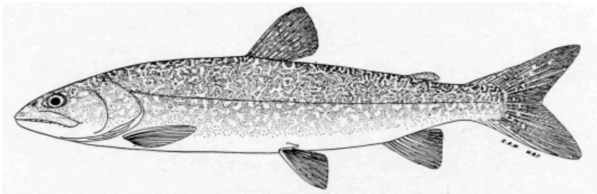
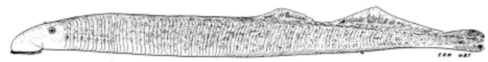

Report of the Lake Erie Coldwater Task Group

30 March 2005

Members:

James Markham	New York Department of Environmental Conservation (Co-Chair)
Phil Ryan	Ontario Ministry of Natural Resources (Co-Chair)
Andy Cook	Ontario Ministry of Natural Resources
John Fitzsimons	Department of Fisheries and Oceans, Canada
Mike Fodale	United States Fish and Wildlife Service
Jim Francis	Michigan Department of Natural Resources
Kevin Kayle	Ohio Department of Natural Resources
Chuck Murray	Pennsylvania Fish and Boat Commission
Martin Stapanian	United States Geological Survey
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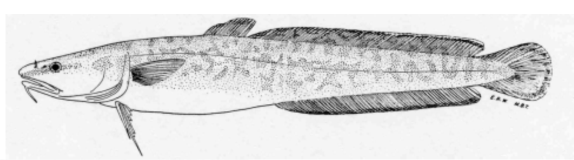
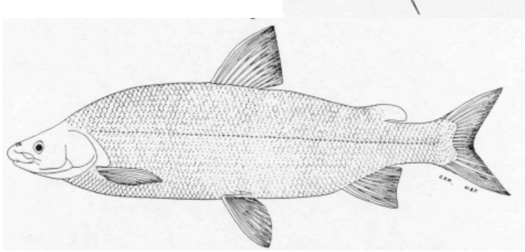
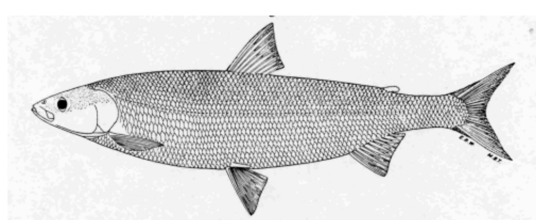
Elizabeth Trometer	United States Fish and Wildlife Service
Elizabeth Wright	Ontario Ministry of Natural Resources

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.

"A Pair of Lake Erie Relics!"
Congratulations Phil!

Acknowledgment

Upon his retirement, the members of the Coldwater Task Group would like to recognize the valuable contributions Phil Ryan made to the task group, to the eastern basin fish community, and to fisheries management in Lake Erie. Among his many accomplishments was the Lake Erie Fish Community Goals and Objectives, which will serve as a guide for Lake Erie managers for years to come. Phil's contributions to this task group, his role as co-chair for OMNR, and his historical knowledge of the lake and coldwater community will be missed (as well as his witty sense of humor and duck-taped shoes!). We congratulate Phil on his retirement and wish him well working in his vineyards and in all of his other future endeavors!

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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). While these two plans still serve as the working documents guiding current assessment efforts, a revision of the plan is due with the completion of the Lake Erie FCGO (Ryan et al. 2003) identifying lake trout as the dominant predator in the profundal waters of the eastern basin.

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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Ryan, P.A., R. Knight, R. MacGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-community goals and objectives for Lake Erie. Great Lakes Fish. Comm. Spec. Publ. 03-02. 56 pp.

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

by James Markham, NYSDEC

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 using nets made of monofilament mesh instead of the standard multifilament nylon mesh. This modification was made following two years of comparative data collection and analysis 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 (A1 – A8) 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). New York is responsible for sampling areas A1 and A2, Pennsylvania A3 and A4, and USGS/OMNR A5 - A8. Each area contains 13 equidistant north/south-oriented LOPs that serve as transects. Six transects are randomly selected for sampling in each area. 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. Areas A1 and A2 have been the most consistently sampled areas during the course of the survey while effort has varied in all other areas (Figure 1.2). Area A4 has only been sampled once due to the lack of enough cold water to set nets according to the sampling protocol.

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 2004 by the combined agencies was 100 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie (Figure 1.2). This included 60 lifts by NYSDEC and 40 by USGS/OMNR. The PFBC was unable to sample in 2004 due to illness.

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 content data are usually collected as on-site enumeration or from preserved samples.

Results and Discussion

Abundance

Sampling was conducted in six of the eight standard areas in 2004 (Figure 1.1), collecting a total of 283 lake trout. Areas A1 and A2 again produced the highest catch per unit effort (CPE) values for the fifth time in the previous six years, coinciding with the areas in which stocking of yearling lake trout occurs. Area A5 produced the most lake trout in Ontario waters. In general, lake trout catches decreased along northerly and westerly gradients.

Sixteen age-classes of lake trout ranging from age 1 to 20 were represented in the catch of known-aged fish (Table 1.1). Similar to the past three years, young cohorts (ages 2 - 6) were the most abundant, representing over 92% of the total catch (Fig. 1.3). All cohorts up to age 9 were represented in the catch; cohorts age 10 and older were only sporadically caught. Lake trout age 10 and older continue to decline in overall abundance in the Lake Erie population, representing only 2.7% of the overall catch in standard assessment nets.

The overall trends in area weighted mean CPE's of lake trout caught in standard nets (mesh sizes 38 - 152 mm) in the eastern basin decreased from a time-series high of 3.38 fish/lift in 2003 to 1.71 fish/lift in 2004, a level comparable to the 2002 survey (Figure 1.4). This was the first decline in overall catch in the past four years. However, the 2004 survey was more in-line with expected results and trends given survey results up to 2002, suggesting that the 2003 survey was an aberration. Overall lake-wide abundance is expected to continue to increase in the near future due to the survival and recruitment of the successful 1999 thru 2004 stockings.

The relative abundance of adult (age 5 and older) lake trout caught in standard assessment gill nets was initially monitored to gauge the response of the lake trout population to sea lamprey treatments initiated in 1986. The index now serves as an important indicator of the size of the lake trout spawning stock in Lake Erie. 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, which corresponded to the decrease in lake trout stocking numbers that began in 1992. The 2004 CPE for age-5-and-older lake trout sampled in New York standard assessment nets decreased in 2004, but was still higher than the 14-year low experienced in 2002 (Figure 1.5). The age 5+ index of 1.55 fish/lift was slightly less than the long-term series average. 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 1.36 lake trout/lift was the second consecutive decrease in juvenile abundance from the 14 year high experienced in 2002 (Figure 1.6). The decrease was primarily due to the low recruitment of the 2003 stocking to age 2, which were absent as age 1 fish in the 2003 survey. The relative abundance of age 3 lake trout comprised the majority of the age 1-3 index (78%), but was still lower than expected given that this cohort had the highest recruitment to age 2 of any lake trout stocking since 1985. Age 1 lake trout were caught for the fifth time in the past six years. One of the yearlings was the new Klondike strain lake trout stocked for the first time in Spring 2004. This was the first time that a different form of lake trout other than a "lean" has been both stocked and captured other than in Lake Superior, where this strain originated. Future surveys will continue to monitor the progress of these fish, and compare their growth, maturity, and wounding rates to lean lake trout strains.

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 show a significant decline ($P<0.001$, $r^2 = 0.80$) in recruitment to age 2 from 1986 through 1999 (Figure 1.7). Very few 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 sharp decrease in 2004 compared to 2003 due to the poor recruitment of the 2003 stocking. However, this cohort did appear in higher abundance than was expected and should contribute to overall lake trout abundance in upcoming surveys.

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 remain consistent with averages from the previous 5 years (1999 – 2003) through age 15 (Figures 1.8 and 1.9). Deviations in older ages are due to low sample sizes. 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. Overall condition coefficients for both age 3 and age 5 lake trout remain above 1, indicating that Lake Erie lake trout are, on average, heavy for their length (Figure 1.10). Condition coefficients for age 3 lake trout declined from 1985 through 1990, increased to 1997, and then stabilized. Average age 3 male condition remains consistently higher than age 3 female condition. Condition coefficients for age 5 lake trout exhibited an increasing trend from 1993 – 1999, and have since stabilized with males and females essentially equal.

Maturity

Fifty-seven mature females ranging in age from 4 through 19 were sampled in standard assessment gill nets in 2004, generating a mean age of mature females of 6.1 years old (Figure 1.11). This is the third 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 female lake trout older than age 7 present in the Lake Erie population compared to females age 7 and younger. 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 (Einhouse et al. 2005).

Natural Reproduction

Despite more than 20 years of stocking, no naturally reproduced lake trout have been documented in Lake Erie. Two potentially wild fish were caught in eastern basin coldwater gill net surveys in 2004, making a total of 27 potentially wild lake trout recorded over the past five 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 attempted to determine if unknown origin fish were wild or of hatchery origin (Ludsin et al. 2004). Results of this research failed to find any unknown-origin lake trout that were significantly different than hatchery-raised lake trout, indicating that natural reproduction, if present at all, is at extremely low levels in Lake Erie.

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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, 2004.

AGE	SEX	NUMBER	MEAN LENGTH (mm)	MEAN WEIGHT (g)
1	Combined	5	214	88
2	Male	8	396	700
	Female	5	415	726
3	Male	53	569	2208
	Female	14	552	1872
4	Male	23	645	3276
	Female	8	647	3149
5	Male	43	693	4125
	Female	53	703	4503
6	Male	15	745	5050
	Female	11	754	5253
7	Male	1	708	3747
	Female	3	704	5135
8	Male	3	748	5920
	Female	0	----	-----
9	Male	1	762	5674
	Female	0	----	----
10	Male	0	----	----
	Female	0	----	----
11	Male	1	870	8000
	Female	1	758	5220
12	Male	0	----	----
	Female	0	----	----
13	Male	0	----	----
	Female	1	865	7720
14	Male	0	----	----
	Female	2	818	6890
15	Male	0	----	----
	Female	0	----	----
16	Male	1	892	7560
	Female	0	----	----
17	Male	0	----	-----
	Female	1	817	4700
18	Male	0	----	----
	Female	0	----	----
19	Male	1	844	6470
	Female	2	899	9370
20	Male	1	910	8800
	Female	0	----	----

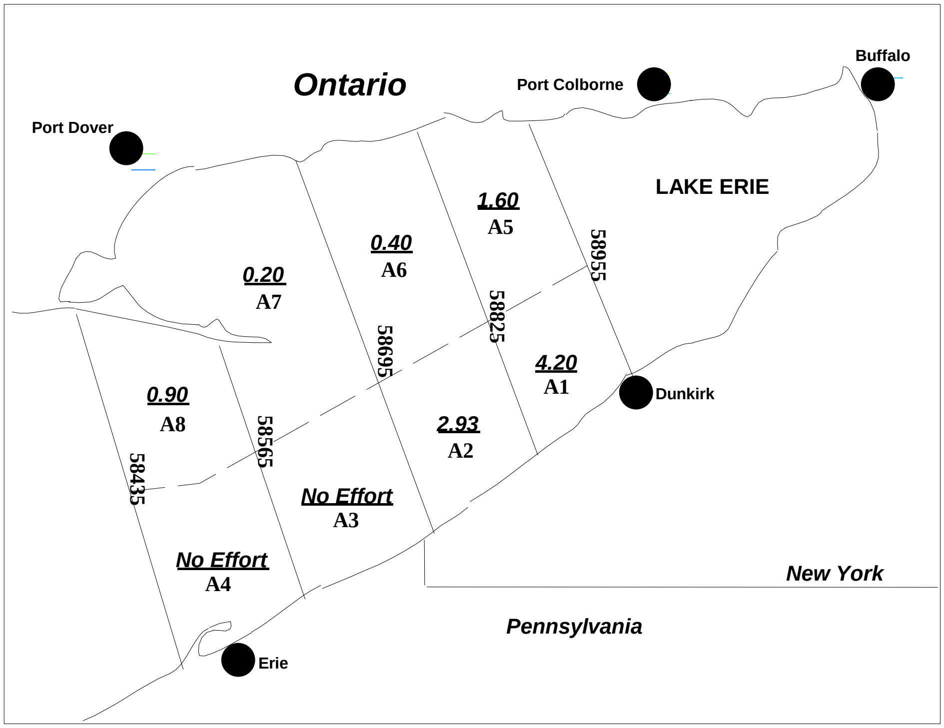


Figure 1.1. Standard sampling areas (A1 – A8) used for assessment of lake trout in the eastern basin of Lake Erie. The numbers in each area represent 2004 CPE (number/lift) for total lake trout catch within that area.

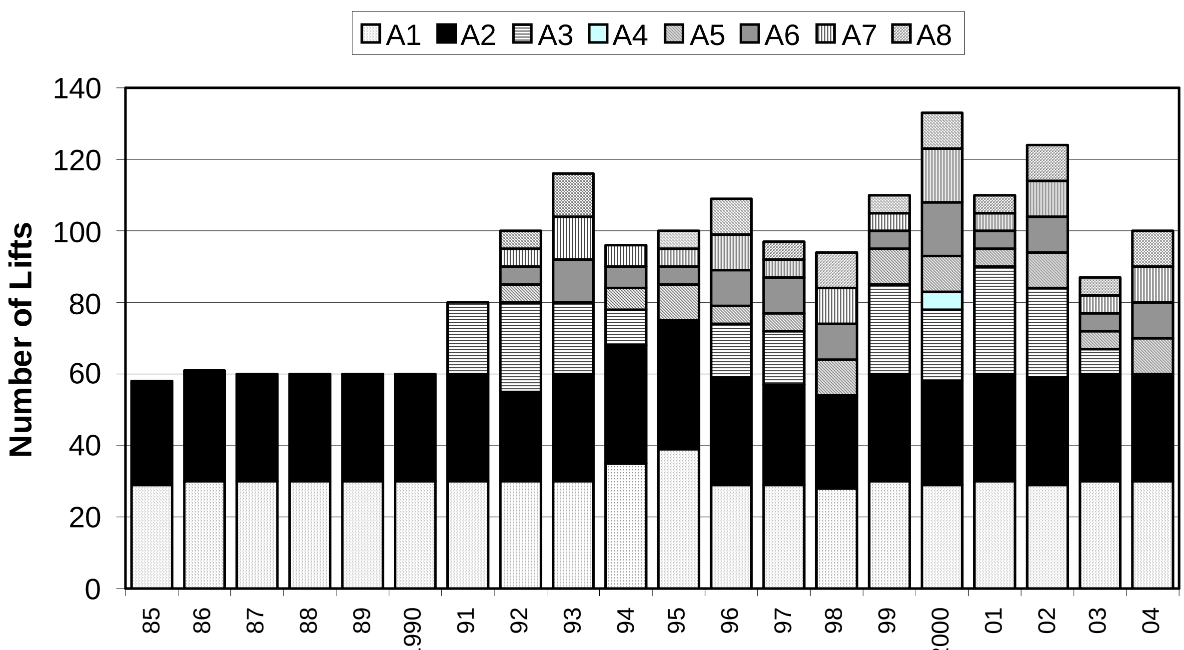


Figure 1.2. Number of coldwater assessment gill net lifts by area in the Eastern Basin of Lake Erie, 1985 - 2004.

Figure 1.3. Relative abundance at age of lake trout collected from standard assessment gill nets fished in the eastern basin of Lake Erie, August 2004.

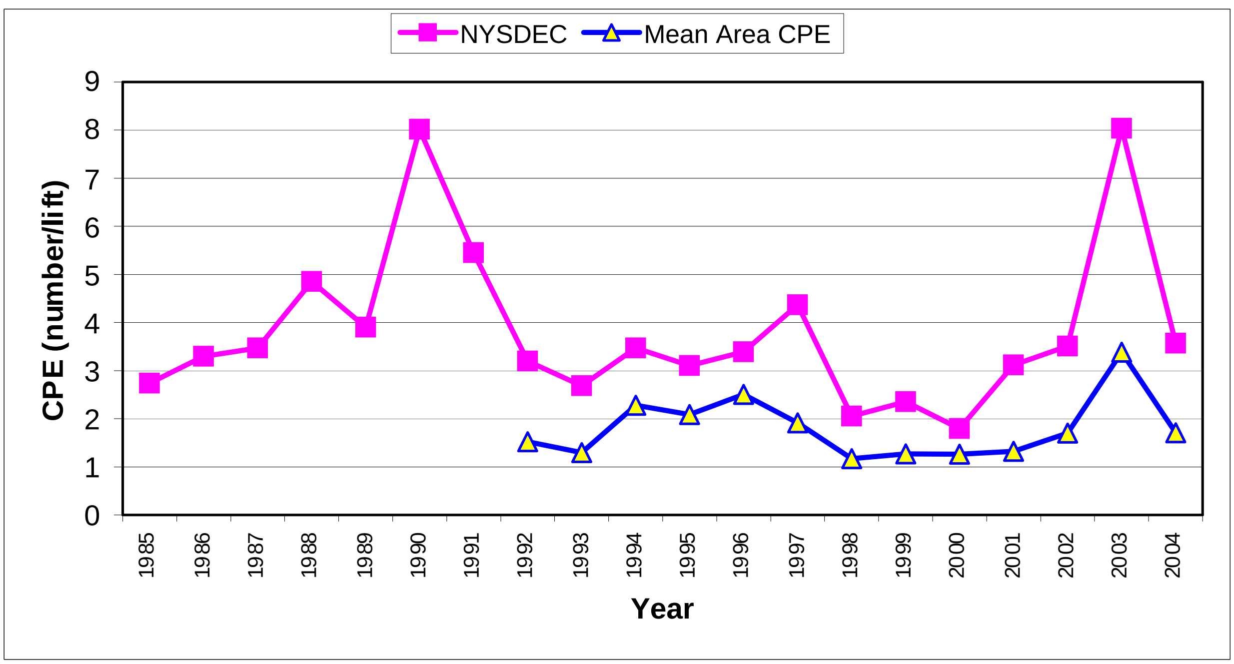


Figure 1.4. Mean CPE (number fish/lift) weighted by area of lake trout caught in standardized gill nets assessment surveys from the eastern basin of Lake Erie, 1992 – 2004. The NYSDEC series from 1985 – 2004 is also shown for reference to a longer time-series.

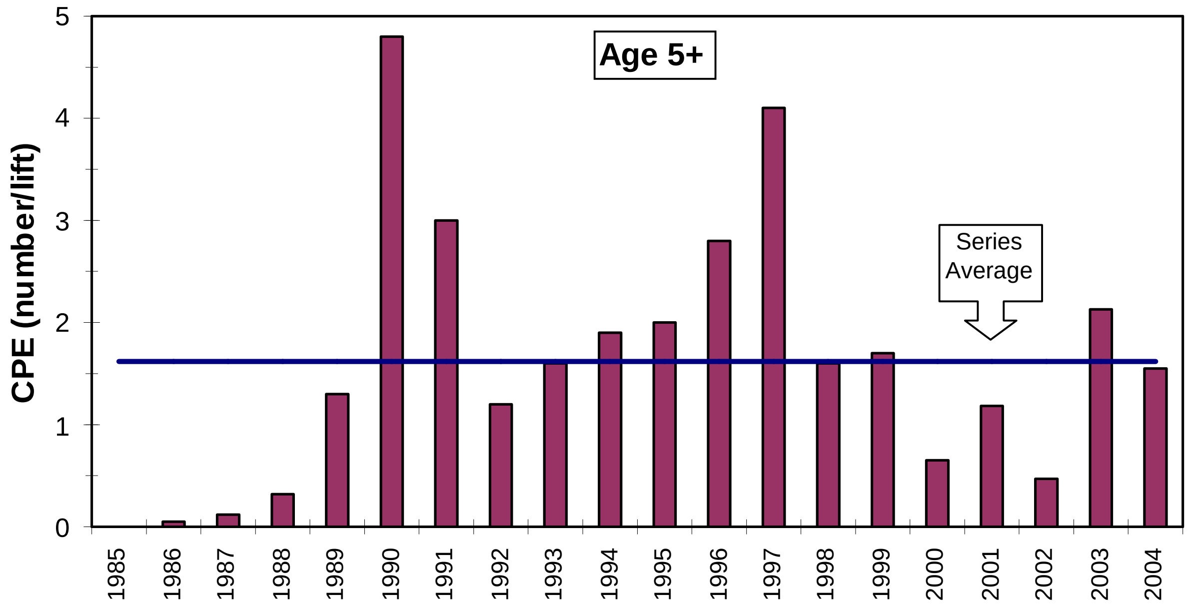


Figure 1.5. Relative abundance (number fish/lift) of age 5 and older lake trout sampled in standard gill net surveys from the New York waters of Lake Erie, August, 1985 – 2004.

