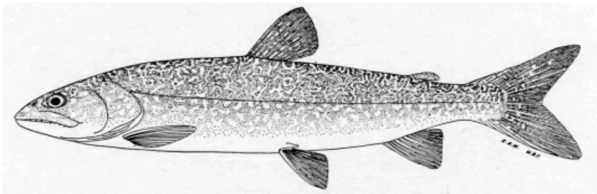

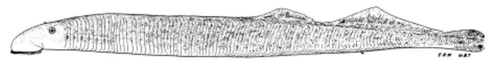

Report of the Lake Erie Coldwater Task Group

31 March 2004

Members:

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Phil Ryan	Ontario Ministry of Natural Resources (Co-Chair)
Andy Cook	Ontario Ministry of Natural Resources
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Elizabeth Trometer	United States Fish and Wildlife Service
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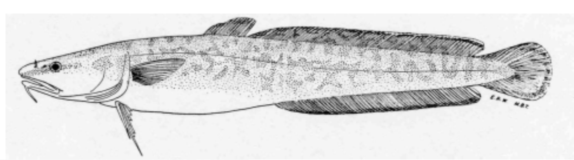
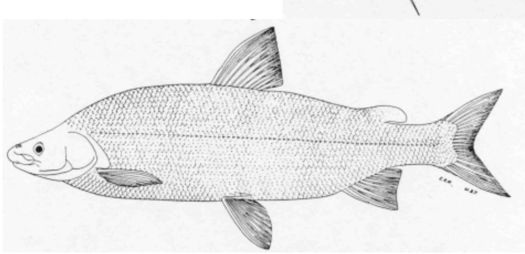
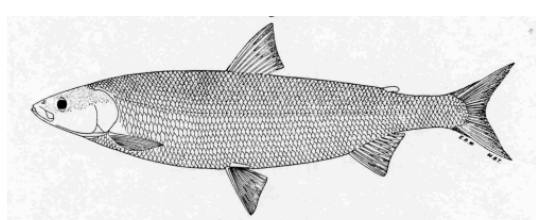
Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fisheries Commission







Line drawings from Trautman (1981)

Protocol for Use of Cold Water Task Group Data and Reports

The Coldwater Task Group (CWTG) uses standardized methods, equipment, and protocols as much as possible; however, data and sampling methods do vary across agencies. The data are based upon surveys that have limitations due to gear, depth, time, and weather constraints that are variable from year to year. Any results or conclusions must be treated with respect to these limitations. Caution should be exercised by outside researchers not familiar with each agency's collection and analysis methods to avoid misinterpretation.

The CWTG strongly encourages outside researchers to contact and involve the CWTG in the use of any specific data contained in this report. Coordination with the CWTG can only enhance the final output or publication and benefit all parties involved.

Any data intended for publication should be reviewed by the CWTG and written permission received from the agency responsible for the data collection.

Cover

Line Drawings from:

Trautman, M. B. 1981. Fishes of Ohio. The Ohio State University Press, Columbus, Ohio, USA. 782 pp.

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2004 – 2005 Cold Water Task Group Charges

Charge 1: Coordinate annual standardized lake trout assessment among all eastern basin agencies and report upon the status of lake trout rehabilitation.

Charge 2: Continue to assess the whitefish population age structure, growth, diet, seasonal distribution and other population parameters.

Charge 3: Continue to assess the burbot population age structure, growth, diet, seasonal distribution and other population parameters.

Charge 4: Continue to participate in the IMSL process on Lake Erie to outline and prescribe the needs of the Lake Erie sea lamprey management program.

Charge 5: Maintain an annual interagency electronic database of Lake Erie salmonid stocking and current projections for the STC, GLFC and Lake Erie agency data depositories.

Charge 6: Report on the status of rainbow trout in Lake Erie, including stocking numbers, strains being stocked, academic and resource agency research interests, and related population parameters, including growth, diet and exploitation.

Charge 7: Monitor the current status of Lake Herring. Review ecology and history of this species and assess potential for recovery.

Charge 8: Improve description of diet for top coldwater predators.

Background

The Cold Water Task Group (CWTG) is one of several technical groups under the Lake Erie Committee (LEC) that addresses specific charges related to the fish community. The group was originally formed in 1980 as the Lake Trout Task Group with its primary function of coordination, collation, analyses, and reporting of annual lake trout assessments among its five member agencies and assessing the results toward rehabilitation status. Restoration of lake trout into its native eastern basin Lake Erie habitat began in 1978, when 236,000 surplus yearlings were obtained from a scheduled stocking in Lake Ontario. Similar numbers of yearlings were also available for Lake Erie in 1979. In 1982, the U.S. Fish and Wildlife Service (USFWS), in cooperation with the Pennsylvania Fish and Boat Commission (PFBC) and the New York State Department of Environmental Conservation (NYSDEC), committed to annually produce and stock at least 160,000 yearlings in Lake Erie and monitor lake trout restoration in the eastern basin. A formal lake trout rehabilitation plan was developed in 1985 (Lake Trout Task Group 1985) that defined goals and specific quantitative objectives for restoration. A draft revision of the plan (Pare 1993) was presented to the LEC in 1993, but the status of that draft has not changed because of a lack of consensus regarding the position of lake trout in the Lake Erie fish community goals and objectives (FCGO) (Cornelius et al. 1995). These two plans still serve as the working documents guiding current assessment efforts.

The group developed into the CWTG in 1992 as interest in the expanding burbot and lake whitefish populations as well as predator/prey relationships involving salmonines and rainbow smelt interactions prompted additional charges to the group from the LEC. Rainbow/steelhead trout dynamics have recently entered into the task group's list of charges. A new charge concerning lake herring was added in 1999.

This report is specifically designed to address each charge presented to the CWTG at the LEC annual meeting, held 30 - 31 March 2005. Data have been supplied by each member agency, when available, and combined for this report if the data conform to standard protocol. Individual agencies may still choose to report their own assessment activities under separate agency letterhead.

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Pare, S. M. 1993. The Restoration of Lake Trout in Eastern Lake Erie. United States Fish and Wildlife Service, Lower Great Lakes Fishery Resources Office Administrative Report 93-02. 73 pp. Prepared for the Coldwater Task Group, Lake Erie Committee.

Trautman, M. B. 1981. Fishes of Ohio. The Ohio State University Press, Columbus, Ohio , USA. 782 pp.

Charge 1: Coordinate annual standardized lake trout assessments among all eastern basin agencies and report upon the status of lake trout rehabilitation (J. Markham)

Methods

A stratified, random design, deepwater gill net assessment protocol for lake trout has been in place since 1986. NYSDEC modified the protocol in 1996 by using nets made of monofilament mesh, instead of the standard multifilament nylon mesh. This modification was made following two years of comparative data that detected no significant difference in the total catch between the two net types (Culligan et al. 1996). In 1998 and 1999, all CWTG agencies except PFBC, which still uses nets made of multifilament nylon mesh, switched to standard monofilament assessment nets to sample eastern basin lake trout.

Ten net panels, each 15.2 m (50 ft) long, are tied together to form 152.4-m (500-ft) gangs. Each panel consists of diamond-shaped units that have the same mesh size. Among the panels, mesh size ranges from 38mm (1.5 in.) to 152 mm (6 in.) on a side (in 12.7-mm increments). Panels are arranged randomly in each gang. Gangs are set overnight, on bottom, along the contour and perpendicular to a randomly selected north/south-oriented transect during the month of August or possibly into early September, prior to fall turnover.

Sampling design divides the eastern basin of Lake Erie into eight equal areas using north/south-oriented 58000 series Loran C Lines of Position (LOP) bounded on the west by LOP 58435 and on the east by LOP 58955 (Figure 1.1). Each area contains 13 equidistant north/south-oriented LOPs that serve as transects. Three transects are randomly selected in each area and sampled first. Once completed, the whole process is repeated, including random selection. A full compliment of standard eastern basin effort should be 60 standard lifts each for New York and Pennsylvania waters (2 areas each) and 120 lifts from Ontario waters (4 areas total). To date, this amount of effort has never been achieved.

Sampling protocol requires the first gang to be set along the contour at which the 8° to 10°C isotherm intersects with the bottom. The top of the gang must be within this isotherm. The next three gangs are set in deeper/colder water at increments of either 1.5 m depth or 0.8-km distance from the previous (shallower) gang, whichever occurs first along the transect. The fifth and deepest gang is set 15 m deeper than the shallowest net (number 1) or at a distance of 1.6 km from net number 4, whichever occurs first.

NYSDEC and PFBC have been responsible for completing standard assessments in their jurisdictional waters since 1986 and 1991, respectively. The Sandusky office of the U.S. Geological Survey (USGS) has assumed responsibility for standard assessments in Canadian waters since 1992. The Ontario Ministry of Natural Resources (OMNR) began coordinating with USGS in 1998 to complete standard assessments in Canadian waters. Total effort for 2003 by the combined agencies was 87 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie. This included 60 lifts by NYSDEC, 7 by PFBC, and 20 by USGS/OMNR.

All lake trout are routinely examined for total length, weight, sex, maturity, fin clips, and wounding by sea lampreys. Snouts from each lake trout are retained and coded-wire tags (CWT) are extracted in the laboratory to accurately determine age and genetic strain. Otoliths are also retained from a sub-sample of lake trout or when the fish is not adipose fin-clipped. Stomach data are usually collected as on-site enumeration or as preserved samples.

<u>Results and Discussion</u>

Abundance

Sampling was conducted in seven of the eight standard areas in 2003 (Figure 1.1), collecting a total of 592 lake trout. No effort was conducted in Area 4 due to the lack of enough cold water to set nets according to the sampling protocol. Overall catch by standard assessment gear found that lake trout were most abundant in New York waters (Fig. 1.1), a result also found four of the previous five years. In general, lake trout catch per lift (i.e., catch per unit effort, or CPE) decreased along northerly and westerly gradients. Areas A1 and A2 again produced the highest CPE values, coinciding with the areas in which stocking of yearling lake trout occurs. CPE in areas A1, A2, A5, and A6 were twice their usual rates while catches in the western sampling areas were consistent with previous survey results.

Seventeen year-classes of lake trout were represented in the total catch, ranging from age 2 to 19 (Table 1.1). No age 1 lake trout were sampled for the first time in the last five years. Similar to the past two years, young cohorts (ages 2 - 5) were the most abundant, representing 73% of the total catch (Fig. 1.2). Lake trout age 10 and older, while more numerous than last year due to the high catches, still represented a relatively small (8.3%) proportion of the overall catch.

The overall trends in relative abundance of lake trout caught in standard nets (mesh sizes 38 - 152 mm) in the eastern basin show a large increase over last year to a time-series high of 8.03 individuals per lift in 2003 (Figure 1.3). This represented the third consecutive year in which the CPE in standard assessment nets increased from the lows experienced from 1998 – 2000. The increasing CPE can be mainly attributed to the survival and recruitment of the successful 1999 thru 2002 stockings.

The response of adult (age-5-and-older) lake trout to sea lamprey treatments (initiated in 1986) has been monitored annually from standard assessments (Figure 1.4). A significant ($P < 0.05$) drop in abundance of lake trout was observed in 1998 following a 6-year (1992 - 1997) period of steady growth. The CPE for age-5-and-older lake trout increased substantially in 2003 following the 14 year low experienced in 2002. The age 5+ index of 2.13 fish/lift was the highest index since 1997 and was mainly due to the recruitment of the successful 1999 stocking to this group. This index is expected to continue to increase over the next 3 years as the successful 2000 thru 2002 stockings recruit to the adult stock.

Recruitment

The age 1-3 relative abundance index of 1.95 lake trout/lift was a slight decrease from the 14 year high experienced in 2002, but still ranks as the third highest age 1-3 index since 1989 (Figure 1.5). This was primarily due to the high numbers of age 2 fish (2002 stocking), which registered the highest catch rates for this age class in the time series. There were no age 1 lake trout caught for the first time since 1998.

A recruitment index for overall survival of stocked fish to age 2 was developed in order to show patterns in yearly recruitment. This index was calculated by dividing age-2 CPE from NYSDEC standardized gill nets by the number of fish in that year class stocked. The quotient provided an index of survival to age 2 that was corrected for stocking. This was then multiplied by 100,000 to obtain an index equal to the age 2 catch per lift per 100,000 lake trout stocked. The results suggest a significant decline ($P<0.001$, $r^2 = 0.80$) in recruitment to age 2 from 1986 through 1999 (Figure 1.6). Virtually none of the yearlings stocked from 1993 through 1998 survived to age 2 in 1994 through 1999. The index began to increase in 2000 as survival of stocked lake trout increased and recruited to the fishing gear at age 2. The age 2 index showed a large increase in 2003 to its highest level in the time series. Returns of the 2002 stocking as age 1 and age 2 in our surveys indicate that this is the best survival of stocked lake trout experienced in Lake Erie since 1985.

Survival

Estimates of annual survival from standard eastern basin assessment gill net catches will not be reported by the CWTG until further analysis can be completed. Previous estimates of annual survival were calculated from age-based catch curves. The CWTG was not confident that survival estimates based upon age-based catch curves were accurately estimating the survival of lake trout in Lake Erie. The lake trout rehabilitation plan calls for survival of 60 percent or better (Lake Trout Task Group 1985).

Growth and Condition

Mean lengths-at-age and mean weights-at-age of sampled eastern basin lake trout were consistent with averages from the previous 5 years (1998 – 2002) through age 15 (Figures 1.7 and 1.8). Overall growth of lake trout in Lake Erie continues to be some of the best in the Great Lakes basin.

Mean coefficients of condition (Everhart and Youngs 1981) were calculated for age 3 and age 5 lake trout by sex to determine time series changes in body condition. Condition coefficients for age 3 males tended to be higher than females and exhibited relatively stable values since 1994 (Figure 1.9). Condition for age 5 lake trout has been on a slightly increasing trend over the past 10 years with males and females essentially equal. Neither age group has exhibited any significant declines in body condition in our time series.

Maturity

Eighty-seven mature females ranging in age from 4 through 18 were sampled in standard assessment gill nets in 2003, generating a mean age of maturity of 5.9 years (Figure 1.10). This is the second consecutive year that mature female lake trout have not met or exceeded the target mean age established in the Strategic Plan of 7.5 years (Lake Trout Task Group 1985) and is reflective of the low abundance of older lake trout caught relative to the abundance of the age 5 fish during the standard assessment gill net survey. The plan's objective assumes that adult females would need at least two spawning years to contribute to the production of detectable, natural reproduction. Female lake trout in Lake Erie reach 100% maturation by age 5 (Culligan et al. 2004).

Natural Reproduction

Despite more than 20 years of stocking, no naturally reproduced lake trout have been documented in Lake Erie. Twelve potentially wild fish were caught in eastern basin coldwater gill net surveys in 2003, making a total of 25 potentially wild lake trout recorded over the past four years. A reliable method for distinguishing between a fry-stocked fish and a naturally produced fish has not been found at this time. However, a stock discrimination study using otolith microchemistry was funded through the Great Lakes Fishery Commission in 2004 that may be able to determine if unknown origin fish were wild or of hatchery origin. Results of this research are ongoing and should be available for the 2005 Coldwater Task Group Report.

The role of one of Lake Erie's most recent invaders, the round goby, could play an important part in the efforts to restore lake trout. Round gobies invaded the eastern basin of Lake Erie in 1998, becoming a prominent bottom forage species in 2000. They have essentially moved into the niche normally occupied by sculpins, which were infrequently caught in bottom trawls in Lake Erie prior to the arrival of gobies and have been non-existent since. Round gobies are similar to sculpins with regard to body shape, size, and habitat preferences. Sculpins have been shown to be important forage items for lake trout (Elrod and O'Gorman 1991; Owens and Bergstedt 1994) as well as predators on eggs and larvae and competitors for food with young lake trout (Hudson et al. 1995). Recent studies on Lake Ontario lake trout spawning reefs (Fitzsimmons, DFO, personal communication) has revealed severe predation by gobies on lake trout eggs and fry. Gobies have also been shown to cause significant mortality on smallmouth bass eggs and fry (Steinhart, Marschall, and Stein 2004). For Lake Erie, where no successful natural lake trout reproduction has been documented since restoration efforts began in 1968, predation by gobies on any successfully spawned lake trout eggs and hatched fry could prove to be an impossible obstacle for them to overcome to establish a wild, naturally reproducing population.

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Table 1.1. Number, sex, mean length and weight, by age class, of lake trout collected in gill nets (all gear types) from eastern basin Lake Erie, August, 2003.

AGE	SEX	NUMBER	MEAN LENGTH (mm)	MEAN WEIGHT (g)
1	Combined	0	---	---
2	Male Female	44 34	411 413	703 757
3	Male Female	31 7	577 547	2311 1973
4	Male Female	157 54	653 658	3330 3503
5	Male Female	49 52	715 716	4342 4431
6	Male Female	10 7	724 738	4548 5071
7	Male Female	7 5	736 745	4989 5600
8	Male Female	1 0	763 ----	5900 -----
9	Male Female	4 2	787 786	6305 5960
10	Male Female	5 2	779 850	5436 8200
11	Male Female	3 1	790 863	6610 6940
12	Male Female	1 3	838 780	7540 6127
13	Male Female	9 3	824 864	6933 8753
14	Male Female	2 4	873 810	7740 6555
15	Male Female	3 1	832 837	6227 7440
16	Male Female	2 1	909 775	9850 5180
17	Male Female	0 0	---- ----	----- -----
18	Male Female	3 1	877 881	9163 7800
19	Male Female	5 0	909 ----	8368 -----

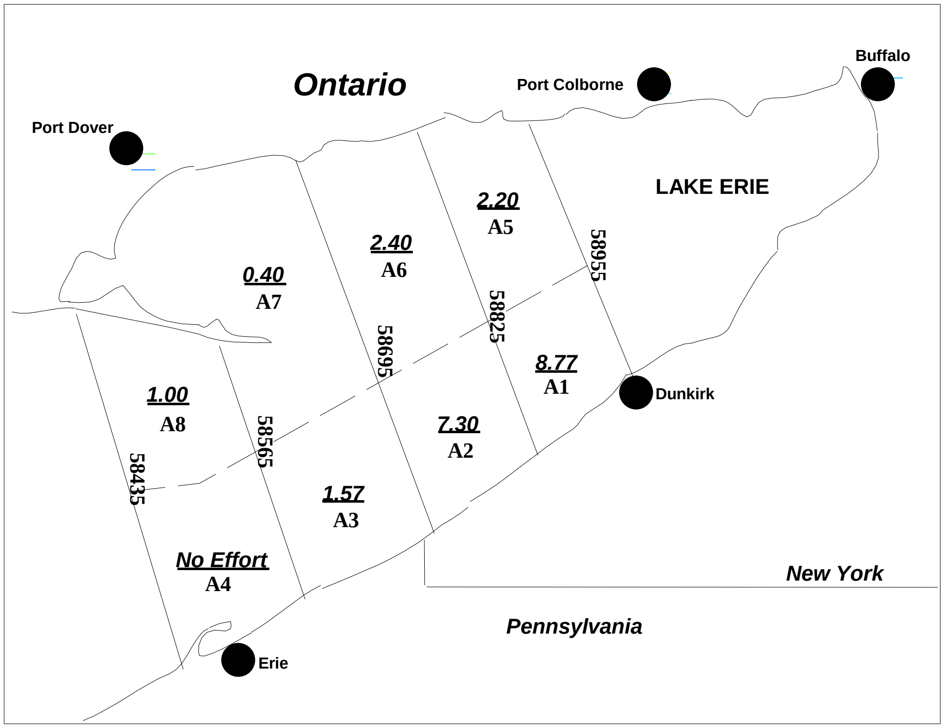


Figure 1.1. Standard sampling areas (A1 – A8) used for assessment of lake trout in the eastern basin of Lake Erie. The numbers in each area represent 2003 CPE (number/lift) for total lake trout catch within that area.

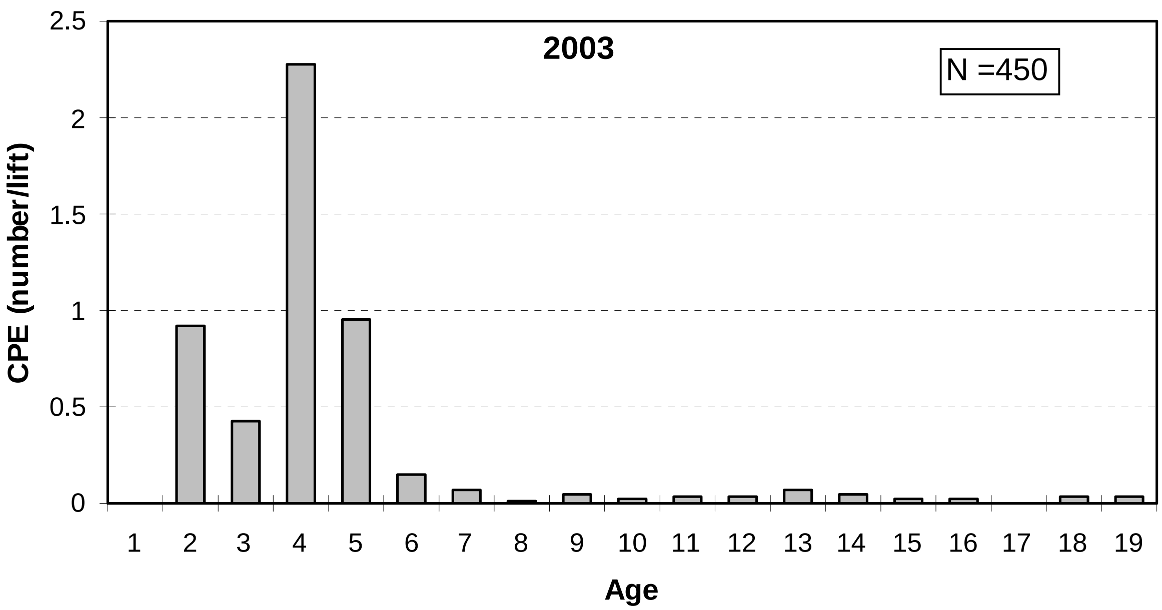


Figure 1.2. Relative abundance at age of lake trout collected from standard assessment gill nets fished in the eastern basin of Lake Erie, August 2003.

