


REPORT OF THE LAKE ERIE COLDWATER TASK GROUP

23 March 2009

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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 require written permission for external use of data, please contact the agencies responsible for the data collection.

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TABLE OF CONTENTS

2008 – 2009 Coldwater Task Group Charges

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

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

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

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

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

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

Charge 7: Prepare Lake Erie Cisco Management Plan. Review ecology and history of this species and assess potential for recovery. Prepare an information paper for LEC recommending numbers needed for stocking for hatchery rearing considerations.

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 revision was never adopted by the LEC because of a lack of consensus regarding the position of lake trout in the Lake Erie fish community goals and objectives (FCGOs; Cornelius et al. 1995). A revision of the Lake Erie FCGOs was completed in 2003 (Ryan et al. 2003) and identified lake trout as the dominant predator in the profundal waters of the eastern basin. A subsequent revision of the Lake Trout Rehabilitation Plan was completed by the task group in 2008 (Markham et al. 2008).

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 and a new charge concerning lake herring rehabilitation was added in 1999. 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.

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 annual meeting, held this year on 23-24 March 2009 in Ypsilanti, Michigan. 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

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Coldwater Task Group Executive Summary Report March 2009

Lake Erie Committee

REPRESENTING THE FISHERY MANAGEMENT AGENCIES OF LAKE ERIE AND LAKE ST. CLAIR

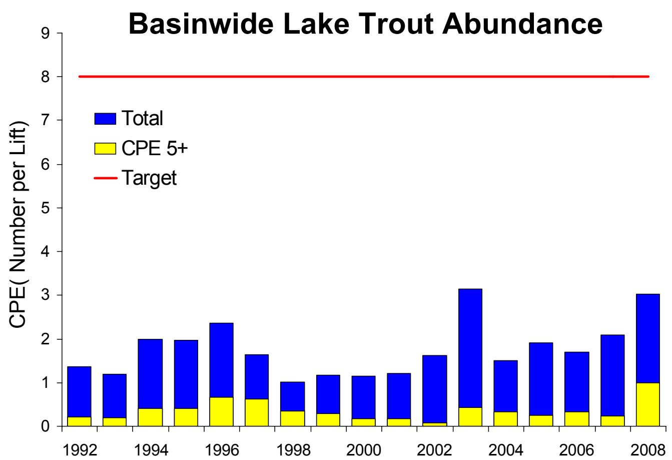
Introduction

This year's Lake Erie Committee (LEC) Coldwater Task Group (CWTG) has produced an Executive Summary Report encapsulating information from the CWTG annual report. The complete report is available from the GLFC's Lake Erie Committee Coldwater Task Group website at http://www.glfc.org/lakecom/lec/CWTG.htm, or upon request from an LEC, Standing Technical Committee (STC), or CWTG representative.

Seven charges were addressed by the CWTG during 2008-2009: (1) Lake trout assessment in the eastern basin; (2) Lake whitefish fishery assessment and population biology; (3) Burbot fishery assessment and population biology; (4) Participation in sea lamprey assessment and control in the Lake Erie watershed; (5) Electronic database maintenance of Lake Erie salmonid stocking information; (6) Steelhead fishery assessment and population biology, and (7) Development of a lake herring management plan.

Lake Trout

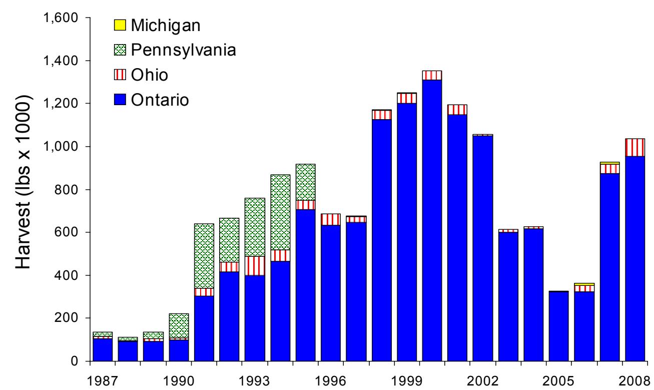
A total of 731 lake trout were collected in 125 lifts across the eastern basin of Lake Erie in 2008. Young cohorts (ages 2-5) dominated catches with lake trout ages 9 and older only sporadically caught. Basin-wide abundance continues to increase, but remains well below the rehabilitation target of 8.0 fish/lift. Adult (age 5+) abundance increased to its highest level in the time series, but also remains well below target. Returns of Klondike strain lake trout remain strong through age-5, despite low stocking amounts. Klondike cohorts were smaller in lengths- and weights-at-age compared to lean lake trout strains.



Whitefish

The total harvest of lake whitefish in 2008 was 1,037,467 pounds. The 2008 lake whitefish harvest was taken mostly in Ontario (92%), with Ohio (8%) and Pennsylvania (<1%) accounting for the remainder. A portion of Ontario's lake whitefish harvest was from gill nets targeting walleye and white bass. Ohio lake whitefish harvest was from trap nets primarily during late fall. Fishery and survey catch rates were among the highest recorded in recent time series from some sources. Five-year-old lake whitefish dominated fishery and survey catches across the lake in 2008, although some three-year-old fish began to show up in fishery and assessment gear. In addition to the dominant 2003 cohort, the 2001 year class and older fish were represented in fishery harvest. Lake whitefish caught in 2008 surveys consisted of fish up to age 12 in Ontario assessment surveys and up to age 23 in Ohio surveys. In 2009, 6-year-old lake whitefish are expected to dominate the harvest, with continued recruitment from the 2005, 2004 and 2001 year classes.

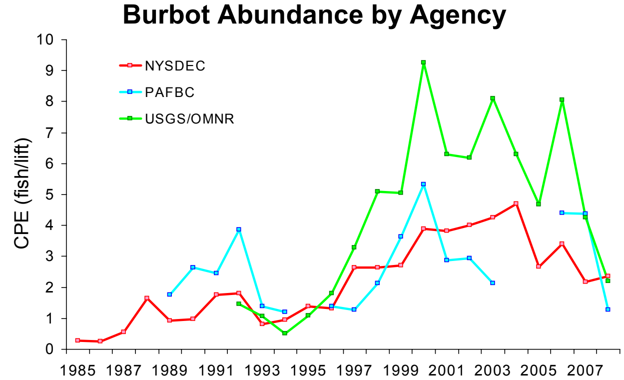
Commercial Whitefish Harvest



Burbot

Total commercial harvest of burbot in Lake Erie during 2008 was 1,707 pounds, the lowest harvest since 1988. Abundance and biomass of burbot as determined from annual coldwater gillnet assessments continued to decline following peaks in 2000 in Pennsylvania and Ontario and in 2004 in New York. Numeric abundance and biomass trends are similar in the Ontario Partnership Index Fishing Program. Increasing mean age since 1998, and dramatically decreased age-4 abundance after 2001 in Canadian waters of the eastern basin, indicates an aging burbot population exhibiting poor recruitment. Round gobies continue to be the dominant prey item in the burbot's diet in eastern Lake Erie.

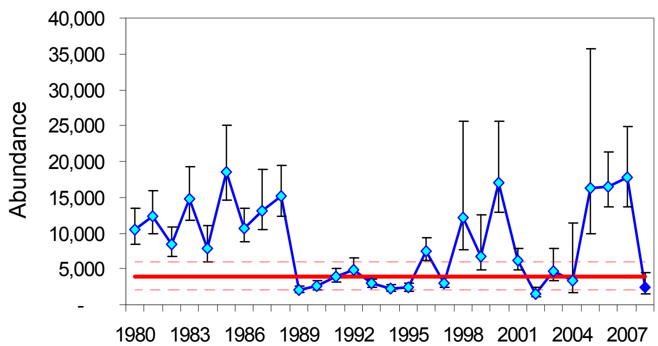
Burbot Abundance by Agency



Sea Lamprey

The A1-A3 wounding rate on lake trout >532 mm was 6.2 wounds/100 fish in 2008. This was a 53% decline from the 2007 wounding rate and the lowest sea lamprey wounding rate in the last six years, but still higher than target level of 5 wounds/100 fish. Wounding rates have been above target for 12 of the past 13 years. Large lake trout over 736 mm continue to receive the highest percentage of the fresh wounds, but smaller lake trout in the 432-532 mm category also received a high percentage of fresh wounds. A4 wounding rates remain above average but continue to decline, dropping to 29.6 wounds/100 fish. The estimated number of spawning-phase sea lampreys was 2,400 in 2008, an 87% decline compared to the 2007 estimate. A two year experiment of back-to-back lampricide treatments in the nine major sea lamprey producing streams began in 2008. These same streams will be treated again in Fall 2009 to reduce the number of parasitic sea lampreys in Lake Erie to target levels.

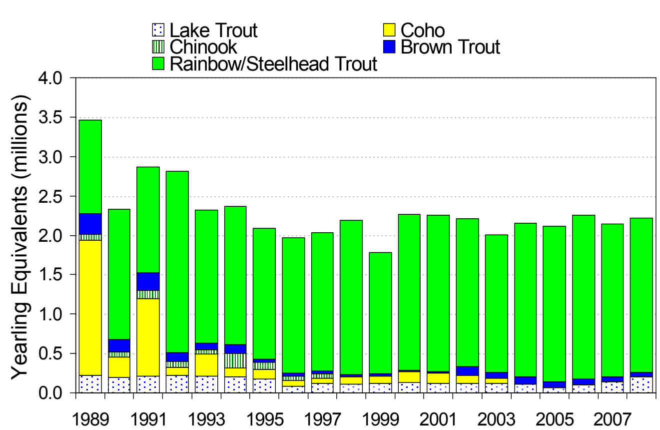
Spawning Sea Lamprey Abundance



Lake Erie Salmonid Stocking

A total of 2,252,255 salmonids were stocked in Lake Erie in 2008. This was a 5.2% increase in the number of yearling salmonids stocked compared to 2007, but 2.2% lower than the long-term average from 1989-2007. By species, there were 202,751 lake trout stocked in New York and Ontario waters; 53,930 brown trout stocked in New York and Pennsylvania waters, and a total of 1,995,574 steelhead/rainbow trout stocked by all five jurisdictions.

Salmonid Stocking



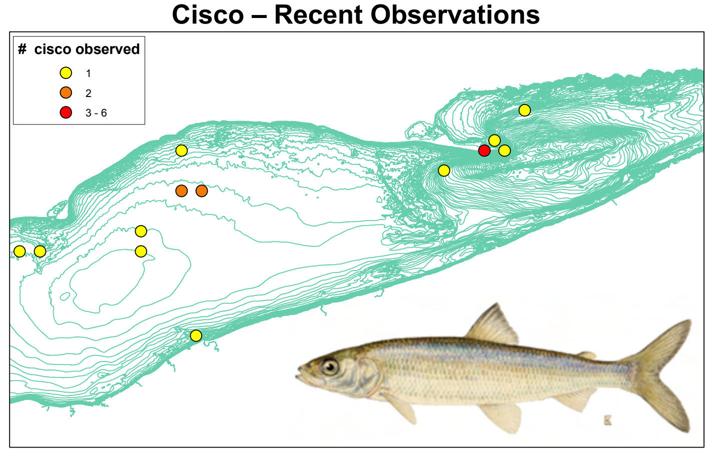
Steelhead

All agencies stocked yearling steelhead/rainbow trout in 2008. An analysis of rainbow trout/steelhead stocked in Lake Erie by jurisdictional waters for 2008 is as follows: Pennsylvania (1,157,968; 58%), Ohio (465,347; 23%), New York (269,800; 14%), Michigan (65,959; 3%) and Ontario (36,500; 2%). Overall steelhead stocking numbers (1.996 million in 2008) were 11% above the long-term average of 1.8 million yearlings. Stockings have been consistently in the 1.7-2.0 million range since 1993. The summer open lake fishery for steelhead was again evaluated by Ohio, Pennsylvania and New York. Open lake harvest was estimated at 5,431, summed for all reporting agencies. Open lake steelhead harvest dropped in all jurisdictions in 2008, representing the lowest recorded harvest in the 10-year time series. A similar trend is evident for open lake angler catch rates. Based on contemporary tributary creel surveys in New York, Pennsylvania and Ohio, the majority (>90%) of the fishery effort for steelhead remains in the tributaries and shore access areas from fall through spring.

Cisco

Cisco is considered extirpated in Lake Erie. However, they periodically are reported in the bycatch of Ontario commercial fishermen, most recently in March 2008 when two cisco, one age-7 male and one age-9 female, were caught in commercial nets in the central basin. Over 20 cisco have been reported in Lake Erie since 1996. Genetic testing of recent catches found them to be most related to the historic Lake Erie stock, indicating the possibility that a remnant Lake Erie stock still exists. Preparation of a cisco management plan began in fall 2007 with the goal of rehabilitating cisco in Lake Erie. The final draft on the plan is expected to be completed in fall 2009.

Cisco – Recent Observations



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 assessing lake trout populations has been in place since 1986. The sampling design divides the eastern basin of Lake Erie into eight sampling areas (A1-A8) of width defined by North/South-oriented 58000 series Loran C Lines of Position (LOP). The entire survey area is bound between the 58435 LOP on the west and the 58955 LOP on the east (Figure 1.1). New York is responsible for sampling areas A1 and A2, Pennsylvania A3 and A4, and USGS/OMNR

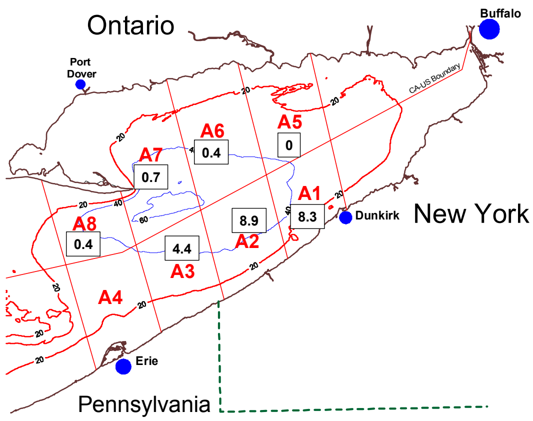


FIGURE 1.1. Standard sampling areas (A1-A8) used for assessment of lake trout in the eastern basin of Lake Erie, 2008, and catch per effort (number/lift) of lake trout in each area.

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 is constructed of diamond-shaped mesh in one of 10 size categories ranging from 38-152 mm

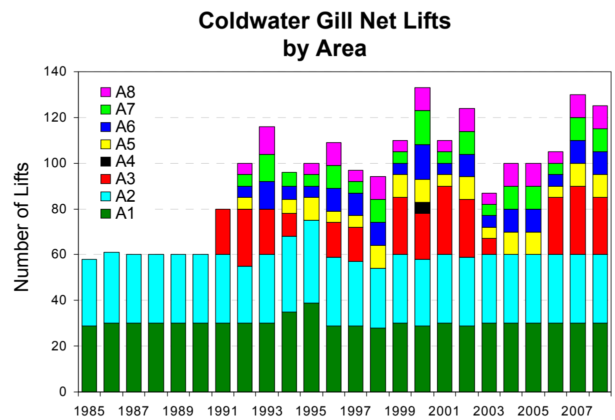


FIGURE 1.2. Number of coldwater assessment gill net lifts by area in the eastern basin of Lake Erie, 1985-2008.

on a side in 12.7-mm increments stretched measure (1.5-6 inches; 0.5 inch 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 progressively deeper/colder water at increments of either 1.5 m depth (5 feet) or a 0.8 km (0.5 miles) distance from the previous (shallower) gang, whichever occurs first along the transect. The fifth and deepest gang is set 15 m (50 feet) deeper than the shallowest net (number 1) or at a distance of 1.6 km (1.0 miles) 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 2008 by the combined agencies was 125 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie (Figure 1.2). This included 60 lifts by the NYSDEC, 25 by the PFBC, and 40 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.

TABLE 1.1. Number, sex, mean length (mm), mean weight (g), and percent maturity, by age class, of **Lean** strain lake trout collected in assessment gill nets from the eastern basin of Lake Erie, August 2008.

AGE	SEX	NUMBER	MEAN LENGTH (mm TL)	MEAN WEIGHT (g)	PERCENT MATURE
1	Combined	5	257	134	0
2	Male Female	11 9	416 423	741 782	0 0
3	Male Female	6 3	530 511	1707 1517	98 47
5	Male Female	40 35	691 702	4150 4397	100 100
6	Male Female	19 18	712 728	4775 5024	100 100
7	Male Female	18 13	753 750	5476 5380	100 100
8	Male Female	10 6	764 664	5730 6183	100 ---
9	Male Female	5 ---	772 ---	5762 ---	100 100
11	Male Female	1 ---	896 ---	7695 ---	--- 100
12	Male Female	1 ---	808 ---	6975 ---	100 100
14	Male Female	1 ---	878 ---	8025 ---	--- 100
15	Male Female	--- 1	--- 860	--- 7725	--- 100
17	Male Female	2 ---	875 ---	7728 ---	--- 100
18	Male Female	--- 2	--- 878	--- 9145	--- 100
21	Male Female	1 ---	888 ---	8755 ---	--- 100
23	Male Female	3 1	873 853	8058 7995	--- 100
24	Male Female	1 ---	1002 ---	11330 ---	--- 100

Klondike strain lake trout (KL) are an offshore form from Lake Superior and are thought to behave differently (i.e. spawn in different areas and at different depths) than traditional Lean lake trout strains (*i.e.* Finger Lakes (FL), Superior (SUP, Lewis Lake (LL) strains). They were first stocked in Lake Erie in 2004. In some analyses, Klondikes are reported as a separate strain for comparison with Lean strain lake trout.

