REPORT OF THE LAKE ERIE COLDWATER TASK GROUP

23 March 2012

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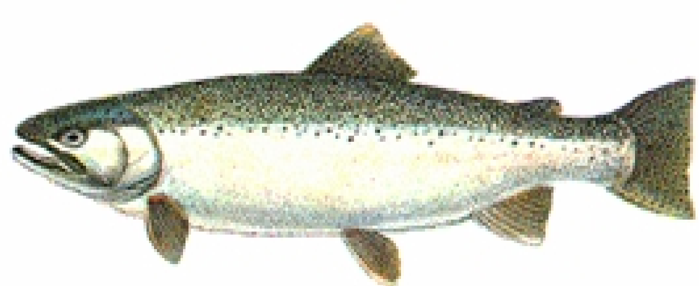
Presented to:

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.

Citation:

Coldwater Task Group. 2012. Report of the Lake Erie Coldwater Task Group, March 2012. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Cover Art and Line Drawings from:

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

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Table of Contents

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 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 evolved 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 cisco 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 orally to the LEC at the annual meeting, held this year on 22-23 March 2012 in Windsor, Ontario. 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 2012

Lake Erie Committee

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

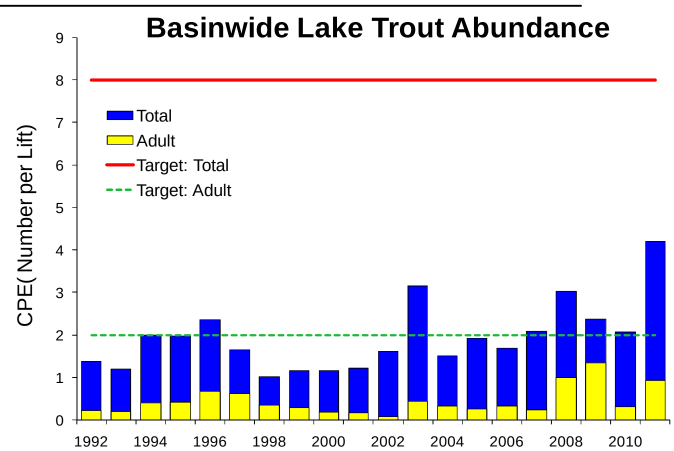
Introduction

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 2011-2012: (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 cisco management plan.

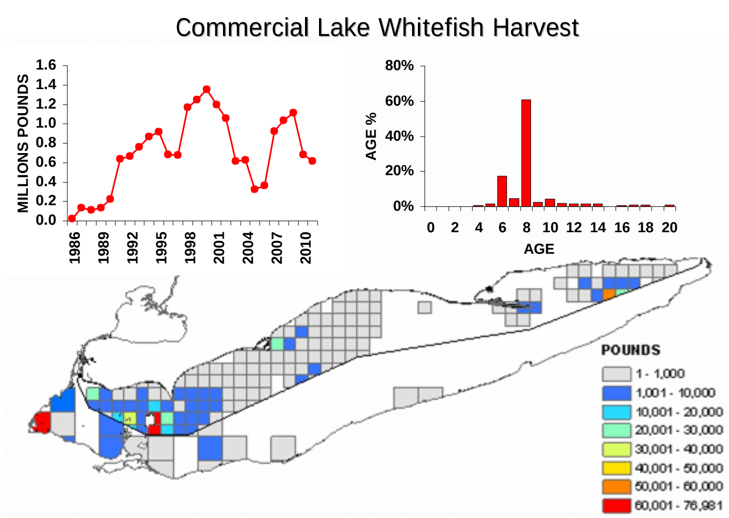
Lake Trout

A total of 717 lake trout were collected in 89 lifts across the eastern basin of Lake Erie in 2011. Record lake trout catches were recorded in New York surveys and near-record in Ontario surveys. Young cohorts (ages 1-5) dominated catches with lake trout ages 10 and older only sporadically caught. Basin-wide lake trout abundance (weighted by area) increased to its highest value in the time series but remains below the rehabilitation target of 8.0 fish/lift. Adult (age 5+) abundance also increased in 2011 and remains below target. Recent estimates indicate very low rates of adult survival. Klondike and Finger Lakes strain lake trout comprise the majority of the population. Successful natural reproduction has yet to be documented in Lake Erie despite more than 30 years of restoration efforts.



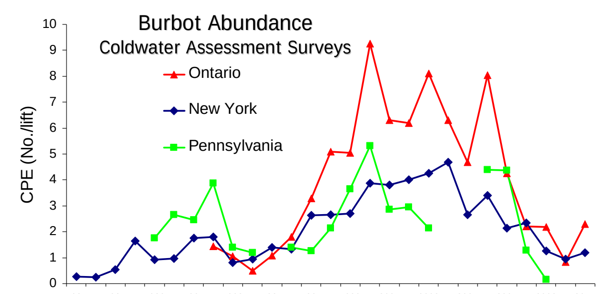
Whitefish

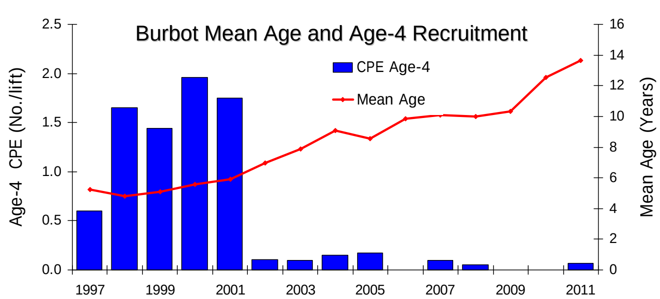
Lake whitefish harvest in 2011 was 616,973 pounds, distributed among Ontario (86%), Ohio (13%), and Michigan (1%) commercial fisheries. The 2003 year class (age 8) dominated the population age structure in the observed harvest and assessment surveys in 2011. Ages present in the 2011 population ranged from 1 to 20, with no evidence of young-of-the-year in assessment surveys lake-wide. With recruitment sparse or absent, population abundance continues to decline. No significant recruitment is expected in 2011, although older lake whitefish persist in the population. Fisheries in 2011 will continue to rely on the 2003 year class followed by the 2005 cohort with some contribution from other adjacent year classes. In 2011, mean condition factor of mature female and male whitefish was above the historic average. Chironomids and isopods represented the largest fraction of prey observed in whitefish diets during 2011.



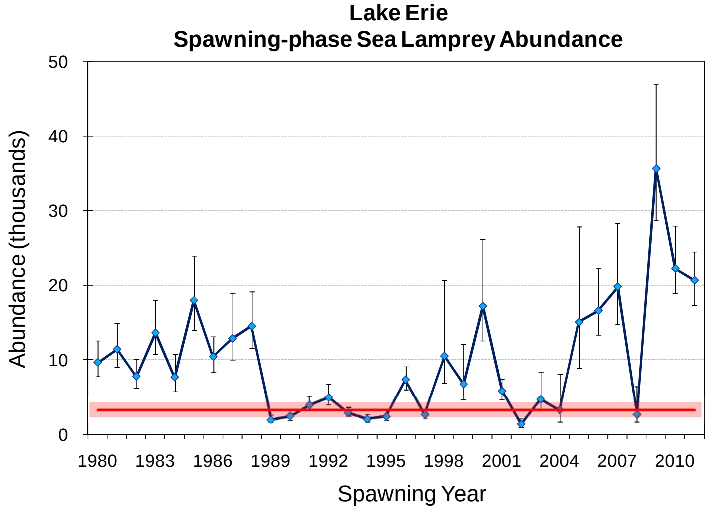
Burbot

Total commercial harvest of burbot in Lake Erie during 2011 was 2,894 pounds, a 40% decrease from 2010. Burbot abundance and biomass indices from annual coldwater gillnet assessments increased slightly in 2011 reversing a downward trend observed across east basin areas following time-series maxima during the early- to mid-2000s. Agency catch rates during 2011 averaged 1.2 (New York) to 2.3 (Ontario) burbot per lift which are about 3.5 to 3.1 times lower than mean catch rates observed from 2000 to 2004. Despite an





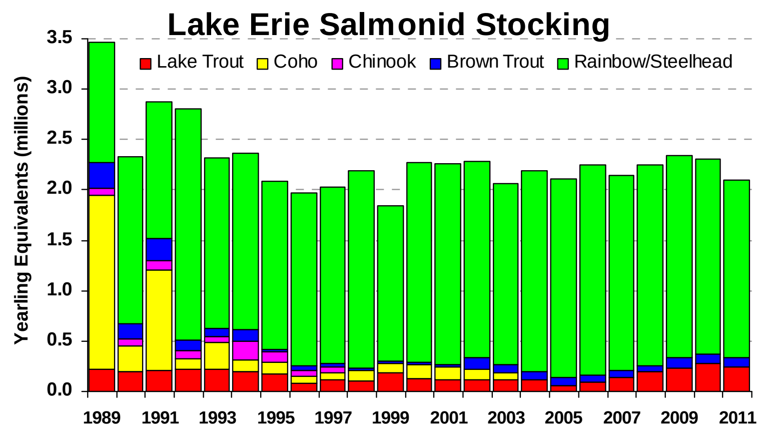
improvement in age-4 recruitment during 2011, ongoing low catch rates of burbot in assessment surveys, combined with increasing mean age of adults and persistent low recruitment, signal continuing troubles for this population. Round gobies and rainbow smelt continue to be the dominant prey items in burbot diets in eastern Lake Erie.



Sea Lamprey

The A1-A3 wounding rate on lake trout over 532 mm was 8.2 wounds per 100 fish in 2011. This was a 36% decline from the 2010 wounding rate of 12.8 wounds per 100 fish and a 58% decrease over the past two years. Despite the decline, likely attributable to a 2008-2010 accelerated lampricide treatment program, the current wounding rate still exceeds the target rate of five wounds per 100 fish. Wounding rates have been above target for 16 of the past 17 years. Large lake trout over 736 mm continue to be the preferred targets for sea lampreys. A4 wounding rates slightly decreased in 2011 to 53.9 wounds/100 fish, the third highest A4 wounding rate in the 27-year time series. A4 wounding rates on lake trout over 736 mm remain very high (163 wounds/100 fish). The estimated number of spawning-phase sea lampreys decreased from 22,179 in 2010 to 20,638 in 2011. However, this is the third highest population estimate in the time-series. Comprehensive stream evaluations in 2011 concluded that intensive streams treatments conducted in 2008-2010 were very effective, suggesting that the continued high abundance of the adult spawning population in Lake Erie is from an unknown and untreated source.

Lake Erie Salmonid Stocking



A total of 2,101,719 salmonids were stocked in Lake Erie in 2011. This was a 9% decrease in the number of yearling salmonids stocked compared to 2010 and the long-term average from 1989-2009. Declines were primarily due to temporary reductions in steelhead/rainbow trout stockings in 2011. By species, there were 240,133 yearling lake trout stocked in New York and Ontario; 100,370 brown trout stocked in New York and Pennsylvania waters, and a 1,761,217 steelhead/rainbow trout stocked in all five jurisdictional waters.

Steelhead

All agencies stocked yearling steelhead/rainbow trout in 2011. A summary of rainbow trout/steelhead stocking in Lake Erie by jurisdictional waters for 2011 is as follows: Pennsylvania (1,091,793; 62%), New York (305,780; 17%), Ohio (265,469; 15%), Michigan (61,445; 3%) and Ontario (36,730; 2%). Overall steelhead stocking numbers (1.761 million in 2011) represented a 4% decrease below the long-term average and a 9% decrease from 2010. Annual stocking numbers 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 4,480 fish, summed for all reporting agencies; Ohio (2,996), Pennsylvania (1,389), New York (92) and Michigan (3). Overall, this was a 51% decrease from the 2010 harvest and 81% below the average harvest between 1999 and 2010. Open lake steelhead harvest decreased in all jurisdictions from 2010, and was greatest in Pennsylvania (-73%), followed by Ohio (-23%) and New York (-16%). The steelhead harvest is negligible in Michigan and not reported in Ontario waters of Lake Erie. Catch rates in the open water fishery were mixed as well in 2011 and were slightly above the long-term average. Based upon creel surveys, the majority (>90%) of the fishery effort targeting steelhead occurs in the tributaries from fall through spring. Catch rates by tributary anglers in the New York cooperative diary program dropped to 0.52 fish/hour in 2010, declining 33% since 2008, but remained near the long-term average of 0.47 fish/hour.

Cisco

Cisco, considered extirpated in Lake Erie, have been reported in small numbers (1-6) in 10 of the past 15 years by commercial fishers; four were observed in 2011. Preliminary genetic testing of some of these fish found them to be most related to an historic Lake Erie stock, suggesting that a remnant Lake Erie stock may still exist. In 2010-11 observations of larval cisco and juvenile coregonids in the Huron-Erie Corridor provide an alternate source of at least some of the Lake Erie observations. Actions undertaken by the CWTG in 2011 were directed at resolving issues which currently prevent the completion of a cisco management plan (first undertaken in 2007). Consultation with cisco experts from other lakes was used to identify deficiencies (in timing and location) of current fisheries programs for accurately targeting and assessing cisco in Lake Erie. This resulted in preliminary gillnet sampling (USGS) at historic western basin spawning locations in the fall of 2011, which did not catch any cisco. A genetic research strategy to address issues of remnant, historic and related stocks was developed which will utilize recent cisco tissue samples and alternate historic DNA (scales). The task group will seek partnerships and funding to further both of these approaches in 2012.

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

James Markham, NYSDEC and Larry Witzel, OMNR

Methods

A stratified, random design, deep-water gill net assessment protocol for lake trout has been in place since 1986. The sampling design divides the eastern basin of Lake Erie into eight sampling areas (A1-A8) 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 A5 through A8.