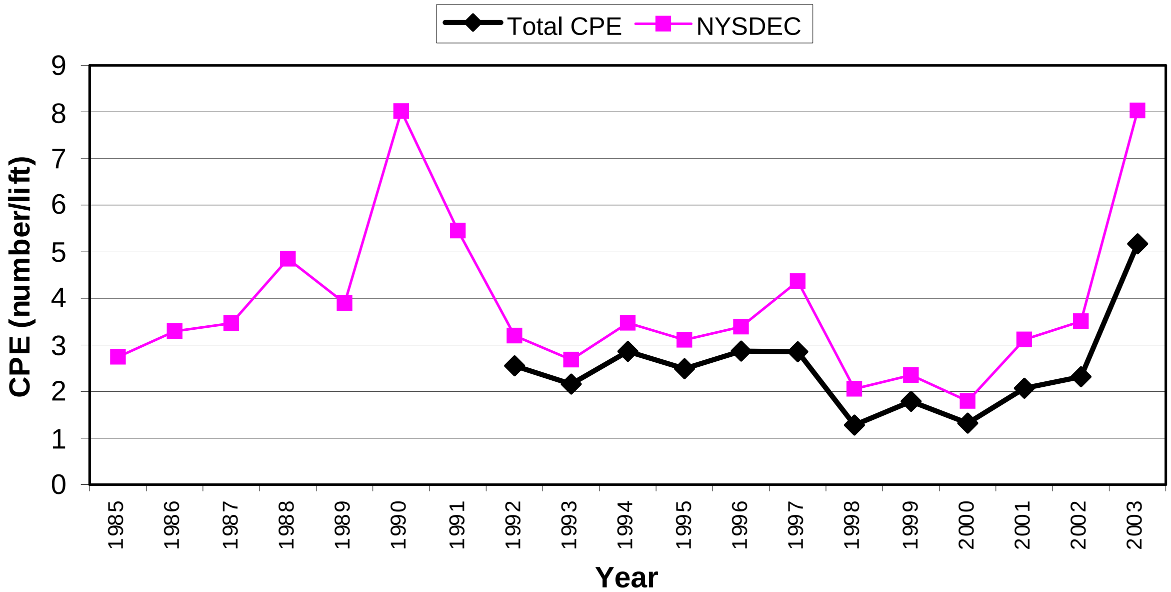


Figure 1.3. Relative abundance (number fish/lift) of lake trout caught in standardized gill nets assessment surveys from the eastern basin of Lake Erie, 1992 – 2003. The NYSDEC series from 1985 – 2003 is also shown for reference to a longer time-series.

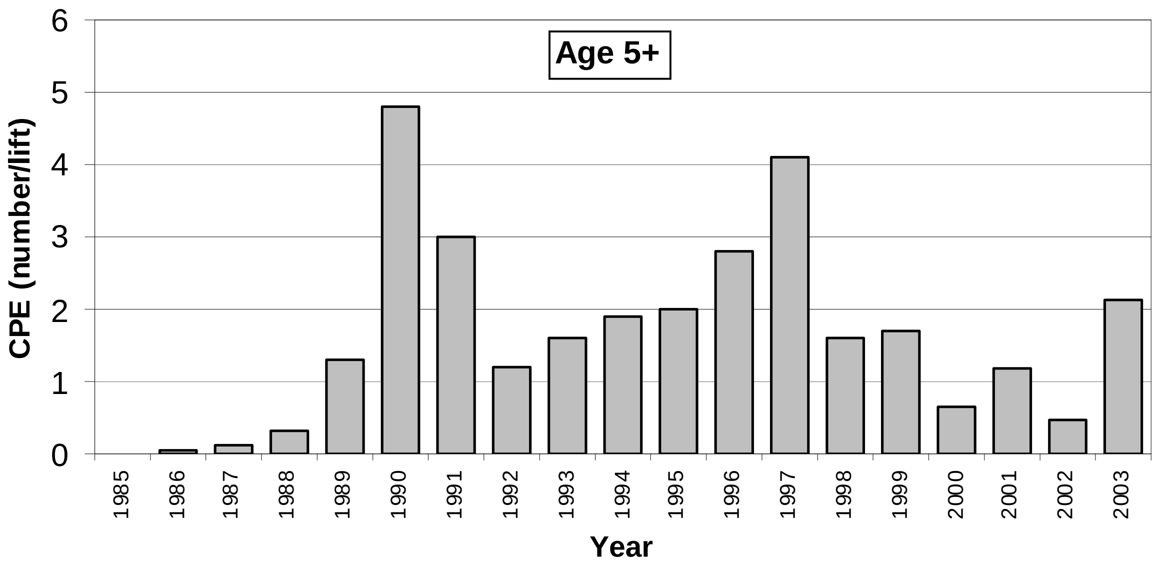


Figure 1.4. Relative abundance (number fish/lift) of age 5 and older lake trout sampled in standard gill net surveys from the New York waters of Lake Erie, August, 1985 – 2003.

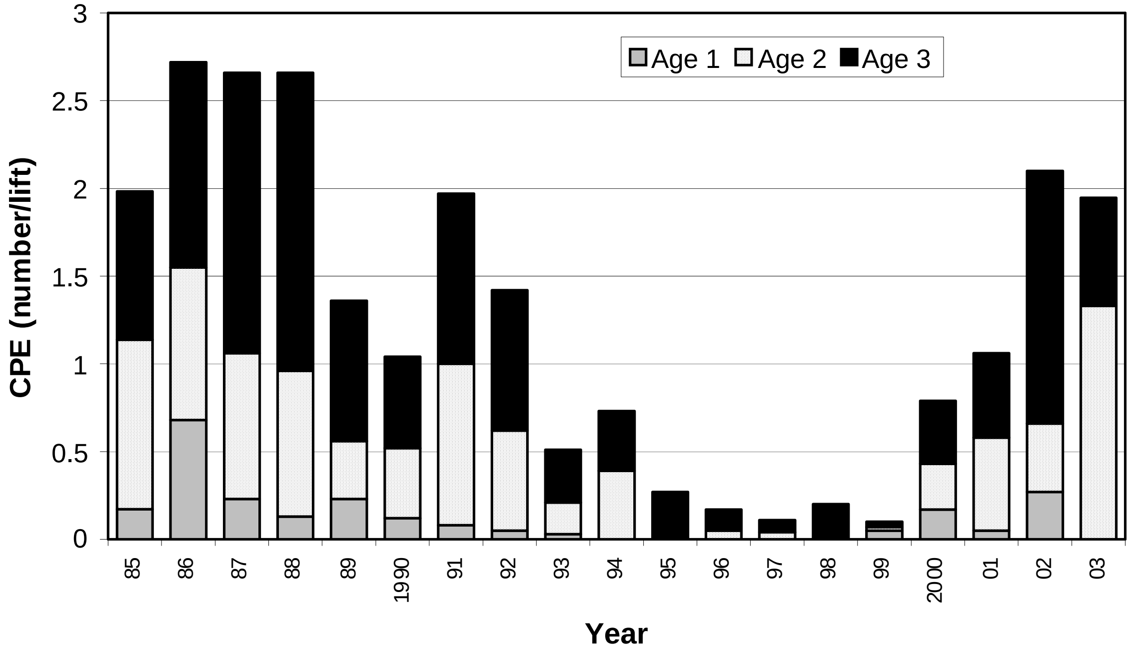


Figure 1.5. Relative abundance (number fish/lift) of juvenile (ages 1-3) lake trout collected in standard assessment gill net surveys in the New York waters of Lake Erie, August, 1985 – 2003.

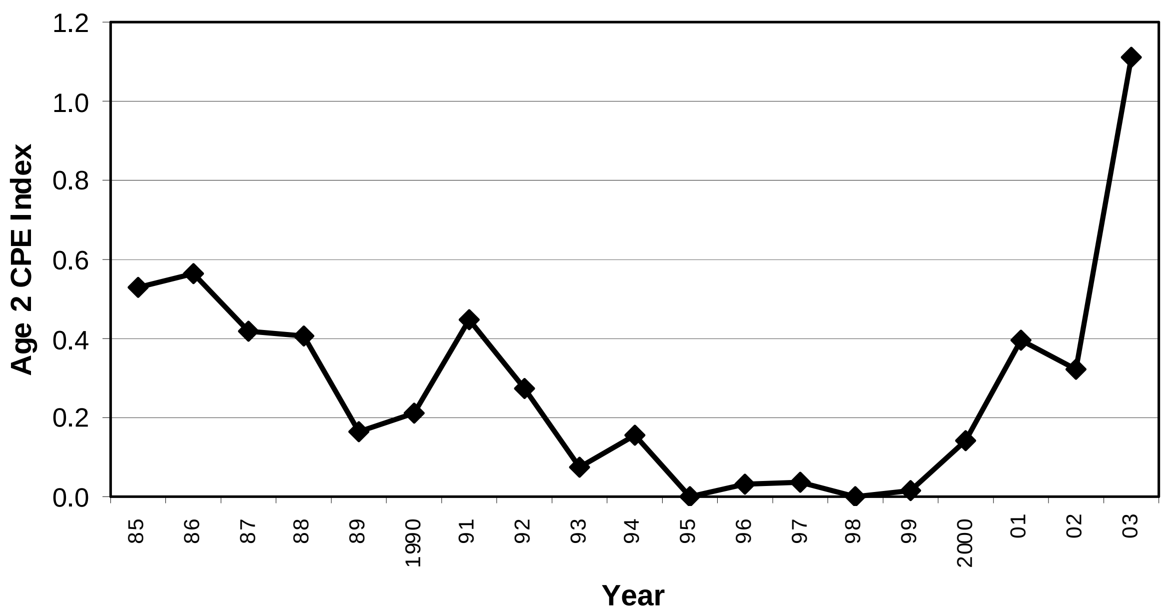


Figure 1.6. Index of age 2 recruitment of lake trout caught in standard assessment gill nets from New York waters of Lake Erie, August, 1985 – 2003. The index is calculated by dividing the age 2 CPE by the stocking rate for each cohort, and then multiplying by 100,000. The final index is equal to the number of age 2 fish caught per lift for every 100,000 yearling lake trout stocked.

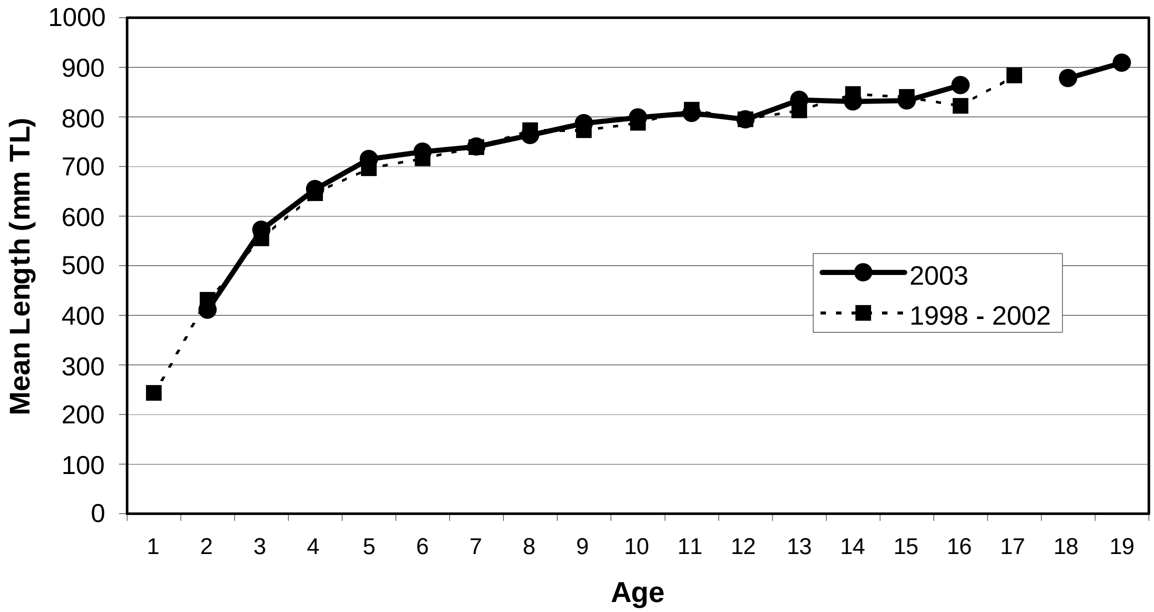


Figure 1.7. Mean length-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2003. The previous 5-year average (1998 – 2002) from New York are shown for current growth rate comparison.

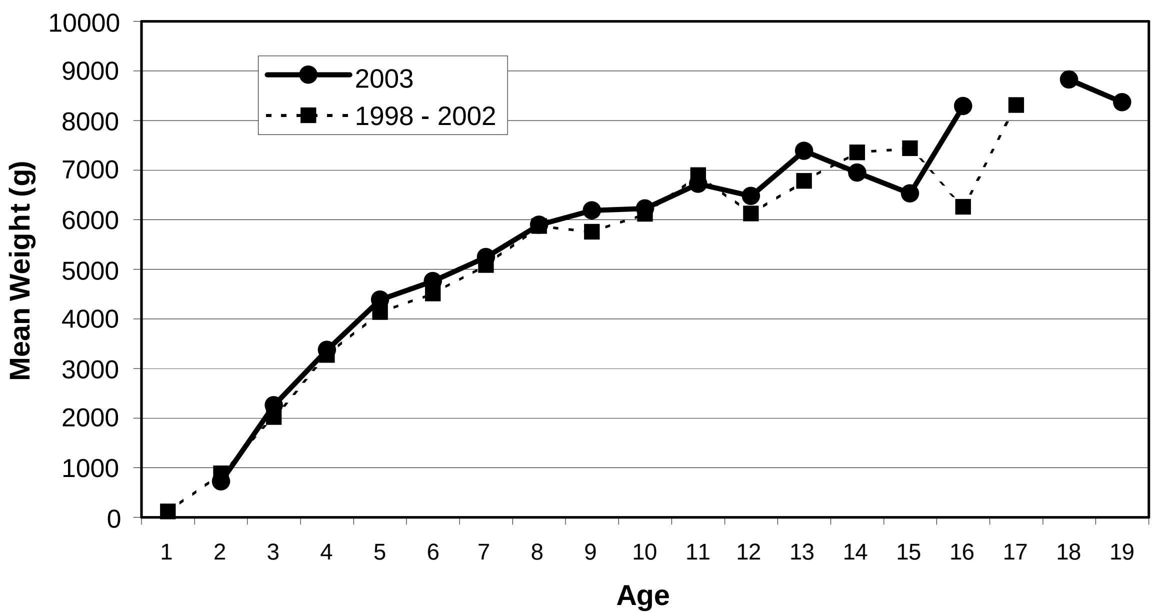
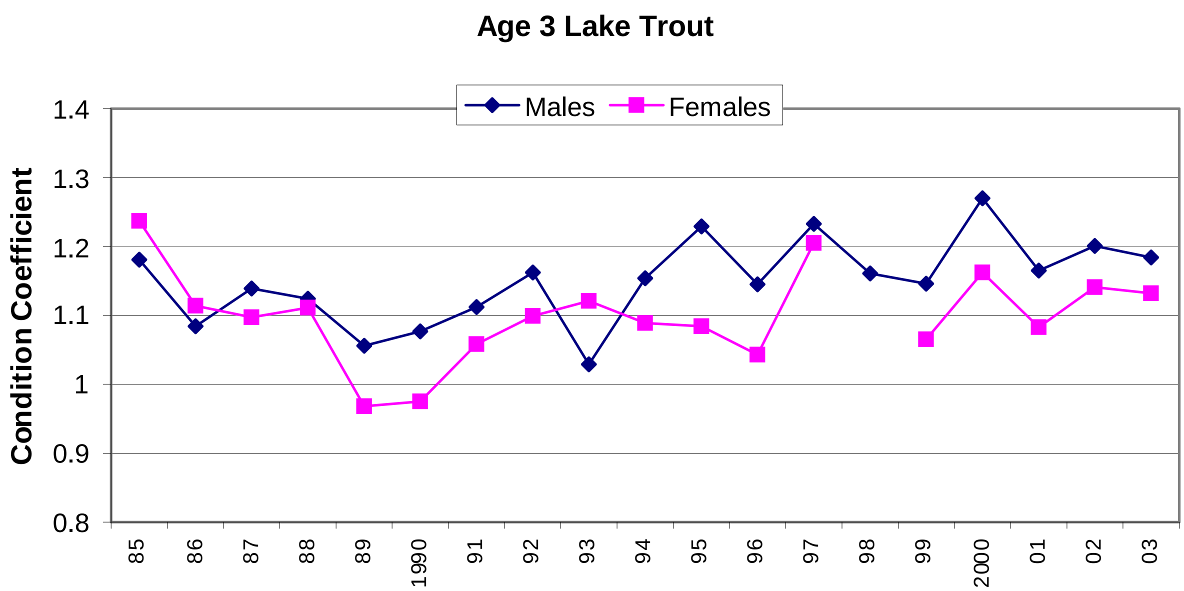


Figure 1.8. Mean weight-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2003. The previous 5-year average (1998 – 2002) from New York are shown for current growth rate comparison.



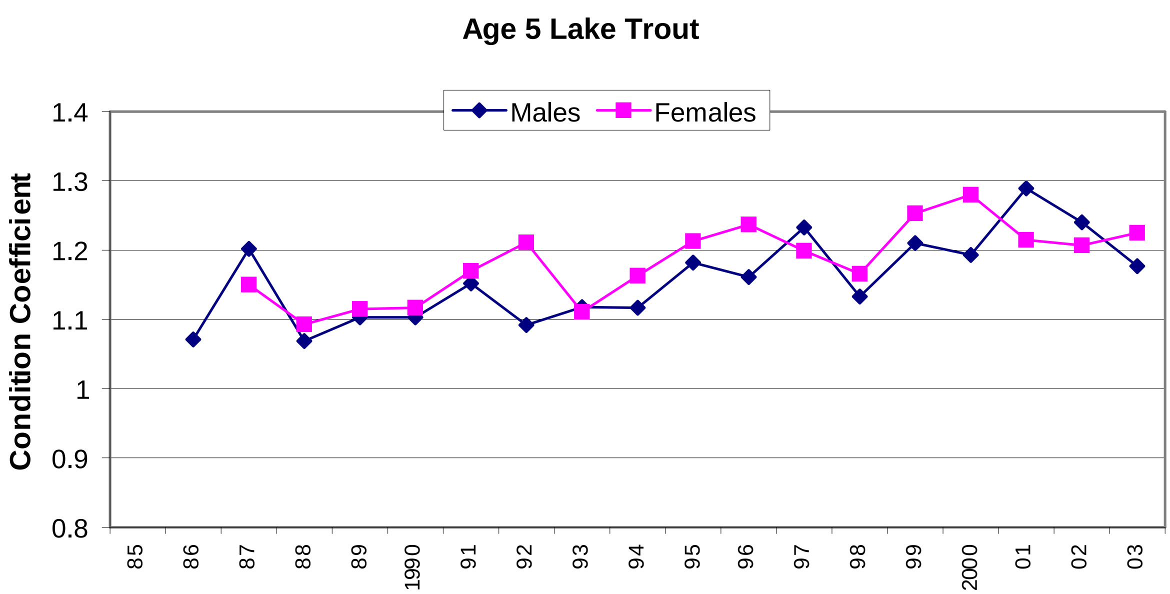


Figure 1.9. Mean coefficients of condition for age 3 and age 5 lake trout, by sex, collected in NYSDEC gill net assessment surveys, August, 1985 – 2003.

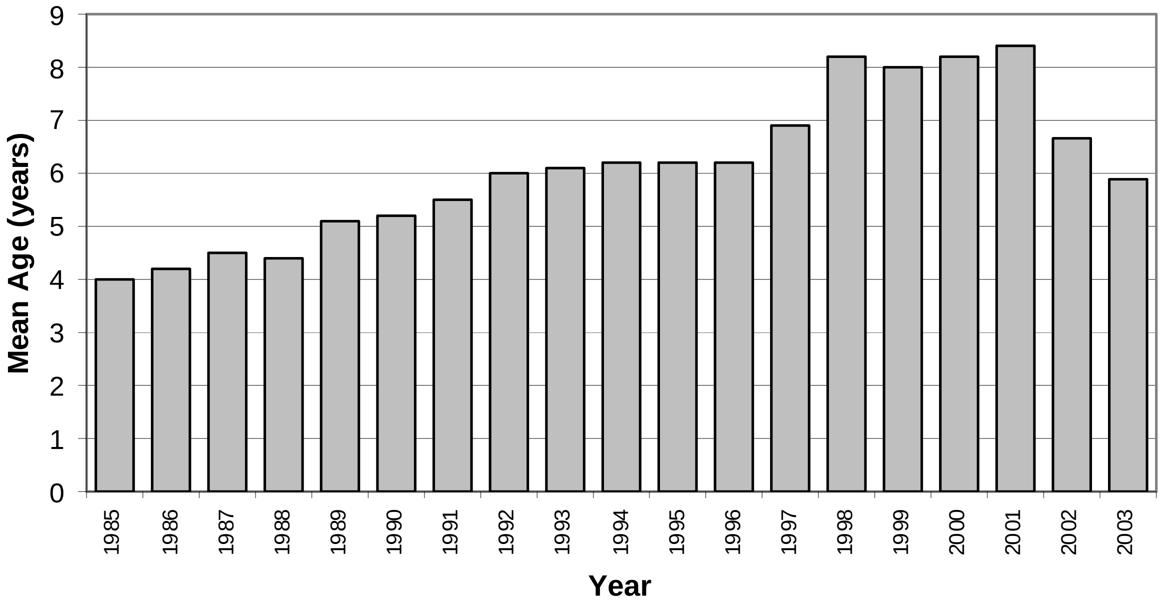


Figure 1.10. Mean age of mature female lake trout sampled in standard assessment gill net surveys in the eastern basin of Lake Erie, 1985 – 2003. The target mean age is 7.5 years.

Charge 2: Continue to assess the whitefish population age structure, growth, diet, seasonal distribution and other population parameters (A. Cook and P. Ryan)

Commercial Harvest

The total harvest of Lake Erie whitefish in 2003 was 612,647 pounds (Figure 2.1). Ontario accounted for the majority (98% or 599,310 lbs) of the catch in 2003 while Ohio harvested 2% (13,244 lbs) and Pennsylvania's harvest remained negligible (93 lbs). Ontario's overall harvest declined 43% from 2002, due to reduced whitefish numbers and to the effect of winter severity on the central basin whitefish fishery.

The majority of Ontario's whitefish harvest was taken in gill nets (96%). The remainder was caught primarily in smelt trawls, mostly in statistical district 4 (OE 4), and to a lesser extent, OE 5. Less than 1% were caught in trap nets in OE 1. In 2003, the largest proportion of Ontario's large mesh gill net (LMGN) whitefish harvest (60% or 344,000 lbs) occurred in the western basin (OE 1) during the fall (October to December). Only 6% (20,737 lbs) of the LMGN whitefish harvest occurred during other months in OE 1. OE 2 accounted for 31% of the LMGN harvest, while OE 3, OE 4, and OE5 accounted for 4%, 2% and < 1% respectively. Ontario's 2003 whitefish LMGN harvest was up 26% from 2002 in OE 1, but down significantly in OE 2 (72%) and OE 3 (81%). In the OE 4 LMGN, whitefish harvest increased 76%, but decreased by 71% in OE 5. The total LMGN harvest from the eastern basin (OE 4 and OE 5) totaled less than 12 thousand pounds.

Ontario's 2003 fall commercial gill net CPE (18 kg/km or 10.4 fish/km) was low for the second consecutive year compared to the recent decade (Figure 2.2). Targeted whitefish gill net effort during the fall in 2003 (1,745 km) increased slightly over the past three years. Due to increasing targeted whitefish gill net effort, west basin fall whitefish catch rates (whitefish from effort with whitefish in the catch) were adjusted from 2000 to 2003 to reflect trends in targeted catch rates.