Results and Discussion

Abundance

Sampling was conducted in seven of the eight standard areas in 2008 (Figure 1.1), collecting a total of 731 lake trout in 125 lifts. No effort was expended in area A4 due to the lack of coldwater habitat, and elimination of this sampling area is recommended by the CWTG. Areas A1 and A2 again produced the highest catch per unit effort (CPE) values (Figure 1.1), coinciding with the areas in which stocking of yearling lake trout occurs. Comparatively, lake trout catches in Ontario waters (A5-A8), where stocking had not occurred until 2006, were over eight times lower. Catches in area A3, which is adjacent to the stocked NY waters, were intermediate. The large disparity between lake trout catches in New York, Pennsylvania, and Ontario waters indicates a lack of movement away from the stocking area.

Eighteen age-classes of lake trout, ranging from ages 1 to 24, were represented in the catch of known-aged fish (Tables 1.1 and 1.2). Similar to the past seven years, young cohorts (ages 2-5) were the most abundant, representing 86% of the total catch in standard assessment nets (Figure 1.3). Cohort abundance continues to decline rapidly after age 5, and lake trout ages 9 and older were only sporadically caught. Similar to the past three years, age 10 and older lake trout comprised only 1.7% of the overall catch in 2008.

TABLE 1.2. Number, sex, mean length (mm), mean weight (g), and percent maturity, by age class, of **Klondike** strain lake trout collected in assessment gill nets from the eastern basin of Lake Erie, August 2008.

AGE	SEX	NUMBER	MEAN LENGTH (mm TL)	MEAN WEIGHT (grams)	PERCENT MATURE
1	Combined	1	304	285	0
2	Male Female	4 4	413 421	721 713	0 0
4	Male Female	233 73	570 577	2130 2277	99 81
5	Male Female	31 35	625 630	3027 3064	85 100

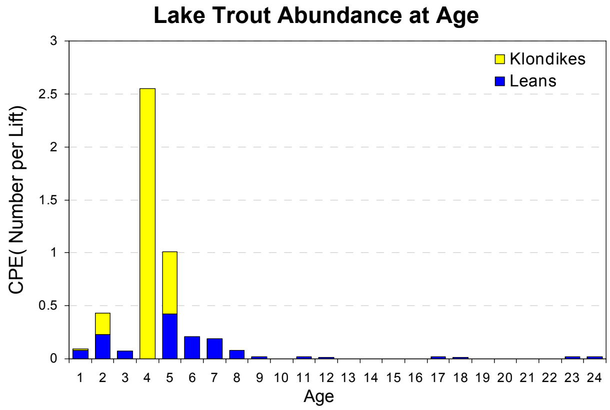


FIGURE 1.3. Relative abundance (number fish/lift) at age of Lean strain and Klondike strain lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, August 2008.

The overall trend in area-weighted mean CPE's of lake trout caught in standard nets in the eastern basin increased in 2008 to 3.03 fish/lift, the second highest basin-wide abundance in the time series (Figure 1.4). Basin-wide abundance has been steadily increasing since 1998, but remains well below the rehabilitation target of 8.0 fish/lift (Markham et al. 2008). Lake trout abundance increased to time series highs in both PA and NY surveys in 2008, but remained low in ON waters.

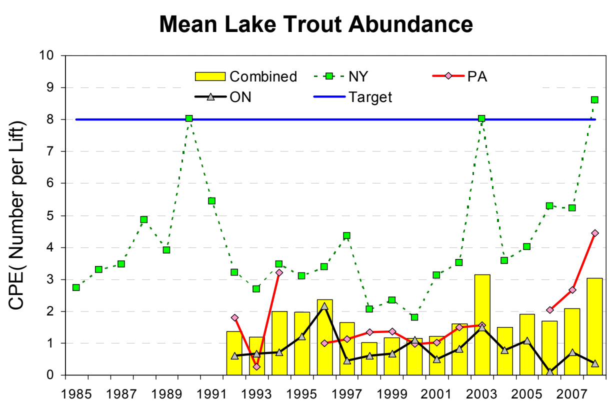


FIGURE 1.4. Mean CPE (number fish/lift) by jurisdiction and combined (weighted by area) for lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1985-2008.

The abundance of lake trout in the 2008 OMNR Partnership Index Fishing Program declined in all areas in 2008 (Figure 1.5). Variability of abundance estimates in this survey is higher due to lower sample sizes, especially in the Pennsylvania Ridge, and to a broader spatial sampling that may have extended outside the preferred habitat of lake trout. Abundance estimates in 2008 were below average in the Pennsylvania Ridge, while the east basin lake trout index was near average and comparable to abundances found in the jurisdictional coldwater

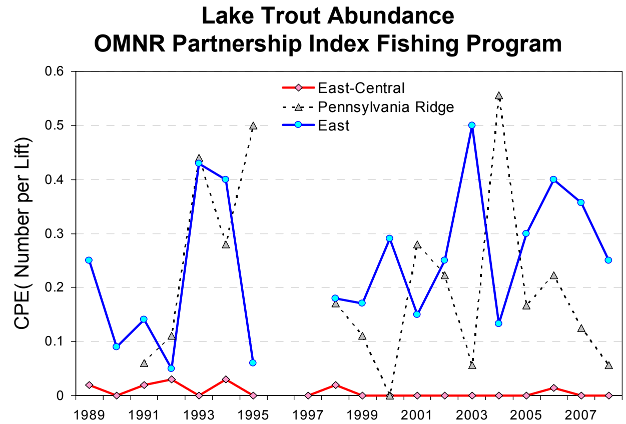


FIGURE 1.5. Lake trout CPE (number fish/lift) by basin from the OMNR Partnership Index Fishing Program, 1989-2008. Includes canned (suspended) and bottom gill net sets excluding thermocline sets.

assessment surveys in the Ontario waters of Lake Erie.

The relative abundance of adult (age-5 and older) lake trout caught in standard assessment gill nets serves as an indicator of the size of the lake trout spawning stock in Lake Erie. Adult abundance declined in 1998 following a five year (1992-1996) period of steady growth, corresponding to a decrease in lake trout stocking numbers that began in 1994, poor post-stocking survival, and increased abundances of sea lamprey. Overall adult abundance reached a time series low in 2002 and has remained at a slightly higher level since. The CPE (weighted by area) for age-5 and older lake trout increased in 2008 to 1.00 fish/lift, which was a time series high (Figure 1.6). The increase is mainly due to the high post-stocking survival of Klondike strain lake trout stocked in 2004 and a decline in the sea lamprey population. The index remains well below the rehabilitation target of 2.0 fish/lift.

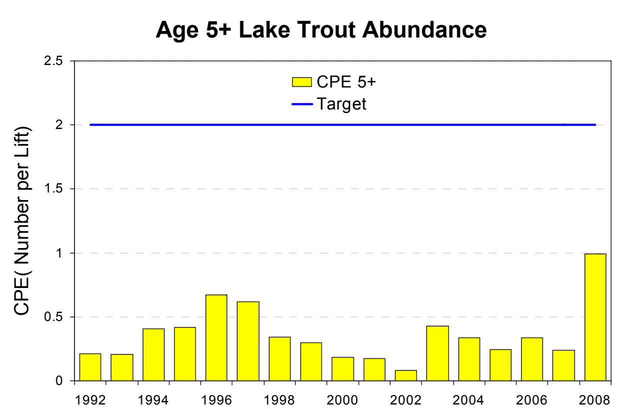


FIGURE 1.6. Relative abundance (number fish/lift) weighted by area of age 5 and older lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, August 1992-2008.

The relative abundance of mature females over 4500g, which represents repeat-spawning females ages 6 and older, increased in 2008 to a time series high of 0.16 fish/lift (Figure 1.7). However, this index value is one-third of the rehabilitation plan target for adult female abundance (Markham et al. 2008). Overall trends for this index indicate the instability of the lake trout spawning stock and may indicate the main reason that natural reproduction has yet to be documented in Lake Erie.

Abundance of Mature Female Lake Trout >4500g

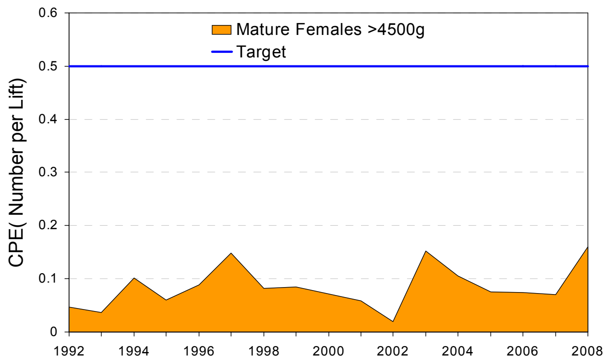


FIGURE 1.7. Relative abundance (number fish/lift) weighted by area of mature female lake trout greater than 4500g sampled in standard assessment gill nets in the eastern basin of Lake Erie, August 1992-2008.

Recruitment

The proportion of stocked lake trout surviving to age 2 provides an index of recruitment. This index is calculated by dividing age-2 CPE from standardized gill net catches by the number of fish in that year-class stocked. The quotient is multiplied by 10^5 to rescale recruitment to the number of age-2 lake trout caught per lift per 100,000 yearling lake trout stocked. The index shows declining recruitment of stocked lake trout from 1992 through 1998 with very few of the yearlings stocked from 1994 through 1997 surviving to age 2 in 1995 through 1998 (Figure 1.8). The index increased erratically beginning in 1999, likely due to a combination of different stocking methods, increased lake trout size at stocking, stocking strains, and a decreased adult lake trout population. Of interest was the 2006 survival index of 1.11, which was the highest value in the time-series and entirely comprised of Klondike strain lake trout stocked in 2005. The 2008 age-2 survival index was 0.30, the third highest value in the time series. This stocking was comprised of Klondike, Finger Lakes, and Traverse Island strains of lake trout with the best survival to age-2 again occurring from the Klondike strain fish.

Age 2 Survival Index

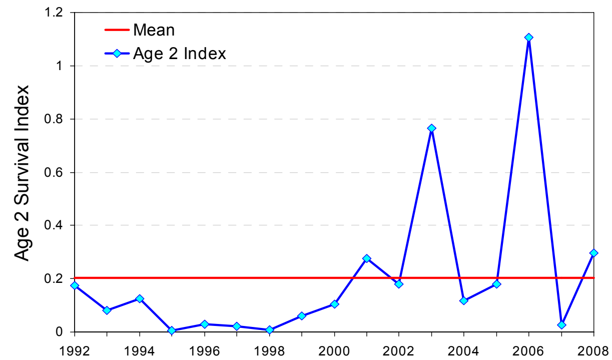


FIGURE 1.8. Index of survival for age-2 lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, August 1992-2008. The index is equal to the number of age 2 fish caught per lift for every 100,000 yearling lake trout stocked.

Strains

Eight different lake trout strains were found in the 659 fish caught with hatchery-implanted coded-wire tags (CWTs) or fin-clips (Table 1.3). The majority of the lake trout were Klondike (KL) strain, which have only been stocked in small amounts in four of the past five years. Age-4 Klondikes alone comprised over 50% of the lake trout caught. Finger Lakes (FL) strain lake trout were the only other strain found

TABLE 1.3. Number of lake trout per stocking strain by age collected in gill nets from the eastern basin of Lake Erie, August 2008. Stocking strain codes are: FL = Finger Lakes, LE = Lake Erie, LL = Lewis Lake, LO = Lake Ontario, SUP = Superior, KL = Klondike, Others = Slate Island, Traverse Island, and Lake Manitou. Shaded cells indicate ages strain was stocked.

AGE	FL	LE	LL	LO	SUP	KL	Others
1						1	
2	23					21	7
3	6						3
4						330	
5	81					77	
6	41						
7	30				1		
8	15				1		
9	3				2		
10							
11	1				1		
12	1						
13							
14		1					
15	1						
16							
17			1	1			
18	2						
19							
20							
21	1						
22							
23	4						
24	3						
TOTAL	212	1	1	1	5	429	10

in significant abundance, and they are the most numerous stocked strain over the last eight years. Superior (SUP) strain lake trout, stocked extensively in Lake Erie in the 1980s and again from 1997-2002, have almost disappeared in assessment netting, presumably due to high mortality from sea lampreys. Lewis Lake (LL), Lake Ontario (LO), Lake Erie (LE), Slate Island, and Traverse Island strains all comprised minor contributions to the Lake Erie stock. The FL strain continues to show the most consistent returns at older ages, including three age-24 lake trout, the oldest lake trout ever caught in the assessment surveys. Also of note was the age-17 LL strain fish, which was the oldest lake trout of this strain ever sampled in Lake Erie.

Returns of the new Klondike (KL) strain of lake trout have been excellent through age 5. Returns of 31,600 yearlings stocked in 2004 (2003 year-class) were almost five times higher at age 3 than a paired stocking of 80,000 FL strain lean lake trout when adjusted for stocking rates (Table 1.4a). Return rates declined at age 4 and age 5 but still remained at least two times higher than FL strain lake trout. Stocking adjusted return rates of the 2005 stocking (2004 year-class; 54,200 yearlings) at age-2 were the highest in the time-series in 2006 (see 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 (Table 1.4b). Return rates at age-3 and at age-4 were similarly high. Age-4 Klondikes comprised over 50% of the Lake Erie lake trout catch in 2008 and have the highest abundance at age-4 of any lake trout strain and year class stocked since rehabilitation efforts began in 1978.

TABLE 1.4a. Return rates (number per 100,000 yearlings stocked) of Klondike (KL) and Finger Lakes (FL) strain lake trout stocked in 2004 by age class and strain from the eastern basin of Lake Erie, August 2004-2008.

AGE	STRAIN	NUMBER STOCKED	NUMBER RETURNS	RETURN RATES (per 100,000 stocked)	RATIO FL:KL
1	FL KL	80,000 31,600	4 1	5 3	1.7:1
2	FL KL	80,000 31,600	7 11	9 35	1:3.9
3	FL KL	80,000 31,600	19 35	24 111	1:4.6
4	FL KL	80,000 31,600	70 55	88 174	1:2.0
5	FL KL	80,000 31,600	81 77	101 244	1:2.4

TABLE 1.4b. Return rates (number per 100,000 yearlings stocked) of Klondike (KL) strain lake trout stocked in 2005 by age class from the eastern basin of Lake Erie, August 2005-2008.

AGE	STRAIN	NUMBER STOCKED	NUMBER RETURNS	RETURN RATES (per 100,000 stocked)
1	KL	54,200	14	26
2	KL	54,200	61	113
3	KL	54,200	146	269
4	KL	54,200	329	607

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; 0.59) and Superior (SUP; 0.58) strains. Survival rates for the Lake Erie (LE) strain were also high (0.79), but this was based on only two year classes with low returns. The Finger Lakes (FL), the most stocked lake trout strain in Lake Erie, had an overall mean survival estimate

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, 1985–2008. 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. Asterisk (*) indicates years where straight CPE's were used for ages 4-9 (SUP 99), 5-9 (FL 99), 4-8 (SUP 00), or 4-7 (SUP 01).

	STRAIN				
Year Class	LE	LO	LL	SUP	FL
83				0.687	
84				0.619	0.502
85				0.543	0.594
86				0.678	
87				0.712	0.928
88		0.784		0.726	0.818
89		0.852		0.914	0.945
90		0.84		0.789	0.634
91		0.763	0.616		
92	0.719		0.568		
93	0.857				0.85
94					
95					
96					0.78
97				0.404	0.85
98				0.414	
99*				0.321	0.894
00*				0.500	
01*				0.213	
MEAN	**0.788**	**0.810**	**0.592**	**0.579**	**0.779**

of 0.78. Mean overall survival estimates for all strains except for the LL and SUP strains 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 of SUP strain lake trout has declined well below target levels. Survival estimates of the 1997-2001 year-classes of SUP strain fish range from 0.21-0.50. These survival estimates are well below the ranges that were observed for this strain during the period of high sea lamprey control (1987-1991).

Growth and Condition

Mean length-at-age and mean weight-at-age of eastern basin Lean strain lake trout remain consistent with averages from the previous ten years (1998-2007) through age 7 (Figures 1.9 and 1.10). Deviations at age 8 and older were due to low sample sizes. Klondike strain lake trout show lower growth trajectories than Lean strain lake trout through age 5. Mean length and weight of Klondike strain lake trout were significantly less at age-4 and age-5 (two sample t-test; P<0.01) compared to the paired stocking of FL strain lake trout.

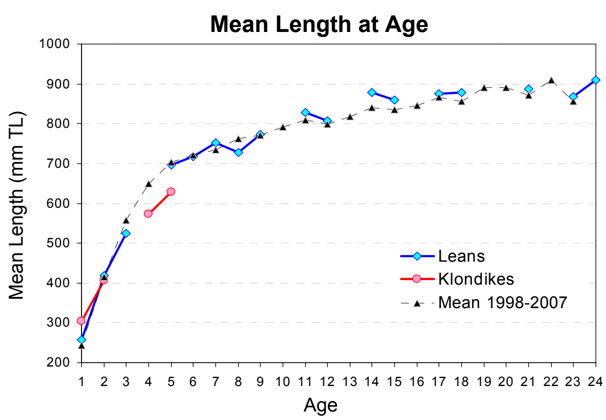


FIGURE 1.9. Mean length-at-age of Lean strain and Klondike strain lake trout sampled in assessment gill nets in the eastern basin of Lake Erie, August 2008. The previous 10-year average (1998-2007) from New York is shown for current growth rate comparison.