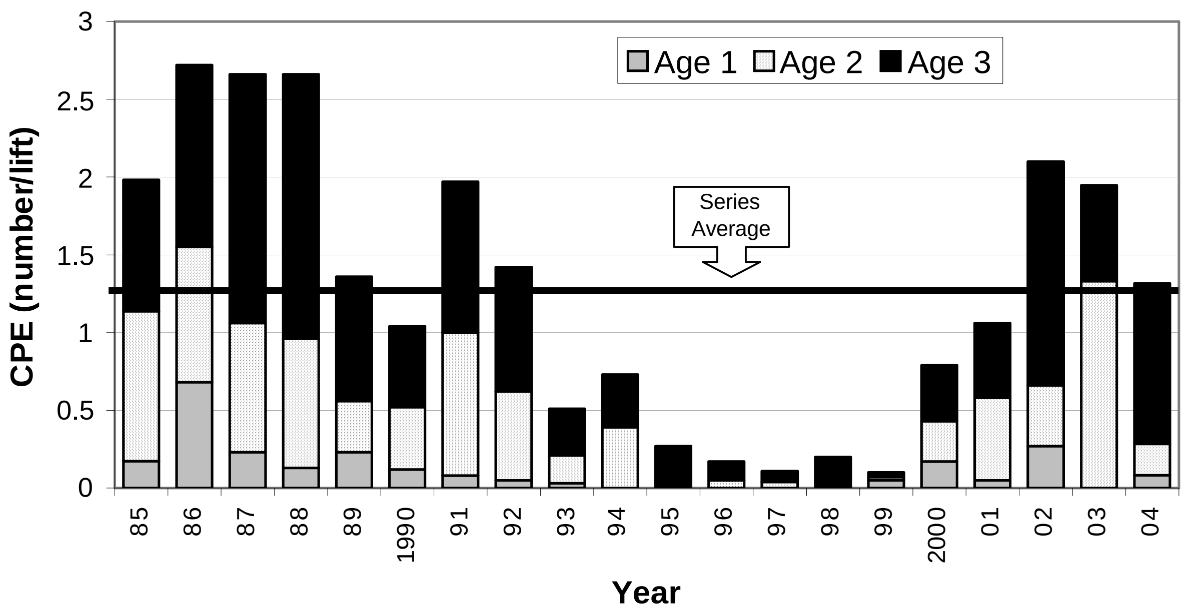


Figure 1.6. Relative abundance (number fish/lift) of juvenile (ages 1-3) lake trout collected in standard assessment gill net surveys in the New York waters of Lake Erie, August, 1985 – 2004.

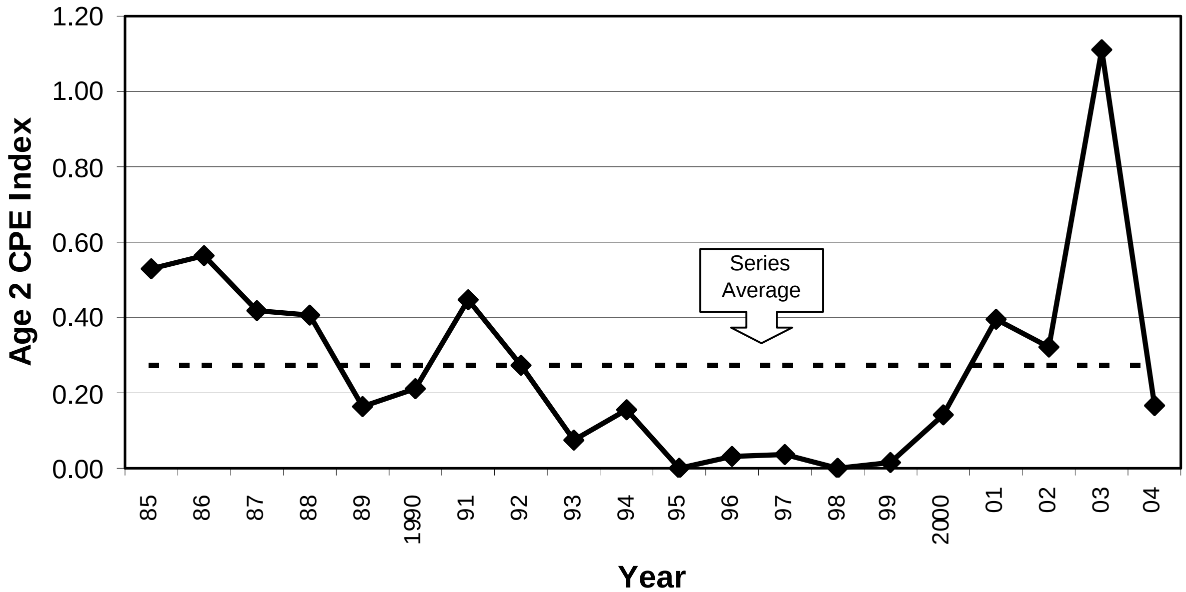


Figure 1.7. Index of age 2 recruitment of lake trout caught in standard assessment gill nets from New York waters of Lake Erie, August, 1985 – 2004. The index is calculated by dividing the age 2 CPE by the stocking rate for each cohort, and then multiplying by 100,000. The final index is equal to the number of age 2 fish caught per lift for every 100,000 yearling lake trout stocked.

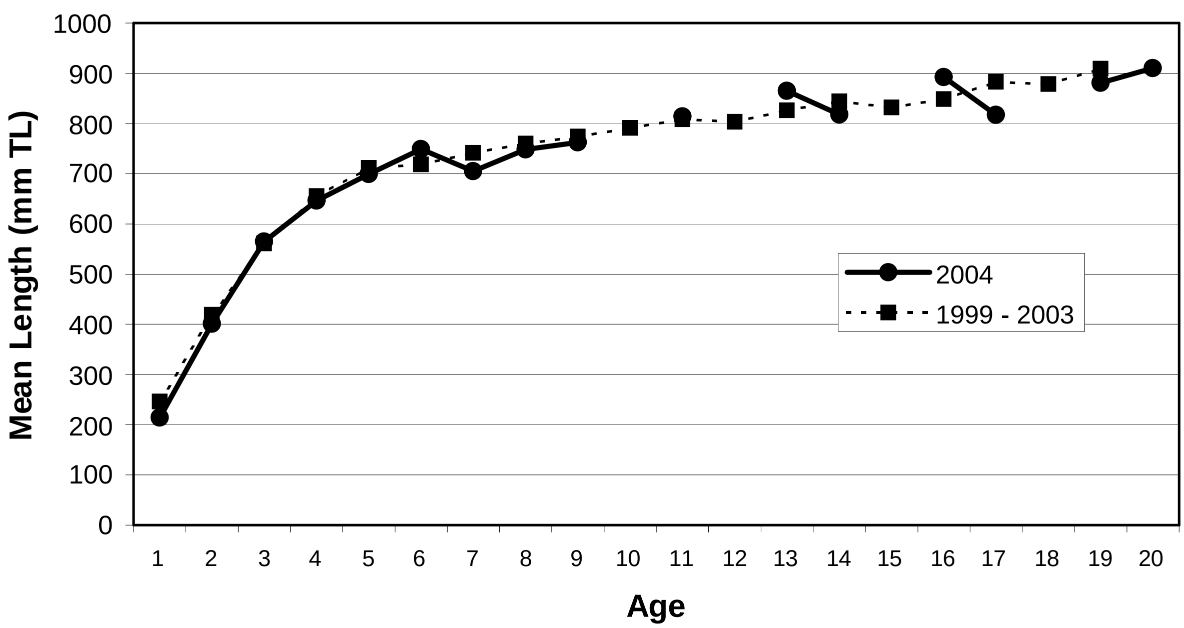


Figure 1.8. Mean length-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2004. The previous 5-year average (1999 – 2003) from New York are shown for current growth rate comparison.

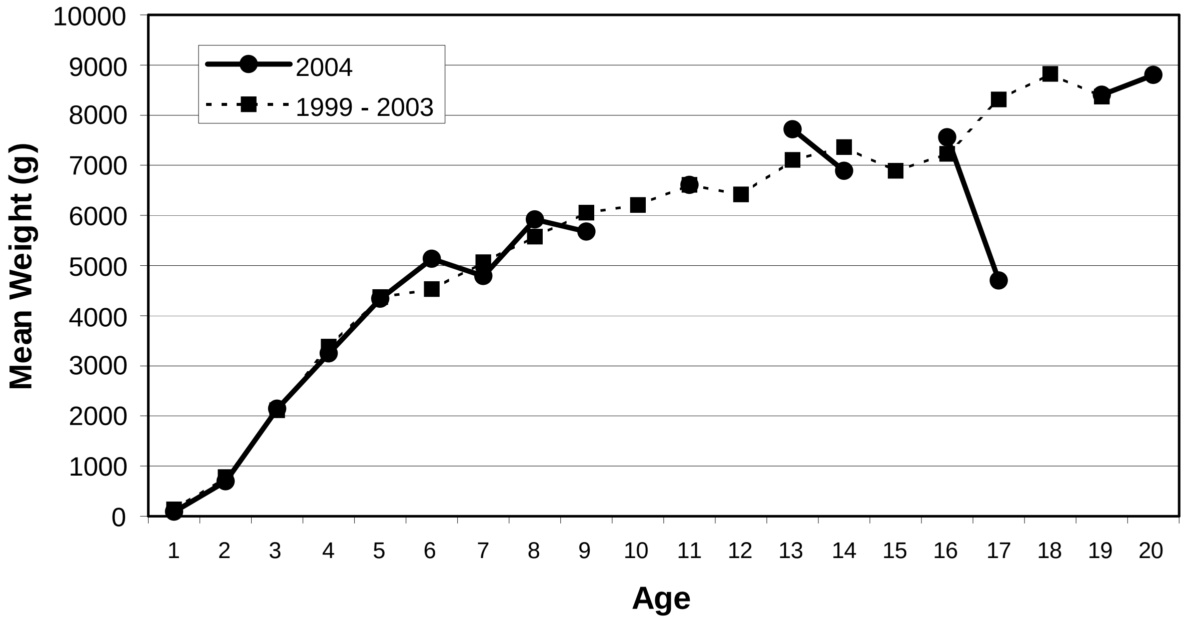
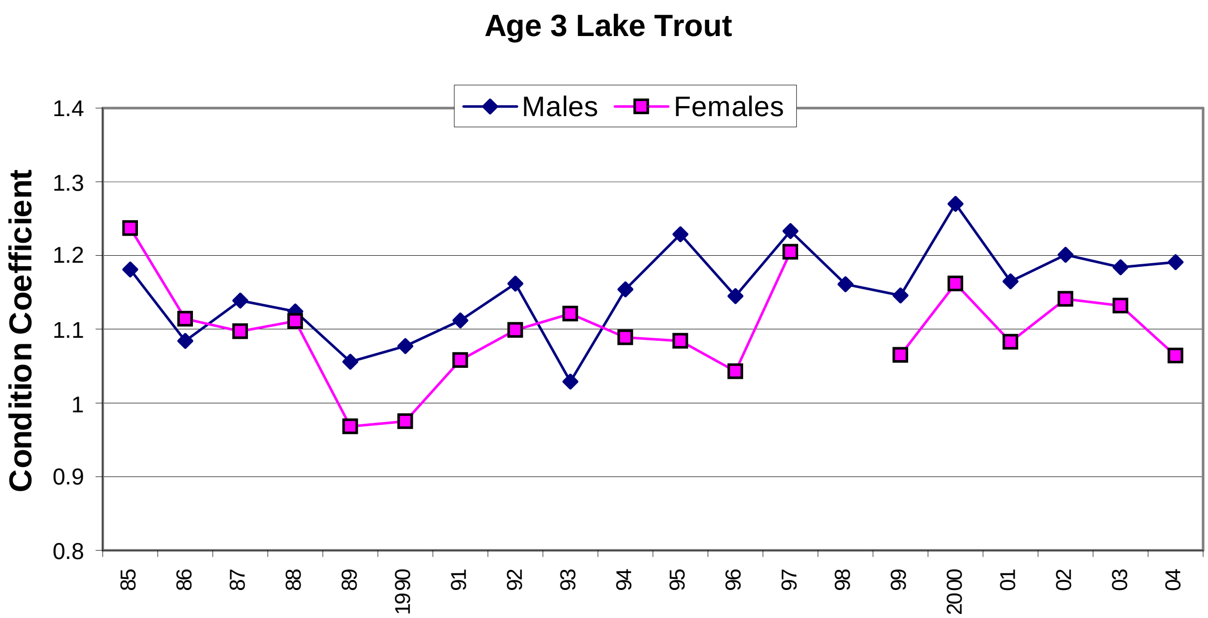


Figure 1.9. Mean weight-at-age of lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2004. The previous 5-year average (1999 – 2003) from New York are shown for current growth rate comparison.



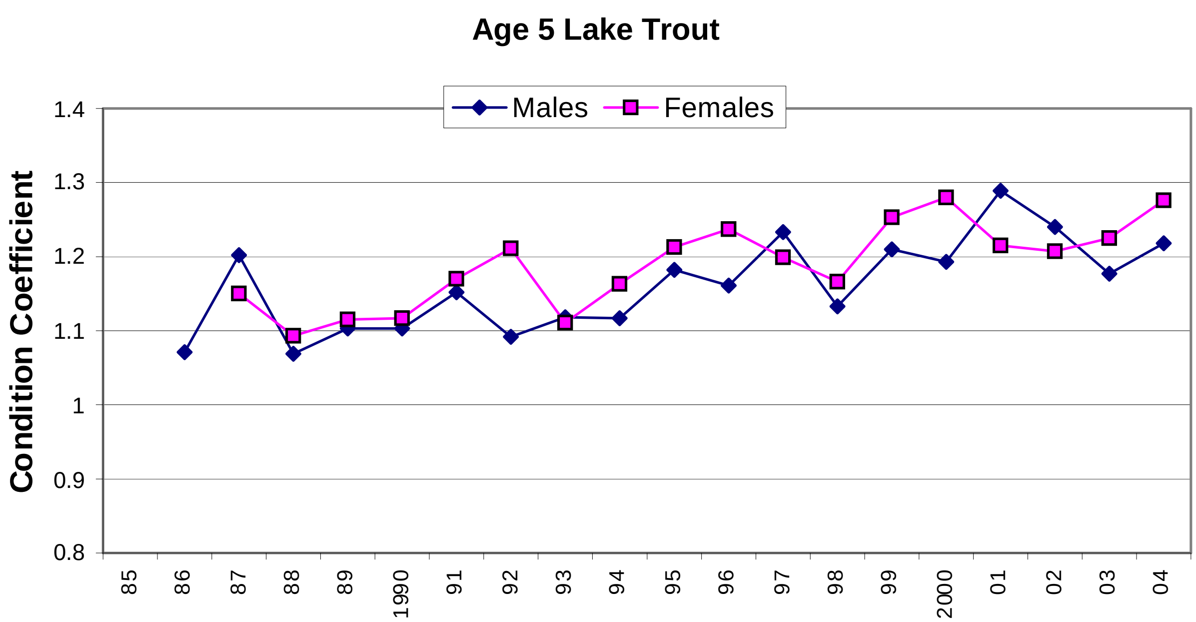


Figure 1.10. Mean coefficients of condition for age 3 and age 5 lake trout, by sex, collected in NYSDEC gill net assessment surveys, August, 1985 – 2004.

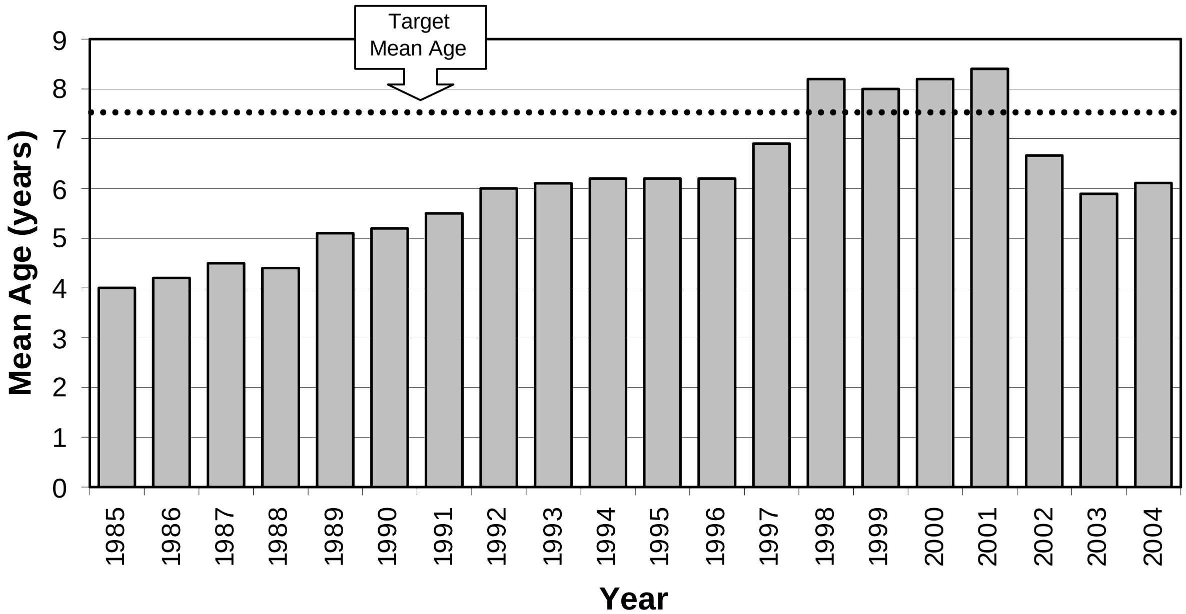


Figure 1.11. Mean age of mature female lake trout sampled in standard assessment gill net surveys in the eastern basin of Lake Erie, 1985 – 2004. The target mean age is 7.5 years.

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

by Andy Cook, OMNR

Commercial Harvest

The total harvest of Lake Erie whitefish in 2004 was 627,913 pounds (Figure 2.1). Ontario accounted for the majority (98% or 617,293 lbs) of the catch in 2004 while Ohio harvested 2% (10,529 lbs) and Pennsylvania's harvest remained negligible (91 lbs). Ontario's overall harvest increased 3%, while Ohio's harvest decreased by 20% from 2003.

The majority (99%) of Ontario's whitefish harvest was taken in gill nets. The remainder was caught in smelt trawls and trap nets. The largest fraction of Ontario's whitefish harvest (48%) was taken in the western basin mostly during the fall (OE 1), followed closely by OE 2 (44%) from January to June and in December. The remainder came from OE 3 (5%) during March and April and OE 5 (2%) in July and August.

Ontario's 2004 west basin fall commercial gill net catch rate (35 kg/km or 22 fish/km) increased substantially from 2003, but was not accompanied by a proportional increase in harvest (Figure 2.2). West basin fall whitefish catch rates (whitefish from gill net effort with whitefish in the catch) were adjusted from 2000 to 2004 to reflect trends in targeted catch rates. Monthly trends of targeted catch rates in the west basin over the October – December period differ from each other (Figure 2.3), potentially diminishing the value of pooling these data in the standardized format presented in Figure 2.2. Targeted catch rates during November varied little between years, with the exception of an apparent drop in 2002 (Figure 2.3). Catch rates associated with spawning aggregations of whitefish may not be reliable indicators of abundance. Trends in monthly catch rates suggest a more pronounced decline in abundance compared to pooled Oct.- Dec. catch rates. Highly variable targeted effort and harvest each month precludes a definitive description of status (Figures 2.4, 2.5). Reported targeted gill net effort from the fall west basin fishery in 2004 decreased 58% from 2003.

The age composition of whitefish caught in Ontario's OE 1 fall fishery ranged from 4 to 18 (using scales), with a mean age of 6.5 (Figure 2.6). Trends in harvest age composition suggest that recruitment to the fishery has declined following the 1996 year class. The 2001 year class may contribute to fisheries in 2005, as this year class may be at least moderate in strength according to survey data.

Index Fishing

The 2002 year class (YOY) was the most abundant year class in Ontario's lake-wide partnership survey, representing 22% of whitefish caught, followed by the 2001 and 1999 year classes (Figure 2.7). Ontario's partnership gill net survey recorded few whitefish in the east basin in 2004 (Figure 2.8). Catches remained below average in all basins surveyed. New York DEC's 2004 deep-water gill net assessment index for whitefish doubled, (3.5 whitefish/net) exceeding the time series average (2 / net) (Figure 2.9). Yearling whitefish were prominent in the NY gill net assessment.

In 2004, YOY lake whitefish were present in Ohio DNR central basin trawl surveys, but did not appear in other surveys. The 2003 year class (age 1) reappeared in central basin surveys in 2004.

In Long Point Bay, one yearling whitefish was collected during October bottom trawl surveys while another whitefish suspected to be yearling (50 g) appeared in index gill nets in June.