The age composition of whitefish caught in Ontario's OE 1 fall fishery ranged from 4 to 17 (using scales), with ages 6 and older most abundant (Figure 2.3). The mean age of the west basin fall large mesh gill net fishery was 7.4, signaling the oldest harvest age composition observed over 18 years (Figure 2.2). Trends indicate that recruitment to the fishery has declined following the 1996 year class.

Ohio trap net harvest in 2003 was 13,244 pounds. Reduced targeted whitefish effort in 2003 was unrelated to the status of the whitefish population.

A catch curve analysis was used to estimate mortality rate from Ontario fall fishery data 1999 - 2003 (Figure 2.4). Total instantaneous mortality (Z) was estimated to be 0.467 (survival = 63%; $r^2 = 0.85$). A catch curve based solely on the 1996 year class (ages 4 to 7) produced Z = 0.675 with a survival estimate of 51% ($r^2 = 0.84$).

Index Fishing

The 2003 year class (YOY) was the most abundant year class in Ontario's lake-wide partnership survey, representing 35% of whitefish caught, followed by the 2001 year class (21%) (Figure 2.5). Ontario's partnership gill net survey recorded few whitefish in the east basin in 2003 (Figure 2.6). Catches remained below the series average on the Pennsylvania Ridge and in the eastern basin, but were slightly above average in the east central and west central basin surveys. New York's 2003 deep-water gill net assessment index for whitefish was identical to 2002 (1.7 whitefish/net), remaining below the 1985 - 2003 average (1.9) (Figure 2.7).

In 2003, YOY lake whitefish were abundant in New York, Pennsylvania and Ohio trawl surveys, but did not appear in Ontario's Outer Long Point Bay trawl index. Only a single YOY whitefish was caught in east basin partnership index gill nets due north of the tip of Long Point. The 2001 year class was detected earlier as YOY and yearlings in Ohio, Pennsylvania, New York and Ontario surveys.

Growth and Diet

In 2003, lake whitefish condition (ages 4 and older) increased to slightly above historic 1927 - 1929 averages reported by Van Oosten and Hile (1947) (Figure 2.8). Sample sizes were low in 2002 producing large standard errors. The diets of young-of-the-year, yearling and older whitefish collected from the central basin by the Ohio Division of Wildlife from May to October 2003 were described according to mean % dry weight (Figure 2.9). Isopods and chironomid larvae comprised significant fractions of the diets of all whitefish examined. Daphnia spp., Ostracods, and other zooplankton represented large components of the YOY diet. Yearling and older whitefish consumed more mollusks than YOY whitefish. Dry weights of fingernail clams (Sphaeridae) were significant in both yearling and older whitefish. Dreissenid mussels and snails (gastropods) were larger components of the stomach contents of whitefish ages 2 and older compared to younger whitefish.

Research Efforts

The CWTG has been assembling the whitefish data for a stock assessment review. In 2003, agencies have been supporting a whitefish bioenergetics study conducted by the University of Windsor. This research is important to understanding the potential for whitefish to increase in Lake Erie.

References

Van Oosten, J. and Hile, R. 1947. Age and growth of the lake whitefish, *Coregonus clupeaformis* (Mitchill), in Lake Erie. Trans. Am. Fish. Soc. 77: 178-249.

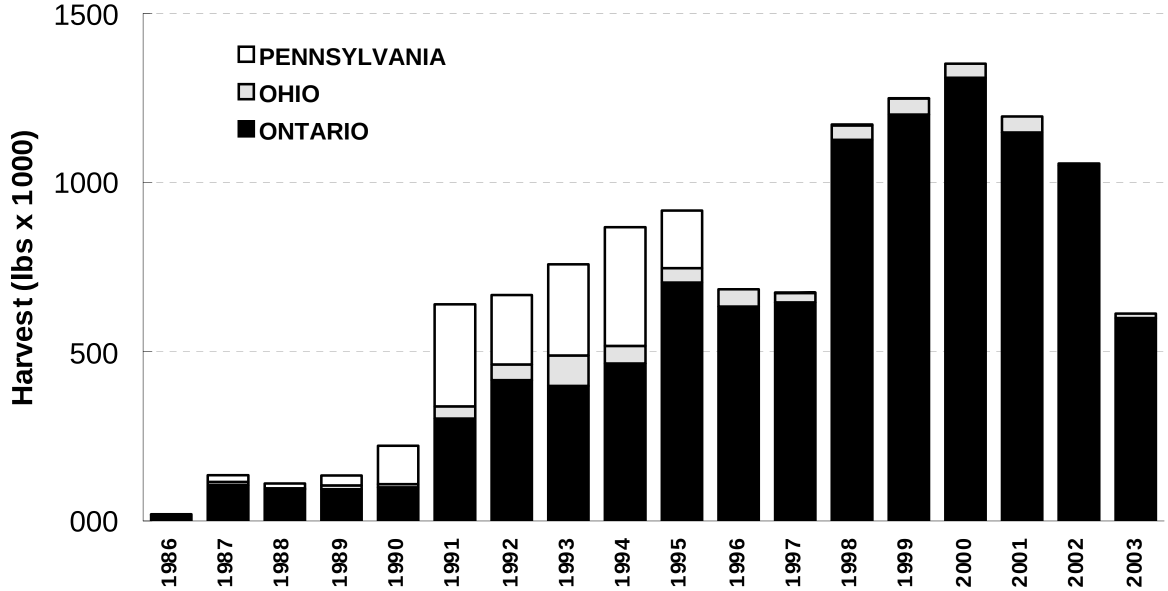


Figure 2.1. Total Lake Erie commercial whitefish harvest from 1986 – 2003 by jurisdiction. Pennsylvania ceased gill netting in 1996.

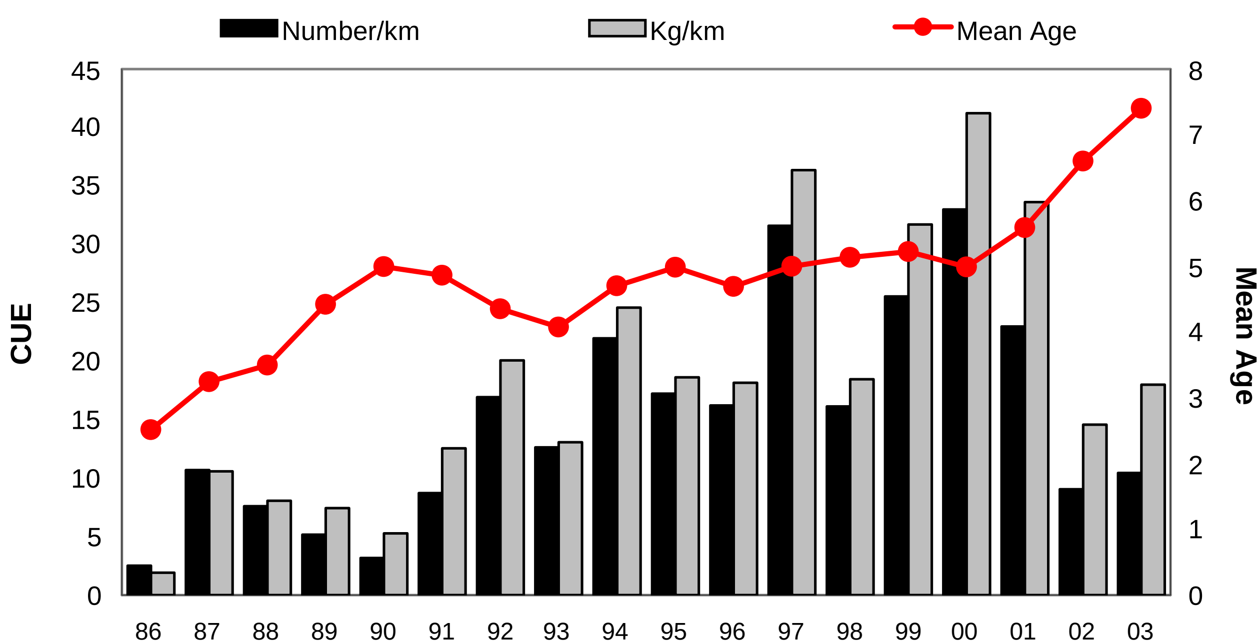


Figure 2.2. Catch rate (number and weight per km) and mean age of lake whitefish harvested by the Ontario fall gill net fishery, OE1, 1986 – 2003. (Fall = October to December).

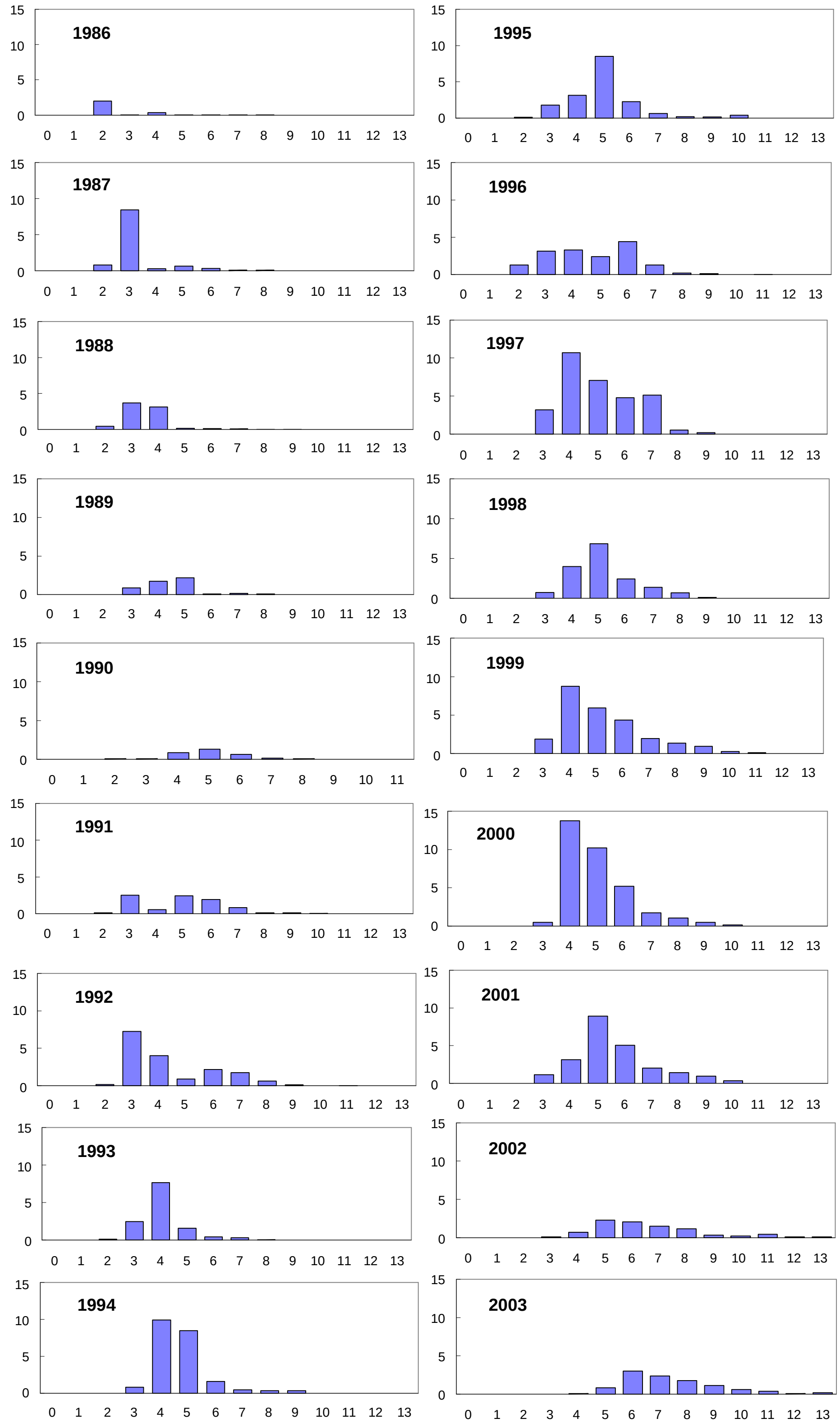


Figure 2.3. Ontario fall commercial whitefish CUE at age (# / km gill net) in statistical district 1, 1986 – 2003. (Effort with gill nets >=3 inches, with whitefish in catch from October to December).

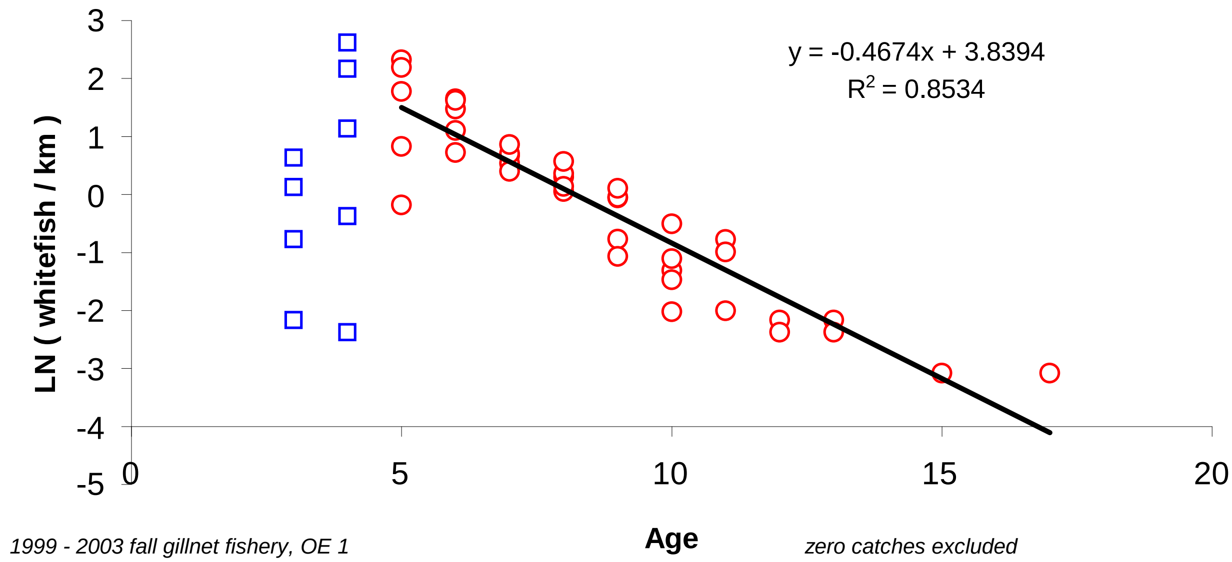


Figure 2.4. Catch curve for lake whitefish using Ontario fall large mesh gill net CPUE (# / km) from 1999 to 2003. Open circles represent fully recruited ages used in regression. Squares indicate partial recruitment to the gear. Z = -0.4674; Survival = 63%

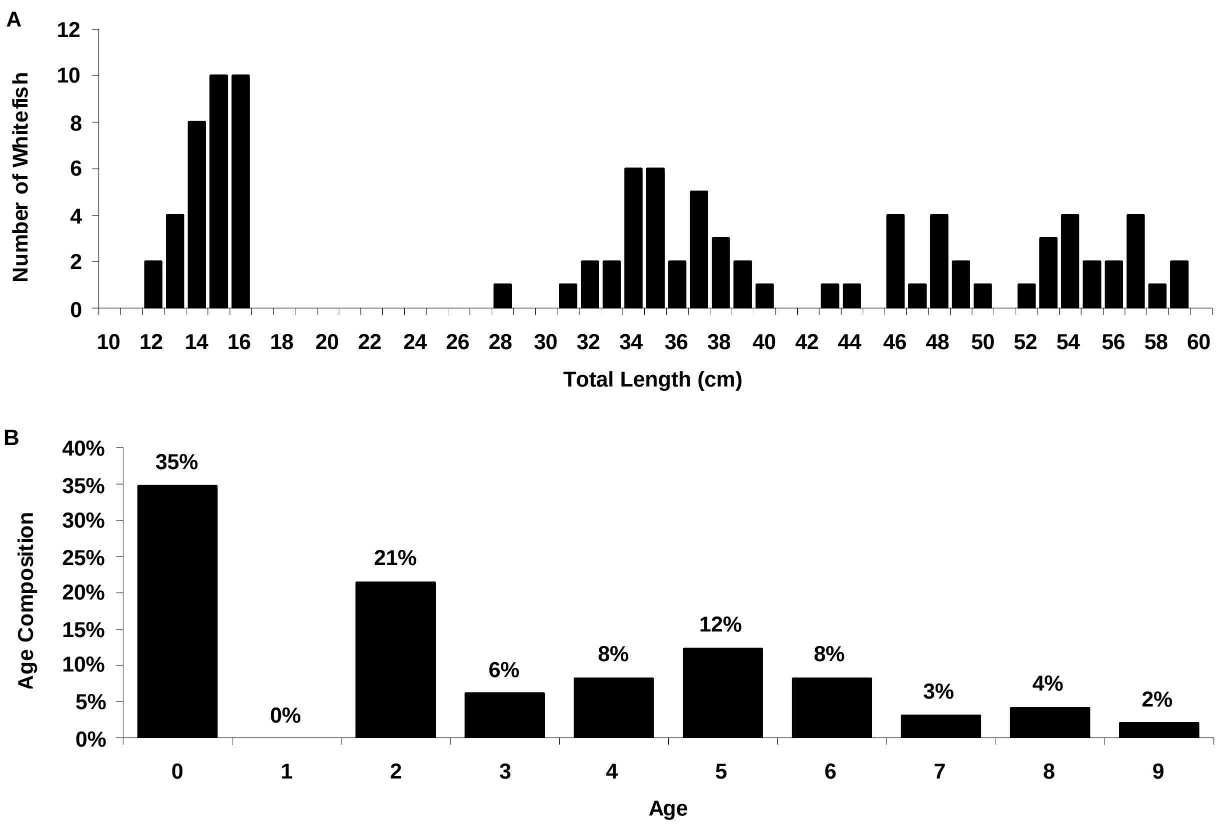


Figure 2.5. Length frequency distribution (A) and age composition (B) of lake whitefish collected from Ontario partnership index fishing, lake-wide, 2003. Standardized to equal effort among mesh sizes.

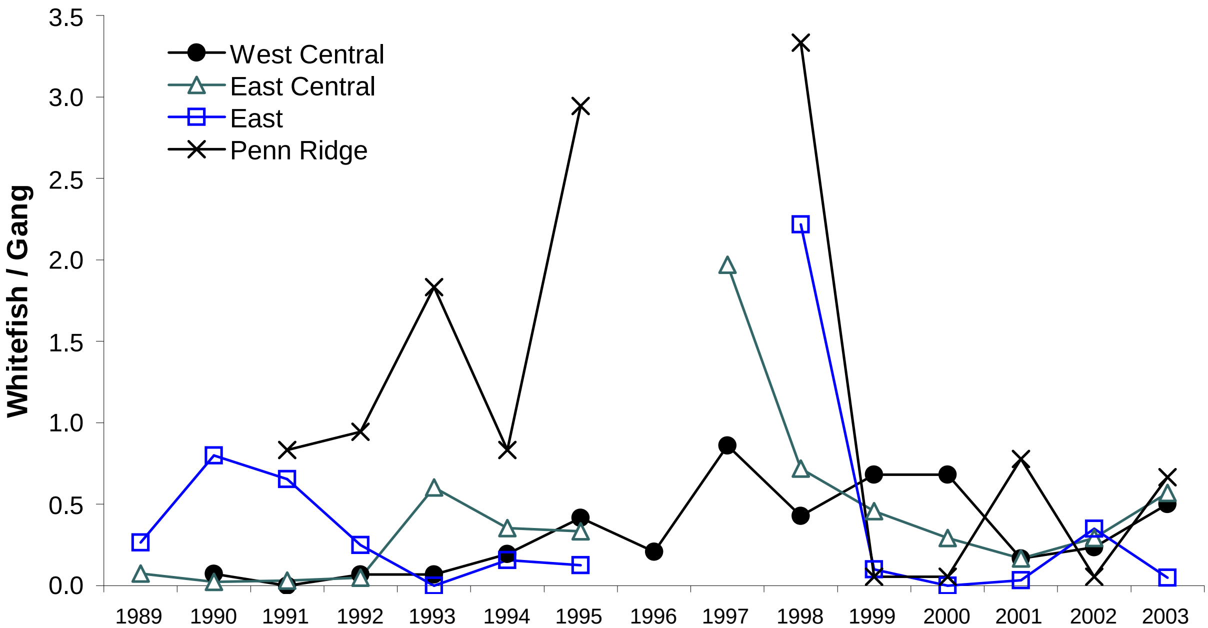


Figure 2.6. Catch rate (number per gang) of lake whitefish from Ontario partnership index gill netting by basin, Lake Erie, 1989 – 2003. West-Central basin not surveyed in 1989. East-Central basin not surveyed in 1996. East basin was not surveyed in 1996 and 1997; few sites were fished in 1995. Pennsylvania Ridge not surveyed in 1989, 1990, 1996, and 1997. Includes canned (suspended) nets. Standardized to equal effort among mesh sizes. Excludes thermocline sets.

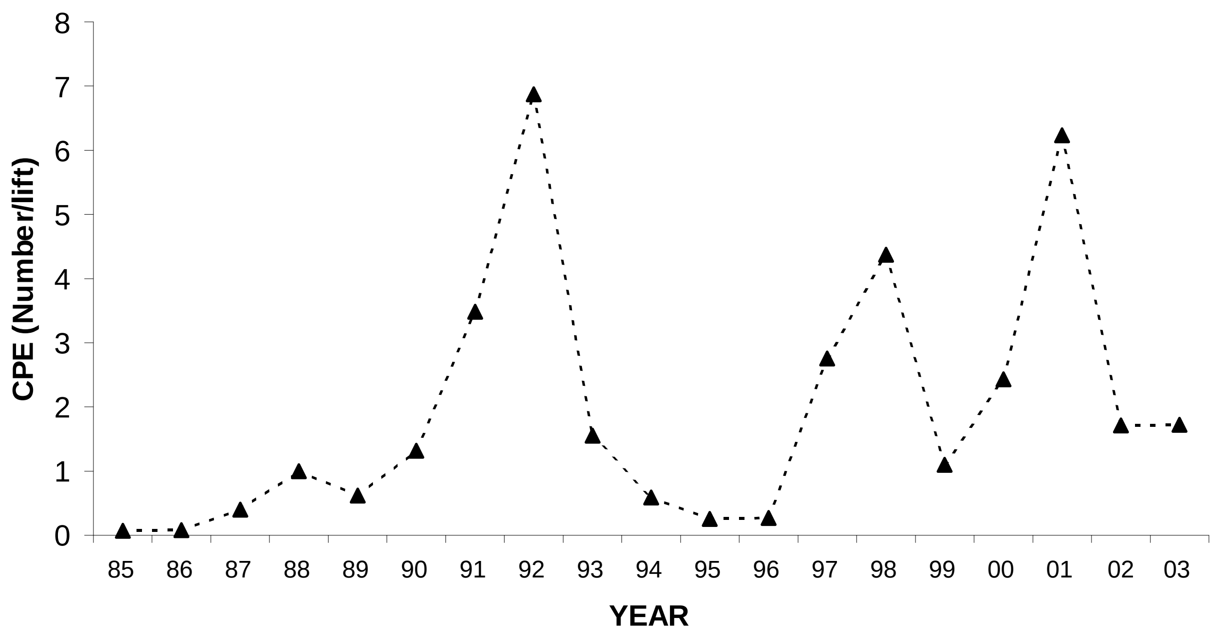


Figure 2.7. Catch per effort (number fish/lift) of lake whitefish caught in standard assessment gill nets from New York waters of Lake Erie, August, 1985 – 2003.