Mean coefficients of condition, K, (Everhart and Youngs 1981) were calculated for age-5 lake trout by sex to determine time-series changes in body condition. Overall condition coefficients for age-5 lake trout remain well above 1.0, indicating that Lake Erie lake trout are, on average, heavy for their length (Figure 1.11). Condition coefficients for age-5 male and female lake trout show an increasing trend from 1993-2000. Female condition began to decline in 2004 and male condition in 2001, but both increased again in 2007. Values in 2008 for both sexes were 1.24, well above the standard (1.0).

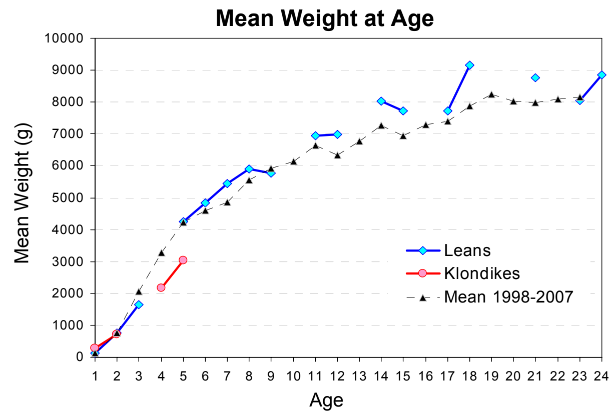


FIGURE 1.10. Mean weight-at-age of Lean strain and Klondike strain lake trout sampled in assessment gill nets in the eastern basin of Lake Erie, August 2008. The previous 10-year average (1998-2007) from New York is shown for current growth rate comparison.

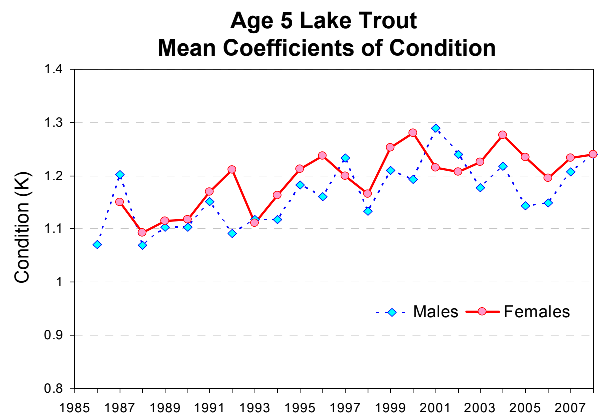


FIGURE 1.11. Mean coefficients of condition for age 5 lake trout, by sex, collected in NYSDEC assessment gill nets in Lake Erie, August 1985-2008.

Maturity

Maturity rates of Lean strain lake trout remain consistent with past years where males are nearly 100% mature by age 4 and females by age 5 (Table 1.1). Klondike strain lake trout appear to have similar maturity rates to Lean strain lake trout in Lake Erie through age 5 (Table 1.2).

Natural Reproduction

Despite more than 30 years of lake trout stocking in Lake Erie, no naturally reproduced lake trout have been documented. Eight lake trout without fin clips or coded wire tags were caught in eastern basin coldwater gill net surveys in 2008, making a total of 39 potentially wild lake trout recorded over the past eight years. Otoliths are collected from lake trout found without CWTs or fin-clips and will be used in future stock discrimination studies to determine their origin (wild or stocked).

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 2006). The goal of this exercise was 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. Side-scan sonar work was also accomplished during 2007 and 2008 on several of the identified sites in the eastern basin of Lake Erie near Port Maitland, Ontario, and at Brocton Shoal near Dunkirk, New York (Habitat Task Group 2008; Habitat Task Group 2009). Several funding proposals (Canada-Ontario Agreement; USFWS Restoration Funds) were accepted in 2007 and 2008 to further examine the sites identified in the GIS-phase of this exercise using side-scan sonar and underwater video imaging. This work is scheduled to continue in 2009.

An overnight gill net set targeting spawning lake trout was accomplished in 2008 by the NYSDEC. Poor weather conditions prohibited further sampling. Two net gangs, each containing 50 foot panels of monofilament mesh ranging from 114.3 to 152.4 mm by 12.7 mm increments, plus 177.8 and 203.2 mm mesh, were set on both Brocton Shoal (offshore, deep) and Van Buren Reef (nearshore, shallow) on 5 November 2008 and pulled the following day (Figure 1.12). Bottom water temperatures at both locations were 51F, which should have been optimal for lake trout spawning. Only 10 lake trout were caught in total; three on Brocton Shoal and seven on Van Buren Reef. Six of the lake trout were females and four males, and all of the fish were hard (unripe) with the exception of one male. The lake trout were all age-6 Finger Lakes strain fish with the exception of one age-5 and one age-7 fish. One female's eggs were undeveloped, presumably due to an A1 sea lamprey wound. Other species caught included catfish, gizzard shad, smallmouth bass, and walleye.

Two egg trap lines were set on raised rock ridges (i.e. suspected spawning areas) on Brocton Shoal on 5 November 2008 and picked up on 24 November 2008 (Figure 1.12). Each line contained six egg traps made from 5-gallon buckets made neutral buoyant, which allowed the traps to return to the upright position after strong storm and current events. The traps were set to determine if lake trout were spawning over these areas. Water temperatures ranged from 51F at setting to 44F at pickup. No lake trout eggs were collected in the 12 egg trap buckets. However, 58 bloody red shrimp (*Hemimysis*), a new invasive species, were collected. The majority (48) of the *Hemimysis* were found in two traps, but seven of the 12 traps contained at least one of the new invader.

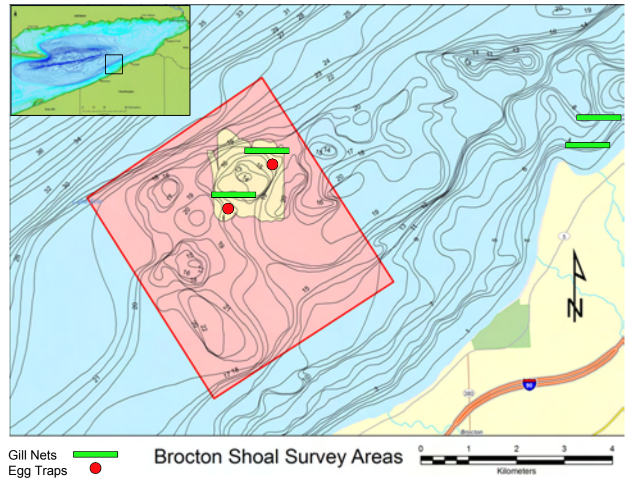


FIGURE 1.12. Gill net and egg trap survey locations sampled for lake trout spawning on Brocton Shoal and Van Buren Bay in the eastern basin of Lake Erie, November 2008.

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 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. 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 current model's output now follows the general trends of the survey data and computes mortality estimates that are near levels measured from survey data. While the absolute numbers generated from model simulations 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 2008 lake trout model, using low sea lamprey mortality rates, estimated the Lake Erie population at 182,832 fish and the age 5 and older population at 35,340 fish, less than half 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. Model simulations indicate that both stocking and lamprey control are major influences on the Lake Erie lake trout population.

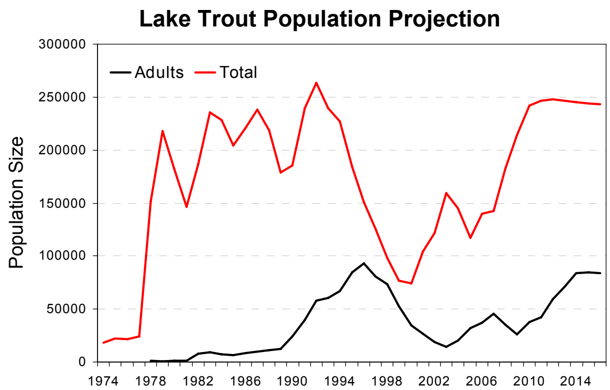


FIGURE 1.13. Projections of the Lake Erie total and adult (ages 5+) lake trout population using the CWTG lake trout model. Projections were made using low rates of sea lamprey mortality with proposed stocking rates. The model estimates the total 2008 population at 182,832 lake trout and the adult population at 35,340 lake trout.

Diet

Seasonal diet information for lake trout is not available based on current sampling protocols. Diet information was limited to fish caught during August 2008 in the coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of the stomach contents of lake trout revealed diets almost exclusively comprised of a combination of rainbow smelt and round gobies (Table 1.6). Rainbow smelt, the longtime main prey item of Lake Erie lake trout, dominated the August diet of both Lean (78.6%) and Klondike (67.4%) strain lake trout. Round gobies occurred in less abundance in both lake trout forms (Leans = 25.8%; Klondikes = 29.5%). Other fish species comprised minor contributions to the diets of both Lean and Klondike strain lake trout. Of note was a mudpuppy found in a large FL strain lake trout.

TABLE 1.6. Frequency of occurrence of diet items from non-empty stomachs of Lean and Klondike strain lake trout collected in gill nets from eastern basin waters of Lake Erie, August 2008.

PREY SPECIES	Lean Lake Trout (N = 182)	Klondike Lake Trout (N = 224)
Smelt	143 (78.6%)	151 (67.4%)
Yellow Perch	1 (0.6%)	
Round Goby	47 (25.8%)	66 (29.5%)
Unknown Fish	18 (9.9%)	40 (17.9%)
Gizzard Shad		1 (0.5%)
White Perch	1 (0.6%)	
Emerald Shiner		1 (0.5%)
Mudpuppy	1 (0.6%)	
Number of Empty Stomachs	64	113

The occurrence of round gobies decreased for the second consecutive year in the diet of Klondike strain lake trout in 2008 following a dramatic increase in 2006 (Figure 1.14). The increase and decline was also observed in Lean strain lake trout. Until 2008, Klondike strain lake trout appeared to have a higher preference for round gobies compared to Lean strain fish. However, the occurrence of smelt and round gobies was very similar in both Lean and Klondike strain lake trout stomachs in 2008. Diets of lake trout appear to be closely

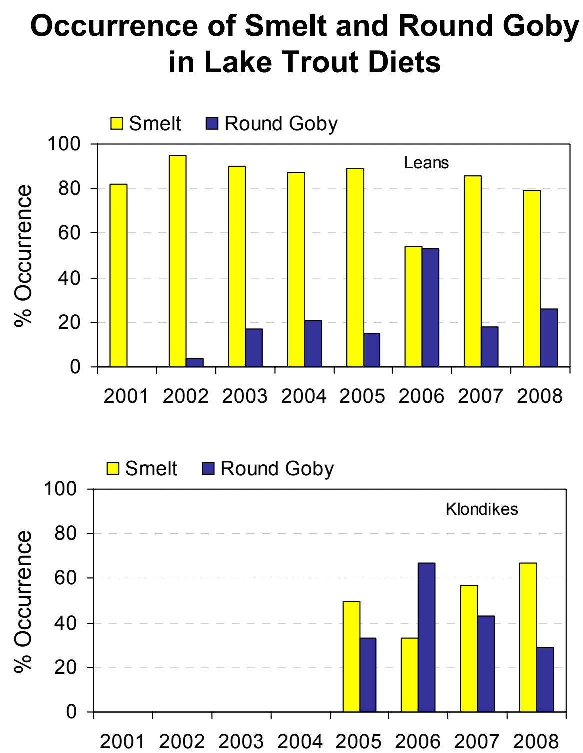


FIGURE 1.14. Percent occurrence of smelt and round goby in the diet of Lean strain (top) and Klondike strain (bottom) lake trout sampled in assessment gill nets in the eastern basin of Lake Erie, 2001-2008.

related to the abundance of these two species in Lake Erie. Below average smelt populations in the eastern basin in 2006 (Forage Task Group 2007) caused a switch in targeted prey species to round gobies, which were at high abundances. Smelt populations rebounded in 2007 (Forage Task Group 2008) and lake trout, especially Lean lake trout strains, targeted smelt once again. Round gobies declined in abundance in the east basin of Lake Erie in 2008 (Forage Task Group 2009), and all lake trout targeted the more abundant smelt population. When smelt are in good supply, they comprise about 85-90% of the diets of Lean strain lake trout and 60% of Klondike strain lake trout. Round gobies typically comprise 15-20% of Lean strain and 50% of Klondike strain lake trout diets. However, in years of low adult smelt abundance, lake trout appear to rely more on round gobies as prey items.

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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 2008 was 1,037,467 pounds (Figure 2.1). Ontario harvested 954,164 pounds, followed by Ohio (82,914 lbs), and Pennsylvania (389 lbs). There was no lake whitefish harvest in Michigan waters in 2008. Total harvest in 2008 was 12% above the 2007 total harvest due to increases of approximately 79,000 pounds in Ontario and 41,000 pounds in Ohio. The 2008 lake whitefish harvest was taken mostly in Ontario (92%), with Ohio (8%) and a scant harvest by Pennsylvania accounting for the rest.

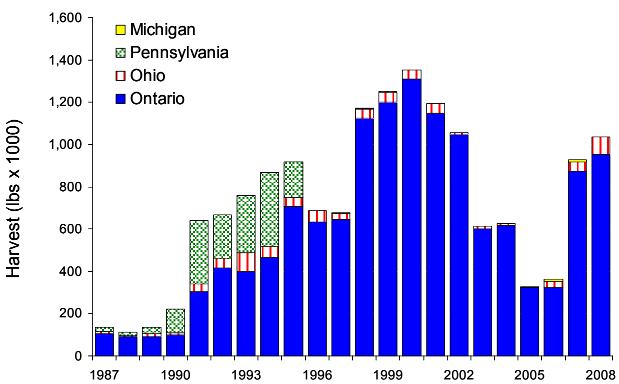

FIGURE 2.1. Total Lake Erie commercial whitefish harvest from 1987-2008 by jurisdiction. Pennsylvania ceased gill netting in 1996 and Michigan resumed commercial fishing in 2006, 2007.

The majority (97%) of Ontario's 2008 lake whitefish harvest was taken in gill nets. The remainder was caught in smelt trawls (3%) and a negligible amount (167 lbs.) in impoundment gear. The largest portion of Ontario's whitefish harvest (51%) was taken in the west basin (Ontario's OE 1) mostly during the fall, followed by the west-central area - OE 2 (24%) primarily in the first half of the year. The remainder came from OE 3 (1%) in spring and OE 4 (5%) and easternmost OE 5 (19%) from April to October. In Ontario, 70% of whitefish harvested in 2008 resulted from effort targeting whitefish, while walleye (17%), white bass (11%), white perch (1%) and yellow perch (<1%) fisheries accounted for the remainder. Most (94%) of Ohio's commercial whitefish harvest was taken in November. There was no commercial harvest of whitefish in Michigan in 2008.

Ontario's annual targeted catch rates in 2008 were slightly below 2007 (Figure 2.2). Ohio's commercial trap net catch rates were the highest in recent history (Figure 2.3). Pennsylvania's smaller commercial trap net fishery experienced a slight decrease from 2007 (Figure 2.3). Ontario's 2008 catch rates, for nets targeting whitefish in the west basin, decreased slightly from 2007, but they were at a record high in December (Figure 2.4). The landed weight of roe from Ontario's 2008 whitefish fishery was 21,303 pounds, with an approximate landed value of CDN$ 50,395.

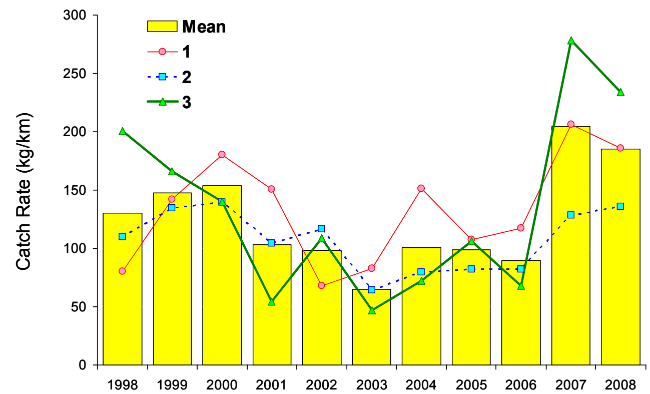

FIGURE 2.2. Ontario annual commercial large mesh gill net catch rates targeting lake whitefish by quota zone, 1998 - 2008. Bars represent averages of catch rates across quota zones.

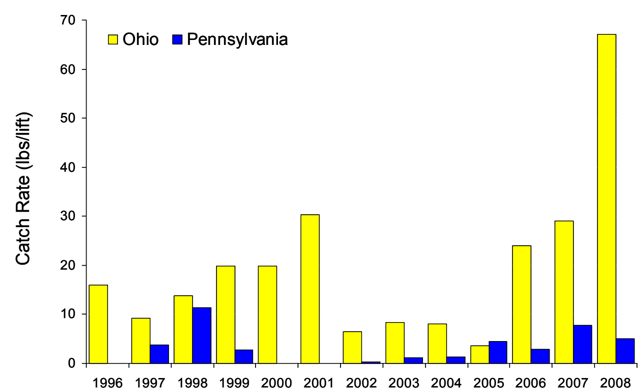

FIGURE 2.3. Ohio and Pennsylvania lake whitefish commercial trap net catch rates (pounds per lift), 1996-2008.

Ontario's west basin fall lake whitefish fishery was dominated by age-5 fish (Figure 2.5). The strong 2003 cohort dominated catches in targeted and non-targeted Ontario fisheries throughout Lake Erie (Figure 2.6). The 2003 cohort dominated harvest since recruiting at age 3 up to age 5 in 2008. This cohort is expected to contribute significantly to fisheries again in 2009. Moderate 2005 and 2004 year classes are expected to contribute marginally to the fisheries in 2009.

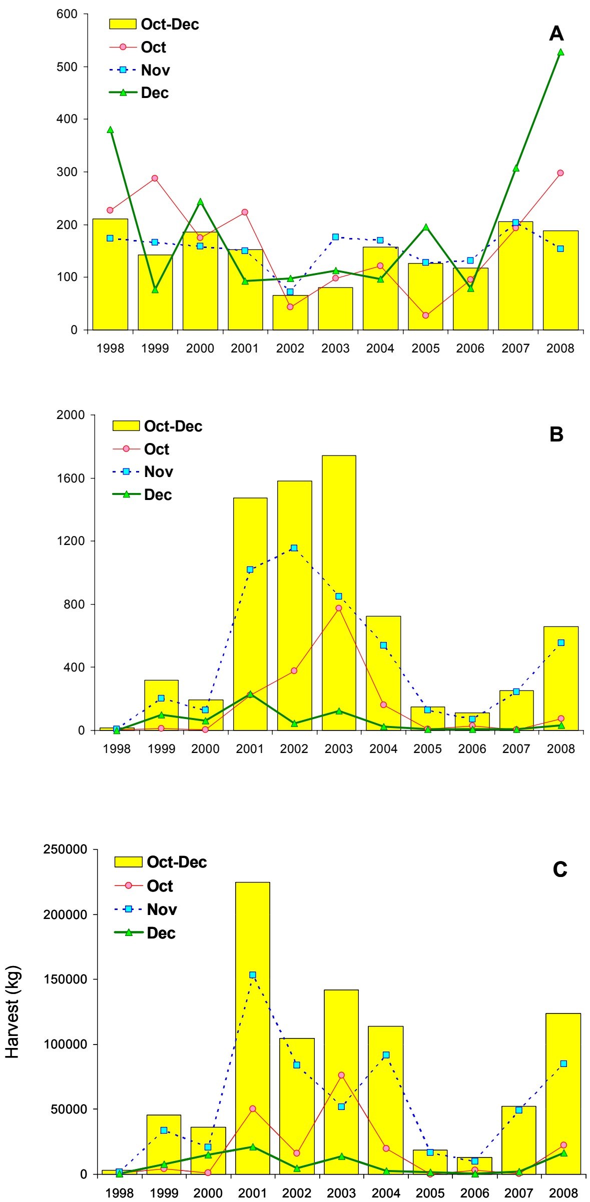

FIGURE 2.4. Targeted large mesh gill net catch rate (A), gill net effort (B) and harvest (C) for lake whitefish in the west basin for October, November, December and pooled (Oct-Dec) 1998 - 2008.

Assessment Surveys

Lake whitefish abundance indices in the 2008 gill net assessments were variable among jurisdictions and basins (Figures 2.7 and 2.8). Lake whitefish catches remained high but dropped from those seen in 2007 in the Pennsylvania Ridge area of Ontario waters. Changes in catch rates varied in central basin indices, but in the east basin survey

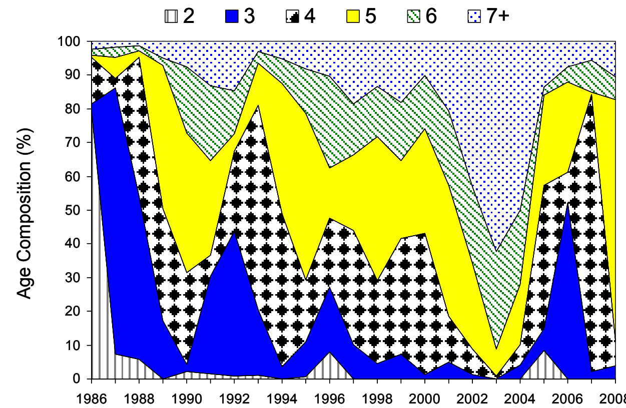

FIGURE 2.5. Ontario fall commercial whitefish harvest age composition in statistical district 1, 1986-2008. From effort with gill nets >=3 inches with whitefish in catch from October to December.

catch rates increased (Figure 2.7). New York, and to a lesser extent, Pennsylvania indices dropped from 2007 levels in a pattern similar to Ontario's Pennsylvania Ridge survey.

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 2008, the August and October assessments for young-of-year whitefish (0.0 fish per hectare) were below the 18-year mean of 0.6 fish per hectare. For yearling lake whitefish, the August and October catch rates (0.0 f/ha) were also well below the 18-year mean for Ohio surveys. August mean values were 1.8 f/ha and 3.5 f/ha in the west central and east central basins, respectively. October mean values were 4.1 f/ha and 3.0 f/ha in the west central and east central basins, respectively.

In trawl and gill net assessment surveys in Ohio waters of Lake Erie during 2008, a total of 159 adult, 0 yearling, and 0 YOY lake whitefish were sampled. The 2003 year class (age 5) were most numerous (50.3% of all whitefish sampled), followed by the 2004 year class (age 4 at 15.1%), and the 2005 year class (age 3 at 12.6%; Figure 2.11). Adult lake whitefish ranged in age from 2 to 22 in these surveys. Mean lengths for lake whitefish from the surveys were 479 mm for males and 483 mm for females (Figure 2.11).

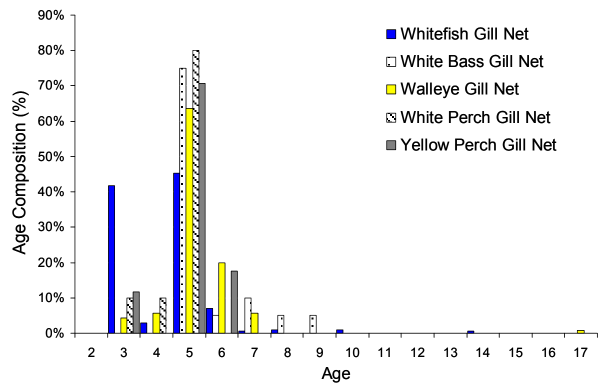

FIGURE 2.6. Age composition of lake whitefish caught commercially in Ontario waters of Lake Erie in 2008 by target species fisheries. Otoliths and scales were used to age whitefish samples.

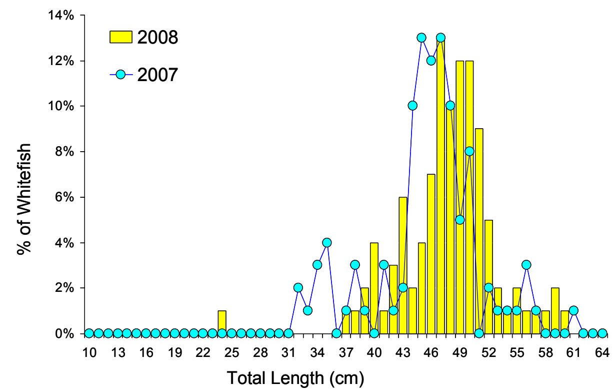

FIGURE 2.9. Length frequency distributions of lake whitefish collected during lakewide partnership index fishing, 2007 and 2008. Standardized to equal effort among mesh sizes.

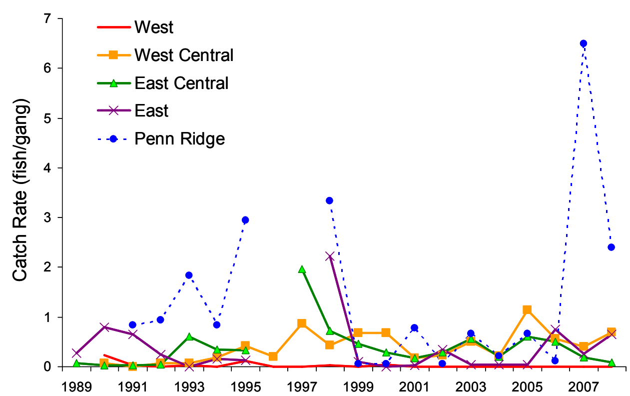

FIGURE 2.7. Catch rate (number per gang) of lake whitefish from Ontario partnership index gill netting by basin, Lake Erie, 1989 - 2008.

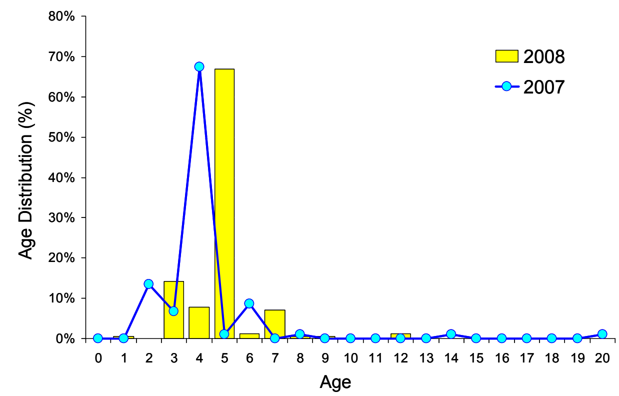

FIGURE 2.10. Age frequency distributions of lake whitefish collected during lake-wide partnership index fishing, 2007 and 2008. Standardized to equal effort among mesh sizes.

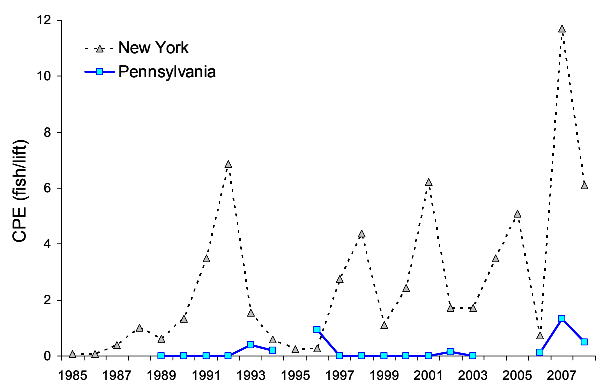

FIGURE 2.8. Catch per effort (number fish/lift) of lake whitefish caught in standard assessment gill nets from New York waters of Lake Erie, August 1985 - 2008 (triangles) and in Pennsylvania August assessment gill nets (squares) 1989 - 2007. No index sampling took place in Pennsylvania waters 1995, 2004, and 2005.

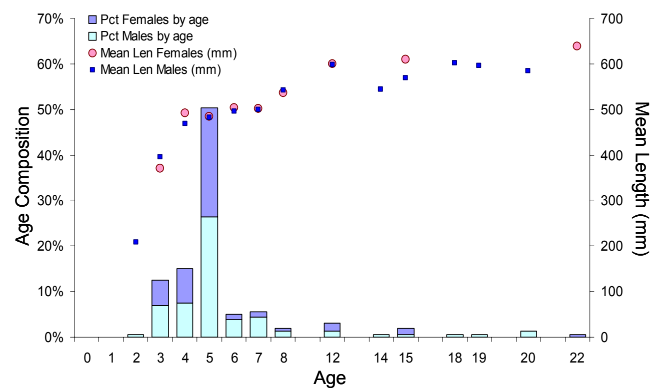

FIGURE 2.11. Age distribution and mean length-at-age of lake whitefish collected during trawl and gill net assessment surveys in Ohio waters of Lake Erie during 2008 (N=159).

Growth and Diet

Whitefish collected from Ohio surveys exhibited condition factors which varied between sexes and ages (Figure 2.12). Ohio surveys also showed that whitefish condition in 2008 for age 4 and older whitefish sampled in assessment trawls and gillnets (males, mean K= 1.015; se= 0.016; females, mean K= 1.078; se= 0.013) remained below Van Oosten and Hile's (1947) historic condition references for the third consecutive year for females (Figure 2.12). Male condition was approximately equal to the historic mean. Prior to 2006, Ohio surveys had shown a moderate increasing trend for condition of females and males ages 4 and older.

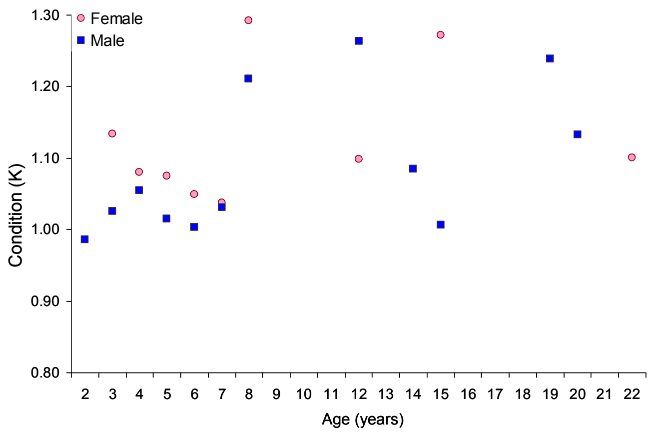

FIGURE 2.12. Mean condition (K) factor vs. age of lake whitefish (ages 2 and older) sampled during Ohio Division of Wildlife trawl and gill net assessment surveys in the central basin of Lake Erie, April-October 2008.

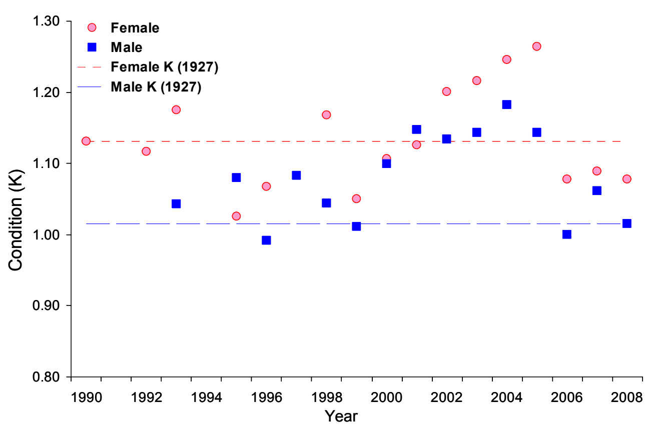

FIGURE 2.13. Mean condition (K) factor values of ages 4 and older lake whitefish sampled during Ohio assessment surveys in the central basin of Lake Erie, May-October 1990-2008. Historic mean condition (1927) presented as dashed lines from Van Oosten and Hile (1947).

In 2008, Ontario lake whitefish condition (ages 4 and older) was relatively low for the third consecutive year, falling below historic 1927-1929 averages for each sex (Van Oosten and Hile 1947; Figure 2.14). Only age 4 and older whitefish that were not spent or running, collected from October to December from surveys and commercial samples were included in calculations of condition factors.

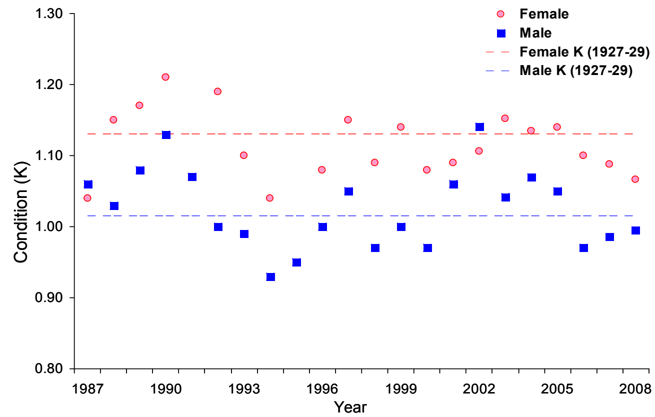

FIGURE 2.14. Mean condition (K) factor values of age 4 and older lake whitefish obtained from fall Ontario commercial and partnership survey data by sex from 1987-2008. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

Lake whitefish diet information available from Ohio central basin surveys in 2008 showed the breadth of whitefish diets (Figure 2.15). The diets of whitefish collected from the central basin are described as percentage total dry weight of all prey taxa (Figure 2.15). Isopods made up the majority of central basin lake whitefish diets (77%) followed by chironomids (6%), sphaeriids (5%), round goby (4%), amphipods (3.5%) and gastropods (2%). Eight other taxa (Dreissenids, oligochaetes, hirudinae, ostracods, nematodes, cladocerans, copepods, and chydorids) and unidentified fish comprised less than 1.5% of the diet by dry weight.

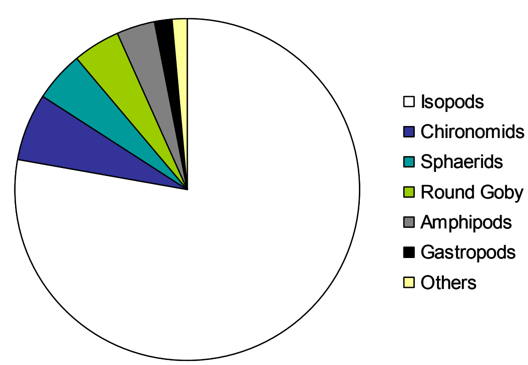

FIGURE 2.15. Diet composition (% dry weight) of lake whitefish from Ohio central basin assessment sites in 2008.

We analyzed seasonal trends of diet composition of lake whitefish in Ohio waters of the central basin (Figure 2.16). Isopods dominated the diets early in the season through early summer. In fall samples in the eastern central basin, gastropods were more numerous in diets examined, but sample sizes across the basin were too low to draw any conclusions about shifting resources and prey items.

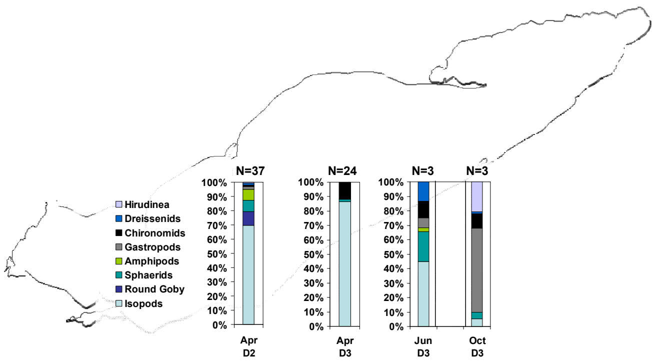

FIGURE 2.16. Diet composition (mean percent by dry weight) of yearling and older lake whitefish by sub-basin and month, captured in Ohio waters of Lake Erie during 2008 bottom trawl and gill net surveys. Numbers in parentheses are monthly sample sizes.

Research Efforts

The CWTG continues to recognize and participate in lake whitefish research efforts led by Drs. Ed Roseman (USGS), Yingming Zhao (OMNR), and Tim Johnson (OMNR).

References

Van Oosten, J. and R. Hile. 1947. Age and growth of the lake whitefish, *Coregonus clupeaformis* (Mitchill), in Lake Erie. Transactions of the American Fisheries Society 77: 178-249.

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

Elizabeth Trometer (USFWS), Larry Witzel (OMNR) 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 (2268 kg) (Table 3.1). Beginning in 1990, harvest began to increase, coinciding with an increase in abundance and harvest of lake whitefish. Most commercial harvest occurs in the eastern end of the lake with minimal harvest occurring in Ohio waters 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 (CWTG 1997).

TABLE 3.1. Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980 - 2008.

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	0.6	0.3	2.4	5.3
2007	0.4	1.1	0.1	3.6	5.2
2008	0.2	0.3	0.0	1.2	1.7

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 opportunistic market did not persist, resulting in declining annual harvests. The Ontario harvest is now a by-catch from various fisheries. More than half of the burbot by-catch in 2008 came from the lake whitefish commercial fishery followed by the white bass (23%) and yellow perch commercial fisheries (13%). The total commercial harvest for Lake Erie in 2008 was 1,707 pounds (774 kg); the lowest recorded since 1988 (Table 3.1).

Assessment Programs

Burbot are seasonally found in all the major basins of Lake Erie; however, the summer distribution of adult fish is restricted primarily to the 20-m and deeper thermally stratified regions of the eastern basin (Figures 3.1 and 3.2).

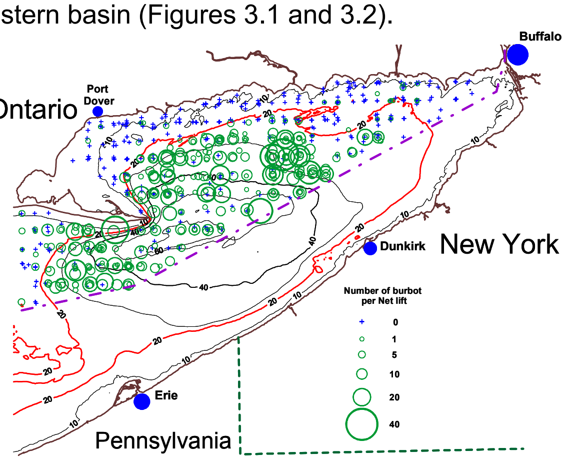

FIGURE 3.1. Distribution of burbot catches (No. per lift) in Ontario Partnership Gill Net surveys of the Ontario waters of eastern Lake Erie, 1989 - 2008.

The Ontario Partnership Index Fishing Program is an annual lakewide gillnet survey of the Canadian waters of Lake Erie and has provided an additional and spatially robust assessment of fish species abundance and distribution since 1989. During the early 1990s, burbot abundance was low throughout

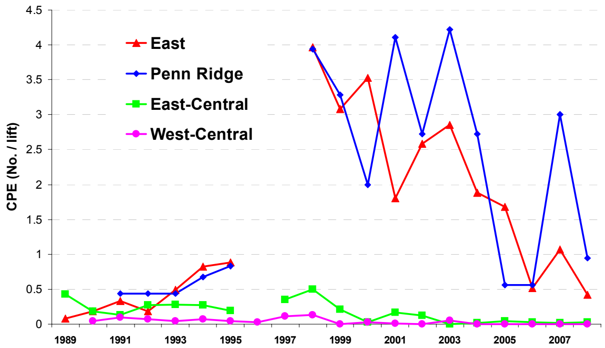

FIGURE 3.2. Burbot CPE (number/lift) by basin from the Ontario Partnership surveys, 1989–2008 (includes canned and bottom gill nets, all mesh sizes, except thermocline sets).

the lake; catch rates in partnership index gill nets averaged less than 0.5 burbot/lift (Figure 3.2). Burbot abundance increased rapidly after 1993 in the Pennsylvania Ridge area and in the eastern basin, reaching a peak of about 4 burbot/lift in 1998. Burbot numbers in the central basin also peaked in 1998, but only to a level of up to 0.5 burbot/lift. Catch rates in the Pennsylvania Ridge area during 1998 to 2004 remained high, but variable, ranging between 2.0 and 4.2 burbot/lift and then decreased to about 0.5 burbot/lift in 2005-2006. Catch rates in the eastern basin since 1998 have been variable in an overall decreasing trend. In 2008, burbot numbers decreased throughout the eastern basin, including the Pennsylvania Ridge, and remained very low in the central basin (Figure 3.2).

Trends in mean numeric abundance and biomass of burbot from bottom sets in the Ontario Partnership assessment data for combined sample locations in the east basin and Pennsylvania Ridge show that the numeric abundance of burbot (in fish/lift) increased approximately eight-fold from 1993 to 1998 (Figure 3.3). Burbot biomass CPE did not peak until 2003, some five years after maximum numeric abundance was observed. Burbot number

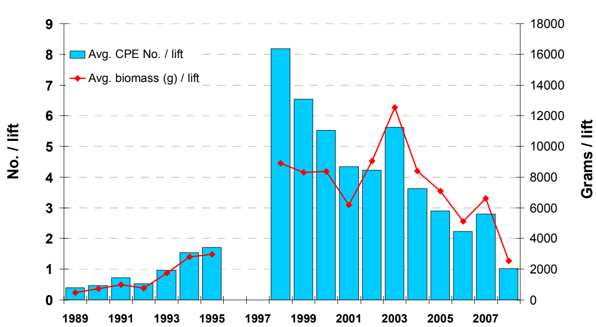

FIGURE 3.3. Average catch rate (CPE as number/lift) and biomass (grams/lift) of burbot in Ontario waters of eastern Lake Erie, Ontario Partnership gillnet assessment, 1989–2008 (includes only bottom sets, all mesh sizes; PA-ridge and east basin sample sites).

and biomass have steadily decreased after reaching their respective peaks. Burbot abundance in 2008 was only one-eighth of 1998 peak numbers and one-fifth of 2003 peak biomass (Figure 3.3).

Numeric abundance of burbot as determined from coldwater assessment gillnetting increased sharply after 1993, peaking in 2000 in all eastern basin jurisdictions except New York, where peak abundance was not observed until 2004 (Figure 3.4). The highest catch rates of burbot have occurred in Ontario waters during most years since 1996. Burbot numeric abundance has decreased across all eastern basin jurisdictions in recent years. In 2008, burbot catch rates were low, ranging from 1 to 2.5 burbot/lift throughout the eastern basin (Figure 3.4).

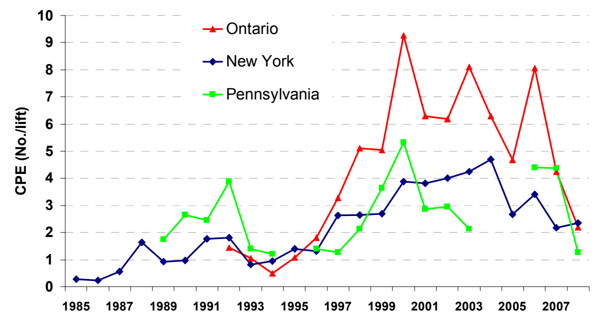

FIGURE 3.4. Average burbot catch rate (number/lift) from summer coldwater gill net assessment by jurisdiction, 1985-2008.

Burbot biomass CPE in general has followed a similar pattern as numeric abundance except that burbot catches did not reach maximum biomass until 2006 in Ontario waters, some four years after maximum numeric abundance was observed (Figure 3.5). The average burbot biomass observed in 2008 represents a 2- to 3- fold decrease from peak levels recorded within the respective data series of the three eastern basin jurisdictions (Figure 3.5).

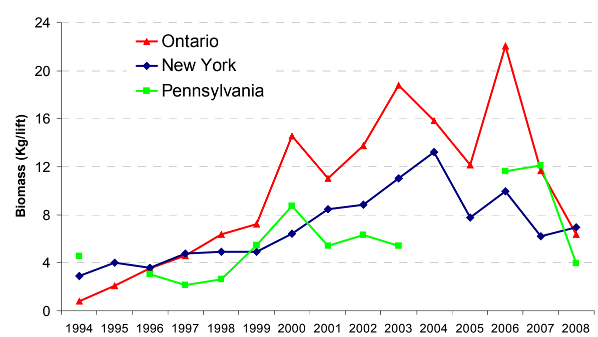

FIGURE 3.5. Average burbot biomass (kg/lift) from summer coldwater gill net assessment by jurisdiction, 1994-2008.

Burbot ages (from examinations of otoliths) have been estimated for fish caught in coldwater assessment gill nets in Ontario waters since 1997. Mean age of burbot has increased steadily during 1998-2007 (Figure 3.6). Preliminary results suggest that this trend continued in 2008. Recruitment of age-4 burbot increased almost 2-fold from 1997 to 2000, but was followed by an abrupt decrease in 2002 and remained poor through 2007 (Figure 3.6). Preliminary analyses suggest that recruitment during 1997-2007 was associated with abundance of yearling and older yellow perch when the burbot were age 0, and winter water temperatures during the spawning and egg development phases of burbot. Preliminary results suggest that burbot recruitment was also low in 2008.

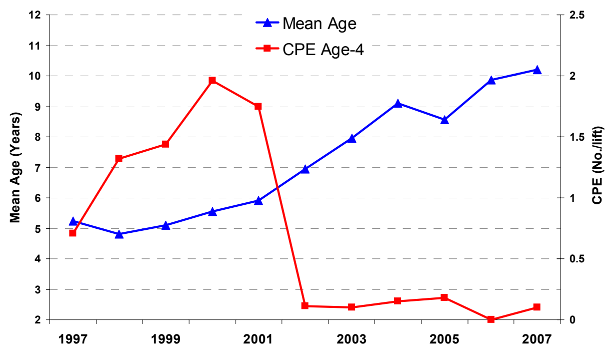

FIGURE 3.6. Mean age and average CPE of Age-4 burbot caught in summer gill net assessment in Ontario waters of eastern Lake Erie, 1997-2007.

Growth

Mean total length of burbot increased across all survey areas in 2008, continuing a trend that has predominated since the late 1990s (Figure 3.7). Average weight of burbot has followed a similar trend, increasing steadily in each of the last 10 years to a time series high in 2008 (Figure 3.8). These

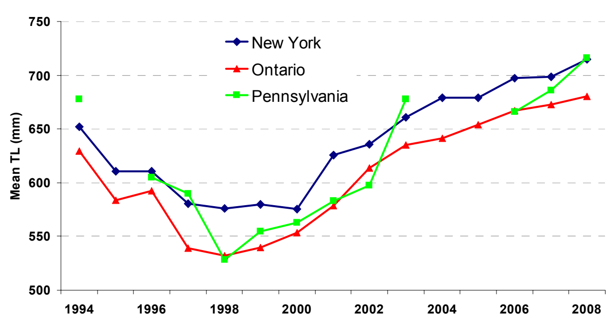

FIGURE 3.7. Average total length (TL, mm) of burbot caught in summer gill net assessments by jurisdiction, 1994-2008.

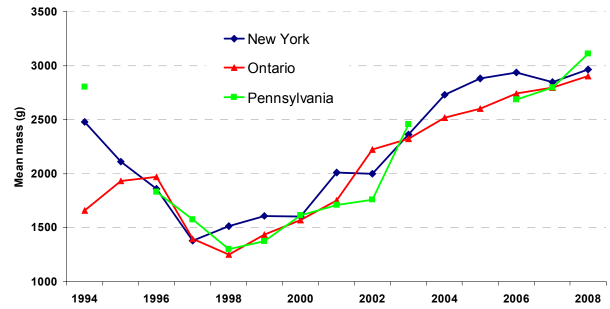

FIGURE 3.8. Average weight (g) of burbot caught in summer gill net assessments by jurisdiction, 1994-2008.

results reflect the increasing mean age of the burbot population.

Diet

Seasonal diet information for burbot is not available based on current sampling protocols. Diet information was limited to fish caught during August 2008 coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of stomach contents revealed a diet made up mostly of fish (Figure 3.9). Burbot diets continued to be diverse with six different fish and one invertebrate species found in stomach samples. Round gobies were the dominant prey item, occurring in 71% of the burbot stomachs, followed by rainbow smelt (23% occurrence). Other identifiable taxa were found in 5% or less of the stomachs and included shiners, yellow perch, alewife, gizzard shad, and dreissenids.

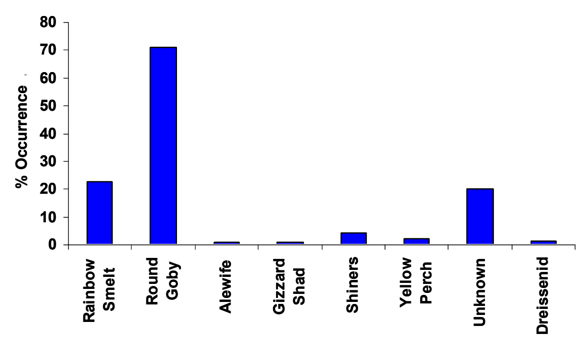

FIGURE 3.9. Frequency of occurrence of diet items from non-empty stomachs of burbot sampled in gill nets from the eastern basin of Lake Erie, August 2008. “Unknown” refers to fish remains that could not be identified to species. Sample size is 145 stomachs.

Gobies have increased in the diet of burbot since they first appeared in the eastern basin in 1999 (Figure 3.10). They were the main diet item for burbot in five of the last six years. Smelt were the dominant prey in 2005.

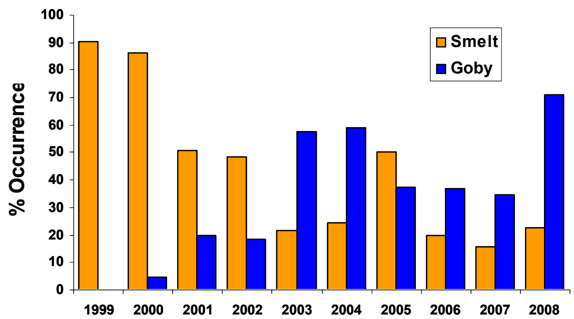

FIGURE 3.10. Frequency of occurrence of rainbow smelt and round goby in the diet of burbot caught in the eastern basin of Lake Erie, 1999-2008.

References

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

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.

Jeff Slade (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 apply the Integrated Management of Sea Lamprey (IMSL) program in Lake Erie including selection of streams for lampricide treatment and implementation of alternative control methods. The Lake Erie Coldwater Task Group has provided the forum for the assemblage of sea lamprey wounding data used to evaluate and guide actions related to managing sea lamprey and for the discussion of ongoing sea lamprey and fishery management actions that impact the Lake Erie fish community.

Lake Trout Wounding Rates

A total of 38 A1-A3 wounds were found on 612 lake trout greater than 532 mm (21 inches) total length in 2008, equaling a wounding rate of 6.2 wounds per 100 fish (Table 4.1; Figure 4.1). This was a 53% decline from the 2007 wounding rate (13.1 wounds/100 fish) and the lowest sea lamprey wounding rate in the last six years. Despite the decline, the wounding rate is still slightly higher than the target rate of 5 wounds per 100 fish (Lake Trout Task Group 1985; Markham et al. 2008). Wounding rates have remained above target for 12 of the past 13 years following reduced sea lamprey control measures in the mid-1990's (Sullivan et al. 2003). Lake trout over 736 mm (29 inches) continue to be preferred targets for sea lamprey, but smaller lake trout in the 432-532 mm (17-21 inch) category also received a high percentage of fresh wounds (Table 4.1). This was the second consecutive year and only the third year since 1988 that sea lamprey wounds were found on lake trout less than 533 mm.

TABLE 4.1. Frequency of sea lamprey wounds observed on several standard length groups of lake trout collected from assessment gill nets in the eastern basin of Lake Erie, August-September 2008.

