |
| Irondequoit Creek | Audubon Property | 0.108 | 4/15 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.7 | None | 23,500 |
| Genesee River | Naval Militia Boat Ramp | 0.117 | 5/27 | 1992 | Salmon River | Washington/Salmon R. | 13 | 9.8 | None | 5,000 |
| Genesee River | Naval Militia Boat Ramp | 0.117 | 4/15 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.7 | None | 19,600 |
| GENESEE RIVER TOTAL | | | | | | | | | | 24,600 |
| Salmon Creek | Near Hilton High School | 0.125 | 4/19 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.3 | None | 6,470 |
| Sandy Creek | DEC Boat Launch | 0.130 | 4/19 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.3 | None | 9,800 |
| Oak Orchard Creek | Twin Bridges | 0.138 | 4/19 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.3 | None | 19,600 |
| Johnson Creek | Kirkville to Lyndonville | 0.139 | 5/10 | 1992 | Salmon River | Washington/Salmon R. | 13 | 12.5 | None | 6,650 |
| Keg Creek | Route 18 | 0.148 | 4/22 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | None | 10,900 |
| East Br. Twelvemile Cr. | Route 18 | 0.152 | 4/22 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | None | 13,030 |
| Twelvemile Creek | Rt. 18 & Youngstown Rd. | 0.152A | 4/22 | 1992 | Salmon River | Washington/Salmon R. | 12 | 14.5 | None | 13,030 |
| Niagara River | Lewiston Sand Docks | 0.158 | 4/20 | 1992 | Salmon River | Washington/Salmon R. | 12 | 13.5 | None | 24,500 |
| Niagara River | Lewiston Sand Docks | 0.158 | 3/29 | 1992 | Caledonia | Skamania | 11 | 10.3 | AdLP | 16,240 |
| NIAGARA RIVER TOTAL | | | | | | | | | | 40,740 |
| WASHINGTON STEELHEAD YEARLINGS | | | | | | | | | | 379,930 |
| SKAMANIA STEELHEAD YEARLINGS | | | | | | | | | | 74,000 |
| TOTAL YEARLINGS | | | | | | | | | | 453,930 |

APPENDIX B4. Sal trout and walleye stocked in New York waters of Lake Ontario in 1993.

| Area Stocked | Location | Grid/Key | Date Stocked | Year Class | Hatchery Reared | Strain or Egg Source | Age Months | Average Size (In.) | Marks Applied | Number Stocked |
|---|---|---|---|---|---|---|---|---|---|---|
| **WALLEYE - FINGERLINGS** | | | | | | | | | | |
| Niagara River | Lewiston | 0.158 | 7/6 | 1993 | Oneida | Oneida | 03 | 1.8 | None | 11,640 |
| Lake Ontario | Irondequoit Bay | 815 | 7/2 | 1993 | Oneida | Oneida | 03 | 2.0 | None | 36,000 |
| Lake Ontario | South Sandy Pond | 523 | 6/30 | 1993 | Oneida | Oneida | 02 | 1.8 | None | 7,240 |
| Lake Ontario | Little Sodus Bay | 720 | 7/9 | 1993 | Oneida | Oneida | 03 | 2.8 | None | 15,000 |
| Lake Ontario | Port Bay | 819 | 6/30 | 1993 | Oneida | Oneida | 02 | 1.8 | None | 10,400 |
| Lake Ontario | Blind Sodus | 720 | 6/30 | 1993 | Oneida | Oneida | 02 | 1.8 | None | 5,600 |
| Lake Ontario | Sodus Bay | 0.84 | 7/9 | 1993 | Oneida | Oneida | 03 | 2.8 | None | 19,814 |
| **TOTAL STOCKED BY NYDEC** | | | | | | | | | | **105,694** |
| Lake Ontario | Niagara River | 0.158 | 7/15 | 1993 | Niagara R. Ang. Assoc. | Oneida | 03 | 2.0-2.5 | None | 22,000 |
| Lake Ontario | Port Bay | 819 | 5/25 | 1993 | Sanford Bait Farms | Oneida | 02 | 1.8 | None | 12,000 |
| Lake Ontario | Port Bay | 819 | 10/ | 1993 | Sanford Bait Farms | Oneida | 06 | 6.0-9.0 | LP | 200 |
| Lake Ontario | Sodus Bay | 0.84 | 6/25 | 1993 | Sanford Bait Farms | Oneida | 02 | 1.8 | None | 62,000 |
| **TOTAL STOCKED BY COOPERATORS** | | | | | | | | | | **96,200** |
| **TOTAL WALLEYE** | | | | | | | | | | **201,894** |