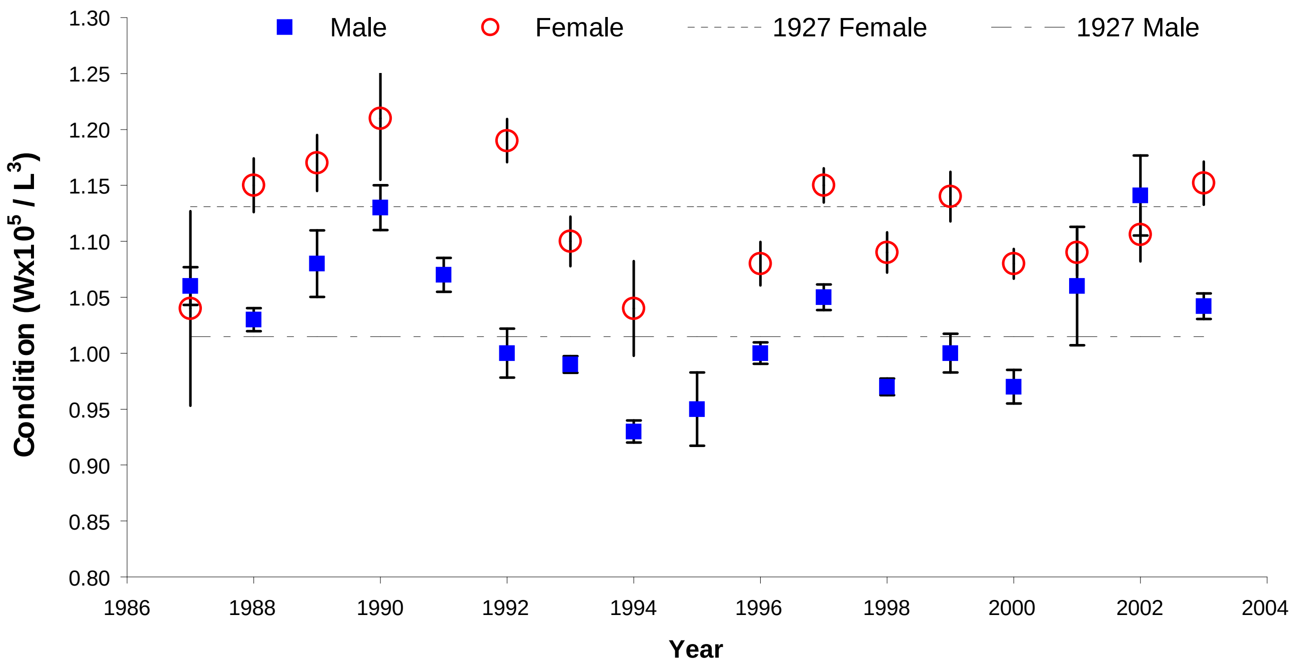


Figure 2.8. Mean condition factor of lake whitefish by sex from 1987 to 2003 with one standard error. Data include whitefish ages 4 and older collected from commercial fish and Partnership index samples from October to December. Spent and ripe whitefish were excluded. Historic mean condition (1927 – 1929) presented as dashed lines, calculated from Van Oosten and Hile (1947).

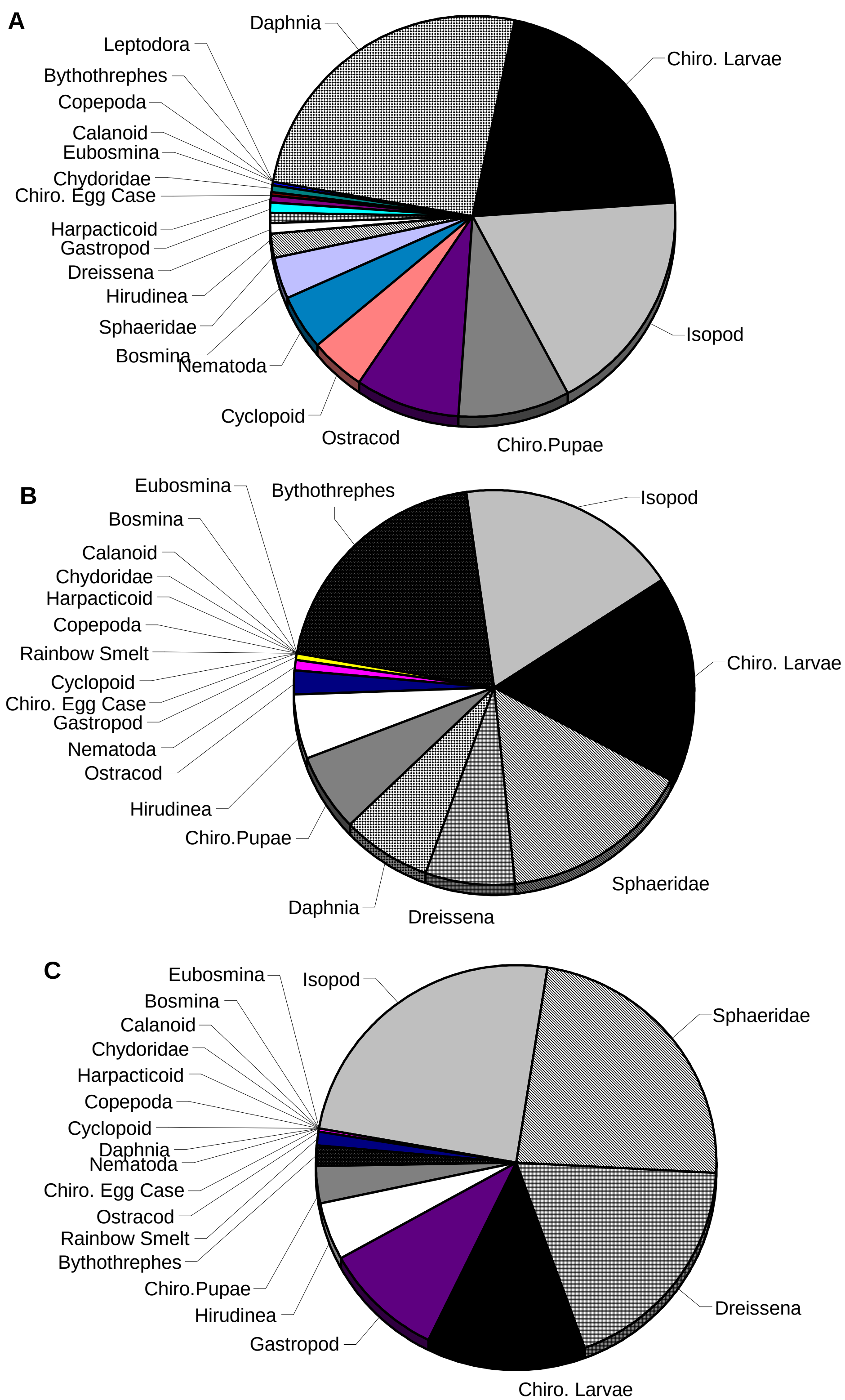


Figure 2.9. Stomach contents (mean % dry weight) of young-of-the-year (A), yearling (B), and lake whitefish ages two and older (C), collected in central Lake Erie by the Ohio Division of Wildlife from May to October (pooled), 2003. N = 76, 20, and 59 respectively.

Charge 3: Continue to assess the burbot population age structure, growth, diet, seasonal distribution and other population parameters (E. Trometer and M. Stapanian)

Commercial Harvest

The commercial harvest of burbot by the Lake Erie jurisdictions was relatively insignificant through the late 1980's, generally remaining under 5,000 pounds (Table 3.1). Beginning in 1990, harvest began to increase, coinciding with an increase in abundance and harvest of lake whitefish. Most commercial harvest occurs in the eastern end of the lake with minimal harvest occurring in Ohio waters. Harvest decreased in Pennsylvania waters after 1995 with a shift from a gill net to trap-net commercial fishery, resulting in a substantial decrease of commercial effort (CWTG 1997). Harvest of burbot in New York is from one commercial fisher. In 1999, a market was developed for burbot in Ontario, leading the industry to actively target this species for the first time. As a result, the commercial harvest in Ontario increased dramatically (Table 3.1). However, this market did not continue, resulting in declining annual harvests from 2000 through 2003. The 2003 commercial harvest of 2,800 pounds of burbot was the lowest total in Lake Erie since 1988.

Assessment Programs

Burbot is one of the most commonly caught species in annual eastern basin coldwater gill net assessment surveys. In 2003, CPE increased from levels recorded in 2002 in Ontario and New York waters, but declined slightly in Pennsylvania waters (Figure 3.1). The catch of burbot increased from 1993 through 2000 in all jurisdictions, most dramatically in Ontario waters. Of the three jurisdictions, Ontario waters have yielded the highest catches since 1996. Between 1994 and 2003, the catch per lift in Ontario declined from the previous year's catch only once, in 2001. In general, New York waters have exhibited a slower, but steady increase in catch per lift since 1993. Between 2000 and 2003, the catch in Pennsylvania decreased to levels recorded in the late 1990s.

In 2003, average biomass of burbot/lift increased from that recorded in 2002 in Ontario and New York and decreased in Pennsylvania (Figure 3.2). Since 1998, average biomass/lift has increased in Ontario and New York waters. This increase has been relatively rapid in Ontario (average increase = 2.7 kg/lift/year) and more gradual in New York (average increase = 1.2 kg/lift/year) waters. Average biomass/lift in Pennsylvania quadrupled between 1997 and 2000, decreased by approximately 38% in 2001, and has remained relatively steady since. Of the three jurisdictions, Ontario waters have yielded the highest average biomass/lift since 1997.

Average mass of individual burbot caught in the deepwater gill net assessment increased in all jurisdictions from values recorded in 2002 (Figure 3.3). Further, there has been a steady increase of average mass per individual since 1997 in New York and since 1998 in Pennsylvania and Ontario, after steady decreases in all jurisdictions in the mid-1990s. Preliminary results (M.A. Stapanian, USGS, unpublished data) suggest that this result is in part due to an increase in the average age of burbot in the catches since 1998.

Burbot was one of the target species in the OMNR Partnership gill net assessment conducted annually since 1989 in Canadian waters during the months of September and October. There was no sampling in the eastern basin in 1996 and 1997. Burbot catches increased in the eastern basin and Pennsylvania Ridge from 1992 to 1998, with a 4-fold increase in catch occurring between 1995 and 1998 (Figure 3.4). Burbot catch has been very low in the central basin in all years examined, with lowest catches in the western portion of the central basin. Catch declined in the Pennsylvanian Ridge basins from 1999 through 2000, peaked in 2001, declined in 2002, and increased again in 2003. The catch declined in the eastern basin from a high in 1998 through 2001, but increased again in 2002 and 2003.

Age Structure & Growth

A total of 447 burbot were collected in the summer gill net assessment in 2003. Lengths ranged from 311 to 870 mm, with 96% of the catch between 500 and 800 mm (Figure 3.5). The respective length distributions of burbot collected in the OMNR Partnership gill net assessment and the summer gill net assessment exhibited a high degree of similarity. Mass of individual burbot ranged from 0.26 to 5.20 kg, with 91% of the catch ranging between 1.00 and 3.5 kg (Figure 3.6).

In January 2003, the CWTG received funding from the Great Lakes Fishery Commission to age approximately 3,000 burbot otoliths collected from 1990 through 2003. Preliminary results suggest that both the mean and median ages of burbot in New York waters have increased since 1999 (Figure 3.7).

Diet

Burbot diets are covered in Charge 8 of this report.

Seasonal Distribution

There is no information on seasonal distribution.

Species Interactions

The data suggest that burbot have increased in population size, mass per individual, and age since the late 1990s in Ontario and New York waters. This suggests that the carrying capacity of burbot has increased in those regions. A few hypotheses are being tested to explain this increase. One hypothesis tested was that the increase in average biomass per lift was due to an increase in the food supply for burbot. The exotic round goby (*Neogobius melanostomus*) first appeared in the eastern basin of Lake Erie in 1998 and became fully established by 2000 (Forage Task Group Report 2003). The round goby has become an increasingly important prey species for burbot. In New York waters in the standard gillnet assessment, the proportion of burbot stomachs collected that contained gobies increased from 0% in 1998 to 64% in 2003. In Ontario waters, there was a significant positive correlation between average biomass/lift of burbot from the summer gill net assessment and average catch/trawl hour of gobies in the OMNR offshore trawl surveys in the eastern basin between 1998 and 2003 (Figure 3.8). However, this correlation was not significant for New York waters.

References

Coldwater Task Group (CWTG). 1997. Report of the Coldwater Task Group to the Standing Technical Committee of the Lake Erie Committee, March 24, 1997.

Forage Task Group (FTG). 2003. Report of the Forage Task Group to the Standing Technical Committee of the Lake Erie Committee, March 24, 2003.

Table 3.1. Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980 - 2003.

Year	New York	Pennsylvania	Ohio	Ontario	Total
1980	0	2.00	0	0	2.00
1981	0	2.00	0	0	2.00
1982	0	0	0	0	0
1983	0	2.00	0	6.00	8.00
1984	0	1.00	0	1.00	2.00
1985	0	1.00	0	1.00	2.00
1986	0	3.00	0	2.00	5.00
1987	0	0	0	4.00	4.00
1988	0	1.00	0	0.00	1.00
1989	0	4.00	0	0.80	4.80
1990	0	15.50	0	1.70	17.20
1991	0	33.40	0	1.20	34.60
1992	0.70	22.20	0	5.90	28.80
1993	2.60	4.20	0	3.10	9.90
1994	3.00	12.10	0	6.80	21.90
1995	1.90	30.90	1.20	8.90	42.90
1996	3.40	2.30	1.20	8.60	15.50
1997	2.90	8.90	1.70	7.40	20.90
1998	0.20	9.00	1.50	9.90	20.60
1999	0.97	7.94	1.15	394.78	404.84
2000	0.09	2.28	0.08	30.13	32.58
2001	0.39	4.36	0.05	6.45	11.25
2002	0.87	5.18	0.06	3.37	9.48
2003	0.14	0.18	0.19	2.29	2.80

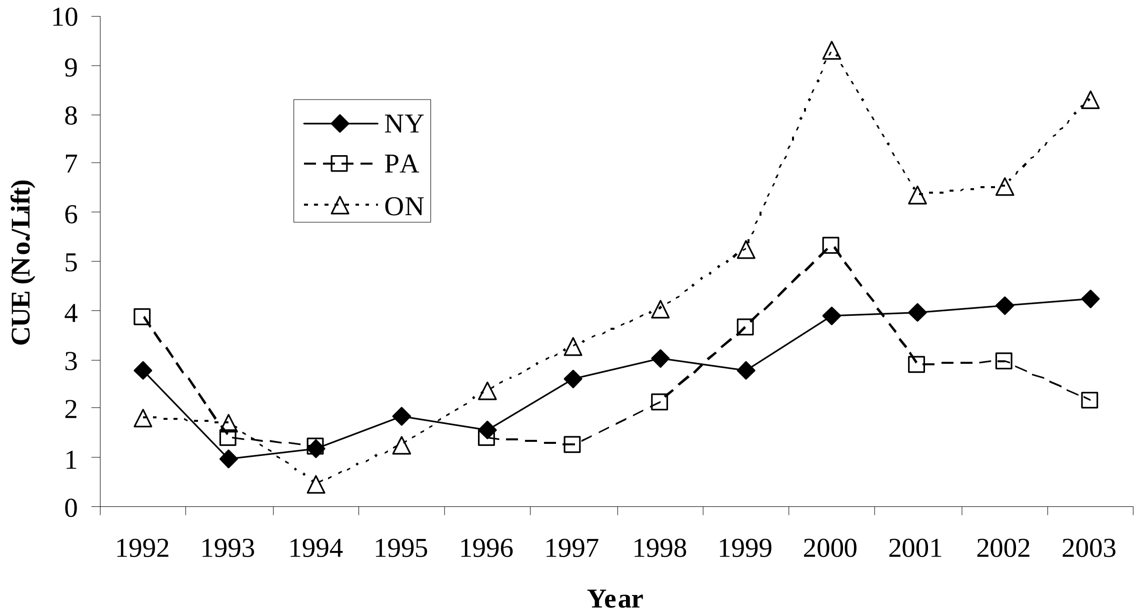


Figure 3.1. Average burbot catch rate (fish/lift) from summer gill net assessment by jurisdiction, 1992 - 2003.

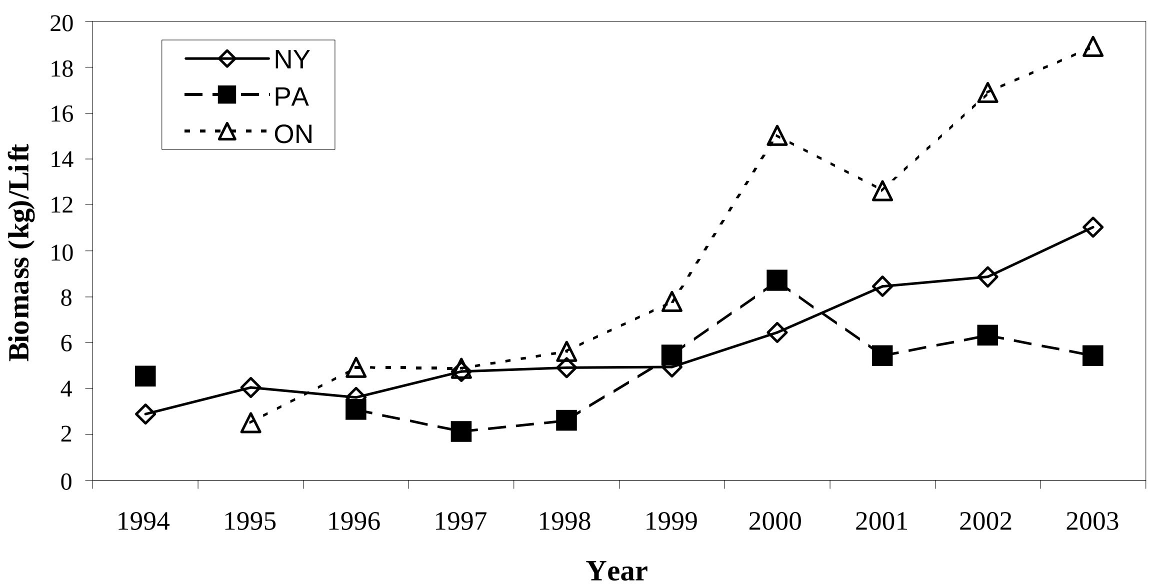


Figure 3.2. Average burbot biomass (kg/lift) from summer gill net assessment by jurisdiction, 1994 - 2003.

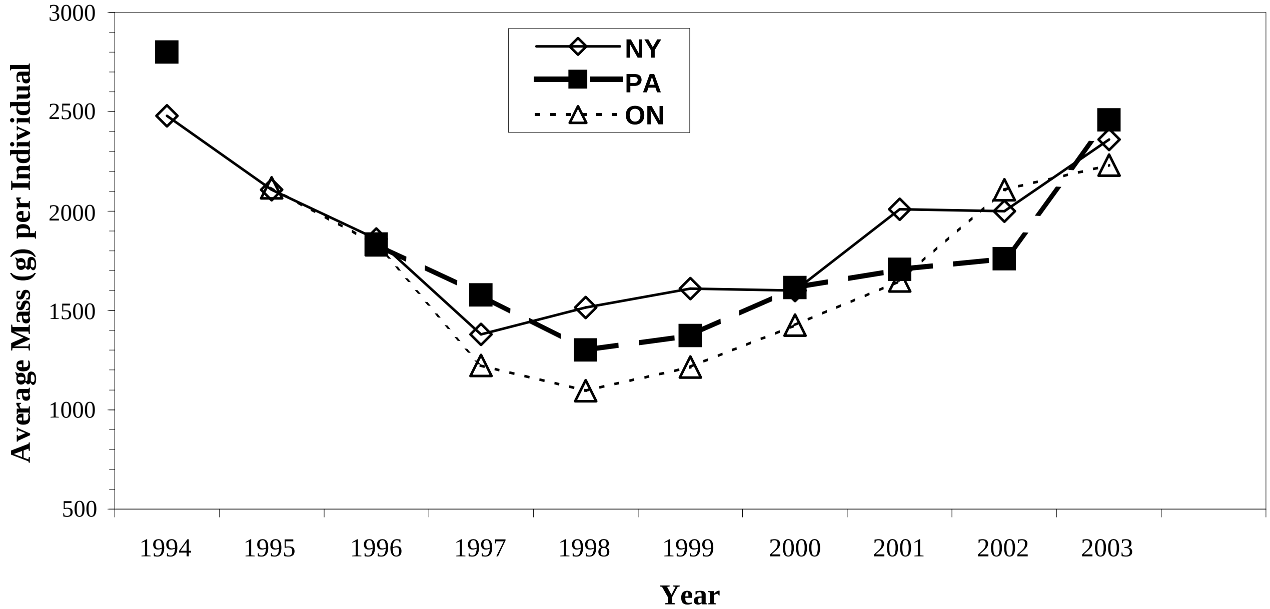


Figure 3.3. Average mass (g) per individual burbot from summer gill net assessment by jurisdiction, 1994 - 2003.

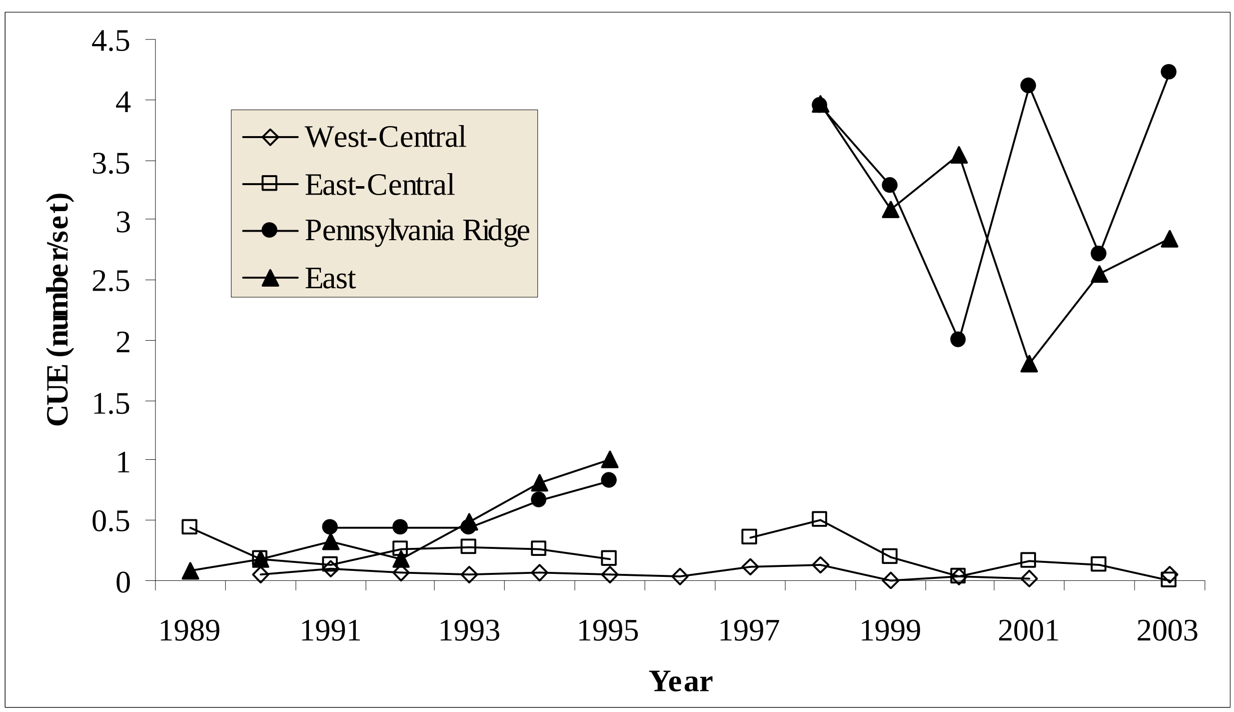


Figure 3.4. Burbot CUE by basin from the OMNR Partnership Index Fishing Program, 1989 - 2003 (Includes canned and bottom nets, all mesh sizes, except thermocline sets).

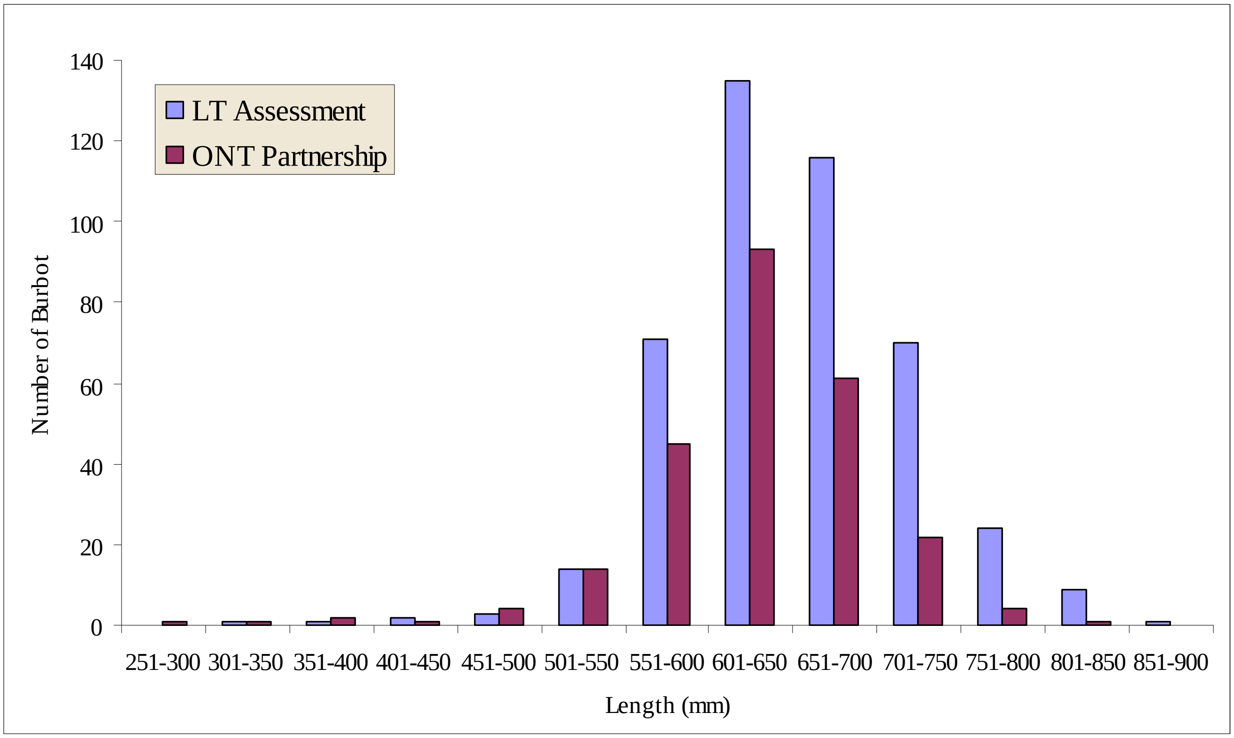


Figure 3.5. Length distribution of burbot collected from all jurisdictions in the summer gill net assessment, 2003 (n = 447), and the OMNR Partnership Index Fishing Program, 2003 (n = 249).

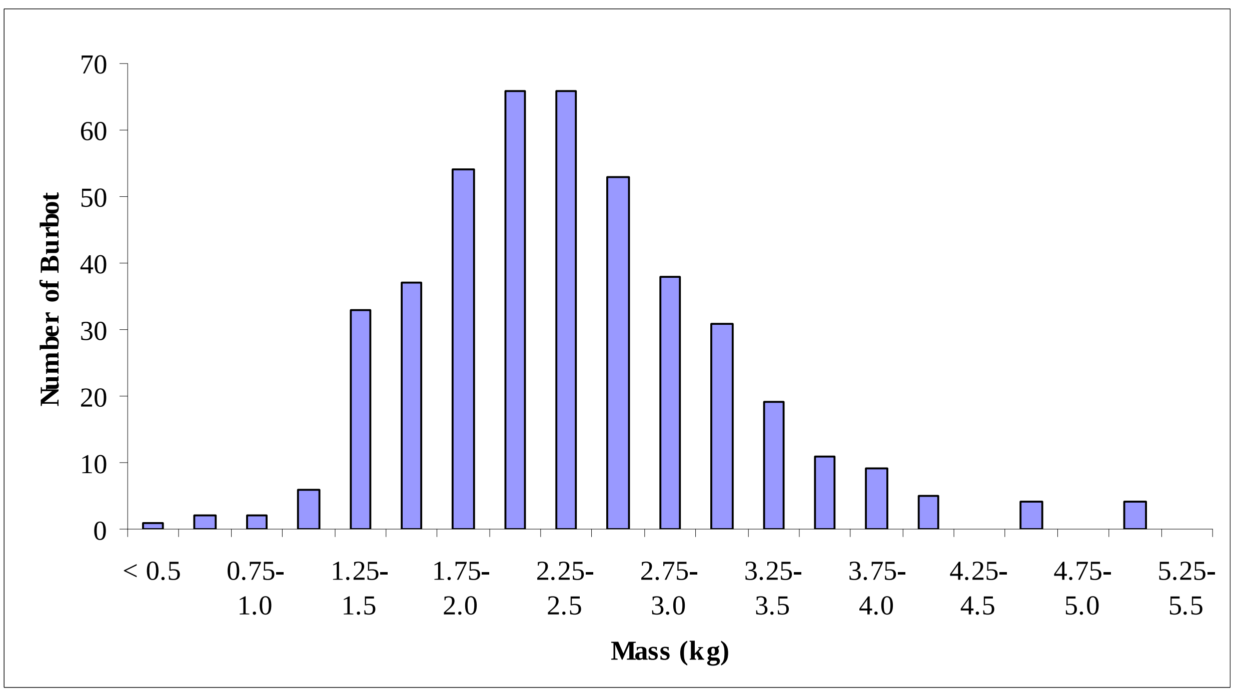


Figure 3.6. Mass distribution of burbot collected from all jurisdictions in the summer gill net assessment, 2003 (n = 441).

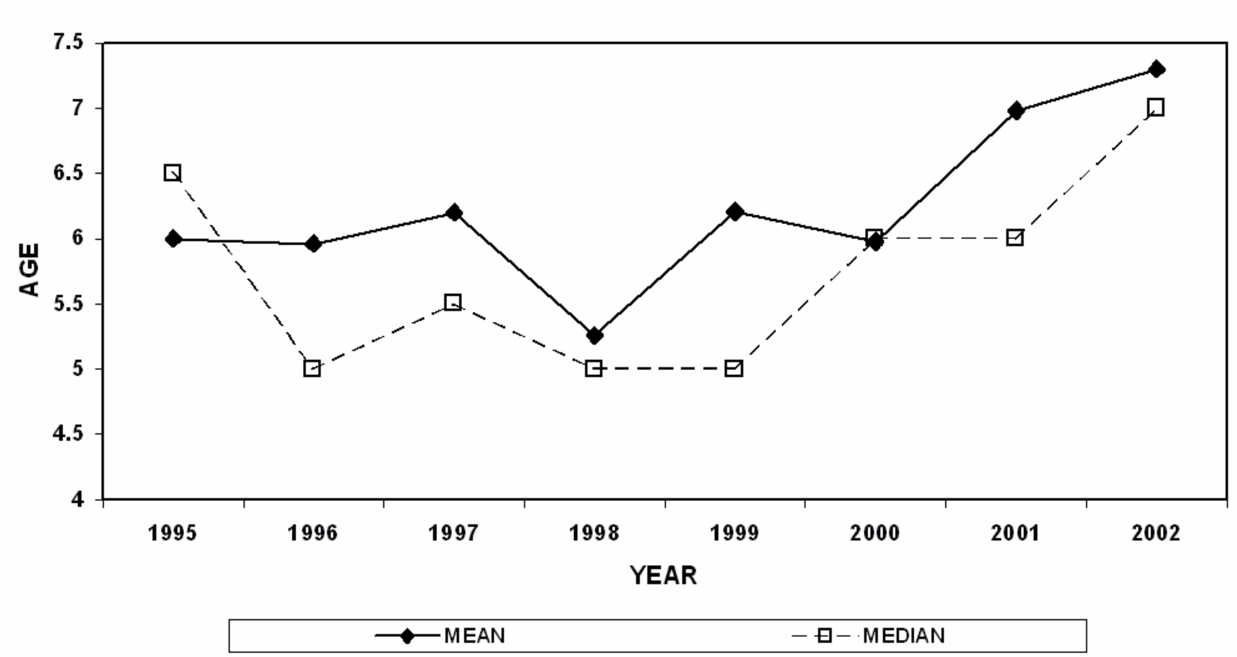


Figure 3.7. Mean and median ages of burbot by year from fish collected in the lake trout summer assessment, New York waters only, 1995 - 2002.

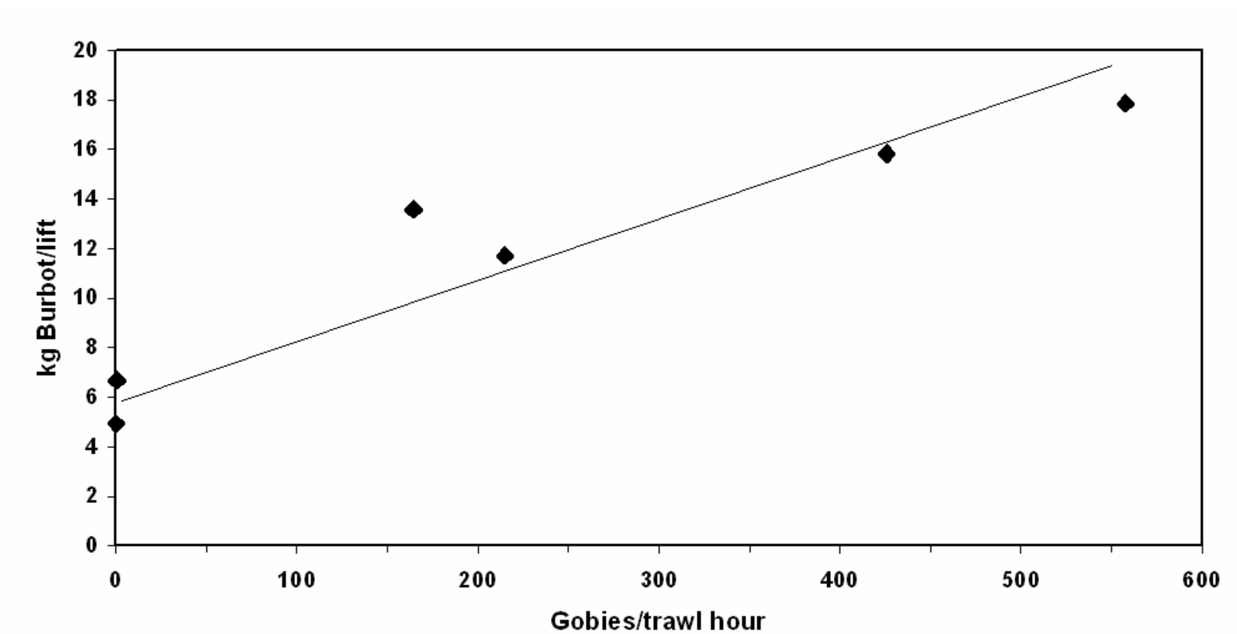


Figure 3.8. Relationship between average mass of burbot per lift in annual gillnet assessment and index of abundance of round gobies from annual trawls by the forage task group in Ontario waters in the eastern basin of Lake Erie, 1998 - 2003 (r^2 = 0.89, P = 0.017).

Charge 4: Continue to participate in the IMSL process on Lake Erie to outline and prescribe the needs of the Lake Erie sea lamprey management program (P. Sullivan, M. Fodale, and J. Markham)

The Great Lakes Fishery Commission and its control agents (U.S. Fish and Wildlife Service and Fisheries and Oceans, Canada) continue to implement Integrated Management of Sea Lampreys (IMSL) in Lake Erie including quantitative selection of streams for treatment implementation of alternative control methods. The Lake Erie Cold Water Task Group has provided the forum for the discussion of concerns about wounding and lake trout mortality.

2003 Lake Trout Wounding Rates

Observed fresh wounding (A1-A3) on lake trout greater than 21 inches total length (532 mm) increased substantially in 2003 to 10.4 wounds per 100 fish (Figure 4.1). While this rate is not as high as the wounding rates found from 1997 through 2001, it does follow a year of low A1-A3 wounding (2002) when rates were below the target of 5 wounds per 100 fish as established by the Sea Lamprey Management Plan for Lake Erie (Lake Trout Task Group 1985). Similar to past years, almost all of the fresh wounds occurred on larger lake trout greater than 25 (635mm) inches with the fish over 29 inches (736 mm) being the preferred host (Table 4.1). There were some fresh wounds on the smaller size classes of lake trout as well.

Fresh wounds (A1) are considered indicators of the attack rate for the current year at the time of sampling (August). A1 wounding in 2003 was 0.028 wounds per adult lake trout greater than 21 inches (Figure 4.2). This rate is almost identical to the A1 wounding rates found in 2000 and 2001 but follows a year of no A1 wounds in 2002. A1 wounds were found in each of the four size categories (Table 4.1), but the larger-sized fish remained the main targets.

The past year's cumulative attacks are indicated by A4 wounds. The 2003 A4 wounding rate of 18.3 wounds per 100 fish for lake trout greater than 21 inches was similar to rates found over the past 2 years (Figure 4.3). Again, the majority of the A4 wounds were found on fish greater than 25 inches in total length (Table 4.1).

2003 Actions

During 2003, assessments were conducted in 3 streams (0 Canada, 3 U.S.) to rank them for lampricide treatment, and another 10 streams (2 Canada, 8 U.S.) to determine presence or absence of sea lamprey larvae (Tables 4.1 and 4.2). The populations considered for treatment were either re-established (Cattaraugus, Raccoon) or residual to treatment (Conneaut). Quantitative assessment of Big Otter Creek was scheduled for 2003 in anticipation of possible lampricide treatment in 2004, however high discharge and turbidity precluded survey. Sea lamprey larvae were detected in Delaware Creek for the first time since 1989.

Control effort, which had been enhanced to counter observed increases in sea lamprey abundance, continued in 2003 with lampricide treatments of Conneaut and Big creeks and the Grand River. This marked the 12th lampricide treatment in the lake's tributaries since 1999. By comparison, only 9 Lake Erie stream treatments had been conducted in the previous eight years from 1991 to 1998.

The estimated numbers of spawning-phase sea lampreys edged up slightly in 2003 after 2 years of decline (Schleen and Klar 2002, Klar and Young 2003, Young and Klar 2004). The 2003 spawning population was estimated at 4,150, up from 1,485 in 2002

(Fig. x; the lowest estimated population size since treatments began in 1986). A total of 100 spawning-phase sea lampreys were trapped in 3 U.S. tributaries (Grand River and Cattaraugus and, Spooner creeks), a reduction of 18% when compared with the 2002 catch. Total catch in 2 Canadian tributaries (Big and Young's creeks) was 375, which represents a 94% increase over the previous year, yet remains far fewer than the 1009 captured in 2001.

Several barrier projects are proceeding on Lake Erie. Consultation occurred between DFO, OMNR and the Grand River Conservation Authority (GRCA) on enhanced native fish passage at the Caledonia dam on the Grand River. Planning for the proposed low-head barrier on Conneaut Creek continued.

2004 Plans

Sea lamprey management plans for Lake Erie in 2004 include lampricide treatment of Cattaraugus Creek, based on a comparison of cost-per-transformer estimates for all Great Lakes streams that were quantitatively assessed in 2003. Pending results from surveys planned for spring 2004, Big Otter Creek may also be treated. Larval assessments are planned on 21 Lake Erie streams (9 Canada, 12 U. S.), 2 of which (0 Canada, 2 U.S.) will be considered for lampricide treatment in 2005 (Tables 4.1, 4.2). In addition, 5 tributaries to Lake St. Clair (2 Canada, 3 U.S.) with histories of sea lamprey production will be assessed. The U.S. Army Corps of Engineers is currently completing a Preliminary Restoration Plan (PRP) that would include the construction of a permanent sea lamprey trap in the Springville dam on Cattaraugus Creek. Plans by the GRCA and OMNR to pass walleyes at the Caledonia dam on the Grand River are moving ahead, and the installation of new denil fish ways has been proposed. These agencies are working with DFO to ensure continued blockage of migrant spawning-phase sea lampreys at this structure. Modifications scheduled for the Taquanyah Creek dam should not impair its ability to prevent spawning-phase sea lampreys from ascending this cold water tributary to the Grand River.

References

Klar, G. T. and Young, R. J. 2003. *Integrated management of sea lampreys in Lake Erie 2002.* 2003 Annual Report to the GLFC's Lake Erie Committee. Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Lake Trout Task Group. 1985. A Sea Lamprey Management Plan for Lake Erie. Report to the Great Lakes Fisheries Commission's Lake Erie Committee, Ann Arbor, Michigan, USA.

Schleen, L. P. and Klar, G. T. 2002. *Integrated management of sea lampreys in Lake Erie 2001.* 2002 Annual Report to the GLFC's Lake Erie Committee. Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Young, R. J. and Klar, G. T. 2004. *Integrated management of sea lampreys in Lake Erie 2003.* 2004 Annual Report to the GLFC's Lake Erie Committee. Great Lakes Fishery Commission, Ann Arbor, Michigan, USA.

Table 4.1. Frequency of sea lamprey wounds observed on several standard length groups of lake trout collected from standard mesh gill nets in New York waters of Lake Erie, August 2003.

SIZE CLASS TOTAL LENGTH (inches)	SAMPLE SIZE	NO. FISH WITH FRESH WOUNDS	WOUND CLASSIFICATION A1	A2	A3	A4	PERCENT WITH A1-A3 WOUNDS	NO. A1-A3 WOUNDS PER 100 FISH
17 - 21	29	1	1	0	0	0	3.4	3.4
21 - 25	95	2	1	1	0	6	2.1	2.1
25 - 29	231	16	5	6	12	45	6.9	10.0
>29	67	10	5	1	10	21	14.9	23.9
>21	393	28	11	8	22	72	7.1	10.4

Table 4.2: Larval sea lamprey assessments of Canadian Lake Erie tributaries in 2003 and plans for 2004.

Stream	History	Surveyed In 2003	Survey Type	Results	Plans for 2004
Big Creek	Positive	**Yes**	Treat. Eval.	Negative	none
Young's Creek	Positive	**Yes**	Evaluation	Negative	none
Big Otter Creek	Positive	No	-	-	**Quantitative survey[1] / Contingency treatment[1a]**
East Creek	Positive	No	-	-	none
Catfish Creek	Positive	No	-	-	Evaluation survey [2]
Silver Creek	Positive	No	-	-	none
South Otter Creek	Positive	No	-	-	Evaluation survey
Clear Creek	Positive	No	-	-	Evaluation survey
Forestville Creek	Positive	No	-	-	Evaluation survey
Normandale Creek	Positive	No	-	-	Evaluation survey
Fishers Creek	Positive	No	-	-	Evaluation survey
Kettle Creek	Negative	No	-	-	none
E-116	Negative	No	-	-	Detection survey[3]
Grand River	Negative	No	-	-	Detection survey
St. Clair tributaries					
St. Clair River	Positive	No	-	-	Evaluation survey
Thames River	Positive	No	-	-	Evaluation survey

[1]*Quantitaive survey* – conducted to estimate larval population and larvae expected to metamorphose in the following year. Projected treatment cost is divided by the metamorphosed larval estimate to provide a ranking against other Great Lakes tributaries for lampricide treatment.
[1a]*Contingency treatment* - Depending on 2004 Quantitative survey results, lampricide treatment may be conducted in 2004.
[2]*Evaluation survey* – conducted to determine requirement for quantitative assessment.
[3]*Detection survey* – conducted to determine larval presence or absence in streams with no history of sea lamprey infestation.

Table 4.3: Larval sea lamprey assessments of U.S. Lake Erie tributaries conducted in 2003 and plans for 2004.