Size Class Total Length (mm)	Sample Size	Wound Classification A1	A2	A3	A4	No. A1-A3 Wounds per 100 Fish
432-532	47	2	0	3	2	10.6
533-634	361	4	5	10	28	5.3
635-736	161	1	6	2	48	5.6
>736	90	3	3	4	105	11.1
>532	612	8	14	16	181	6.2

Fresh A1 wounds are considered indicators of the attack rate for the current year at the time of sampling (August). A1 wounding in 2008 was 1.3 wounds per adult lake trout greater than 532 mm, which was the lowest rate since 2002 and below the series average of 2.18 wounds/100 fish (Table 4.1; Figure 4.2). A total of eight A1 wounds were found spread across all size categories. Two A1 wounds were also recorded on lake trout less than 533 mm.

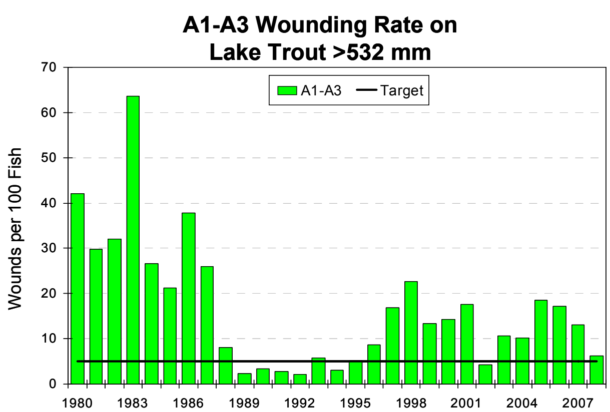

FIGURE 4.1. Number of fresh (A1-A3) sea lamprey wounds per 100 adult lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August -September, 1980-2008. The target rate is 5 wounds per 100 fish.

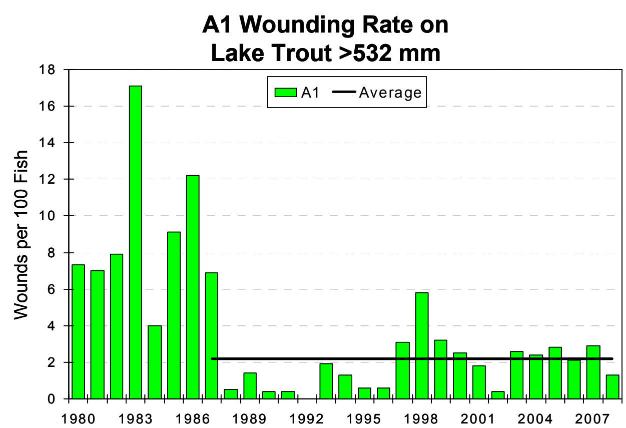

FIGURE 4.2. Number of A1 sea lamprey wounds per 100 adult lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1980-2008. The post-treatment average includes 1987-2007.

The past year's cumulative attacks are indicated by A4 wounds. A4 wounding rates continued to decline from the time series high in 2006 (68.4 wounds/100 fish) to 29.6 wounds/100 fish in 2008 (Figure 4.3). This was the lowest A4 wounding rate in the last four years, but was still above the time series average of 21.2 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). A4 wounding rates on lake trout over 29 inches in length remain very high (116.7 wounds/100 fish) with many fish possessing multiple wounds.

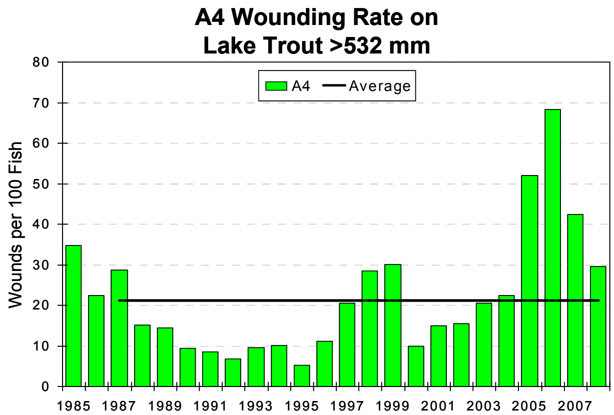

FIGURE 4.3. Number of healed (A4) sea lamprey wounds per 100 adult lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1985-2008. The post-treatment average includes 1987-2007.

Finger Lakes (FL) and Klondike (KL) strain lake trout were the most prevalent strains sampled, and they accounted for all the fresh (A1-A3) sea lamprey wounds and the majority of the A4 wounds (Table 4.2). Overall, A1-A3 and A4 wounding rates were higher on Finger Lakes strain compared to Klondike strain lake trout. However, almost all of the lake trout over 736 mm, which are the preferred targets, were FL strain fish. A4 wounding rates were very high on other lake trout strains (Lake Erie, Lewis Lake, Lake Ontario, and Lake Superior) due to low sample sizes and multiple wounds per fish.

TABLE 4.2. Frequency of sea lamprey wounds observed on lake trout >532 mm, by strain, collected from assessment gill nets in the eastern basin of Lake Erie, August-September 2008.

LAKE TROUT STRAIN	SAMPLE SIZE	WOUND CLASSIFICATION A1	A2	A3	A4	NO. A1-A3 WOUNDS PER 100 FISH	NO. A4 WOUNDS PER 100 FISH
FL	185	3	8	4	109	8.1	58.9
KL	378	5	6	11	32	5.8	8.7
LE	1	0	0	0	7	0	700.0
LL	1	0	0	0	2	0	200.0
LO	1	0	0	0	9	0	900.0
SUP	5	0	0	0	10	0	200.0

Burbot Wounding Rates

The burbot population, once the most prevalent coldwater predator in the eastern basin of Lake Erie, has declined to levels less than half of those observed only a few years ago (Coldwater Task Group 2008). Both A1-A3 and A4 wounding rates on burbot have increased since 2001 in the New York waters of Lake Erie. The fresh (A1-A3) wounding rate on burbot declined in 2008 from a time series high in 2007, but A4 wounding rates continued a 4-year increasing trend to a time series high of 15.6 wounds/100 fish (Figure 4.4).

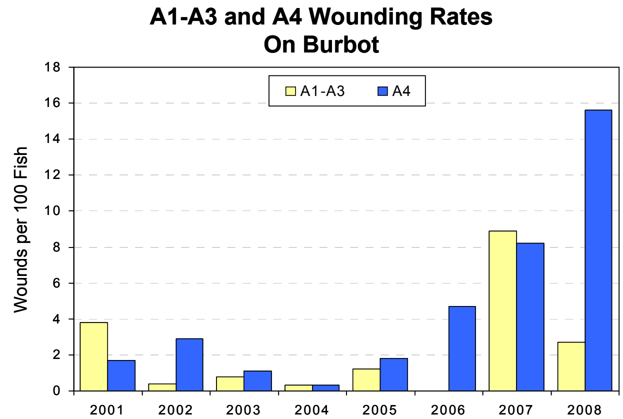

FIGURE 4.4. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot (all sizes) sampled in assessment gill nets in the New York waters of Lake Erie, August, 2001-2008.

Lake Whitefish Wounding Rates

Sea lamprey wounds on lake whitefish have not been consistently recorded in Lake Erie agency assessment surveys until 2001. Wounds on lake whitefish did not appear in New York assessment surveys until 2003, which coincides with the lowest level of adult lake trout abundance since the mid-1980's (see Charge 1). Fresh A1-A3 wounds on whitefish of all sizes appear to be declining since 2003 while A4 wounding is more variable (Figure 4.5). Overall, wounding rates on lake whitefish are low compared to lake trout and burbot and may be due to higher post-wounding mortality.

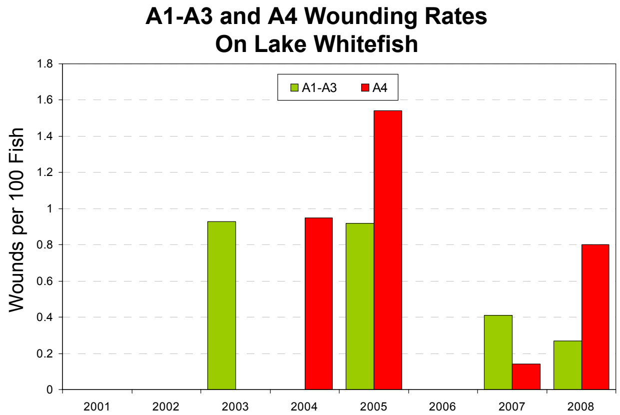

FIGURE 4.5. Number of A1-A3 and A4 sea lamprey wounds per 100 lake whitefish (all sizes) sampled in assessment gill nets in the New York waters of Lake Erie, August, 2001-2008.

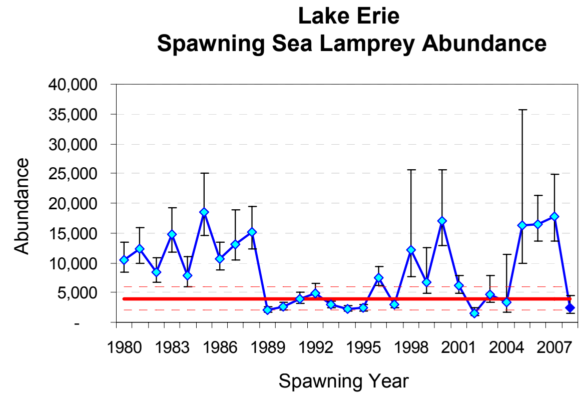

FIGURE 4.6. Lakewide estimate of spawning-phase sea lampreys in Lake Erie with 95% confidence limits, 1980-2008. Thick solid line indicates spawner abundance target level with 95% confidence range (thin lines).

2008 Sea Lamprey Control Actions

Lampricide control efforts were intensified in 2008 with lampricide treatments conducted in all tributaries to Lake Erie that contained larval sea lamprey. Treatments were conducted in 5 U. S. tributaries (Cattaraugus, Crooked, Raccoon and Conneaut Creeks and Grand River) and 4 Canadian tributaries (Silver, Big Otter, Big and Young's Creeks). These treatments were conducted as part of a two year experiment designed to reduce the number of parasitic sea lamprey in Lake Erie to target levels of abundance by treating all streams that contain sea lamprey in two consecutive years.

Assessments for larval sea lamprey were conducted in 41 tributaries (29 U.S., 12 Canada) and offshore of one U.S. tributary (Canadaway Creek). Surveys to detect new populations were conducted in 26 tributaries (20 U.S, 6 Canada) and no new populations were discovered. For the fourth consecutive year, surveys to assess larval recruitment in a section of the Chagrin River upstream of the washed out barrier at Daniels Park were conducted and no larval sea lamprey were found. In addition, larval habitat was quantified in the Chagrin River.

The estimated number of spawning-phase sea lamprey decreased from 17,686 during 2007 to 2,400 during 2008. When compared to the 2007 estimate, this was a decrease of about 87% (Figure 4.5). A total of 246 spawning-phase sea lamprey were trapped in four tributaries (2 U.S., 2 Canada) during 2008, a decrease of about 85% when compared to 2007 catches.

A new approach to ranking streams for lampricide treatment was implemented throughout the Great Lakes in 2008. This new approach was based on several years of research, which demonstrated that streams could be ranked for treatment using a more rapid assessment technique (i.e. ranking surveys) and that as many or more lampreys would be killed as when streams were ranked with the more labor-intensive quantitative assessment sampling used since the mid 1990's. Due to the ongoing experiment designed to achieve target levels of sea lamprey abundance in Lake Erie, ranking surveys were not used in Lake Erie tributaries in 2008, but will likely be used after 2009 when required.

2009 Sea Lamprey Control Plans

Each of the nine sea lamprey producing streams treated in 2008 is scheduled for treatment in the fall of 2009. Larval assessment surveys will be conducted to confirm lampricide application points on each of these streams. An additional 15 streams (9 U.S., 6 Canada) and 3 U.S. lentic areas are scheduled to be surveyed for the presence of larval sea lampreys in 2009.

Adult assessment traps will be operated on four streams (2 U.S., 2 Canada) to estimate lakewide spawning-phase abundance.

The Normandale Creek sea lamprey barrier was destroyed by a flood-wave when a dam upstream washed out. A replacement barrier is scheduled to be built in 2009.

TABLE 4.2. Larval sea lamprey assessments of Lake Erie tributaries during 2008 and plans for 2009.

Stream	History	Surveyed in 2008	Survey Type[1]	Results	Plans for 2009
Canada					
St. Clair River	Positive	Yes	Evaluation	Positive	None
Ox Creek	Negative	Yes	Detection	Negative	None
Unnamed (E-62)	Negative	Yes	Detection	Negative	None
Unnamed (E-63)	Negative	Yes	Detection	Negative	None
Talbot Creek	Negative	Yes	Detection	Negative	None
East Creek	Positive	No	---	---	Evaluation
Catfish Creek	Positive	No	---	---	Evaluation
Silver Creek	Positive	Yes	Dist/Trt.Eval	Negative	Distribution
Big Otter Creek	Positive	Yes	Dist/Trt. Eval	Negative	Distribution
South Otter Creek	Positive	No	---	---	Evaluation
Clear Creek	Positive	No	---	---	Evaluation
Big Creek	Positive	Yes	Dist/Trt. Eval	Positive	Distribution
Forestville Creek	Positive	Yes	Evaluation	Negative	None
Normandale Creek	Positive	Yes	Evaluation	Positive	Evaluation
Fishers Creek	Positive	Yes	Evaluation	Negative	None
Unnamed (E-116)	Negative	Yes	Detection	Negative	None
Young's Creek	Positive	Yes	Evaluation	Negative	Distribution
Grand River	Positive	Yes	Evaluation	Negative	Evaluation
United States					
Smoke Creek	Negative	Yes	Detection	Negative	None
Rush Creek	Negative	Yes	Detection	Negative	None
Big Sister Creek	Negative	Yes	Detection	Negative	None
Muddy Creek	Negative	Yes	Detection	Negative	None
Cattaraugus Creek	Positive	Yes	Dist/Trt. Eval	Positive	Dist/Trt. Eval/Eval
Silver Creek	Negative	Yes	Detection	Negative	None
Beaver Creek	Negative	Yes	Detection	Negative	None
Scott Creek	Negative	Yes	Detection	Negative	None
Canadaway Creek	Positive	Yes	Evaluation	Negative	None
Little Canadaway Creek	Negative	Yes	Detection	Negative	None
Slippery Rock Creek	Negative	Yes	Detection	Negative	None
Walker Creek	Negative	Yes	Detection	Negative	None
Chautaugqua Creek	Negative	Yes	Detection	Negative	None
Twenty Mile Creek	Negative	Yes	Detection	Negative	None

Stream	History	Surveyed in 2008	Survey Type[1]	Results	Plans for 2009
Sixteen Mile Creek	Negative	Yes	Detection	Negative	None
Twelve Mile Creek	Negative	Yes	Detection	Negative	None
Eight Mile Creek	Negative	No	---	---	Detection
Seven Mile Creek	Negative	Yes	Detection	Negative	None
Six Mile Creek	Negative	No	---	---	Detection
Four Mile Creek	Negative	No	---	---	Detection
Trout Run Creek	Negative	Yes	Detection	Negative	None
Fairplain Creek	Negative	No	---	---	Detection
Lake Erie Park Creek	Negative	Yes	Detection	Negative	None
Elk Creek	Negative	Yes	Detection	Negative	None
Townline Creek	Negative	No	---	---	Detection
Crooked Creek	Positive	Yes	Trt. Eval	Negative	Dist/Trt. Eval
Raccoon Creek	Positive	Yes	Trt. Eval	Negative	Dist/Trt. Eval
Conneaut Creek	Positive	Yes	Trt. Eval	Positive	Dist/Trt. Eval/Eval
Indian Creek	Negative	Yes	Detection	Negative	None
Wheeler Creek	Positive	No	Evaluation	Negative	None
Grand River	Positive	Yes	Trt. Eval	Negative	Dist/Trt. Eval/Bar/Eval
Chagrin River	Positive	Yes	Evaluation	Negative	None
Huron River (OH)	Negative	No	---	---	Detection
Huron River (MI)	Negative	Yes	Detection	Negative	None
Black River	Positive	No	---	---	Distribution
Pine River	Positive	Yes	Evaluation	Negative	None
Belle River	Positive	Yes	Evaluation	Negative	None
Clinton River	Positive	No	---	---	Evaluation
St. Clair River	Positive	No	---	---	Evaluation

[1]*Evaluation survey* – conducted to detect larval recruitment in streams with a history of sea lamprey infestation.
Detection survey – conducted to detect larval recruitment in streams with no history of sea lamprey infestation.
Distribution survey – conducted to determine instream geographic distribution or to determine lampricide treatment application points.
Treatment evaluation survey – conducted to determine the relative abundance of survivors from a lampricide treatment.
Ranking survey – conducted to index the larval population to determine need for lampricide treatment the following year. Projected treatment cost is divided by the estimate of larvae > 100 mm to provide a ranking against other Great Lakes tributaries for lampricide treatment.
Biological collection – conducted to collect lamprey specimens for research purposes.
Barrier survey - conducted to determine larval recruitment upstream of barriers.