Species-specific catch-per-standard gillnet lift, northeastern Lake Ontario 1992

| | Brighton | | | | | Main Duck Sill | | | | | Middle Ground | Rocky Point | | | | | Wellington | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Depth (m) | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 | 5 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 |
| Alewife | 153 | 332 | 241 | 779 | 745 | 2571 | 1778 | 1013 | 652 | 651 | 31 | 148 | 229 | 102 | 159 | 84 | 13 | 43 | 128 | 78 | 44 |
| Gizzard shad | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chinook salmon | 0 | 1 | 1 | 4 | 10 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| Brown trout | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Lake Trout | 50 | 46 | 47 | 49 | 103 | 0 | 9 | 15 | 103 | 158 | 22 | 1 | 7 | 11 | 33 | 88 | 145 | 138 | 110 | 190 | 181 |
| Lake whitefish | 1 | 4 | 16 | 2 | 8 | 0 | 0 | 7 | 19 | 12 | 0 | 0 | 0 | 4 | 2 | 27 | 0 | 0 | 3 | 1 | 4 |
| Lake herring | 1 | 3 | 1 | 0 | 2 | 7 | 7 | 2 | 4 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 2 |
| Round whitefish | 0 | 22 | 19 | 38 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 |
| Rainbow Smelt | 0 | 0 | 4 | 4 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 5 | 0 | 5 |
| Northern pike | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| White sucker | 11 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 2 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| Lake chub | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carp | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Brown bullhead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| American eel | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Burbot | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| White perch | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 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 |
| Rock bass | 1 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 0 | 0 | 4 | 9 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 0 |
| Smallmouth bass | 0 | 0 | 0 | 0 | 0 | 47 | 16 | 1 | 0 | 0 | 1 | 60 | 22 | 4 | 2 | 0 | 1 | 1 | 0 | 0 | 0 |
| Yellow perch | 115 | 170 | 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 540 | 0 | 0 | 0 | 0 | 0 | 478 | 327 | 212 | 54 | 11 |
| Walleye | 2 | 1 | 0 | 0 | 0 | 152 | 5 | 0 | 0 | 0 | 19 | 37 | 4 | 1 | 0 | 0 | 24 | 0 | 1 | 1 | 1 |
| Freshwater drum | 3 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |

Species-specific catch-per-standard gillnet lift, northeastern Lake Ontario 1993.

| | Brighton | | | | | Main Duck Sill | | | | | Middle Ground | Rocky Point | | | | | Wellington | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Depth (m) | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 | 5 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 |
| Lamprey | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alewife | 129 | 80 | 148 | 119 | 300 | 127 | 143 | 458 | 197 | 34 | 5 | 106 | 65 | 191 | 112 | 94 | 22 | 37 | 94 | 230 | 235 |
| Gizzard shad | 67 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 |
| Coho salmon | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chinook Salmon | 0 | 0 | 7 | 21 | 10 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 6 | 13 | 16 | 1 | 0 | 0 | 1 | 6 | 2 |
| Brown trout | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Lake trout | 1 | 12 | 79 | 32 | 128 | 29 | 52 | 83 | 134 | 145 | 0 | 0 | 4 | 24 | 50 | 51 | 0 | 7 | 20 | 47 | 105 |
| Lake whitefish | 0 | 1 | 13 | 9 | 8 | 1 | 9 | 23 | 33 | 8 | 0 | 0 | 0 | 1 | 5 | 35 | 0 | 0 | 0 | 5 | 65 |
| Lake herring | 0 | 0 | 3 | 5 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 3 | 4 |
| Round whitefish | 0 | 0 | 10 | 36 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rainbow smelt | 0 | 0 | 0 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| Northern pike | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| White sucker | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 |
| Lake Chub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 4 | 5 | 0 |
| Carp | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 |
| Brown bullhead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Burbot | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 10 | 3 |
| White perch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rock bass | 22 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 |
| Smallmouth bass | 1 | 0 | 0 | 0 | 0 | 41 | 4 | 0 | 0 | 1 | 0 | 32 | 17 | 8 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Yellow perch | 538 | 564 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 268 | 0 | 0 | 4 | 1 | 0 | 439 | 883 | 587 | 279 | 16 |
| Walleye | 34 | 1 | 0 | 0 | 0 | 43 | 4 | 0 | 0 | 0 | 13 | 39 | 3 | 1 | 2 | 0 | 10 | 4 | 2 | 0 | 0 |
| Freshwater drum | 23 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |

Species-specific catch-per-standard gillnet lift, outlet basin Lake Ontario 1992.

| | Outlet Basin | | Flatt Point | | | | | Grape Island | | | | | Melville Shoal | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site depth (m) | 30 | 30 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 |
| Lamprey | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alewife | 497 | 100 | 179 | 230 | 648 | 491 | 699 | 1467 | 1221 | 1631 | 1169 | 397 | 1667 | 611 | 605 | 942 | 324 |
| Gizzard shad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Chinook salmon | 1 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brown trout | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lake trout | 275 | 279 | 2 | 4 | 14 | 91 | 227 | 3 | 7 | 41 | 118 | 287 | 9 | 12 | 35 | 60 | 235 |
| Lake whitefish | 21 | 82 | 0 | 0 | 0 | 101 | 8 | 0 | 0 | 3 | 47 | 67 | 0 | 0 | 0 | 84 | 30 |
| Lake herring | 3 | 1 | 0 | 0 | 0 | 72 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |
| Rainbow smelt | 16 | 9 | 0 | 0 | 0 | 13 | 19 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 11 |
| Northern pike | 0 | 0 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 |
| White sucker | 0 | 0 | 18 | 48 | 10 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| Carp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Channel catfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 7 | 3 | 1 | 1 | 0 |
| Burbot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| White perch | 1 | 1 | 5 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 4 | 0 | 3 | 2 | 5 | 2 | 0 |
| Rock bass | 0 | 0 | 24 | 1 | 2 | 0 | 0 | 26 | 16 | 2 | 0 | 0 | 35 | 37 | 10 | 2 | 0 |
| Smallmouth bass | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 8 | 13 | 1 | 0 | 0 | 10 | 18 | 3 | 0 | 0 |
| Yellow perch | 3 | 0 | 376 | 727 | 682 | 461 | 8 | 234 | 189 | 168 | 58 | 0 | 355 | 322 | 335 | 577 | 79 |
| Walleye | 0 | 0 | 5 | 1 | 1 | 0 | 0 | 85 | 12 | 27 | 1 | 0 | 300 | 79 | 31 | 7 | 0 |
| Freshwater drum | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 8 | 2 | 1 | 0 | 0 | 3 | 0 | 2 | 0 | 0 |
| Soulpin | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Species-specific catch-per-standard gillnet lift, outlet basin Lake Ontario 1993.

| | Outlet Basin | | Flatt Point | | | | | Grape Island | | | | | Melville Shoal | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site depth (m) | 30 | 30 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 | 8 | 13 | 18 | 23 | 28 |
| Lamprey | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alewife | 298 | 70 | 329 | 552 | 616 | 1673 | 249 | 518 | 281 | 166 | 97 | 174 | 264 | 297 | 402 | 858 | 470 |
| Chinook salmon | 1 | 0 | 1 | 2 | 2 | 9 | 3 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 1 | 3 | 0 |
| Brown trout | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lake trout | 243 | 246 | 5 | 3 | 21 | 148 | 302 | 9 | 50 | 125 | 190 | 205 | 1 | 1 | 10 | 36 | 171 |
| Lake whitefish | 24 | 118 | 0 | 0 | 5 | 141 | 42 | 0 | 1 | 99 | 99 | 62 | 0 | 0 | 0 | 142 | 55 |
| Lake herring | 1 | 1 | 0 | 0 | 0 | 26 | 20 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 3 |
| Round whitefish | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rainbow Smelt | 4 | 5 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Northern pike | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| White sucker | 0 | 0 | 11 | 36 | 37 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| Redhorse sucker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Channel catfish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| Stonecat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 |
| Burbot | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 0 | 0 | 0 | 0 | 0 |
| White perch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 0 | 0 | 27 | 3 | 1 | 0 | 0 |
| Rock bass | 0 | 0 | 21 | 12 | 0 | 0 | 0 | 23 | 16 | 6 | 11 | 0 | 30 | 29 | 17 | 0 | 0 |
| Smallmouth bass | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 10 | 16 | 0 | 1 | 0 | 13 | 8 | 7 | 0 | 0 |
| Yellow perch | 0 | 0 | 131 | 582 | 516 | 66 | 0 | 290 | 272 | 300 | 332 | 18 | 425 | 767 | 606 | 189 | 11 |
| Walleye | 0 | 0 | 10 | 1 | 0 | 0 | 0 | 87 | 31 | 34 | 8 | 0 | 216 | 65 | 39 | 7 | 0 |
| Freshwater drum | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |

Species-specific catch-per-standard gillnet lift, Bay of Quinte 1992.

| | Big Bay | Hay Bay | | Lennox | | |
|---|---|---|---|---|---|---|
| Site Depth (m) | 5 | 8 | 13 | 8 | 15 | 23 |
| Longnose gar | 5 | 0 | 0 | 0 | 0 | 0 |
| Alewife | 1 | 178 | 61 | 423 | 758 | 473 |
| Gizzard shad | 4 | 4 | 0 | 2 | 0 | 0 |
| Chinook salmon | 0 | 0 | 0 | 0 | 0 | 1 |
| Brown trout | 0 | 1 | 0 | 9 | 23 | 7 |
| Lake trout | 0 | 5 | 2 | 5 | 22 | 99 |
| Lake whitefish | 0 | 3 | 1 | 0 | 0 | 44 |
| Lake herring | 0 | 2 | 1 | 1 | 0 | 2 |
| Rainbow smelt | 0 | 3 | 1 | 0 | 0 | 3 |
| Northern Pike | 9 | 4 | 3 | 0 | 0 | 0 |
| White Sucker | 64 | 31 | 63 | 18 | 12 | 12 |
| Carp | 3 | 0 | 3 | 1 | 1 | 0 |
| Brown bullhead | 36 | 1 | 1 | 0 | 0 | 0 |
| Channel Catfish | 3 | 0 | 0 | 0 | 0 | 0 |
| White perch | 1236 | 32 | 20 | 19 | 24 | 0 |
| White bass | 3 | 0 | 0 | 0 | 0 | 0 |
| Rock bass | 0 | 1 | 0 | 80 | 8 | 0 |
| Smallmouth bass | 0 | 0 | 0 | 12 | 5 | 0 |
| Black crappie | 2 | 0 | 0 | 0 | 0 | 0 |
| Yellow perch | 118 | 1395 | 1100 | 535 | 943 | 260 |
| Walleye | 238 | 30 | 2 | 154 | 76 | 7 |
| Freshwater drum | 86 | 3 | 0 | 8 | 3 | 0 |

Species-specific catch-per-standard gillnet lift, Bay of Quinte 1993.

| | Big Bay | | | Conway | | | | Hay Bay | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Site Depth (m) | 5 | 5 | 8 | 13 | 20 | 30 | 45 | 5 | 8 | 13 |
| Longnose gar | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alewife | 1 | 92 | 173 | 820 | 667 | 0 | 0 | 53 | 59 | 26 |
| Gizzard shad | 109 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 26 | 0 |
| Chinook salmon | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 7 |
| Brown trout | 0 | 0 | 0 | 2 | 31 | 0 | 0 | 0 | 0 | 0 |
| Lake trout | 0 | 0 | 0 | 0 | 4 | 151 | 20 | 0 | 0 | 0 |
| Lake whitefish | 0 | 0 | 0 | 0 | 0 | 132 | 7 | 0 | 0 | 0 |
| Lake herring | 0 | 0 | 0 | 0 | 0 | 0 | 59 | 0 | 0 | 39 |
| Rainbow smelt | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 |
| Northern pike | 8 | 7 | 2 | 0 | 0 | 0 | 0 | 20 | 7 | 0 |
| White sucker | 54 | 39 | 39 | 4 | 15 | 13 | 0 | 13 | 39 | 26 |
| Redhorse sucker | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carp | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 26 | 7 |
| Brown bullhead | 100 | 13 | 2 | 0 | 0 | 0 | 0 | 33 | 26 | 7 |
| Channel catfish | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Burbot | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trout-perch | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| White perch | 758 | 46 | 94 | 114 | 57 | 0 | 0 | 309 | 217 | 20 |
| Rock bass | 1 | 125 | 86 | 13 | 31 | 0 | 0 | 0 | 0 | 0 |
| Pumpkinseed | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Smallmouth bass | 2 | 7 | 13 | 2 | 0 | 0 | 0 | 13 | 0 | 0 |
| Black crappie | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yellow perch | 380 | 2204 | 947 | 1592 | 1603 | 0 | 0 | 711 | 1145 | 1145 |
| Walleye | 142 | 487 | 254 | 86 | 34 | 0 | 0 | 204 | 99 | 7 |
| Freshwater drum | 31 | 13 | 31 | 4 | 0 | 0 | 0 | 39 | 26 | 0 |