Stream	**History**	**Surveyed In 2003**	**Survey Type**	**Results**	**Plans for 2004**
Cattaraugus Creek	Positive	**Yes**	*Quantitative*	Positive	**Lampricide treatment**
Conneaut Creek	Positive	**Yes**	*Quantitative*	Positive	None
Grand River	Positive	**Yes**	Treatment Eval	Positive	None
Raccoon Creek	Positive	**Yes**	*Quantitative*	Positive	Quantitative survey
Delaware Creek	Positive	**Yes**	Evaluation	Positive	Quantitative survey
Halfway Brook	Positive	**Yes**	Evaluation	Negative	None
Wheeler Creek	Positive	**Yes**	Detection	Negative	None
Little Sister Creek	Negative	**Yes**	Detection	Negative	None
Ashtabula River	Negative	**Yes**	Detection	Negative	None
Arcola Creek	Negative	**Yes**	Detection	Negative	None
Chagrin River	Negative	**Yes**	Detection	Negative	None
Buffalo River					
Cayuga Creek	Positive	No	-	-	Evaluation survey
Canadaway Creek	Positive	No	-	-	Evaluation survey
Chautaqua Creek	Negative	No	-	-	Detection survey
Walnut Creek	Negative	No	-	-	Detection survey
Crooked Creek	Positive	No	-	-	Evaluation survey
Black River	Negative	No	-	-	Detection survey
Vermilion River	Negative	No	-	-	Detection survey
Sandusky River	Negative	No	-	-	Detection survey
Portage River	Negative	No	-	-	Detection survey
Maumee River	Negative	No	-	-	Detection survey
St. Clair tributaries					
St. Clair River	Positive	No	-	-	Evaluation survey
Clinton River	Positive	No	-	-	Evaluation survey
Belle River	Positive	No	-	-	Evaluation survey

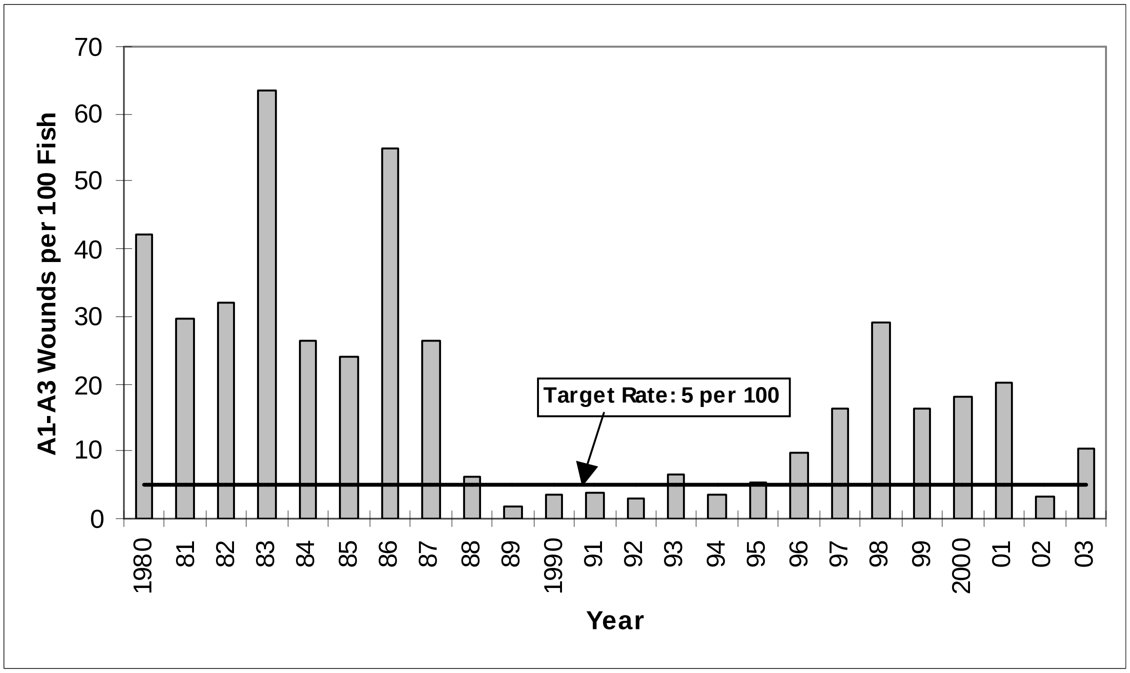


Figure 4.1. Number of fresh (Type A1 – A3) sea lamprey wounds per 100 adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1980 – 2003. The Strategic Plan target rate is 5 wounds per 100 fish.

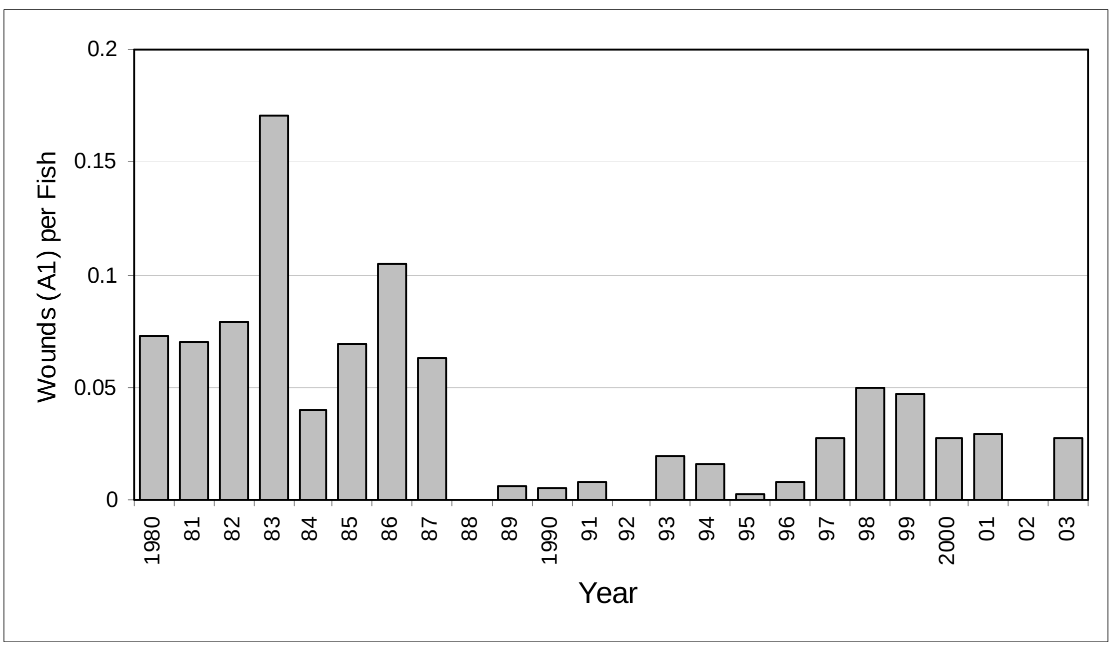


Figure 4.2. Number of fresh Type A1 sea lamprey wounds observed per adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August - September, 1980 - 2003.

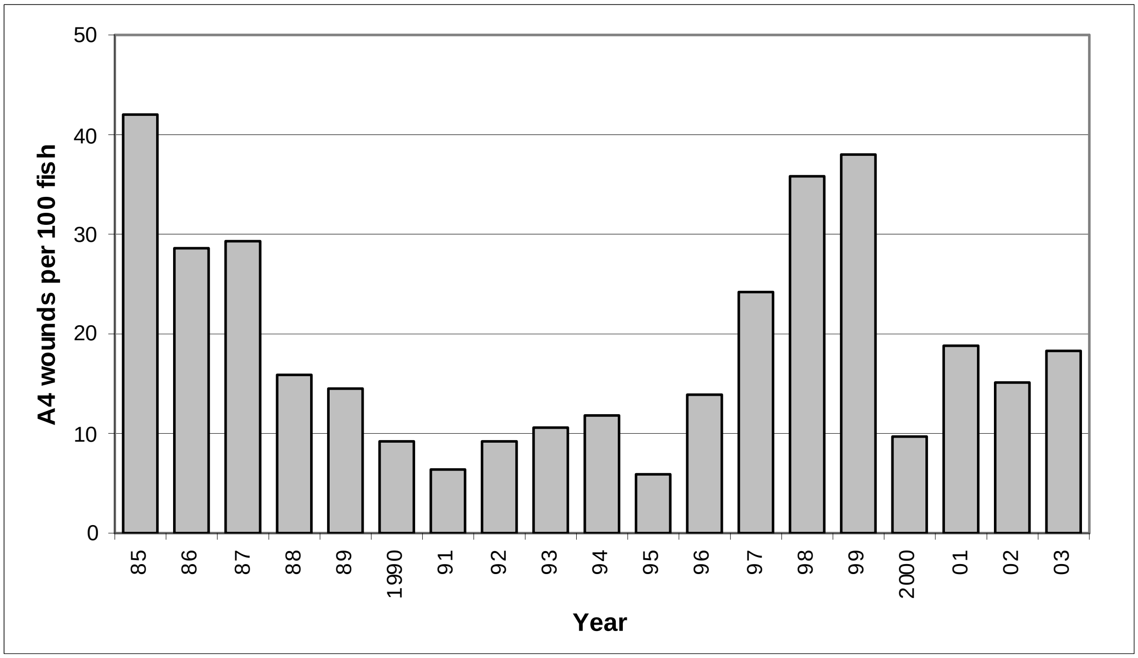


Figure 4.3. Number of Type A4 sea lamprey wounds observed per 100 adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1985 - 2003.

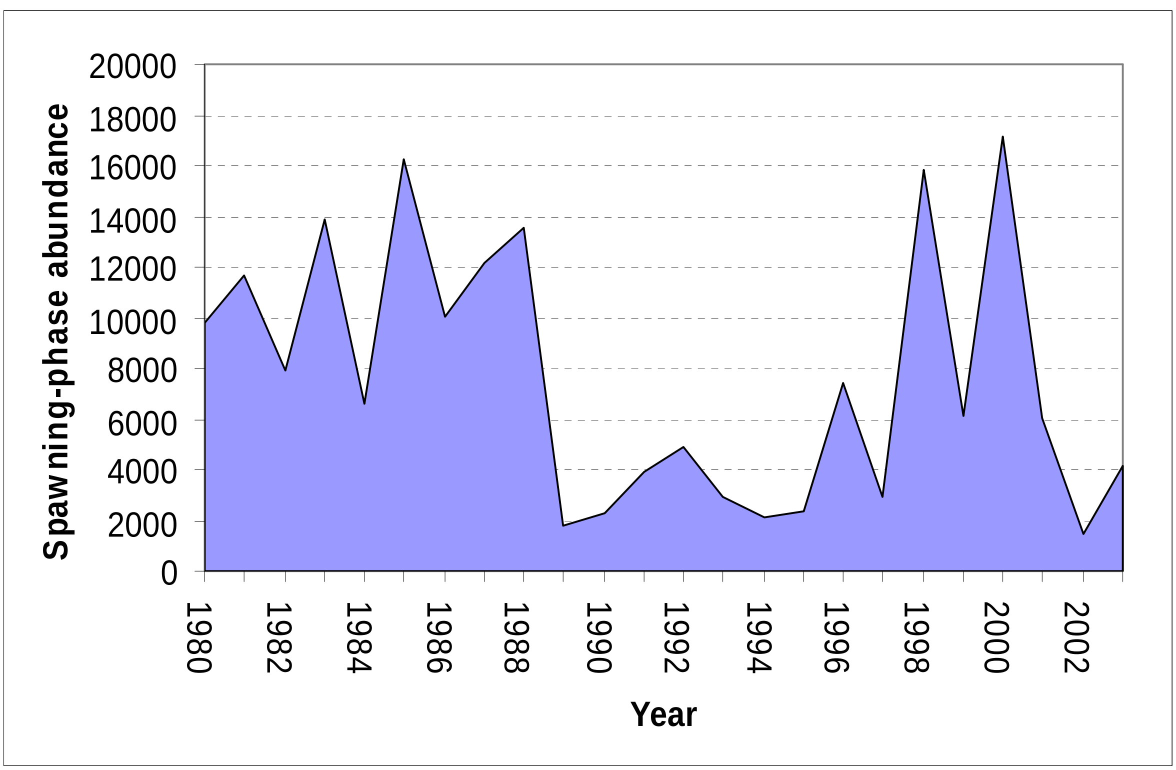


Figure 4.4. Lake-wide estimate of spawning-phase sea lampreys in Lake Erie, 1980-2003.

Charge 5: Maintain an annual interagency electronic database of Lake Erie salmonid stocking and current projections for the STC, GLFC and Lake Erie agency data depositories (C. Murray and J. Markham)

Stocking of Lake Trout

The current lake trout goal of 120,000 yearlings stocked was met for the fifth straight year (Figure 5.1). This was equal to effort in both 2001 and 2002, but still 23% below the long-term average. The Allegheny National Fish Hatchery (ANFH) supplied all of the lake trout, with all 120,000 Finger Lakes strain delivered to New York. These fish were all stocked over 70 feet of water north of Dunkirk between 7 May and 15 May, 2003. No lake trout were stocked in Pennsylvania waters in 2003. All yearling lake trout were adipose fin-clipped and coded-wire tagged prior to stocking. An additional 109,230 lake trout sac fry, also supplied by ANFH, were stocked by tube over cobble material on Brocton Shoal by NYS DEC personnel on 27 May, 2003. This was well below the stocking goal of 500,000. All lake trout fry were otolith marked by exposure to temperature change prior to release for future identification.

To address the lack of natural recruitment in the Lake Erie system and declining adult numbers, a new strain of lake trout from Lake Superior is currently being raised at ANFH for stocking in Lake Erie beginning in 2004. The Klondike strain, also referred to as humpers or bankers, is an offshore form that lives its entire life around deep-water reef areas. The Klondike appears to have characteristics that are more conducive for spawning in the Lake Erie than those of the forms currently stocked. Further, it is the most genetically diverse strain of all the Federal Hatchery fish. This combination of characteristics may improve the chances of establishing a self-sustaining lake trout population in Lake Erie. Approximately 31,000 Klondike yearlings are scheduled to be stocked in Lake Erie in Spring 2004. Overall stocking effort of yearling lake trout in Lake Erie is expected to increase in 2005 to 160,000 yearlings split between the Klondike and Finger Lakes strains.

A paired planting of yearling lake trout to compare survival and growth rates of large versus small stocking size was continued in 2003. This was the fourth year of the five year comparison study that began in 2000. Because all lake trout were stocked off of Dunkirk in 2003, we will have three different size groups to evaluate over the next few years. The first stocking of yearling lake trout averaged 15.0 fish/pound and were stocked on 7 May 2003. The second group averaged 13.5 fish/pound and were stocked on 8 May. The largest-sized group ranged from 10 to 10.5 fish/pound and were stocked on 9 May and 15 May 2003. All the lake trout were stocked off the RV ARGO in 70 feet of water north of Dunkirk. Each of the size groups consisted of 40,000 fish and had different coded-wire tag (CWT) numbers for future identification.

Results of the study thus far significantly favor the larger stocked fish. Cumulative returns from the first paired stocking in 2000 favored the larger stocked fish 2.33:1 (205 large, 89 small) (t-test; $P<0.0005$), the 2001 stocking 2.33:1 (37 large, 16 small) (t-test; $P<0.01$), and 1.94:1 (55 large, 28 small) (t-test; $P<0.005$) with 2002 stocked lake trout (Figure 5.2). No age 1 (2003 stocking) lake trout were caught during the 2003 coldwater assessment survey to assess return rates. Significant differences (chi-square; $P<0.01$) in average sizes were also found up to age 4. Differences were generally about one inch in length.

While the larger sized fish have return rates around 2:1 compared to the normal "smaller" stocking size, the question remains whether this is enough of a difference to change stocking policy. The larger fish are raised at half the raceway density (20,000 vs. 40,000). At a 2:1 return rate, this equals the same number of recruits returned. A similar size comparison study in Lake Michigan found no differences in return rates from different size and quality lake trout stockings (Chuck Bronte, USFWS, Personal Communication). Future studies to evaluate other stocking densities such as 30,000 fish/raceway may be needed to determine the best stocking strategy to maximize returns and stabilize recruitment of lake trout yearlings, which is the ultimate goal.

Stocking of Other Salmonids

In 2003, over 2 million yearling trout and salmon were stocked in Lake Erie, including rainbow trout / steelhead, lake trout, brown trout and coho salmon (Figure 5.3). Total salmonine stocking decreased nearly 10% from 2002 and had decreased 12% from the long-term average (1989 - 2003). Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 5.1.

All riparian agencies stock rainbow trout in Lake Erie. Rainbow trout / steelhead accounted for 87% of all salmonids stocked in 2003. A total of 1,793,083 yearling rainbow trout were stocked in 2003, representing a 7.6% decrease from 2002. Rainbow trout stocking in 2003 had increased over 16% from the long-term average, primarily a result of the increased prominence of this species in jurisdictional fisheries over that last decade. Details on strain composition and stocking location are covered in detail under Charge 6 of this report.

Brown trout stocking in Lake Erie totaled 74,734 yearlings in 2003. This represented a decrease of 36% from 2002, and a 15% decrease from the long-term average. The majority (90%) of the brown trout are of domestic (inland) origin and stocked in New York and Pennsylvania. The remainder are a Lake Ontario (Ganaraska River) strain stocked in Ontario waters of Lake Erie.

The Pennsylvania Fish and Boat Commission stocked 69,912 coho salmon in Lake Erie in 2003. The Pennsylvania Fish and Boat Commission has terminated the coho salmon program with no plans to stock this species in the future. This final stocking represented a 30% decrease from 2002, and a 76% decrease from the 1989-2003 annual average. As with other jurisdictional anadromous fisheries, there has been a shift in emphasis to the steelhead trout fishery.

Table 5.1 : Summary of salmonid stocking in number of yearling equivalents, Lake Erie 1989 – 2003.

Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
ONTARIO	--	--	--		14,370	14,370
NEW YORK	143,200	154,210	70,370	54,590	141,740	564,110
PENNSYLVANIA	80,000	1,166,480	--	62,450	720,920	2,029,850
OHIO	--	--	--	92,120	242,000	334,120
MICHIGAN	--	400,190	--	50,350	69,560	520,100
1989 Total	**223,200**	**1,720,880**	**70,370**	**259,510**	**1,188,590**	**3,462,550**
ONTARIO	--	--	--	--	31,530	31,530
NEW YORK	113,730	5,730	65,170	48,320	160,500	393,450
PENNSYLVANIA	82,000	249,810	5,670	55,670	889,470	1,282,620
OHIO	--	--	--	--	485,310	485,310
MICHIGAN	--	--	--	51,090	85,290	136,380
1990 Total	**195,730**	**255,540**	**70,840**	**155,080**	**1,652,100**	**2,329,290**
ONTARIO	--	--	--	--	98,200	98,200
NEW YORK	125,930	5,690	59,590	43,500	181,800	416,510
PENNSYLVANIA	84,000	984,000	40,970	124,500	641,390	1,874,860
OHIO	--	--	--	--	367,910	367,910
MICHIGAN	--	--	--	52,500	58,980	111,480
1991 Total	**209,930**	**989,690**	**100,560**	**220,500**	**1,348,280**	**2,868,960**
ONTARIO	--	--	--	--	89,160	89,160
NEW YORK	108,900	4,670	56,750	46,600	149,050	365,970
PENNSYLVANIA	115,700	98,950	15,890	61,560	1,485,760	1,777,860
OHIO	--	--	--	--	561,600	561,600
MICHIGAN	--	--	--	--	14,500	14,500
1992 Total	**224,600**	**103,620**	**72,640**	**108,160**	**2,300,070**	**2,809,090**
ONTARIO	--	--	--	650	16,680	17,330
NEW YORK	142,700	--	56,390	47,000	256,440	502,530
PENNSYLVANIA	74,200	271,700	--	36,010	973,300	1,355,210
OHIO	--	--	--	--	421,570	421,570
MICHIGAN	--	--	--	--	22,200	22,200
1993 Total	**216,900**	**271,700**	**56,390**	**83,660**	**1,690,190**	**2,318,840**
ONTARIO	--	--	--	--	69,200	69,200
NEW YORK	120,000	--	56,750	--	251,660	428,410
PENNSYLVANIA	80,000	112,900	128,000	112,460	1,240,200	1,673,560
OHIO	--	--	--	--	165,520	165,520
MICHIGAN	--	--	--	--	25,300	25,300
1994 Total	**200,000**	**112,900**	**184,750**	**112,460**	**1,751,880**	**2,361,990**
ONTARIO	--	--	--	--	56,000	56,000
NEW YORK	96,290	--	56,750	--	220,940	373,980
PENNSYLVANIA	80,000	119,000	40,000	30,350	1,223,450	1,492,800
OHIO	--	--	--	--	112,950	112,950
MICHIGAN	--	--	--	--	50,460	50,460
1995 Total	**176,290**	**119,000**	**96,750**	**30,350**	**1,663,800**	**2,086,190**
ONTARIO	--	--	--	--	38,900	38,900
NEW YORK	46,900	--	56,750	--	318,900	422,550
PENNSYLVANIA	37,000	72,000	--	38,850	1,091,750	1,239,600
OHIO	--	--	--	--	205,350	205,350
MICHIGAN	--	--	--	--	59,200	59,200
1996 Total	**83,900**	**72,000**	**56,750**	**38,850**	**1,714,100**	**1,965,600**
ONTARIO	--	--	--	1,763	51,000	52,763
NEW YORK	80,000	--	56,750	--	277,042	413,792
PENNSYLVANIA	40,000	68,061	--	31,845	1,153,606	1,293,512
OHIO	--	--	--	--	197,897	197,897
MICHIGAN	--	--	--	--	71,317	71,317
1997 Total	**120,000**	**68,061**	**56,750**	**33,608**	**1,750,862**	**2,029,281**

Table 5.1 (Continued): Summary of salmonid stocking in number of yearling equivalents, Lake Erie 1989 – 2003.

Jurisdiction	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
ONTARIO	--	--	--	--	61,000	61,000
NEW YORK	106,900	--	--	--	299,610	406,510
PENNSYLVANIA	--	100,000	--	28,030	1,271,651	1,399,681
OHIO	--	--	--	--	266,383	266,383
MICHIGAN	--	--	--	--	60,030	60,030
1998 Total	**106,900**	**100,000**	**0**	**28,030**	**1,958,674**	**2,193,604**
ONTARIO			--		85,235	85,235
NEW YORK	143,320		--		310,300	453,620
PENNSYLVANIA	40,000	100,000	--	20,780	835,931	996,711
OHIO			--		238,467	238,467
MICHIGAN			--		69,234	69,234
1999 Total	**183,320**	**100,000**	**0**	**20,780**	**1,539,167**	**1,843,267**
ONTARIO	--	--	--	--	10,787	10,787
NEW YORK	92,200	--	--	--	298,330	390,530
PENNSYLVANIA	40,000	137,204	--	17,163	1,237,870	1,432,237
OHIO	--	--	--	--	375,022	375,022
MICHIGAN	--	--	--	--	60,000	60,000
2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**
ONTARIO	--	--	--	100	40,860	40,960
NEW YORK	80,000	--	--	--	276,300	356,300
PENNSYLVANIA	40,000	127,641	--	17,000	1,185,239	1,369,880
OHIO	--	--	--	--	424,530	424,530
MICHIGAN	--	--	--	--	67,789	67,789
2001 Total	**120,000**	**127,641**	**0**	**17,100**	**1,994,718**	**2,259,459**
ONTARIO	--	--	--	4,000	66,275	70,275
NEW YORK	80,000	--	--	72,300	257,200	409,500
PENNSYLVANIA	40,000	100,289	--	40,675	1,145,131	1,326,095
OHIO	--	--	--	--	411,601	411,601
MICHIGAN	--	--	--	--	60,000	60,000
2002 Total	**120,000**	**100,289**	**0**	**116,975**	**1,940,207**	**2,277,471**
ONTARIO	--	--	--	7,000	48,672	55,672
NEW YORK	120,000	--	--	44,813	253,750	418,563
PENNSYLVANIA	--	69,912	--	22,921	866,789	959,622
OHIO	--	--	--	--	544,280	544,280
MICHIGAN	--	--	--	--	79,592	79,592
2003 Total	**120,000**	**69,912**	**0**	**74,734**	**1,793,083**	**2,057,729**

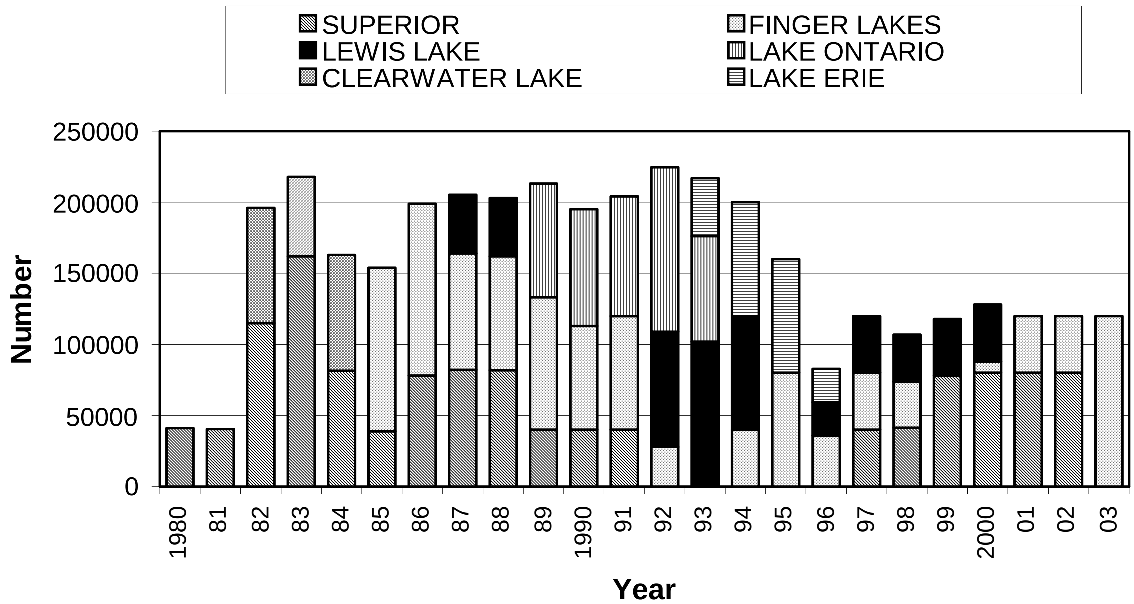


Figure 5.1. Yearling lake trout stocked in U.S. waters of the eastern basin of Lake Erie, 1980 – 2002, by strain. The current stocking goal is 120,000 yearlings per year.

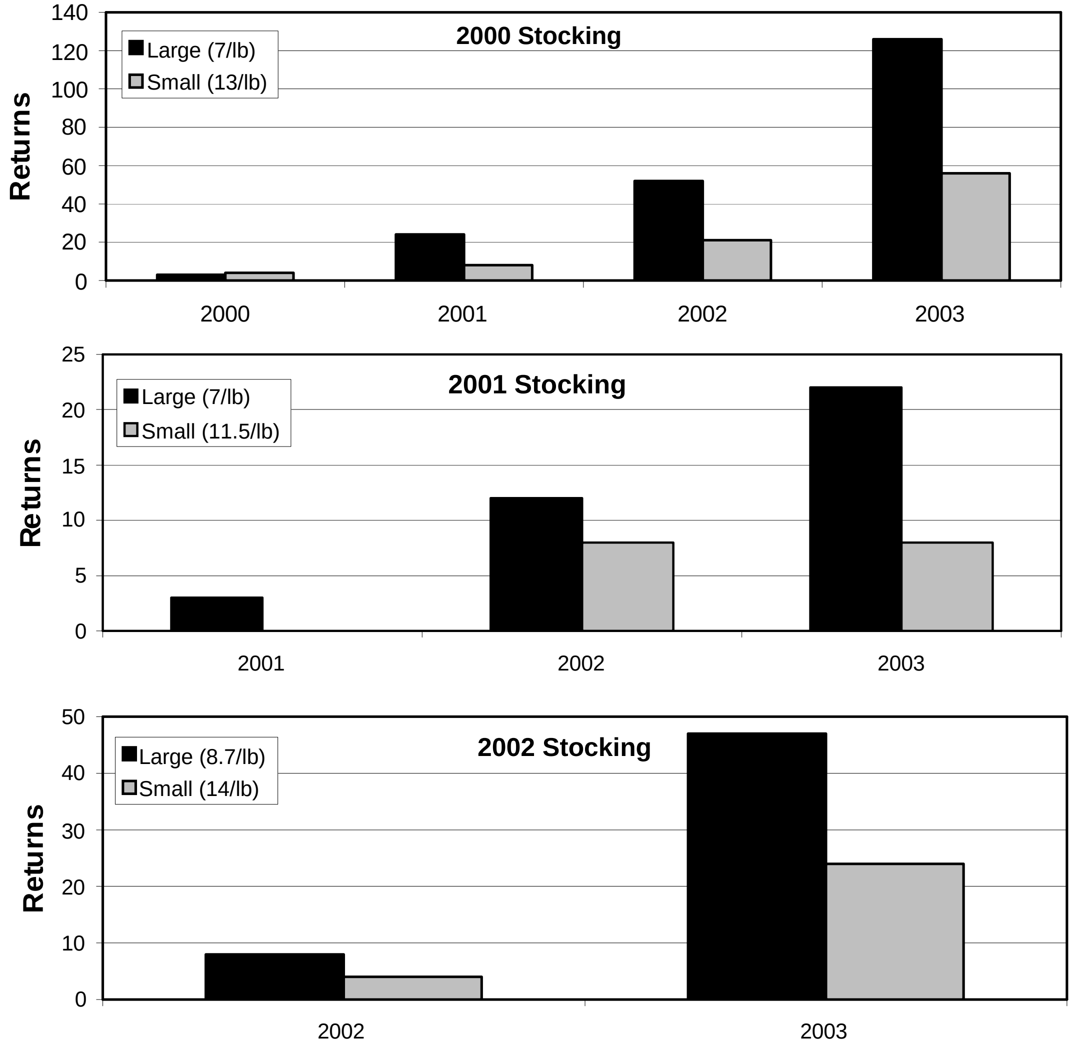


Figure 5.2. Returns of tagged yearling lake trout stocked in 2000 – 2002 from a large vs. small comparison study being conducted in New York waters of Lake Erie.

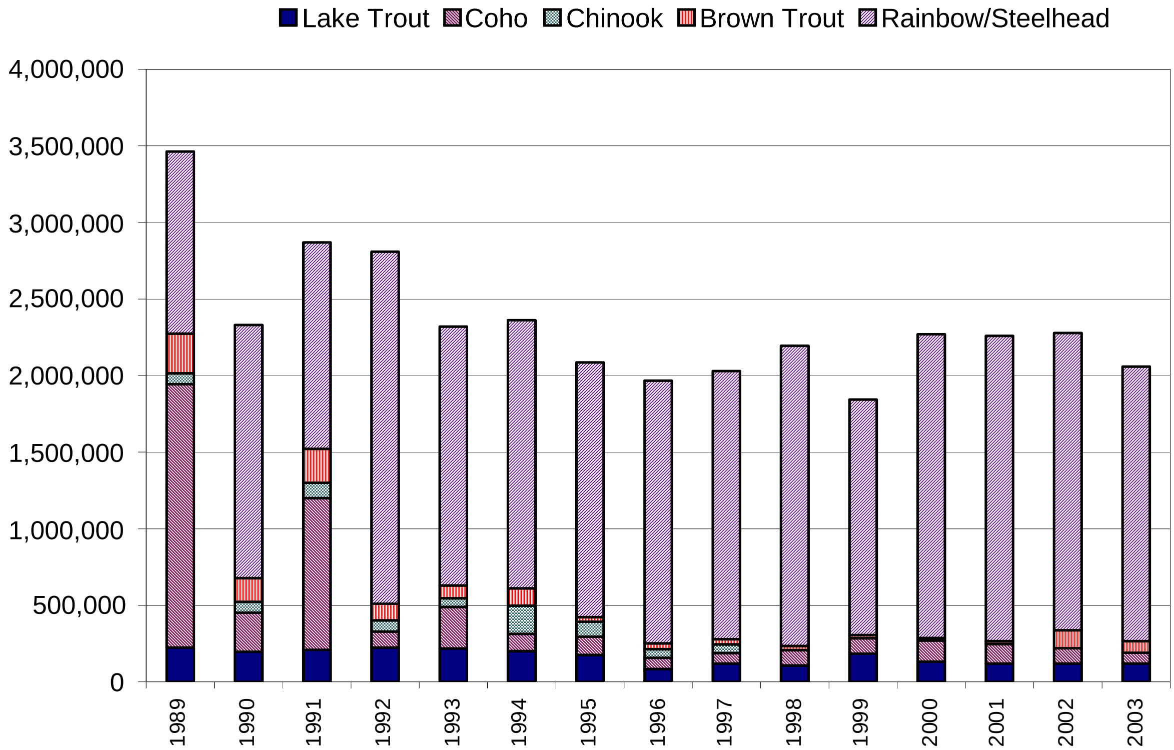


Figure 5.3. Annual stocking of all salmonid species in Lake Erie by all riparian agencies, 1989 – 2003. Numbers of stocked fish are represented in yearling equivalents.

Charge 6. Report on the status of rainbow trout in Lake Erie, including stocking numbers, strains being stocked, academic and resource agency research interests, and related population parameters, including growth and exploitation (C. Murray and J. Markham)

Stocking

All jurisdictions stocked rainbow trout in 2003 (Table 6.1). Nearly all (99.9%) rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A naturalized Lake Erie strain comprises approximately 48% of the strain composition followed by a Lake Michigan strain (35%) and a Lake Ontario strain (17%); about 0.1% of the stocked rainbow trout were of domestic (inland) origin.

Approximately 7% of all rainbow trout stocked in 2003 were fin clipped. Michigan continued a standard RP clip for all yearling plant. New York DEC RV clipped 10,000 steelhead in a continued evaluation of Dunkirk Harbor steelhead stocking and Ontario did a LP clip of all steelhead stocked in Lake Erie tributaries. Summary data for fish marked from 1999 - 2003 are summarized in table 6.2.

Assessment of Natural Reproduction

A comprehensive, multi-year stream electrofishing survey cataloging New York's Lake Erie tributaries for potential of natural reproduction by steelhead began in Fall 2002. A total of 13 streams have been sampled thus far, but there were no efforts conducted during 2003. Results from this survey will be used to develop a comprehensive map of steelhead spawning waters in New York Lake Erie tributaries. Over time, key areas for natural reproduction will be identified and a more comprehensive sampling protocol will be used to estimate wild population size for each positive stream and estimate overall wild steelhead production. This survey will also identify areas to target for stream improvement to increase wild trout production. The stream inventory survey is planned to resume in 2004.

Exploitation

Agency data for the rainbow trout/steelhead fisheries on Lake Erie is limited. Ohio, New York, Pennsylvania and Michigan provide annual estimates of open lake boat angling effort, catch and harvest from creel surveys. Ontario has generated estimates of open lake effort and harvest through an angler diary program. New York and Pennsylvania also operate angler diary programs on Lake Erie and measure the annual catch rates by both open lake and stream anglers. These data sets can provide a general overview of the steelhead fisheries on Lake Erie, but care must be taken when providing direct comparisons. More comprehensive assessments of the tributary fisheries in New York and Pennsylvania are presently being conducted and will provide a more contemporary overview of the steelhead fisheries in New York and Pennsylvania.

Previous creel surveys have shown that most of the targeted effort for rainbow trout is in the tributaries. Annual assessment of this component is limited by all agencies. Results from the New York and Pennsylvania diary programs show a steady increase in the angler catch rate in the tributaries since 1996 (Figure 6.1). A similar trend is evident when observing steelhead angler catch rates from open lake boat anglers in Ohio, New York, Pennsylvania and Ontario (Figure 6.2).

A summary of open lake rainbow trout harvest by Ohio, Ontario, New York, Pennsylvania and Michigan is provided in Table 6.3. Harvest decreased in all jurisdictions in 2003 (Figure 6.3). Based on the 2003 harvest estimates most (97%) of the harvest was in central basin waters, followed by the eastern basin waters (3%). The harvest in the western basin is negligible. Estimates of 2003 open water steelhead harvest for Ontario waters of both the central and eastern basins were not available for this report.

Table 6.1. Rainbow trout /steelhead stocking by jurisdiction for 2003.

	Location	Strain	Fin Clips	Number	Life Stage	Yearling Eqivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	**RP**	63,000	Yearling	63,000	
	Huron River	Manistee River, L. Michigan	NO	470,027	Fall Fingerlings	16,592	
						79,592	**Sub-Total**
Ontario	Big Creek	Ganaraska River, L. Ontario	LP	11,672	Yearling	11,672	
	Mill Creek	Ganaraska River, L. Ontario	LP	27,000	Yearling	27,000	
	Erieau Harbour	Ganaraska River, L. Ontario	LP	10,000	Yearling	10,000	
						48,672	**Sub-Total**
Pennsylvania	Conneaut Creek	Trout Run & Godfrey Run, L. Erie	NO	75,000	Yearling	75,000	
	Raccoon Creek	Trout Run & Godfrey Run, L. Erie	"	31,991	Yearling	31,991	
	Crooked Creek	Trout Run & Godfrey Run, L. Erie	"	38,389	Yearling	38,389	
	Elk Creek	Trout Run & Godfrey Run, L. Erie	"	181,750	Yearling	181,750	
	Fourmile Creek	Trout Run & Godfrey Run, L. Erie	"	9,877	Yearling	9,877	
	Godfrey Run	Trout Run & Godfrey Run, L. Erie	"	70,992	Yearling	70,992	
	Lake Erie	Trout Run & Godfrey Run, L. Erie	"	29,000	Yearling	29,000	
	Orchard Beach Run	Trout Run & Godfrey Run, L. Erie	"	6,398	Yearling	6,398	
	Peck Run	Trout Run & Godfrey Run, L. Erie	"	6,398	Yearling	6,398	
	Presque Isle Bay	Trout Run & Godfrey Run, L. Erie	"	25,593	Yearling	25,593	
	Sevenmile Creek	Trout Run & Godfrey Run, L. Erie	"	13,246	Yearling	13,246	
	Trout Run	Trout Run & Godfrey Run, L. Erie	"	86,037	Yearling	86,037	
	Twelvemile Creek	Trout Run & Godfrey Run, L. Erie	"	25,838	Yearling	25,838	
	Twentymile Creek	Trout Run & Godfrey Run, L. Erie	"	102,919	Yearling	102,919	
	Walnut Creek	Trout Run & Godfrey Run, L. Erie	"	163,361	Yearling	163,361	
						866,789	**Sub-Total**
Ohio	Chagrin River	Manistee River, L. Michigan	NO	95,925	Yearling	95,925	
	Conneaut Creek	Manistee River, L. Michigan	"	108,024	Yearling	108,024	
	Grand River	Manistee River, L. Michigan	"	116,151	Yearling	116,151	
	Rocky River	Manistee River, L. Michigan	"	106,736	Yearling	106,736	
	Vermillion River	Manistee River, L. Michigan		117,444	Yearling	117,444	
						544,280	**Sub-Total**
New York	Buffalo Creek	Chambers Creek, L. Ontario	NO	17,870	Yearling	17,870	
	Buffalo Harbor	Domestic	"	2,500	Yearling	2,500	
	Canadaway Creek	Chambers Creek, L. Ontario	"	19,860	Yearling	19,860	
	Cattaraugus Creek	Chambers Creek, L. Ontario	"	89,350	Yearling	89,350	
	Cayuga Creek	Chambers Creek, L. Ontario	"	14,890	Yearling	14,890	
	Chautauqua Creek	Chambers Creek, L. Ontario	"	39,710	Yearling	39,710	
	Dunkirk Harbor	Chambers Creek, L. Ontario	**RV**	10,000	Yearling	10,000	
	East Bran Cazenovia	Chambers Creek, L. Ontario	NO	9,930	Yearling	9,930	
	Eighteen-Mile Creek	Chambers Creek, L. Ontario	"	39,720	Yearling	39,720	
	Silver Creek	Chambers Creek, L. Ontario	"	4,960	Yearling	4,960	
	Walnut Creek	Chambers Creek, L. Ontario	"	4,960	Yearling	4,960	
						253,750	**Sub-Total**
						1,793,083	**Grand Total**

Table 6.2. Rainbow trout fin-clip summary for Lake Erie, 1999 – 2003.

Year Stocked	Year Class	Michigan	New York	Ontario	Ohio	Pennsylvania
1999	1998	RP	ADRP	RV; AD; ADRV	---	---
2000	1999	RP	RV	LP	---	---
2001	2000	RP	AD	---	---	---
2002	2001	RP	ADLV	---	---	---
2003	2002	RP	RV	LP	---	---
AD = adipose; RP = right pectoral; RV = right ventral; LP = left pectoral; LV = left ventral						

Table 6.3. Estimated harvest of rainbow/steelhead trout by open lake boat anglers, 1999 – 2003.

	Ohio	Pennsylvania	New York	Ontario	Michigan
1999	20,396	7,401	1,017	13,000	100
2000	33,524	11,011	996	28,200	100
2001	29,243	7,053	944	15,900	3
2002	41,357	5,229	1,559	75,000	70
2003	21,571	1,711	420	N/A	15

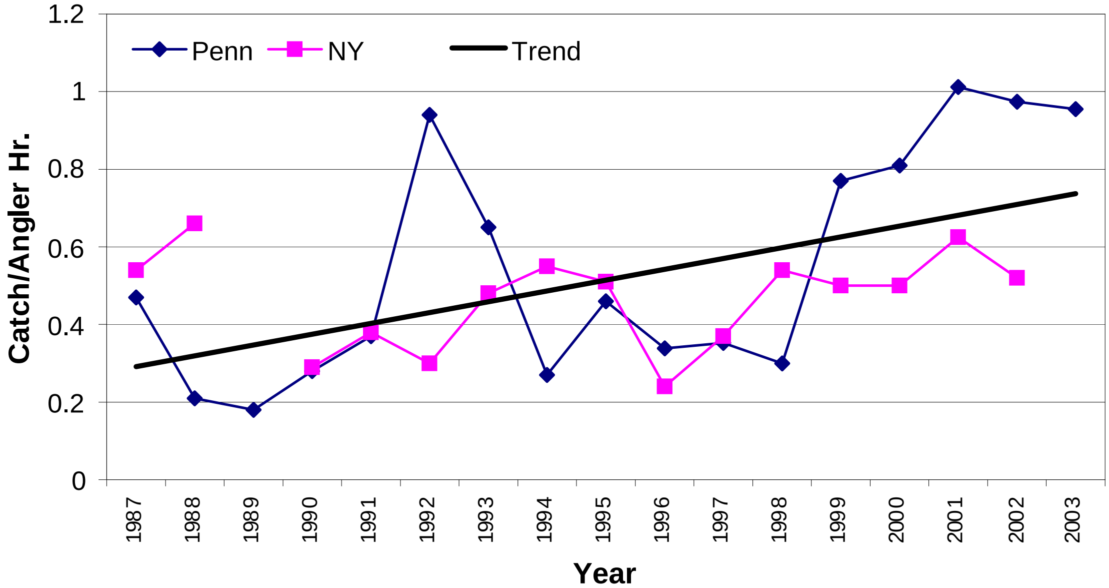


Figure 6.1. Targeted salmonid catch rates in Lake Erie tributaries by Pennsylvania and New York angler diary cooperators, 1987 – 2003. A trend line indicates mean overall catch rate by year.

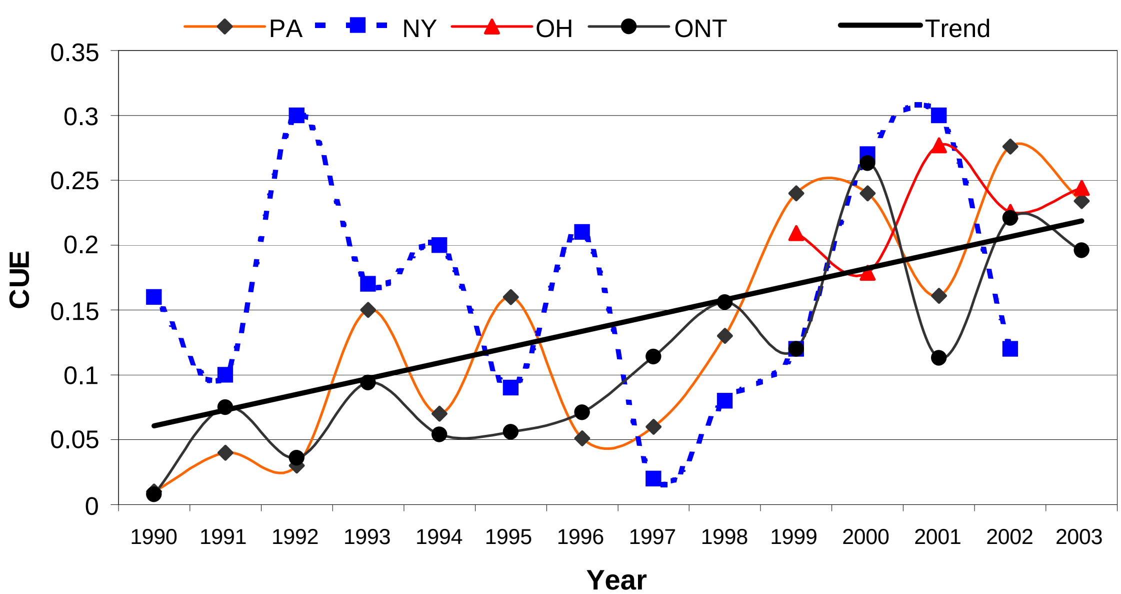


Figure 6.2. Targeted salmonid catch rates by open lake boat anglers in Pennsylvania, New York, Ohio, and Ontario, 1990 – 2003. A trend line indicates mean overall catch rate by year.

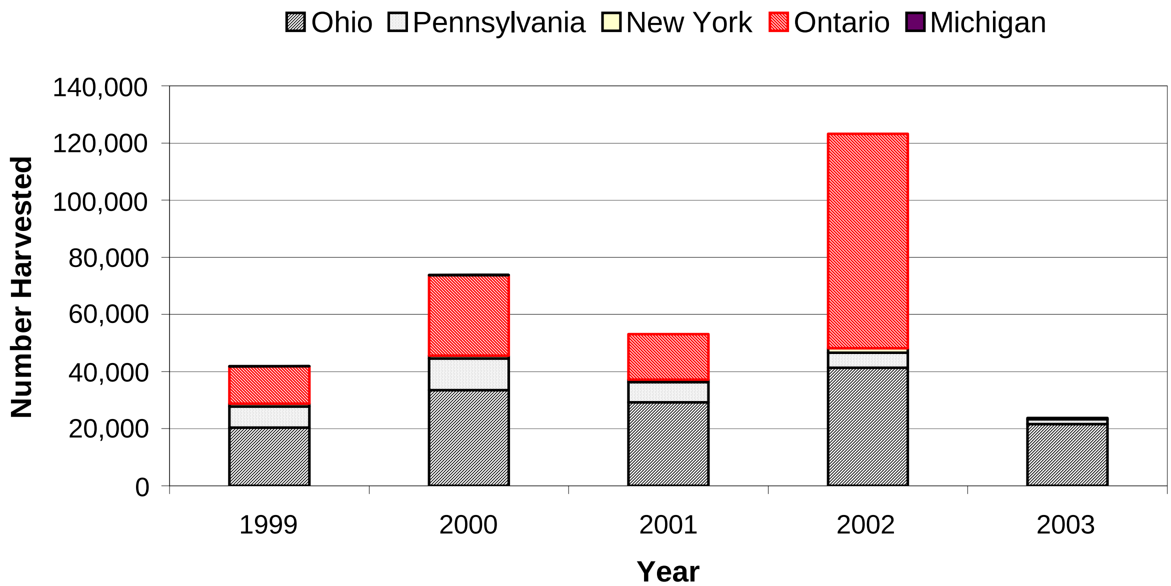


Figure 6.3. Open lake harvest of rainbow/steelhead trout by Lake Erie jurisdictions, 1999 – 2003.