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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 Stocking

The current lake trout stocking goal (160,000 yearlings) was met for the first time since 2003 (Figure 5.1). A total of 152,751 yearlings were stocked into New York waters while 50,000 surplus lake trout yearlings were stocked by the Ontario Ministry of Natural Resources (OMNR). Combined, the 202,751 yearlings were the most lake trout stocked into Lake Erie waters since 1993. Since the Allegheny National Fish Hatchery (ANFH) remained closed for renovations, lake trout stocked in New York waters were raised at two federal facilities in Vermont (White River and Pittsford National Fish Hatcheries) and stocked between 29 April and 7 May, 2008. All lake trout were stocked offshore of Dunkirk in approximately 70 feet of water via the *R/V Argo*. The majority of the lake trout were Finger Lakes strain fish with lesser numbers of Klondike strain also stocked. The Vermont hatcheries are scheduled to raise lake trout for Lake Erie until renovations at the ANFH are complete. Current projections for resuming production at the ANFH have been pushed back to 2012 due to lack of funding. Lake Manitou strain lake trout were stocked by OMNR on 15 May 2008. These fish were boat stocked off Port Dover onto Nanticoke Shoals, a potential lake trout spawning reef. Annual stockings of 50,000 yearling lake trout are scheduled by OMNR for the next three years.

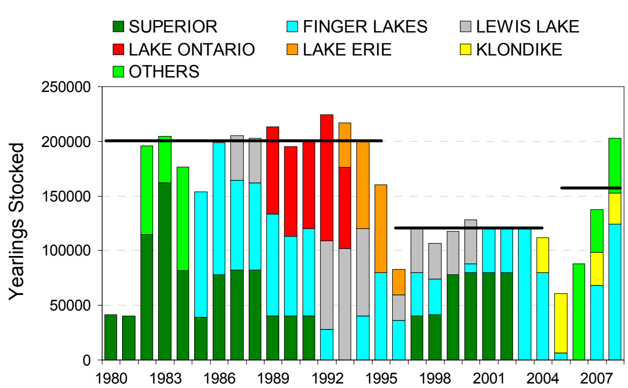

Figure 5.1. Yearling lake trout stocked (in yearling equivalents) in eastern basin waters of Lake Erie, 1980-2008, by strain. The current stocking goal (black line) is 160,000 yearlings per year. OTHERS = Clearwater Lake (1982-84), Slate Island (2006), Traverse Island (2007), and Lake Manitou (2008).

Stocking of Other Salmonids

In 2008, over 2.2 million yearling trout and salmon were stocked in Lake Erie, including rainbow/ steelhead trout, brown trout and lake trout (Figure 5.2). Total salmonid stocking increased 5% from 2007 but was 2% below the long-term average (1989-2007). Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 5.1.

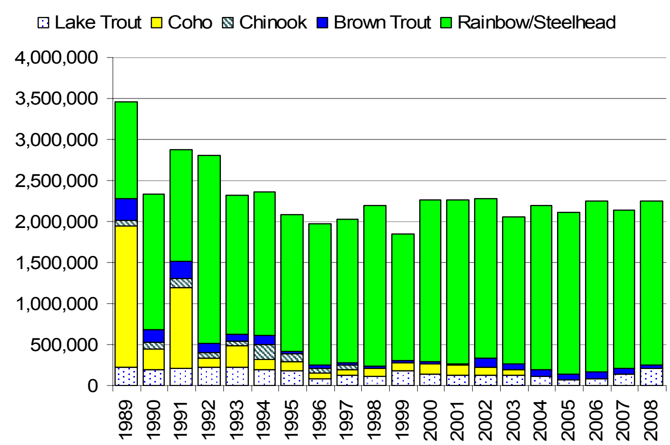

Figure 5.2: Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1989-2008.

All of the U.S. state fisheries resource agencies and a few non-governmental organizations (NGO's) in Ontario and Pennsylvania presently stock rainbow/steelhead trout in the Lake Erie watershed. A total of 1,995,574 yearling rainbow/steelhead trout were stocked in 2008, accounting for nearly 89% of all salmonids stocked. This represented a 3% increase from 2007, and was 11% higher than the long-term average. The increase above the long-term average is primarily a result of the increased emphasis of rainbow trout/steelhead in jurisdictional fisheries over other pacific salmon during the last decade. A breakdown of rainbow/ steelhead trout stocked in Lake Erie by jurisdiction for 2008 is as follows; Pennsylvania (1,157,968; 58%), Ohio (465,347; 23%), New York (269,800; 14%), Michigan (65,959; 3%) and Ontario (36,500; 2%). Yearling plants take place each spring, between

March and May, when smolts average about 150 mm in length. Details on strain composition and stocking location of rainbow/ steelhead trout are in Charge 6 of this report.

Brown trout stocking in Lake Erie totaled 53,930 yearlings in 2008. This represented an 18% decrease from 2007 and a 37% decrease from the long-term average. Most (67%) of the brown trout stocked in Lake Erie were in New York waters for the purposes of providing a put-grow-and-take trophy brown trout fishery for offshore boat anglers and seasonal tributary anglers. The 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 also stocked brown trout (17,930) in the Lake Erie watershed. All of the brown trout stocked in Pennsylvania tributaries in 2008 were stocked for the opening day of trout season, and are managed according to standard put-and-take adult trout management strategies (9" MSL).

A put-grow-and-take brown trout program is being implemented in Pennsylvania waters of Lake Erie beginning in 2009 and is expected to continue until an evaluation of these efforts can be completed. This program was in response to requests from Pennsylvania angler constituency groups for increased diversity in trout fishing opportunities on Lake Erie and the discontinuation of the Coho salmon program in Pennsylvania that occurred in 2003. Two NGO hatcheries are ready to stock brown trout in 2009, and currently have about 40,000 yearling fish in inventory. Additionally, the Pennsylvania Fish and Boat Commission (PFBC) had received 100,000 certified disease free, fertilized brown trout eggs from the New York State Department of Environmental Conservation (NYSDEC) in 2008. Based on the current inventory at the Linesville State Fish Hatchery, there should be about 35,000 brown trout available for stocking in 2010 by the PFBC. The addition of brown trout to Pennsylvania's Lake Erie salmonid stocking program will not result in an increase in overall stocking as there will be a commensurate decrease in steelhead stocking.

TABLE 5.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2008.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
ONT.	--	--	--	--	14,370	14,370
NYS DEC	143,200	154,210	70,370	54,590	141,740	564,110
PFBC	80,000	1,166,480	--	62,450	720,920	2,029,850
ODNR	--	--	--	92,120	242,000	334,120
MDNR	--	400,190	--	50,350	69,560	520,100
1989 Total	**223,200**	**1,720,880**	**70,370**	**259,510**	**1,188,590**	**3,462,550**
ONT.	--	--	--	--	31,530	31,530
NYS DEC	113,730	5,730	65,170	48,320	160,500	393,450
PFBC	82,000	249,810	5,670	55,670	889,470	1,282,620
ODNR	--	--	--	--	485,310	485,310
MDNR	--	--	--	51,090	85,290	136,380
1990 Total	**195,730**	**255,540**	**70,840**	**155,080**	**1,652,100**	**2,329,290**
ONT.	--	--	--	--	98,200	98,200
NYS DEC	125,930	5,690	59,590	43,500	181,800	416,510
PFBC	84,000	984,000	40,970	124,500	641,390	1,874,860
ODNR	--	--	--	--	367,910	367,910
MDNR	--	--	--	52,500	58,980	111,480
1991 Total	**209,930**	**989,690**	**100,560**	**220,500**	**1,348,280**	**2,868,960**
ONT.	--	--	--	--	89,160	89,160
NYS DEC	108,900	4,670	56,750	46,600	149,050	365,970
PFBC	115,700	98,950	15,890	61,560	1,485,760	1,777,860
ODNR	--	--	--	--	561,600	561,600
MDNR	--	--	--	--	14,500	14,500
1992 Total	**224,600**	**103,620**	**72,640**	**108,160**	**2,300,070**	**2,809,090**
ONT.	--	--	--	650	16,680	17,330
NYS DEC	142,700	--	56,390	47,000	256,440	502,530
PFBC	74,200	271,700	--	36,010	973,300	1,355,210
ODNR	--	--	--	--	421,570	421,570
MDNR	--	--	--	--	22,200	22,200
1993 Total	**216,900**	**271,700**	**56,390**	**83,660**	**1,690,190**	**2,318,840**
ONT.	--	--	--	--	69,200	69,200
NYS DEC	120,000	--	56,750	--	251,660	428,410
PFBC	80,000	112,900	128,000	112,460	1,240,200	1,673,560
ODNR	--	--	--	--	165,520	165,520
MDNR	--	--	--	--	25,300	25,300
1994 Total	**200,000**	**112,900**	**184,750**	**112,460**	**1,751,880**	**2,361,990**
ONT.	--	--	--	--	56,000	56,000
NYS DEC	96,290	--	56,750	--	220,940	373,980
PFBC	80,000	119,000	40,000	30,350	1,223,450	1,492,800
ODNR	--	--	--	--	112,950	112,950
MDNR	--	--	--	--	50,460	50,460
1995 Total	**176,290**	**119,000**	**96,750**	**30,350**	**1,663,800**	**2,086,190**
ONT.	--	--	--	--	38,900	38,900
NYS DEC	46,900	--	56,750	--	318,900	422,550
PFBC	37,000	72,000	--	38,850	1,091,750	1,239,600
ODNR	--	--	--	--	205,350	205,350
MDNR	--	--	--	--	59,200	59,200
1996 Total	**83,900**	**72,000**	**56,750**	**38,850**	**1,714,100**	**1,965,600**
ONT.	--	--	--	1,763	51,000	52,763
NYS DEC	80,000	--	56,750	--	277,042	413,792
PFBC	40,000	68,061	--	31,845	1,153,606	1,293,512
ODNR	--	--	--	--	197,897	197,897
MDNR	--	--	--	--	71,317	71,317
1997 Total	**120,000**	**68,061**	**56,750**	**33,608**	**1,750,862**	**2,029,281**
ONT.	--	--	--	--	61,000	61,000
NYS DEC	106,900	--	--	--	299,610	406,510
PFBC	--	100,000	--	28,030	1,271,651	1,399,681
ODNR	--	--	--	--	266,383	266,383
MDNR	--	--	--	--	60,030	60,030
1998 Total	**106,900**	**100,000**	**0**	**28,030**	**1,958,674**	**2,193,604**

TABLE 5.1. (Continued) Summary of salmonid stockings in number of yearling equivalents, 1990-2008.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
ONT.	--	--	--	--	85,235	85,235
NYS DEC	78,000		--	--	310,300	388,300
PFBC	40,000	100,000	--	20,780	835,931	996,711
ODNR	--	--	--	--	238,467	238,467
MDNR	--	--	--	--	69,234	69,234
1999 Total	**118,000**	**100,000**	**0**	**20,780**	**1,539,167**	**1,777,947**
ONT.	--	--	--	--	10,787	10,787
NYS DEC	92,200	--	--	--	298,330	390,530
PFBC	40,000	137,204	--	17,163	1,237,870	1,432,237
ODNR	--	--	--	--	375,022	375,022
MDNR	--	--	--	--	60,000	60,000
2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**
ONT.	--	--	--	100	40,860	40,960
NYS DEC	80,000	--	--	--	276,300	356,300
PFBC	40,000	127,641	--	17,000	1,185,239	1,369,880
ODNR	--	--	--	--	424,530	424,530
MDNR	--	--	--	--	67,789	67,789
2001 Total	**120,000**	**127,641**	**0**	**17,100**	**1,994,718**	**2,259,459**
ONT.	--	--	--	4,000	66,275	70,275
NYS DEC	80,000	--	--	72,300	257,200	409,500
PFBC	40,000	100,289	--	40,675	1,145,131	1,326,095
ODNR	--	--	--	--	411,601	411,601
MDNR	--	--	--	--	60,000	60,000
2002 Total	**120,000**	**100,289**	**0**	**116,975**	**1,940,207**	**2,277,471**
ONT.	--	--	--	7,000	48,672	55,672
NYS DEC	120,000	--	--	44,813	253,750	418,563
PFBC	--	69,912	--	22,921	866,789	959,622
ODNR	--	--	--	--	544,280	544,280
MDNR	--	--	--	--	79,592	79,592
2003 Total	**120,000**	**69,912**	**0**	**74,734**	**1,793,083**	**2,057,729**
ONT.	--	--	--	--	34,600	34,600
NYS DEC	111,600	--	--	36,000	257,400	405,000
PFBC	--	--	--	50,350	1,211,551	1,261,901
ODNR	--	--	--	--	422,291	422,291
MDNR	--	--	--	--	64,200	64,200
2004 Total	**111,600**	**0**	**0**	**86,350**	**1,990,042**	**2,187,992**
ONT.	--	--	--	--	55,000	55,000
NYS DEC	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**
ONT.	88,000	--	--	175	44,350	132,525
NYS DEC	--	--	--	37,540	275,000	312,540
PFBC	--	--	--	35,170	1,205,203	1,240,373
ODNR	--	--	--	--	491,943	491,943
MDNR	--	--	--	--	66,514	66,514
2006 Total	**88,000**	**0**	**0**	**72,885**	**2,083,010**	**2,243,895**
ONT.	--	--	--		27,700	27,700
NYS DEC	137,637	--	--	37,900	272,630	448,167
PFBC	--	--	--	27,715	1,122,996	1,150,711
ODNR	--	--	--	--	453,413	453,413
MDNR	--	--	--	--	60,500	60,500
2007 Total	**137,637**	**0**	**0**	**65,615**	**1,937,239**	**2,140,491**
ONT.	50,000	--	--	--	36,500	86,500
NYS DEC	152,751	--	--	36,000	269,800	458,551
PFBC	--	--	--	17,930	1,157,968	1,175,898
ODNR	--	--	--	--	465,347	465,347
MDNR	--	--	--	--	65,959	65,959
2008 Total	**202,751**	**0**	**0**	**53,930**	**1,995,574**	**2,252,255**

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), Kevin Kayle (ODW), and James Markham (NYSDEC)

Stocking

All Lake Erie jurisdictions stocked lake-run rainbow trout (or steelhead) in 2008 (Table 6.1). Additionally, a small number of domestic and golden rainbow trout were stocked to supplement the put-and-take trout fishery in Pennsylvania. Based on these efforts, a total of 1,995,574 yearling steelhead/rainbow trout were stocked in 2008, representing a 3% increase from 2007 and an 11% increase from the long-term (1989-2007) average.

Nearly all of the rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A Lake Erie strain accounted for 57% of the strain composition followed by a Lake Michigan strain (27%) and a Lake Ontario strain (15%); less than 2% of the rainbow trout stocked in Lake Erie were miscellaneous strains including a domestic strain (1%), a Skamania strain (0.5%) and a golden rainbow trout strain (0.01%). Only the Skamania strain steelhead stocked by New York received fin-clips in 2008 (Table 6.2).

TABLE 6.1. Rainbow trout/steelhead stocking by jurisdiction for 2008.

	Location	Strain	Fin Clips	Number	Life Stage	Yearling Eqivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	NO	65,959	Yearling	**65,959**	**Sub-Total**
Ontario	Mill Creek	Ganaraska River, L. Ontario	NO	21,000	Yearling	21,000	
	Erieau Harbor	Ganaraska River, L. Ontario	NO	15,500	Yearling	15,500	
						36,500	**Sub-Total**
Pennsylvania	Conneaut Creek	Trout Run, L. Erie	NO	75,000	Yearling	75,000	
	Conneaut Creek - West Branch	Domestic	NO	6,098	Adult	6,098	
	Conneaut Creek - West Branch	Golden	NO	60	Adult	60	
	Crooked Creek	Trout Run, L. Erie	NO	78,397	Yearling	78,397	
	Elk Creek	Domestic	NO	475	Adult	475	
	Elk Creek	Golden	NO	5	Adult	5	
	Elk Creek	Trout Run, L. Erie	NO	274,311	Yearling	274,311	
	Fourmile Creek	Golden	NO	50	Adult	50	
	Fourmile Creek	Trout Run, L. Erie	NO	19,599	Yearling	19,599	
	Godfrey Run	Trout Run, L. Erie	NO	51,000	Fall Fingerlings	1,800	
	Godfrey Run	Trout Run, L. Erie	NO	19,600	Yearling	19,600	
	Godfrey Run	Trout Run, L. Erie	NO	51,000	Yearling	51,000	
	Peck Run	Domestic	NO	1,500	Adult	1,500	
	Presque Isle Bay	Trout Run, L. Erie	NO	94,386	Yearling	94,386	
	Raccoon Creek	Trout Run, L. Erie	NO	19,600	Yearling	19,600	
	Sevenmile Creek	Golden	NO	150	Adult	150	
	Sevenmile Creek	Trout Run, L. Erie	NO	19,599	Yearling	19,599	
	Sixteenmile Creek	Trout Run, L. Erie	NO	19,600	Yearling	19,600	
	Taylor Run	Domestic	NO	2,223	Adult	2,223	
	Taylor Run	Golden	NO	5	Adult	5	
	Temple Creek	Domestic	NO	3,173	Adult	3,173	
	Temple Creek	Golden	NO	5	Adult	5	
	Trout Run	Trout Run, L. Erie	NO	48,998	Yearling	48,998	
	Trout Run	Trout Run, L. Erie	NO	20,000	Yearling	20,000	
	Twelvemile Creek	Trout Run, L. Erie	NO	39,200	Yearling	39,200	
	Twentymile Creek	Trout Run, L. Erie	NO	157,334	Yearling	157,334	
	Walnut Creek	Trout Run, L. Erie	NO	205,800	Yearling	205,800	
						1,157,968	**Sub-Total**
Ohio	Chagrin River	Manistee River, L. Michigan	NO	105,770	Yearling	105,770	
	Conneaut Creek	Manistee River, L. Michigan	NO	91,915	Yearling	91,915	
	Grand River	Manistee River, L. Michigan	NO	106,164	Yearling	106,164	
	Rocky River	Manistee River, L. Michigan	NO	105,755	Yearling	105,755	
	Vermillion River	Manistee River, L. Michigan	NO	55,743	Yearling	55,743	
						465,347	**Sub-Total**
New York	Walnut Creek	Washington	NO	10,000	Yearling	10,000	
	Silver Creek	Washington	NO	10,000	Yearling	10,000	
	Buffalo River	Washington	NO	43,200	Yearling	43,200	
	Cattaraugus Cr.	Washington	NO	90,000	Yearling	90,000	
	Cattaraugus Cr.	Skamania	LPAD	9,800	Yearling	9,800	
	18-Mi. Creek	Washington	NO	20,000	Yearling	20,000	
	S. Branch 18-Mi. Creek	Washington	NO	20,000	Yearling	20,000	
	Canadaway Cr.	Washington	NO	20,000	Yearling	20,000	
	Chautauqua Cr.	Washington	NO	40,000	Yearling	40,000	
	Buffalo River (Pen)	Washington	NO	1,800	Yearling	1,800	
	18 Mile Creek	Randolf Domestic	NO	5,000	Yearling	5,000	
						269,800	**Sub-Total**
						1,995,574	**Grand Total**

TABLE 6.2. Rainbow trout fin-clip summary for Lake Erie, 1999-2008.