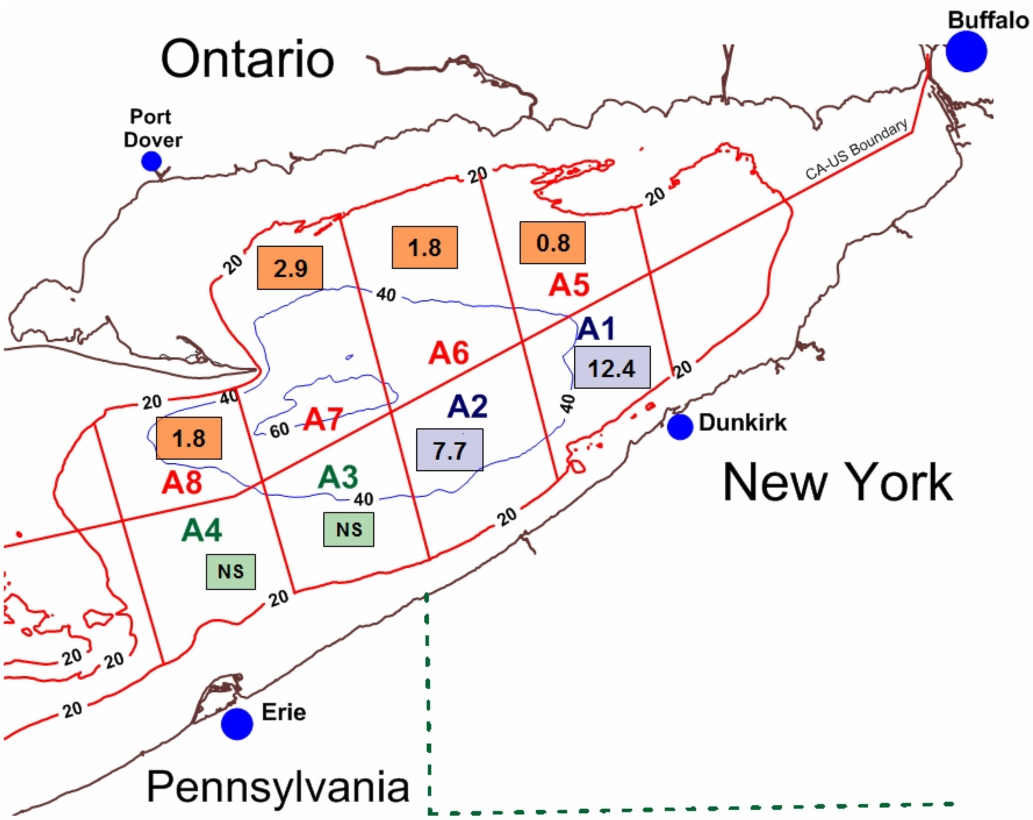


FIGURE 1.1. Standard sampling areas (A1-A8) used for assessment of lake trout in the eastern basin of Lake Erie, 2011, and catch per effort (No. per lift) of lake trout in each area. Areas A3 and A4 were not sampled in 2011.

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 complement of eastern basin effort should be 60 standard gill net 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. A1 and A2 have been the most consistently sampled areas across survey years 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 gill nets according to the sampling protocol.

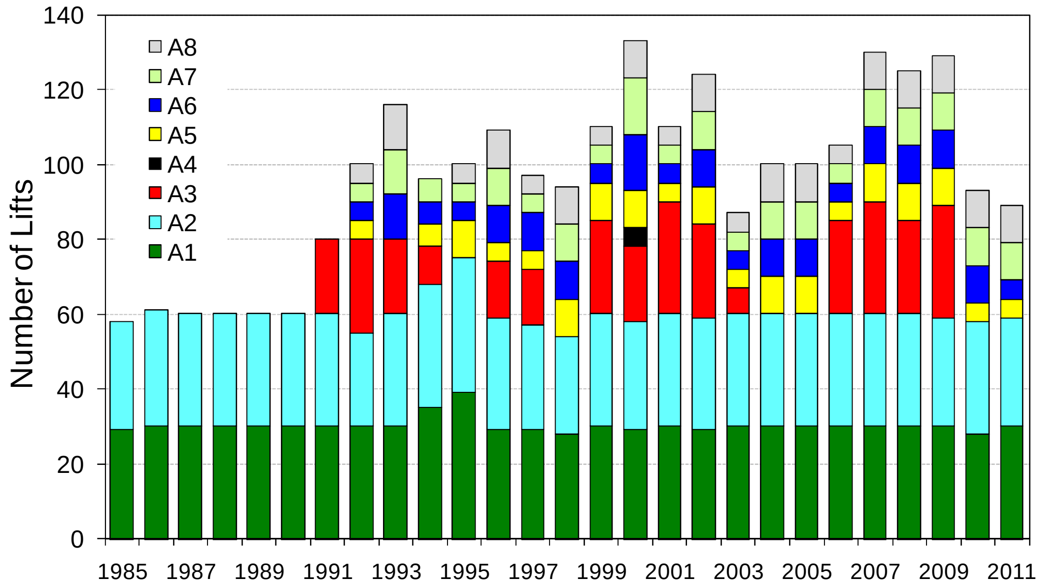


FIGURE 1.2. Number of unbiased coldwater assessment gill net lifts by area in the eastern basin of Lake Erie, 1985-2011.

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 on a side in 12.7-mm increments stretched measure (1.5-6 inches; in 0.5 inch increments). Panels are arranged randomly in each gang. A series of five gangs per transect 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 in each five net series to be set along the contour where 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 maximum 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) assumed responsibility for standard assessments in Canadian waters in 1992. The Ontario Ministry of Natural Resources (OMNR) began coordinating with USGS in 1998 to complete standard assessments in Canadian waters. Total effort for 2011 by the combined agencies was 89 unbiased standard lake trout assessment lifts in the eastern basin of Lake Erie (Figure 1.2). This included 59 lifts by the NYSDEC and 30 by USGS/ OMNR; no sets were made in Pennsylvania waters in 2011 due to budget and personnel issues. This was the second lowest total effort since combined agency assessments began in 1992.

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.

Klondike strain lake trout (KL) are an offshore form from Lake Superior and are thought to behave differently 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 analysis, Klondikes are reported as a separate strain for comparison with Lean strain lake trout.

Results and Discussion

Abundance

Sampling was conducted in six of the eight standard areas in 2011 (Figure 1.1), collecting a total of 717 lake trout in 89 unbiased lifts. Areas A1 and A2 again produced the highest catch per unit effort (CPE) values (Figure 1.1), coinciding with stocking areas of yearling lake trout. Comparatively, lake trout catches were much lower in Ontario waters (A5-A8), where stocking did not commence until 2006. The large disparity in lake trout catches among survey areas in the east basin indicates a lack of movement away from the stocking area.

Seventeen age-classes of lake trout, ranging from ages 1 to 21, were represented in the 2011 catch of known-aged fish (Table 1.1). Similar to the past ten years, young cohorts (ages 1-5) were the most abundant, representing 90% of the total catch in standard assessment nets (Figure 1.3). Cohort abundance continues to decline rapidly after age-5, and lake trout older than age-10 were only sporadically caught. Lake trout age-10 and older comprised only 2% of the overall catch in 2011.

TABLE 1.1. Number, sex, mean length (mm), mean weight (g), and percent maturity, by age class, of Lean strain (A) and Klondike strain (B) lake trout collected in assessment gill nets from the eastern basin of Lake Erie, August 2011.

A) Lean Strain

AGE	SEX	NUMBER	MEAN LENGTH (mm TL)	MEAN WEIGHT (g)	PERCENT MATURE
1	Combined	7	248	163	0
2	Male Female	30 23	410 410	787 768	13 0
3	Male Female	62 31	533 521	1867 1586	87 3
4	Male Female	77 38	627 626	2885 2904	99 50
5	Male Female	35 49	681 686	3785 3979	100 98
6	Male Female	5 1	699 717	4063 4110	100 100
8	Male Female	11 12	767 754	5629 5538	100 100
9	Male Female	13 12	773 764	5789 5786	100 100
10	Male Female	5 4	791 795	5965 6336	100 ---
11	Male Female	1 0	825 -----	6825 -----	100 -----
12	Male Female	2 0	788 -----	5855 -----	100 -----
13	Male Female	1 0	787 -----	6245 -----	100 -----
15	Male Female	1 0	797 -----	4680 -----	100 -----
16	Male Female	0 1	----- 796	----- 6505	----- 100
19	Male Female	0 1	----- 880	----- 7500	----- 100
21	Male Female	1 0	888 -----	8165 -----	100 -----

B) Klondike Strain

AGE	SEX	NUMBER	MEAN LENGTH (mm TL)	MEAN WEIGHT (grams)	PERCENT MATURE
3	Male Female	81 17	503 485	1469 1288	86 12
4	Male Female	40 12	559 576	1972 2269	95 75
5	Male Female	12 17	597 628	2445 2995	100 94
7	Male Female	6 3	648 623	3353 3117	100 100
8	Male Female	2 0	625 -----	2710 -----	100 100

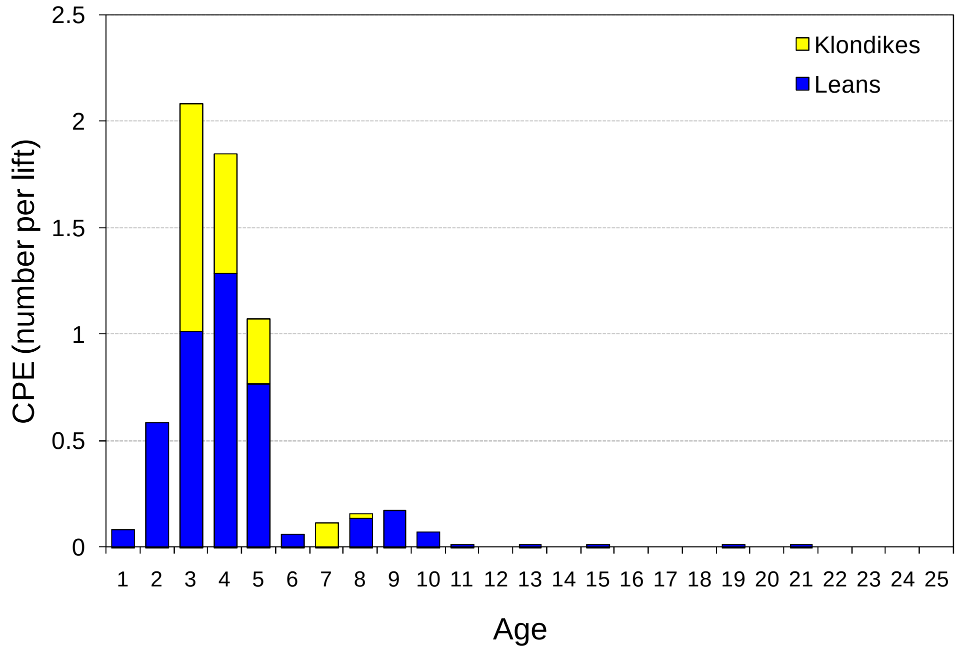


FIGURE 1.3. Relative abundance (number per lift) at age of Lean strain and Klondike strain lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie 2011.

The overall trend in area-weighted mean CPE of lake trout caught in standard nets in the eastern basin increased in 2011 to 4.3 fish per lift (Figure 1.4). This was the highest value in the time-series and follows two consecutive years of decline in basin-wide abundance. Increases were observed in both NY and ON waters in 2011, and abundance estimates were the highest on record in NY waters. Despite the increases, basin-wide abundance remains below the rehabilitation target of 8.0 fish/lift (Markham et al. 2008).

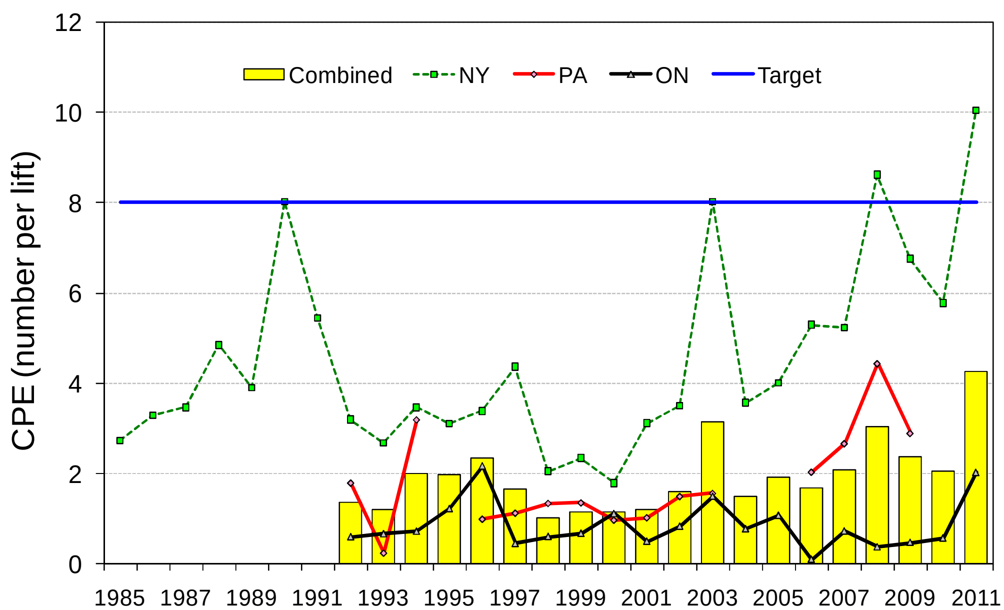


FIGURE 1.4. Mean CPE (number per lift) by jurisdiction and combined (weighted by area) for lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1985-2011.

The abundance of lake trout in the OMNR Partnership Index Fishing Program in 2011 increased for the third consecutive year in the Pennsylvania Ridge area but remained steady in the East (Figure 1.5). Overall, abundance estimates remained at high levels in the East basin and above average in the Pennsylvania Ridge. The increase in the East basin is most likely due to increased stocking by OMNR over the past five years. Catches remain low in East-Central basin. Variability of abundance estimates in this survey is high due to low sample sizes, especially in the Pennsylvania Ridge, and to a broad spatial sampling that may have extended outside the preferred habitat of lake trout.

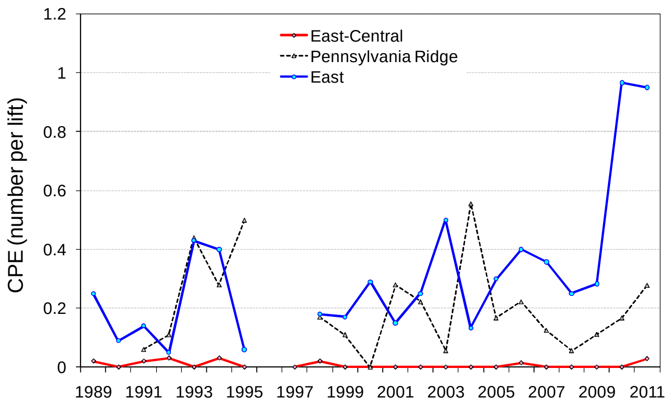


FIGURE 1.5. Lake trout CPE (number per lift) by basin from the OMNR Partnership Index Fishing Program, 1989-2011. Includes canned (suspended) and bottom gill net sets, excluding thermocline sets.