Charge 7: Monitor the current status of Lake Herring. Review ecology and history of this species and assess potential for recovery (by M. Bur, P. Ryan, and E. Trometer)

Lake herring (*Coregonus artedii*) is indigenous to the Great Lakes and historically supported one of the most productive fisheries in Lake Erie (Scott and Crossman 1973, Trautman 1981). Lake herring is considered extirpated in Lake Erie, although commercial fishermen report it periodically from the area of the Pennsylvania Ridge and the shoals of the western basin (Ryan et al. 1999). Their demise was mainly due to over-fishing, although habitat degradation and competition likely contributed to recruitment failure (Greeley 1929, Hartman 1973, Scott and Crossman 1973). Siltation of spawning shoals, low dissolved oxygen, and chemical pollution are a few factors contributing to habitat degradation (Hartman 1973). Although the population of lake herring in Lake Erie collapsed prior to the expansion of introduced rainbow smelt (*Osmerus mordax*) and alewife (*Alosa psuedoharengus*) in the 1950s, these exotic species may have prevented any recovery of herring through competition and predation. Selgeby et al. (1978) documented consumption of lake herring eggs by rainbow smelt. Evans and Loftus (1987) summarized two studies in which smelt consumed large numbers of lake herring in the larval stage.

With the recent recovery of other native coldwater species (particularly lake whitefish and burbot), and the decline in abundance of rainbow smelt, there may be an opportunity for lake herring to recover in Lake Erie. Commercial fisherman occasionally reported lake herring in the 1990s. Two large specimens (lengths 467+ mm and 367 mm) were collected from the eastern part of the central basin in 1995 and 1996, respectively. Herring were also recorded in the catch from an experimental gear study conducted south of Long Point in 1997. However, their significance was not recognized and the fish were not examined. Small numbers of lake herring have been caught in the commercial fishery of the western basin during November and December 1998 (J. Omstead, Omstead Foods, Wheatley, Ont. pers. com.).

Frequency of lake herring reports increased in 1999, when commercial fishermen reported seven small herring (lengths 140-211 mm). Capture locations suggested that herring were present south of Long Point and southwest of Port Stanley. Fish were captured primarily in deep-water trawls targeting smelt. All specimens collected in the 1990s were examined at the Royal Ontario Museum (Erling Holm, unpubl. data). Counts of gill rakers placed them into the range for *Coregonus artedii* (Koeltz 1929, Scott and Smith 1962). The herring collected in 1995 and 1996 were aged as 9 and 7 + respectively. Five of the herring caught in 1999 were aged as 1+ (1998 year class), and one was aged as 2+ (1997 year class).

Two more specimens were recorded from the central basin in 2000: one from Ohio (K. Kayle, ODW, Fairport, OH, pers.com.) and one from Ontario (L.Witzel, OMNR, Port Dover, Ont., pers. com.). Two additional specimens were recorded at Port Stanley in 2001. OMNR biologists believe that the level of reporting has declined. Three specimens were captured in yellow perch nets near Erieau during spring 2002. A fisherman from Port Dover reported capturing four herring in one day in a smelt trawl. A fisherman from Port Burwell reported one herring caught and that it had been smoked. The herring caught in 2002 should have been larger than those caught in previous years and would have been highly prized for smoked fish.

Numerous investigators have shown that alewife and smelt have negative effects on coregonid populations in the north-temperate lakes (reviewed by Ryan et al. 1999). The recent warm winters have promoted over-winter survival of alewife in eastern Lake Erie, while smelt numbers have continued to decline (L.D. Witzel, OMNR Port Dover, ON unpubl. data). A major die-off of alewife was documented in winter of 2001. When alewife and smelt stocks are depressed, it creates an opportunity for coregonids and other species to have stronger year classes. There is some evidence accumulating to indicate that this has occurred for whitefish in eastern Lake Erie in 2001. Lake herring would also be favored by these conditions. The 2002-03 winter began as an apparent El Niño warm winter, but then became one of the coldest winters of recent years. This would favor reproduction of coregonids and other native species adapted to Lake Erie's adverse winter conditions (Ryan et al. 1999).

Genetic Analysis

Lake herring specimens gathered over the past several years from Lake Erie have been shipped to USGS's Conte Anadromous Fish Laboratory for genetic analysis (microsatellite markers). The specimens are in the process of being cleaned to identify DNA. Efforts are underway to collect Lake Huron genetic material from the southern Lake Huron and from museum specimens to compare with recent collections from Lake Erie. The objective is to determine if the Lake Erie specimens are genetically distinct from Lake Huron stocks. If the lineage is similar, then a proposal to reintroduce lake herring from Lake Huron stocks may be submitted to the Lake Erie Committee. The proposal will include four elements: 1) Lake Huron herring broodstock acquisition, 2) rearing and marking at the USGS's Northern Appalachian Research Laboratory in Wellsboro, Pennsylvania, 3) stocking fingerlings into eastern Lake Erie, and 4) evaluation through assessment cruises by the USGS's Lake Erie Biological Station. Otherwise, if the stocks are dissimilar, then efforts will be channeled away from stocking and towards enhancing within lake spawning stocks. (e.g. identification and improvement of spawning sites).

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Charge 8: Improve description of diet for top coldwater predators (K. Kayle and J. Markham)

Lake Trout and Burbot

Seasonal diet information for both lake trout and burbot is incomplete. Diet information was limited to fish caught during August 2003 in the coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of the stomach contents of lake trout and burbot revealed diets almost exclusively made of fish in both species (Figure 8.1). Rainbow smelt remained the main prey item in lake trout stomach samples, comprising 81% of the fish component of the diet and 76% of the overall diet (Figure 8.2). Round gobies, first found in lake trout stomachs last year, became a more prominent diet item, comprising 16% of the fish component of the lake trout diet in 2003 samples. Other prey items included two yellow perch, one small whitefish, two gizzard shad, dreissenids, bythotrephes, and unknown fish.

Burbot diets were more diverse with 9 different fish and invertebrate species found in stomach samples (Figure 8.2). Smelt comprised 21% of the fish component of the diet, but were replaced by round gobies (55%) as the most abundant diet item. Other prey items included crayfish, dreissenids, yellow perch, shiners, white bass, white perch, one alewife, and one whitefish. Two unusual diet items worth mentioning include a freshly filleted walleye belly flap found inside a large lake trout stomach and a white Krispy Kreme balloon found inside a burbot.

The importance of round gobies in the diets of both lake trout and burbot has become evident since their invasion in the eastern basin of Lake Erie in 1998. Gobies did not become a significant part of the eastern basin fish community until 2000, coinciding with their appearance in the diets of burbot (Figure 8.3) and other predators such as smallmouth bass and yellow perch. Their occurrence in burbot diets has been increasing ever since and they became the most prevalent prey species for burbot in 2003. Lake trout were slower to incorporate round gobies into their diet with the first ones being found in stomach samples in 2002 (Figure 8.3). Their similar appearance, size, and habitat preferences to sculpins, which have been shown to be important forage items for lake trout (Elrod and O'Gorman 1991; Owens and Bergstedt 1994), could be an indicator of their importance as a forage item in the future.

Steelhead

In 2002, the Ohio Department of Natural Resources, Division of Wildlife initiated a pilot project to examine the diets of steelhead in the open water of Lake Erie's Central Basin during the summer. This project was repeated in summer 2003 to further provide information describing steelhead movements and life habits during a time period when we have little data due to ineffective sampling in any of our current fishery assessment gear. Diet information is invaluable for describing steelhead food web interactions and to include in steelhead and predator bioenergetics modeling to be performed by the Coldwater and Forage Task Groups. This project is being used as a precursor to a larger, interagency project on Lake Erie salmonid diets and bioenergetics which begins in summer 2004.

From the end of June through early September, Ohio DNR biologists contacted completed charter boat fishers at a local fish cleaning station in Fairport Harbor, Ohio. Samples were obtained on random weekdays and weekend days when charter boats fished, and when Division personnel were available to complete the diet analyses. All steelhead sampled were caught in Ohio waters. Fishing trip locations (latitude/longitude and 10-minute Lake Erie Committee sampling grid) were recorded for each trip and assigned to steelhead in that charter trip catch. All steelhead from the trip were examined for the presence of food items. Steelhead stomachs were removed at the fish processing house on afternoon of charter trip return and processed on site. All diet items were identified, enumerated (plankton was field estimated) and fish were measured to length (either vertebral, standard, fork or total length depending on condition). Known length to wet weight to dry weight conversion relationships from central basin diet items were used to calculate biomass of prey consumed.

In summer 2003, a total of 115 steelhead were analyzed for diet composition. Steelhead caught ranged from 360-753mm, with 565mm being the median length. Field estimates of age were made from known length-age keys. Most fish had spent two summers in the lake and two summer fish ranged from 500-650mm. Only 6.1% of the steelhead stomachs examined were empty. The most common item seen in steelhead diets was the spiny water flea, *Bythotrephes cederstroemi* (Table 8.1). The next two most frequently occurring food items were smelt and emerald shiners. Steelhead ate many different food items; a total of 17 different items were encountered- not including unidentified fish remains. In analysis of food ingested by biomass (Table 8.2), the bulk of steelhead diet was mostly fish. Smelt was the greatest item by weight, followed by yellow perch, white perch, emerald shiners and freshwater drum. Gizzard shad, white bass, insects and plankton made up a smaller portion of the biomass of the diverse steelhead diet. The predominance of yellow perch in the diet can be traced to one fish that consumed 11 young-of-year (YOY) yellow perch. Only a few other fish consumed one or two YOY yellow perch; they did not show up continually in the diet. Two years of field sampling showed that Central Basin steelhead, during the summer, are generalists regarding types of food items consumed. They get the majority of their caloric energy from fish (primarily smelt). The complete steelhead diet trial study is being summarized by Ohio DNR personnel.

We will expand the frequency and location of sampling with the larger effort required for the interagency Great Lakes Fishery Commission project which has been approved and begins in the summer of 2004. Setting specific fishery assessment gear such as gill nets in areas where trout are concentrated can also be used as a control for temporal comparisons of diets and consumption. The project results and the interagency bioenergetics modeling exercises can also be enhanced by paralleling or incorporating diet analysis of other species like walleye and smallmouth bass for direct comparisons.

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Table 8.1. Diet items (by frequency of occurrence) for Central Basin steelhead examined in July - August charter fishery, 2003.

Item	**% Occurrence (N=115)**	**% with Food (N=108)**	**% with Fish (N=51)**
Bythotrephes	63.5	67.6	---
Smelt	28.7	30.6	64.7
Emerald Shiners	13.9	14.8	31.4
Yellow Perch	9.6	10.2	21.6
Chironomids	7.0	7.4	---
Un-ID'd fish remains	5.2	5.6	11.8
Freshwater Drum	4.3	4.6	9.8
Dreissena Mussels	4.3	4.6	---
Water Boatmen	3.5	3.7	---
White Perch	2.6	2.8	5.9
Moths	2.6	2.8	---
Fingernail Clams	1.7	1.9	---
Mayflies	1.7	1.9	---
Gizzard Shad	0.9	0.9	2.0
Asian Lady Beetles	0.9	0.9	---
White Bass	0.9	0.9	2.0
Dipterans	0.9	0.9	---
Other Coleopterans	0.0	0.9	---
empty	6.1		

Table 8.2. Diet biomass analysis (by dry weight) for Central Basin steelhead examined in July - August charter fishery, 2003.

Item	**% Dry Weight (N=108)**
Smelt	61.390
Yellow Perch	24.307
White Perch	6.311
Emerald Shiners	4.447
Freshwater Drum	2.790
Un-ID'd fish remains	0.219
Gizzard Shad	0.213
Bythotrephes	0.160
White Bass	0.111
Chironomids	0.044
Dipterans	<0.01
Moths	<0.01
Fingernail Clams	<0.01
Dreissena Mussels	<0.01
Water Boatmen	<0.01
Other Coleopterans	<0.01
Asian Lady Beetles	<0.01

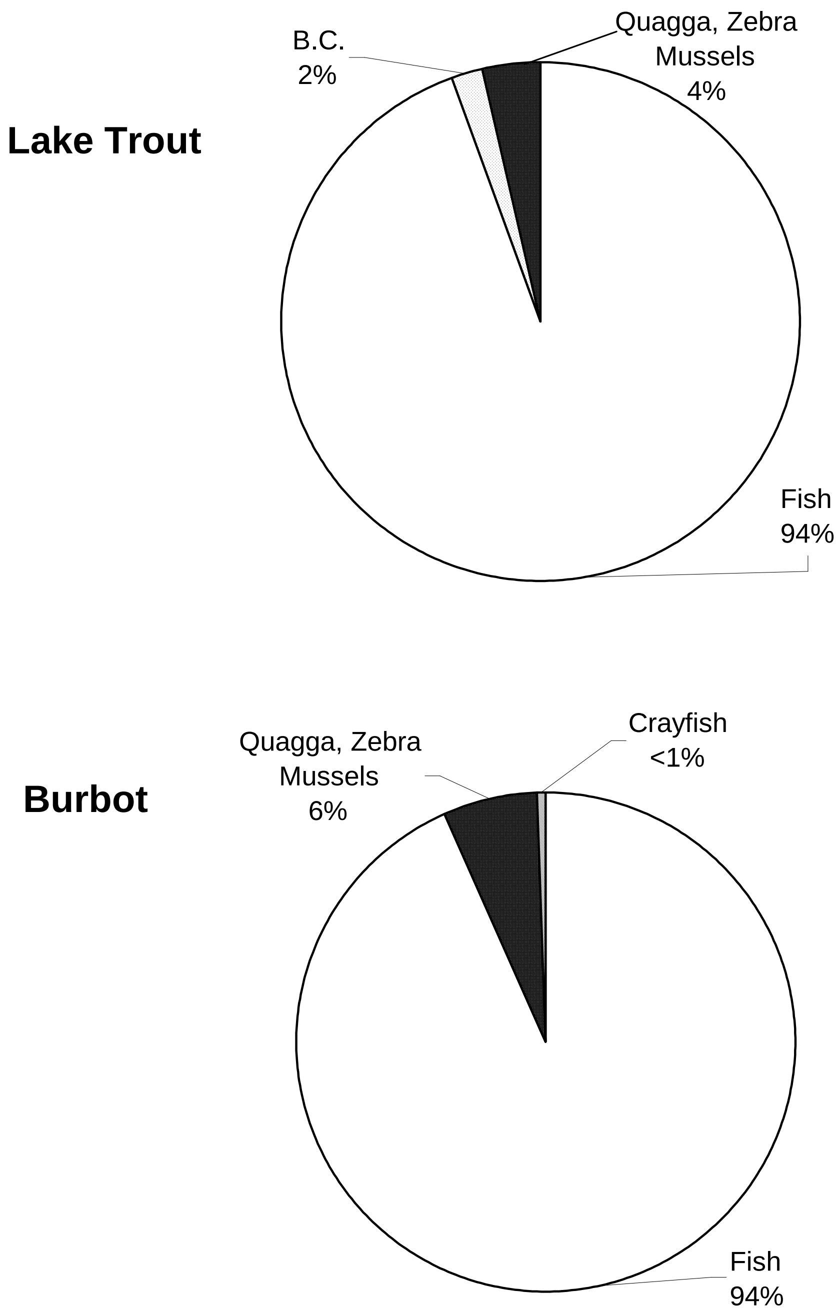

Figure 8.1. Diet composition of lake trout and burbot sampled in gill nets from the eastern basin of Lake Erie, August, 2003.

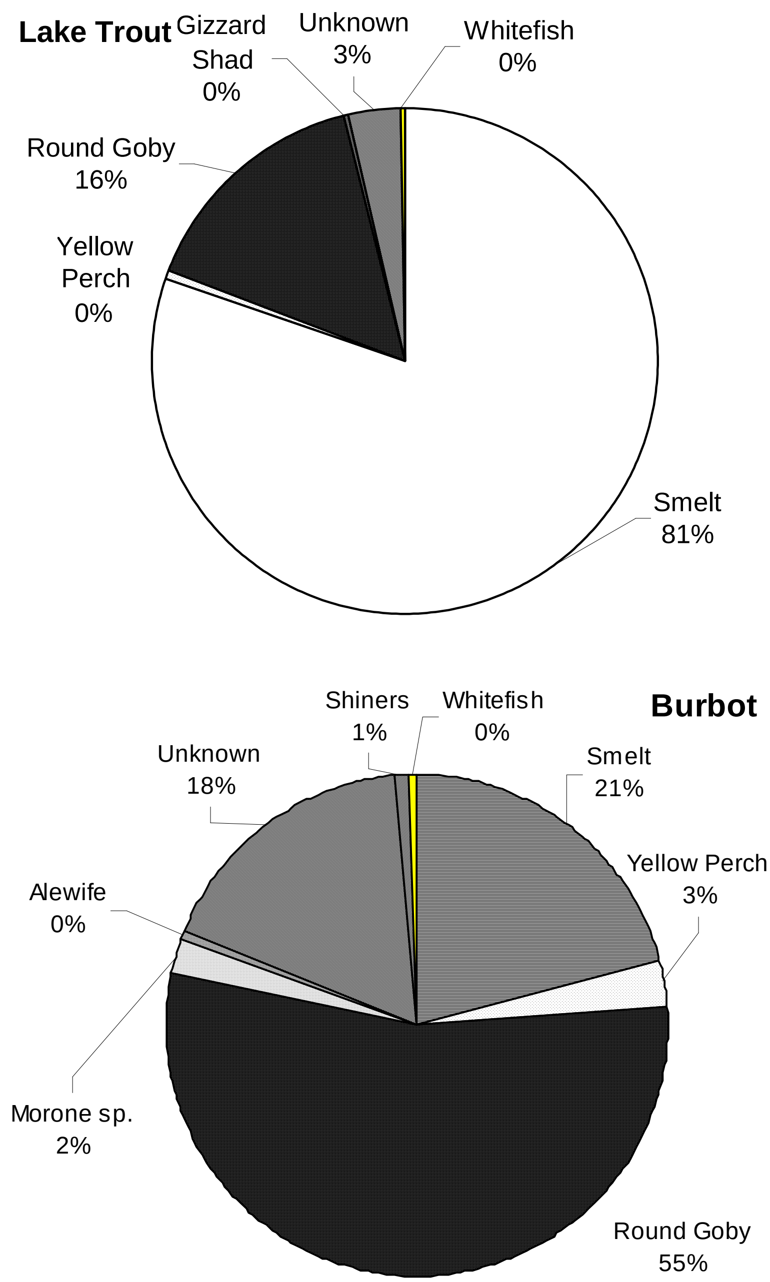

Figure 8.2. Frequency of occurrence of fish in the diet of lake trout and burbot sampled in gill nets from the eastern basin of Lake Erie, August, 2003.

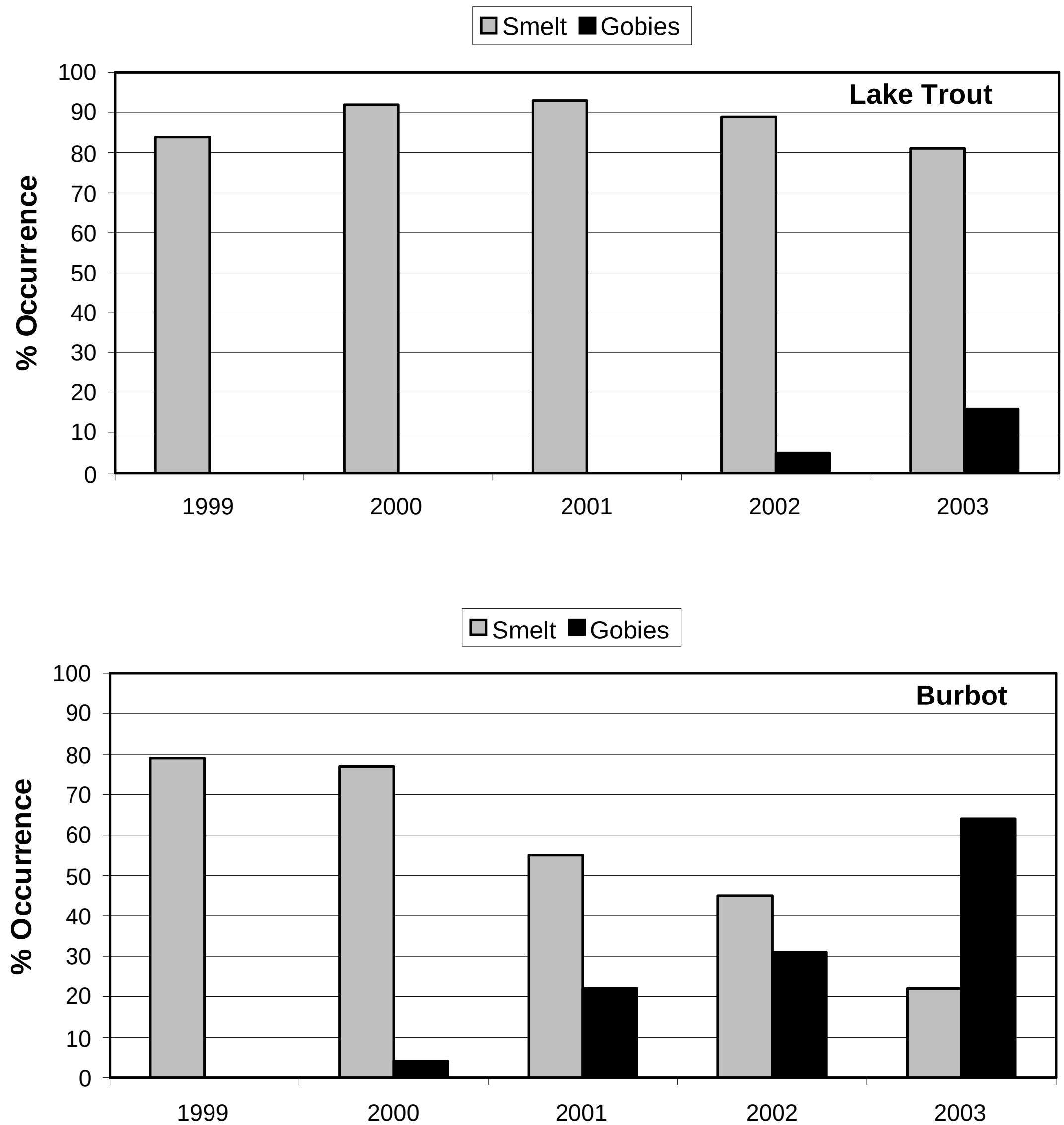

Figure 8.3. Percent occurrence of smelt and round gobies in the diet of lake trout and burbot caught in NYSDEC assessment gill nets, August, 1999 – 2003.