Species-specific catch-per-trawl, Bay of Quinte and Outlet Basin Lake Ontario, 1992.

| | Bay of Quinte | | | | | | | Outlet | |
|---|---|---|---|---|---|---|---|---|---|
| | Trenton | Belleville | Big Bay | Deseronto | Hay Bay | Conway | EB02 | EB03 | EB06 |
| Alewife | 34 | 45 | 10 | 86 | 8 | 55 | 0 | 6 | 37 |
| Gizzard shad | 30 | 6 | 92 | 48 | 0 | 0 | 0 | 0 | 0 |
| Lake trout | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Lake whitefish | 0 | 0 | 0 | 0 | 0 | 29 | 4 | 1 | 1 |
| Lake herring | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Rainbow smelt | 0 | 0 | 0 | 0 | 2 | 24 | 30 | 59 | 5 |
| White sucker | 11 | 3 | 2 | 4 | 8 | 19 | 0 | 1 | 0 |
| Carp | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| Spottail shiner | 19 | 32 | 8 | 28 | 6 | 0 | 0 | 37 | 0 |
| Brown Bullhead | 16 | 28 | 19 | 22 | 5 | 0 | 0 | 0 | 0 |
| American eel | 0 | 0 | 0 | 1 | 4 | 1 | 0 | 0 | 0 |
| Threespine stickleback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 0 |
| Trout-perch | 24 | 180 | 42 | 93 | 119 | 126 | 0 | 270 | 0 |
| White perch | 16 | 34 | 113 | 104 | 26 | 1 | 0 | 0 | 0 |
| Rock bass | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pumpkinseed | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Black crappie | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yellow perch | 63 | 9 | 3 | 21 | 21 | 21 | 0 | 1 | 0 |
| Walleye | 10 | 19 | 19 | 51 | 10 | 5 | 0 | 1 | 0 |
| Johnny darter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |
| Freshwater drum | 2 | 6 | 3 | 7 | 0 | 0 | 0 | 0 | 0 |
| Slimy Sculpin | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 |

Species-specific catch-per-trawl, Bay of Quinte and Outlet Basin Lake Ontario, 1993.

| | Bay of Quinte | | | | | | Outlet | | |
|---|---|---|---|---|---|---|---|---|---|
| | Trenton | Belleville | Big Bay | Deseronto | Hay Bay | Conway | EB02 | EB03 | EB06 |
| Alewife | 154 | 502 | 94 | 496 | 21 | 66 | 148 | 420 | 84 |
| Gizzard shad | 54 | 12 | 73 | 35 | 0 | 0 | 0 | 0 | 0 |
| Lake trout | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Lake whitefish | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 5 | 25 |
| Lake herring | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Rainbow smelt | 0 | 0 | 0 | 0 | 1 | 3 | 582 | 20 | 697 |
| White sucker | 6 | 1 | 2 | 2 | 7 | 2 | 0 | 0 | 0 |
| Carp | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| Spottail shiner | 54 | 161 | 5 | 23 | 22 | 0 | 0 | 23 | 0 |
| Brown bullhead | 22 | 11 | 36 | 48 | 9 | 0 | 0 | 0 | 0 |
| Channel catfsih | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| American eel | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| Threespine stickleback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trout-perch | 45 | 54 | 11 | 54 | 35 | 273 | 1 | 938 | 1 |
| White perch | 38 | 150 | 134 | 29 | 86 | 48 | 0 | 0 | 0 |
| Sunfish spp | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pumpkinseed | 24 | 11 | 13 | 3 | 1 | 0 | 0 | 0 | 0 |
| Black crappie | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Yellow perch | 294 | 46 | 11 | 101 | 23 | 11 | 0 | 0 | 0 |
| Walleye | 18 | 23 | 9 | 21 | 13 | 23 | 0 | 1 | 0 |
| Johnny darter | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Logperch | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Freshwater drum | 23 | 12 | 15 | 8 | 16 | 0 | 0 | 0 | 0 |
| Slimy sculpin | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |