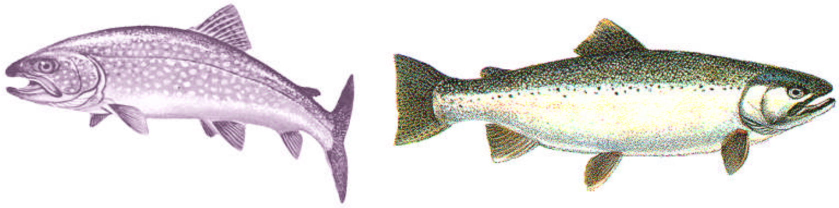


Report of the Lake Erie Coldwater Task Group

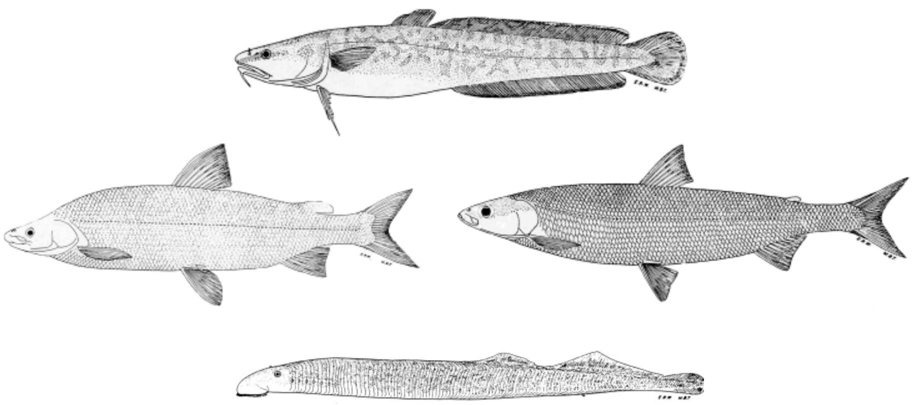
March 2007

Members:

James Markham	New York Department of Environmental Conservation (Co-Chair)
Kevin Kayle	Ohio Division of Wildlife (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
Tom MacDougall	Ontario Ministry of Natural Resources
Chuck Murray	Pennsylvania Fish and Boat Commission
Fraser Neave	Department of Fisheries and Oceans, Canada
Martin Stapanian	United States Geological Survey
Elizabeth Trometer	United States Fish and Wildlife Service
Larry Witzel	Ontario Ministry of Natural Resources

Presented to:

Standing Technical Committee
Lake Erie Committee
Great Lakes Fishery Commission



Protocol for Use of Coldwater Task Group Data and Reports

The Lake Erie Coldwater Task Group (CWTG) uses standardized methods, equipment, and protocols as much as possible; however, data, sampling and reporting 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 members 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 CWTG data or findings intended for outside publication must be reviewed and approved by the CWTG members. Agencies may also require written permission for external use of data; please contact the agencies responsible for the data collection.

Citation:

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Cover Art and Line Drawings from:

Raver, Duane. 1999. Duane Raver Art. U.S. Fish and Wildlife Service. Shepherdstown, West Virginia, USA.

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

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2006 – 2007 Coldwater Task Group Charges

Background

The Coldwater 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 main functions of coordinating, collating, analyzing, and reporting of annual lake trout assessments among Lake Erie's 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 by the newly-formed Lake Trout Task Group 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 first Lake Erie fish community goals and objectives (FCGOs; Cornelius et al. 1995). While these two plans still serve as the working documents guiding current assessment efforts, the updated Lake Erie FCGOs (Ryan et al. 2003) identified lake trout as the dominant predator in the profundal waters of the eastern basin. A revision of the Lake Trout Management Plan is a part of the current charges to the Task Group.

The Lake Trout Task Group developed into the CWTG in 1992 as interest in the expanding burbot and lake whitefish populations, as well as predator/prey relationships involving salmonid 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. Continued assessments of coldwater species' fisheries and biological characteristics has added new depth to the understanding of how these species function in the shallowest and warmest lake of the Great Lakes. A new charge concerning lake herring was added in 1999.

This report is specifically designed to address activities undertaken by the task group toward each charge in this past year and is presented verbally to the LEC at the 2007 annual meeting, held this year on 22-23 March 2007. Data have been supplied by each member agency, when available, and combined for this report, if the data conform to standard protocols. Individual agencies may still choose to report their own assessment activities under separate agency reporting processes.

References

Cornelius, F. C., K. M. Muth, and R Kenyon. 1995. Lake trout rehabilitation in Lake Erie: a case history. J. Great Lakes Res. 21 (Supplement 1): 65-82, International Association of Great Lakes Research.

Lake Trout Task Group. 1985. A strategic plan for the rehabilitation of lake trout in eastern Lake Erie. Report to the Great Lakes Fishery Commission's Lake Erie Committee, Ann Arbor, Michigan, USA.

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

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 Fishery Commission 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

James Markham, NYSDEC

Methods

A stratified, random design, deepwater gill net assessment protocol for lake trout has been in place since 1986. The 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 (two areas each) and 120 lifts from Ontario waters (four 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.

Ten gill 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 38 mm (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. New York State Department of Environmental Conservation (NYSDEC) personnel 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 Coldwater Task Group (CWTG) agencies except the Pennsylvania Fish and Boat Commission (PFBC) switched to standard monofilament assessment nets to sample eastern basin lake trout. Personnel from the PFBC switched to monofilament mesh in 2006.

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 a 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 2006 by the combined agencies was 105 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie (Figure 1.2). This included 60 lifts by NYSDEC, 25 by the PFBC, and 20 by USGS/OMNR.

All lake trout are routinely examined for total length, weight, sex, maturity, fin clips, and wounds 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 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 seven of the eight standard areas in 2006 (Figure 1.1), collecting a total of 408 lake trout. No effort was expended in area A4 due to the lack of coldwater habitat, and elimination of this area is being considered by the CWTG. Areas A1 and A2 again produced the highest catch per unit effort (CPE) values, coinciding with the areas in which stocking of yearling lake trout occurs. CPE was also high in A3, adjacent to the stocked waters. Lake trout catches in ON waters (A5-A8) were sparse with lake trout only caught in standard assessment nets in areas A5 and A8.

Eighteen age-classes of lake trout ranging from age 2 to 22 were represented in the catch of known-aged fish (Tables 1.1 and 1.2). Similar to the past five years, young cohorts (ages 2-5) were the most abundant, representing 85% of the total catch in standard assessment nets (mesh sizes 38-152 mm; Figure 1.3). Cohort abundance continues to decline rapidly after age 5, and lake trout ages 8 and older were only sporadically caught. Identical to last year, age 10 and older lake trout comprised only 3.2% of the overall catch in 2006. Three age-21 and two age-22 lake trout were sampled; these represent the oldest lake trout ever caught in the assessment survey.

The overall trends in area-weighted mean CPE's of lake trout caught in standard nets in the eastern basin decreased slightly in 2006 to 1.69 fish/lift (Figure 1.4). However, CPE's in the New York portion (A1 and A2) increased to 5.3 fish/lift. A general trend of increasing abundance in the overall lake trout population has been observed since 2000 in both the overall and NY times-series, and both are slightly above the time-series averages.

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 six year (1992-1997) period of steady growth, which corresponded to the decrease in lake trout stocking numbers that began in 1992. The 2006 CPE for age-5 and older lake trout sampled in New York standard assessment nets more than doubled from last year, increasing from 1.03 fish/lift in 2005 to 2.42 fish/lift in 2006 and well above the series average of 1.60 fish/lift (Figure 1.5). This was the highest age-5+ index since 1997 and ends a two-year decline. This increase was expected due to the good recruitment of the 2001 year-class to age 5.

The relative abundance of mature females in New York waters increased in 2006 to the fourth highest abundance in the time-series (Figure 1.6). The overall CPE of females >4500g, which represents repeat-spawning females ages 6 and older, also rose slightly, but it remains only half of its peak abundance that occurred in 1997. Overall trends in this index indicate the instability of the lake trout spawning stock and may signal the main reason that natural reproduction has yet to be documented in Lake Erie.

Recruitment

The relative abundance index of ages 1-3 was 1.97 fish/lift (Figure 1.7). This is above the series average of 1.24 fish/lift and ends a three year declining trend in overall juvenile abundance. Increases were primarily due to the excellent recruitment of the 2004 stocking (age 3) and 2005 stocking (age-2) Klondike strain lake trout despite low stocking numbers. Yearling lake trout (age 1) were not sampled in 2006, but this may have been due to the low amounts of assessment netting in Ontario waters where these fish were stocked.

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 1994 through 1998 survived to age 2 in 1995 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, likely due to a combination of different stocking methods, increases in lake trout stocking size, and decreases in the adult lake trout population. The age-2 lake trout recruitment index increased to 1.85 in 2006, the highest value in the time-series (Figure 1.8). The increase was due to the excellent recruitment of Klondike strain lake trout stocked in 2005, which were very abundant in assessment netting despite low stocking densities.

Strains

Similar to the last five years, six different lake trout strains were found in the 379 fish caught with hatchery-implanted coded-wire tags (CWTs) or fin-clips (Table 1.3). The majority of the lake trout remain Superior (SUP) and Finger Lakes (FL) strain fish, which have been the most numerous stocked strains over the last seven years. However, Klondike (KL) strain lake trout, only stocked in small amounts in 2004 and 2005, increased dramatically in 2006 and became almost as abundant as either SUP or FL strain fish in assessment surveys. Lewis Lake (LL), Lake Ontario (LO), and Lake Erie (LE) strains comprised minor contributions to the Lake Erie stock. The FL strain continues to show the most consistent returns with lake trout being caught from each year of stocking through age-13, and then at some of its previous stockings (ages 16, 21 and 22). Comparatively, no SUP strain fish over age-15 have ever been caught in assessment surveys despite excellent returns at younger ages. Overall, there were poor returns from all strains over age 7.

Returns of the new Klondike (KL) strain of lake trout have been excellent at ages 2 and 3. Returns of 31,600 yearlings stocked in 2004 (2003 year-class) were almost six times higher at age 3 than a paired stocking of 80,000 FL strain lean lake trout when adjusted for stocking rates (Table 1.4). Stocking adjusted return rates of the 2005 stocking (2004 year-class; 54,200 yearlings) at age-2 were the highest in the time-series (Figure 1.8) and over three times higher than KL strain and 13 times higher than FL strain lake trout (2003 year-class) at age-2. Growth of Klondikes is significantly less at age 3 (two sample t-test; $P<.01$) for both length and weight (see Table 1.1 and 1.2) compared to the paired stocking of FL strain lake trout. Future surveys will continue to monitor the progress of these fish, and compare their growth, maturity, and wounding rates to the currently stocked lean lake trout strains.

Survival

Cohort analysis estimates of annual survival (S) were calculated by strain and year class using a three-year running average of CPE with ages 4 through 10 (Table 1.5). A running average was used due to the high year-to-year variability in catches. Mean overall adult survival estimates were highest for the Lake Ontario (LO) strain (0.81) and lowest for the Lewis Lakes (LL) strain (0.59). Survival rates for the Lake Erie (LE) strain were also high (0.79), but this was based on only two year classes with relatively poor returns. The Finger Lakes (FL) and Superior (SUP) strains, the most stocked lake trout strains in Lake Erie, had overall mean survival estimates of 0.74 and 0.62, respectively. Mean overall survival estimates for all strains except for the LL strain were above the Strategic Plan's target goal of 60% or higher (Lake Trout Task Group 1985).

More recent estimates of survival indicate that survival has declined well below target levels. Survival estimates of the 1997-1999 year-classes of SUP strain fish using straight CPE's from ages 5-8 or 4-7 range from 0.33-0.42. Survival estimates of the 1997 FL strain stocking also declined to 0.62. Both of these survival estimates are well below the ranges that were observed for these strains during the period of high-lamprey control (1987-1991).

Growth and Condition

Mean lengths-at-age and mean weights-at-age of eastern basin lake trout sampled remain consistent with averages from the previous ten years (1996-2005) through age 8 (Figures 1.9 and 1.10). 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, K, (Everhart and Youngs 1981) were calculated for age-3 (Lean strain only) 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 1.0, indicating that Lake Erie lake trout are, on average, heavy for their length (Figure 1.11). Condition coefficients for age-3 lake trout declined from 1985 through 1990, increased to 1997, and have generally stabilized since. Average age-3 male condition remains consistently higher than age-3 female condition. Condition coefficients for age-3 Klondike strain lake trout were similar in range to Lean strain lake trout (K for females=1.108; males=1.148). Condition coefficients for age-5 lake trout exhibited an increasing trend from 1993-1999. Female condition has declined since 2004, and male condition has declined since 2001, but both remain well above the standard (1.0).

Maturity

Ninety-six mature females ranging in age from 4 through 22 were sampled in standard assessment gill nets in 2006, generating a mean age of mature females of 6.32 years old (Figure 1.12). This is the fifth 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 it is reflective of the low abundance of female lake trout older than age 7 in the Lake Erie population. The Strategic Plan's objective assumes that adult females would need at least two spawning years to contribute to detectable natural reproduction. Female lake trout in Lake Erie reach 100% maturation by age 5 (Einhouse et al. 2007).

Natural Reproduction

Despite more than 20 years of stocking, no naturally reproduced lake trout have been documented in Lake Erie. One potentially wild fish was caught in eastern basin coldwater gill net surveys in 2006, making a total of 29 potentially wild lake trout recorded over the past six years. Otoliths are collected from lake trout found without CWTs or fin-clips and will be used in future stock discrimination studies.

A GIS project was conducted by the USGS (Sandusky) and Ohio Division of Wildlife to determine potential lake trout spawning sites within Lake Erie (Habitat Task Group [HTG] 2006). The goal of this exercise is to identify areas with suitable physical habitat for lake trout spawning within Lake Erie so that future stocking efforts may be directed at those sites. Preliminary side-scan sonar work was also accomplished on one of the identified sites at Grants Point off Port Maitland, Ontario, in 2006 (HTG 2007). Several funding proposals were submitted to various agencies to further examine the sites identified in the GIS-phase of this exercise using side-scan sonar, underwater video imaging, and diving to fully examine substrate type (*i.e.*, bedrock, boulder, cobble) and interstice depth. The type and extent of future work will depend on funding.

Lake Trout Population Model

The CWTG has assisted the Forage Task Group (FTG) in the past by providing a lake trout population model to estimate the lake trout population in Lake Erie. The model is a spreadsheet-type accounting model, initially created in the late 1980's, and uses stocked numbers of lake trout and annual mortality to generate an estimated adult (age 5+) population. The population estimates are used in FTG bioenergetics models and to gauge the progress of Lake Erie lake trout rehabilitation efforts. The model starts with a known number of yearling equivalents for each cohort and then annually applies an appropriate survival rate to that cohort as it passes through the fishery up to age 20+. Applied mortality rates were derived mostly from past standard assessment data. Several adjustments to be model were made through the years to account for poor juvenile survival and increased mortality due to sea lampreys. Initial versions of the model matched observations seen in annual coldwater gill nets surveys conducted by the NYSDEC with an increasing lake trout population with high survival. However, runs of the original model in the late 1990's depict a departure between the model and annual surveys with the model showing a high, increasing lake trout population while surveys indicated a dropping population. Concerns over this older model's ability to predict lake trout numbers were evident in the initial 1991 version of the bioenergetics model (Einhouse et al. 1999).

The Lake Erie CWTG has been updating and revising the model since 2005, incorporating new information on strain performance, survival, sea lamprey mortality, longevity, and stocking into the model. The most recent working version of the model separates each lake trout strain to accommodate strain-specific mortality, lamprey mortality, and stocking. The individual strains are then combined to provide an overall estimate of the adult (ages 5+) lake trout population. Unlike previous versions, the model now follows the general trend of the survey data and computes mortality estimates that are near levels measured from survey data. While the absolute numbers in the model are probably not comparable to the actual Lake Erie lake trout population, the model does provide a good tool for predicting trends into the future under various management and population scenarios.

The 2006 lake trout model estimated the Lake Erie adult population of age 5 and older lake trout at around 38,000 fish, about 40% of what it was a decade ago when the lake trout population was at its peak (Figure 1.13). The Strategic Plan for Lake Trout Restoration (Lake Trout Task Group 1985) suggested that successful Lake Erie rehabilitation required an adult population of 75,000 lake trout. Model projections using low and moderate rates of sea lamprey mortality and proposed stocking rates show that the adult lake trout population is suppressed by one-third over the next decade with moderate mortality compared to low mortality (Figure 1.13). Model runs indicated that both stocking and lamprey control are major influences on the Lake Erie lake trout population.

Diet

Seasonal diet information for lake trout is not available based on current sampling protocols. Diet information was limited to fish caught during August 2006 in the coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of the stomach contents of lake trout reveal diets almost exclusively made of fish (Table 1.6). Rainbow smelt, the longtime main prey item for lake trout, declined in lake trout diets in 2006 while the occurrence of round gobies increased. The occurrence of gobies and smelt were equal in Lean strain lake trout stomachs (53%) while round gobies were twice as common as smelt in Klondike strain fish (68% vs. 32%). Other fish species comprised minor contributions to the diets of both Lean and Klondike strain lake trout.

The occurrence of round gobies increased dramatically in the diet of both strains of lake trout in 2006 (Figure 1.14). This represents a major change for Lean strain lake trout as smelt have comprised over 88% of their diet since 1999. Gobies have been increasing in lake trout diets since 2001. Gobies tended to be more prevalent in Klondike strain lake trout, possibly due to their orientation closer to the bottom compared to Lean lake trout strains. Gobies continue to provide an alternate food source for Lake Erie's coldwater predators, relieving some dependency on the smelt resource.

References

Culligan, W. J., F. C. Cornelius, D. W. Einhouse, D. L. Zeller, R. C. Zimar, B. J. Beckwith, and M. A. Wilkinson. 1996. 1995 Annual Report to the Lake Erie Committee. New York State Department of Environmental Conservation, Albany, New York, USA.

Einhouse, D. W., M. T. Bur, F. C. Cornelius, R. Kenyon, C. P. Madenjian, P. S. Rand, K. L Sztramko, and L. D. Witzel. 1999. Consumption of rainbow smelt by walleye and salmonine fishes in eastern Lake Erie. Pages 291-303 *in:* M. Munawar, T. Edsall, and I. F. Munawar (eds). State of Lake Erie (SOLE) – Past, Present, and Future. Ecovision World Monograph Series. Backhuys, The Netherlands.

Einhouse, D. W., J. L. Markham, D. L. Zeller, R. C. Zimar, and B. J. Beckwith. 2007. 2006 Annual Report to the Lake Erie Committee. New York State Department of Environmental Conservation, Albany, New York, USA.

Everhart, W.H., and W.D. Youngs. 1981. Principles of Fishery Science, Second Edition. Cornell University Press, Ithaca, NY.

Habitat Task Group. 2006. Report of the Lake Erie Habitat Task Group, March 2006. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Habitat Task Group. 2007. Report of the Lake Erie Habitat Task Group, March 2007. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Lake Trout Task Group. 1985. A Strategic Plan for the Rehabilitation of Lake Trout in Eastern Lake Erie. Report to the Great Lakes Fishery Commission's Lake Erie Committee, Ann Arbor, Michigan, USA.

Table 1.1. Number, sex, mean length (mm) and weight (g), by age class, of **Lean-strain** lake trout collected in gill nets (all gear types) from eastern basin Lake Erie, August, 2006.

Age	Sex	Number	Mean Length (mm TL)	Mean Weight (grams)
3	Male	13	532	1838
	Female	6	533	1585
4	Male	40	633	2963
	Female	6	641	2953
5	Male	51	697	3924
	Female	80	709	4283
6	Male	13	714	4473
	Female	12	745	4980
7	Male	12	745	4819
	Female	5	713	4286
8	Male	4	756	5126
	Female	1	800	6450
9	Male	0	---	---
	Female	2	688	4425
10	Male	1	851	7126
	Female	1	830	8415
11	Male	1	817	7185
	Female	0	---	---
12	Male	1	758	5180
	Female	1	863	8535
13	Male	2	854	6618
	Female	2	775	5680
14	Male	1	866	8350
	Female	1	767	6735
15	Male	1	843	6090
	Female	1	853	7730
16	Male	1	942	10240
	Female	0	---	---
18	Male	1	812	5550
	Female	0	---	---
21	Male	1	1000	11470
	Female	2	865	8163
22	Male	1	906	8610
	Female	1	911	7580

Table 1.2. Number, sex, mean length (mm) and weight (g), by age class, of **Klondike-strain** lake trout collected in gill nets (all gear types) from eastern basin Lake Erie, August, 2006.

Age	Sex	Number	Mean Length (mm TL)	Mean Weight (grams)
2	Male	39	369	506
	Female	24	374	493
3	Male	37	511	1534
	Female	7	493	1332

Table 1.3. Number of lake trout per stocking strain by age collected in gill nets from eastern basin waters of Lake Erie, August 2006. Stocking strain codes are: FL = Finger Lakes, LE = Lake Erie, LL = Lewis Lake, LO = Lake Ontario, SUP = Superior, KL = Klondike. Shaded cells indicate ages (years) in which that strain was stocked.

AGE	FL	LE	LL	LO	SUP	KL
1						
2						68
3	19					44
4	46					
5	32				101	
6	10				15	
7	5		3		9	
8			1		4	
9	2					
10	1				1	
11	1					
12	1	1				
13	4					
14			1	1		
15				2		
16	1					
17						
18				1		
19						
20						
21	3					
22	2					
TOTAL	**127**	**1**	**5**	**4**	**130**	**112**

Table 1.4. Return rates (number of returns per 100,000 yearlings stocked) of Klondike and Finger Lakes strain lake trout by age class and strain collected in gill nets (all gear types) from eastern basin waters of Lake Erie, August 2004-2006. KL = Klondike strain; FL = Finger Lakes strain.

Year	Age	Strain	Number Collected	Number Stocked (yearlings)	Return Rate (#/100,000)
2003	1	KL	1	31,600	3.2
2003		FL	4	80,000	5.0
2004		KL	14	54,200	25.8
2003	2	KL	12	31,600	38.0
2003		FL	7	80,000	8.8
2004		KL	63	54,200	116.2
2003	3	KL	44	31,600	139.2
2003		FL	19	80,000	23.8

Table 1.5. Cohort analysis estimates of annual survival (S) by strain and year class for lake trout caught in standard assessment nets in the New York waters of Lake Erie, 1985-2006. Three-year running averages of CPE from ages 4–10 were used due to year-to-year variability in catches. Shaded cells indicate survival estimates that fall below the 0.60 target rate. An asterisk (*) indicates years in which straight CPE's were used and includes ages 4-7 (FL 97, SUP 99) or 5-8 (SUP 97, 98).

	STRAIN				
Year Class	LE	LO	LL	SUP	FL
1983				0.687	
1984				0.619	0.502
1985				0.543	0.594
1986				0.678	
1987				0.712	0.928
1988		0.784		0.726	0.818
1989		0.852		0.914	0.945
1990		0.840		0.789	0.634
1991		0.763	0.616		
1992	0.719		0.568		
1993	0.857				0.850
1994					
1995					
1996					0.780
1997*				0.419	0.617
1998*				0.331	
1999*				0.367	
MEAN	**0.788**	**0.810**	**0.592**	**0.618**	**0.741**

Table 1.6. Frequency of occurrence of diet items from non-empty stomachs of Lean (N = 121) and Klondike strain (N = 69) lake trout collected in gill nets from eastern basin waters of Lake Erie, August 2006.

PREY SPECIES	Lean Lake Trout		Klondike Lake Trout	
	Number	**%**	**Number**	**%**
Smelt	64	52.9%	22	31.9%
Yellow Perch	3	2.5%		
Round Goby	64	52.9%	47	68.1%
Gizzard Shad			1	1.5%
White Perch	2	1.7%		
Shiner sp.			1	1.5%
Unknown fish	9	7.4%	2	2.9%
Cladoceran *(B.c.)*			1	1.5%
Empty Stomachs	91		22	

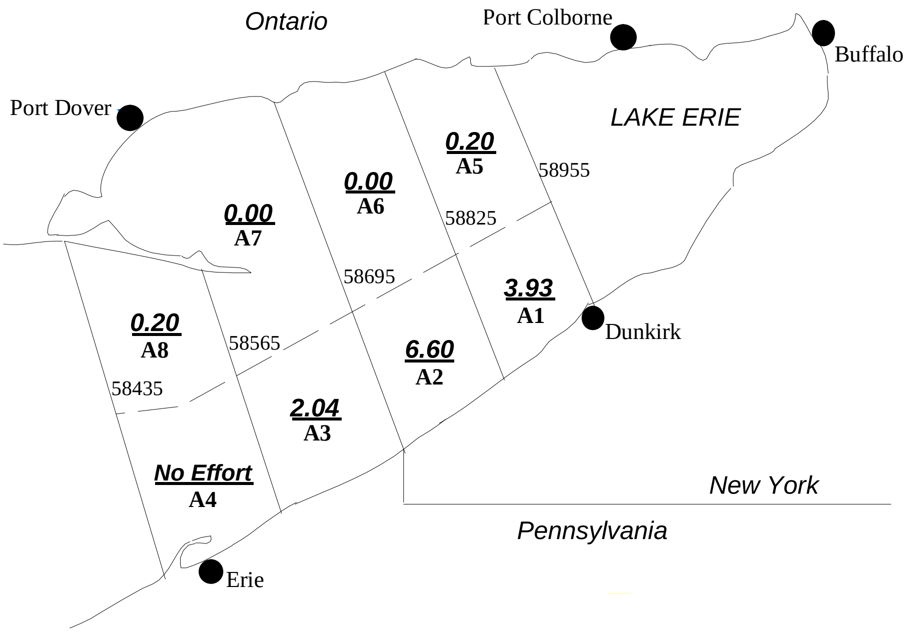


Figure 1.1. Standard sampling areas (A1-A8) used for assessment of lake trout in the eastern basin of Lake Erie, 2006. The numbers in italics for each sampling area represent numbers per net-lift for total lake trout catches in that area. Five-digit numbers near the angled vertical lines that represent sample area grid borders are Loran TDs.