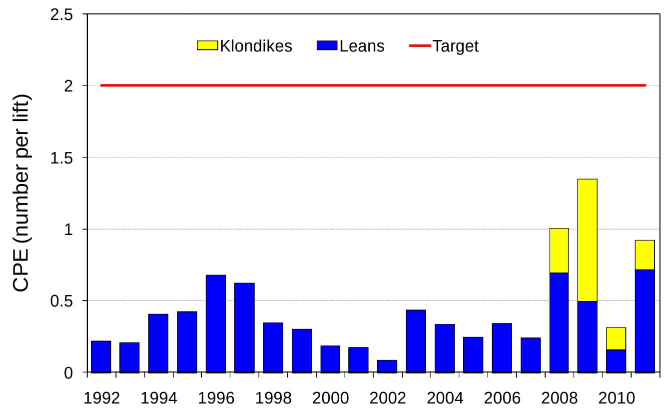


FIGURE 1.6. Relative abundance (number per lift) weighted by area of age 5 and older Lean strain and Klondike strain lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1992-2011.

The relative abundance of adult (age-5 and older) lake trout caught in standard assessment gill nets (weighted by area) serves as an indicator of the size of the lake trout spawning stock in Lake Erie. Adult abundance increased in 2011 to 0.92 fish per lift following a sharp decline in 2010 (Figure 1.6). Adult abundance estimates in 2011 were comparable to estimates from 2008 and 2009. The index remains well below the basin-wide rehabilitation target of 2.0 fish/lift (Markham et al. 2008).

The relative abundance of mature females over 4500 g, an index of repeat-spawning females ages 6 and older, also increased in 2011 to 0.15 fish per lift (Figure 1.7). This index value remains well below the rehabilitation plan basin-wide target 0.50 fish/lift for adult female abundance (Markham et al. 2008). An overall pattern of low and variable abundance of the adult lake trout spawning stock may be a key contributing factor to the continued absence of any documented evidence of natural reproduction in Lake Erie.

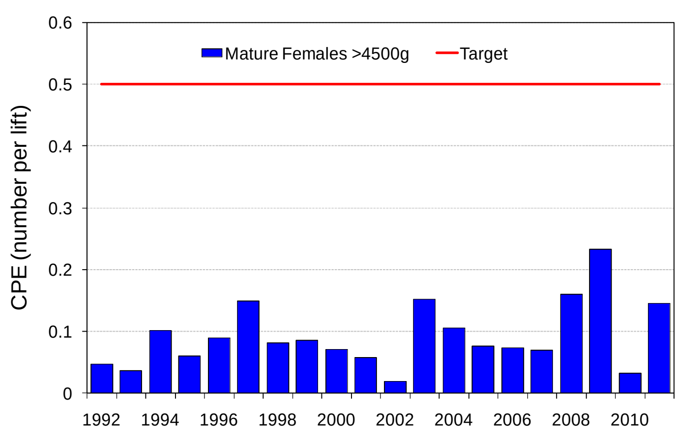


FIGURE 1.7. Relative abundance (number per lift) weighted by area of mature female lake trout (all strains) greater than 4500g in standard assessment gill nets in the eastern basin of Lake Erie, 1992-2011.

Stocking Performance

The proportion of stocked lake trout surviving to age 2 provides an index of stocking success. The stocking performance (SP) 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 the index to the number of age-2 lake trout caught per lift per 100,000 yearling lake trout stocked. Because the index is scaled to a standard, it can be used to compare survival of stocked fish to age-2 between years with any confounding effects from stocking amounts.

The SP index shows declining survival 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 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 spike in survival index to 1.11, which was the highest value in the time-series and can be attributed entirely to returns from Klondike-strain lake trout stocked in 2005. The 2011 SP index was 0.22, which was slightly above average for the time series and identical to the 2010 index. Stocking success has been near average for the past four years. However, actual age-2 abundances have been high the last two years relative to the time series due to

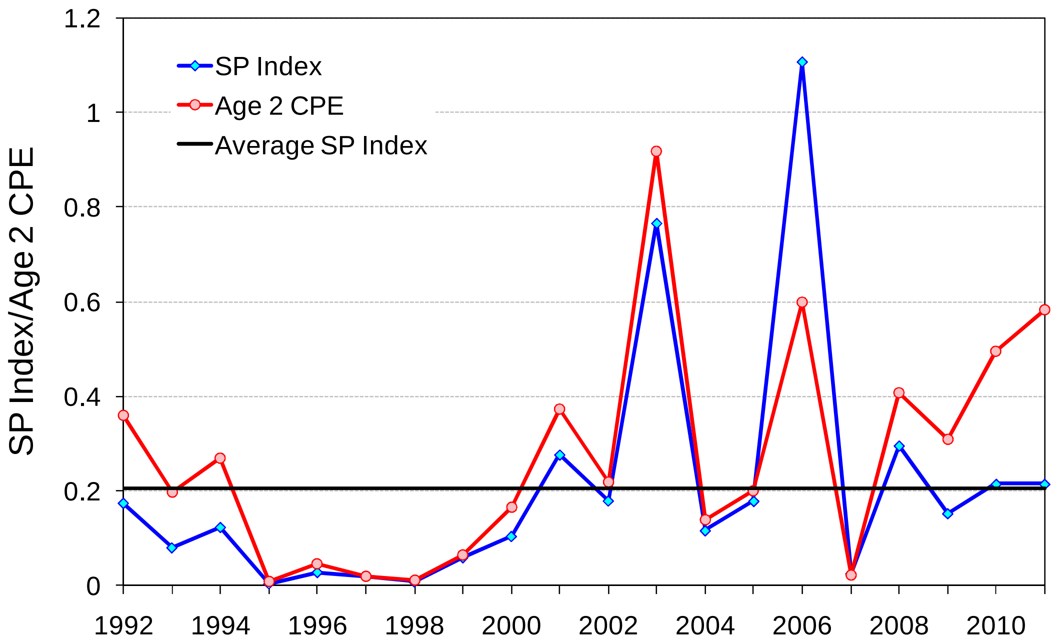


FIGURE 1.8. Stocking Performance (SP) index and age-2 CPE (number per lift) for lake trout sampled in standard assessment gill nets in the eastern basin of Lake Erie, 1992-2011. The SP index is equal to the number of age-2 fish caught per lift for every 100,000 yearling lake trout stocked.

Strains

Ten different lake trout strains were found in the 615 fish caught with either hatchery-implanted coded-wire tags (CWTs) or fin-clips in 2011 (Table 1.2). Finger Lakes (FL; 48%) and Klondike (KL; 31%) strain lake trout remain the most prevalent strains in the Lake Erie lake trout population. Finger Lakes have been the most prevalent strain stocked in Lake Erie while Klondikes have only been stocked in five of the past eight years. Lake Champlain (LC; 9%), Slate Island (SI; 5%), Traverse Island (TI; 3%) and Apostle Island (AI; 2%)) were the only other strains caught in significant numbers. Superior (SUP) strain lake trout, stocked extensively in Lake Erie in the 1980s and again from 1997-2002, disappeared in assessment netting in 2010 and only one individual was sampled in 2011. The FL strain continues to show the most consistent returns at older ages; all but two of lake trout age-9 and older were FL or FL-hybrid (LE, LO, LC) strain fish.

TABLE 1.2. Number of lake trout per stocking strain by age collected in gill nets from the eastern basin of Lake Erie, August 2011. Stocking strain codes are: FL = Finger Lakes, SUP = Superior, LL = Lewis Lake, KL = Klondike, LE = Lake Erie, SI = Slate Island, TI = Traverse Island, AI = Apostle Island, LC = Lake Champlain, MIC = Michipicoten. Shaded cells indicate cohorts with a stocking history.

AGE	FL	SUP	LL	KL	LE	SI	TI	AI	LC	MIC
1									7	
2						20			32	1
3	46		6	99		12		14	15	
4	115			52						
5	66			29			18			
6	6									
7				10						
8	23			2						
9	25									
10	9									
11	1									
12	2									
13		1								
14										
15	1									
16					1					
17										
18										
19			1							
20										
21	1									
TOTAL	**295**	**1**	**7**	**192**	**1**	**32**	**18**	**14**	**54**	**1**

TABLE 1.3. 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, 1985–2011. Three-year running averages of CPE from ages 4–11 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 4-10 (SUP 2001, FL 2001), 5-9 (FL 2002), 5-8 (FL 2003, KL 2003), or 4-7 (KL 2004).

	STRAIN					
Year Class	**LE**	**LO**	**LL**	**SUP**	**FL**	**KL**
1983				0.687		
1984				0.619	0.502	
1985				0.543	0.594	
1986				0.678		
1987				0.712	0.928	
1988		0.784		0.726	0.818	
1989		0.852		0.914	0.945	
1990		0.840		0.789	0.634	
1991		0.763	0.616			
1992	0.719		0.568			
1993	0.857				0.850	
1994						
1995						
1996					0.780	
1997				0.404	0.850	
1998				0.414		
1999				0.323	0.760	
2000				0.438	0.769	
2001*				0.296	0.753	
2002*					0.692	
2003*					0.596	0.321
2004*						0.308
MEAN	**0.788**	**0.81**	**0.592**	**0.580**	**0.748**	**0.315**

Survival

Cohort analysis estimates of annual survival (S) were calculated by strain and year class using a 3-year running average of CPE with ages 4 through 11. A running average was used due to the high year-to-year variability in catches. Mean overall adult survival estimates varied by strain and year. The Finger Lakes (FL) strain, the most consistently stocked lake trout strain in Lake Erie, had an overall mean survival estimate of 0.748. Survival estimates prior to 1986 are low due to the effects of a large sea lamprey population. Survival of the 1987 –1991 year classes were comparably higher as the sea lamprey population declined and the number of adult lake trout increased, decreasing the affect of host density. Survival estimates during this period (1987-91) were highest for the FL strain (0.83) and lowest for the SUP strain (0.79). The LO strain, a cross between SUP and FL strains, was intermediate at 0.81. Survival estimates declined beginning with the 1992 year class as the lamprey population increased.

More recent estimates indicate that survival has declined well below target levels, presumably due to increased levels of sea lamprey predation. Survival estimates of the 1997-2001 year classes of SUP strain lake trout range from 0.296-0.438 (Table 1.3). Survival estimates from the 1996, 1997, and 1999-2001 FL strain are much higher, but are based on very low returns. More recent estimates from the 2002 and 2003 year classes of FL strain indicate lower survival rates. All of these survival estimates are below the ranges that were observed for these strains during the period of high-lamprey control. Preliminary estimates of the 2003 and 2004 year classes of Klondike strain fish indicate very low survival rates (0.308 – 0.321) at adult ages. These rates are comparable to survival rates of Superior strain lake trout from the 1997-2001 year classes. Mean overall survival estimates were above the target goal of 60% or higher (Lake Trout Task Group 1985; Markham et al. 2008) for LE, LO, and FL strains but below target for the LL, SUP, and KL strains.

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 (2001-2010) through age 11 (Figures 1.9 and 1.10). Deviations at older ages were due to low sample sizes. Klondike strain lake trout show lower growth trajectories than Lean strain lake trout through age-7. Mean length and weight of Klondike strain lake trout was significantly less than FL strain fish by age-3 (two sample t-test; P<.01).

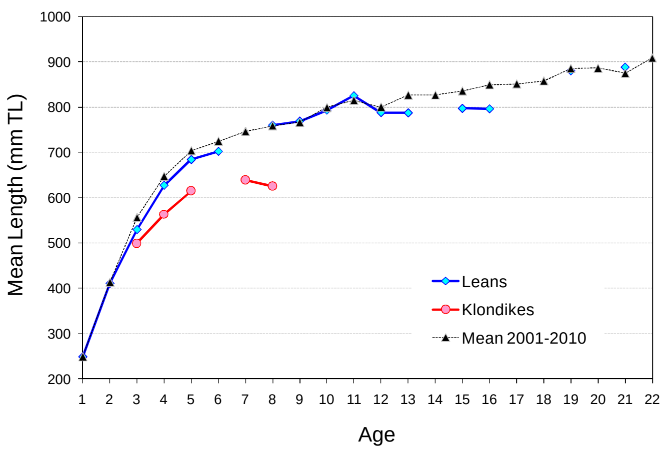


FIGURE 1.9. Mean length-at-age of Lean strain and Klondike strain lake trout sampled in assessment gill nets in the eastern basin of Lake Erie, August 2011. The previous 10-year average (2001-2010) from New York waters is shown for current growth rate comparison.

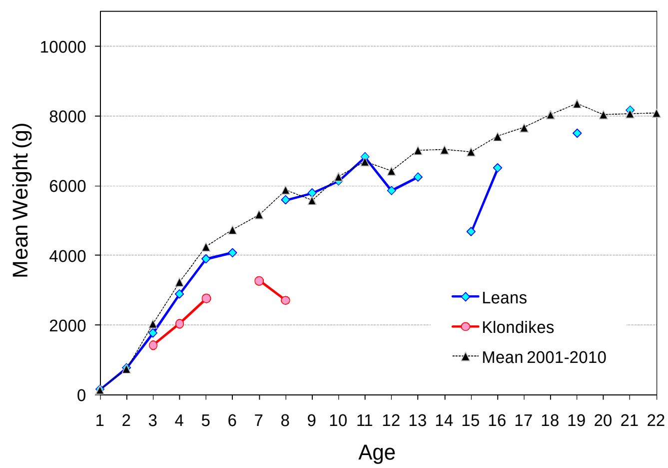


FIGURE 1.10. Mean weight-at-age of Lean strain and Klondike strain lake trout sampled in assessment gill nets in the eastern basin of Lake Erie, August 2011. The previous 10-year average (2001-2010) from New York waters is shown for current growth rate comparison.

Mean coefficients of condition (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 and 2008. Condition of male and female age-5 fish was lower for Klondike than for Lean strain lake trout in 2008; condition of Klondike's in both sexes decreased in 2009. In 2011, condition coefficients increased slightly for females of both Lean and Klondike strains compared to their last value, but decreased slightly for both Lean strain and Klondike strain males.

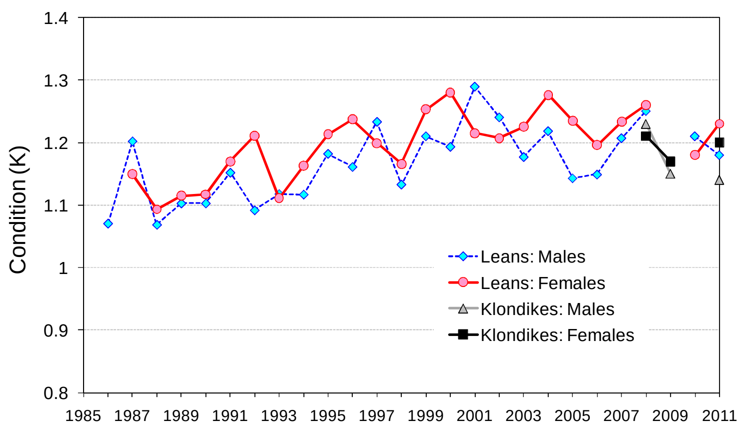


FIGURE 1.11. Mean coefficients of condition for age-5 Lean strain and Klondike strain lake trout, by sex, collected in NYSDEC assessment gill nets in Lake Erie, August 1985-2011.