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	-	-
2007	2006	-	LPAD	-	-	-
2008	2007	-	LPAD	-	-	-

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

Assessment of Natural Reproduction

In anticipation of a fish passage project on a series of dams in Chautauqua Creek (NY), a comprehensive survey of the fish community and assessment of juvenile production of steelhead both below and above the two existing fish barriers was conducted in both 2007 and 2008 by the NYSDEC. The results of these surveys showed the impact of the two dams on the passage of steelhead and the overall fish community. Abundance of YOY steelhead was 3-4 times higher below the dams compared to sites above the dams, and composition of non-trout species differed as well. These results indicate that while some steelhead do make it over both barriers and are able to migrate upstream to spawn, the bulk of the fish are stopped and spawn in the riffle areas below the dams. The abundance of YOY steelhead in Chautauqua Creek was comparable to fall densities found in higher quality Michigan streams (Seelback 1993; Godby et al. 2007). However, densities were lower than Spooner Creek (3,245 fish/acre), which is considered the top steelhead producing stream in New York's Lake Erie watershed (Culligan et al. 2002). Nearly identical abundances of YOY steelhead below the dams in both sampling years suggest that this area is at its carrying capacity. Further studies need to be conducted to determine if this production is contributing to the adult steelhead population of this stream.

Exploitation

Previous creel surveys confirm that the majority of rainbow trout (steelhead) angling activity takes place in the tributaries as fish move from the lake into the streams to spawn. This was established 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 steelhead harvest tabulated by most Lake Erie agencies. Several agencies provide annual measurements of open lake summer harvest by boat anglers, which may provide some measure of the relative abundance of adult steelhead in Lake Erie.

The estimated harvest from the summer open-water boat angler fishery in 2008 was 5,431 steelhead in all US waters; a 79% decrease from the estimated 2007 steelhead harvest (Table 6.3). It was the lowest open lake harvest of steelhead in the ten-year time series. Annual declines in harvest were comparable in Ohio (-81%) and Pennsylvania (-78%), but less pronounced in New York (-56%).

Table 6.3. Reported estimated harvest of rainbow/steelhead trout by open lake boat anglers in Lake Erie, 1999-2008.

	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
2007	19,216	4,936	1,465	N/A*	68	25,685
2008	3,656	1,089	647		39	5,431

* no creel data collected by OMNR in 2003, 2005, 2006 and 2007
** 2004 OMNR sport harvest data is July and August, Central basin waters only

Most of the reported harvest was concentrated in Central Basin waters of Ohio (67%) and Pennsylvania (5%) followed by the eastern basin waters in Pennsylvania (15%) and New York (12%). Less than 1% of the estimated steelhead harvest occurred in Michigan waters of the western basin. The Ontario Ministry of Natural Resources did not conduct angler surveys during 2008 that could provide measurable estimates of rainbow trout harvest in open lake waters of Lake Erie.

Boat angler catch rates for rainbow trout also decreased from 2007 as well (Figure 6.1). Catch rates by open lake boat anglers have been below the mean average interagency catch rate (0.13 fish/angler hour) since 2005, and the steelhead catch rate by Pennsylvania (0.02 fish/angler hour) boat anglers was the lowest in over a decade.

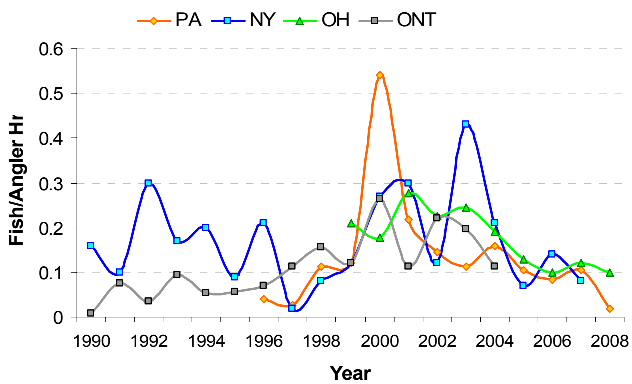

Figure 6.1: Targeted steelhead catch rates (fish/angler hour) in Lake Erie by open lake boat anglers in Ohio, Pennsylvania, New York and Ontario.

The Lake Erie tributaries provide the core of the steelhead fishery. Contemporary 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 estimate steelhead angler release rates of 93% on New York tributaries (Markham 2006), and 78% on Pennsylvania tributaries (Murray and Shields 2004). The tributary steelhead fishery remains an exceptional fishery with high catch rates and increasing popularity. Trends in angler diary catch rates by steelhead anglers in New York waters have steadily increased since the late 1990s (Figure 6.2).

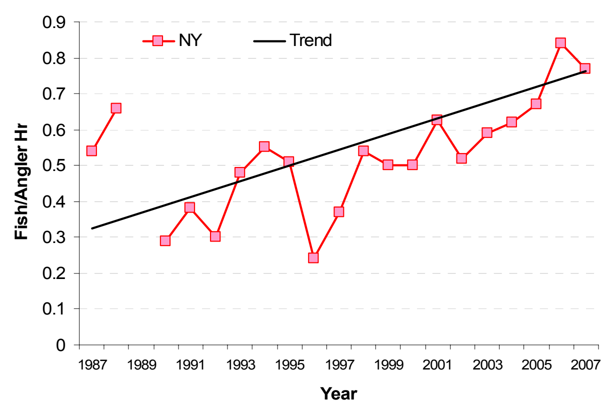

Figure 6.2: Targeted salmonid catch rates (fish/angler hour) in Lake Erie tributaries by New York angler diary cooperators, 1987-2007.

Tributary Creel Surveys

A roving-roving creel survey design was implemented on the New York tributaries to Lake Erie from 15 September 2007 - 15 May 2008 to estimate effort, catch, and harvest of the salmonid fishery (Markham 2008). This was the third creel survey conducted since 2003 and continues an effort to monitor this valuable fishery. The survey covered the eight major Lake Erie tributaries in New York stocked with steelhead (Chautauqua, Canadaway, Silver, Walnut, Cattaraugus, 18 Mile, Buffalo, and Cayuga Creeks). Two creel agents conducted a total of 2,740 interviews on five routes to estimate catch, harvest, and obtain demographic and angler opinion information. They also covered 73 sites to estimate overall angler effort. Demographics of the fishery were very similar to previous surveys conducted in 2003-04 and 2004-05 (Markham 2006) with the majority of the anglers (98%) being males between the ages of 25 and 60. Spinning rods were the most popular fishing gear followed by fly rods and noodle/float rods. Artificials and baits were equally popular with anglers. The majority (88%) of the anglers were New York residents with >93% coming from the three local counties. The majority of the non-resident anglers were from Pennsylvania (46%) and Ontario (30%). Total tributary effort was estimated at 202,142 angler-hours, which was similar to previous surveys. Cattaraugus Creek received the most directed effort followed by 18 Mile, Chautauqua, and Canadaway Creeks. October, November, and April were the months with the highest angler effort. Catch and harvest rates equaled 0.60 and 0.06 fish/hour, respectively. Catch rates varied between streams and generally declined from west to east. Peak catch rates occurred in the winter months. Overall tributary catch was estimated at 124,918 salmonids with an overall harvest of 11,986 fish. The majority (98%) of the catch was steelhead. Four tributaries (Chautauqua, Canadaway, 18 Mile, Cattaraugus) were responsible for 97% of the total catch and 94% of the total harvest with the highest catches occurring in April, November and October.

Otolith Microchemistry Research

Because the vast majority of steelhead in Lake Erie appear to come from the stocking activities by MI, OH, PA, and NY (about 2 million smolts per year), there is the potential opportunity to assess these mixed stocks in Lake Erie using unique chemical signatures in otoliths, generated while the fish are in the hatcheries for a year (J. Miner, Personal communication). If the concentration of strontium, barium, magnesium and manganese is sufficiently different in the water among hatcheries, then there is potential for these differences to be incorporated into the calcium carbonate crystalline structure of steelhead otoliths. Using this principle, Drs. Jeffrey Miner and John Farver from Bowling Green State University, are attempting to differentiate hatchery stocks and then address management questions about philopatry (homing back to the release streams for spawning), characterizing natural reproduction, and stock-specific distribution of these steelhead in Lake Erie.

Using laser ablation – inductively coupled plasma mass spectrometry (LA-ICPMS) at the University of Windsor (Great Lakes Institute for Environmental Research), Farver and Miner have used lasers to track the concentration of these elements across the otoliths of hatchery fish searching for 'hatchery-specific' signatures. The easiest hatchery stock to identify is the Ohio steelhead raised in the Castalia Fish Hatchery. In the spring waters feeding that hatchery the concentration of naturally-occurring strontium is high enough that they can identify these fish with near 100% accuracy (based on preliminary analyses). New York steelhead (Salmon River Hatchery) also appear to be easily distinguished based on the pattern of change in strontium concentration (i.e., the switch from river to well water in the summer generates a characteristic pattern). They will use other elements and patterns in the chemical signatures to identify Michigan (Wolf Lake Hatchery) steelhead from the three state and one private hatchery supplying steelhead in Pennsylvania. Then they will look for annual consistency of these signatures, as well as address questions of homing and distribution.

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Charge 7: Prepare Lake Erie Cisco Management Plan. Review ecology and history of this species and assess potential for recovery.

Elizabeth Trometer (USFWS), Tom MacDougall (OMNR) and Kurt Oldenburg (OMNR)

Cisco (formerly lake herring) (*Coregonus artedi*) is indigenous to the Great Lakes and historically supported one of the most productive fisheries in Lake Erie (Scott and Crossman 1973, Trautman 1981). Cisco is considered extirpated in Lake Erie, although commercial fishermen report it periodically (Table 7.1, Figure 7.1). Their demise was mainly through over-fishing, although habitat degradation and competition likely contributed to recruitment failure (Greeley 1929, Hartman 1973, Scott and Crossman 1973). Siltation of spawning shoals, low dissolved oxygen, and chemical pollution are a few factors contributing to habitat degradation (Hartman 1973). The cisco collapsed also coincided with the introduction of both rainbow smelt (*Osmerus mordax*) and alewife (*Alosa psuedoharengus*), and the expansion of these exotic species in the 1950s may have prevented any recovery of cisco through competition and predation. Selgeby et al. (1978) documented consumption of cisco eggs by rainbow smelt. Evans and Loftus (1987) summarized two studies in which smelt consumed large numbers of cisco in the larval stage.

Numerous investigators have shown that alewife and smelt have negative effects on coregonid populations in the north-temperate lakes (Ryan et al. 1999). When alewife and smelt stocks are depressed, it creates an opportunity for coregonids to have stronger year classes. There is some evidence to indicate that this has occurred for whitefish (Oldenburg et al. 2007). Cisco should also be favored by these conditions. Rainbow smelt abundance declined sharply in the 1990's and continues to remain relatively low (Ryan et al. 1999 and FTG 2008). Alewife has never been very abundant in Lake Erie due to overwinter temperatures that frequently prove lethal (Ryan et al. 1999).

With the recent recovery of other native coldwater species (i.e. lake whitefish and burbot), and the relatively low abundance of rainbow smelt compared to the past, there has been an opportunity for cisco to recover in Lake Erie. Commercial fishermen have been reporting cisco since the 1990s, although these reports are rare. Recent reports and collections are listed in Table 7.1 with locations shown in Figure 7.1.

Cisco – Recent Observations

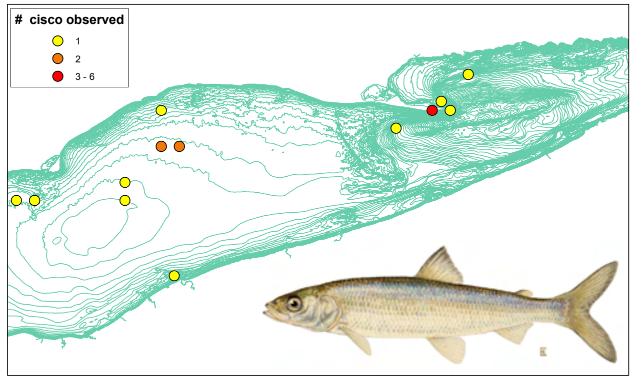

Figure 7.1. Spatial distribution of some recent (1996-2008) cisco observations. All reports are from the Ontario commercial gillnet and trawl fisheries with the exception of one occurrence in the ODNR index gillnet program near Fairport, OH. Total number of sightings is higher than shown as observation without location information have been excluded.

TABLE 7.1. Sampling details from a selection of cisco captured during commercial and fishing efforts, 1996-2008.

Date caught	TL (mm)	FL (mm)	Weight (g)	Maturity	Sex	Age
24-Apr-96	371	336	295	Mature	F	8
Summer 1999	156	140	289	Immature	F	1+
10-Aug-99	153	137	275	maturing	F	1+
15-Aug-99	158	142	282	Immature	M	1+
24-Aug-99	211			maturing	F	2+
21-Sep-99	140	126	214	maturing	M	1+
21-Sep-99		139	315	Immature	F	1+
06-Sep-02	315	284	239	mature	F	
06-Sep-02	170	153	135	Mature	F	
9-Jul-03	298	266	275	u/k	M	2+
9-Jul-03	222	203	103	u/k	M	1+
16-Jul-03	301	271	248	u/k	UNK	UNK
27-Aug-03	278		183	Immature	F	UNK
22-Sep-04						
17-Jun-05				Mature	F	6
5-Aug-05				Mature	F	6
8-May-07	389	352	427	Mature	F	7
15-May-07	333	300	295	Mature	F	7
27-Mar-08	464	420	874	Mature	M	7
27-Mar-08	413	373	537	Mature	F	9

Rehabilitation Efforts

Within the last few years, there have been several different management efforts leading toward the re-establishment of cisco into Lake Erie. A workshop sponsored by the Great Lakes Restoration Act was held in July 2003 reviewing the status and impediments for cisco 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 cisco 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 necessary, but only where it will not affect an existing remnant stock. Another cisco 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 cisco stock still exists in Lake Erie, nine cisco specimens gathered over the past several years from Lake Erie were shipped to the USGS Leetown Science Center, Northern Appalachian Research Laboratory for genetic analysis using microsatellite markers. Recent and museum specimen cisco 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 results of this research indicate that the recently caught cisco are genetically most similar to Lake Erie specimens from 1950s and 1960s, suggesting that a remnant of the original Lake Erie stock exits (Rocky Ward, USGS Northern Appalachian Research Laboratory, Wellsboro, unpublished data). The extant surviving cisco that is most similar to the Lake Erie remnant is from Lake Huron. The implications of these findings pose difficult management decisions for restoration efforts involving stocking with cisco 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.

Disease testing of potential cisco broodstock from other viable sources has begun in case stocking is required for lake herring recovery. Positive results for BKD from Lake Superior bloaters in 2005 have eliminated this lake as a potential source of cisco broodstock gametes. Ciscoes collected from eastern Lake Ontario from November 2006 through 2008 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. There is a need to investigate the possibility of using Lake Huron stocks as a source of broodstock.

Management Plan

The Lake Erie Coldwater Task Group was charged with preparing a Lake Erie cisco management plan at the Lake Erie Committee Annual meeting in March of 2007. Preparation of the management plan began in fall 2007. An outline was developed and approved by the members of the Coldwater Task Group in December 2007. A first draft was completed in January 2009 and circulated to the Coldwater Task Group members for review. Those comments are in the process of being addressed.

Some issues that have arisen in the preparation of this plan:

- Do recently observed specimens represent a remnant stock?
- What is the population trend of cisco currently inhabiting Lake Erie? (There have been no directed surveys for cisco in Lake Erie. Occurrences in fishery catches are very likely unrecognized or underreported)
- Do L. Erie cisco face different constraints than other coregonids which have shown evidence of recovery (e.g. whitefish; 1990s)
- Do we stock? Should we stock on top of a possible remnant population? If so, what is the best broodstock?
- What are the genetic implications of stocking on a remnant population? Is there currently a genetic bottleneck?

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