Growth and Diet

In 2004, lake whitefish condition (ages 4 and older) remained above historic 1927-1929 averages reported by Van Oosten and Hile (1947) (Figure 2.10). Sample sizes were low in 2004, producing large standard errors. The diets of young-of-the-year, yearling and older whitefish collected from the central basin from were described according to mean % dry weight (Ohio DNR, 2004, unpublished data) (Figure 2.11). Chironomid larvae, chironomid pupae, and sphaerid clams were the most significant prey items in all age groups of whitefish. Isopods, spiny water fleas, copepods and other invertebrates contributed to the YOY diet. Dreissenid mussels were present in yearling and older whitefish stomachs.

Research Efforts 2003 - 2004

Lake Erie agencies provided data and sample support to two graduate student projects during 2004. Chesley Lumb (M.Sc. candidate, University of Windsor) is using bioenergetic models to contrast the response of lake whitefish to ecological changes in Lakes Erie and Ontario. With strong support from fishery agencies, Chesley has summarised diets, energy dynamics, gonadosomatic index (GSI), fecundity, and growth rates for lake whitefish in 2003. Using published and unpublished data, in addition to tissue analyses derived from historic scale archives, Chelsey is inferring relative growth, diet, and fish health metrics for discrete periods corresponding to pre- and post-phosphorous abatement, and pre- and post-dreissenid invasion to evaluate the impact of these major ecological events on the growth and production of lake whitefish in the lower Great Lakes.

Michael Rennie is a Ph.D. candidate at the University of Toronto evaluating the effects of invasive species, climate change, and stock density on the growth response of lake whitefish throughout the Great Lakes basin. In 2004, Mike obtained tissue and diet samples and biological data from eastern Lake Erie. These samples are currently being processed for stomach contents and methyl mercury content; the later analyses will be used to compare rates of consumption and active metabolism with ten other lake whitefish stocks from across the Great Lakes basin.

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.

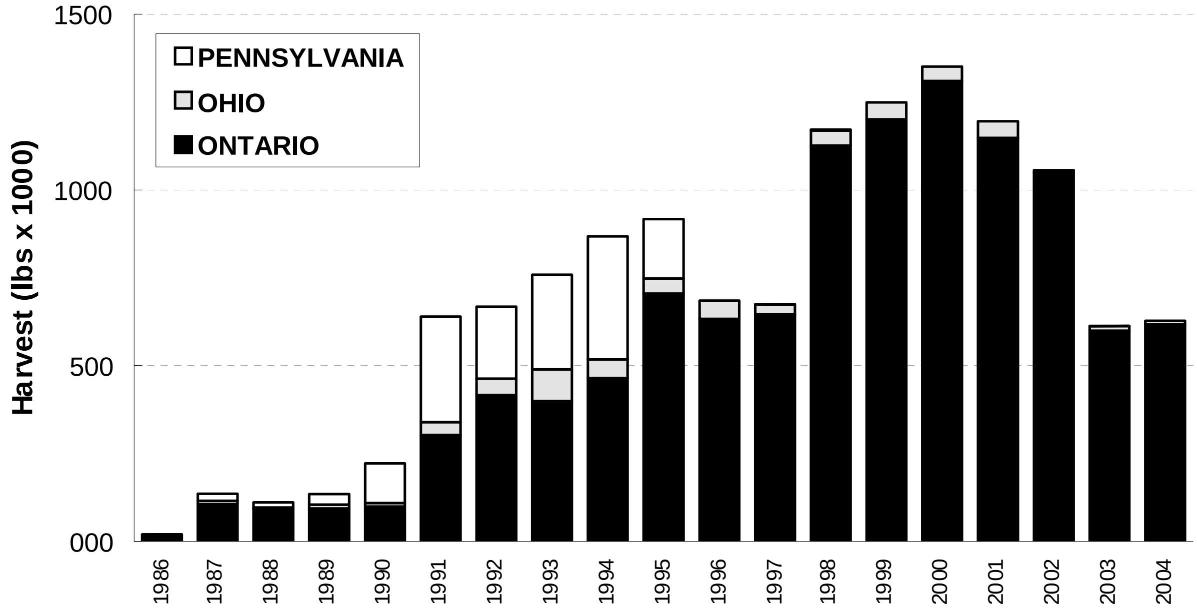


Figure 2.1. Total Lake Erie commercial whitefish harvest from 1986 – 2004 by jurisdiction. Pennsylvania ceased gill netting in 1996.

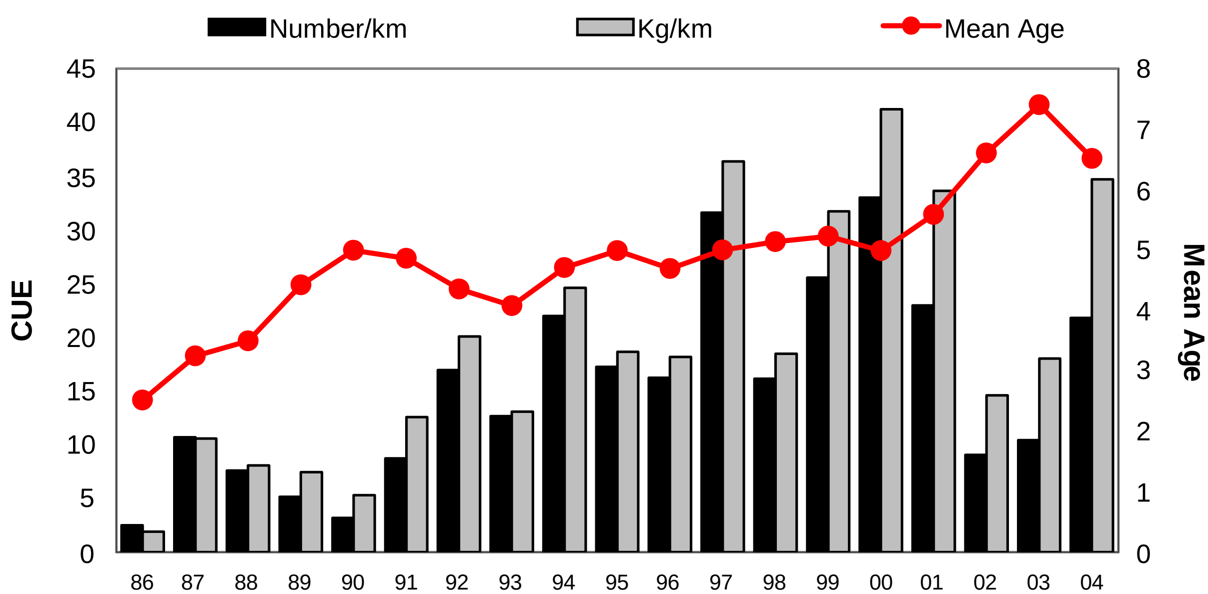


Figure 2.2. Catch rate (number and weight per km) and mean age of lake whitefish harvested by the Ontario fall gill net fishery, OE1, 1986 – 2004. (Fall = October to December).

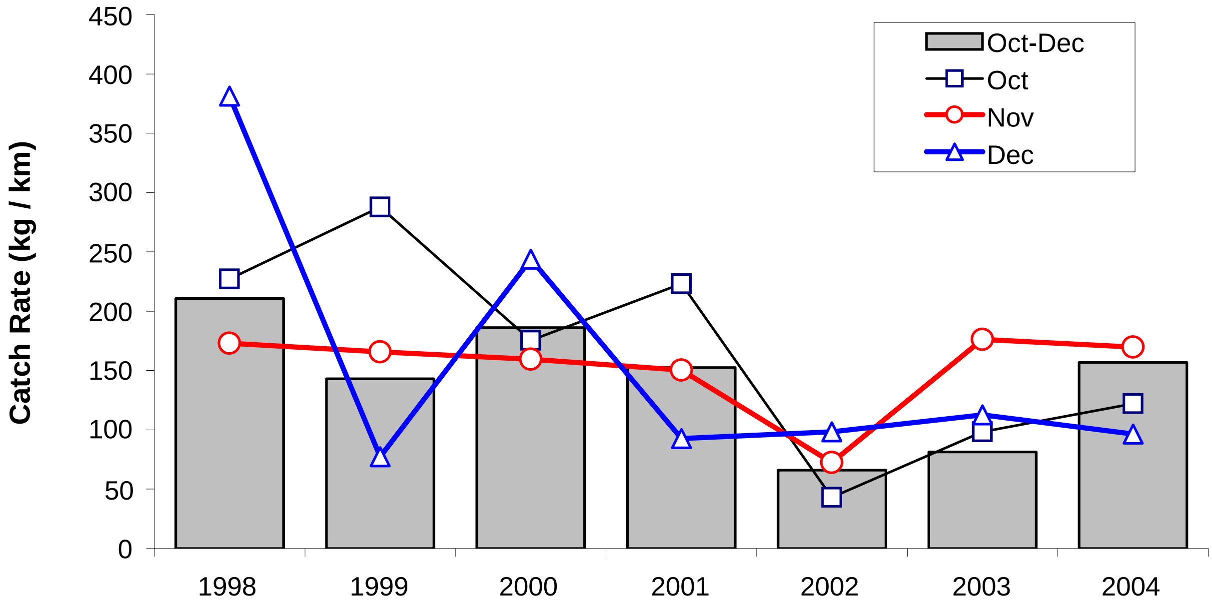


Figure 2.3. Targeted large mesh gill net catch rate (kg/km) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct. – Dec.), 1998 – 2004.

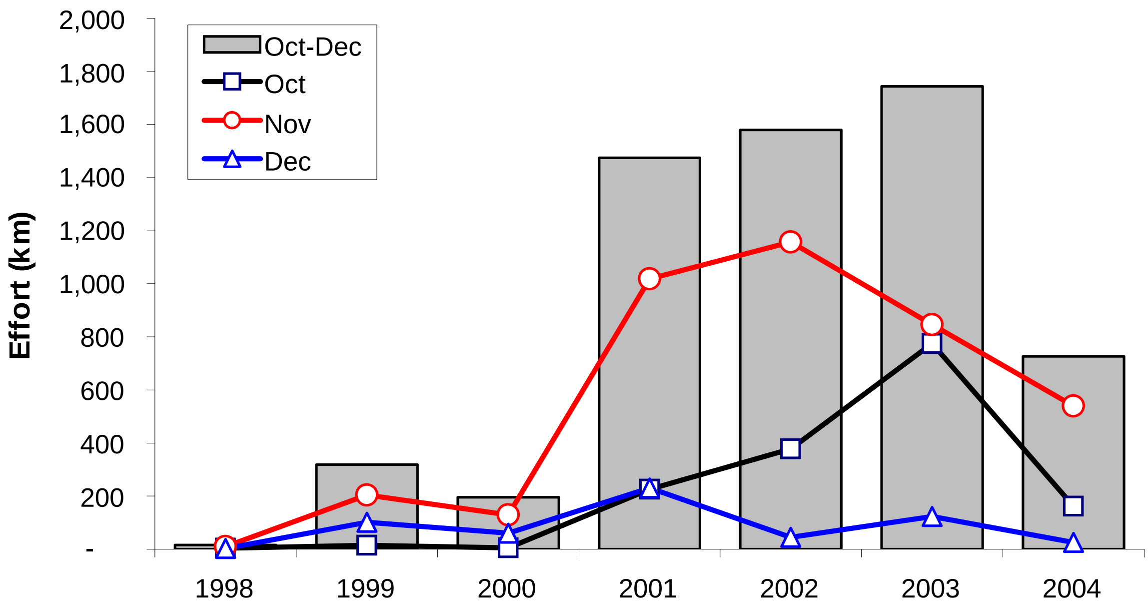


Figure 2.4. Targeted large mesh gill net effort (km) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct. – Dec.), 1998 – 2004.

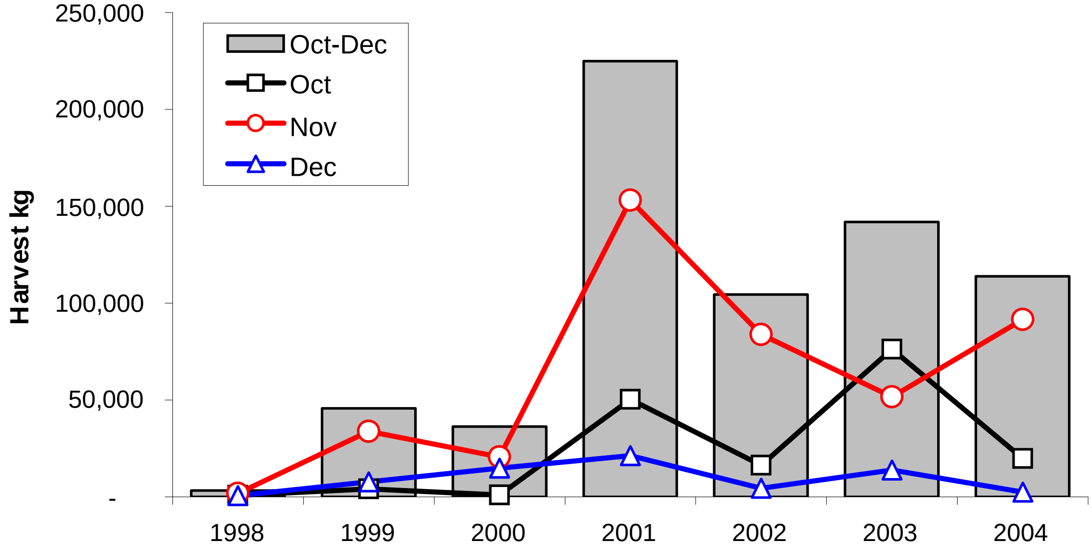


Figure 2.5. Targeted large mesh gill net harvest (kg) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct. – Dec.), 1998 – 2004.

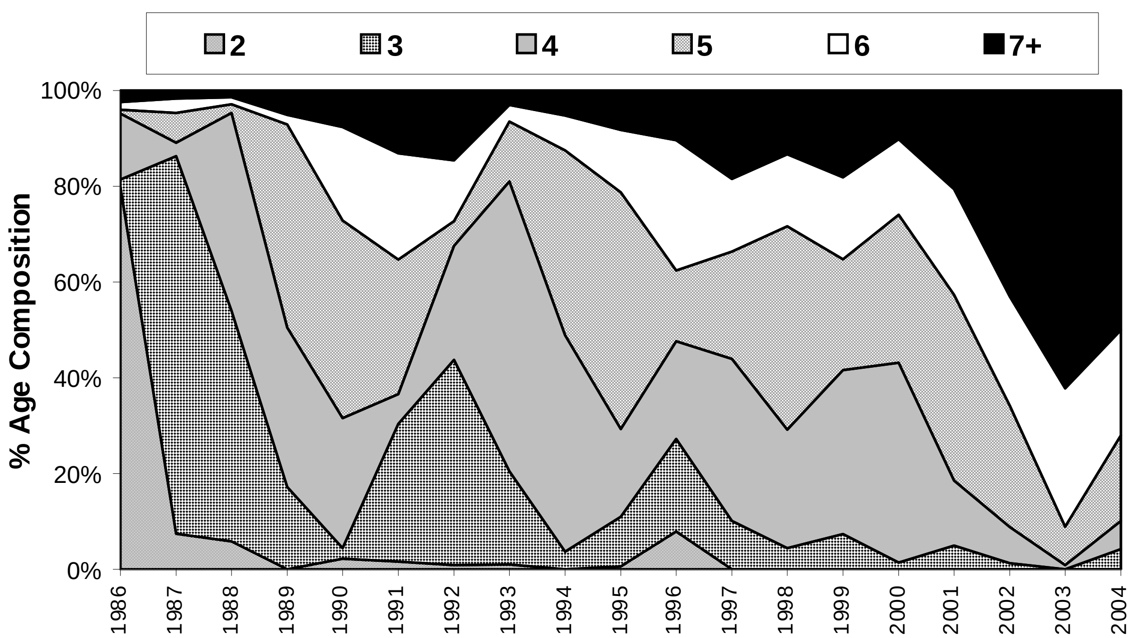


Figure 2.6. Ontario fall commercial whitefish harvest age composition in statistical district 1, 1986 – 2004. Effort with gill nets >=3 inches, with whitefish in catch from October to December.

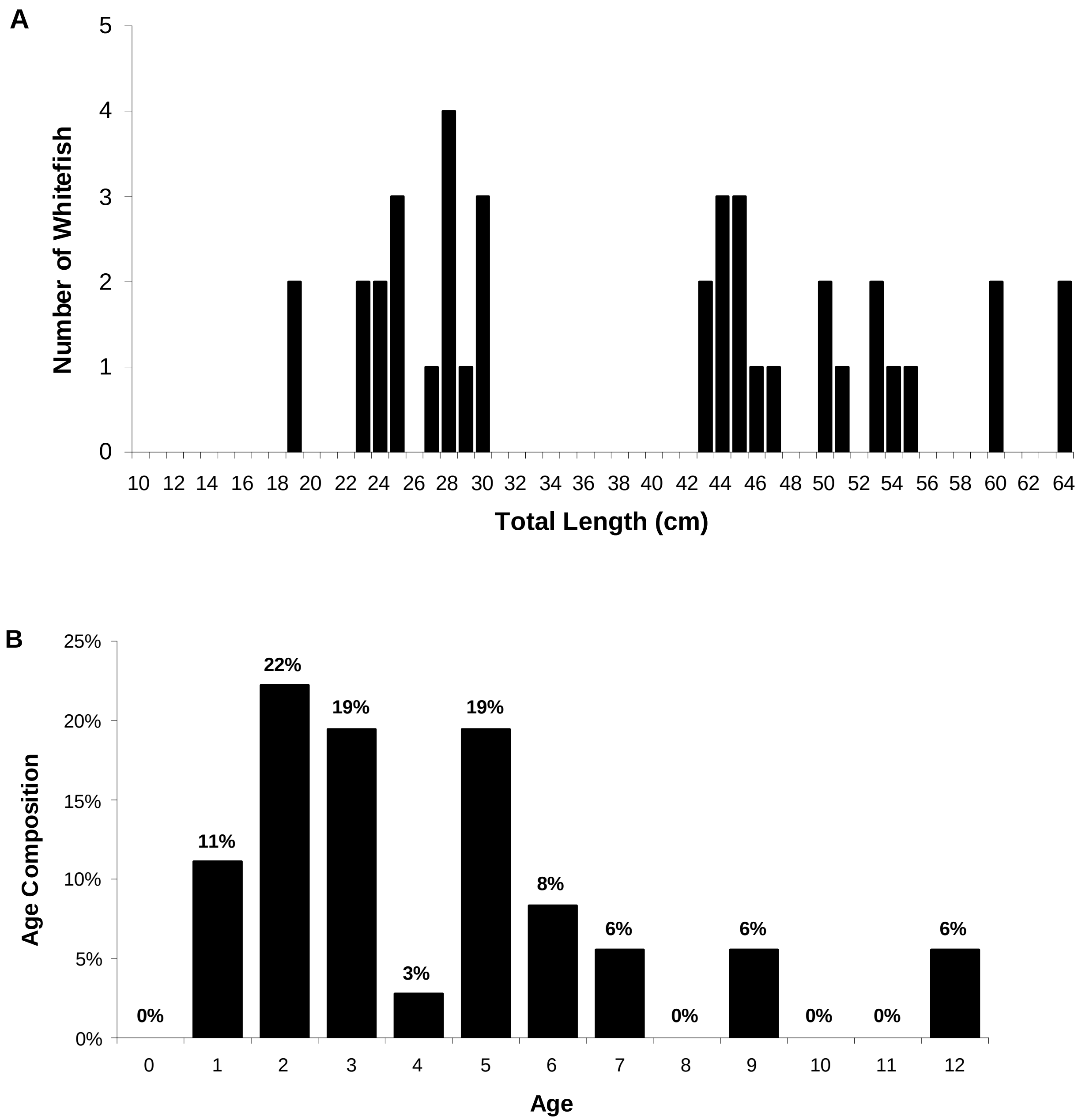


Figure 2.7. Length frequency distribution (A) and age composition (B) of lake whitefish collected from Ontario partnership index fishing, lake-wide, 2004.

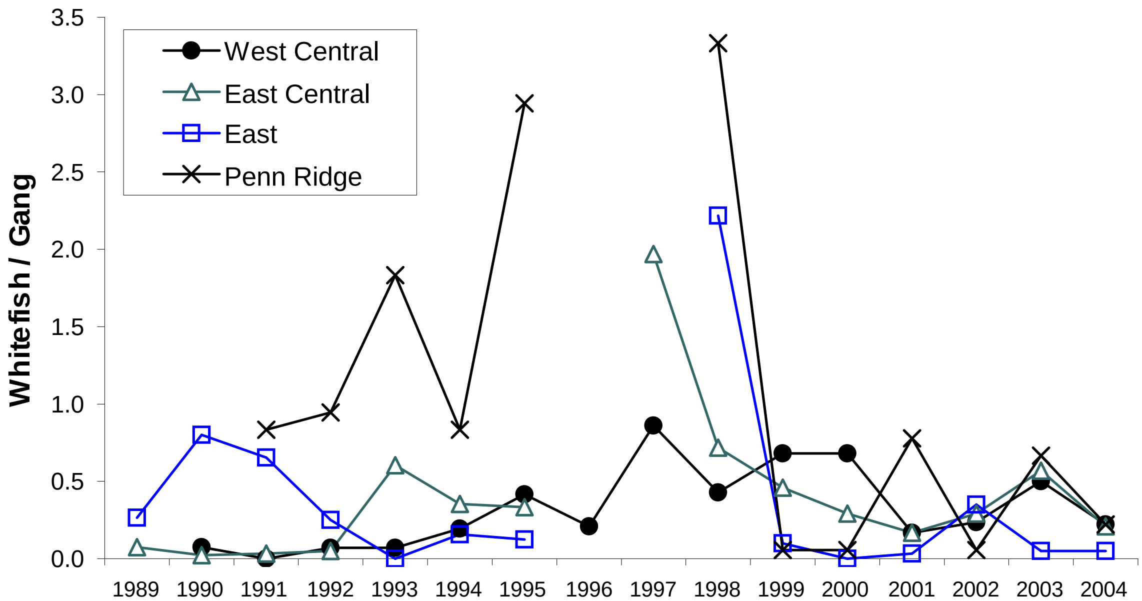


Figure 2.8. Catch rate (number per gang) of lake whitefish from Ontario partnership index gill netting by basin, Lake Erie, 1989 – 2004. West-Central basin not surveyed in 1989. East-Central basin not surveyed in 1996. East basin was not surveyed in 1996 and 1997; few sites were fished in 1995. Pennsylvania Ridge not surveyed in 1989, 1990, 1996, and 1997. Includes canned (suspended) nets. Standardized to equal effort among mesh sizes. Excludes thermocline sets.

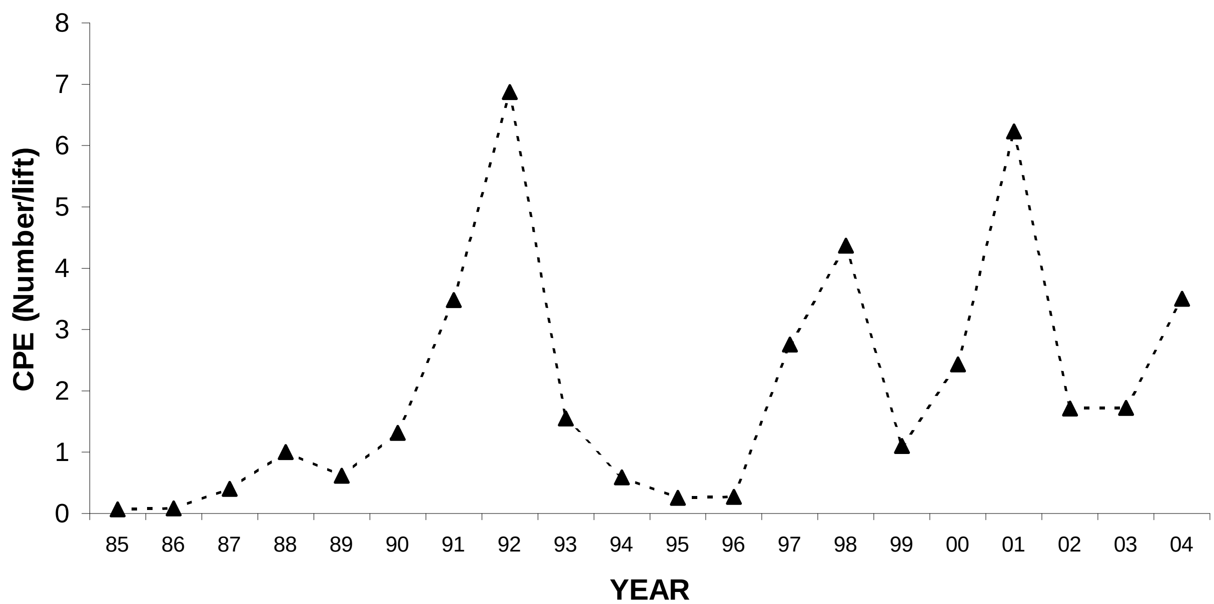


Figure 2.9. Catch per effort (number fish/lift) of lake whitefish caught in standard assessment gill nets from New York waters of Lake Erie, August, 1985 – 2004.

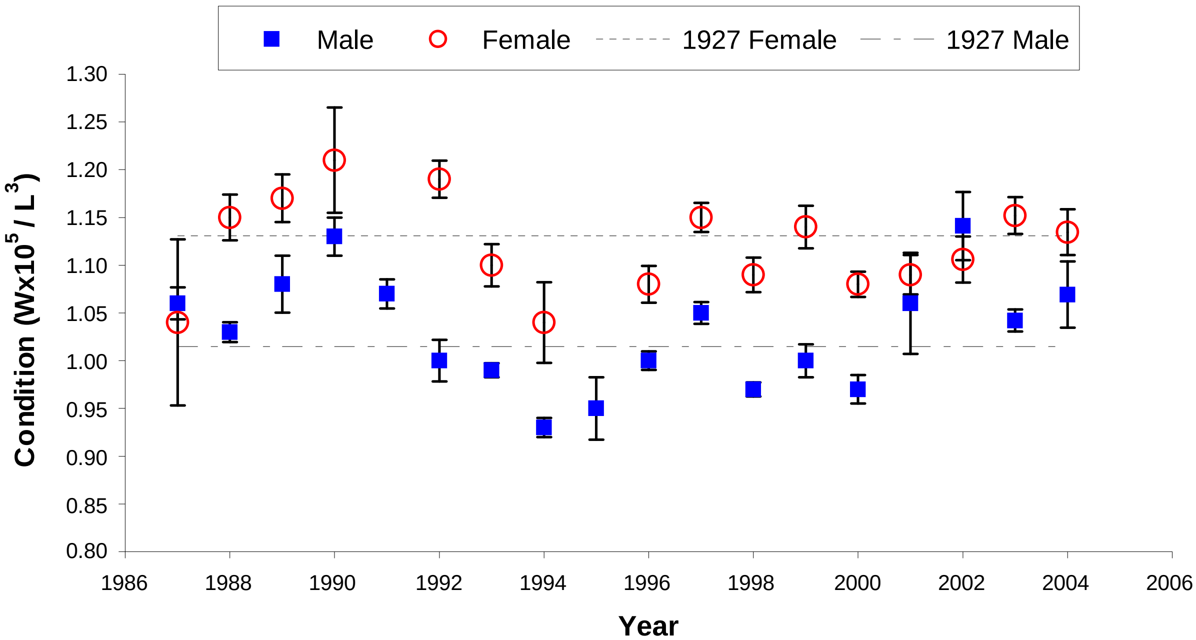


Figure 2.10. Mean condition factor of lake whitefish by sex from 1987 – 2004 with one standard error. Data includes whitefish ages 4 and older collected from commercial fish, Partnership, and whitefish index samples from October to December. Spent and ripe whitefish were excluded. Historic mean condition (1927 – 29) presented as dashed lines, calculated from Van Oosten and Hile (1947).

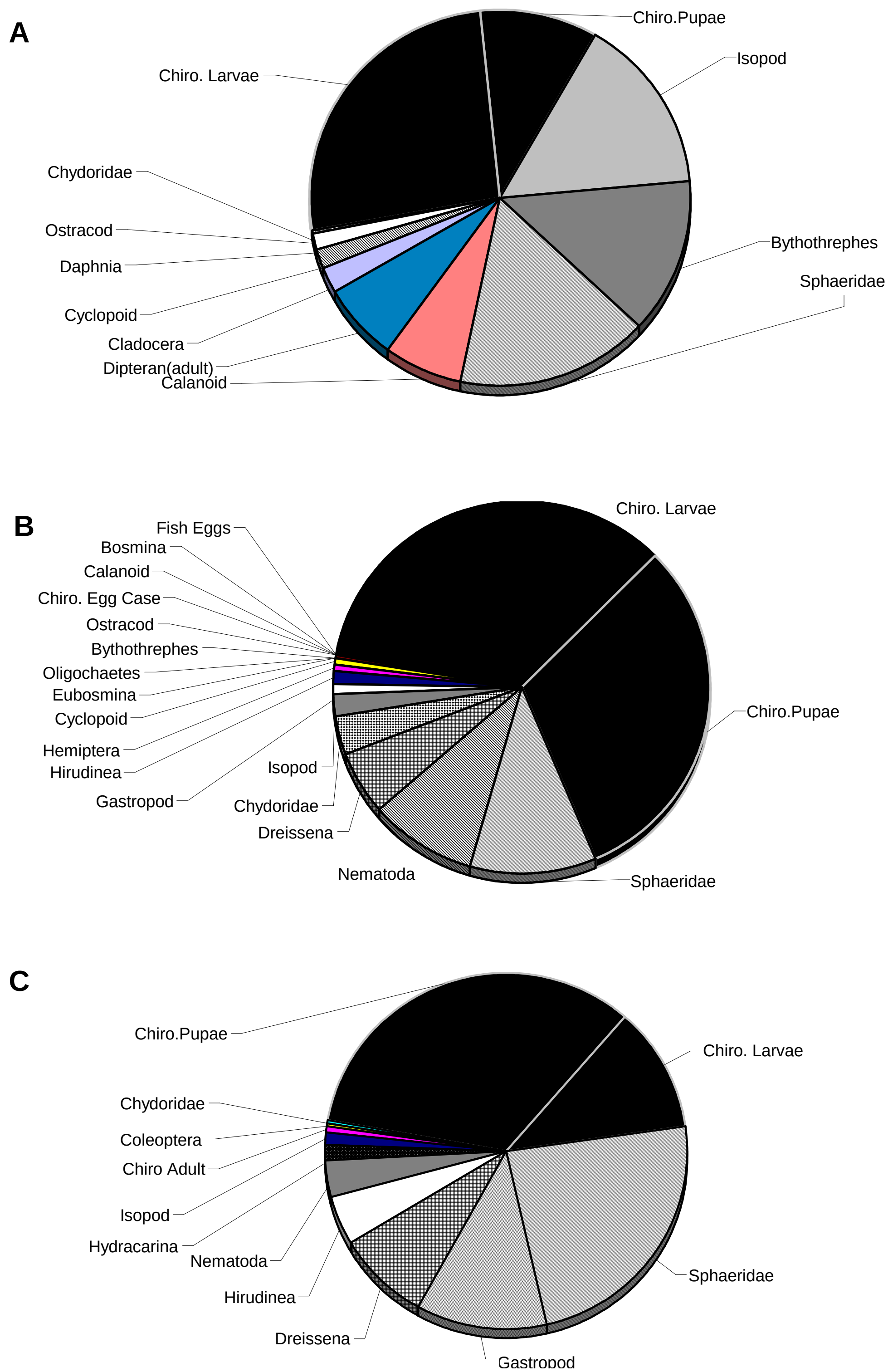


Figure 2.11. Stomach contents (mean % dry weight) of young-of-the-year (A), yearling (B), and lake whitefish ages two and older (C), collected from central Lake Erie by the Ohio Division of Wildlife from May to October, 2004. N = 5, 100, and 28 respectively. Weighted by number of samples collected each month. YOY collected during July and October. Yearlings collected during May, June, July, and October. Age two and older collected during May and June.

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

by Elizabeth Trometer (USFWS) and Martin Stapanian (USGS)

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. In 2004, commercial harvest in all jurisdictions increased slightly for al total harvest of 7,030 pounds.

Assessment Programs

Burbot is one of the most commonly caught species in annual eastern basin coldwater gill net assessment surveys. 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. In 2004, CUE increased from levels recorded in 2003 in New York waters, but declined to 2002 levels in Ontario waters (Figure 3.1). 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. No sampling was conducted in Pennsylvania waters in 2004.

In 2004, average biomass of burbot/lift increased from that recorded in 2003 in New York and decreased slightly in Ontario waters (Figure 3.2). Since 1998, average biomass/lift has increased in Ontario and New York waters. This increase has been more rapid in Ontario (average increase = 1.8 kg/lift/year) than in New York (average increase = 1.4 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 2004 eastern basin coldwater gill net assessment increased in New York and Ontario jurisdictions from values recorded in 2003 (Figure 3.3). Further, there has been a steady increase of average mass per individual since 2000 in New York and since 1998 in Pennsylvania and Ontario, after steady decreases in all jurisdictions in the mid-1990s. Preliminary analyses of age data suggest that this result is in part due to an increase in the average age of burbot in the catches since 1998.

Burbot is 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 decreased in the Pennsylvanian Ridge basin from 1999 through 2000, peaked in 2001, decreased in 2002, increased again in 2003, and decreased again in 2004. The catch declined in the east basin from a high in 1998 through 2001, but increased again in 2002 and 2003. In 2004, catch decreased again in east basin, but still remains high in Pennsylvania Ridge and east basin relative to the early 1990s.

Age Structure & Growth

Average length of burbot collected in the eastern basin coldwater gill net assessment surveys declined through the 1990s (Figure 3.5). Beginning in 1999, average length increased annually in all sampling jurisdictions. In 2004, average length of burbot was at an all-time high in New York (679 mm) and Ontario waters (643 mm).

In 2003, the Great Lakes Fishery Commission funded a study to age 3,000 burbot otoliths collected by the CWTG from 1993 through 2003. Preliminary results suggest that the average age of burbot has steadily increased since 1998 (Figure 3.6). In 2003, the average age of burbot collected was 8.4 in New York waters, 8.0 in Ontario waters and 9.2 in Pennsylvania waters.

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. Stapanian et al. (manuscript in review) tested four hypotheses to explain this increase: (1) reduced competition with lake trout *Salvelinus namaycush*, the other major coldwater piscivore in Lake Erie; (2) increased abundance of the two main prey species, rainbow smelt *Osmerus mordax* and round goby *Neogobius melanostomus*; (3) reduced interference with burbot reproduction by alewife *Alosa pseudoharengus*; and (4) reduced predation by sea lamprey *Petromyzon marinus* on burbot. Regression models were used to test all four hypotheses. The first three hypotheses were not supported by the data. The results suggested that the apparent recovery of the burbot population of Lake Erie was driven by effective sea lamprey control. Sea lamprey predation appeared to be the common factor affecting burbot abundance in all five Laurentian Great Lakes. In addition, relatively high alewife density likely affected burbot abundance in at least two of the lakes. Sustainability of a burbot fishery in Lake Erie would require continued measures to control sea lampreys.

Preliminary data also suggest that growth rates of age-3 and age-4 female burbot age in New York and Ontario waters of Lake Erie were higher after the invasion of round gobies in Lake Erie. This increase does not appear to be due to an overall increase in total available prey in the eastern basin. Further, round gobies have a lower energetic content (3.8 J/g [Steinhart et al. 2004]) than rainbow smelt (5.3 J/g [Lantry and Stewart 1993]). Burbot probably obtain a higher net energy reward from round gobies because round gobies are relatively benthic and territorial, whereas rainbow smelt are more pelagic and rapid-swimming. Growth rates of burbot for the same age classes were generally higher in New York waters than in Ontario waters, owing probably to the higher abundances of rainbow smelt and round gobies in New York. No regional or temporal differences in the growth rates of male burbot were found.

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.

Lantry, B.F., and D.J. Stewart. 1993. Ecological energetics of rainbow smelt in the Laurentian Great Lakes: an interlake comparison. Transactions of the American Fisheries Society 122:951-976.

Stapanian, M.A., C.P. Madenjian, and L.D. Witzel. Recovery of the burbot population in Lake Erie. Transactions of the American Fisheries Society. (in review).

Steinhart, G.B., R.A. Stein, and E.A. Marschall. 2004. High growth rate of young-of-the-year smallmouth bass in Lake Erie: a result of the round goby invasion? Journal of Great Lakes Research 30:381-389.

Table 3.1. Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980 - 2004.

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
2004	0.52	0.24	0.86	5.41	7.03

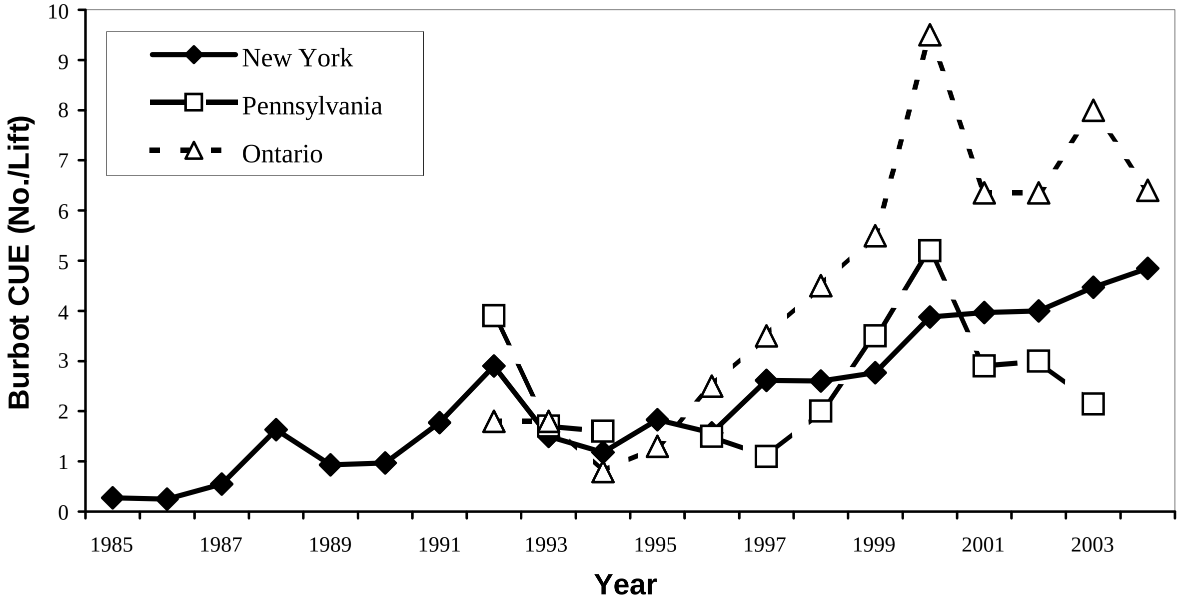


Figure 3.1. Burbot catch rate (fish/lift) from eastern basin coldwater gill net assessment by jurisdiction, 1985 -2004.

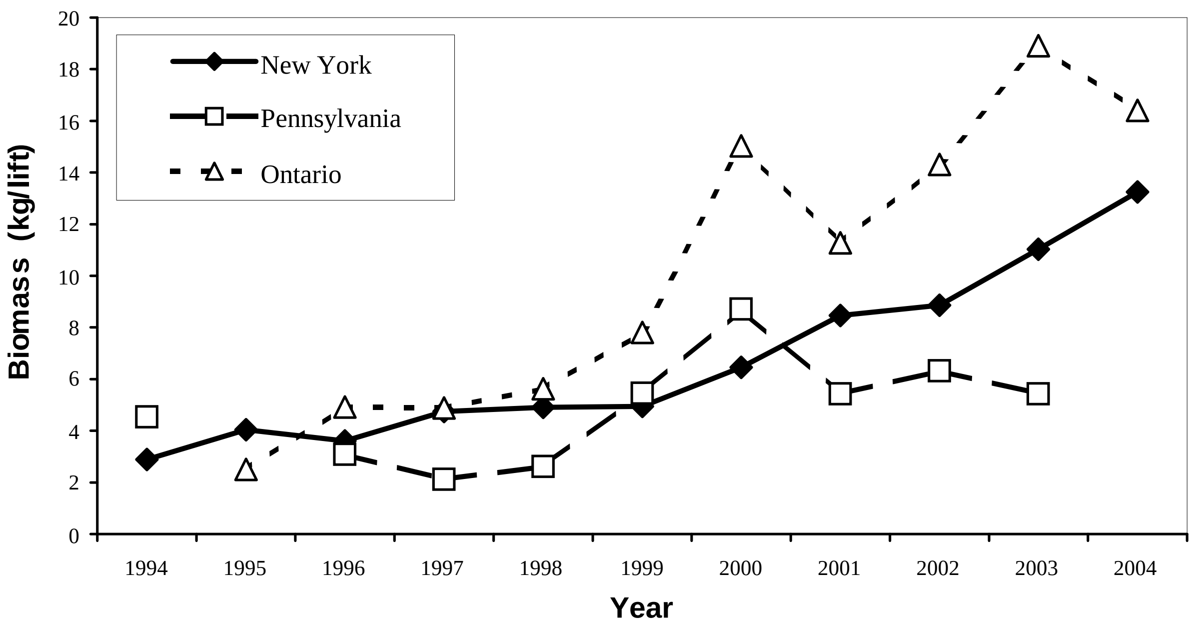


Figure 3.2. Average burbot biomass (kg/lift) from eastern basin coldwater gill net assessment by jurisdiction, 1994 -2004.