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 1.1A). Klondike strain lake trout appear to have similar maturity rates to Lean strain lake trout in Lake Erie (Table 1.1B).

Harvest

Angler harvest of lake trout in Lake Erie remains very low. Approximately 247 lake trout were harvested in New York waters out of an estimated catch of 637 in 2011 (Figure 1.12). In Pennsylvania waters, a total 117 lake trout were harvested out of an estimated total catch of 1,338 fish. This was the first harvest of lake trout in Pennsylvania waters since 2005.

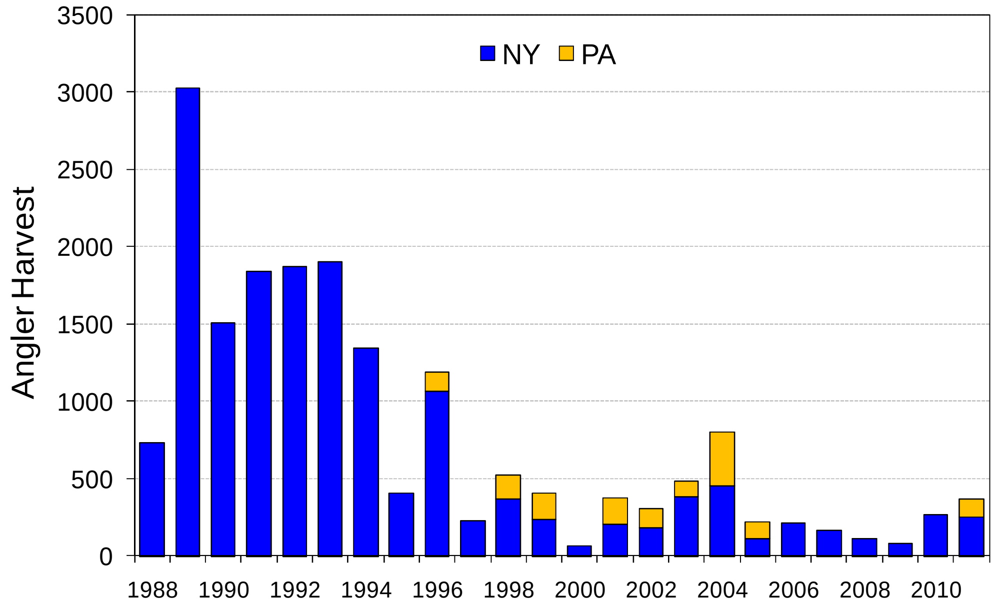


FIGURE 1.12. Estimated lake trout harvest by recreational anglers in the New York and Pennsylvania waters of Lake Erie, 1988-2011.

Natural Reproduction

Despite more than 30 years of lake trout stocking in Lake Erie, no naturally reproduced lake trout have been documented. Five potentially wild fish (no fin clips; no CWT's) were caught in eastern basin coldwater gill net surveys in 2011, making a total of 54 potentially wild lake trout recorded over the past eleven years. Otoliths are collected from lake trout found without CWTs or fin-clips and will be used in future stock discrimination studies.

A GIS project was conducted by the USGS (Sandusky) and Ohio Division of Wildlife to determine potential lake trout spawning sites within Lake Erie (Habitat Task Group 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, 2008 and 2009 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 2011). 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. Results of the data analysis of the side-scan mosaics and underwater video indicate potential spawning habitat on Brocton Shoal, Presque Isle Bay, Nanticoke

Shoal, Hoover Point, and Tecumseh Reef. However, underwater video indicates that the quality of the habitat has undergone considerable deterioration, especially at Brocton Shoal, mainly due to dreissenid colonization and extensive sedimentation. There are nearshore areas in Presque Isle Bay and Nanticoke Shoal that do not exhibit extensive dreissenid colonization, and appear to hold more favorable spawning substrate.

For the fourth consecutive year, a gill net survey was conducted by the NYSDEC during November to determine if lake trout were using any local spawning areas. Underwater bottom video work conducted during the summer months revealed a large area of rocks off the mouth of 18 Mile Creek near Hamburg, NY. Rock formations at this site appeared to be favorable for spawning lake trout – cobble sized rocks in piles with open interstitial spaces (Figure 1.13). Furthermore, the rocks did not appear to be as heavily encrusted with dreissenids as areas on Brocton Shoal. Despite being far from lake trout stocking locations (25 miles), the quality and quantity of suitable habitat in this area made it a candidate for lake trout spawning assessment.

FIGURE 1.13. Underwater photo of bottom habitat off 18 Mile Creek Shoal in Lake Erie, July 2011.

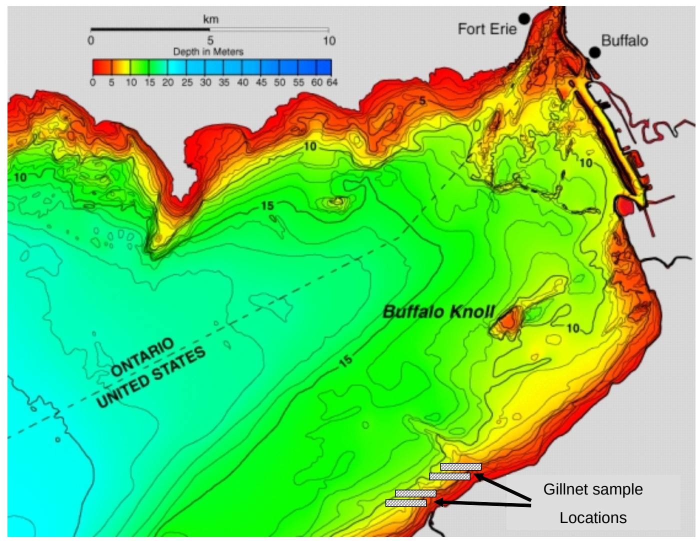


FIGURE 1.14. Gill net survey locations sampled for spawning lake trout in the New York waters of Lake Erie, November 2011.

A total of four gangs (1200 gill net feet) were fished overnight on 7 November 2011 at 18 Mile Creek (Figure 1.14). Two sets were made at the east end of rocky area in 11-17 feet of water, and two at the west end in 12-18 feet of water. Bottom water temperature during all sampling was 50F. Poor weather conditions prevented further sampling later in the fall.

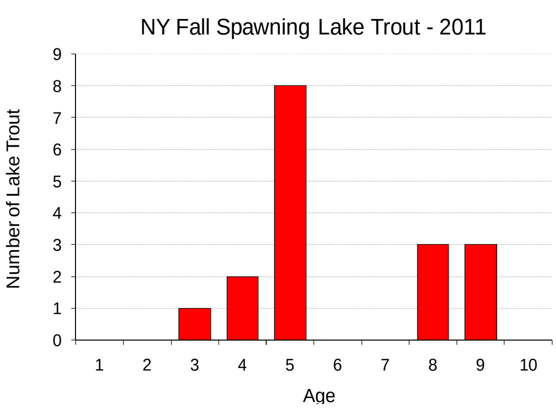


FIGURE 1.15. Age distribution of lake trout sampled in the New York waters of Lake Erie, November 2011.

A total of 18 lake trout were caught in the four nets. The fish were generally scattered over the site with 10 fish caught in the two western nets and 8 fish in the two eastern nets. Twelve of the lake trout were males and six females, and all the females were pre-spawn, mature fish. All the lake trout were Finger Lakes (FL) strain with the exception of a single 3-year old Lake Champlain (LC) strain fish. Ages ranged from 3-9 years old with the majority of the fish being 5 years old (2006 year class; Figure 1.15). Fifteen of the lake trout caught were stocked offshore of Dunkirk and the remaining three were stocked offshore at Barcelona.

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, sea 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 2011 lake trout model estimated the Lake Erie population at 307,817 fish and the age-5 and older population at 35,817 fish, less than half of what it was a decade ago when the lake trout population was at its peak (Figure 1.16). 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 sea lamprey control are major influences on the Lake Erie lake trout population.

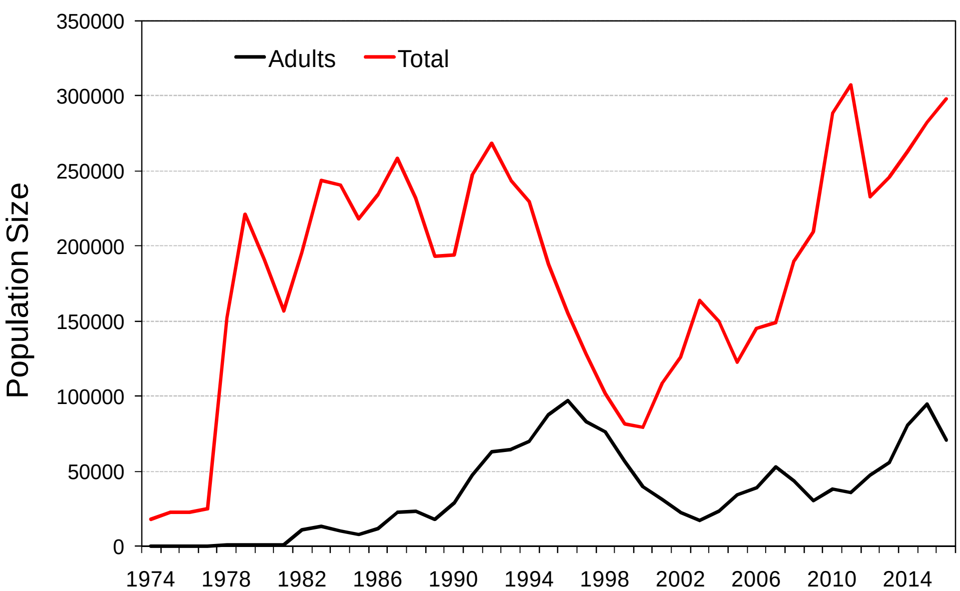


FIGURE 1.16. Projections of the Lake Erie total and adult (ages 5+) lake trout population using the CWTG lake trout model. Projections for 2012-2016 were made using low rates of sea lamprey mortality with proposed stocking rates. The model estimates the lakewide lake trout population in 2011 at 307,817 and the adult population at 35,817.

Diet

Diet information was limited to fish caught during August 2011 in the coldwater gill net assessment surveys in the eastern basin of Lake Erie. Analysis of the stomach contents of lake trout revealed diets comprised mainly of rainbow smelt and round gobies (Table 1.4). Rainbow smelt were the most prevalent diet item in both Lean

(83%) and Klondike (71%) strain lake trout. Round gobies were the second most commonly encountered prey item (Leans = 19%; Klondikes = 32%). When smelt are in good supply, they appear to be the preferred prey item for all lake trout. However, in years of lower adult smelt abundance, lake trout appear to prey more on round gobies. Klondike strain lake trout consistently have higher percentages of round gobies in their diets compared to lean strain lake trout (Coldwater Task Group 2011). Emerald shiners and yellow perch were the only other identified prey species that were encountered in 2011.

TABLE 1.4. 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 2011.

PREY SPECIES	Lean Lake Trout (N = 262)	Klondike Lake Trout (N = 99)
Smelt	218 (83%)	70 (71%)
Yellow Perch	1 (<1%)	
Round Goby	49 (19%)	32 (32%)
Emerald Shiner	4 (2%)	1 (1%)
Unknown Fish	20 (8%)	7 (7%)
Number of Empty Stomachs	204	74

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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 2011 was 616,973 pounds (Figure 2.1). Ontario accounted for 86% of the total, harvesting 530,013 pounds, followed by Ohio (13%; 82,805 lbs.), with less than 1% of the harvest in Michigan (4,155 lbs.) and none in Pennsylvania or New York (Figure 2.2). Total harvest in 2011 was 10% lower than the total harvest in 2010. Lake whitefish harvest in 2011 declined 1% in Ohio waters and 12% in Ontario from 2010.

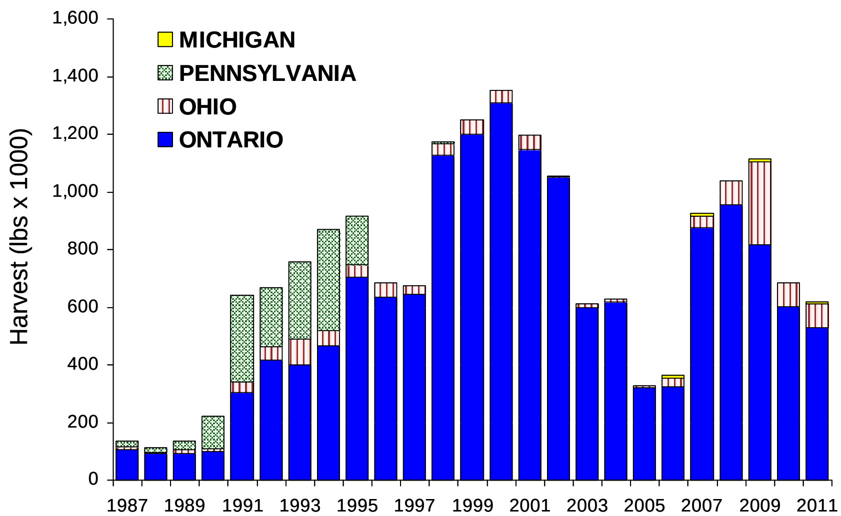

FIGURE 2.1. Total Lake Erie commercial whitefish harvest from 1987-2011 by jurisdiction. Pennsylvania ceased gill netting in 1996, and Michigan resumed commercial fishing in 2006, excluding 2008.

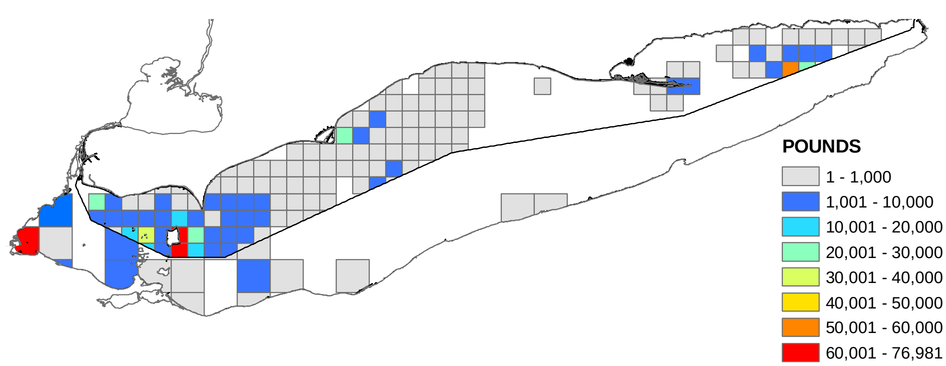

FIGURE 2.2. Lake whitefish harvest among all Lake Erie jurisdictions during 2011 by 5 minute (Ontario) and 10 minute (Michigan, Ohio) grids. No lake whitefish harvest was reported in Pennsylvania and New York.

The majority (99%) of Ontario's 2011 lake whitefish harvest was taken in gill nets. The remainder was caught in smelt trawls (1%), and harvest in impoundment gear (85 lbs.) was negligible. The largest fraction of Ontario's whitefish harvest (64%) was caught in the west basin (OE1) followed by OE5 (19%), and OE2 (15%), with the remaining harvest divided equally in OE3 (1%) and OE4 (1%). Harvest in OE1 occurred primarily from October to December (99%), whereas OE5 peaked from August to October (89%) with some harvest (11%) occurring during April and May. The majority of the lake whitefish harvest in OE2 (81%) occurred from March to May, with additional harvest during the fall. Harvest in OE3 and OE4 occurred throughout the year. In Ontario, 82% of lake whitefish were harvested from gill nets targeting whitefish, followed by fisheries targeting walleye (10%), white bass (6%), and white perch (1%), with a small portion coming from smelt trawls (1%), and a negligible harvest from yellow perch gill nets.

Ohio's lake whitefish trap net effort in 2011 occurred primarily in the western basin in November (20%) and in the central basin in May (31%) and June (14%); however, the peak harvest occurred during November (85%) and December (8%) in the western basin.

Ontario annual commercial catch rates targeting lake whitefish dropped in quota areas 2 and 3, but increased in quota area 1 (Figure 2.3). The mean catch rate of the three quota areas in 2011 decreased 14% from the 2010 mean. In the west basin (OE1), targeted gill net effort was greatest in November, while harvest was similar between October and November, and much less during December (Figure 2.4). OE1 catch rates in 2011 increased from 2010 levels during October and November, but were lower in December. Overall, Ohio commercial trap net catch rates observed for 2011 were 29% lower than 2010 and 80% lower than peak catch rates observed in 2009 (Figure 2.5).

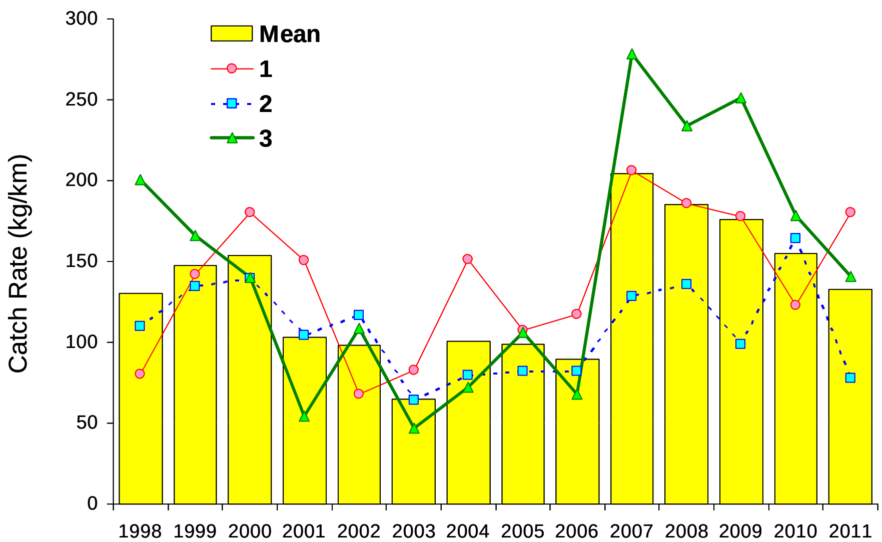

FIGURE 2.3. Ontario annual commercial large mesh gill net catch rates targeting lake whitefish by quota zone, 1998 - 2011. Bars represent averages of catch rates across quota zones. Quota zone 1 refers to the west basin, zone 2 extends eastward to the middle of the central basin. The eastern portion remaining is quota zone 3.

The landed weight of roe from Ontario's 2011 lake whitefish fishery was 25,265 pounds, most of which came from OE1 during November (59%) and October (38%). The remaining fraction of roe was collected from OE2 (2%) during October and November, and OE5 during October (1%). The approximate landed value of the roe was CDN $77,779.

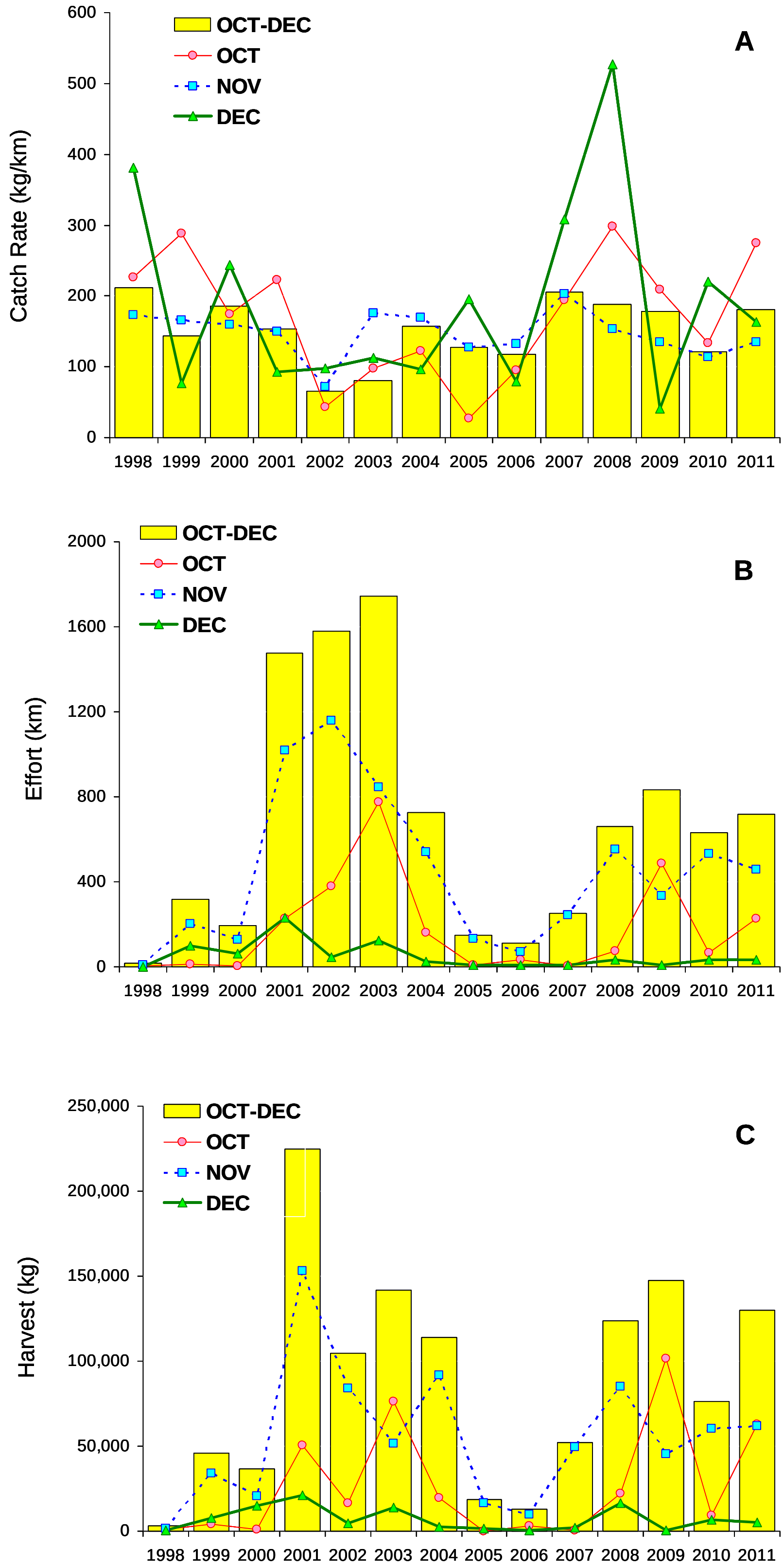

FIGURE 2.4. Targeted large mesh gill net catch rate (A), gill net effort (B) and harvest (C) for lake whitefish in the west basin for October, November, December and pooled (Oct-Dec) 1998 - 2011.

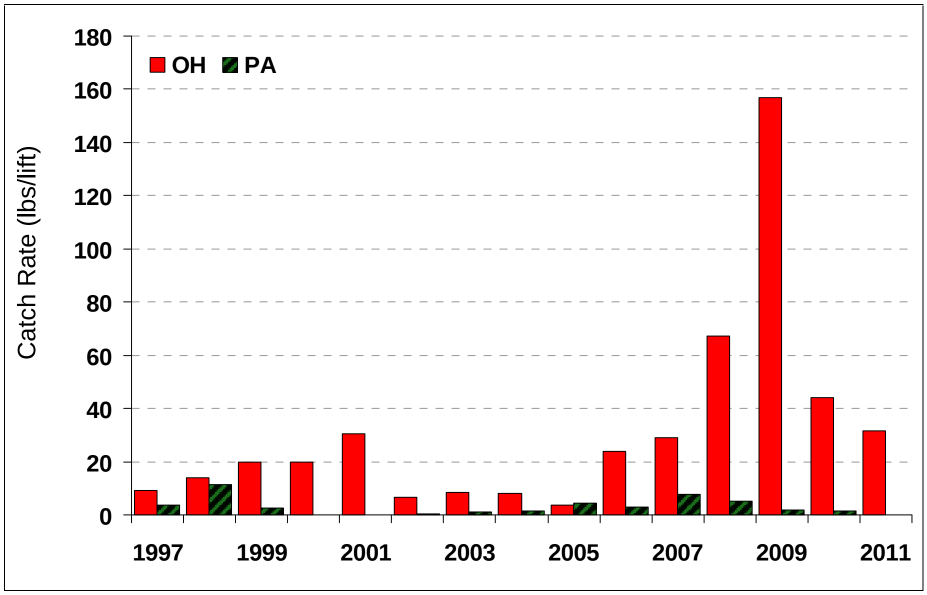

FIGURE 2.5. Ohio and Pennsylvania lake whitefish commercial trap net catch rates (pounds per lift), 1996-2011. There was no lake whitefish harvest in Pennsylvania in 2011.

Ontario's west basin fall lake whitefish fishery was dominated by age-8 fish (Figure 2.6). The strong 2003 cohort dominated catches in targeted and non-targeted (walleye) fisheries (Figure 2.7). Age-6 was the next most abundant year class (2005) and the oldest lake whitefish in Ontario's harvest was 20 (Figure 2.6 and 2.7). There was no characterization of the lake whitefish commercial fishery by age in Ohio in 2011.

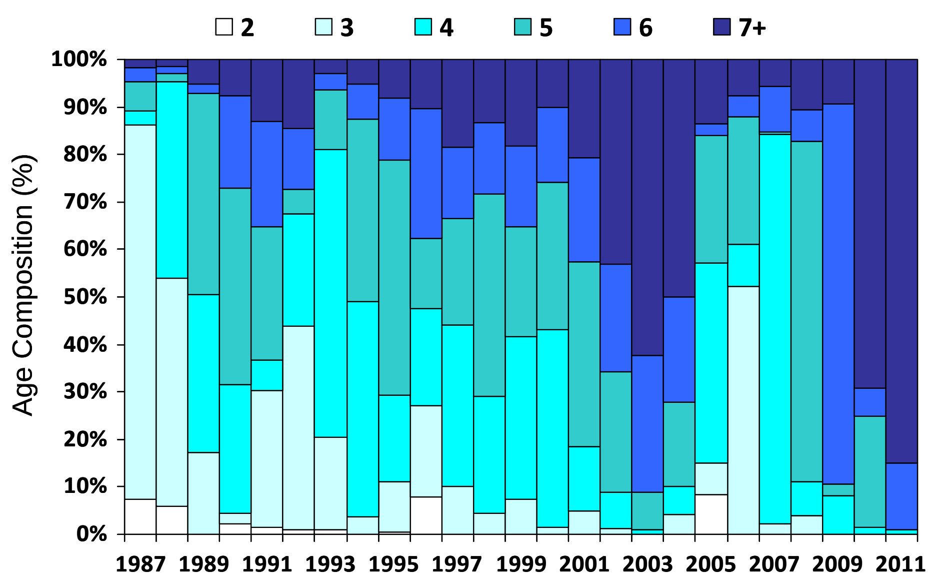

FIGURE 2.6. Ontario fall commercial whitefish harvest age composition in statistical district 1, 1986-2011. From effort with gill nets >=3 inches with whitefish in catch from October to December.

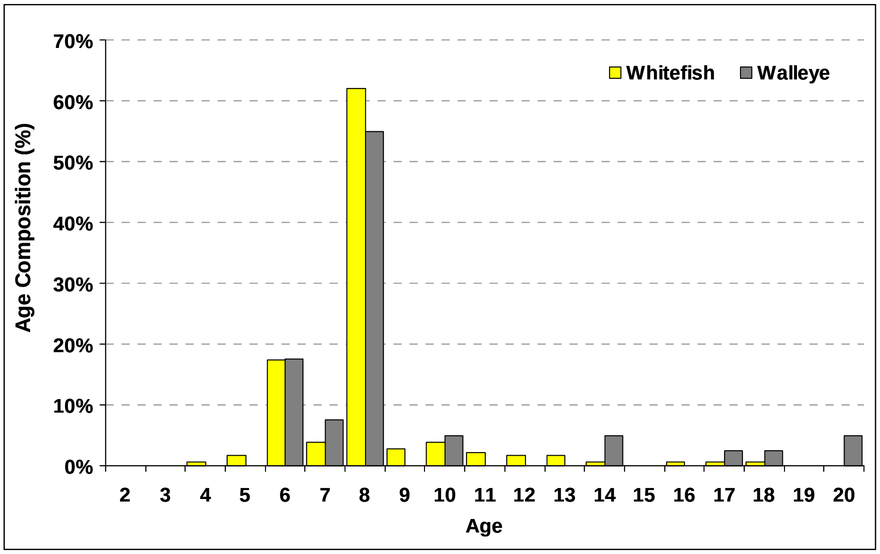

FIGURE 2.7. Age composition of lake whitefish caught commercially in Ontario waters of Lake Erie in 2011 by target species fisheries. Otoliths and scales were used to age whitefish samples. N=219.