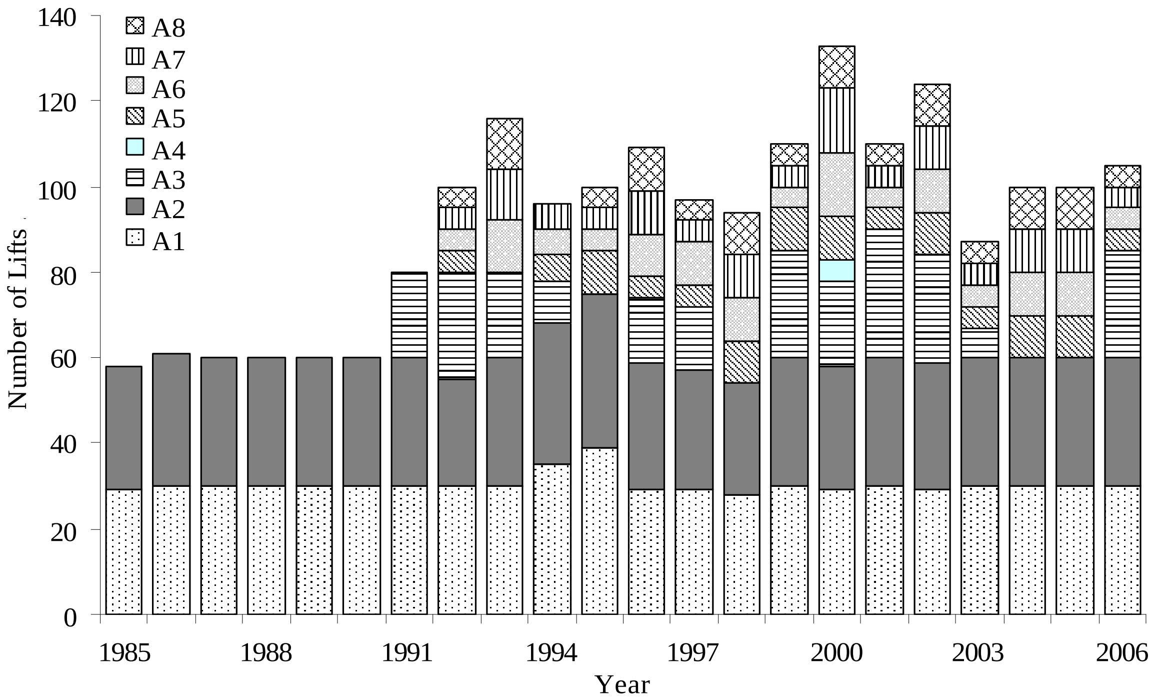


Figure 1.2. Number of coldwater assessment gill net lifts by area in the eastern basin of Lake Erie, 1985-2006.

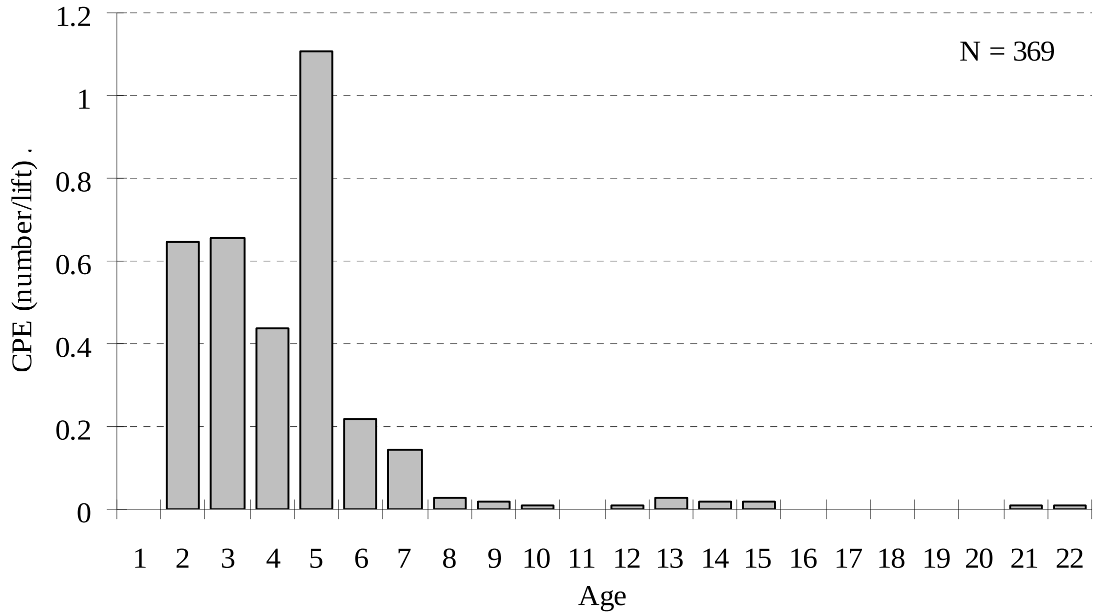


Figure 1.3. Relative abundance at age of lake trout collected from standard assessment gill nets fished in the eastern basin of Lake Erie, August 2006.

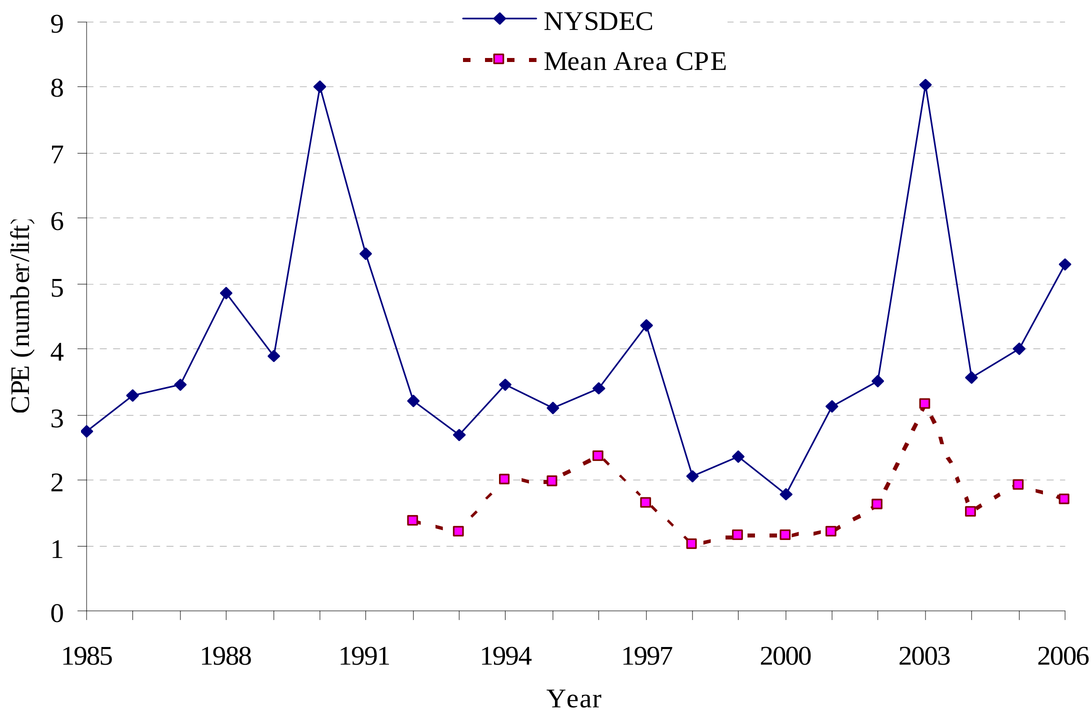


Figure 1.4. Mean CPE (number fish/lift) weighted by area for lake trout caught in standardized gill nets assessment surveys from the eastern basin of Lake Erie, 1992-2006. The NYSDEC series from 1985-2006 is also shown for reference to a longer time-series.

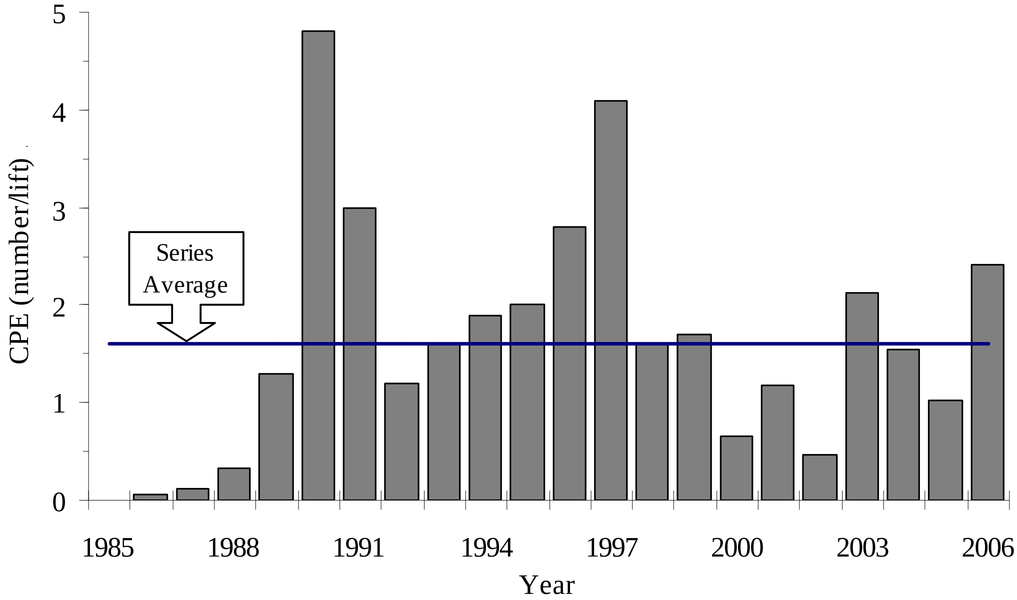


Figure 1.5. Relative abundance (number fish/lift) of age 5 and older lake trout sampled in standard gill net surveys from the New York waters of Lake Erie, August, 1985-2006.

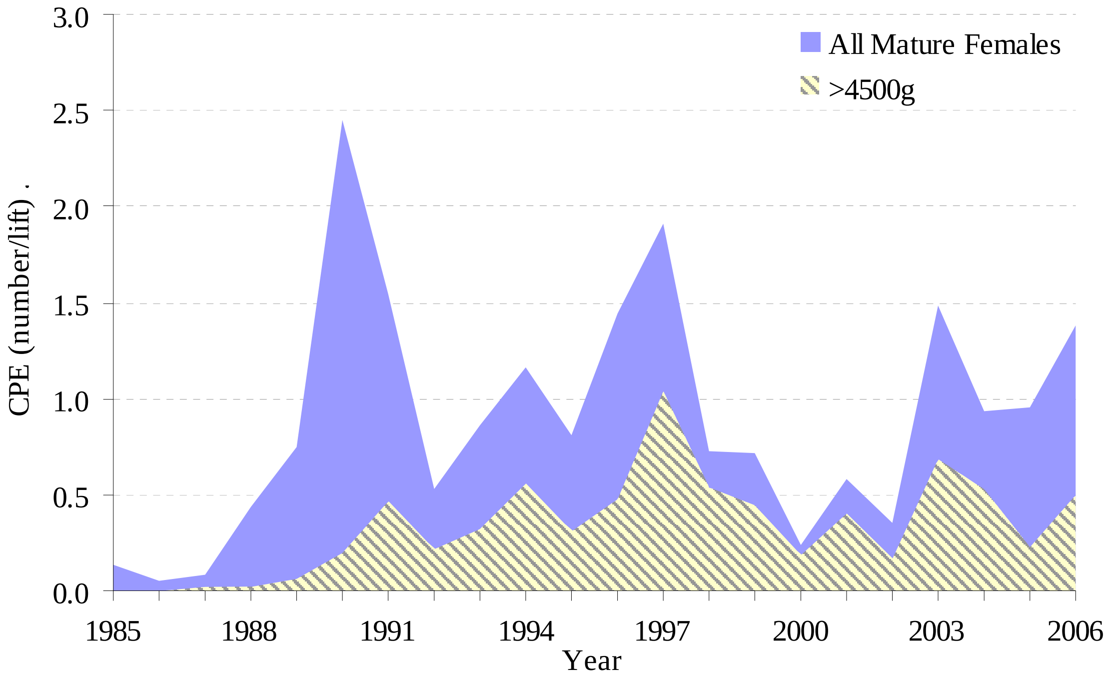


Figure 1.6. Relative abundance (number fish/lift) of all mature female lake trout and mature females greater than 4500g sampled in standard gill net surveys from the New York waters of Lake Erie, August, 1985-2006.

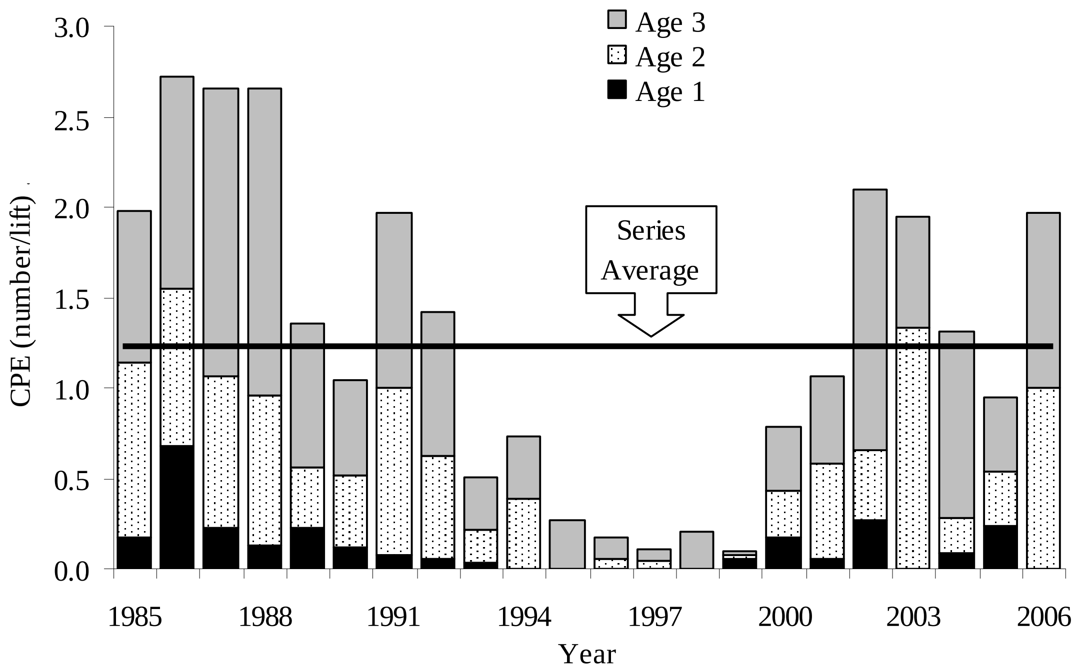


Figure 1.7. Relative abundance (number fish/lift) of juvenile (ages 1-3) lake trout collected in standard assessment gill net surveys in the New York waters of Lake Erie, August, 1985-2006.

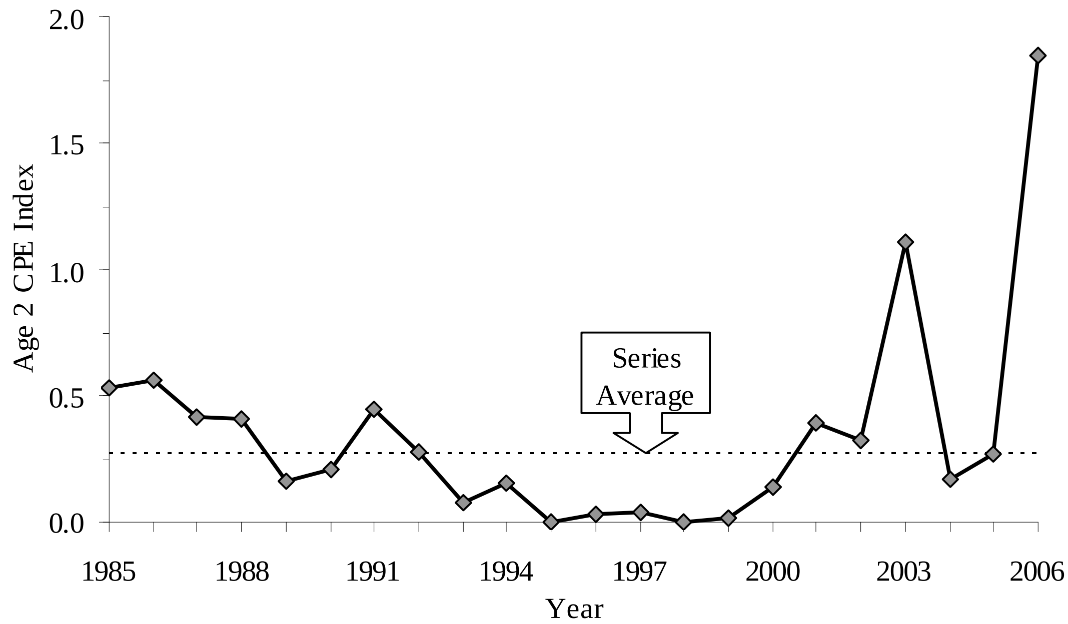


Figure 1.8. Index of recruitment for age 2 lake trout caught in standard assessment gill nets from New York waters of Lake Erie, August, 1985-2006. The index is calculated by dividing the age-2 CPE by the stocking rate for each cohort, and then multiplying by 100,000. The final index is equal to the number of age-2 fish caught per lift for every 100,000 yearling lake trout stocked.

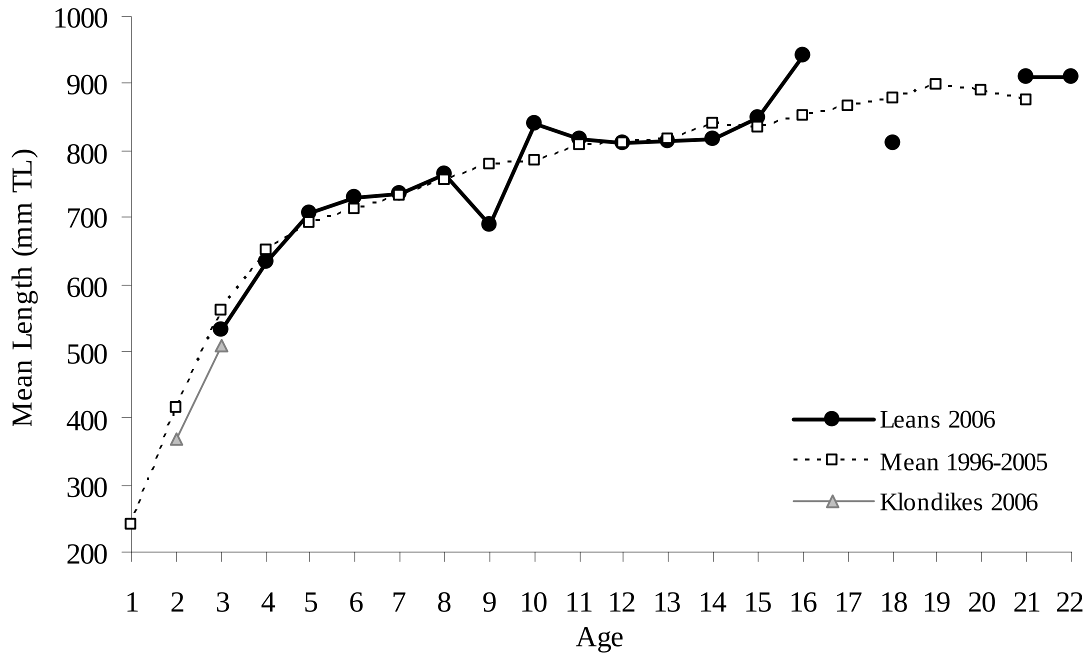


Figure 1.9. Mean length-at-age of Lean-strain and Klondike-strain lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2006. The previous 10-year average (1996-2005) from New York is shown for current growth rate comparison.

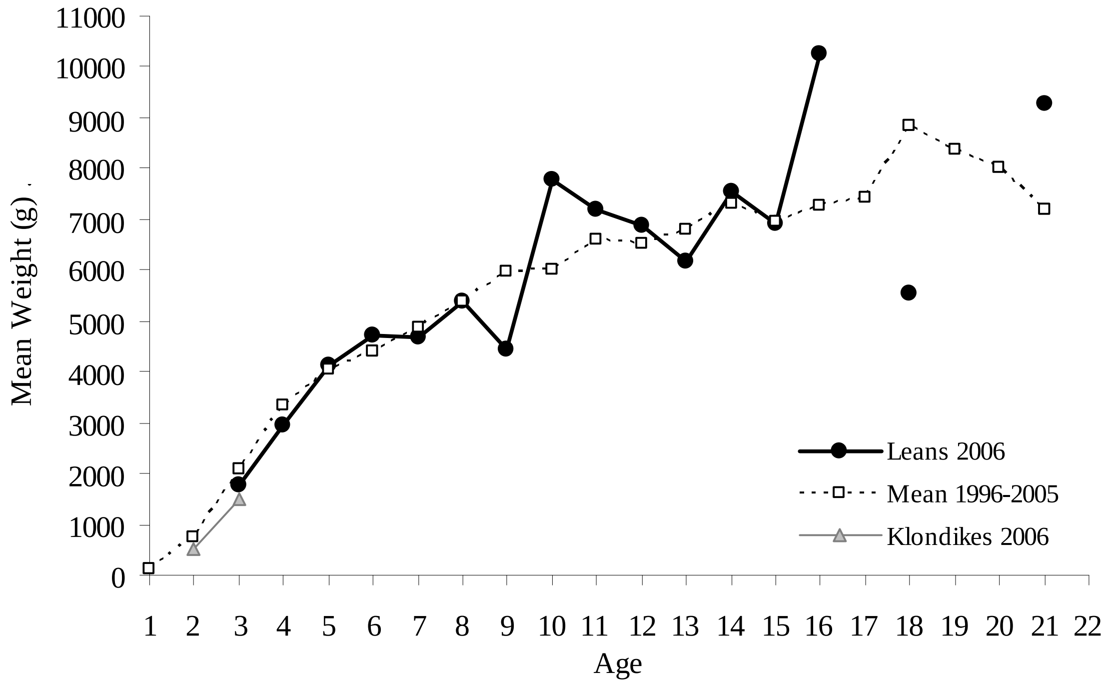


Figure 1.10. Mean weight-at-age of Lean-strain and Klondike-strain lake trout collected in gill nets from the eastern basin of Lake Erie, August, 2006. The previous 10-year average (1996-2005) from New York is shown for current growth rate comparison.

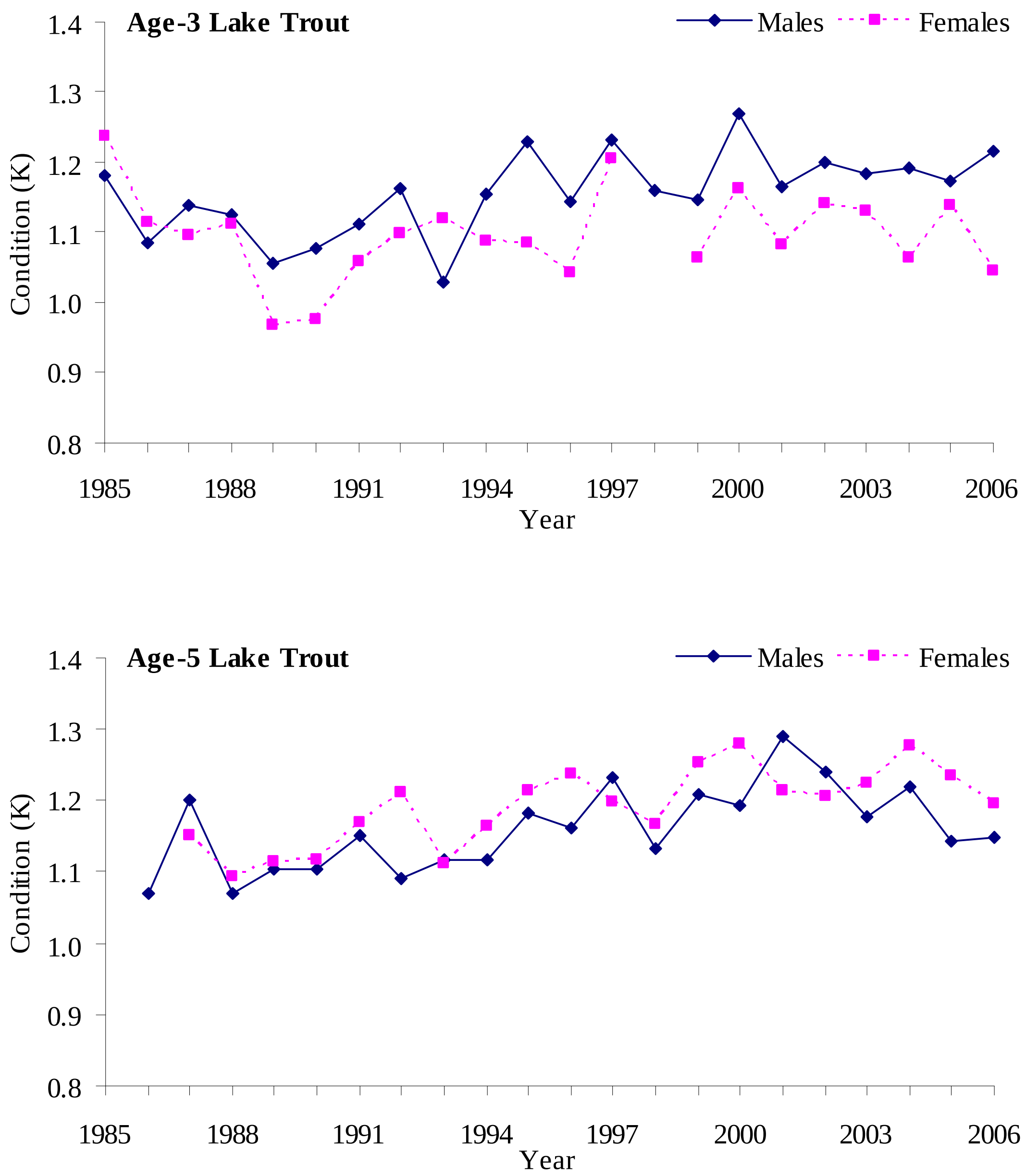


Figure 1.11. Mean coefficients of condition (K) for age-3 lake trout (top) and age-5 lake trout (bottom), by sex, collected in NYSDEC gill net assessment surveys, August, 1985-2006.

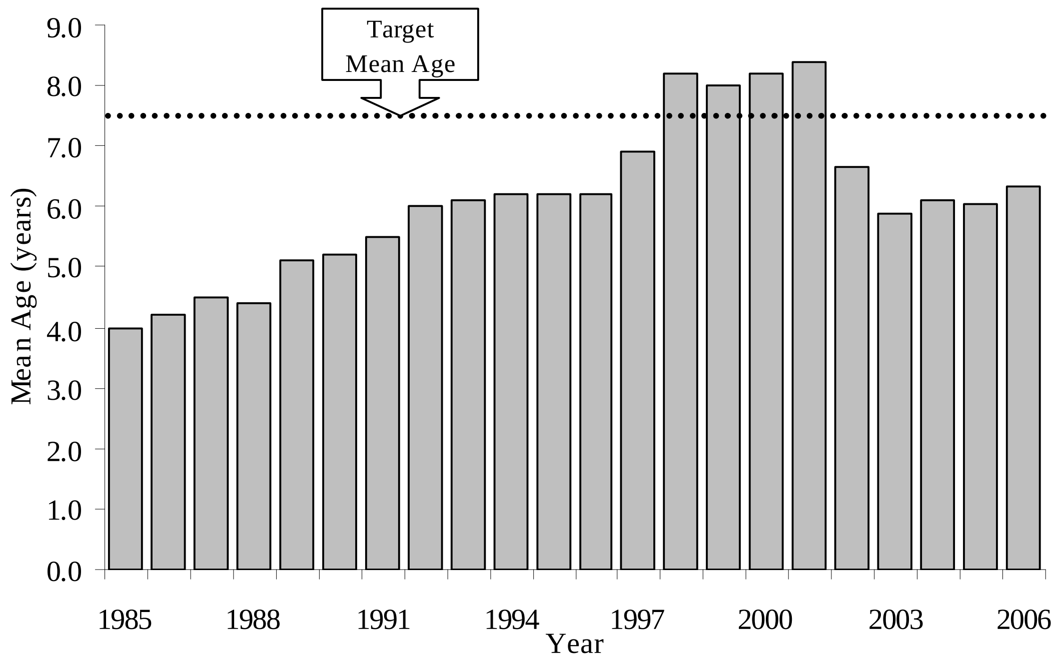


Figure 1.12. Mean age of mature female lake trout sampled in standard assessment gill net surveys in the eastern basin of Lake Erie, 1985-2006. The target mean age is 7.5 years.

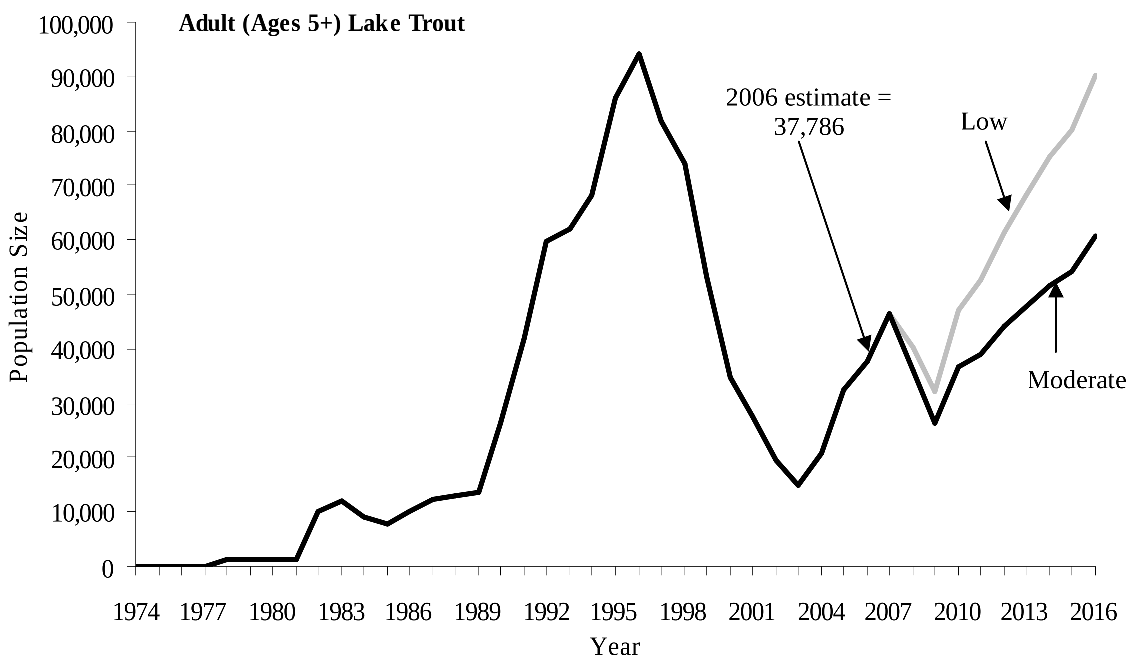
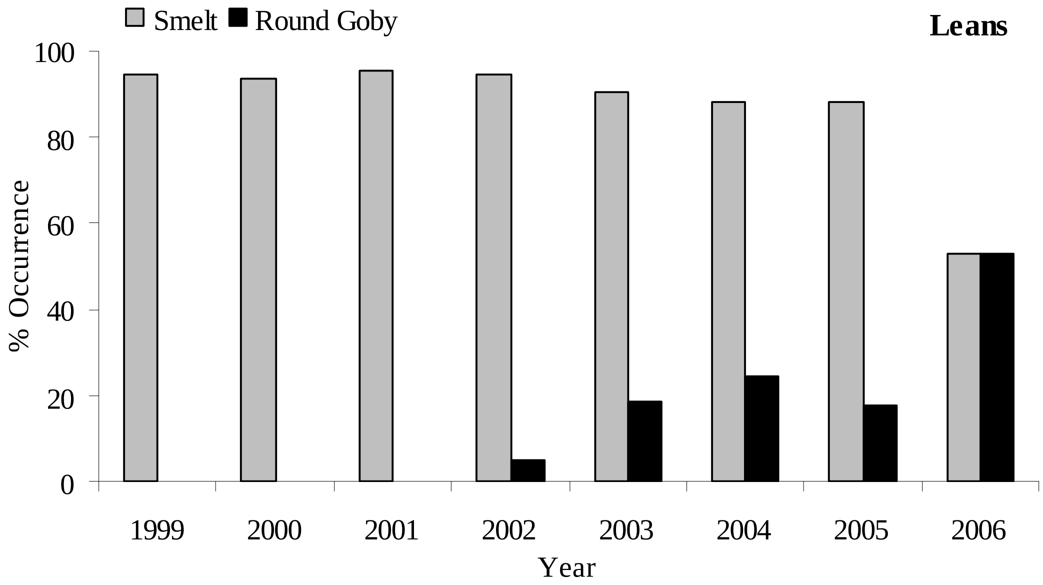


Figure 1.13. Projections of the Lake Erie adult lake trout population (ages 5+) using the CWTG lake trout model. Projections were made using both low and moderate rates of lamprey mortality with proposed stocking rates. The model estimates the current (2006) population at 37,786 adult lake trout.



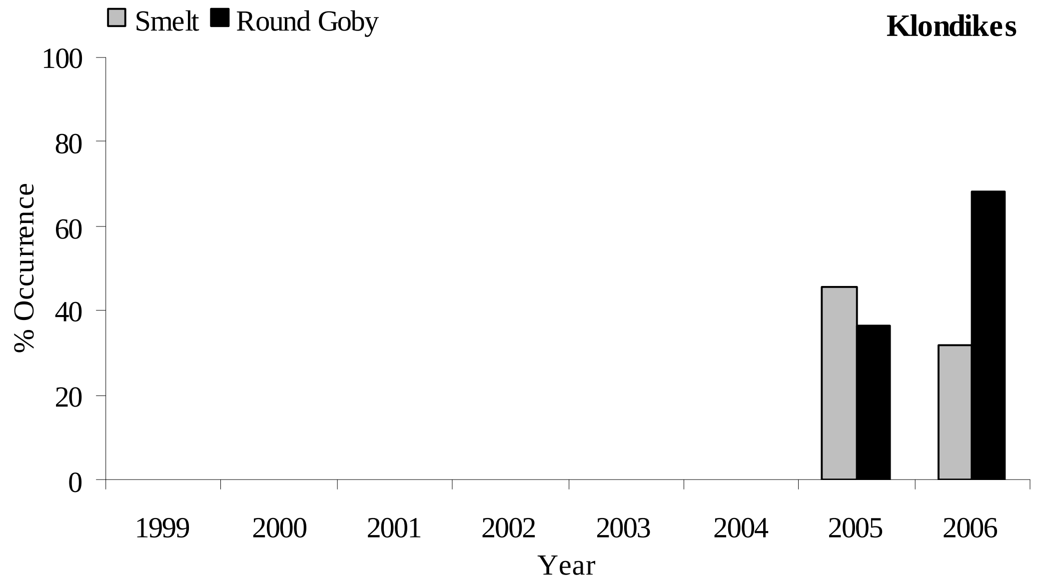


Figure 1.14. Percent occurrence of smelt and round gobies in the diet of Lean (top) and Klondike (bottom) strains of lake trout caught in assessment gill nets in the New York waters of Lake Erie, August, 1999-2006.

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

Andy Cook, OMNR and Kevin Kayle, ODW

Commercial Harvest

The total harvest of Lake Erie lake whitefish in 2006 was 363,269 pounds (Figure 2.1). Total harvest in 2006 increased marginally (11%) from 2005, due to increases in Ohio and Michigan waters, while Ontario's harvest remained unchanged. The 2006 whitefish harvest was taken primarily in Ontario (89%), Ohio (8%) and Michigan (3%) waters. Ontario harvested 322,418 pounds, followed by Ohio (29,795 lbs), Michigan (10,693 lbs), and Pennsylvania (363 lbs). New York's Lake Erie trap and hoop net fishery, consisting of two fishermen in 2006, had a negligible whitefish harvest (1 lb). In 2006, an inactive Michigan trap net license was purchased by a commercial seine operator, who began fishing for whitefish, and harvested 10,693 pounds. This represents the largest whitefish harvest in Michigan waters since 1932 (19,000 lbs). The reappearance of whitefish harvest in Michigan waters of Lake Erie is not indicative of whitefish abundance, but rather the reopening of the dormant trap net fishery.

The majority (99%) of Ontario's 2006 lake whitefish harvest was taken in gill nets. The remainder was caught in smelt trawls and to a lesser extent, impoundment gear. The largest fraction of Ontario's whitefish harvest (57%) was taken in the west basin (Ontario's OE 1) mostly during the fall, followed by west-central OE 2 (32%) primarily during spring months. The remainder came from OE 3 (4%) in spring and OE 4 (2%) and easternmost OE 5 (4%) generally during summer months. In Ontario, 31% of whitefish harvested in 2006 resulted from effort targeting whitefish, while walleye (47%), white bass (19%), white perch (1%) and yellow perch (2%) fisheries accounted for the remainder. Ohio's whitefish fishery harvested the majority of their fish (86%) in November, with the remainder harvested during October, December and May. Michigan's west basin harvest occurred from October to December.

Ontario's annual targeted catch rates in 2006 remained comparable to 2005 with mixed trends between quota zones 1, 2 and 3 (Figure 2.2). Ohio's commercial trap net catch rates increased markedly from 2005 (Figure 2.3). Pennsylvania's smaller commercial trap net fishery had slightly lower catch rates compared to 2005. November 2006 catch rates targeting spawning whitefish in Ontario were similar to 2005, but increased during October and decreased during December compared to 2005 (Figure 2.4).

Targeted whitefish effort from October to December in the west basin has remained low in 2005 and 2006, following a period of greater targeted effort (2001-2004) which coincided with lower walleye quotas (Figure 2.5). The trend in Ontario targeted lake whitefish harvest follows targeted effort during the fall in the west basin (Figure 2.6). The landed weight of roe from the 2006 whitefish fishery was 2,286 pounds, with an approximate landed value of CAN$2.19/lb.

Ontario's west basin fall lake whitefish fishery was dominated by age-3 fish (Figure 2.7). The strong 2003 cohort dominated catches in targeted and non-targeted Ontario fisheries throughout Lake Erie (Figure 2.8). The USGS-Lake Erie Biological Station completed fall net-run samples to characterize the fishery in Michigan and Ohio waters of the far western basin (Stapanian et al. 2007). They determined through otolith aging that 62% of the sample was age 3, followed by 35% age 5, but ages out to age 13 were found (Figure 2.9). Whitefish are usually fully recruited to the gill net fishery by age 5, but often earlier ages dominate the harvest when year classes are relatively strong. The dominance of 3-year-old lake whitefish in 2006 fisheries is due to differences in relative abundance between age groups.

Assessment Surveys

Lake whitefish abundance indices in the 2006 gill net assessments varied among jurisdictions and basins (Figures 2.10 and 2.11). East basin catches were relatively high in Ontario whereas New York's 2006 index dropped drastically from 2005. Pennsylvania's August gill net assessment does not frequently catch lake whitefish, but three were caught in 25 lifts during 2006 (Figure 2.11). Ontario central basin index catch rates were moderate (Figure 2.10). The age composition in Ontario's gill net surveys was comprised mostly of age-3 lake whitefish (65%) followed by 5-year-olds (12%), with a range of ages from 1 to 17 (Figures 2.12 and 2.13).

Ohio trawl surveys in the central basin of Lake Erie assess juvenile lake whitefish and can describe the general magnitude of year class strength. In 2006, the August and October assessments for young-of year whitefish (0.0 fish per hectare) were below the 17-year mean. For yearling lake whitefish, the catch rates were below the 17-year mean for August surveys in the west central (0.0 f/ha), and for October surveys in the west central (0.0 f/ha) and east central (0.1 f/ha). However, yearling catch rates were above the 17-year mean for August surveys in the east central (0.4 f/ha).

In trawl and gill net assessment surveys in Ohio waters of Lake Erie during 2006, a total of 47 adult lake whitefish were sampled. The 2001 year class (age 5) were most numerous (25.5%), followed by the 2003 year class (age 3 at 21.3%; Figure 2.14). Adult lake whitefish ranged in age from 2 to 20 in these surveys. Mean length of lake whitefish from the survey was 484 mm (Figure 2.14).

Growth and Diet

In 2006, Ontario lake whitefish condition (ages 4 and older) declined, falling below historic 1927-1929 averages for each sex (Van Oosten and Hile 1947; Figure 2.15). Age 4 and older whitefish were only included in calculations as condition varies substantially between juvenile and mature life stages. Ohio surveys also showed that whitefish condition in 2006 for age 4 and older whitefish sampled in assessment trawls and gillnets (mean K = 1.006; std dev= 0.101) slipped below Van Oosten and Hile's condition standards (Figure 2.16). Prior to 2006, Ohio surveys had shown a moderate increasing trend for condition of both females and males ages 4 and older. In spite of these declines in the recent year of the surveys, there was still a general increasing trend for mean condition (K) with older age (Figure 2.17).

Lake whitefish diet information available from Ohio surveys showed the breadth of whitefish diets. The diets of whitefish collected from the central basin are described according to mean percent of diet items by wet weight (Figure 2.18). By wet weight, zooplankton made up the majority of central basin lake whitefish diets, followed by chironomids, mollusca (sphaeriids and gastropods), dreissenids, *Bythotrephes*, isopods and benthos. The composition differed this year from previous years due to the presence of a greater percentage of lake whitefish less than 400 mm (80% of the whitefish obtained for diet samples).

Diet data was collated over the recent Ohio central basin survey period (1995-2006) and summarized by length of lake whitefish sampled. Smaller juvenile whitefish ate primarily zooplankton while pelagic (Figure 2.19). As they grew to mature adults, they became more benthic-oriented, preferring dreissenids, sphaeriids and gastropods (Figure 2.19). Whitefish also consumed significant numbers of chironomid larvae and pupae, isopods, and *Bythotrephes*. Tricopterans, leptodorans, larval fish and other invertebrates contributed rarely to the juvenile and adult whitefish diet.

Research Efforts 2006-2007

Ed Roseman began a GLSC/FWS (Great Lakes Science Center/U.S. Fish and Wildlife Service) project in 2005 to quantify and characterize lake whitefish reproductive habitat in the Detroit River and added western basin Lake Erie sites in 2006. Objectives include identifying spawning/incubation areas and associated physical characteristics; quantifying relative egg abundance and survival, assessing egg viability and physiological condition, predation of lake whitefish eggs, spawning stock characteristics (age, size, fecundity, and genotype) and developing a geographic database of spawning sites using a geographic information system. Information gained from this study will support the development of comprehensive models of spawning and nursery habitats. Adult whitefish in spawning condition were sampled on Toussaint Reef (averaging 50-60 fish per net-night). Some eggs were pumped from females, and fertilized eggs were retrieved from egg mats placed on spawning reefs. Subsequent larvae hatched in the lab were identified as lake whitefish.

References

Ohio Division of Wildlife. 2007. Ohio's Lake Erie Fisheries 2006. Annual status report. Federal Aid in Fish Restoration Project F-69-P. Ohio Department of Natural Resources, Division of Wildlife, Lake Erie Fisheries Units, Fairport and Sandusky.

Stapanian, M.A., M. T. Bur, P. M. Kocovsky, W. H. Edwards, and M. J. Porta. 2007. Age composition of yellow perch (*Perca flavescens*) and lake whitefish (*Coregonus clupeaformis*) in commercial trap nets in western Lake Erie. Report to the Great Lakes Fishery Commission, Lake Erie Committee. March 2007. Sandusky. 8 pp.

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

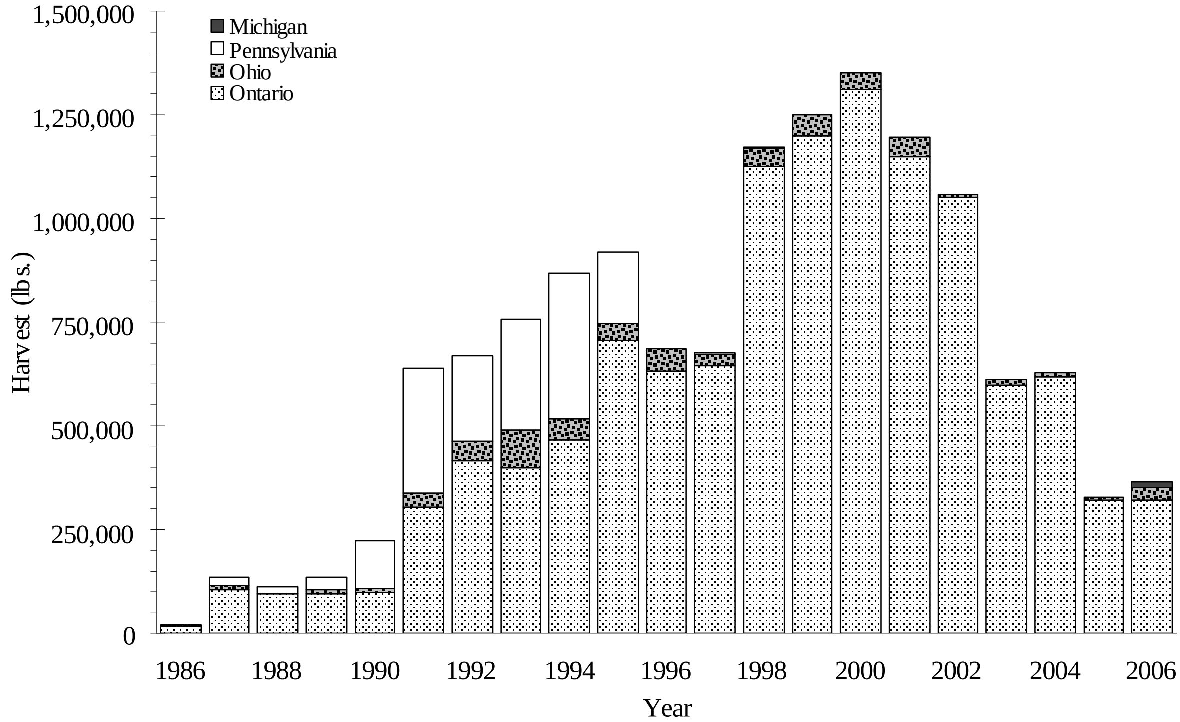


Figure 2.1. Total Lake Erie commercial whitefish harvest from 1986-2006 by jurisdiction. Pennsylvania ceased gill netting in 1996. Michigan trap net fishery reopened in 2006.

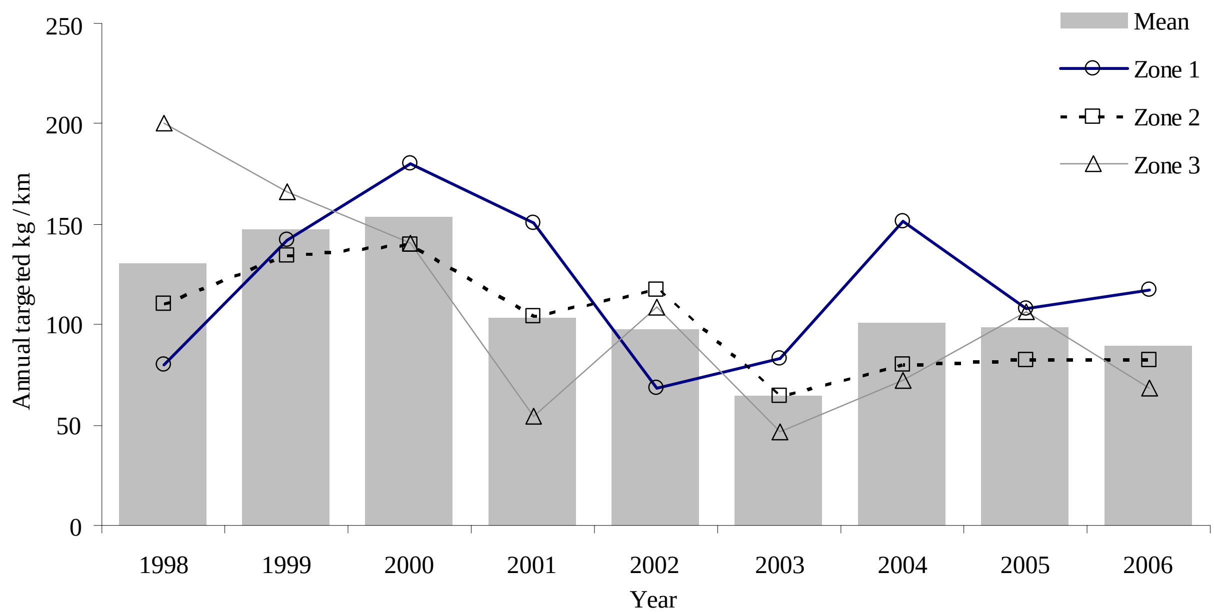


Figure 2.2. Ontario annual commercial large mesh gill net catch rates targeting lake whitefish by quota zone, 1998-2006. Bars represent the unweighted averages of catch rates by quota zone.

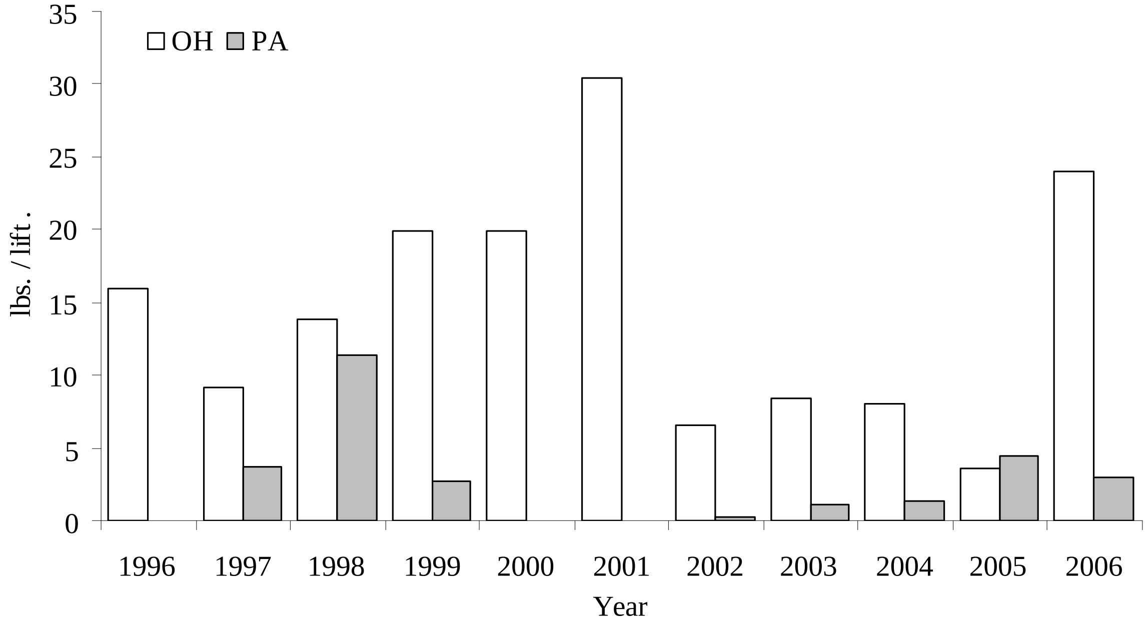


Figure 2.3. Ohio and Pennsylvania lake whitefish commercial trap net catch rates (pounds per lift), 1996-2006.

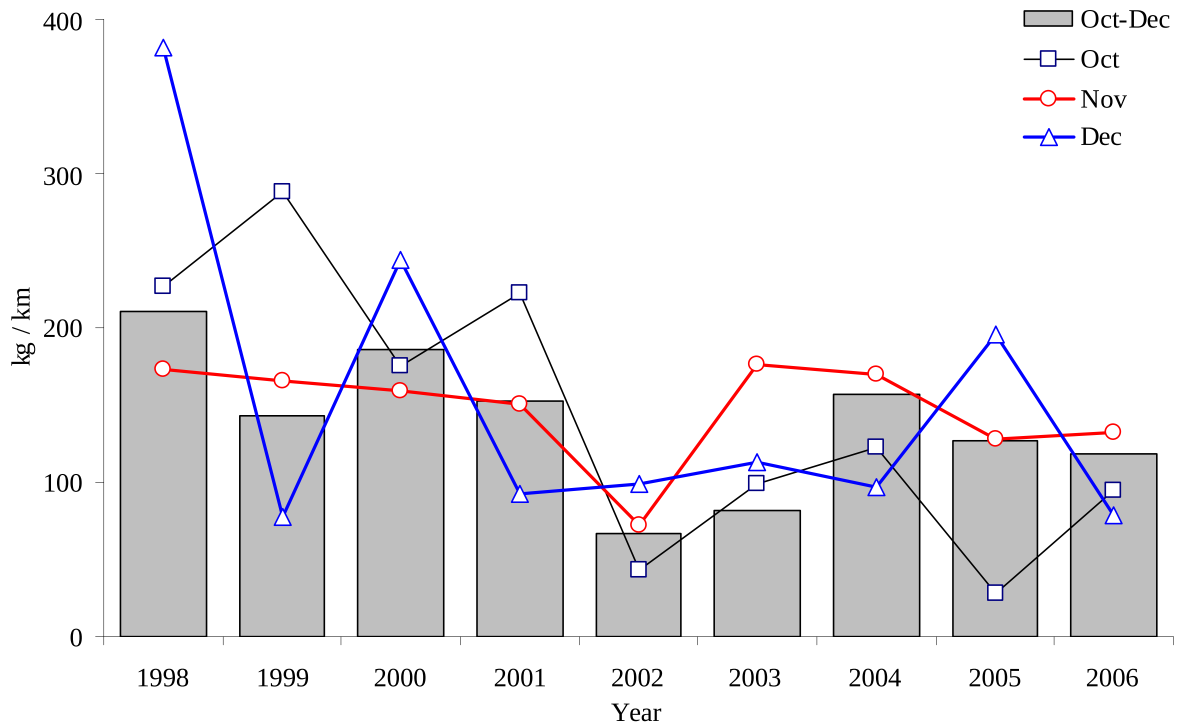


Figure 2.4. Targeted large mesh gill net catch rate (kg / km) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct.–Dec.), 1998–2006.

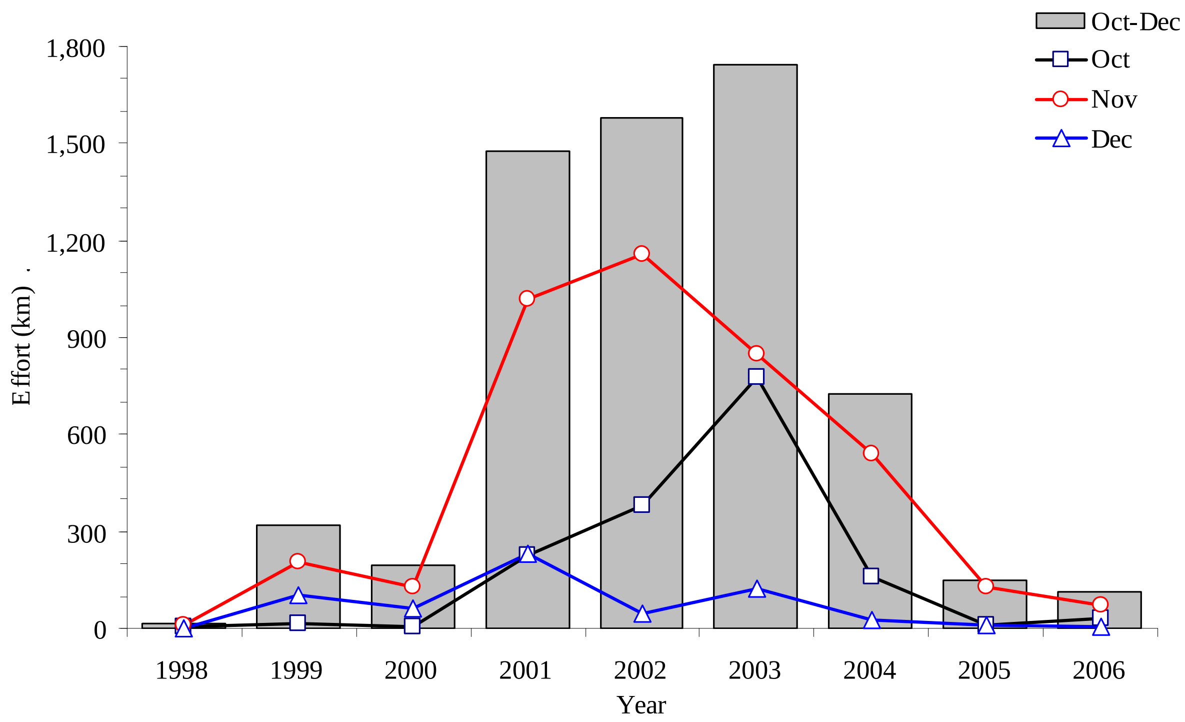


Figure 2.5. Targeted large mesh gill net effort (km) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct.–Dec.), 1998–2006.

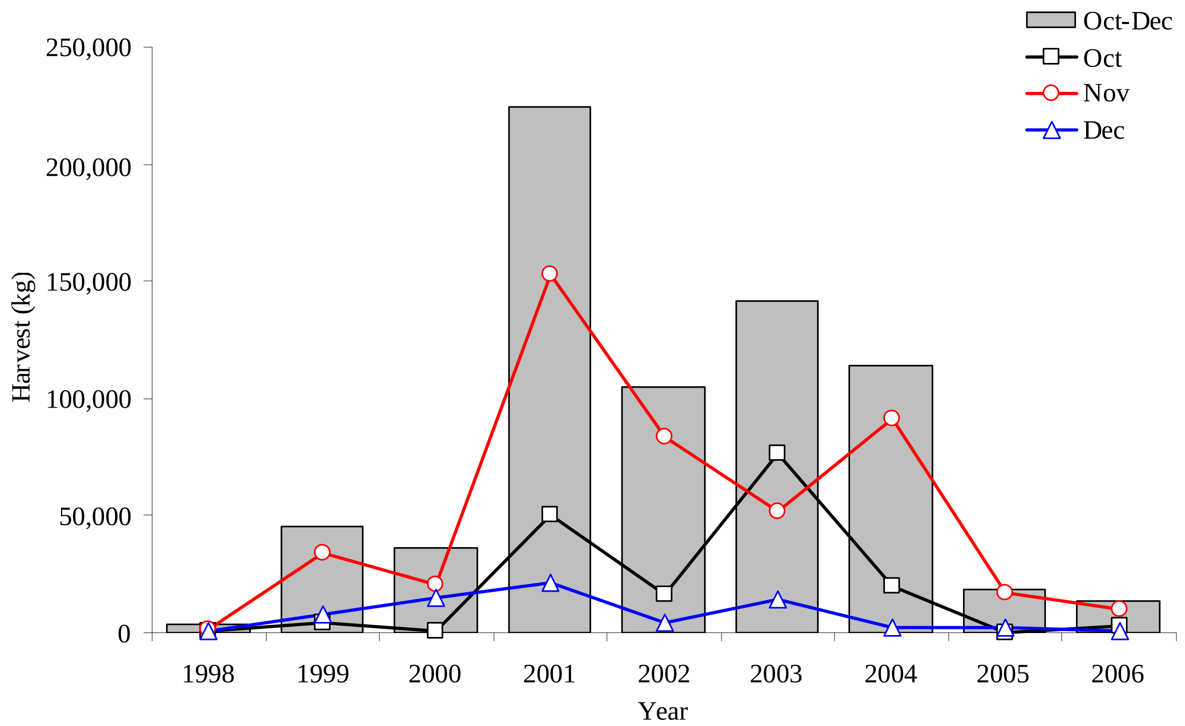


Figure 2.6. Targeted large mesh gill net harvest (kg) for lake whitefish in the west basin of Lake Erie for October, November, December, and pooled (Oct.-Dec.), 1998-2006.

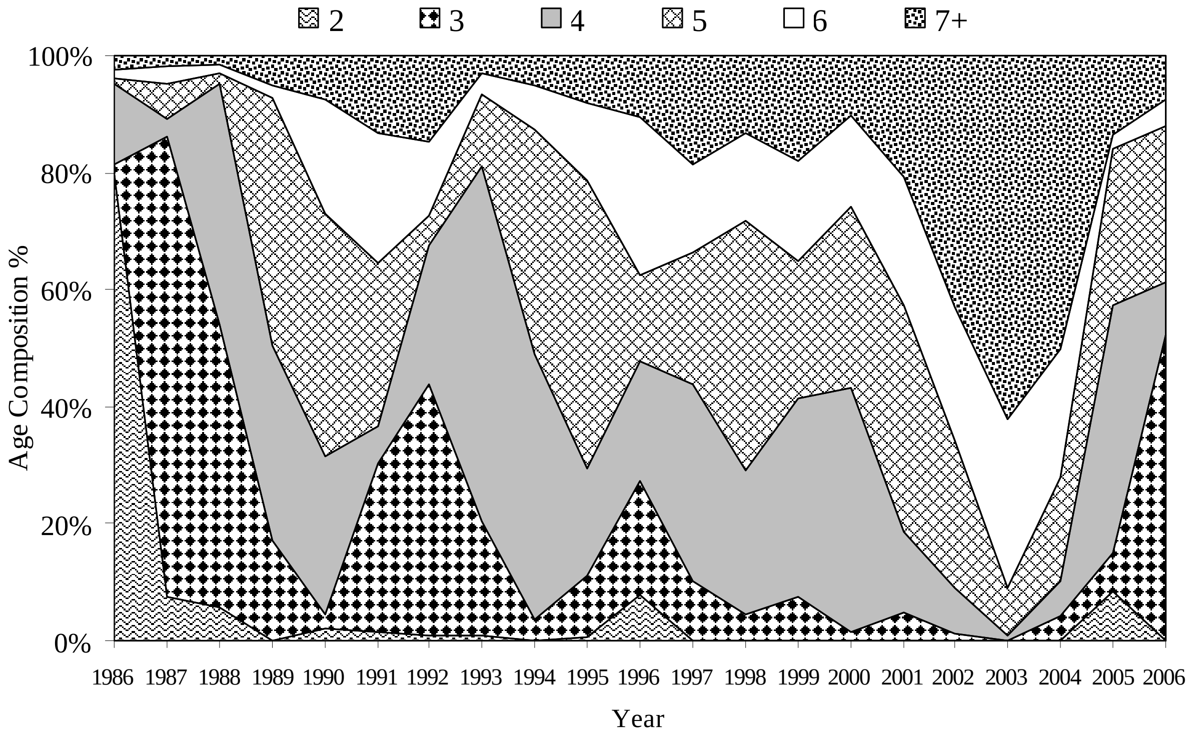


Figure 2.7. Ontario fall commercial whitefish harvest age composition in statistical district 1, 1986-2006. (Effort with gill nets >=3 inches, with whitefish in catch from October to December). Otoliths were primarily used for aging commercial whitefish samples in 2006.

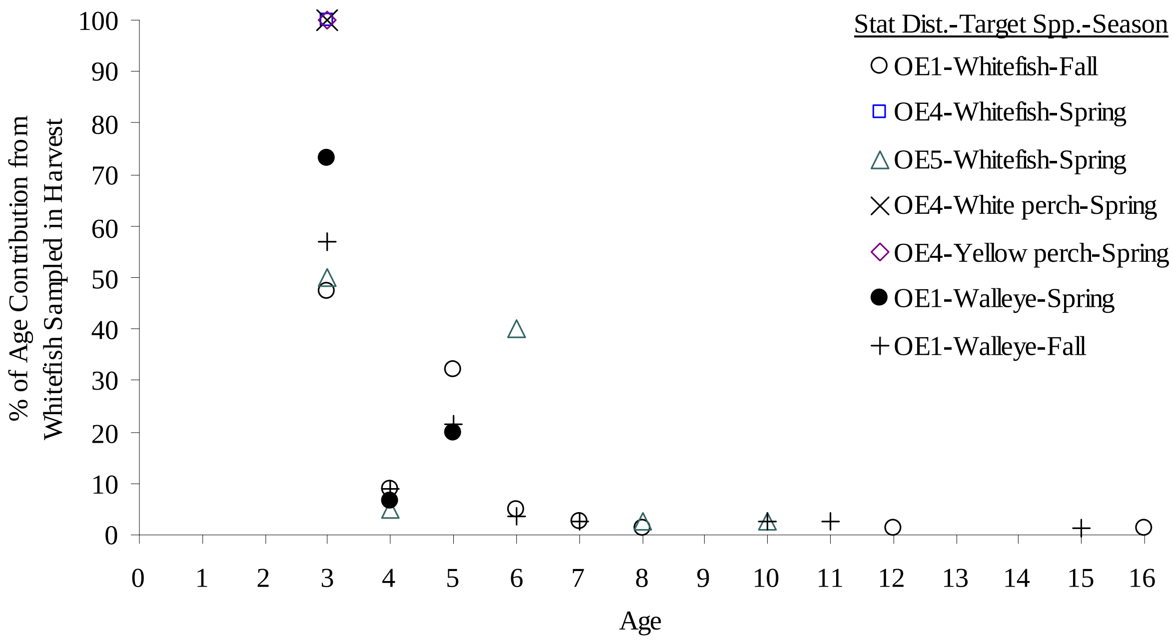


Figure 2.8. Age composition of lake whitefish caught commercially in Ontario waters of Lake Erie in 2006. Samples were obtained from the gillnet fishery targeting whitefish, white perch, yellow perch and walleye as presented.

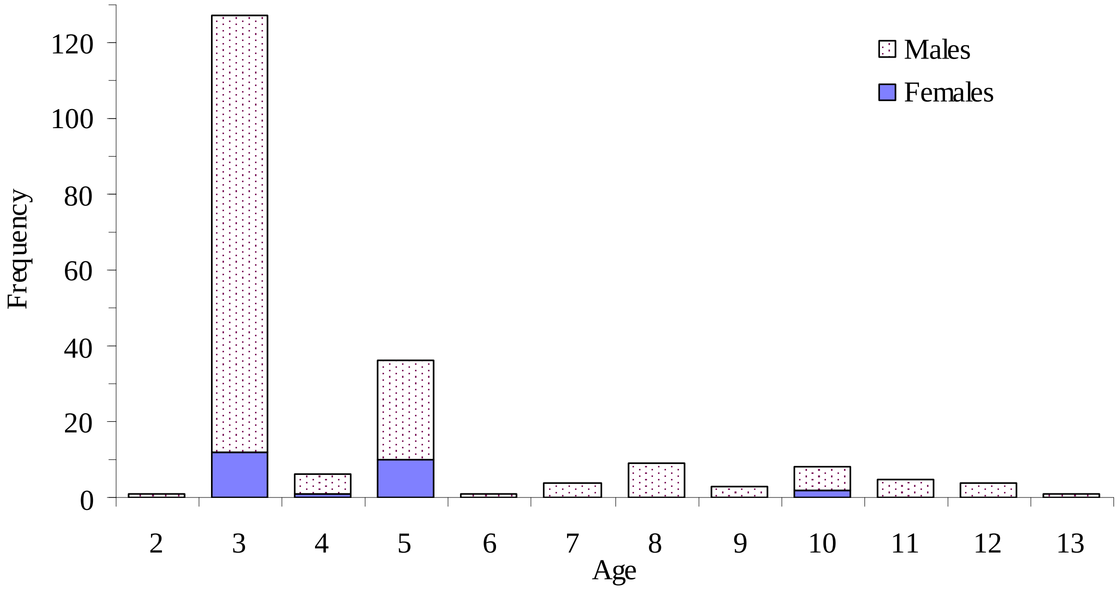


Figure 2.9. Whitefish age composition in net-run samples from fall commercial trap nets in Michigan and Ohio portions of Lake Erie's western basin by USGS personnel (Stapanian et al. 2007).

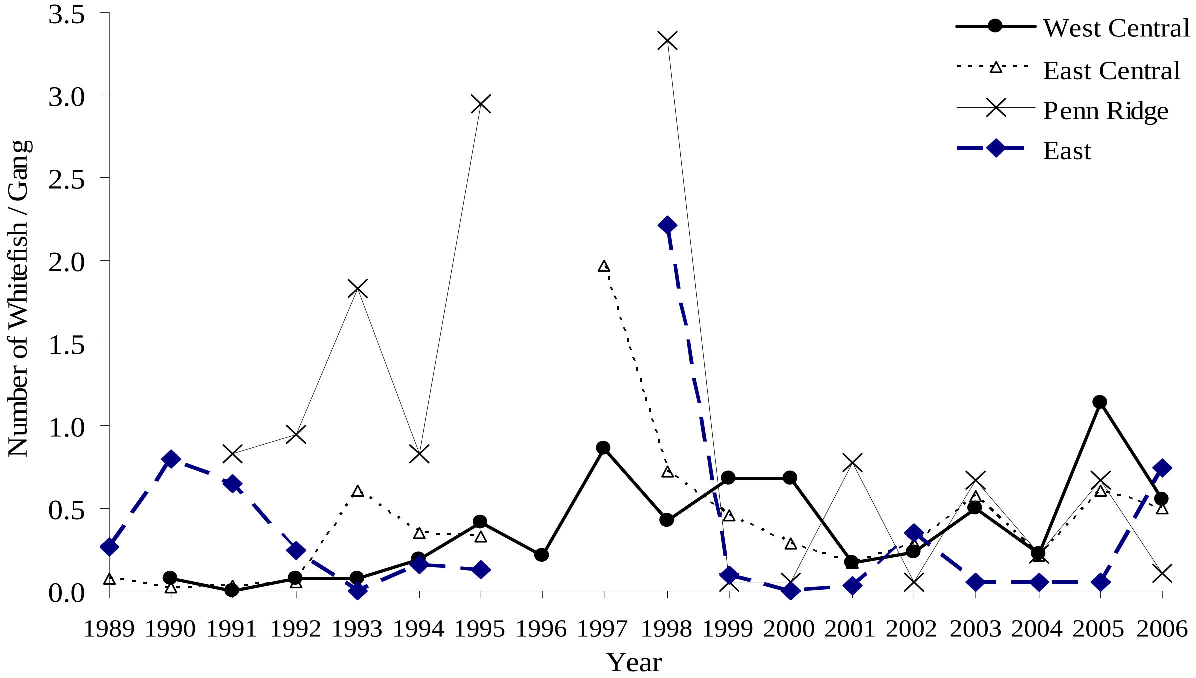


Figure 2.10. Catch rate (number per gang) of lake whitefish from Ontario partnership index gill netting by basin, Lake Erie, 1989-2006. West central basin was not surveyed in 1989. East central basin was not surveyed in 1996. East basin was not surveyed in 1996 and 1997. The Pennsylvania Ridge was not surveyed in 1989, 1990, 1996, and 1997. Includes canned (suspended) nets, excludes thermocline sets. Rates standardized to equal effort among mesh sizes.

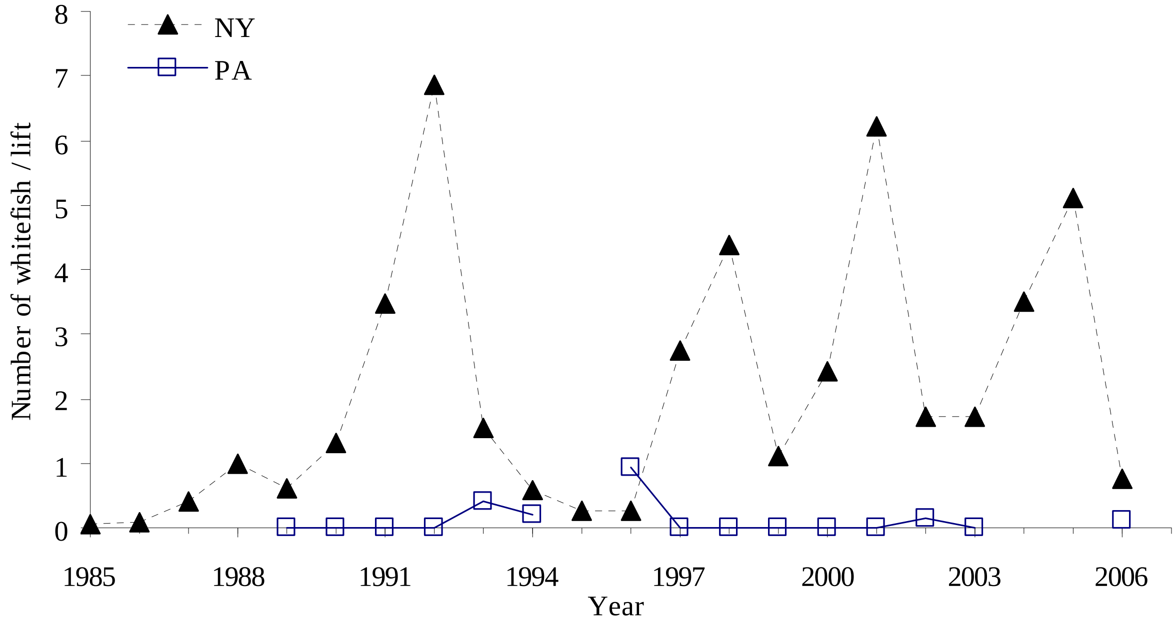


Figure 2.11. Catch per effort (number fish/lift) of lake whitefish caught in standard assessment gill nets from New York waters of Lake Erie, August 1985-2006 (triangles) and Pennsylvania August gill net assessment 1989-2006 (squares). Pennsylvania index surveys were not performed in 1995, 2004 and 2005.

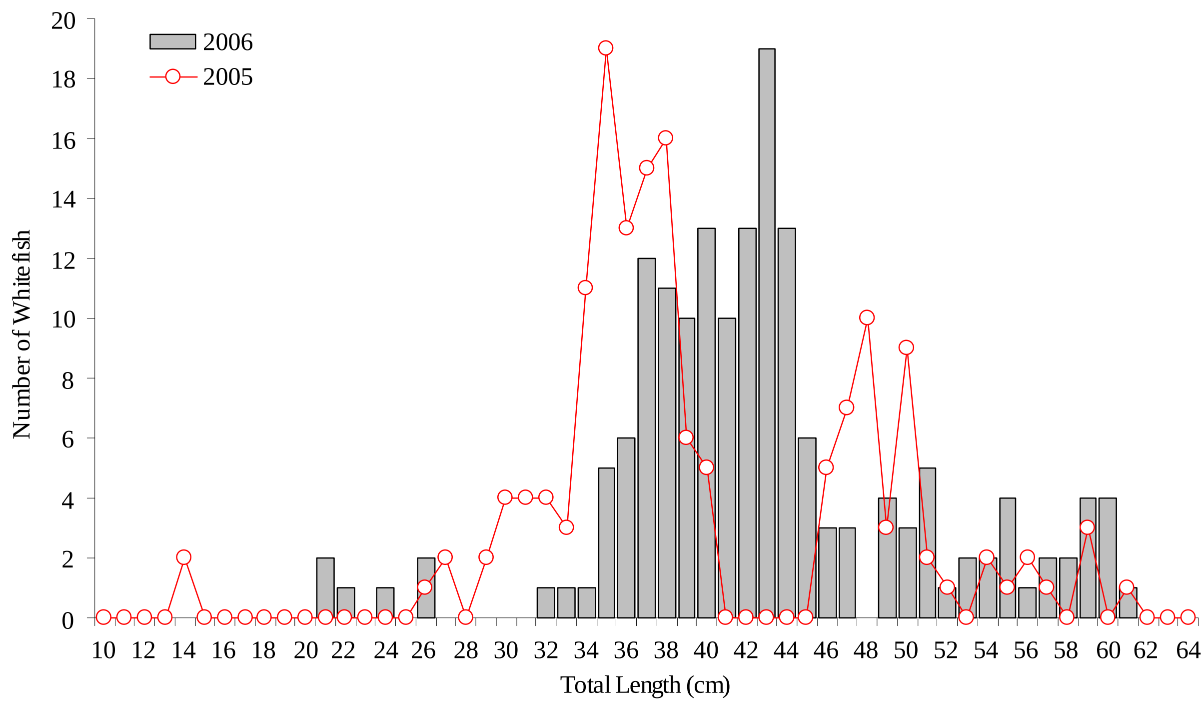


Figure 2.12. Length frequency distributions of lake whitefish collected during Ontario lakewide Partnership index fishing in 2005 and 2006. Rates standardized to equal effort among mesh sizes.

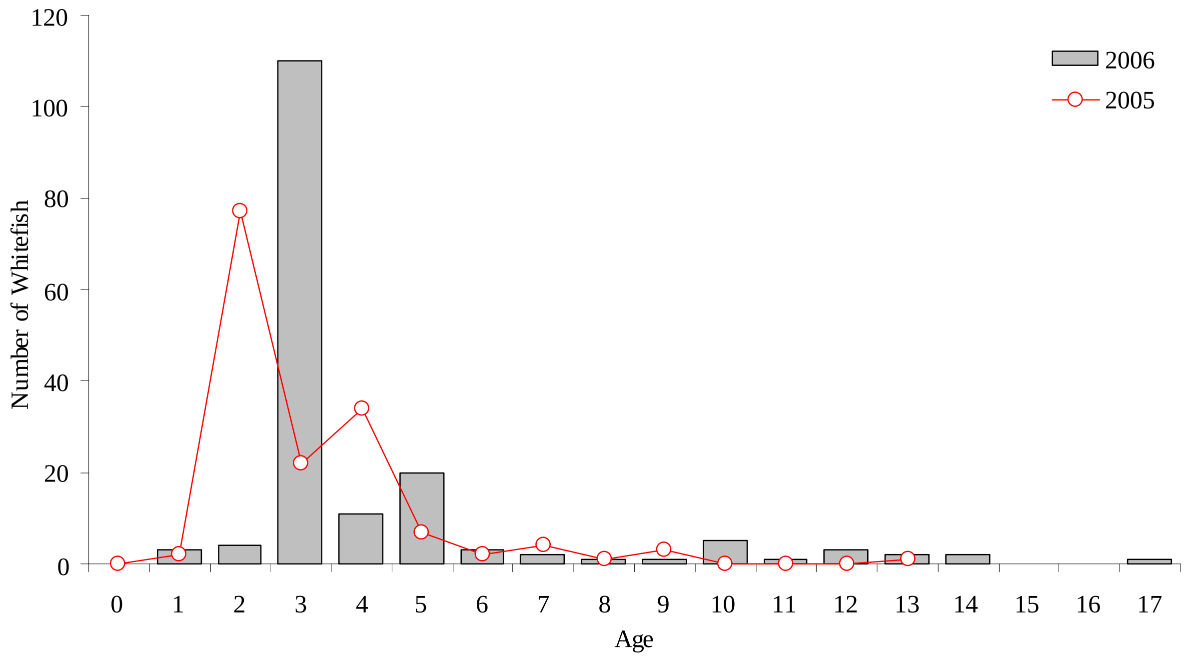


Figure 2.13. Age-frequency distributions of lake whitefish collected during Ontario lakewide Partnership surveys in 2005 and 2006. Rates standardized to equal effort among mesh sizes.

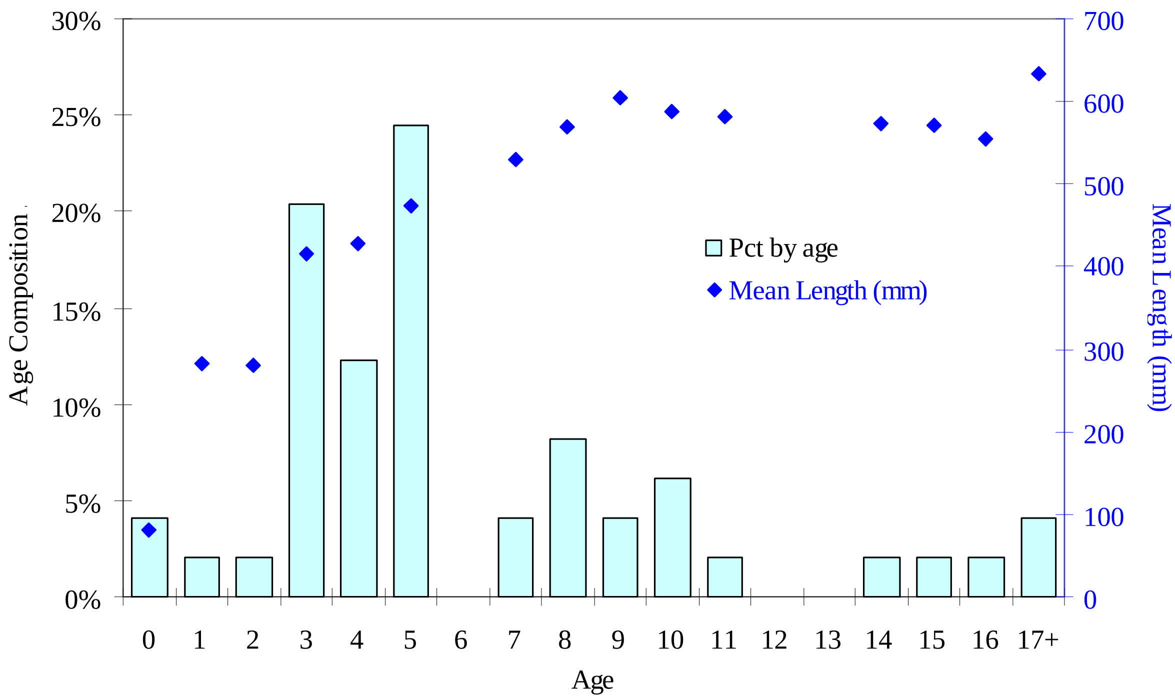


Figure 2.14. Age distribution and mean length-at-age of lake whitefish collected during trawl and gill net assessment surveys in Ohio waters of Lake Erie during 2006 (N=49).

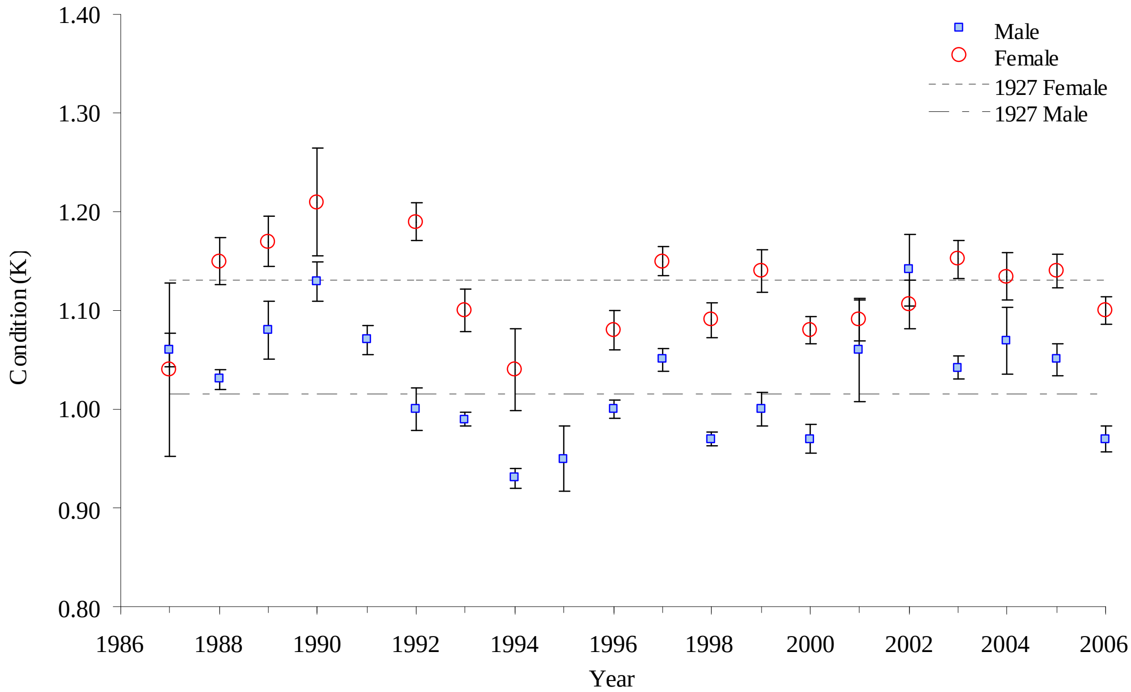


Figure 2.15. Mean condition factor of ages 4 and older lake whitefish by sex from Oct.-Dec. 1987-2006 with one standard error. Whitefish were collected from Ontario commercial fish, Partnership and whitefish index samples. Historic mean condition (1927–1929), presented as dashed lines, was calculated from Van Oosten and Hile (1947).

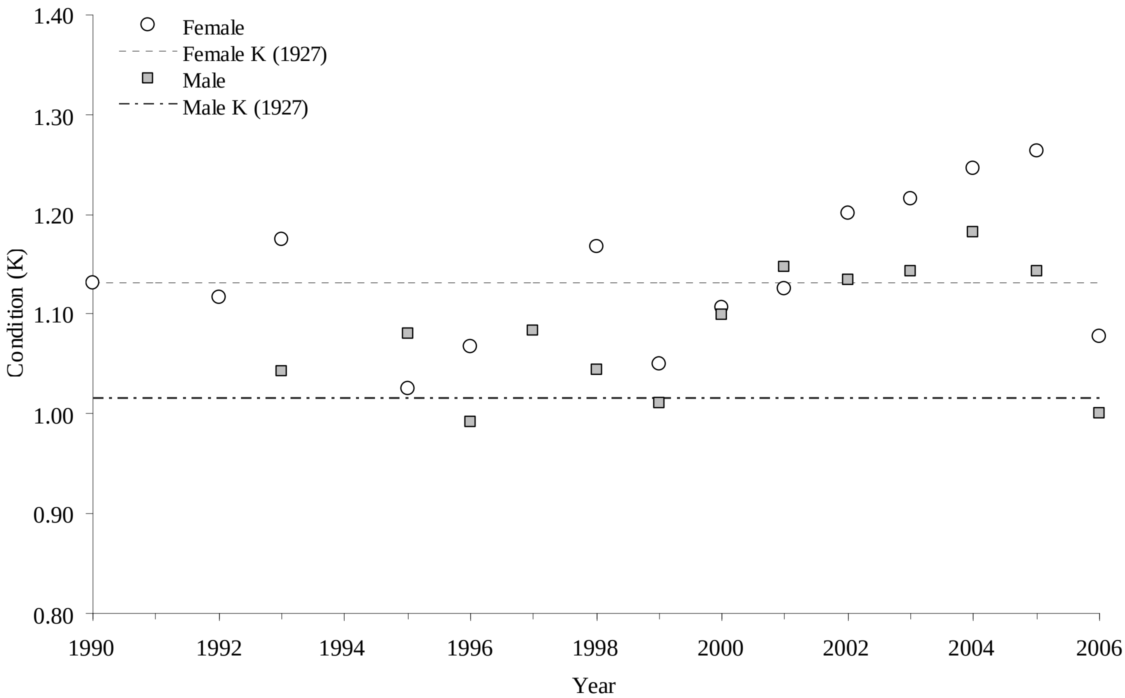


Figure 2.16. Condition (K) factor of ages 4 and older lake whitefish sampled during Ohio Division of Wildlife assessment surveys in the central basin of Lake Erie, May-October 2006.

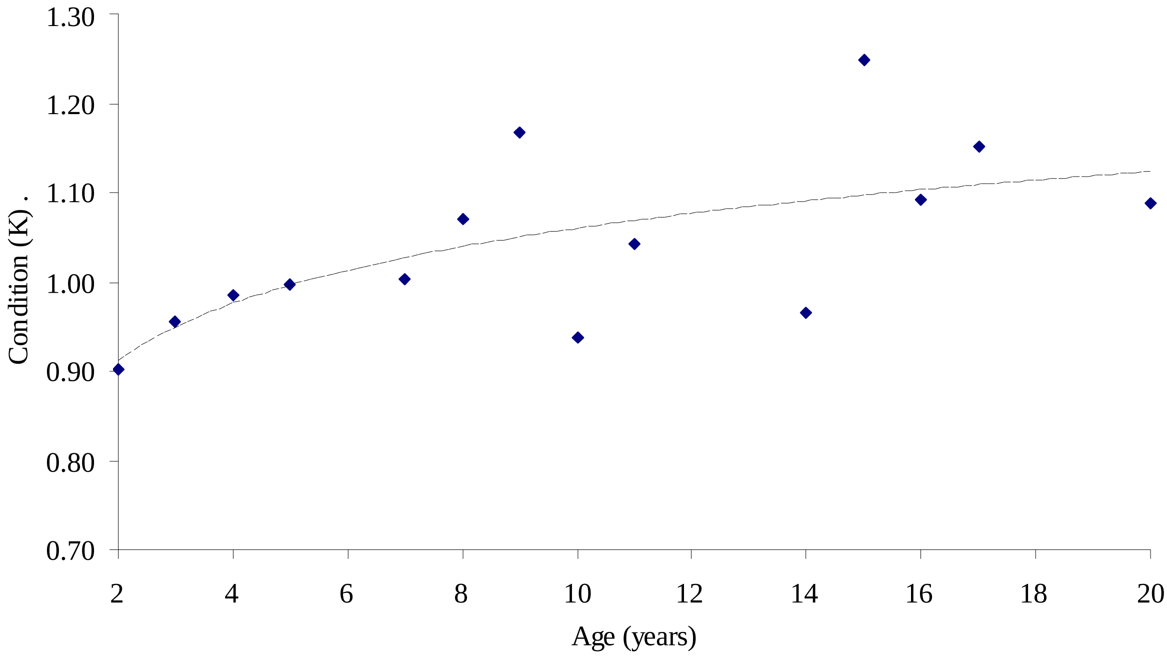


Figure 2.17. Mean condition (K) factor vs. age of lake whitefish (ages 2 and older) sampled during Ohio Division of Wildlife trawl and gill net assessment surveys in the central basin of Lake Erie, May-October 2006.

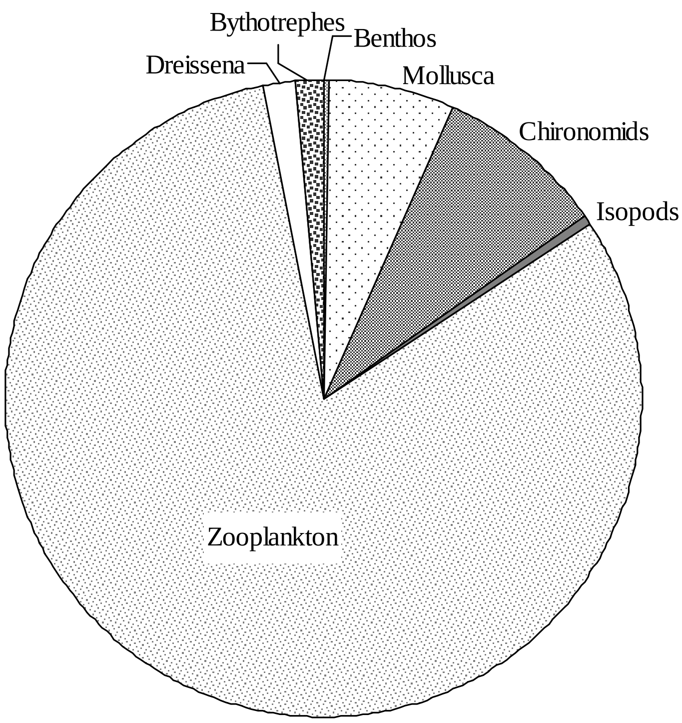


Figure 2.18 Stomach contents of lake whitefish by mean % wet weight collected from Lake Erie's central basin by Ohio Division of Wildlife trawls and gill nets from May-October, 2006.

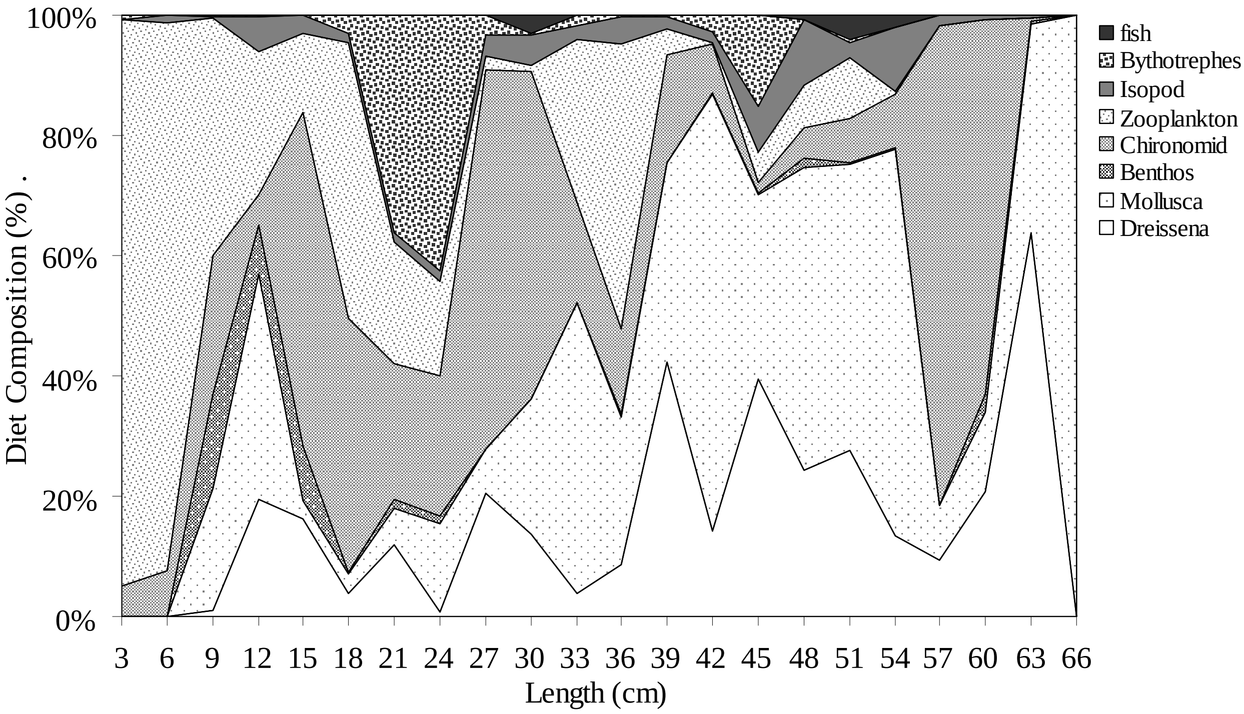


Figure 2.19 Stomach contents (mean % wet weight) of lake whitefish by length (cm) group collected in Lake Erie's central basin by Ohio Division of Wildlife trawl and gill net surveys from May to October, 1995-2006.

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

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, burbot 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 and the western and central basins of Ontario 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 (Coldwater Task Group 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. As a result, the commercial harvest in Ontario increased dramatically (Table 3.1). However, this market did not continue, resulting in declining annual harvests. The Ontario harvest is a bycatch from various fisheries. Half of the burbot bycatch in 2006 came from the lake whitefish commercial fishery, followed by the yellow perch (20%), and rainbow smelt commercial fishery (13 %). The total commercial harvest for burbot in Lake Erie during 2006 was 5,305 pounds which was the lowest recorded since 2003 (Table 3.1).

Assessment Programs

Burbot is one of the most commonly caught species in annual eastern basin coldwater gill net assessment surveys. In 2006, catch per unit of effort (CPE) and biomass per lift increased from levels recorded in 2005 in Ontario and New York waters (Figures 3.1 and 3.2). Burbot were not assessed in Pennsylvania waters in 2004 or 2005, but CPE in 2006 was greater than levels recorded in 2003, and was the highest since 2000. Biomass per lift in Pennsylvania in 2006 was the highest ever recorded for the jurisdiction on this survey. 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 general, burbot in New York waters exhibited a slower, but steady increase in CPE during 1993-2004, dropping in 2005 and increasing again in 2006.

Burbot is one of the target species in the OMNR Partnership gill net assessment surveys 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 four-fold increase in catch occurring between 1995 and 1998 (Figure 3.3). 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 in the Pennsylvanian Ridge basin showed an alternating pattern from 1999 through 2004, with the highest CPE recorded in 2003. This pattern did not continue in 2005 and 2006. Instead the CPE dropped to levels similar to the catches of the early 1990s. The catch in the east basin has generally been declining from a high in 1998 through 2006, also similar to catches of the early 1990s.

Mean total length and mean mass of burbot in New York and Ontario in 2006 increased from 2005 levels, continuing an increasing trend in size since the late 1990s (Figures 3.4 and 3.5). Although mean total length of burbot in Pennsylvania waters was slightly smaller in 2006 than in 2003, mean mass in 2006 was greater than mean mass in 2003, continuing an overall increasing trend in size since 1998.

Diet

Seasonal diet information for burbot is not available based on current sampling protocols. Diet information was limited to fish caught during August 2006 coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of stomach contents revealed a diet made up almost exclusively of fish (Figure 3.6). Burbot diets continued to be diverse with eight fish and two invertebrate species found in stomach samples (Figure 3.6). Round gobies were the dominant prey item, occurring in 42% of the burbot stomachs, followed by rainbow smelt (26% occurrence). Other identifiable taxa were found in less than 5% of the stomachs and included shiners, yellow perch, alewife, white perch, freshwater drum, trout perch, dreissenids and *Bythotrephes*.

Gobies have increased in the diet of burbot since they first appeared in the eastern basin in 1999 (Figure 3.7). They were the main forage item for burbot in three of the last four years in New York waters. Smelt were the dominant prey in 2005, but round goby became the dominant prey again in 2006.

References

Coldwater Task Group. 1997. Report of the Lake Erie Coldwater Task Group, March 1997. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Table 3.1. Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980 -2006.

Year	New York	Pennsylvania	Ohio	Ontario	Total
1980	0.0	2.0	0.0	0.0	2.0
1981	0.0	2.0	0.0	0.0	2.0
1982	0.0	0.0	0.0	0.0	0.0
1983	0.0	2.0	0.0	6.0	8.0
1984	0.0	1.0	0.0	1.0	2.0
1985	0.0	1.0	0.0	1.0	2.0
1986	0.0	3.0	0.0	2.0	5.0
1987	0.0	0.0	0.0	4.0	4.0
1988	0.0	1.0	0.0	0.0	1.0
1989	0.0	4.0	0.0	0.8	4.8
1990	0.0	15.5	0.0	1.7	17.2
1991	0.0	33.4	0.0	1.2	34.6
1992	0.7	22.2	0.0	5.9	28.8
1993	2.6	4.2	0.0	3.1	9.9
1994	3.0	12.1	0.0	6.8	21.9
1995	1.9	30.9	1.2	8.9	42.9
1996	3.4	2.3	1.2	8.6	15.4
1997	2.9	8.9	1.7	7.4	20.9
1998	0.2	9.0	1.5	9.9	20.5
1999	1.0	7.9	1.1	394.8	404.8
2000	0.1	3.5	0.1	30.1	33.8
2001	0.4	4.4	0.0	6.5	11.2
2002	0.9	5.2	0.1	3.4	9.5
2003	0.1	1.8	0.2	2.3	4.4
2004	0.5	2.4	0.9	5.4	9.2
2005	0.7	2.2	0.4	10.0	13.3
2006	0.9	1.7	0.3	2.4	5.3

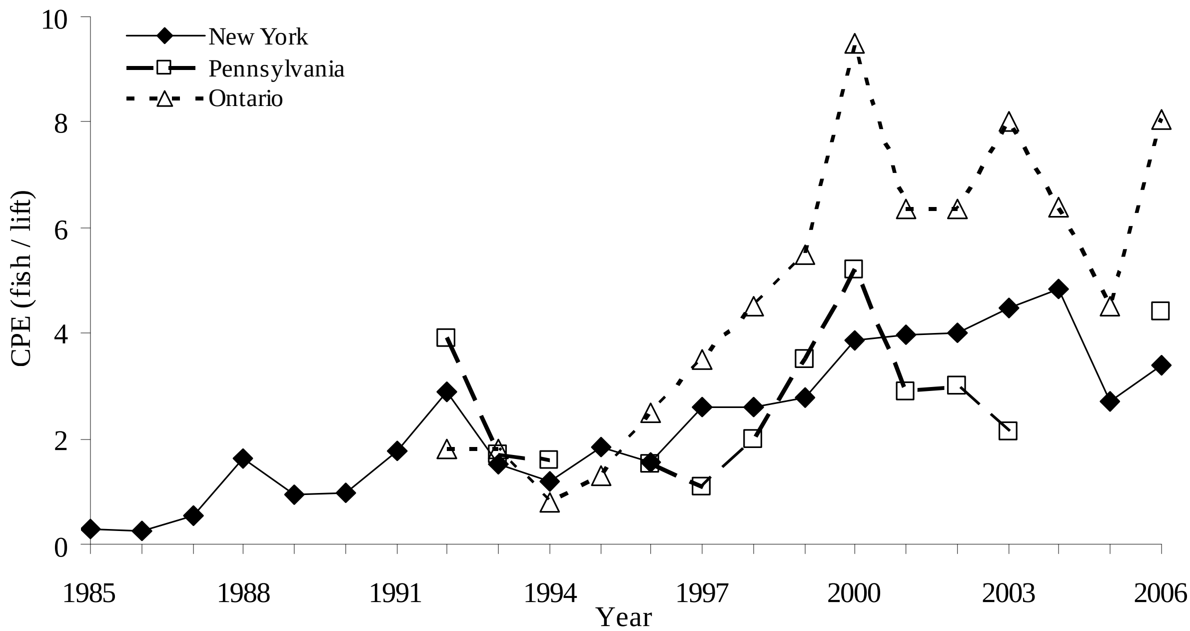


Figure 3.1. Average burbot catch rate (fish/lift) from summer gill net assessment by jurisdiction, 1985-2006.

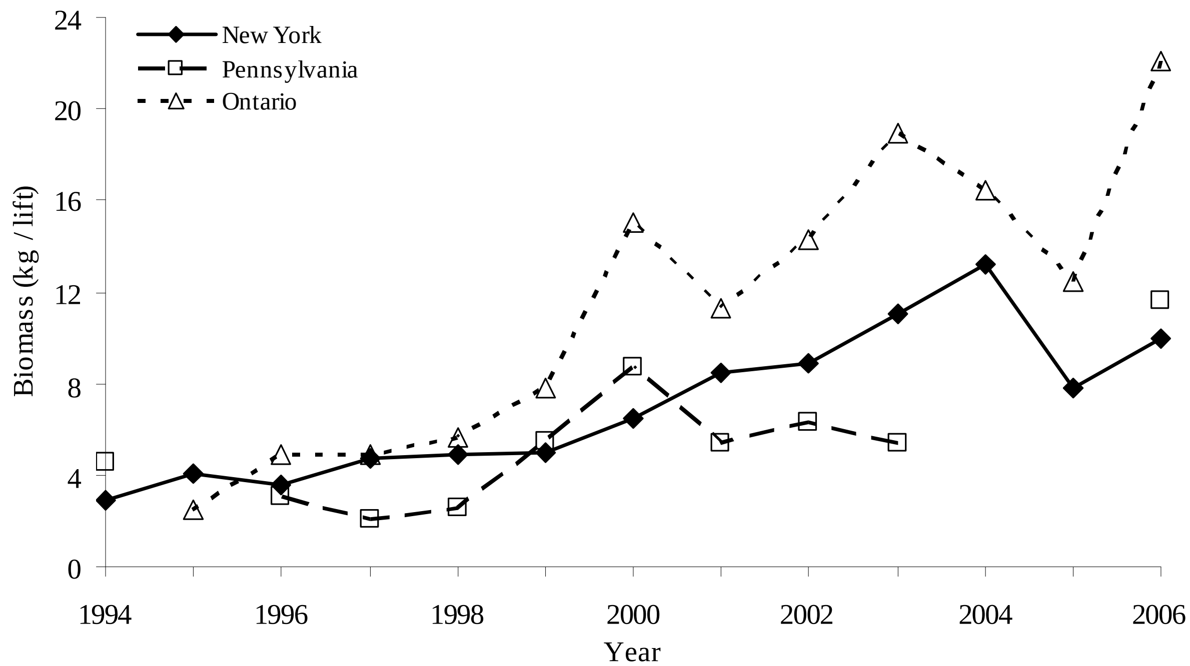


Figure 3.2. Average burbot biomass (kg/lift) from summer gill net assessment by jurisdiction, 1994-2006.

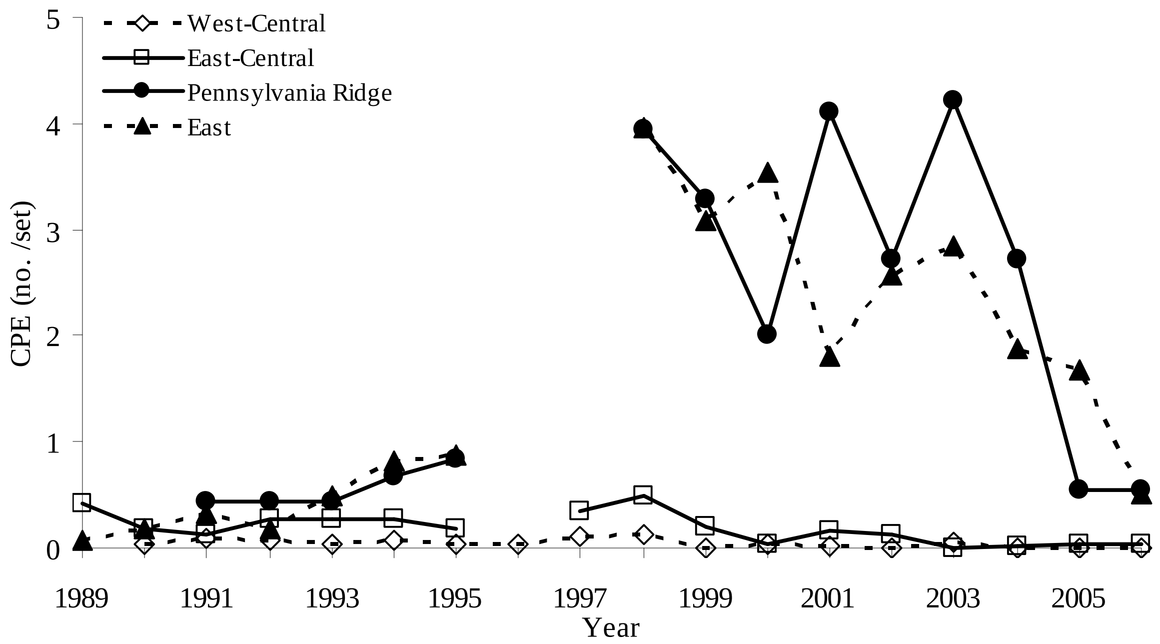


Figure 3.3. Burbot CPE by basin from the OMNR Partnership Index Fishing Program, 1989-2006 (includes canned and bottom nets; all mesh sizes, except thermocline sets).

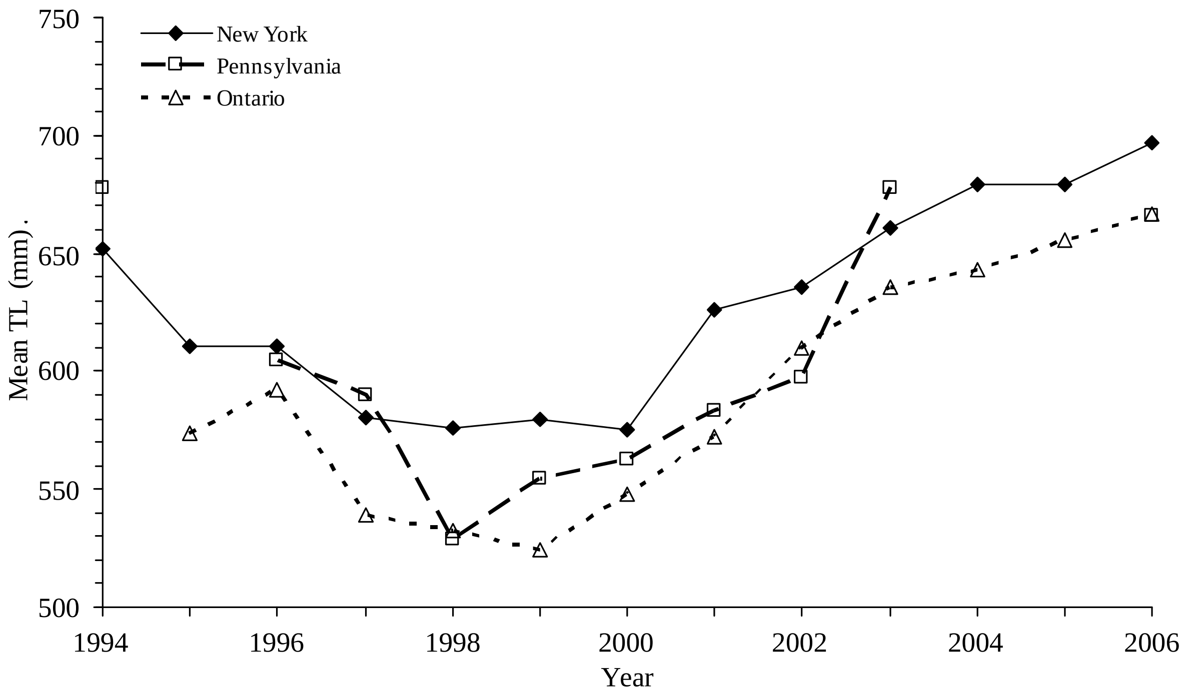


Figure 3.4. Average total length (TL in mm) of burbot caught in summer gill net assessments by jurisdiction during 1994-2006.

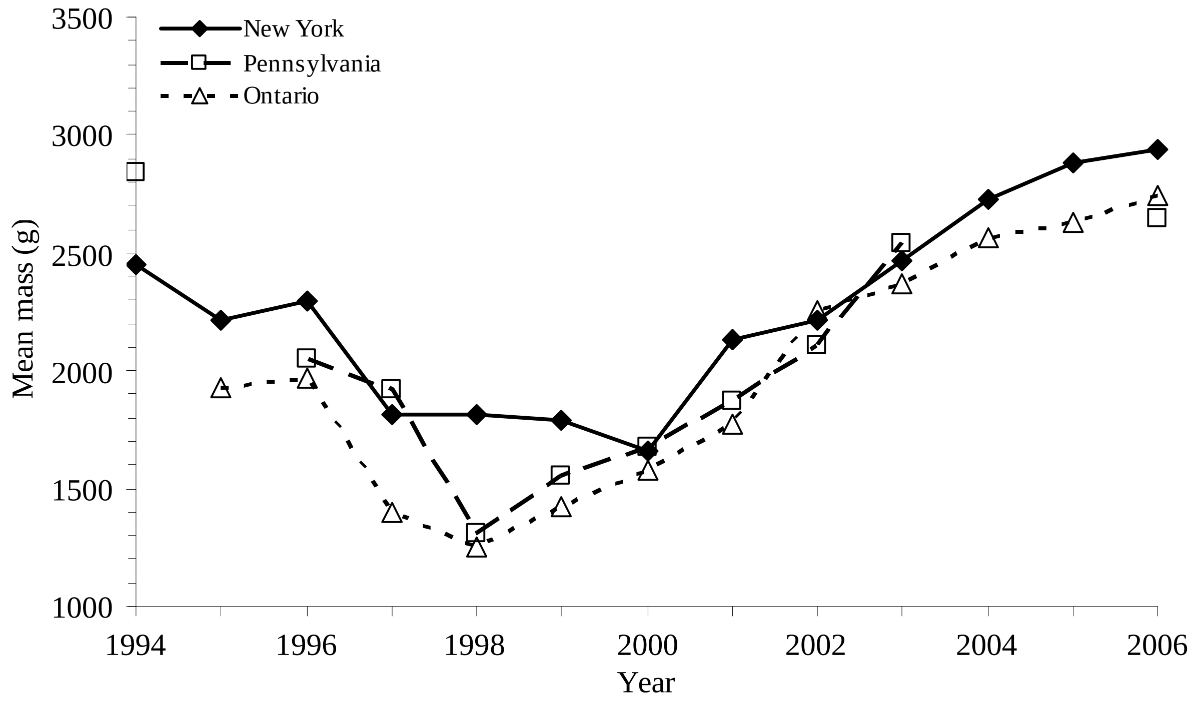


Figure 3.5. Average mass of burbot caught in summer gill net assessments by jurisdiction during 1994-2006.

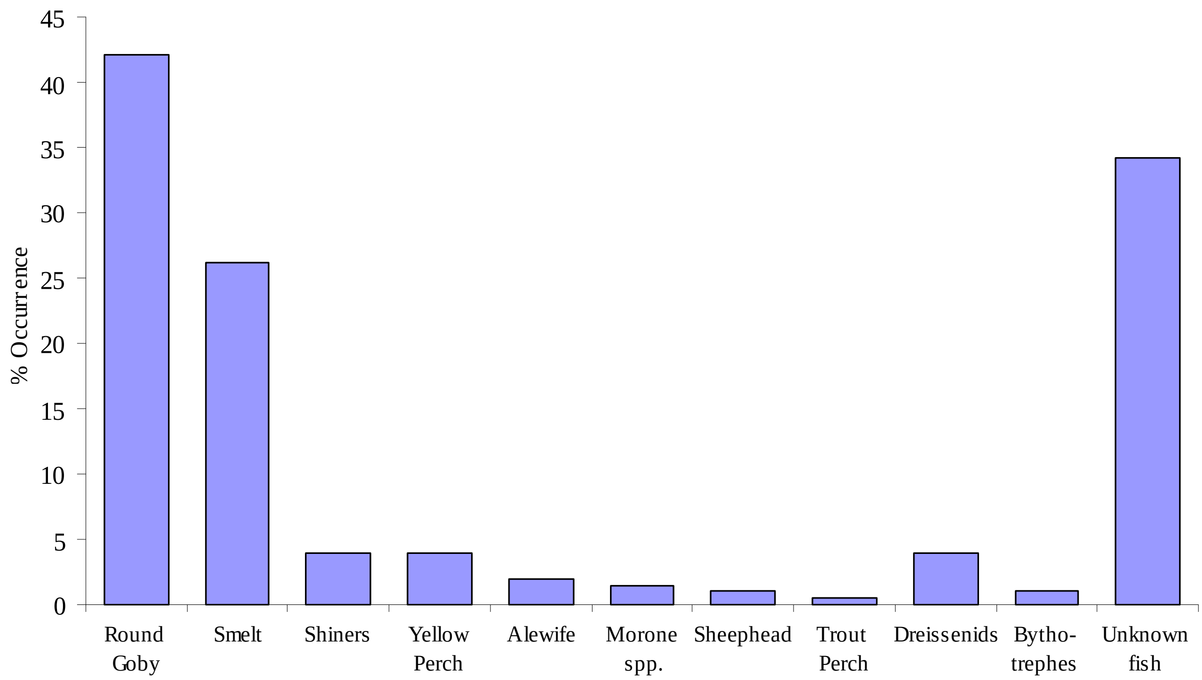


Figure 3.6. Frequency of occurrence of prey items in the diet of burbot sampled in gill nets from the eastern basin of Lake Erie, August, 2006. Sample size is 202 stomachs.

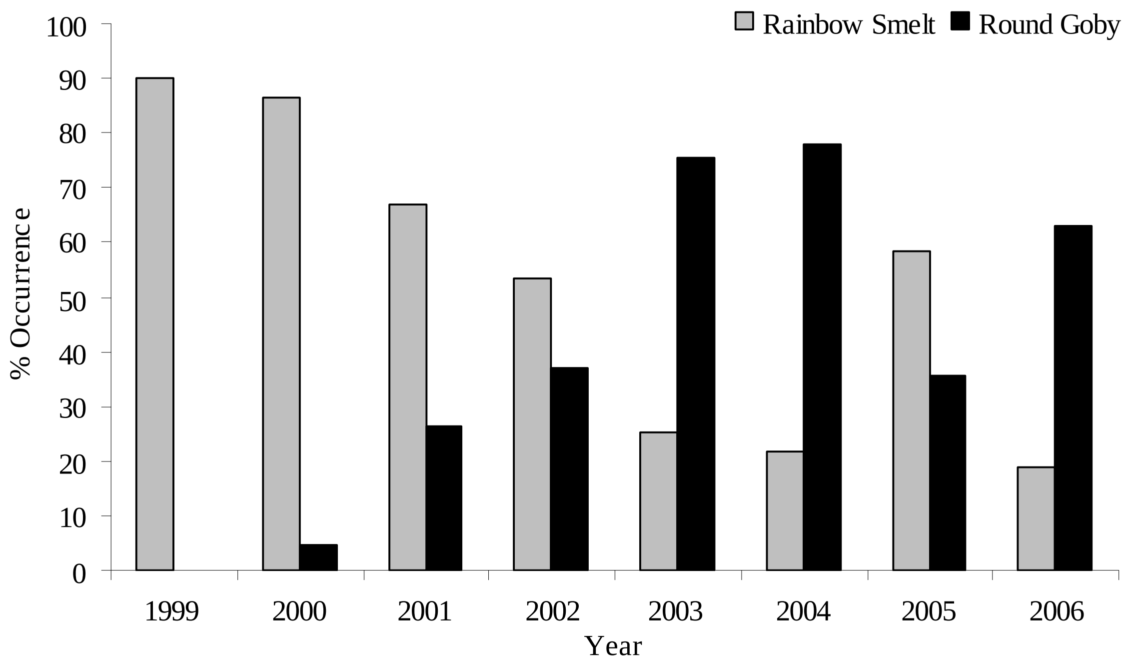


Figure 3.7. Percent occurrence of smelt and round gobies in the diet of burbot caught in NYSDEC coldwater assessment gill nets, August, 1999-2006.

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.

Michael Fodale (USFWS), Fraser Neave (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 lampricide treatment and implementation of alternative control methods. The Lake Erie Coldwater Task Group has provided the forum for the discussion of concerns about wounding and lake trout mortality.

2006 Lake Trout Wounding Rates

The observed A1-A3 wounding rate on lake trout greater than 21 inches total length was 16.0 wounds per 100 fish during 2006 (Figure 4.1). This was slightly lower than 2005 (17.0 wounds/100 fish), but still over three times higher than the target rate of 5 wounds per 100 fish (Lake Trout Task Group 1985). Wounding rates have remained well above target for 10 of the last 11 years following relaxed lamprey control measures during the mid-1990's. Sea lampreys continue to target larger fish with lake trout over 29 inches receiving the highest percentage of fresh wounds (Table 4.1) followed by fish in the 25-29 inch range. 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 2006 was 0.024 wounds per adult lake trout greater than 21 inches, which was lower than 2005 (0.03) but still above the series average of 0.021 wounds/fish (Figure 4.2). A1 wounding rates have remained at or above average for nine of the last ten years, but the rate has remained stable since 2000. All A1 attacks occurred on lake trout >25 inches in length (Table 4.1).

Past years' cumulative attacks are indicated by A4 wounds. The 2006 A4 wounding rate increased for the fourth consecutive year to 70.4 wounds per 100 fish for lake trout greater than 21 inches (Figure 4.3). This is the highest A4 wounding rate in the time series, which includes pre-treatment years, and 3.7 times the series average of 19.2 wounds/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). Twenty-nine of the 45 lake trout sampled over 29 inches in length (64.4%) possessed A4 lamprey wounds, and many of these fish had multiple wounds.

Population projections using the task group's Lake Erie Lake Trout Population Model indicate that sea lamprey control is one of the major influences on the lake trout population in Lake Erie. Adult lake trout populations cannot reach levels needed for successful rehabilitation efforts without effective sea lamprey control (Coldwater Task Group 2006). Unfortunately, adult lake trout, especially the larger fish over 29 inches, continue to decline rapidly within the lake trout population, presumably due to high lamprey mortality. Almost 1/3 of the lake trout over 29 inches exhibited recent lamprey attacks, and the average number of A4 wounds per fish was greater than one. Estimates from recently stocked Superior-strain year classes indicate that survival is only half of what it was when sea lamprey wounding rates were below target levels (see Charge 1). Mortality estimates based upon wounding rates (Swink 2003) show that 34% of the adult population died from lamprey attacks in 2005 with the majority of those losses occurring in the larger adults. Another estimate of the sea lamprey induced mortality rate based on fresh wounding (Woldt et al. 2004) observed during 2006 was 0.15 for lake trout over 25 inches. In order to proceed with successful lake trout rehabilitation, consistent measures will need to be taken to reduce mortality and increase survival of the adult lake trout population to allow it to attain levels where successful natural reproduction is possible.

The susceptibility of Klondike strain lake trout to sea lamprey attacks should become more evident during 2007 as they grow into size ranges preferred by sea lampreys. This lake trout strain appears to be bottom-oriented based upon diet studies, and this could mean that it will have a high affinity for lamprey attacks. Superior strain lake trout have been shown to have higher sea lamprey induced mortality compared to the Finger Lakes strain (Schneider et al. 1996) due to their environmental preferences (Swink 2003), and increased wounding rates may be partially due to these fish comprising the majority of the current adult lake trout population (Swink 1991). Strain-specific sea lamprey mortality will undoubtedly play a major role in guiding lake trout strain selection for future rehabilitation efforts in Lake Erie.

2006 Actions

Control efforts continued by GLFC agents during 2006 with lampricide treatments in 3 U. S. tributaries (Grand River and Conneaut and Crooked creeks) and 2 Canadian tributaries (Big and Young's creeks). Assessments were conducted in Cattaraugus Creek to rank it for possible lampricide treatment during 2007. Another 26 streams (11 U.S., 15 Canada) and an area offshore of one U.S. tributary were surveyed to search for new or monitor existing populations. For the second consecutive years, larval assessment surveys seeking upstream recruitment above the washed out barrier at Daniels Park on the Chagrin River did not find any larval sea lampreys.

The estimated number of spawning-phase sea lampreys decreased slightly from 17,475 during 2005 to 15,874 during 2006 (Figure 4.4). The confidence intervals for the 2006 estimate are much more comparable to the 1999-2003 period, due largely to the successful operation of the Big Creek barrier and trap. A total of 1,943 spawning-phase sea lampreys were trapped in four tributaries (2 U.S., 2 Canada) during 2006, an increase of about 226% when compared to 2005 catches.

A study of paired quantitative assessment sampling and catch-per-unit-effort sampling was conducted in Cattaraugus Creek as part of a larger three-year project to test a potentially more efficient sampling method for an alternative model of stream selection for lampricide treatments. This is a GLFC-sponsored research project with Dr. Michael Jones of Michigan State University as the principle investigator.

2007 Plans

Sea lamprey management plans for Lake Erie during 2007 include lampricide treatment of Cattaraugus and Big Otter creeks and are based on a comparison of cost-per-transformer kill estimates for all Great Lakes streams that were quantitatively assessed during 2006. Larval assessments are planned on 16 streams (11 U.S., 5 Canada). Three of these streams (all U.S) will be ranked during 2007 for potential lampricide treatment during 2008. Adult assessment traps likely will be operated on four streams (2 U.S., 2 Canada) and an estimate of the lake-wide spawning-phase abundance will be conducted during 2007. Work will continue with researchers on the comparison of quantitative assessment sampling and catch-per-unit-effort sampling in developing an alternative stream selection model for lampricide treatments.

References

Lake Trout Task Group. 1985. A sea lamprey management plan for Lake Erie. Report to the Great Lakes Fishery Commission, Lake Erie Committee, Ann Arbor, Michigan, USA.

Coldwater Task Group. 2006. Report of the Lake Erie Coldwater Task Group, March 2006. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Schneider, C.P., R.W. Owens, R.A. Bergstedt, and R. O'Gorman. 1996. Predation by sea lamprey (*Petromyzon marinus*) on lake trout (*Salvelinus namaycush*) in southern Lake Ontario, 1982-1992. Canadian Journal of Fisheries and Aquatic Sciences 53(9): 1921-1932.

Swink, W.D. 1991. Host-size selection by parasitic sea lampreys. Transactions of the American Fisheries Society 120: 637-643.

Swink, W.D. 2003. Host selection and lethality of attacks by sea lampreys (*Petromyzon marinus*) in laboratory studies. Journal of Great Lakes Research 29 (Supplement 1): 307-319.

Woldt, A.P., S.P. Sitar, J.R. Bence, and M.P. Ebener. 2004. Summary status of lake trout and lake whitefish populations in the 1836 treaty-ceded waters of Lakes Superior, Huron, and Michigan in 2002, with recommended yield and effort levels for 2003. Report of Modeling Subcommittee to the Technical Fisheries Review Committee of Great Lakes Fishery Commission, Ann Arbor, Michigan, USA. 124 pp.

Table 4.1. Frequency of sea lamprey wounds observed on several standard length groups of lake trout collected from standard mesh gill nets in New York waters of Lake Erie, August 2006.

Size Class Total Length (in.)	Sample Size	No. fish with fresh wounds	Wound Classification A1	A2	A3	A4	% with A1-A3 wounds	No. A1-A3 wounds per 100 fish
17 - 21	44	0	0	0	0	0	0.0	0.0
21 - 25	37	1	0	0	1	1	2.7	2.7
25 - 29	130	15	3	6	9	100	11.5	13.9
>29	45	14	2	5	8	49	31.1	33.3
>21	212	30	5	11	18	150	14.2	16.0

Table 4.2. Larval sea lamprey assessments of Canadian Lake Erie tributaries during 2006 and plans for 2007.

Stream	**History**	**Surveyed in 2006**	**Survey Type**	**Results**	**Plans for 2007**
Detroit River	Negative	Yes	Detection	Negative	None
Kettle Creek	Negative	Yes	Detection	Negative	None
East Creek	Positive	Yes	Evaluation	Negative	None
Big Otter Creek	Positive	Yes	Evaluation	Positive	Distribution
Clear Creek	Positive	Yes	Evaluation	Negative	None
Big Creek	Positive	Yes	Distribution	Positive	Treatment Evaluation
Dedrich Creek	Negative	Yes	Detection	Negative	None
Forestville Creek	Positive	Yes	Evaluation	Negative	None
Normandale Creek	Positive	Yes	Evaluation	Negative	None
Fishers Creek	Positive	Yes	Evaluation	Negative	None
Lynn River	Negative	Yes	Detection	Negative	None
Nanticoke Creek	Negative	Yes	Detection	Negative	None
Sandusk Creek	Negative	Yes	Detection	Negative	None
Grand River, ON	Positive	Yes	Evaluation	Negative	None
Welland River	Positive	Yes	Evaluation	Negative	None
Catfish Creek	Positive	No			Evaluation
Silver Creek	Positive	No			Evaluation
Young’s Creek	Positive	No			Treatment Evaluation

[1]*Quantitative survey* – conducted to estimate larval population and larvae expected to metamorphose in the following year. Projected treatment cost is divided by the metamorphosed sea lamprey estimate to provide a ranking against other Great Lakes tributaries for lampricide treatment.

[2]*Evaluation survey* – conducted to determine requirement for quantitative assessment.

[3]*Detection survey* – conducted to determine larval presence or absence in streams with no history of sea lamprey infestation.

[4]*Distribution survey* – conducted to determine instream geographic distribution or to determine lampricide treatment application points.

[5]*Treatment Evaluation survey* – conducted to determine if the relative abundance of survivors from a lampricide treatment is large enough to warrant a Quantitative survey.

Table 4.3. Larval sea lamprey assessments of U.S. Lake Erie tributaries during 2006 and plans for 2007.

Stream	**History**	**Surveyed in 2006**	**Survey Type**	**Results**	**Plans for 2007**
Buffalo River	Positive	Yes	Evaluation	Negative	None
Delaware Creek	Positive	Yes	Treatment Evaluation	Negative	*Quantitative*
Cattaraugus Creek	Positive	Yes	*Quantitative*	Positive	Treatment Evaluation
Halfway Brook	Positive	No			Evaluation
Canadaway Creek	Positive	No			*Quantitative*
Walnut Creek	Negative	Yes	Detection	Negative	None
Crooked Creek	Positive	Yes	Treatment Evaluation	Negative	None
Raccoon Creek	Positive	No			Evaluation
Turkey Creek	Negative	Yes	Detection	Negative	None
Conneaut Creek	Positive	Yes	Treatment Evaluation	Positive	Treatment Evaluation
Ashtabula River	Negative	Yes	Evaluation	Negative	Evaluation
Grand River, OH	Positive	Yes	Treatment Evaluation	Positive	None
Chagrin River	Positive	No			Evaluation
Euclid Creek	Negative	Yes	Detection	Negative	None
Rocky River	Negative	Yes	Detection	Negative	None
Black River, MI	Positive	No			*Quantitative*
River Rouge	Negative	No			Detection
Brownstone Creek	Negative	No			Detection

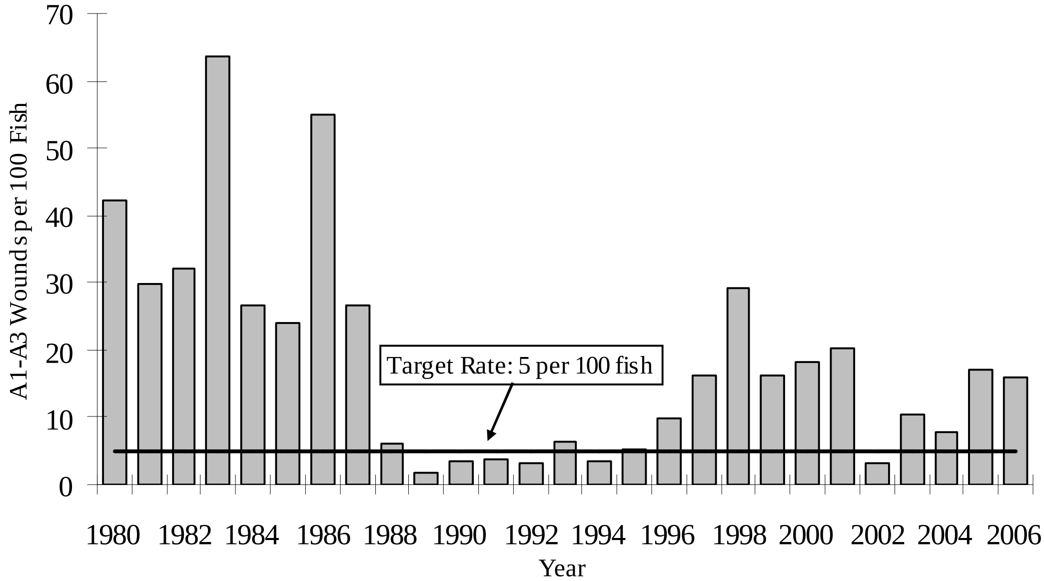


Figure 4.1. Number of fresh (A1-A3) sea lamprey wounds per 100 adult lake trout greater than 21 inches sampled in standard assessment gill nets from New York waters of Lake Erie, August - September, 1980-2006. The Strategic Plan target rate is 5%.

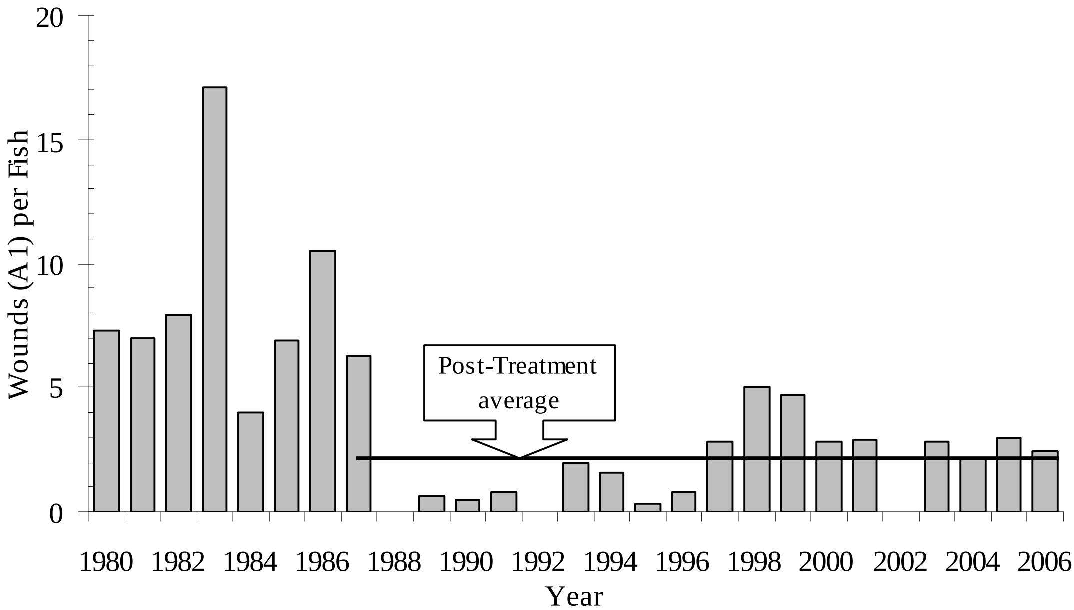


Figure 4.2. Number of fresh (A1) sea lamprey wounds observed per 100 adult lake trout greater than 21 inches sampled in standard assessment gill nets from New York waters of Lake Erie, August-September, 1980-2006. The post-treatment average includes 1987 through 2006.

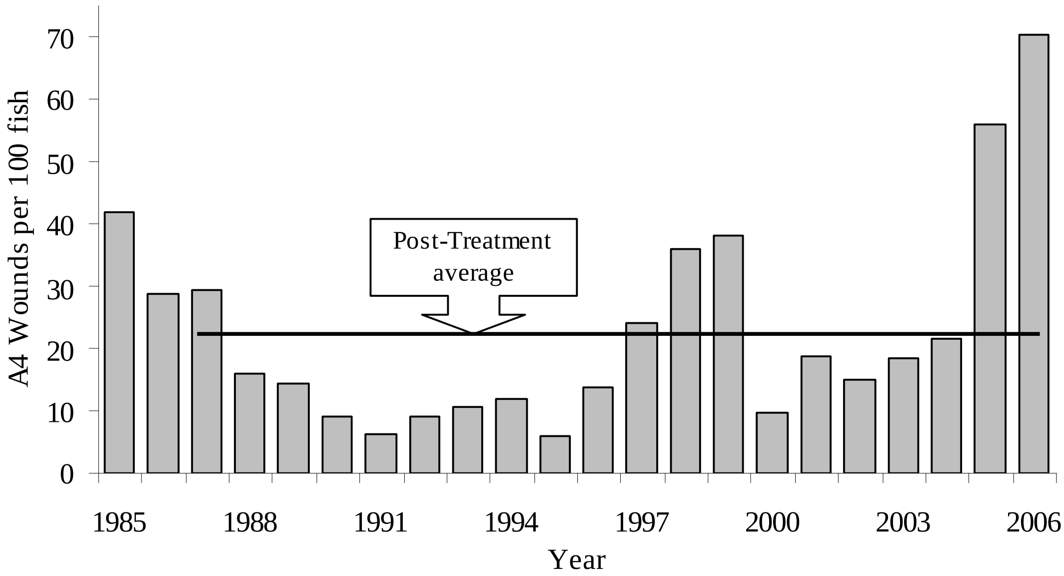


Figure 4.3. Number of healed (A4) sea lamprey wounds observed per 100 adult lake trout greater than 21 inches sampled in standard assessment gill nets from New York waters of Lake Erie, August, 1985-2006. The post-treatment average includes 1987 through 2005.

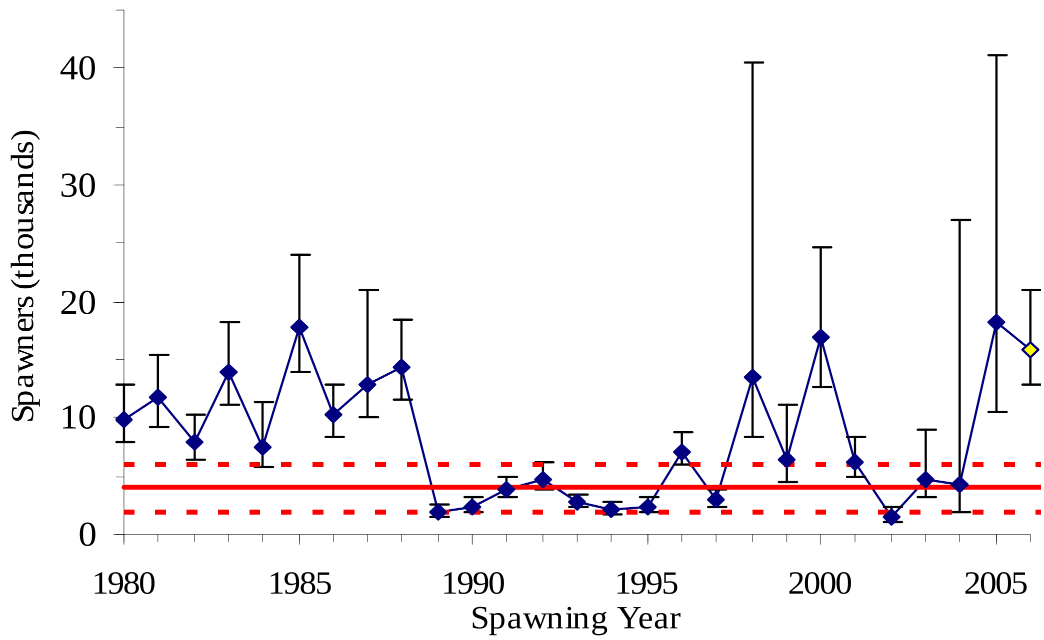


Figure 4.4. Lakewide estimate of spawning-phase sea lampreys with 95% confidence limits (dashed lines) in Lake Erie, 1980-2006. Solid line indicates spawner abundance target level.

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.

Chuck Murray (PFBC) and James Markham (NYSDEC)

Lake Trout Stockings

The current lake trout stocking goal of 160,000 yearlings was not met for the third consecutive year (Table 5.1; Figure 5.1). The shortage was due to the detection of Infectious Pancreatic Necrosis (IPN) in July 2005 and subsequent depopulation of the Allegheny National Fish Hatchery (ANFH). Lake Erie was initially without any lake trout for stocking in spring 2006, but 88,000 surplus yearlings destined for Lake Huron were redirected by the Ontario Ministry of Natural Resources (OMNR) and became available for Lake Erie. These Slate Island strain lake trout were raised at the Chatsworth Fish Hatchery and marked with left pectoral fin-clips instead of coded-wire tags. The fish were shore-stocked at Port Maitland on 18 April and 25 April 2006. Lake trout for 2007 stockings are currently being raised at two federal hatcheries in Vermont (White River and Pittsford), and these hatcheries will continue to raise lake trout for Lake Erie until renovations at the ANFH are completed and production is resumed.

Evaluation of five consecutive years of paired plantings of yearling lake trout to compare survival and growth rates of large versus small stocking size was continued in 2006. The plantings began in 2000. In general, the results of the first three years of stocking using Lake Superior (SUP) strain fish have favored the larger stocked fish at a ratio of 2:1 (Einhouse et al. 2005), and this has remained fairly consistent up to age 7 (Figure 5.2 a-c). Returns of the 2000 stocking (1999 year-class) have dwindled dramatically from age 4 through age 7 (Figure 5.2a), presumably due to sea lamprey mortality, and survival estimates for this once abundant year-class were low (S=0.367; ages 4-7; r^2 = 0.9993). Results of the last two years of the paired plantings (2003, 2004 stockings) using Finger Lakes (FL) strain fish remain inconclusive due to poor returns from either of these stockings (Figure 5.2 d-e). Overall smaller stocking sizes, especially in 2004, or differences in sampling availability (*i.e.* behavior) due to strain differences may be responsible for the poor return rates. However, excellent returns from Klondike strain lake trout stocked at similar sizes and at less densities than FL strain fish (31.6K vs. 40K) in 2004 indicate that behavior differences in strain or poor post-stocking survival is most likely contributing to poor returns of FL strain lake trout, not small stocking size. There were no significant differences in growth between any of the paired stockings. Growth differences observed at earlier ages (Einhouse et al. 2005) has diminished at older ages.

Stocking of Other Salmonids

In 2006, over two million yearling trout and salmon were stocked in Lake Erie, including rainbow trout/steelhead, brown trout and lake trout (Figure 5.3). Total salmonid stocking increased almost 6% from 2005, but was 3.3% below the long-term average (1989-2006). 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 (steelhead) in the Lake Erie watershed. Rainbow trout/steelhead accounted for nearly 93% of all salmonids stocked in 2006. A total of 2,083,010 yearling rainbow trout were stocked in 2006, representing a 5.4% increase from 2005. Steelhead stocking in 2006 was 16% higher than 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 (58%), followed by Ohio (24%), New York (13%), Michigan (3%), and

Ontario (2%). Details on strain composition and stocking location of rainbow trout are covered more extensively under Charge 6 of this report.

Brown trout stocking in Lake Erie totaled 67,185 yearlings in 2006. This represents an 8% decrease from 2005 and a 15% decrease from the long-term average. Slightly more than half (55%) of the brown trout stocked in Lake Erie were in New York waters for the purposes of providing an improved trophy brown trout fishery for offshore boat anglers and seasonal tributary anglers. The New York Department of Environmental Conservation (NYSDEC) began re-emphasizing brown trout stocking in place of domestic rainbow trout in 2002 for the purposes of diversifying their tributary trout/salmon fishery and for maintaining migratory behavior of their Salmon River steelhead strain. Pennsylvania stocked almost 30,000 brown trout in the Lake Erie basin. The majority of these fish (75%) were stocked for the opening day of trout season, and are managed according to standard put-and-take trout management strategies (9" minimum size limit). Similar to NYSDEC brown trout stocking objectives, about 7,300 brown trout were stocked by Pennsylvania Fish and Boat Commission cooperative non-governmental organizations (NGOs) directly into Lake Erie to provide offshore boat anglers and seasonal tributary anglers an opportunity to catch trophy lake run brown trout. Also in 2006, an Ontario NGO group stocked 175 brown trout into Young's Creek.

References

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.

Table 5.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2006.

YEAR	Agency	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/ Steelhead	Total
1990	**ONT.**	--	--	--	--	31,530	31,530
	NYSDEC	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**
1991	**ONT.**	--	--	--	--	98,200	98,200
	NYSDEC	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**
1992	**ONT.**	--	--	--	--	89,160	89,160
	NYSDEC	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**
1993	**ONT.**	--	--	--	650	16,680	17,330
	NYSDEC	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**
1994	**ONT.**	--	--	--	--	69,200	69,200
	NYSDEC	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**
1995	**ONT.**	--	--	--	--	56,000	56,000
	NYSDEC	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**
1996	**ONT.**	--	--	--	--	38,900	38,900
	NYSDEC	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**
1997	**ONT.**	--	--	--	1,763	51,000	52,763
	NYSDEC	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**

Table 5.1. (Continued) Summary of salmonid stockings in number of yearling equivalents, 1990-2006.

YEAR	Agency	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/ Steelhead	Total
1998	**ONT.**	--	--	--	--	61,000	61,000
	NYSDEC	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**
1999	**ONT.**			--		85,235	85,235
	NYSDEC	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**
2000	**ONT.**	--	--	--	--	10,787	10,787
	NYSDEC	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**
2001	**ONT.**	--	--	--	100	40,860	40,960
	NYSDEC	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**
2002	**ONT.**	--	--	--	4,000	66,275	70,275
	NYSDEC	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**
2003	**ONT.**	--	--	--	7,000	48,672	55,672
	NYSDEC	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**
2004	**ONT.**	--	--	--	--	34,600	34,600
	NYSDEC	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**
2005	**ONT.**	--	--	--	--	55,000	55,000
	NYSDEC	62,545	--		37,440	275,000	374,985
	PFBC	--	--	--	35,483	1,183,246	1,218,729
	ODNR	--	--	--	--	402,827	402,827
	MDNR	--	--	--	--	60,900	60,900
	2005 Total	**62,545**	**0**	**0**	**72,923**	**1,976,973**	**2,112,441**
2006	**ONT.**	88,000	--	--	175	44,350	132,525
	NYSDEC		--		37,540	275,000	312,540
	PFBC	--	--	--	29,470	1,205,203	1,234,673
	ODNR	--	--	--	--	491,943	491,943
	MDNR	--	--	--	--	66,514	66,514
	2006 Total	**88,000**	**0**	**0**	**67,185**	**2,083,010**	**2,238,195**

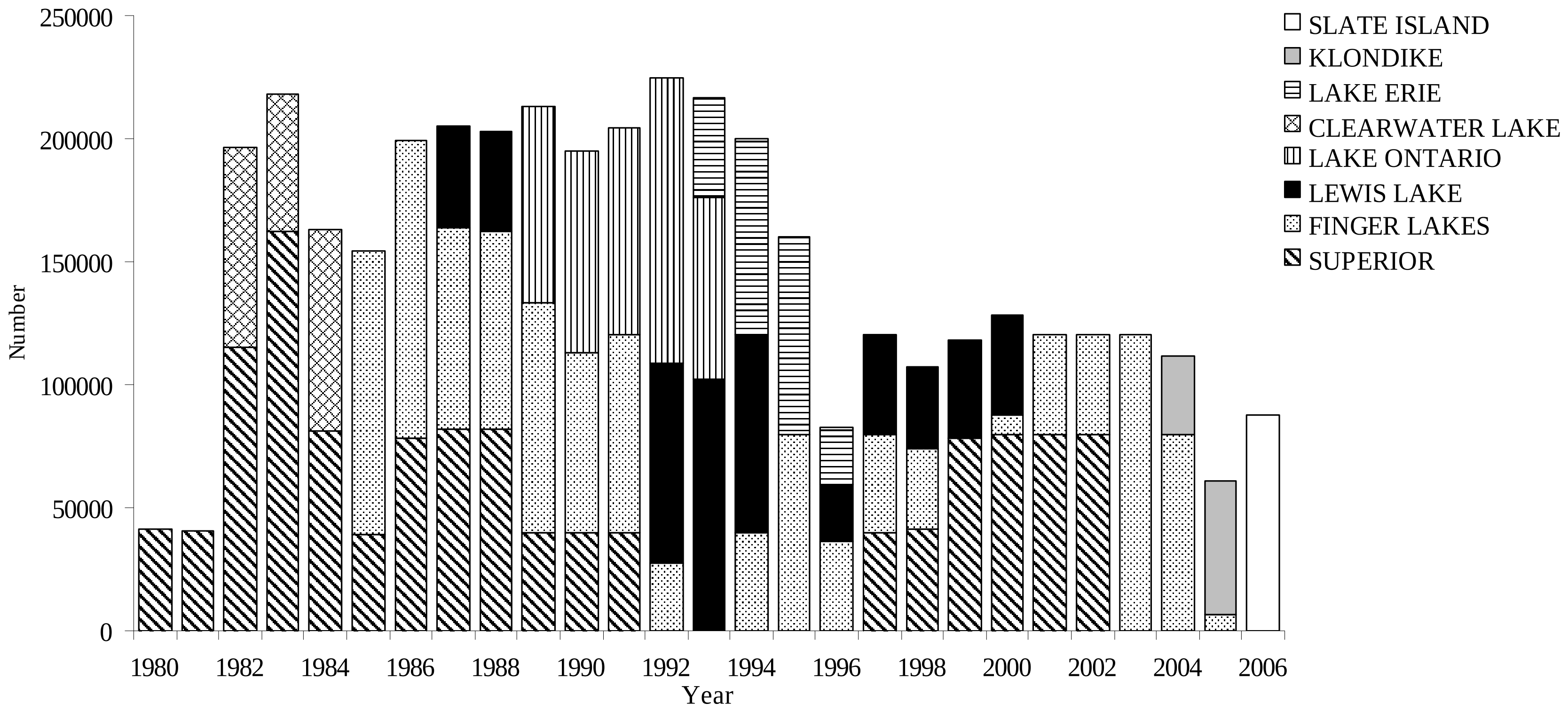
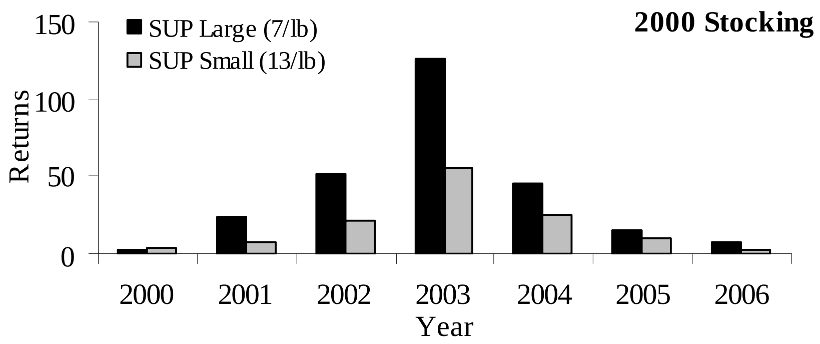
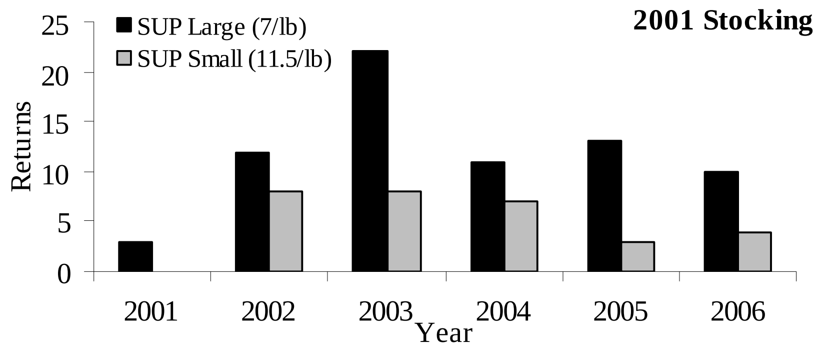
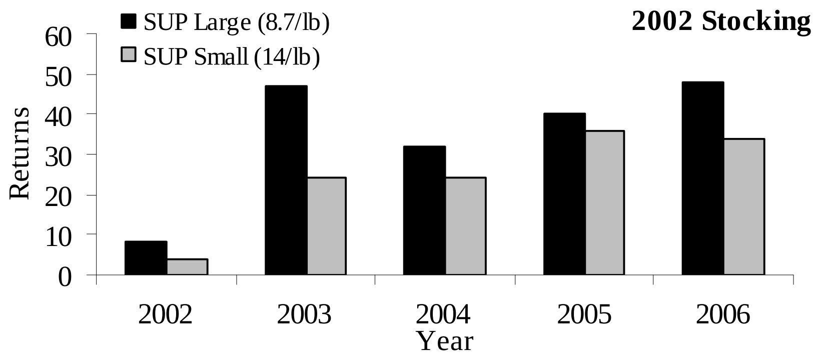
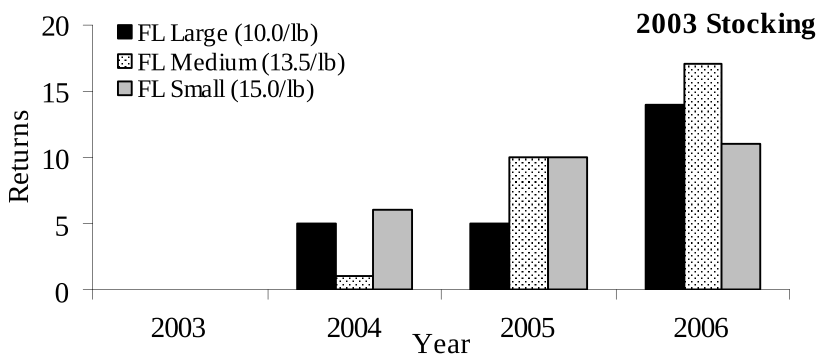


Figure 5.1. Yearling lake trout stocked in eastern basin waters of Lake Erie, 1980-2006, by strain in yearling equivalents (YRL). The stocking goal is 160,000 yearlings per year.









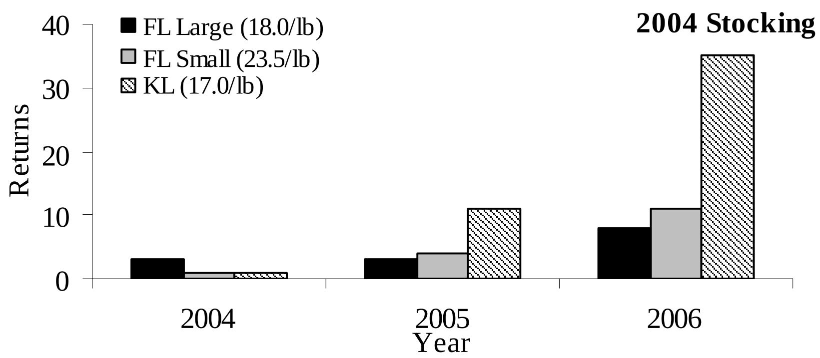


Figure 5.2. Returns of tagged yearling lake trout stocked in 2000-2004 for a stocking comparison study in New York waters of Lake Erie. Strain key: SUP=Superior, FL=Finger Lakes, and KL=Klondike.