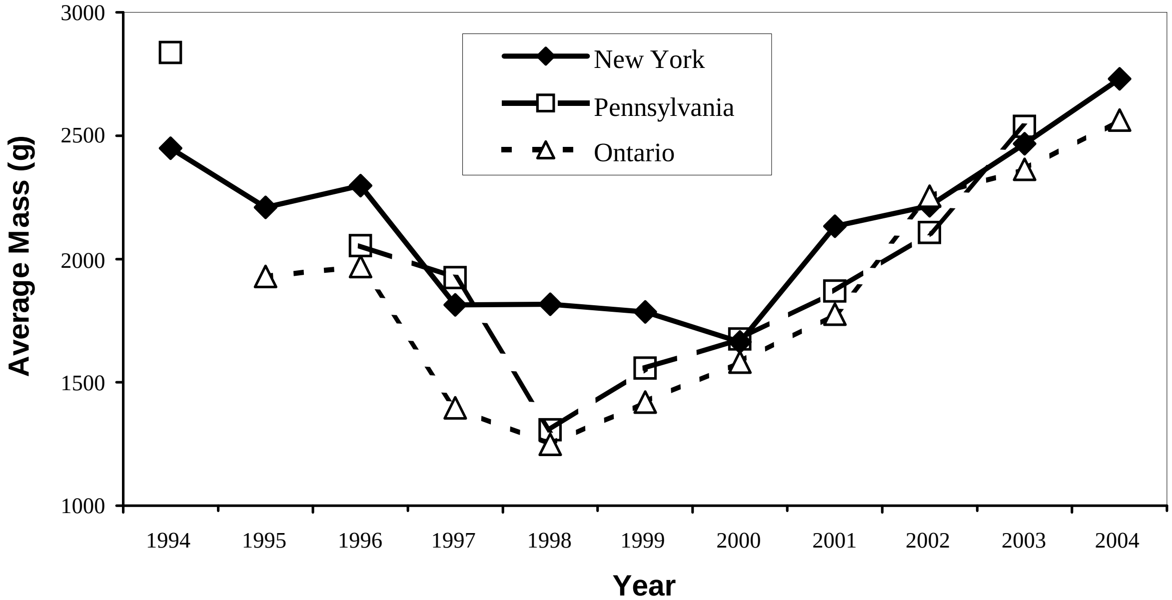


Figure 3.3. Average mass (g) per individual burbot from eastern basin coldwater gill net assessment by jurisdiction, 1994 - 2004.

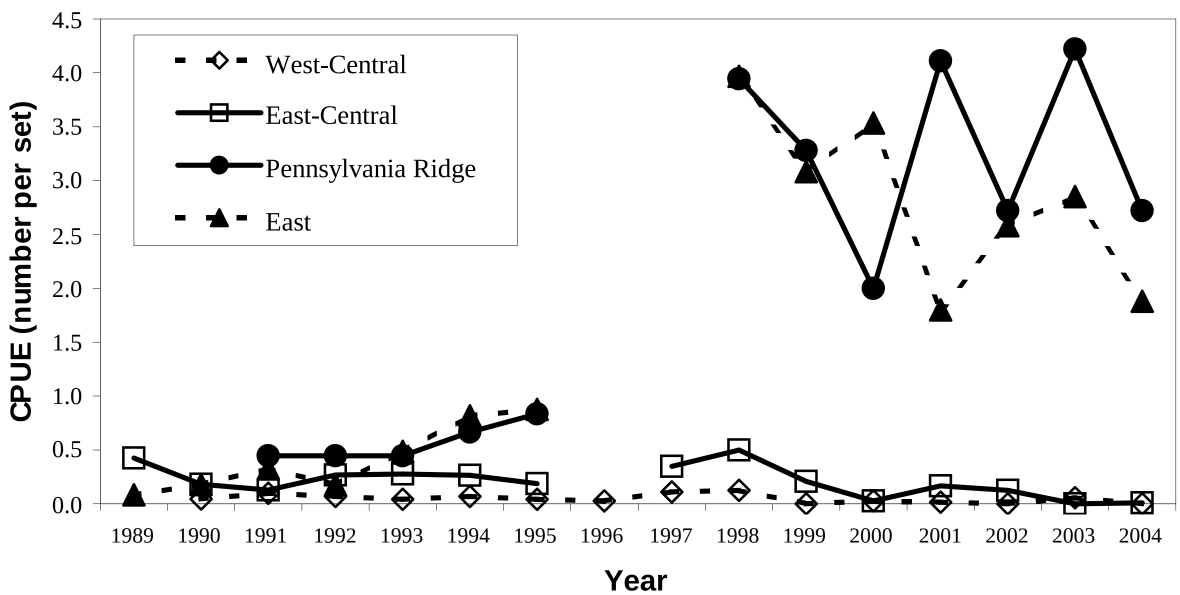


Figure 3.4. Burbot CUE by basin from the OMNR Partnership Index Fishing Program, 1989 – 2004 (Includes canned and bottom nets, all mesh sizes, except thermocline sets).

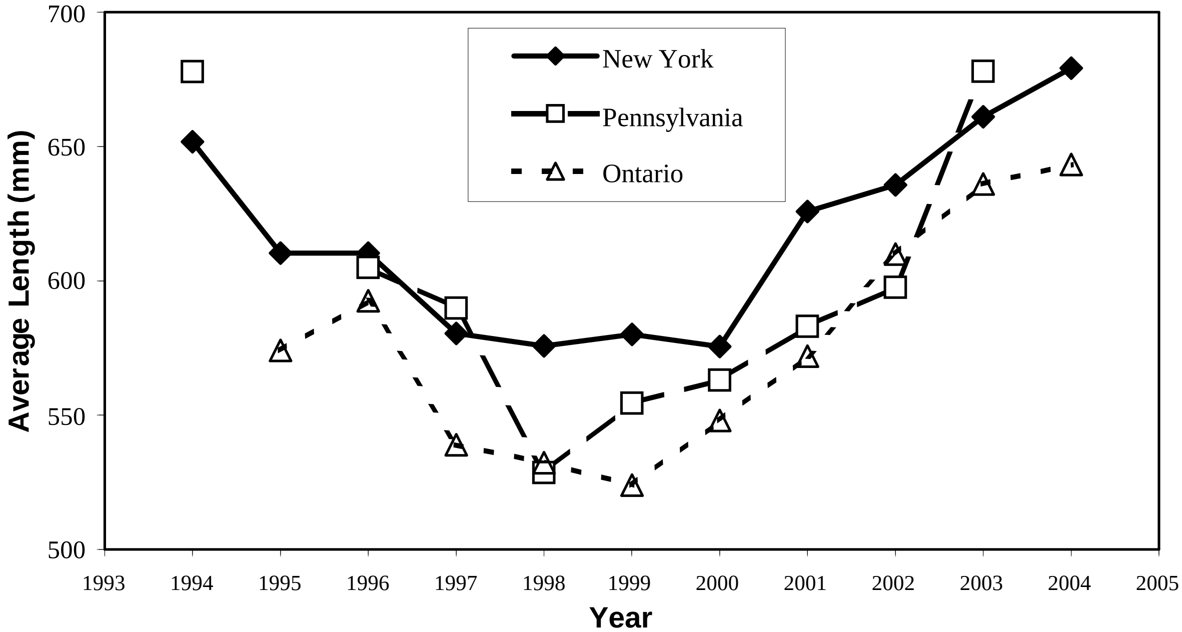


Figure 3.5. Average length of burbot collected by jurisdiction in the eastern basin coldwater gill net assessment, 1993 - 2004.

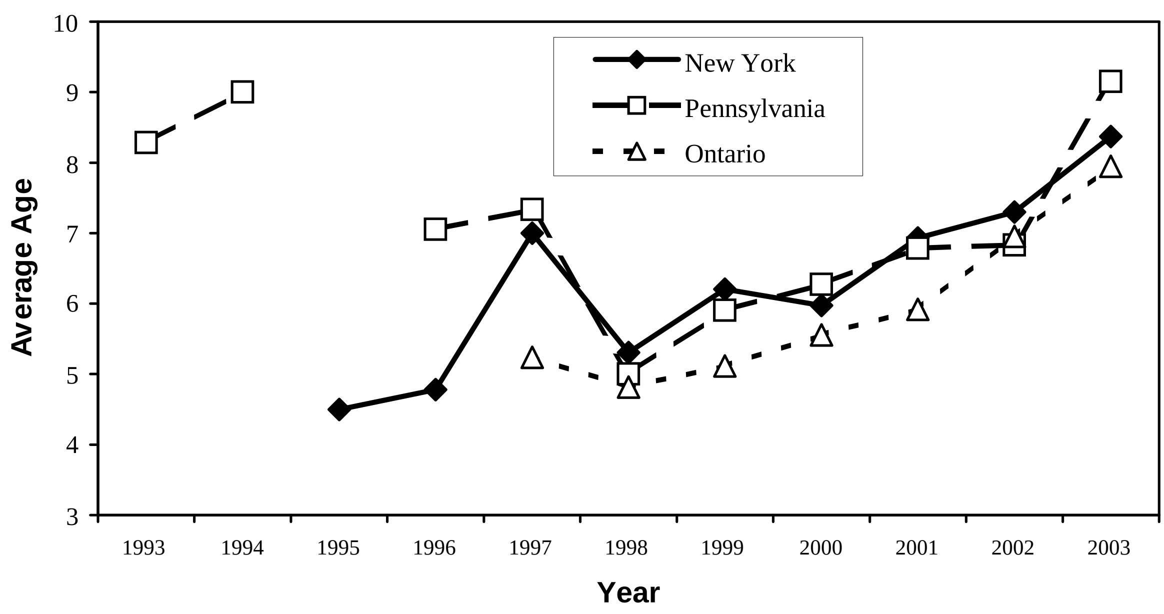


Figure 3.6. Average ages of burbot by year from fish collected by jurisdiction in the eastern basin coldwater gill net assessment, 1995 - 2003.

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.

by Michael Fodale (USFWS), Paul Sullivan (DFO), and James Markham (NYSDEC)

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.

2004 Lake Trout Wounding Rates

Observed A1-A3 wounding on lake trout greater than 21 inches total length (532 mm) decreased from 10.4 in 2003 to 7.9 wounds per 100 fish in 2004 (Figure 4.1). Although this is still above the target rate of 5 wounds per 100 fish established by the Sea Lamprey Management Plan for Lake Erie (Lake Trout Task Group 1985), it is the third consecutive year that wounding rates remained relatively low compared to the 1997 - 2001 time period where rates averaged 20 wounds per 100 fish. Lake trout between 21 and 29 inches received the most fresh wounds (Table 4.1). There were no wounds found on lake trout less than 21 inches.

Fresh A1 wounds are considered indicators of the attack rate for the current year at the time of sampling (August). A1 wounding in 2004 was 0.021 wounds per adult lake trout greater than 21 inches (Figure 4.2), which was slightly above the post-treatment time-series average of 0.020 wounds per fish. With the exception of 2002, where no A1 wounds were observed, this rate has remained steady since 2000. Three of the four observed A1 wounds occurred on fish in the 21-25" range (Table 4.1). Lampreys were still attached to two lake trout brought aboard the RV ARGO.

The past year's cumulative attacks are indicated by A4 wounds. The 2004 A4 wounding rate increased for the second consecutive year to 21.7 wounds per 100 fish for lake trout greater than 21 inches (Figure 4.3). Six of the past eight years have had A4 wounding rates higher than the post-treatment series average of 17.1 wounds per 100 fish. Similar to past surveys, the majority of the A4 wounds were found on fish greater than 25 inches in total length (Table 4.1).

2004 Actions

During 2004, assessments were conducted in 3 streams (0 Canada, 3 U.S.) to rank them for lampricide treatment, and another 20 streams (6 Canada, 14 U.S.) to determine presence or absence of sea lamprey larvae (Tables 4.2, 4.3). Quantitative assessment of 3 creeks were scheduled for 2004 in anticipation of possible lampricide treatment during 2005, however high discharge and turbidity precluded survey. Detection surveys were conducted on several U.S. streams to discover new populations of larvae and all such surveys were negative.

Control effort, which had been enhanced to counter observed increases in sea lamprey abundance, continued during 2004 with lampricide treatments of Cattaraugus and Big Otter creeks.

The estimated numbers of spawning-phase sea lampreys edged up slightly again during 2004 for the second consecutive year after 2 years of decline (Klar and Young 2005). The 2004 spawning population was estimated at 5,055 adults, up from 1,597 in 2002. A total of 186 spawning-phase sea lampreys were trapped in 3 U.S. tributaries (Grand River; Cattaraugus and Spooner Creeks), an increase of 86% when compared with the 2003 catch. In Canada, only the

Young's Creek trap was operational, as mechanical failure of the inflatable barrier precluded trapping at Big Creek. Catch at Young's Creek was 22, a decline of approximately 50% when compared with 2003.

Several barrier projects are proceeding on Lake Erie. Consultation occurred between Department of Fisheries and Oceans, 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.

2005 Plans

Sea lamprey management plans for Lake Erie during 2005 include lampricide treatment of 2 U.S. tributaries (Raccoon and Delaware Creeks) based on a comparison of cost-per-transformer estimates for all Great Lakes streams that were quantitatively assessed during 2004. Larval assessments are planned on 16 Lake Erie streams (4 Canada, 12 U. S.), 4 of which (1 Canada, 3 U.S.) will be considered for lampricide treatment during 2006 (Tables 4.2, 4.3). 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. Installation of denil fish ways to pass walleyes at the Caledonia dam on the Grand River will proceed once funding has been secured by the proponents (the Grand River Conservation Authority (GRCA) and Ontario Ministry of Natural Resources). These agencies are working cooperatively with DFO to ensure the continued blockage of migrant spawning-phase sea lampreys at this structure. In another joint DFO-GRCA venture, flow studies are being conducted at a stop-log dam on Taquanyah Creek (a Grand River tributary) to determine the optimal height at which upstream cold water habitat will be restored while continuing to block spawning-phase sea lampreys.

References

Klar, G. T. and Young, R. J. 2005. *Integrated management of sea lampreys in Lake Erie 2004.* 2004 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.

Table 4.1. Frequency of sea lamprey wounds observed on several standard length groups of lake trout collect form standard mesh gill nets in New York water of Lake Erie, August 2004.

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	9	0	0	0	0	0	0	0
21 - 25	75	4	3	1	0	3	5.3	5.3
25 - 29	85	9	0	2	7	22	10.6	10.6
>29	29	2	1	0	1	16	6.9	6.9
>21	189	15	4	3	8	41	7.9	7.9

Table 4.2. Larval sea lamprey assessments of Canadian Lake Erie tributaries during 2004 and plans for 2005.

Stream	History	Surveyed In 2004	Survey Type	Results	Plans for 2005
East Creek	Positive	Yes	Evaluation[1]	Negative	None
Catfish Creek	Positive	Yes	Evaluation	Negative	None
Forestville Creek	Positive	Yes	Evaluation	Negative	None
Fishers Creek	Positive	Yes	Evaluation	Positive	None
E-116	Negative	Yes	Detection[2]	Negative	None
E-118	Negative	Yes	Detection	Negative	None
Silver Creek	Positive	No	-	-	Evaluation survey
Big Otter Creek	Positive	No	-	-	Evaluation survey
South Otter Creek	Positive	No	-	-	None
Clear Creek	Positive	No	-	-	None
Big Creek	Positive	No	-	-	*Quantitative survey*[3]
Normandale Creek	Positive	No	-	-	None
Young's Creek	Positive	No	-	-	Evaluation survey
St. Clair tributaries					
St. Clair River	Positive	Yes	Evaluation	Positive	None
Thames River	Positive	Yes	Detection	Negative	None

[1]*Evaluation survey* – conducted to determine requirement for quantitative assessment of an untreated larval population, or whether larvae have repopulated a stream following treatment.
[2]*Detection survey* – conducted to determine larval presence or absence in streams with no history of sea lamprey infestation.
[3]*Quantitive 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.

Table 4.3. Larval sea lamprey assessments of U.S. Lake Erie tributaries during 2004 and plans for 2005.

Stream	History	Surveyed In 2004	Survey Type	Results	Plans for 2005
Delaware Creek	Positive	Yes	*Quantitative*	Positive	**Lampricide treatment**
Raccoon Creek	Positive	Yes	*Quantitative*	Positive	**Lampricide treatment**
Buffalo River					
Cayuga Creek	Positive	Yes	Evaluation	Positive	None
Cattaraugus Creek	Positive	Yes	*Quantitative*	Positive	Evaluation survey
Canadaway Creek	Positive	Yes	Evaluation	Positive	Evaluation survey
Crooked Creek	Positive	Yes	Evaluation	Positive	*Quantitative survey*
Chagrin River	Negative	Yes	Detection	Negative	None
Black River	Negative	Yes	Detection	Negative	None
Vermilion River	Negative	Yes	Detection	Negative	None
Sandusky River	Negative	Yes	Detection	Negative	None
Portage River	Negative	Yes	Detection	Negative	None
Toussaint River	Negative	Yes	Detection	Negative	None
Flat Creek	Negative	Yes	Detection	Negative	None
Little Lake Creek	Negative	Yes	Detection	Negative	None
Otter Creek	Negative	Yes	Detection	Negative	None
Laplaisance Creek	Negative	Yes	Detection	Negative	None
Sandy Creek	Negative	Yes	Detection	Negative	None
Stony Creek	Negative	Yes	Detection	Negative	None
Swan Creek	Negative	Yes	Detection	Negative	None
Conneaut Creek	Positive	No	-	-	*Quantitative survey*
Wheeler Creek	Positive	No	-	-	Evaluation survey
Grand River	Positive	No	-	-	*Quantitative survey*
Eighteen Mile Cr.	Negative	No	-	-	Detection survey
Walnut Creek	Negative	No	-	-	Detection survey
Elk Creek	Negative	No	-	-	Detection survey
Cowles Creek	Negative	No	-	-	Detection survey
Swan River	Negative	No	-	-	Detection survey
Black River	Positive	No	-	-	Evaluation survey
Pine River	Positive	No	-	-	Evaluation survey
Belle River	Positive	No	-	-	Evaluation survey
Swan River	Negative	No	-	-	Detection survey
Salt River	Negative	No	-	-	Detection survey
Clinton River	Positive	No	-	-	Evaluation survey

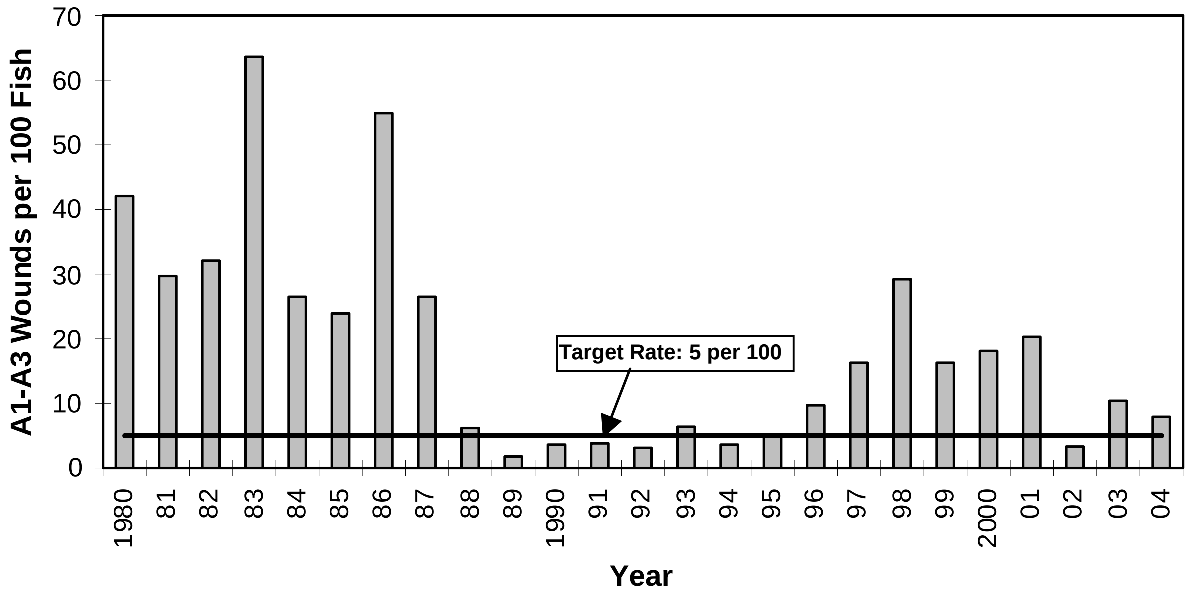


Figure 4.1. Number of fresh (Type A1 – A3) sea lamprey wounds per 100 adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1980 – 2004. The Strategic Plan target rate is 5 wounds per 100 fish.

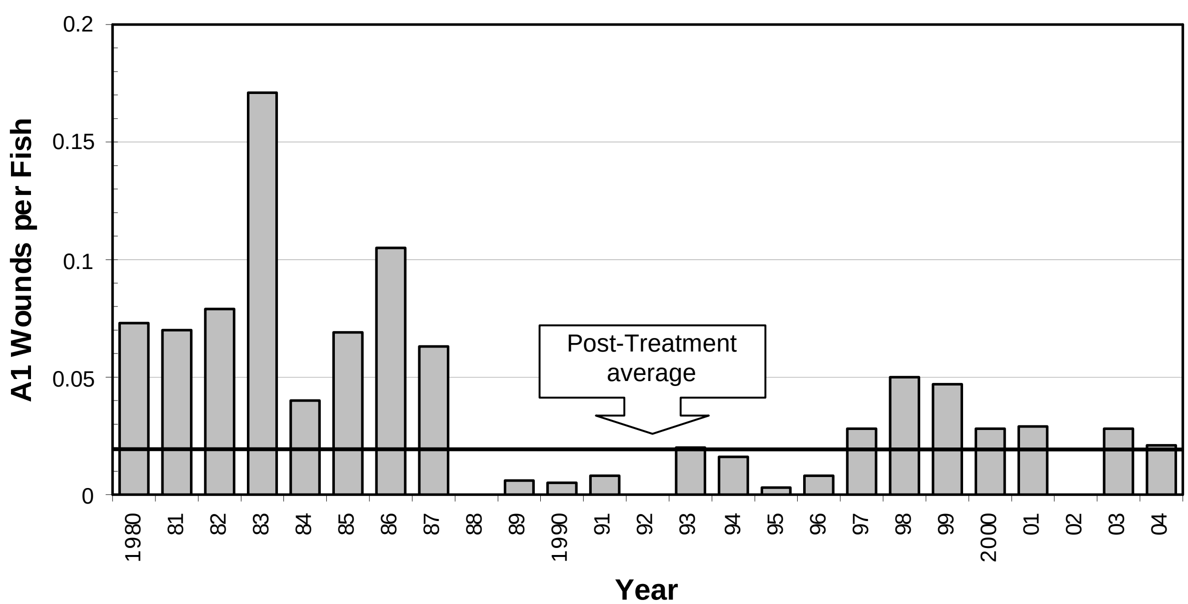


Figure 4.2. Number of fresh Type A1 sea lamprey wounds observed per adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August - September, 1980 - 2004. The post-treatment average includes 1987 – 2004.

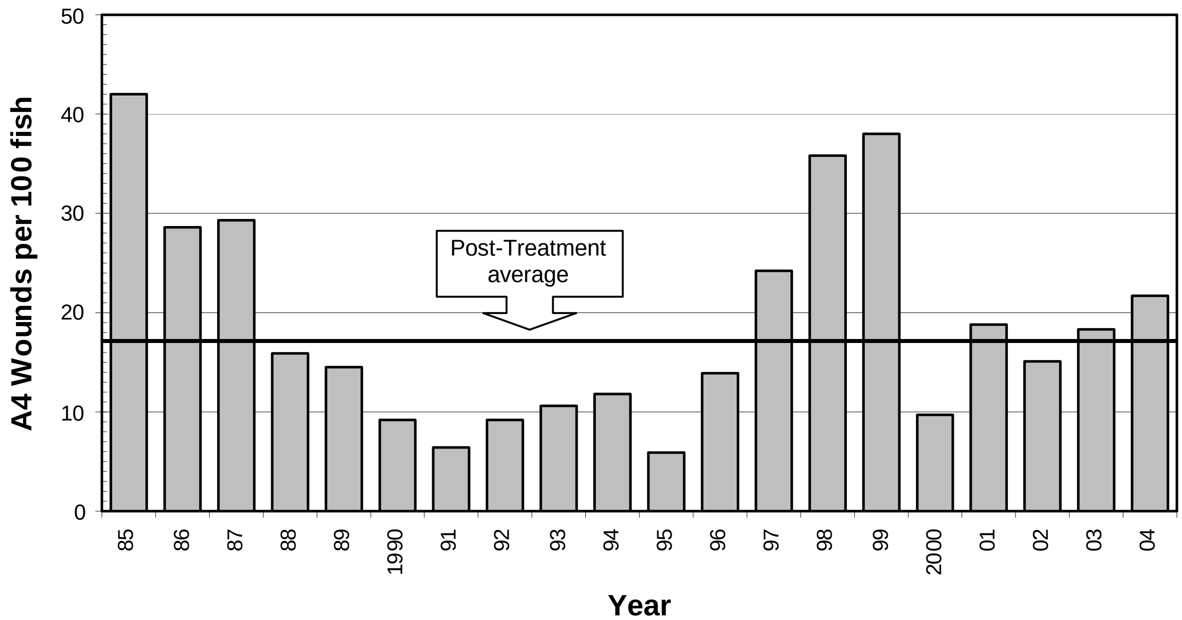


Figure 4.3. Number of Type A4 sea lamprey wounds observed per 100 adult lake trout greater than 21 inches (532 mm) sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1985 - 2004. The post-treatment average includes 1987 – 2004.

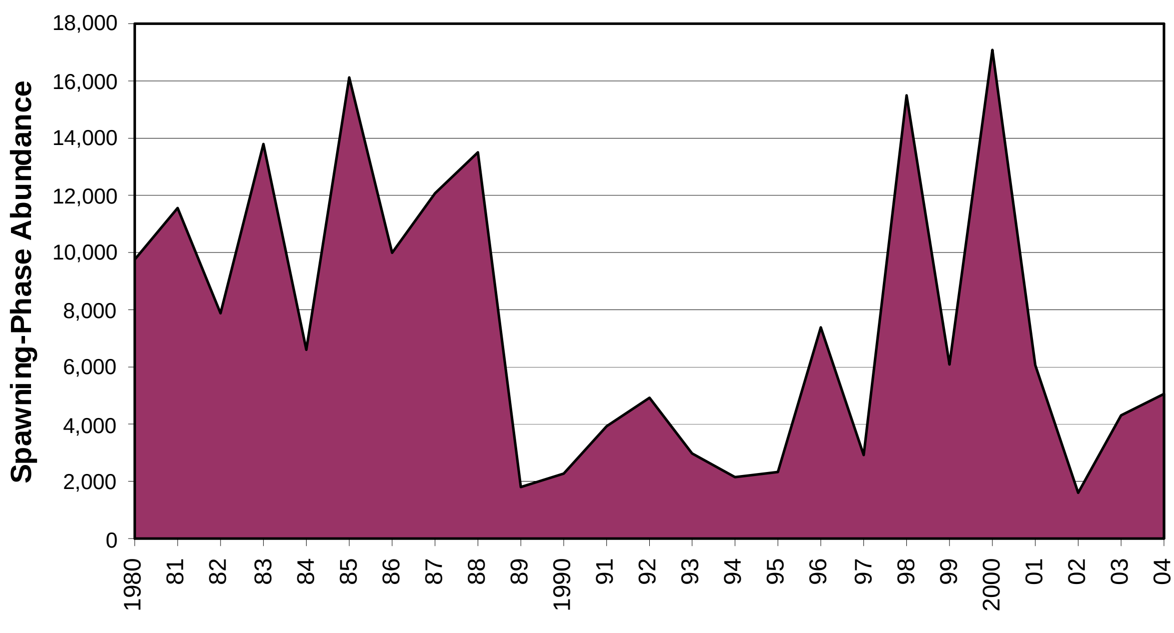


Figure 4.4. Lake-wide estimate of spawning-phase sea lampreys in Lake Erie, 1980-2004.

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.

by Chuck Murray (PFBC) and James Markham (NYSDEC)

Stocking of Lake Trout

The current lake trout goal of 120,000 yearlings stocked was not met for the first time in the past six years (Table 5.1; Figure 5.1). The shortage was due to the low availability of an initial lot of a new strain of lake trout, the Klondike strain. The Allegheny National Fish Hatchery (ANFH) supplied all of the lake trout, with all 80,000 Finger Lakes strain and 31,600 Klondike strain delivered to New York. These fish were all stocked in over 70 feet of water north of Barcelona on 5-6 May 2004. No lake trout were stocked in Pennsylvania waters for the second consecutive year. All yearling lake trout were adipose fin-clipped and coded-wire tagged prior to stocking. Extra sac fry for stocking were not available in 2004 due to poor eye-up of the lake trout eggs.

A paired planting of yearling lake trout to compare survival and growth rates of large versus small stocking size was continued in 2004. This was the final year of the five year comparison study that began in 2000. The two 40,000 lots of Finger Lakes strain lake trout were both stocked off of the RV ARGO in 70+ feet of water north of Barcelona with the larger sized fish at 18 fish/pound and the smaller lot at 23.5 fish/pound. However, both of these lots were significantly smaller than fish stocked in the past at around 7 - 14 fish/pound. The Klondike strain, although stocked at a lower rate, will also be able to be compared to the Finger Lakes strain stockings for long-term survival. Each of the size groups and strains had different coded-wire tag (CWT) numbers for future identification.

Results of the study continue to favor the larger stocked fish. With the exception of first year returns of the 2000 stocking, large lot fish have had higher return rates than small lot fish in each year for the 2000, 2001, and 2002 stockings (Figure 5.2). Cumulative returns from the first paired stocking in 2000 favored the larger stocked fish 2.19:1 (250 large, 114 small) (t-test; $P<0.001$), the 2001 stocking 2.09:1 (48 large, 23 small) (t-test; $P<0.05$), and 1.67:1 (87 large, 52 small) (t-test; $P<0.05$) for 2002 stocked lake trout. Not enough age 2 (2003 stocking) or age 1 (2004 stocking) lake trout were caught during coldwater assessment surveys to assess return rates of these paired plantings. Significant differences in mean size were not apparent although age 4 (2001 stocking) and age 3 (2002 stocking) large lot fish averaged one inch and one-half inch, respectively, more than small lot fish (Figure 5.3). Small lot fish were actually larger on average by age 5 (2000 stocking).

Stocking of Other Salmonids

In 2004, over 2 million yearling trout and salmon were stocked in Lake Erie, including rainbow trout/steelhead, lake trout and brown trout (Figure 5.4). Total salmonine stocking increased 6% from 2003 but was still 6% below the long-term average (1989 - 2004). Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 5.1.

All riparian agencies presently stock rainbow trout in the Lake Erie watershed. Rainbow trout/steelhead accounted for 91% of all salmonids stocked in 2004. A total of 1,990,042 yearling rainbow trout were stocked in 2004, representing an 11% increase from 2003. Rainbow trout stocking in 2004 had increased nearly 14% from the long-term average, primarily a result of the increased prominence of this species in jurisdictional fisheries over that last decade. The majority of rainbow trout stocked in Lake Erie are planted in Pennsylvania (61%), followed by Ohio (21%), New York (13%), Michigan (3%)

and Ontario (2%). Details on strain composition and stocking location are covered in detail under Charge 6 of this report.

Brown trout stocking in Lake Erie totaled 86,350 yearlings in 2004. This total represents a 16% increase from 2003, but a 2% decrease from the long-term average. Nearly 58% of the brown trout stocked in Lake Erie were in Pennsylvania waters, and 42% were stocked in New York waters. No other agencies reported stocking brown trout in Lake Erie in 2004. Of the 50,350 brown trout stocked in Pennsylvania waters, most (74%) were stocked for the opening day of trout, put-and-take fishery. The remainder of the brown trout stocked in Pennsylvania waters to Lake Erie were stocked by cooperative sportsman's groups for the purpose of providing a modest lake-run brown trout tributary fishery. The New York DEC began re-emphasizing brown trout stocking in place of domestic rainbow trout in 2002 for the purposes of diversifying their tributary salmonid fishery and maintaining migratory behavior of their Washington steelhead strain. Although brown trout represent less than 4% of all trout / salmon stocked in Lake Erie, respectable annual catches are noted and this species remains popular with tributary anglers. Tributary creel survey estimates from 2003 in Pennsylvania showed that anglers caught over 20,000 brown trout and harvested one third of that catch.

Table 5.1. Summary of salmonid stocking in numbers of yearling equivalents, Lake Erie, 1989 – 2004.

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

Table 5.1. (Continued): Summary of salmonid stocking in number of yearling equivalents, Lake Erie, 1989 – 2004.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
ONT.	--	--	--	1,763	51,000	52,763
NYS DEC	80,000	--	56,750	--	277,042	413,792
PFBC	40,000	68,061	--	31,845	1,153,606	1,293,512
ODNR	--	--	--	--	197,897	197,897
MDNR	--	--	--	--	71,317	71,317
1997 Total	**120,000**	**68,061**	**56,750**	**33,608**	**1,750,862**	**2,029,281**
ONT.	--	--	--	--	61,000	61,000
NYS DEC	106,900	--	--	--	299,610	406,510
PFBC	--	100,000	--	28,030	1,271,651	1,399,681
ODNR	--	--	--	--	266,383	266,383
MDNR	--	--	--	--	60,030	60,030
1998 Total	**106,900**	**100,000**	**0**	**28,030**	**1,958,674**	**2,193,604**
ONT.			--		85,235	85,235
NYS DEC	143,320		--		310,300	453,620
PFBC	40,000	100,000	--	20,780	835,931	996,711
ODNR			--		238,467	238,467
MDNR			--		69,234	69,234
1999 Total	**183,320**	**100,000**	**0**	**20,780**	**1,539,167**	**1,843,267**
ONT.	--	--	--	--	10,787	10,787
NYS DEC	92,200	--	--	--	298,330	390,530
PFBC	40,000	137,204	--	17,163	1,237,870	1,432,237
ODNR	--	--	--	--	375,022	375,022
MDNR	--	--	--	--	60,000	60,000
2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**
ONT.	--	--	--	100	40,860	40,960
NYS DEC	80,000	--	--	--	276,300	356,300
PFBC	40,000	127,641	--	17,000	1,185,239	1,369,880
ODNR	--	--	--	--	424,530	424,530
MDNR	--	--	--	--	67,789	67,789
2001 Total	**120,000**	**127,641**	**0**	**17,100**	**1,994,718**	**2,259,459**
ONT.	--	--	--	4,000	66,275	70,275
NYS DEC	80,000	--	--	72,300	257,200	409,500
PFBC	40,000	100,289	--	40,675	1,145,131	1,326,095
ODNR	--	--	--	--	411,601	411,601
MDNR	--	--	--	--	60,000	60,000
2002 Total	**120,000**	**100,289**	**0**	**116,975**	**1,940,207**	**2,277,471**
ONT.	--	--	--	7,000	48,672	55,672
NYS DEC	120,000	--	--	44,813	253,750	418,563
PFBC	--	69,912	--	22,921	866,789	959,622
ODNR	--	--	--	--	544,280	544,280
MDNR	--	--	--	--	79,592	79,592
2003 Total	**120,000**	**69,912**	**0**	**74,734**	**1,793,083**	**2,057,729**
ONT.	--	--	--	--	34,600	34,600
NYS DEC	111,600	--	--	36,000	257,400	405,000
PFBC	--	--	--	50,350	1,211,551	1,261,901
ODNR	--	--	--	--	422,291	422,291
MDNR	--	--	--	--	64,200	64,200
2004 Total	**111,600**	**0**	**0**	**86,350**	**1,990,042**	**2,187,992**

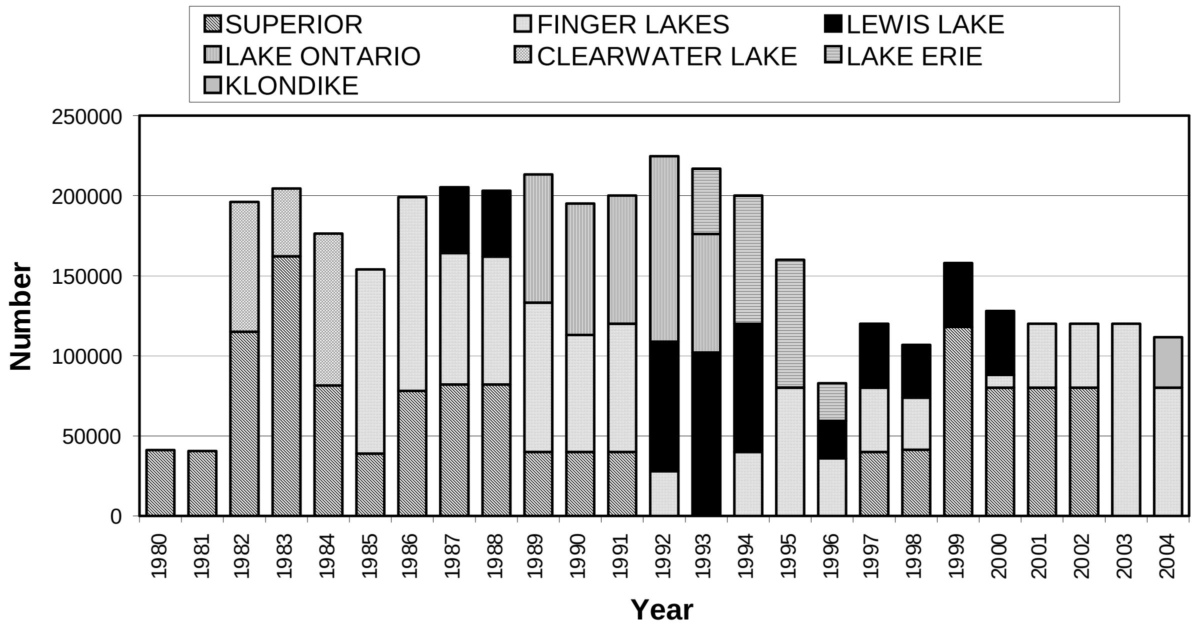


Figure 5.1. Yearling lake trout stocked in U.S. waters of the eastern basin of Lake Erie, 1980 – 2004, by strain. The current stocking goal is 120,000 yearlings per year.

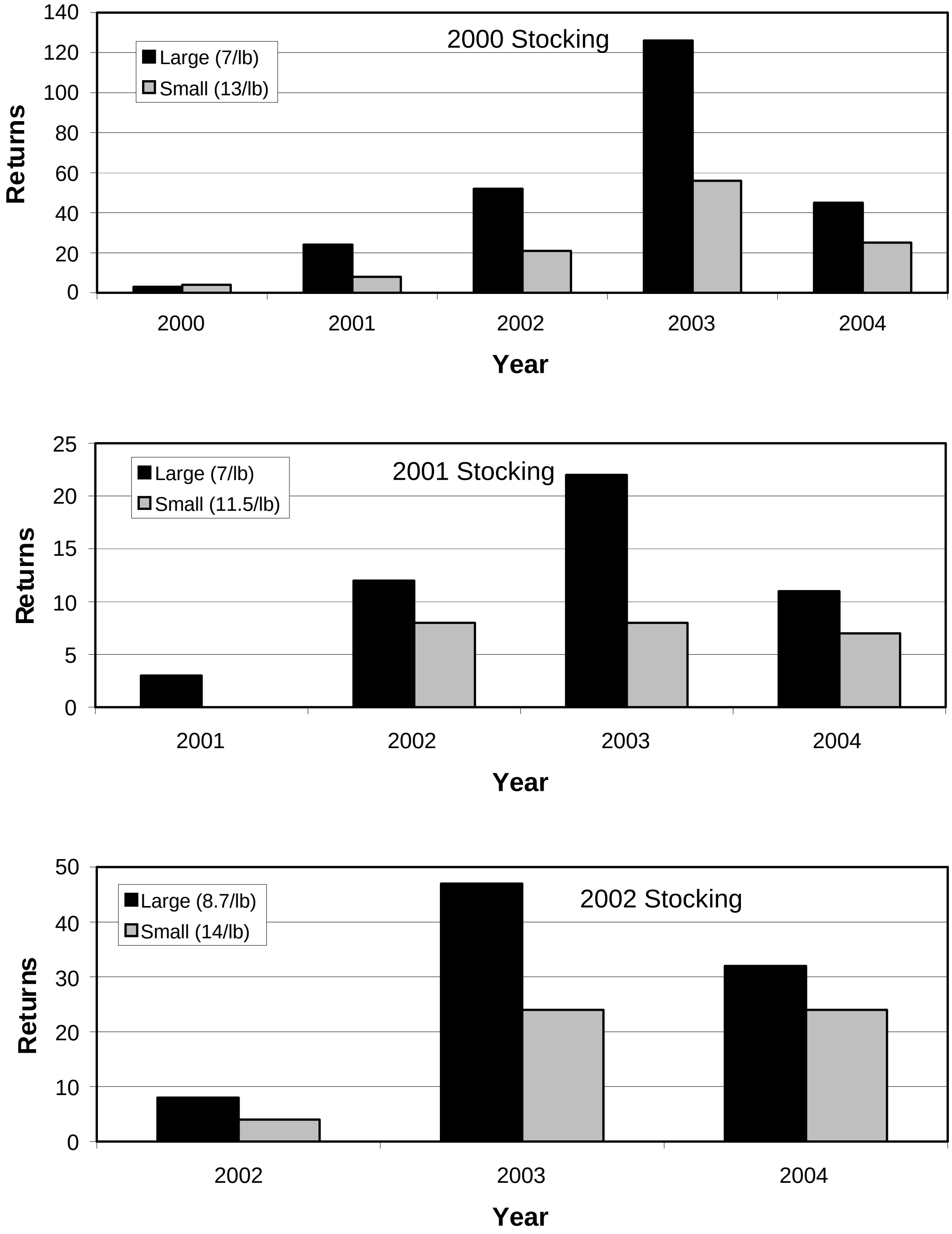


Figure 5.2. Returns of tagged yearling lake trout stocked in 2000 – 2002 from a large vs. small comparison study being conducted in New York waters of Lake Erie.

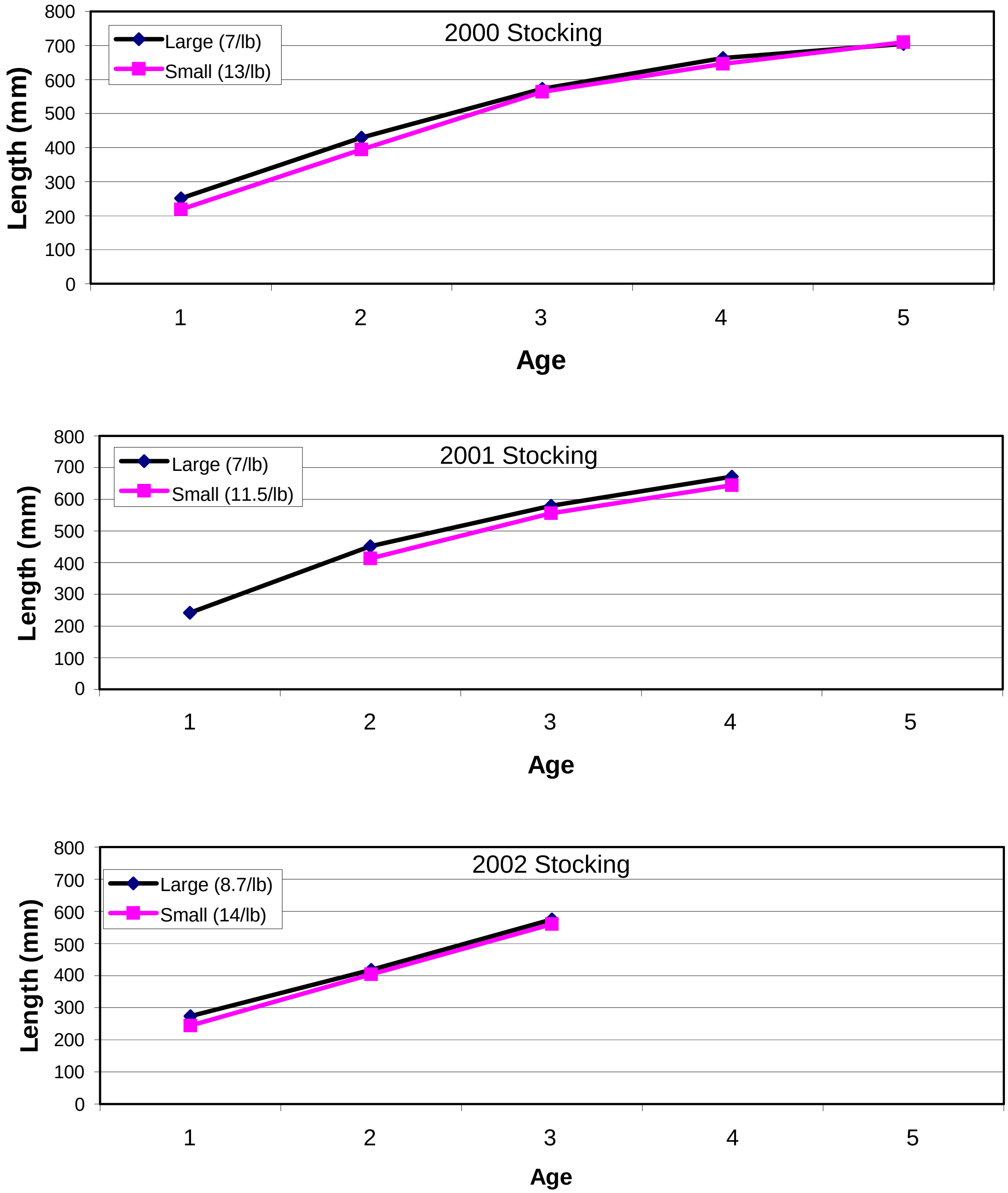


Figure 5.3. Mean length-at-age (mm) of tagged yearling lake trout stocked in 2000 – 2002 from a large vs. small comparison study being conducted in New York waters of Lake Erie.

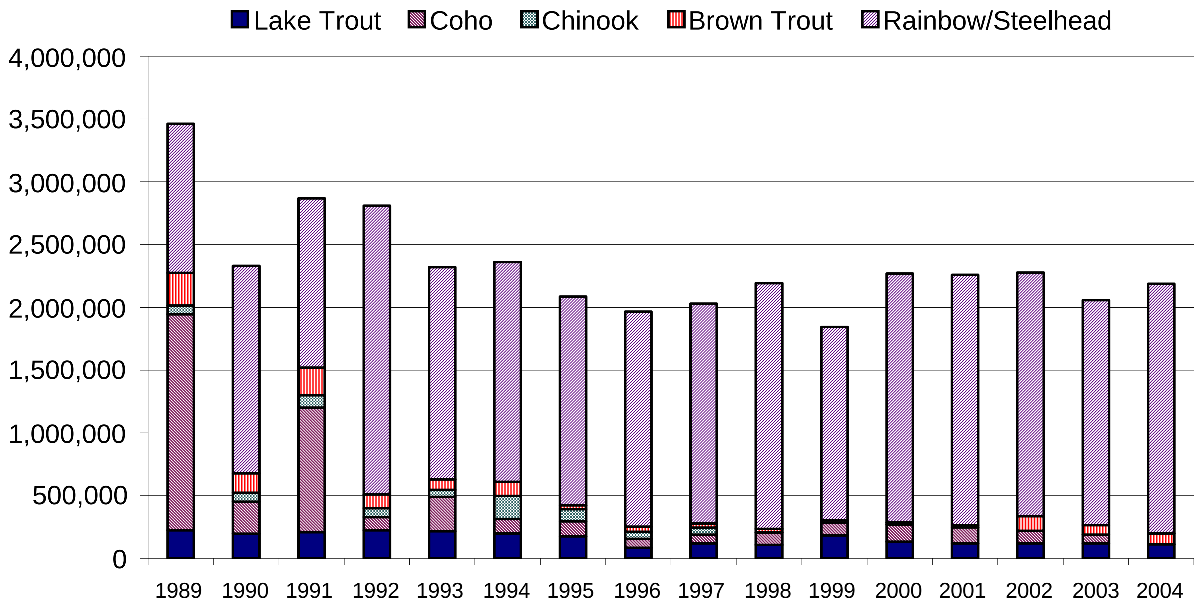


Figure 5.4. Annual stocking of all salmonid species in Lake Erie by all riparian agencies, 1989 – 2004. Numbers of stocked fish are represented in yearling equivalents.

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.

by Chuck Murray (PFBC) and James Markham (NYSDEC)

Stocking

All jurisdictions stocked rainbow trout in 2004 (Table 6.1). Nearly all (99.9%) rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A naturalized Lake Erie strain comprised approximately 61% of the strain composition followed by a Lake Michigan strain (24%) and a Lake Ontario strain (15%); about 0.1% of the stocked rainbow trout were of domestic origin.

Approximately 5% of all rainbow trout stocked in 2004 were fin clipped. Michigan continued a standard RP clip for all yearling plants and Ontario did a LP clip of all steelhead stocked in Lake Erie tributaries. Summary data for fish marked from 1999 - 2004 are summarized in table 6.2. No coordinated interagency effort was made to compile fin clip return data on rainbow trout.

Assessment of Natural Reproduction

A comprehensive, multi-year stream electofishing survey cataloging New York's Lake Erie tributaries for steelhead reproduction potential began in Fall 2002. Candidate streams for the survey include all of the New York tributaries known to have adult steelhead runs in the Fall and/or Spring. Five tributaries were sampled between 29 September and 7 October 2004. Juvenile steelhead were found in 4 of the 5 streams, but only two of the streams (Clear Creek, Derby Brook) had moderate potential for production. Similar to past surveys (Culligan et al. 2003), many of the YOY steelhead were found in deep riffle areas with large rocks and woody debris. This appears to be an essential habitat in marginal trout streams. Of the 19 streams that have been sampled for potential YOY steelhead production in the past 4 years, 8 have shown at least moderate potential for producing wild steelhead trout (Einhouse et al. 2005). Only two streams, Spooner Creek and Little Chautauqua Creek, have shown a high potential for producing wild fish. Results from this survey will be used to develop a comprehensive map of steelhead spawning waters in New York Lake Erie tributaries.

Exploitation

Previous creel surveys confirm that nearly all the rainbow trout angling activity takes place in the tributaries as fish move from the lake into the streams during spawning runs. This was confirmed through tributary and boat creel surveys conducted in Pennsylvania and New York between 2003 and 2004. Over 98% of the angler effort directed at steelhead in Pennsylvania occurs on shore. Angling effort directed at rainbow trout on Pennsylvania streams to Lake Erie between the September 2003 and April 2004 estimated a targeted angler effort in excess of 847,000 hours. An open lake boat angler survey in Pennsylvania between May 2004 and October 2004 estimated that anglers directed nearly 20,000 hours fishing for rainbow trout. Results from New York's Lake Erie open water and tributary creel surveys between 2003 and 2004 demonstrated similar results. Over 89% of the yearly directed angling effort for salmonids occurred in the tributaries. Directed effort in the New York streams was estimated at 191,294 angler-hours while open lake effort was 20,889 angler-hours.

All agencies provide some measure of open lake summer harvest by boat anglers (Figure 6.1). Annual open lake creel surveys are conducted by Michigan, Ohio, Pennsylvania and New York. The Ontario Ministry of Natural Resources conducted an abbreviated creel survey in the Central Basin of Lake Erie from June 7 - August 31, 2004. Although harvest by boat anglers represents only a fraction of the total estimated harvest, it remains the only annual estimate of rainbow trout harvest by all agencies, and might be used as a barometer of total harvest. The reported estimated harvest from the summer open-water boat angler fishery in 2004 was 31,793 rainbow trout in all areas. Nearly all (95%) of the reported steelhead harvest was concentrated in the Central Basin, mainly in Ontario (18,148 fish) and Ohio (10,092 fish) waters. Michigan anglers harvested no rainbow trout in 2004. Catch rates by boat anglers targeting steelhead have demonstrated a slight decrease from 2003 (Figure 6.2).

The Lake Erie tributaries provide the core of the steelhead fishery. All indicators point to an exceptional fishery with high catch rates and increasing popularity. Trends in angler diary catch rates by steelhead anglers in Pennsylvania and New York waters are near historical highs and have been steadily increasing (Figure 6.3). Creel survey data collected on Pennsylvania streams in 2003-04 show effort had increased 200% in the last decade. Similar survey data collected on New York streams showed less growth with a 42% increase in effort over the past 20 years. Results from these creel surveys also indicate relatively high catch and release rates among stream anglers. Steelhead catch rates in both the Pennsylvania and New York tributary surveys were estimated at 0.63 fish/hour. Based on this rate, total catch was estimated at 533,873 steelhead in Pennsylvania tributaries and 113,897 in New York waters. Total harvest was estimated at 126,880 and 14,223 steelhead for Pennsylvania and New York, respectively. Pennsylvania stream anglers released over 75% of their steelhead catch while New York anglers released over 87%. Detailed descriptions of the 2003–04 tributary creel survey and steelhead fishery are available for both Pennsylvania (Murray and Shields 2004) and New York (Markham 2005).

Reference

Culligan, W.J., D.W. Einhouse, J.L. Markham, D.L. Zeller, R.C. Zimar, and B.J. Beckwith. 2003. NYSDEC Lake Erie Unit 2002 Annual Report to the Lake Erie Committee. New York State Department of Environmental Conservation, Albany, New York, USA.

Einhouse, D.W., J.L. Markham, D.L. Zeller, R.C. Zimar, B.J. Beckwith, and M.L. Wilkinson. 2005. NYSDEC Lake Erie Unit 2004 Annual Report to the Lake Erie Committee. New York State Department of Environmental Conservation, Albany, New York, USA.

Markham, J.L. 2005. Interim Report: Lake Erie Tributary Creel Survey Fall 2003 – Spring 2004. New York State Department of Environmental Conservation, Albany, New York, USA.

Murray, C., and M. Shields. 2004. Creel Analysis and Economic Impact of Pennsylvania's Lake Erie Tributary Fisheries in Erie County, Pennsylvania, with Special Emphasis on Landlocked Steelhead Trout (*Oncorhynchus mykiss*). Pennsylvania Fish and Boat Commission. Lake Erie Research Unit. Fairview, Pennsylvania, USA.

Table 6.1. Rainbow trout /steelhead stocking by jurisdiction for 2004.

	Location	Strain	Fin Clips	Number	Life Stage	Yearling Eqivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	**RP**	64,200	Yearling	64,200	
						64,200	**Sub-Total**
Ontario	Mill Creek	Ganaraska River, L. Ontario	**LP**	34,600	Yearling	34,600	
						34,600	**Sub-Total**
Pennsylvania	Conneaut Creek	Trout Run & Godfrey Run, L. Erie	NO	75,000	Yearling	75,000	
	Crooked Creek	Trout Run & Godfrey Run, L. Erie	NO	58,192	Yearling	58,192	
	Elk Creek	Trout Run & Godfrey Run, L. Erie	NO	273,400	Yearling	273,400	
	Fourmile Creek	Trout Run & Godfrey Run, L. Erie	NO	15,135	Yearling	15,135	
	Godfrey Run	Trout Run & Godfrey Run, L. Erie	NO	94,802	Yearling	94,802	
	Presque Isle Bay	Trout Run & Godfrey Run, L. Erie	NO	56,685	Yearling	56,685	
	Raccoon Creek	Trout Run & Godfrey Run, L. Erie	NO	48,501	Yearling	48,501	
	Sevenmile Creek	Trout Run & Godfrey Run, L. Erie	NO	20,020	Yearling	20,020	
	Trout Run	Trout Run & Godfrey Run, L. Erie	NO	124,750	Yearling	124,750	
	Twelvemile Creek	Trout Run & Godfrey Run, L. Erie	NO	39,278	Yearling	39,278	
	Twentymile Creek	Trout Run & Godfrey Run, L. Erie	NO	155,200	Yearling	155,200	
	Walnut Creek	Trout Run & Godfrey Run, L. Erie	NO	250,588	Yearling	250,588	
						1,211,551	**Sub-Total**
Ohio	Chagrin River	Manistee River, L. Michigan	NO	95,907	Yearling	95,907	
	Conneaut Creek	Manistee River, L. Michigan	NO	75,764	Yearling	75,764	
	Grand River	Manistee River, L. Michigan	NO	92,787	Yearling	92,787	
	Rocky River	Manistee River, L. Michigan	NO	93,740	Yearling	93,740	
	Vermillion River	Manistee River, L. Michigan	NO	64,093	Yearling	64,093	
						422,291	**Sub-Total**
New York	Buffalo Creek	Chambers Creek, L. Ontario	NO	20,000	Yearling	20,000	
	Buffalo Harbor	Domestic	NO	2,400	Yearling	2,400	
	Canadaway Creek	Chambers Creek, L. Ontario	NO	20,000	Yearling	20,000	
	Cattaraugus Creek	Chambers Creek, L. Ontario	NO	90,000	Yearling	90,000	
	Cayuga Creek	Chambers Creek, L. Ontario	NO	15,000	Yearling	15,000	
	Chautauqua Creek	Chambers Creek, L. Ontario	NO	40,000	Yearling	40,000	
	Dunkirk Harbor	Chambers Creek, L. Ontario	NO	10,000	Yearling	10,000	
	East Bran Cazenovia	Chambers Creek, L. Ontario	NO	10,000	Yearling	10,000	
	Eighteen-Mile Creek	Chambers Creek, L. Ontario	NO	40,000	Yearling	40,000	
	Silver Creek	Chambers Creek, L. Ontario	NO	5,000	Yearling	5,000	
	Walnut Creek	Chambers Creek, L. Ontario	NO	5,000	Yearling	5,000	
						257,400	**Sub-Total**
						1,990,042	**Grand Total**

Table 6.2. Rainbow trout fin-clip summary for Lake Erie, 1999 – 2004.

Year Stocked	Year Class	Michigan	New York	Ontario	Ohio	Pennsylvania
1999	1998	RP	ADRP	RV; AD; RVAD	-	-
2000	1999	RP	RV	LP	-	-
2001	2000	RP	AD	-	-	-
2002	2001	RP	ADLV	-	-	-
2003	2002	RP	RV	LP	-	-
2004	2003	RP	-	LP	-	-

AD=adipose; RP= right pectoral; RV=right ventral; LP=left pectoral LV=left ventral

Table 6.3. Reported estimated harvest of rainbow/steelhead trout by open lake boat anglers, 1999 – 2004.

Year	Ohio	Pennsylvania	New York	Ontario	Michigan
1999	20,396	7,401	1,017	----	100
2000	33,524	11,011	996	----	100
2001	29,243	7,053	944	----	3
2002	41,357	5,229	1,599	----	70
2003	21,571	1,717	420	785 *	15
2004	10,322	2,657	896	18,148 **	0

* Eastern basin waters only; Previous estimate 2,737 fish harvested in 1998
* Central basin waters only

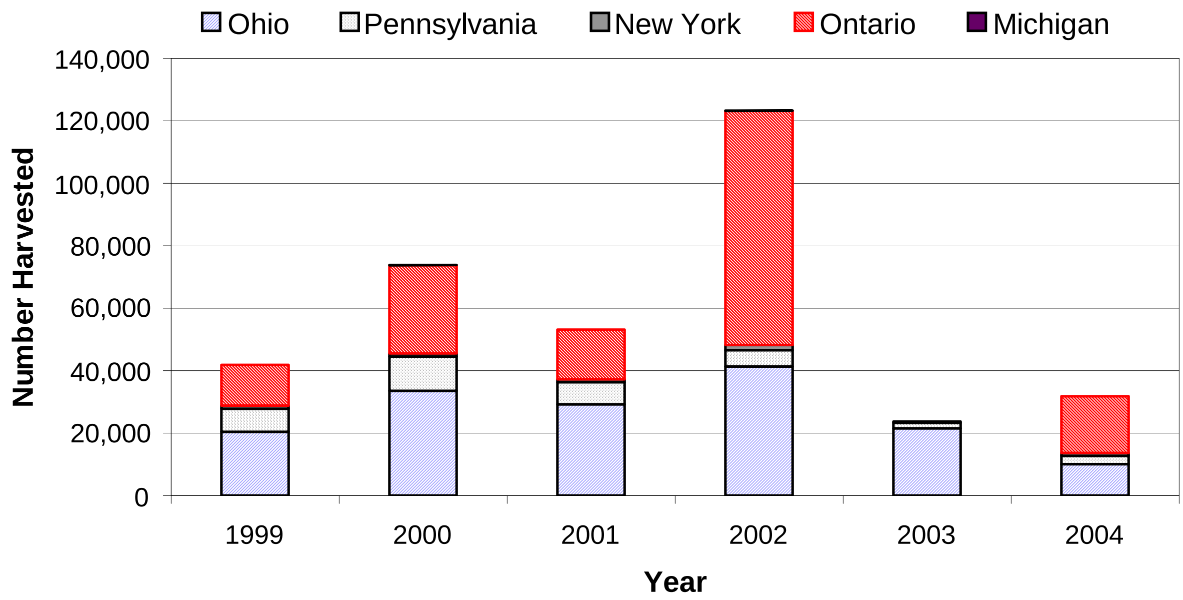


Figure 6.1. Open lake harvest of rainbow/steelhead trout by Lake Erie jurisdictions, 1999 – 2004.

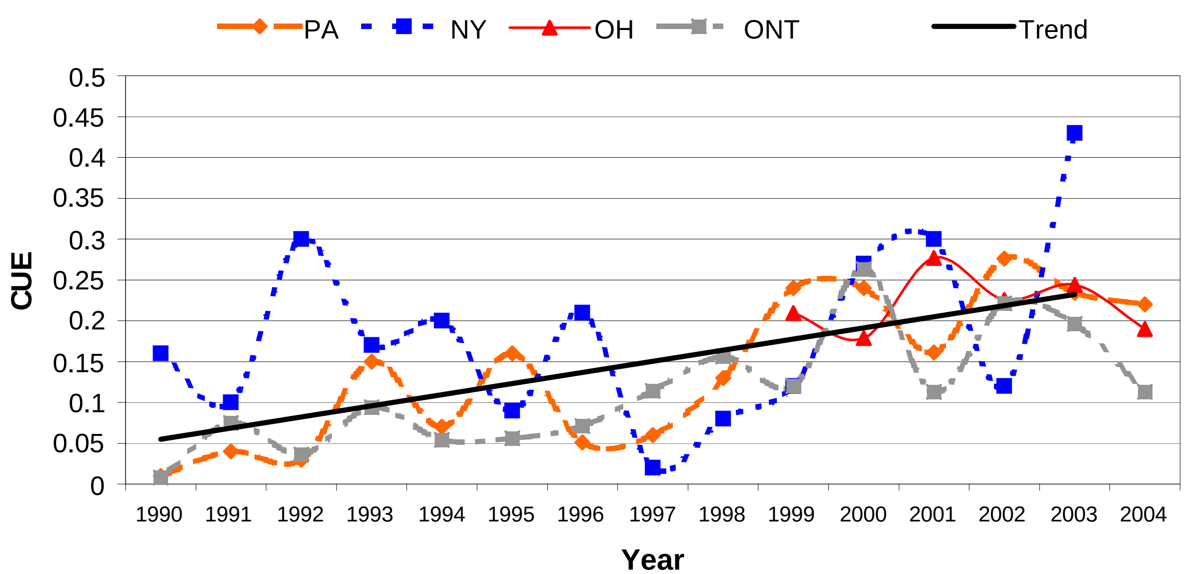


Figure 6.2. Targeted salmonid catch rates by open lake anglers in Pennsylvania, New York, Ohio, and Ontario, 1990 – 2004. A trend line indicates mean overall catch rate by year.

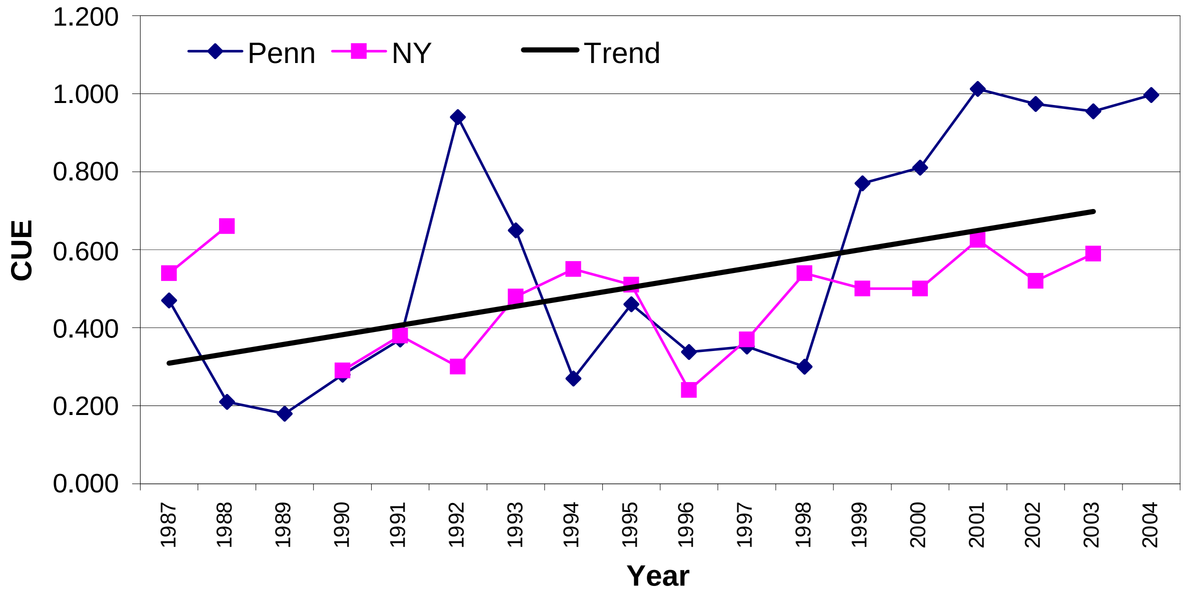


Figure 6.3. Targeted salmonid catch rates in Lake Erie tributaries by Pennsylvania and New York angler diary cooperators, 1987 – 2004. A trend line indicates mean overall catch rate by year.

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

by James Markham (NYSDEC) and Phil Ryan (OMNR)

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 1990's. 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. 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).

Rehabilitation Efforts

Until recently, the possibility of rehabilitation of lake herring stocks in Lake Erie has relied on natural recruitment from remnant/transient stocks to rebuild the population. Although a few fish have been caught in recent years, the probability of the stock recovering on its own appears remote. Within the last two years, there has been several different efforts which are the initial stages for re-establishment of lake herring into Lake Erie.

A workshop sponsored by the Great Lakes Restoration Act was held in July 2003 reviewing the status and impediments for lake herring recovery in the Great Lakes (Fitzsimons and O'Gorman 2004). The goal of the workshop was to help managers and interested researchers develop actions to assess lake herring stocks and develop research with the goal of recovering remnant stocks. The loss of stocks was identified by the workshop participants as the most important impediment facing Great Lakes restoration efforts. Consequently, restoration stocking was identified as a necessary part of most restoration efforts in many parts of the Great Lakes, but only where it will not affect an existing remnant stock.

In an effort to determine if a remnant lake herring stock still exists in Lake Erie, 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). DNA is also being extracted from Lake Huron lake herring specimens and archived Lake Erie specimens from 1955-65 for comparison to determine if the Lake Erie specimens are genetically distinct from Lake Huron stocks. The results of this research may play an important role in the future of lake herring restoration efforts in Lake Erie. 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 may be channeled away from stocking and towards enhancing within lake spawning stocks. (e.g. identification and improvement of spawning sites).

Recently, another opportunity has arisen from a joint Lower Great Lakes proposal for the re-introduction of lake herring in Lake Erie. The proposal requires the acquisition of lake herring brood stock and/or gametes from Lake Superior and raising at the USGS Fish Laboratory in Wellsboro, PA. While the re-establishment of lake herring is consistent with achieving the fish community goals and objectives for the eastern basin of Lake Erie, there are ecological risks as well as benefits that need to be addressed. The Cold Water Task Group will be preparing a report on the issues surrounding a possible introduction, including specifics on stocking (numbers, size, location) that would be required. The Lake Erie Committee will be using this report as well as results from the genetic analysis to determine the best course of action for lake herring restoration in Lake Erie.

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

By James Markham (NYSDEC) and Kevin Kayle (ODNR)

Lake Trout and Burbot

Seasonal diet information for both lake trout and burbot is not available based on current sampling protocols. Diet information was limited to fish caught during August 2004 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 for lake trout, occurring in 76% of the stomach samples (Figure 8.2). Round gobies continue to be a more prominent diet item, comprising 18% of the total lake trout diet in 2004 samples. Other prey items included emerald shiners, yellow perch, dreissenids, and unknown fish.

Burbot diets were more diverse with 9 different fish and invertebrate species found in stomach samples (Figure 8.2). Round gobies were the dominant prey item (51%) for the second consecutive year. Smelt were also common, occurring in 22% of the burbot stomachs. Other minor prey items included dreissenids, yellow perch, shiners, white perch, trout perch, one alewife, and one whitefish.

Round goby continued to increase in the diet of lake trout and remain the main forage item for burbot. Gobies have increased in lake trout diets over the past four years while smelt have decreased (Figure 8.3). Gobies have now become the main forage fish for burbot. While gobies may ultimately prove to be detrimental to the Lake Erie lake trout restoration efforts (see Einhouse et al. 2004), they are providing an alternate forage source that is thiaminase-free (John Fitzsimmons, DFO, personal communication) and relieving some dependency on the smelt resource. Future studies will continue to follow the prevalence of gobies in the diets of the lake trout, particularly in the new Klondike strain.

Steelhead

Collection of steelhead for a lake-wide summer diet study funded by the Great Lake Fisheries Commission was completed by interjurisdictional agencies in 2004. Results of this study will not be available until Fall 2005 and should provide a lake-wide perspective on summer steelhead forage preferences.

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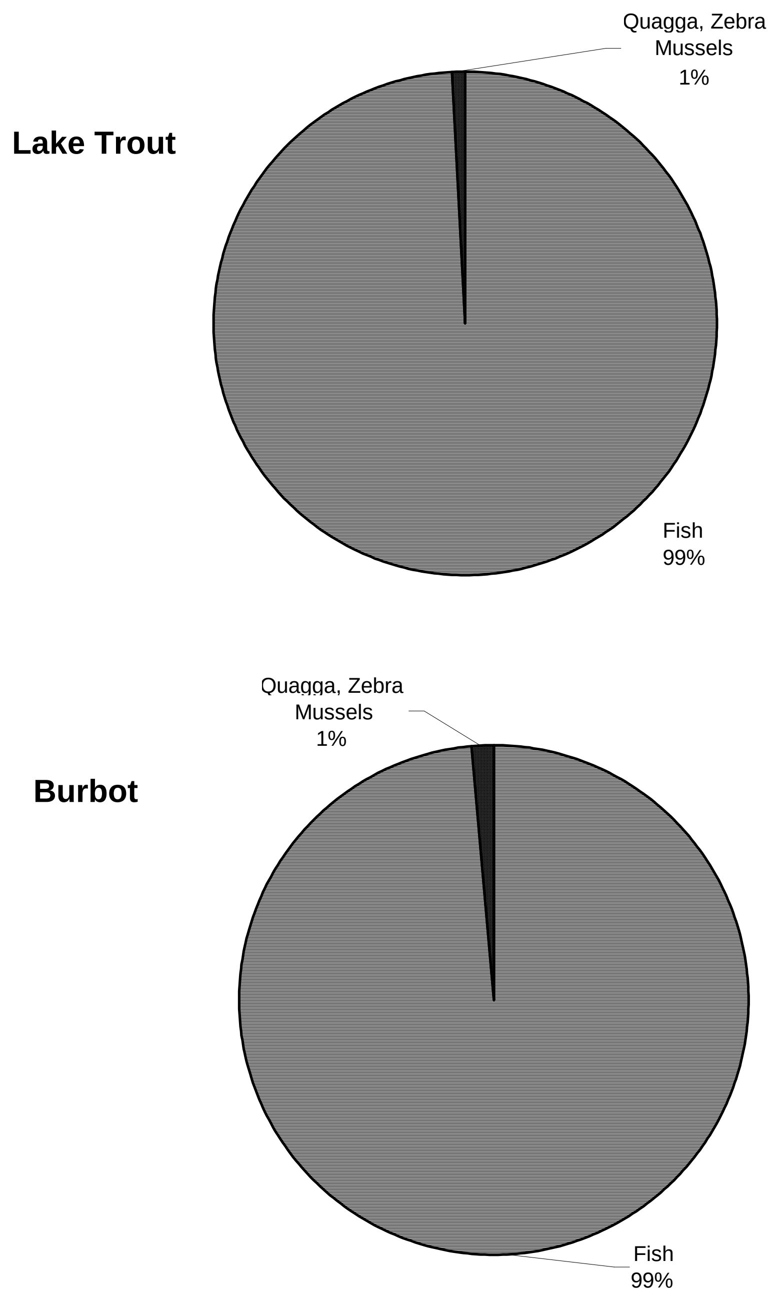


Figure 8.1. Diet composition of lake trout and burbot sampled in gill nets from the eastern basin of Lake Erie, August, 2004.

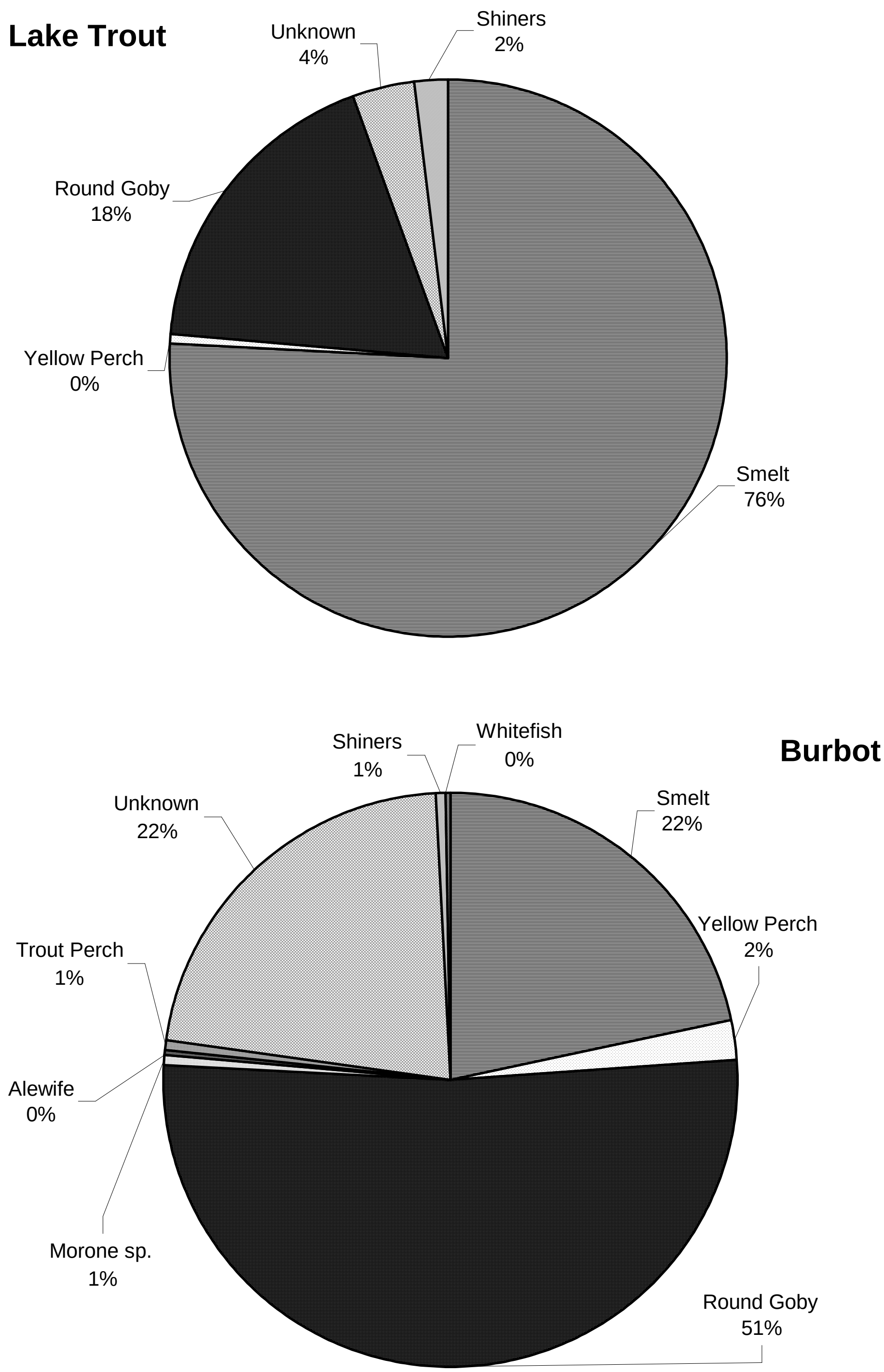
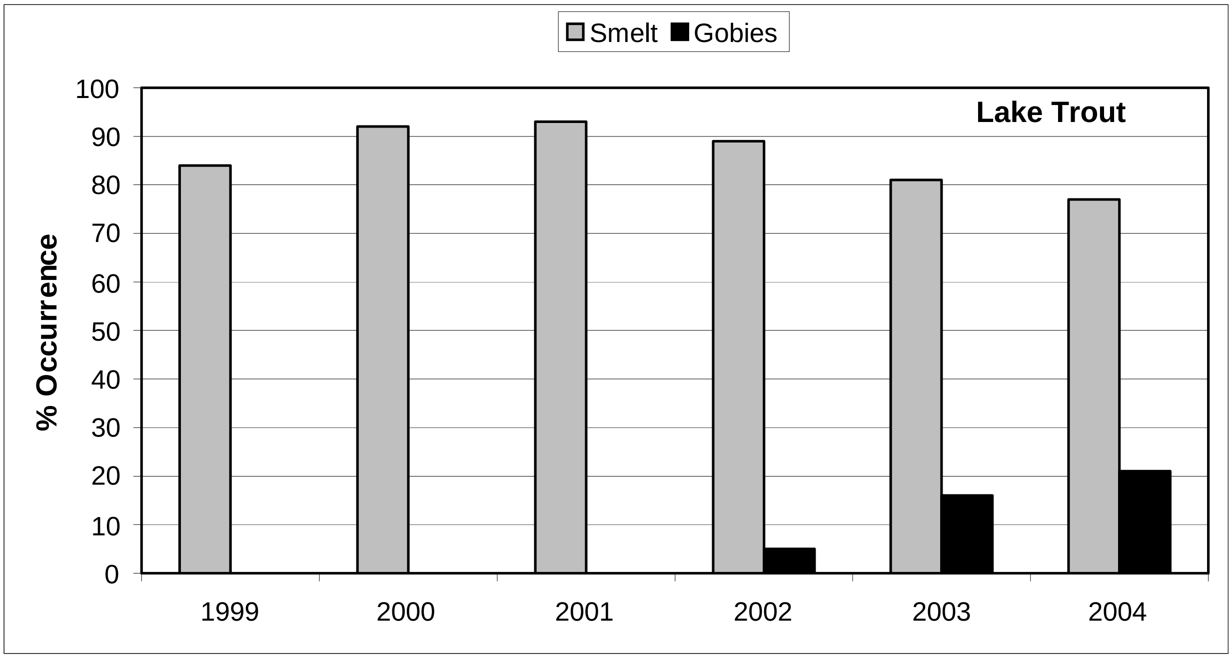


Figure 8.2. Frequency of occurrence of fish in the diet of lake trout and burbot sampled in gill nets from the eastern basin of Lake Erie, August, 2004.



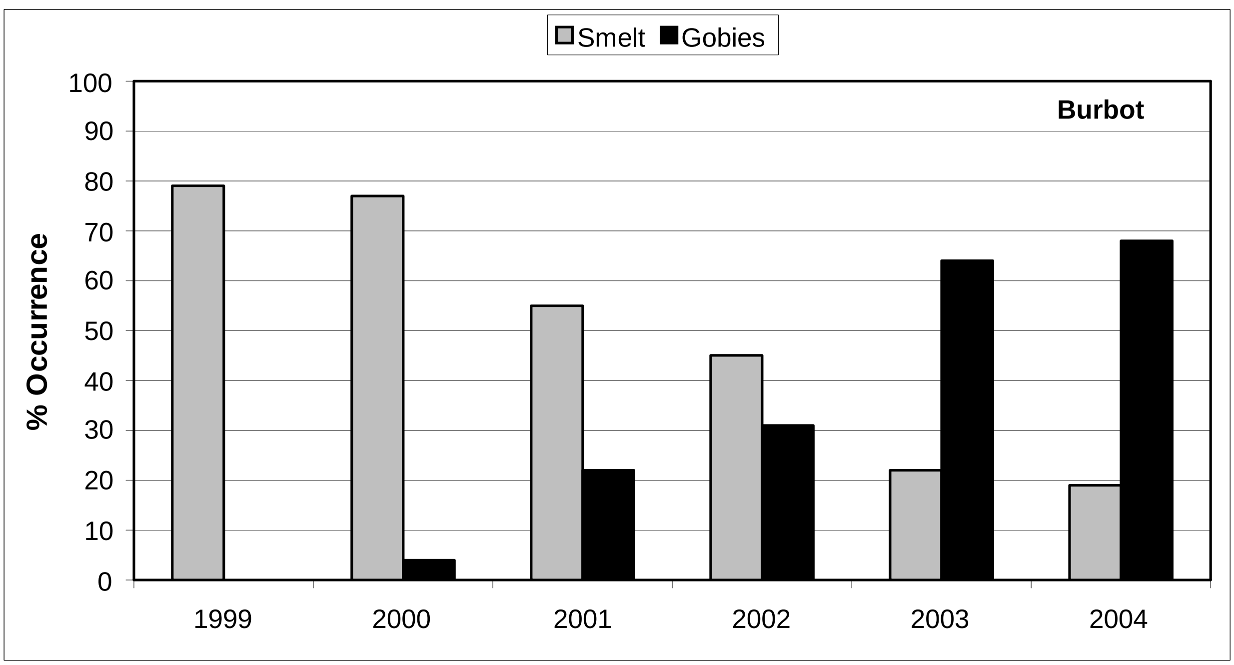


Figure 8.3. Percent occurrence of smelt and round gobies in the diet of lake trout and burbot caught in NYSDEC assessment gill nets, August, 1999 – 2004.