Assessment Surveys

Lake whitefish abundance indices in the 2011 gill net assessments were generally low (Figures 2.8 and 2.9). Lake whitefish were absent in Ontario west basin, east basin, and Pennsylvania Ridge gill net surveys. Catch rates in central basin surveys were low, with a drop in the east-central basin catch rates offset by a marginal increase in the west-central basin catch rates (Figure 2.8).

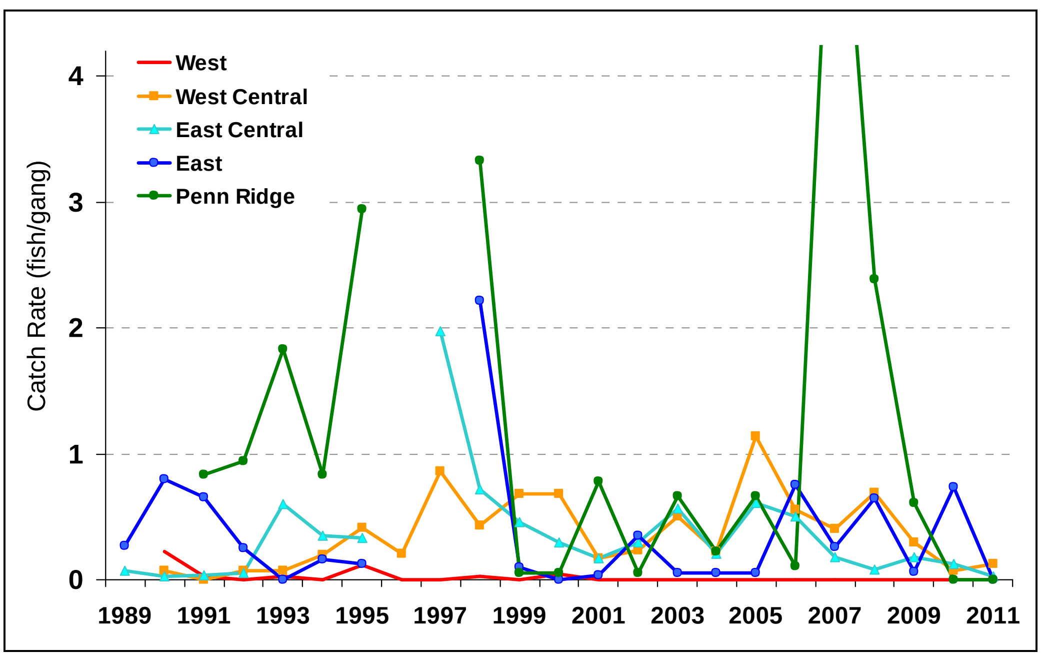

FIGURE 2.8. Catch rate (number per gang) of lake whitefish from Ontario partnership index gill netting by basin, Lake Erie, 1989 - 2011.

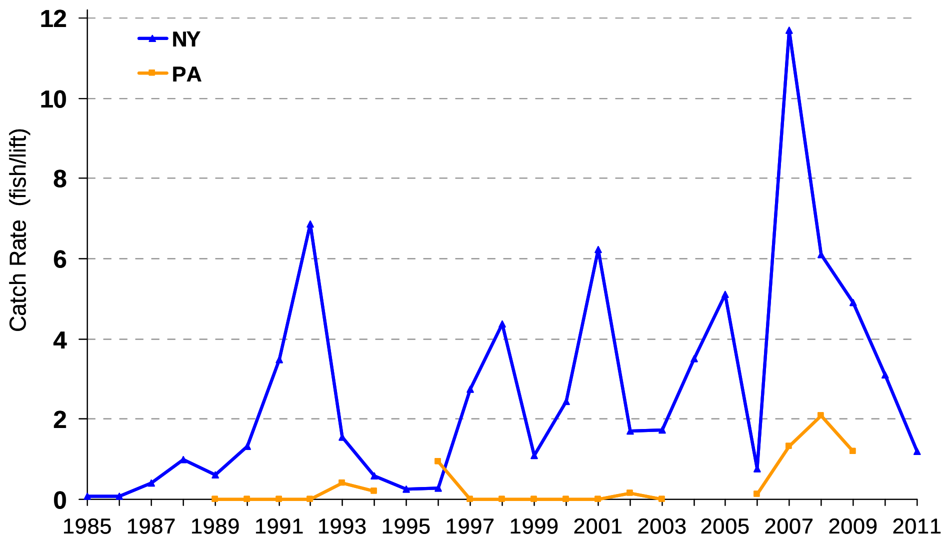

FIGURE 2.9. Catch per effort (number fish/lift) of lake whitefish caught in standard assessment gill nets from New York waters of Lake Erie, August 1985-2009 (triangles) and in Pennsylvania August assessment gill nets (squares) 1989-2009. No index sampling took place in Pennsylvania waters 1995, 2004, 2005, 2010 and 2011.

Declining lake whitefish catch rates observed since 2007 continued during the 2011 New York coldwater assessment survey (1.2 whitefish per lift; Figure 2.9). Length-frequency distributions of lake whitefish captured in Ontario partnership index gill netting reflected the dominance of older whitefish (Figure 2.10). The majority (64%) of lake whitefish sampled in the Ontario surveys were from the 2003 cohort, with the 2005, 2002, 1999 and 1995 year classes present (Figure 2.11). The youngest whitefish caught during Ontario Partnership surveys was age-6.

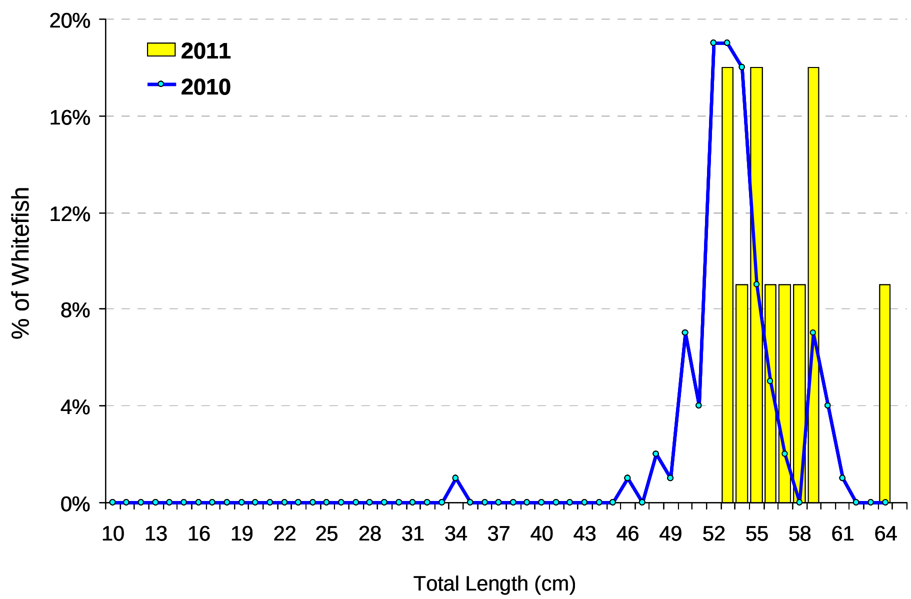

FIGURE 2.10. Length frequency distributions of lake whitefish collected during lake-wide partnership index fishing, 2010 and 2011. Standardized to equal effort among mesh sizes.

Ohio trawl surveys in the central basin of Lake Erie assess juvenile lake whitefish and describe the presence or general magnitude of year classes. These surveys can encounter migrating lake whitefish during the spring and fall. Since the strong 2003 year class, Ohio central basin (Statistical District 2 and District 3) bottom trawl surveys conducted in August and October only captured young-of-the-year (YOY) from the 2004, 2005 and 2007

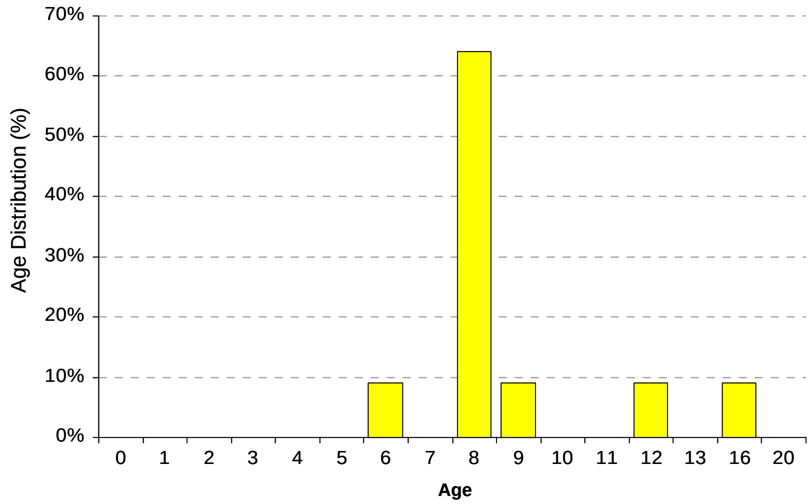

FIGURE 2.11. Age frequency distributions of lake whitefish collected during lake-wide partnership index fishing, 2011.

year classes. In addition, yearlings from the 2004 and 2005 year classes were caught in Ohio bottom trawls. During this past year, one yearling lake whitefish was captured in a June trawl survey. The 2007-2009 and 2011 year classes were not present in the 2011 Ohio surveys. In interagency trawl and gill net assessment surveys in Ohio waters of Lake Erie during August and October 2011, a total of 24 adult lake whitefish were sampled. The 2003 year class (age-8) was most numerous (54%), followed by lake whitefish from 2002 (age-9; 13%) and 2004 cohorts (age-7; 8%). Older lake whitefish, ages-10 to -20, represented 17% of the age composition (Figure 2.12).

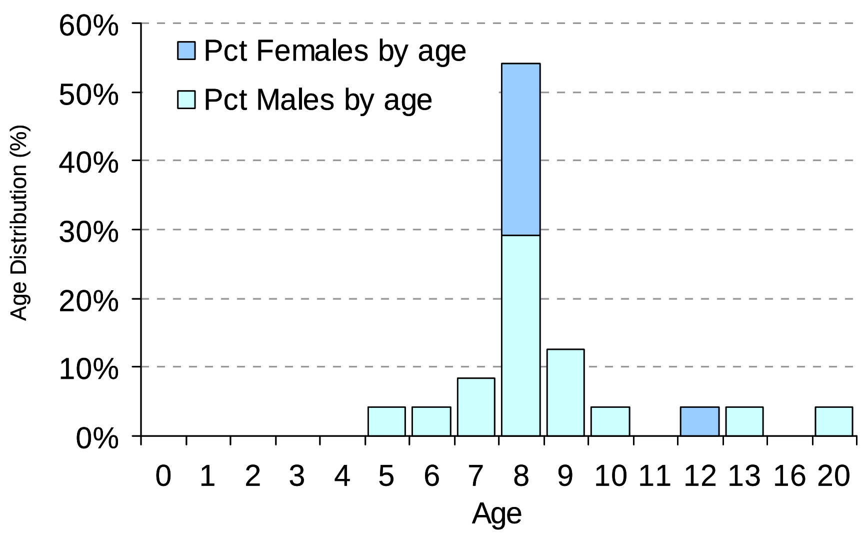

FIGURE 2.12. Age distribution of lake whitefish collected during trawl and gill net assessment surveys in Ohio waters of Lake Erie during 2011.

Growth and Diet

Lake whitefish sampled in Ohio assessment trawl and gillnet surveys in 2011 indicated that condition of age-4 and older males (mean K= 1.043) and females (mean K= 1.266) were above Van Oosten and Hile's (1947) historic condition reference values (Figure 2.13).

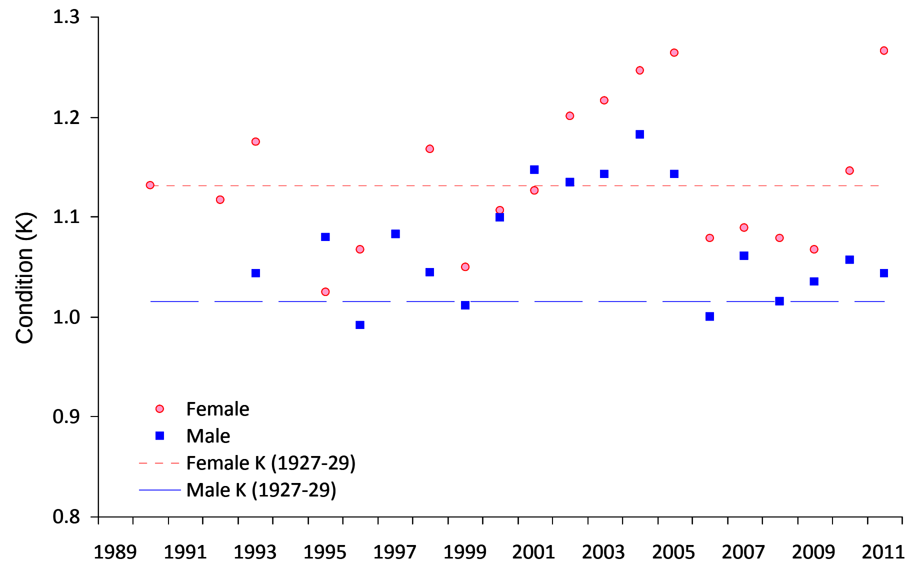

FIGURE 2.13. Mean condition (K) factor values of ages 4 and older lake whitefish sampled during Ohio assessment surveys in the central basin of Lake Erie, May-October 1990-2011. Historic mean condition (1927) presented as dashed lines from Van Oosten and Hile (1947).

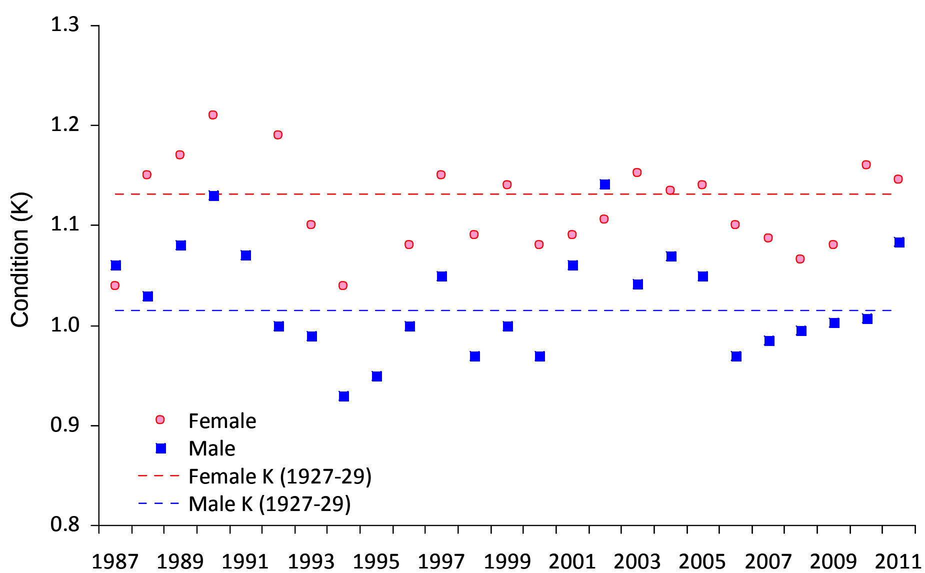

FIGURE 2.14. Mean condition (K) factor values of age 4 and older lake whitefish obtained from Ontario commercial and partnership survey data (Oct-Dec) by sex from 1987-2011. Historic mean condition (1927-29) presented as dashed lines calculated from Van Oosten and Hile (1947).