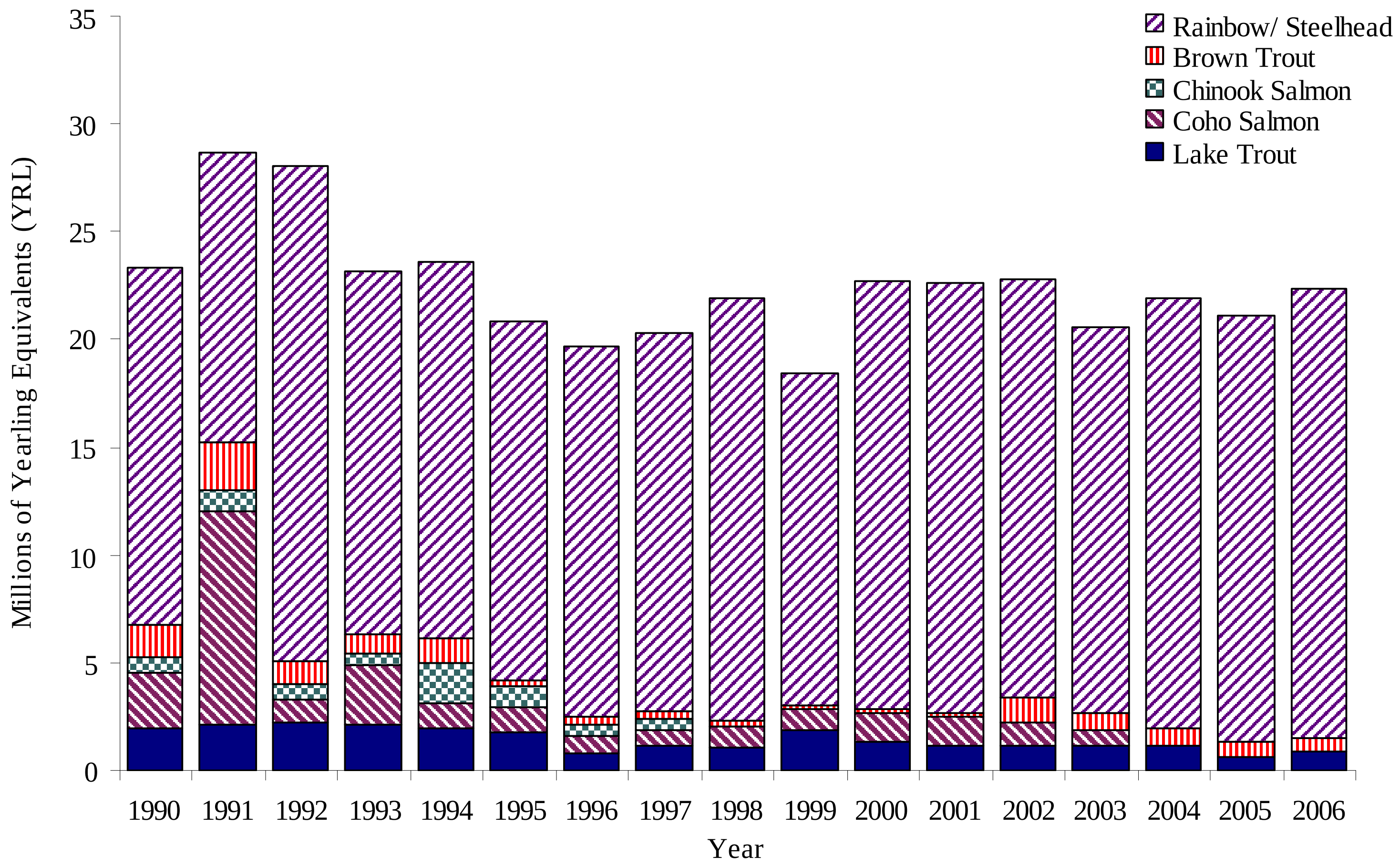


Figure 5.3. Annual stocking of all salmonid species in Lake Erie by all riparian agencies, 1989-2006. Numbers of stocked fish are represented in yearling (YRL) equivalents.

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

Chuck Murray (PFBC), James Markham (NYSDEC), and Kevin Kayle (ODW)

Stocking

All jurisdictions stocked rainbow trout in 2006 (Table 6.1). Nearly all (99.8%) rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A naturalized Lake Erie strain comprised approximately 58% of the strain composition, followed by a Lake Michigan, Little Manistee River strain at 27%. Two Lake Ontario strains were stocked: New York's Chambers Creek at 12% and Ontario's Ganaraska River strain at 2% of all steelhead stocked in 2006. New York stocked a minor amount (0.7%) of Skamania steelhead. About 0.2% of the stocked rainbow trout were of domestic hatchery broodstock origin. Only the wild-origin steelhead stocked by Ontario received fin clips in 2006 (Table 6.2). They received left pectoral fin clips prior to release. No other agencies stocked any fin-clipped steelhead in 2006.

Assessment of Natural Reproduction

A comprehensive, multi-year stream electrofishing 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 through spring. Five different streams were sampled between 6 October and 16 October 2006. Three of the five sampled streams were in the Cattaraugus Creek watershed; the two other streams were direct tributaries to Lake Erie. Of the streams sampled in 2006, North Branch Clear Creek was the only one considered as an average or above average stream for the potential production of juvenile steelhead. Access to this stream is perhaps the biggest hurdle preventing this stream from being a major steelhead producer. Point Peter Brook, Doty Creek, Bournes Creek, and Kelley Brook were all judged to have limited reproductive potential due to habitat limitations within these streams.

The five streams sampled in 2006 brought the total number of streams evaluated to 30 since the beginning of the stream inventory survey. Adding on previously sampled streams (Utley Brook) and other streams judged to be limiting in production potential, a total of 38 streams have been inventoried. The majority of the streams sampled have limited potential for steelhead production, but thirteen streams have shown a higher potential for producing wild steelhead. Four streams (Spooner Creek, Derby Brook, Little Chautauqua Creek, North Branch Clear Creek) were judged to have a high potential for producing wild fish while three other streams (Clear Creek, Connoisarauley Creek, Coon Brook) were large enough in size, despite some limitations, to produce a significant amount of juvenile recruits. Twenty Mile Creek, which runs through both New York and Pennsylvania, was sampled by NYSDEC Region 9 Inland Fisheries personnel this summer. This creek also appears to have significant production of wild juvenile steelhead. Future sampling should concentrate on developing more comprehensive surveys on these eight "producer" tributaries to gain a better estimate of overall wild steelhead production in the New York waters of Lake Erie.

Ohio has initiated a program to catalog streams with steelhead natural reproduction into digital maps with GIS layers. Future work may employ cooperative ventures between the member agencies to develop a master set of maps of high quality watersheds for documenting and monitoring production and contribution of wild steelhead smolts, and may be used to target areas for stream improvement projects.

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 creel surveys conducted in Pennsylvania and New York tributaries to Lake Erie in 2003 (NY and PA) and 2004 (NY).

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 most Lake Erie agencies, and might be used as a gauge of total harvest. Several agencies provide annual measurements of open lake summer harvest by boat anglers. Annual open lake creel surveys are conducted by Michigan, Ohio, Pennsylvania and New York.

Rainbow trout harvest estimates, as derived through the agency open lake boat angler surveys, are shown in Table 6.3. The estimated harvest from the summer open-water boat angler fishery in 2006 was 7,741 rainbow trout in all US waters, decreasing about 41% from 2005. Steelhead harvest was down in all areas; decreasing 48% in Ohio, 40% in New York and about 6% in Pennsylvania. Boat angler catch rates for rainbow trout declined in 2006 as well (Figure 6.1).

Nearly all (95%) of the reported harvest was concentrated in Central Basin waters of Ohio (69%) and Pennsylvania (26%). The remainder of open lake harvest (6 %) occurred in the eastern basin waters of New York. Michigan reported no summer steelhead harvest in 2006. The Ontario Ministry of Natural Resources was unable to provide sport harvest estimates for rainbow trout in 2006.

The Lake Erie tributaries provide the core of the steelhead fishery. Recent trends in the Lake Erie tributary fishery show increased effort in the last decade, with anglers demonstrating a high catch-and-release ethic. Recent creel surveys on Lake Erie streams estimated release rates of 93% on New York tributaries (Markham 2006), and 78% on Pennsylvania tributaries (Murray and Shields 2004). The steelhead fishery remains 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 have steadily increased since the late 1990's (Figure 6.2). There was a slight decrease in angler catch rate in 2005 in both New York (0.67 steelhead/hour) and Pennsylvania (0.82 steelhead/hour), but the catch rates in both areas remains well above the long-term average (0.54 steelhead/hour; Figure 6.2).

References

Markham, J.L. 2006. Lake Erie tributary creel survey: fall 2003-spring 2004, fall 2004-spring 2005. New York State Department of Environmental Conservation. Lake Erie Fisheries Unit. Dunkirk, 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 stockings by jurisdiction for 2006.

Jurisdiction	Location	Strain	Fin Clips	Number	Life Stage	Yearling Equivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	No	66,514	Yearling	**66,514**	**Sub-Total**
Ontario	Young's Creek	Young's Creek (wild), L. Erie	No	550	Yearling	550	
	Mill Creek	Ganaraska River, L. Ontario	LP	21,000	Yearling	21,000	
	Erieau Harbour	Ganaraska River, L. Ontario	LP	22,800	Yearling	22,800	
						44,350	**Sub-Total**
Pennsylvania	Bear Creek	Trout Run & Godfrey Run, L. Erie	No	9,500	Yearling	9,500	
	Conneaut Creek	Trout Run & Godfrey Run, L. Erie	No	75,000	Yearling	75,000	
	Crooked Creek	Trout Run & Godfrey Run, L. Erie	No	58,800	Yearling	58,800	
	Elk Creek	Trout Run & Godfrey Run, L. Erie	No	277,590	Yearling	277,590	
	Fourmile Creek	Trout Run & Godfrey Run, L. Erie	No	15,790	Yearling	15,790	
	Godfrey Run	Trout Run & Godfrey Run, L. Erie	No	92,100	Yearling	92,100	
	Presque Isle Bay	Trout Run & Godfrey Run, L. Erie	No	58,800	Yearling	58,800	
	Raccoon Creek	Trout Run & Godfrey Run, L. Erie	No	49,007	Yearling	49,007	
	Sevenmile Creek	Trout Run & Godfrey Run, L. Erie	No	21,260	Yearling	21,260	
	Trout Run	Trout Run & Godfrey Run, L. Erie	No	123,500	Yearling	123,500	
	Twelvemile Creek	Trout Run & Godfrey Run, L. Erie	No	40,270	Yearling	40,270	
	Twentymile Creek	Trout Run & Godfrey Run, L. Erie	No	156,794	Yearling	156,794	
	Walnut Creek	Trout Run & Godfrey Run, L. Erie	No	226,792	Yearling	226,792	
						1,205,203	**Sub-Total**
Ohio	Chagrin River	Manistee River, L. Michigan	No	109,310	Yearling	109,310	
	Conneaut Creek	Manistee River, L. Michigan	No	87,334	Yearling	87,334	
	Grand River	Manistee River, L. Michigan	No	108,116	Yearling	108,116	
	Rocky River	Manistee River, L. Michigan	No	106,598	Yearling	106,598	
	Vermillion River	Manistee River, L. Michigan	No	80,585	Yearling	80,585	
						491,943	**Sub-Total**
New York	Buffalo Creek	Chambers Creek, L. Ontario	No	15,000	Yearling	15,000	
	Buffalo River	Chambers Creek, L. Ontario	No	10,000	Yearling	10,000	
	Canadaway Creek	Chambers Creek, L. Ontario	No	20,000	Yearling	20,000	
	Cattaraugus Creek	Chambers Creek, L. Ontario	No	90,000	Yearling	90,000	
	Cattaraugus Creek	Skamania, L. Ontario	No	15,000	Yearling	15,000	
	Cayuga Creek	Chambers Creek, L. Ontario	No	10,000	Yearling	10,000	
	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 Branch Cazenovia	Chambers Creek, L. Ontario	No	10,000	Yearling	10,000	
	Eighteen-Mile Creek	Domestic	No	5,000	Yearling	5,000	
	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	
						275,000	**Sub-Total**
						2,083,010	**Grand Total**

Table 6.2. Rainbow trout fin-clip summary for Lake Erie, 1999-2006.

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	-	-
2005	2004	RP	ADLV	LP	-	-
2006	2005	-	-	LP	-	

Fin clip key: AD=adipose; RP=right pectoral; RV=right ventral; LP=left pectoral; LV=left ventral.

Table 6.3. Estimated harvest of rainbow/steelhead trout by open lake boat anglers, 1999-2006.

Year	Ohio	Pennsylvania	New York	Ontario	Michigan	Total
1999	20,396	7,401	1,000	13,000	100	41,897
2000	33,524	11,011	1,000	28,200	100	73,835
2001	29,243	7,053	940	15,900	3	53,139
2002	41,357	5,229	1,600	75,000	70	123,256
2003	21,571	1,717	400	N/A*	15	23,703
2004	10,092	2,657	896	18,148	0	31,793
2005	10,364	2,183	594	N/A*	19	13,160
2006	5,343	2,044	354	N/A*	0	7,741

* no creel data collected by OMNR in 2003, 2005 and 2006

** 2004 OMNR sport harvest data is July and August, Central basin waters only

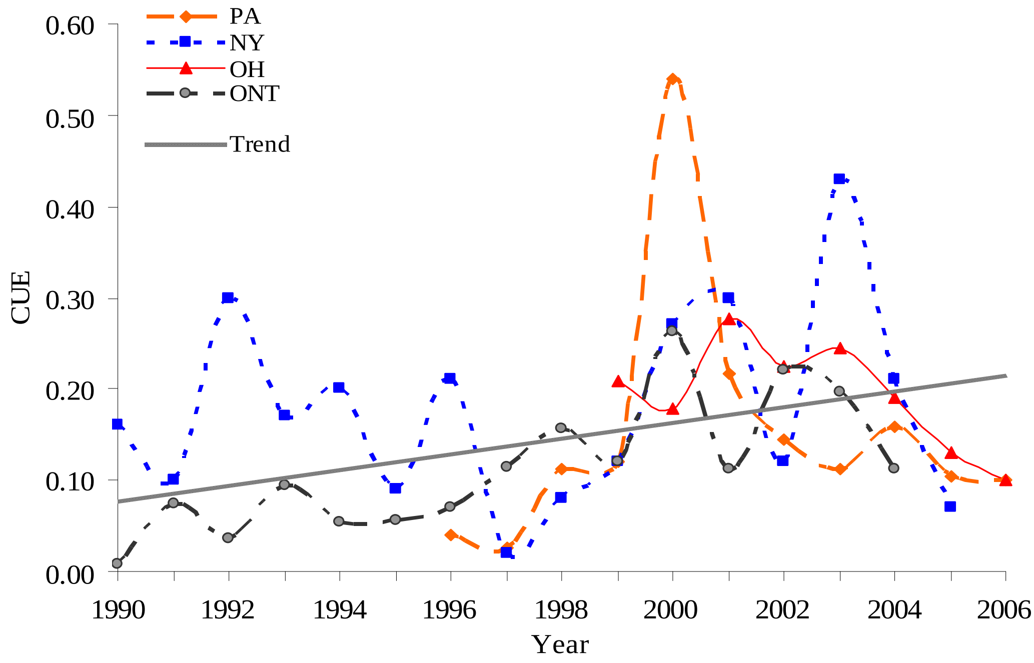


Figure 6.1. Targeted salmonid catch rates by open lake boat anglers in Pennsylvania, New York, Ohio, and Ontario, 1990-2006. A fitted linear trend line is presented for mean interagency catch rates by year.

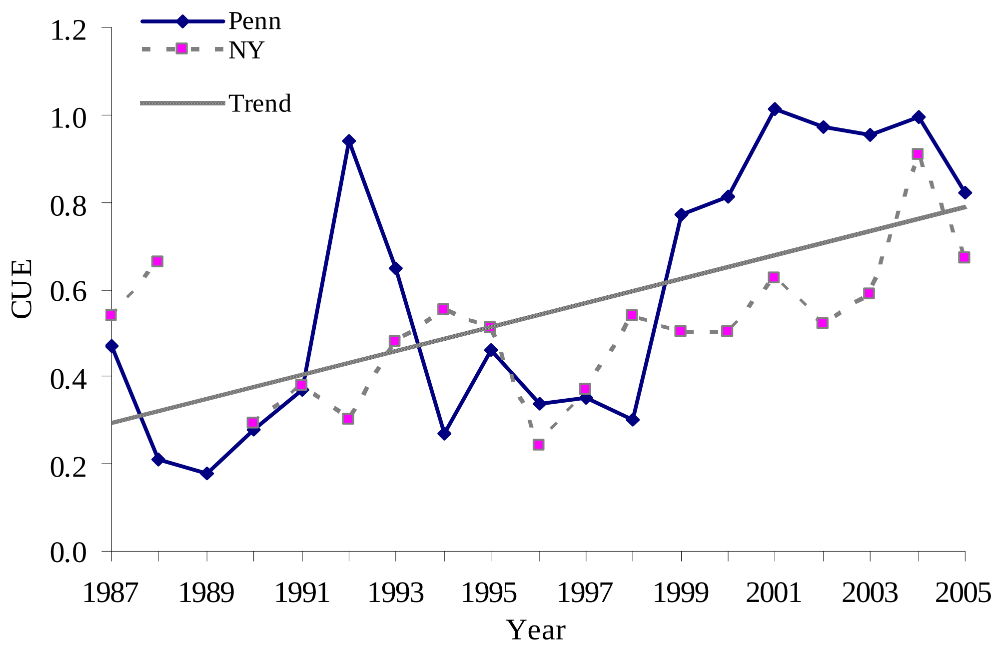


Figure 6.2. Targeted salmonid catch rates in Lake Erie tributaries by Pennsylvania and New York angler diary cooperators, 1987-2005. A fitted linear trend line is presented from mean interagency catch rates by year.

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

James Markham (NYSDEC), Tom MacDougall (OMNR), and John Fitzsimons (DFO)

Lake herring (*Coregonus artedi*) is a complex species indigenous to the Great Lakes. Herring historically supported one of the most productive fisheries in Lake Erie (Scott and Crossman 1973, Trautman 1981). Lake herring are considered extirpated from Lake Erie, although commercial fishermen report them 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 overfishing, 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 lake 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 of 467 mm and 367 mm) were collected from the eastern part of the central basin in 1995 and 1996, respectively. Several lake 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, unpublished data). Counts of gill rakers placed them into the range for *Coregonus artedi* (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 Harbor, OH, pers. comm.) and one from Ontario (L. Witzel, OMNR, Port Dover, Ont., pers. comm.). Two additional specimens were recorded at Port Stanley in 2001. 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. Two more specimens were reported in 2005 as by-catch from the commercial yellow perch fishery near Kent to the southeast of Wheatley in the Central Basin. Both herring were mature females of similar length (357 and 367 mm), and one of these was aged as six years old (1999 year class). Only one herring was reported in 2006. It was caught in commercial yellow perch gill nets off of Essex and was a three-year-old male (2003 year class) that measured 261 mm. OMNR biologists believe that the level of reporting has declined in recent years as herring catches become more common.

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 overwinter survival of alewife in eastern Lake Erie, while smelt numbers have continued to decline (L. Witzel, OMNR, Port Dover, ON unpublished 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 lake whitefish in eastern Lake Erie in 2001. Lake herring would also be favored by these conditions. The winter of 2006-2007 began as an apparent El Niño warm winter, but then became one of the coldest winters of recent years as most of the surface of Lake Erie froze. 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 by default relied on natural recruitment from extremely small remnant/transient stocks to rebuild the population, with almost no information on the identity and impacts of potential impediments. Although a few fish have been caught in recent years, the probability of the stock recovering on its own under current conditions appears remote. Within the last three years, there have 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. Another lake herring workshop was held in April 2006 to discuss a model developed for Lake Superior and implications for restoration in the Lower Great Lakes.

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 the USGS Conte Anadromous Fish Laboratory for genetic analysis using microsatellite markers. Recent and museum specimen lake herring from Lake Erie and other Great Lakes, including archived Lake Erie specimens from 1955-65, were compared to determine if the Lake Erie specimens are genetically distinct from other Great Lakes stocks (i.e. remnant population) or are strays from other populations. The initial results of this research indicate that the recently caught lake herring are genetically most similar to Lake Erie specimens from 1950's and 1960's and are a surviving remnant population (Rocky Ward, USGS Wellsboro, unpublished data). However, sample sizes of the findings are still small (9) and additional testing is needed to confirm the results. The implications of these findings pose difficult management decisions for restoration efforts involving stocking with lake herring from other sources of broodstock. However, the current stocks may not be large enough to re-establish themselves as a significant forage fish in the eastern basin of Lake Erie.

Plans have begun to begin disease testing of potential lake herring brood stock from other viable sources in case stocking is required for lake herring rehabilitation. Positive results for BKD from Lake Superior bloaters in 2005 have eliminated the upper Great Lakes as a potential source of lake herring broodstock or gametes. However, 37 adult lake herring were collected from eastern Lake Ontario in November 2006 and were screened for various diseases by the NYSDEC Fish Disease Control Unit. Tests for VHS, IHN, IPN, BKD, heterosporis, and furunculosis were all negative for these fish. Negative results are required for three consecutive years before the collection of broodstock or gametes can be considered. New York Finger Lakes lake herring populations, such as the one found in Skaneateles Lake, may be considered for lake herring production as well.

References

Evans, D.O. and D.H. Loftus. 1987. Colonization of inland lakes in the Great Lakes region by rainbow smelt, *Osmerus mordax*: their freshwater niche and effects on indigenous species. Canadian Journal of Fisheries and Aquatic Sciences 44 (Supplement 2): 249-266.

Fitzsimons, J., and R. O'Gorman. 2004. Status and assessment, research, and restoration needs for lake herring in the Great Lakes. Final Report: Great Lakes Restoration Act. Great Lakes Fisheries Commission, Ann Arbor, MI, USA.

Greeley, J. R. 1929. Fishes of the Erie-Niagara watershed. Pages 150-179 *in*: A biological survey of the Erie-Niagara System, supplemental to eighteenth annual report, 1928. J.B. Lyon Co. Albany, New York, USA.

Hartman, W. L. 1973. Effects of exploitation, environmental changes, and new species on the fish habitat and resources of Lake Erie. Great Lakes Fishery Commission Technical Report No. 22. 43 pp.

Koeltz, W. 1929. Coregonid fishes of the Great Lakes. Bulletin of the U. S. Bureau of Fisheries 43 (1927): 297-643.

Ryan, P.A., L.D. Witzel, J. Paine, M. Freeman, M. Hardy, S. Scholten, L. Sztramko, and R. MacGregor. 1999. Recent trends in fish populations in eastern Lake Erie in relation to changing lake trophic state and food web. pp. 241-289 *in:* M. Munawar, T. Edsall and I.F. Munawar [*eds.*]. State of Lake Erie (SOLE) – Past, Present and Future. Ecovision World Monograph Series, Backhuys Publishers, Leiden, The Netherlands.

Scott, W.B., and E.J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin of the Fisheries Research Board Canada 184. 966 pp.

Scott, W.B. and S.H. Smith. 1962. The occurrence of the long jaw cisco, *Leucichthys alpenae*, in Lake Erie. Journal of the Fisheries Research Board of Canada 19: 1013-1023.

Selgeby, J.H., W.P. MacCuallum, and D.V. Swedberg. 1978. Predation by rainbow smelt (*Osmerus mordax*) on lake herring (*Coregonus artedi*) in western Lake Superior. Journal of the Fisheries Research Board Canada 35: 1457-1463.

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

Charge 8: Revision of the Lake Erie Lake Trout Rehabilitation Plan

James Markham (NYSDEC)

A revision of the Lake Erie Lake Trout Rehabilitation Plan was proposed through the Lake Erie Coldwater Task Group (CWTG) to the Lake Erie Committee (LEC) at the annual meeting in March 2006. The original Lake Trout Restoration Plan (Lake Erie Lake Trout Task Group 1985), written in 1985, precedes many of the changes that occurred in the Lake Erie fish community and ecosystem following the invasion of dreissenids and other invasive species. Some of these changes were documented in a 1993 revision of the plan, written by Pare (1993), but this revision was never officially adopted by the Lake Erie Committee. Since the initial Restoration Plan, we have gained 20 years of additional knowledge of the lake trout population, how they function in the Lake Erie community, and the challenges they face for the future. This experience, combined with the goals and objectives of the initial Restoration Plan, were used in the development of a new planning document to guide restoration of lake trout in the Eastern basin of Lake Erie.

To date, a draft of the revised plan is completed and under review. The draft covers the historical background of lake trout restoration in Lake Erie, current status of stocks, new goals and objectives, management strategies to achieve these new goals, and impediments to lake trout restoration. The document also outlines assessment and research needs by lake jurisdictions as well as the agency roles and responsibilities. While this draft does list revised goals and objectives for achieving these goals, successful lake trout rehabilitation in Lake Erie still relies on the two main strategies listed in the original 1985 plan: continued sea lamprey control and increased and consistent stocking. Without these, adult lake trout stocks cannot be built to high enough levels to begin overcoming the obstacles needed for successful rehabilitation. The final draft on the revised plan is expected to be completed in 2007 and reported in 2008.

References

Lake Trout Task Group. 1985. A strategic plan for the rehabilitation of lake trout in eastern Lake Erie. Report to the Great Lakes Fishery Commission, Lake Erie Committee. Ann Arbor, Michigan, USA.

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