In 2011, condition of female (mean = 1.146) and male (1.131) lake whitefish assessed using Ontario fall commercial fishery and partnership gillnet survey data was above the historic average for each sex: 1.131 for females and 1.015 for males, respectively (Van Oosten and Hile 1947; Figure 2.14). Ontario lake whitefish assessed for condition analyses only included age-4 and older fish that were not spent or running, and were collected from October to December.

Lake whitefish collected from Ohio surveys in 2011 (N=30) were examined for diet composition from samples from Ohio central basin Districts 2 and 3 (Figure 2.15). Approximately 27% of the diet samples taken from lake whitefish in 2011 were empty (N=8); and all of these were in fall survey samples. Whitefish diets, expressed as percentage total dry weight of all prey taxa consumed, were composed primarily of chironomids (64%) and isopods (34%). When looking at a smaller subset of lake whitefish diets taken during fall surveys (N=11), snails (gastropods, at 47% of the total dry weight) and fingernail clams (sphaeriids, at 11% by dry weight), were also important to the lake whitefish diets as were chironomids (37% by dry weight).

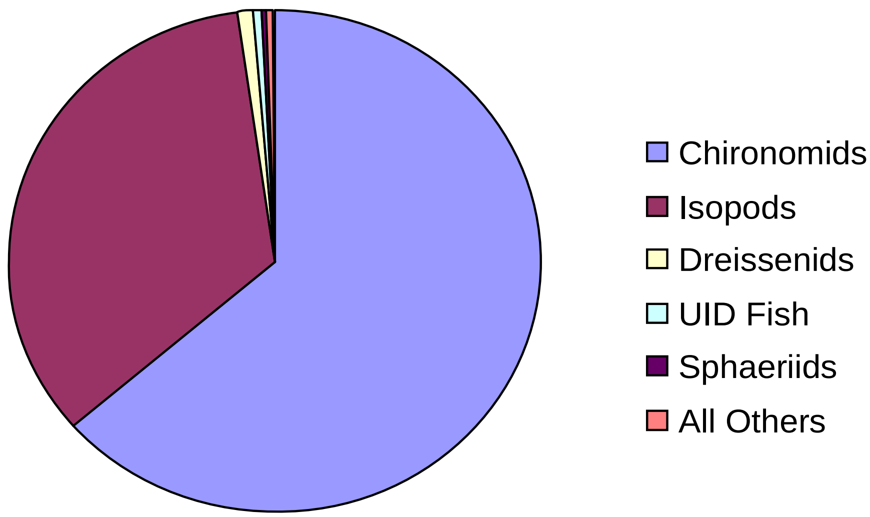

FIGURE 2.15. Diet composition (% dry weight) of lake whitefish from Ohio central basin assessment sites in 2011.

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 fishery, age structure, growth, diet, seasonal distribution and other population parameters.

Larry Witzel (OMNR), Richard Kraus (USGS), and Elizabeth Trometer (USFWS)

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 (2,268 kg; Table 3.1). Harvest began to increase in 1990, 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.

TABLE 3.1. Total burbot commercial harvest (thousands of pounds) in Lake Erie by jurisdiction, 1980-2011.

Year	New York	Pennsylvania	Ohio	Ontario	Total
1980	0	2	0	0	2.0
1981	0	2	0	0	2.0
1982	0	0	0	0	0.0
1983	0	2	0	6	8.0
1984	0	1	0	1	2.0
1985	0	1	0	1	2.0
1986	0	3	0	2	5.0
1987	0	0	0	4	4.0
1988	0	1	0	0	1.0
1989	0	4	0	0.8	4.8
1990	0	15.5	0	1.7	17.2
1991	0	33.4	0	1.2	34.6
1992	0.7	22.2	0	5.9	28.8
1993	2.6	4.2	0	3.1	9.9
1994	3	12.1	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	15.5
1997	2.9	8.9	1.7	7.4	20.9
1998	0.2	9	1.5	9.9	20.6
1999	1	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	6.5	11.3
2002	0.9	5.2	0.1	3.4	9.6
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	13.3
2006	0.9	1.7	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
2009	0.4	0.6	0.0	3.8	4.8
2010	1.4	0.1	0.0	1.8	3.2
2011	0.7	0.0	0.0	2.2	2.9

Harvest decreased in Pennsylvania waters after 1995 with a shift from a gill net to trap net commercial fishery, resulting in a substantial decrease of commercial effort (CWTG 1997). Harvest of burbot in New York is from one commercial fisher. In 1999, a market was developed for burbot in Ontario, leading the industry to actively target this species. 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. Most of the burbot caught by the commercial fishing industry in 2011 was by-catch in gillnets from the lake whitefish fishery (88%) followed by the white bass fishery (8%). The total commercial harvest for Lake Erie in 2011 was 2,894 pounds (1,313 kg); a 40% decrease from 2010. In addition, some 3,577 pounds (1,622 kg) were released or discarded by Ontario commercial fishers in 2011.

Abundance and Distribution

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 (Figure 3.1).

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 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 at a much lower catch rate of 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 but exhibit an overall decreasing trend. In 2011, only one burbot was captured in the central basin and abundance increased slightly in the east basin and Pennsylvania Ridge, reversing the prevailing downward trend. Despite the recent upturn, burbot numbers in eastern Lake Erie remained low relative to 1998 peak abundance (Figure 3.2).

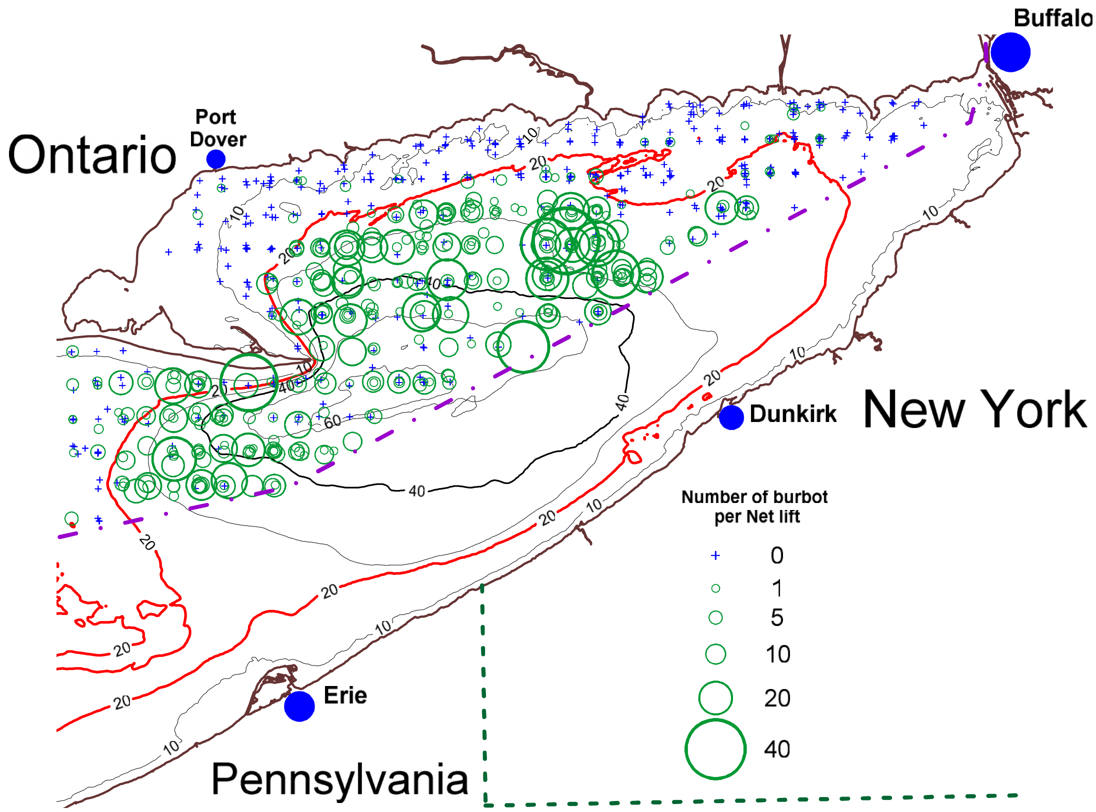

FIGURE 3.1 Distribution of burbot catches (No. per lift) in Ontario Partnership gill nets during August surveys of eastern Lake Erie, 1989 - 2011.

An examination of only the 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, whereas the biomass CPE did not peak until 2003, some five years after maximum numeric abundance was observed (Figure 3.3). Burbot number and biomass have steadily decreased after reaching their respective peaks. Burbot abundance increased in 2011 and were similar to catch rates (numeric and biomass) observed during 2008-2009 (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. Burbot catch rates increased in 2011, more so in Ontario (2.1 burbot/lift) than in New York (1.2 burbot/lift), but were still only about one-quarter of peak-year abundance. Pennsylvania waters were not surveyed in 2011.

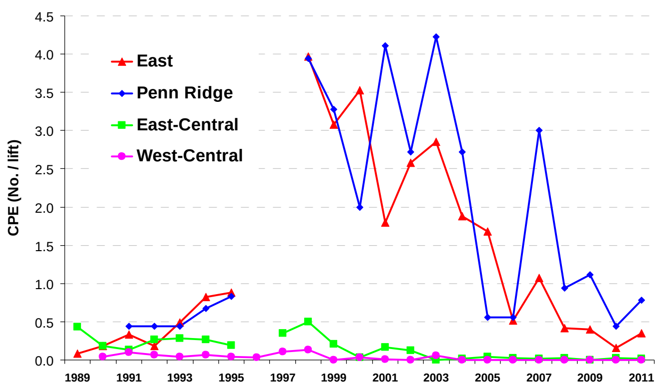

FIGURE 3.2 Burbot CPE (number of fish/lift) by basin from the Ontario Partnership surveys 1989–2011 (includes canned and bottom gill nets, all mesh sizes, except thermocline sets).

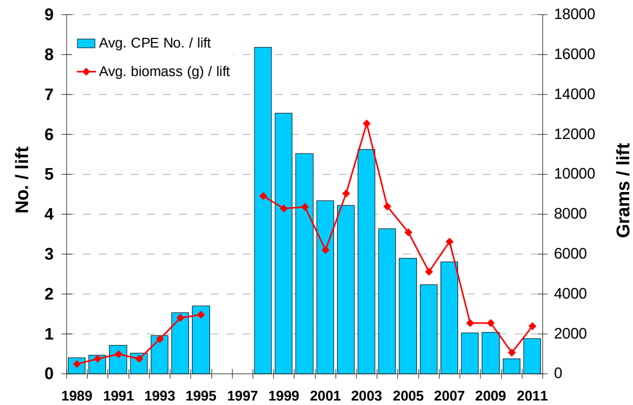

FIGURE 3.3. Average catch rate (CPE as number of fish/lift) and biomass (grams/lift) of burbot in Ontario waters of eastern Lake Erie, Ontario Partnership gillnet survey 1989–2011 (includes only bottom sets, all mesh sizes; PA-ridge and east basin sample sites).

In general, burbot biomass CPE has followed a similar pattern as numeric abundance except that burbot catches in summer coldwater gillnet assessments in Ontario and Pennsylvania did not reach maximum biomass until six or more years after maximum numeric abundance was observed (Figure 3.5). Although average burbot biomass CPE increased in Ontario (7.0 Kg/lift) and New York (3.7 Kg/lift), the 2011 catch rates were only about one-third or less of the maxima observed in these respective east basin areas (Figure 3.5). In Pennsylvania, the 2009 burbot biomass estimate was the lowest in their time series; no assessment occurred in 2010 and 2011.

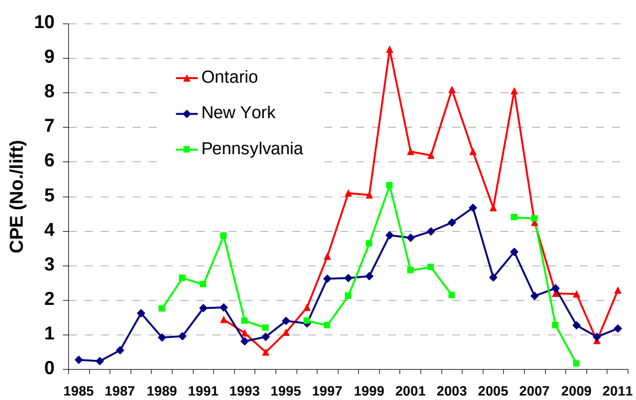

FIGURE 3.4 Average burbot catch rate (number of fish/lift) from summer coldwater gill net assessment by jurisdiction, 1985-2011. Pennsylvania waters were not surveyed in 2010 and 2011.

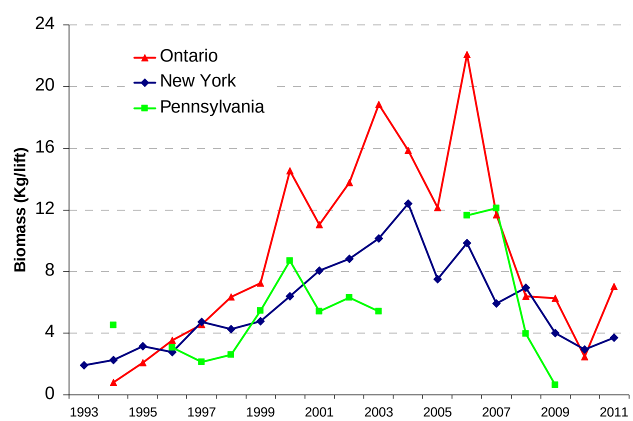

FIGURE 3.5 Average burbot biomass (kg/lift) from summer coldwater gill net assessment by jurisdiction, 1993-2011. Pennsylvania waters were not surveyed in 2010 and 2011.

Age and Recruitment

Burbot ages (from examinations of otoliths) have been estimated for fish caught in coldwater assessment gill nets in Ontario waters since 1997 and for the entire east basin survey area in 2011. The 2011 burbot catch ranged in age from 3 to 20 years (Figure 3.6). Burbot older than 12 years represented 74% of aged fish with 15 and 16 year-olds from the 1996 and 1995 year classes most abundant. Mean age of burbot has increased since 1998 and this trend continued in 2011 (Figure 3.7). Recruitment of age-4 burbot increased almost two-fold from 1997 to 2000, but was followed by an abrupt decrease in 2002 and remained poor through 2011 (Figure 3.7). A recently published analysis (Stapanian et al. 2010) suggests 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. Burbot have the highest reproductive success at water temperatures between 0 and 2C, and are susceptible during early life to predation by yellow perch. Despite an improvement in age-4 recruitment during 2011, ongoing low catch rates of burbot in assessment surveys, combined with increasing mean age of adults and persistent low recruitment signal continuing troubles for this population. For accurate assessment of this aging population, the use of otolith thin-sections is recommended as the best approach for accurate age determination (Edwards et al. 2011). More importantly, efforts to reduce mortality (e.g., through sea lamprey control) on the remaining spawning stock would help ensure that this population can exploit favorable conditions for recruitment in future years.

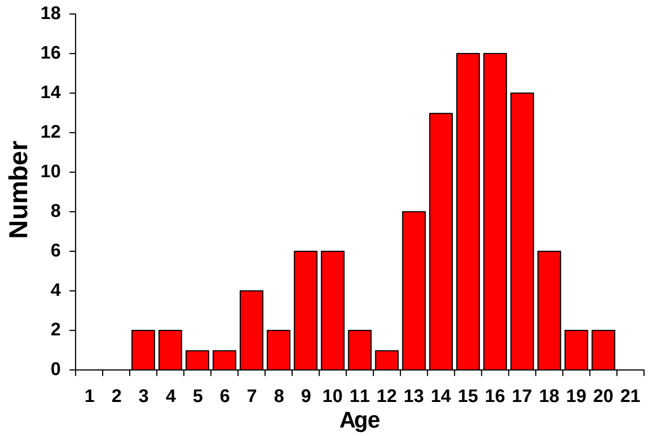

FIGURE 3.6. Age distribution of burbot caught in summer coldwater gill net assessment in eastern Lake Erie, 2011 (N=104).

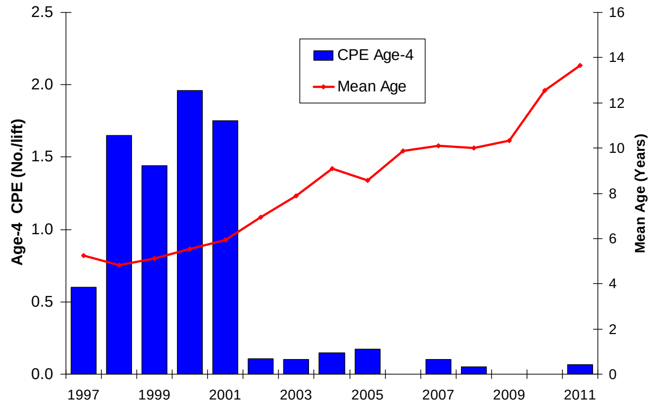

FIGURE 3.7. Mean age and average CPE of AGE-4 burbot caught in summer gill net assessment in Ontario waters of eastern Lake Erie during 1997-2011.

Growth

Mean total length of burbot increased slightly (New York) or was unchanged (Ontario) in surveyed east basin areas in 2011, continuing a trend that has predominated since the late 1990s (Figure 3.8). Average weight of burbot has followed a similar trend, increasing steadily since 1998, reaching a time-series maxima in 2009 or 2011, respectively, in New York and Ontario (Figure 3.9). These results reflect the increasing mean age of the burbot population.

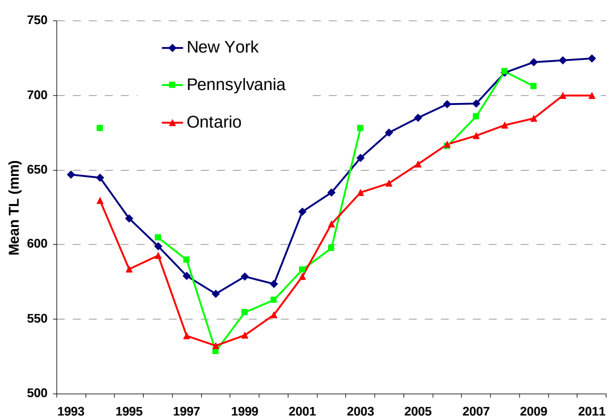

FIGURE 3.8 Average total length (TL) of burbot caught in summer gill net assessments by jurisdiction during 1993-2011. Pennsylvania waters were not surveyed in 2010 and 2011.

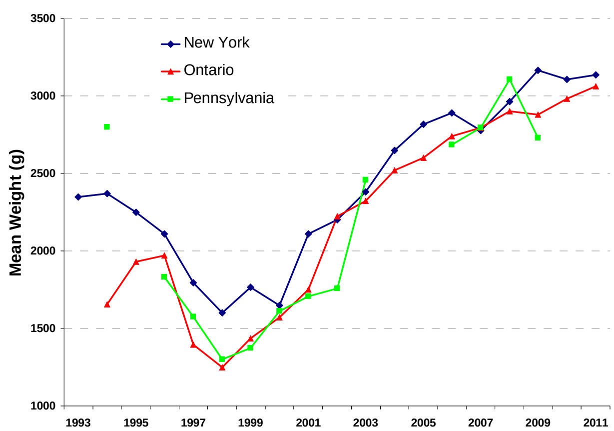

FIGURE 3.9 Average weight of burbot caught in summer gill net assessments by jurisdiction during 1993-2011. Pennsylvania waters were not surveyed in 2010 and 2011.

Diet

Diet information was limited to fish caught during August 2011 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 3.10). Burbot diets continued to be diverse, with six different identifiable fish species and one invertebrate species found in stomach samples. Round goby were the dominant prey item, occurring in 50% of the burbot stomachs, followed by rainbow smelt (46% occurrence). Other identifiable taxa were found in 8% or less of the stomachs and included yellow perch, emerald shiners, alewife, white perch, and dreissenids.

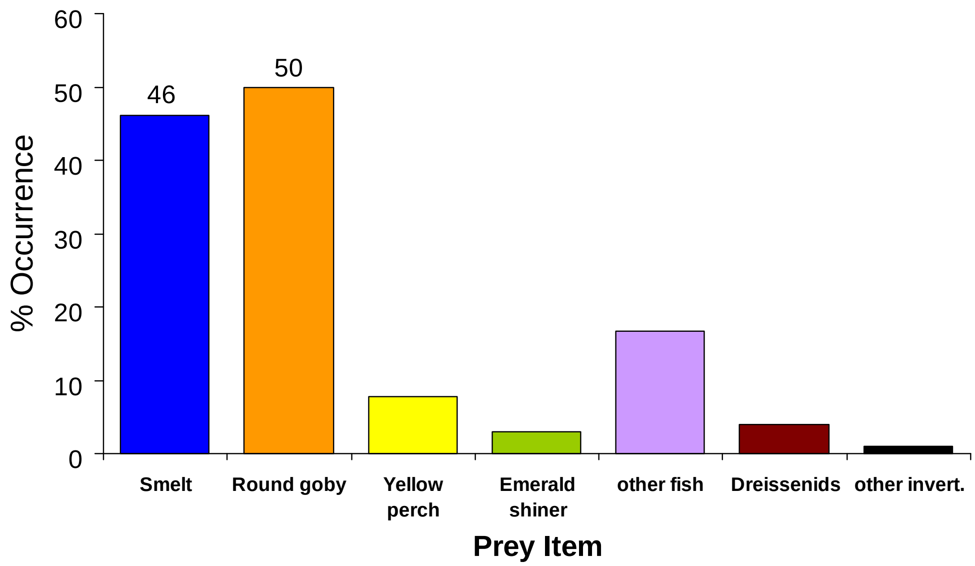

FIGURE 3.10. Frequency of occurrence of diet items from non-empty stomachs of burbot sampled in gill nets from the eastern basin of Lake Erie, August 2011. Other fish includes alewife, white perch and fish remains that could not be identified to species. Sample size is 102 stomachs.

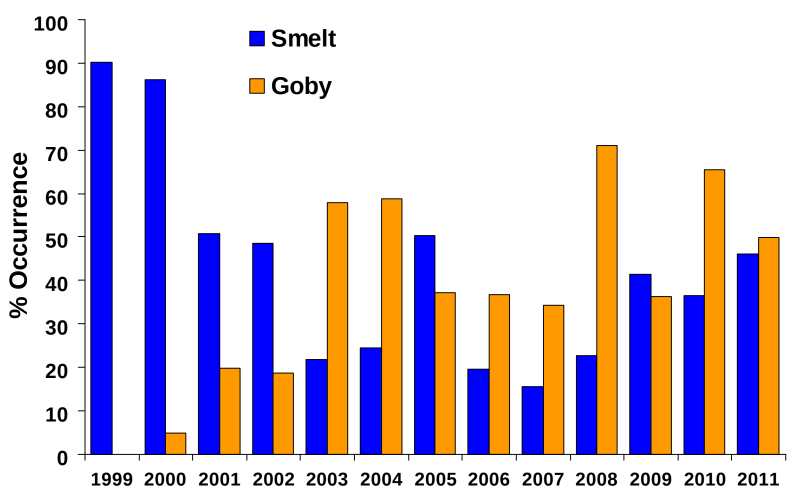

FIGURE 3.11. Frequency of occurrence of rainbow smelt and round gobies in the diet of burbot caught in gillnets set during August in the eastern basin of Lake Erie, 1999-2011.

Gobies have increased in the diet of burbot since they first appeared in the eastern basin in 1999 (Figure 3.11). They were the main diet item for burbot in six of the last eight years. Smelt were the dominant prey in 2005 and again in 2009.

To support ongoing analyses of contaminants (Hg and PCBs) in burbot, Stapanian (M.A. Stapanian, U.S. Geological Survey, Sandusky, OH USA, pers. comm.) applied analysis of variance models to recent burbot diets since the expansion of round gobies (2007-2011) and found that the main effects of sex and year and the interaction term were all insignificant.

Preliminary analyses indicate that burbot exhibit predatory control of round goby in deep water ($\geq$ 20 m) areas of the eastern basin (Madenjian et al. 2011). Further, size-at-age of burbot has increased since round gobies became a significant component of the burbot diet (Stapanian et al. in review). This increase in size is thought to be associated with reduced competition for food among juvenile burbot during low recruitment years.

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Edwards, WH, Stapanian MA, Stoneman AT. 2011. Precision of Two Methods for Estimating Age from Burbot Otoliths. Journal of Applied Ichthyology 27 (Suppllement 1): 43-48.

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.

Tim Sullivan (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 40 A1-A3 wounds were found on 490 lake trout greater than 532 mm (21 inches) total length in 2011, equaling a wounding rate of 8.2 wounds per 100 fish (Table 4.1; Figure 4.1). This was a 36% decline from the 2010 wounding rate of 12.8 wounds per 100 fish and a 58% decrease over the past two years. Despite the recent decline, likely attributable to a 2008-2010 accelerated lampricide treatment program, the current wounding rate still exceeds the target rate of five wounds per 100 fish (Lake Trout Task Group 1985; Markham et al. 2008). Wounding rates have remained above target for 16 of the past 17 years following reduced sea lamprey control measures in the mid-1990's (Sullivan et al. 2003). Lake trout larger than 736 mm (29 inches) total length (TL) continue to be the preferred targets for sea lamprey with A1-A3 wounding rates more than twice as high as any other length group (Table 4.1). Conversely, small lake trout in the 432-532 mm (17-21 inch) size category only received one fresh wound in 171 fish examined (0.58 wounds/100 fish) in 2011.

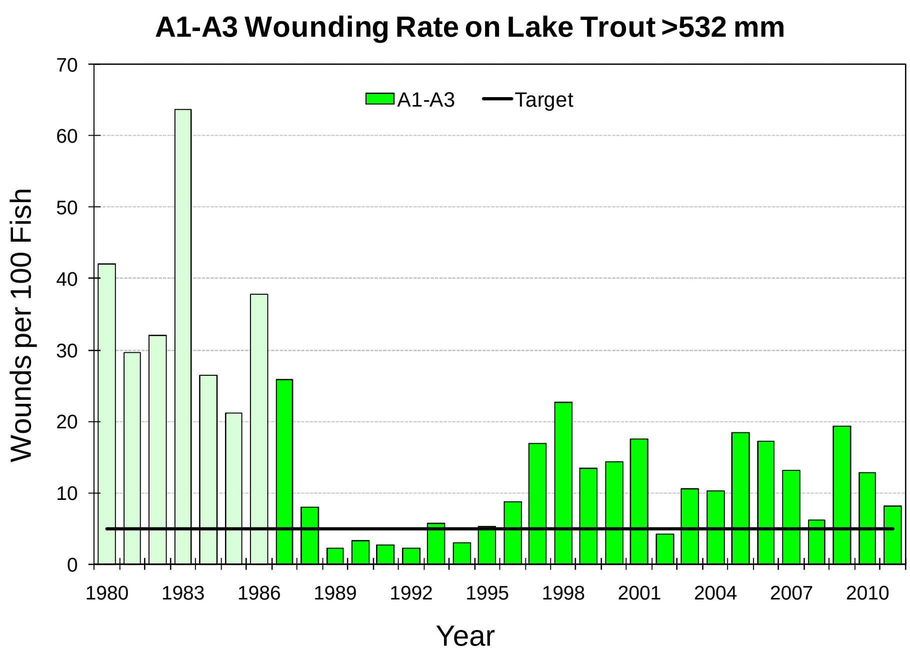

FIGURE 4.1. Number of fresh (A1-A3) sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1980-2011. The target rate is 5 wounds per 100 fish. Lighter shading indicates pre-treatment years.

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 2011.

Size Class Total Length (mm)	Sample Size	Wound Classification A1	A2	A3	A4	No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
432-532	171	0	0	1	11	0.6	6.4
533-634	249	4	4	5	55	5.2	22.1
635-736	173	1	1	11	98	7.5	56.6
>736	68	2	5	7	111	20.6	163.2
>532	490	7	10	23	264	8.2	53.9

Fresh A1 wounds are considered indicators of the attack rate for the current year at the time of sampling (August). The A1 wounding rate in 2011 was 1.4 wounds per adult lake trout greater than 532 mm, which was both lower than the 2010 A1 wounding rate of 2.1 wounds per 100 fish and the time series average (Table 4.1; Figure 4.2). A total of seven A1 wounds were spread across all size categories greater than 532 mm.

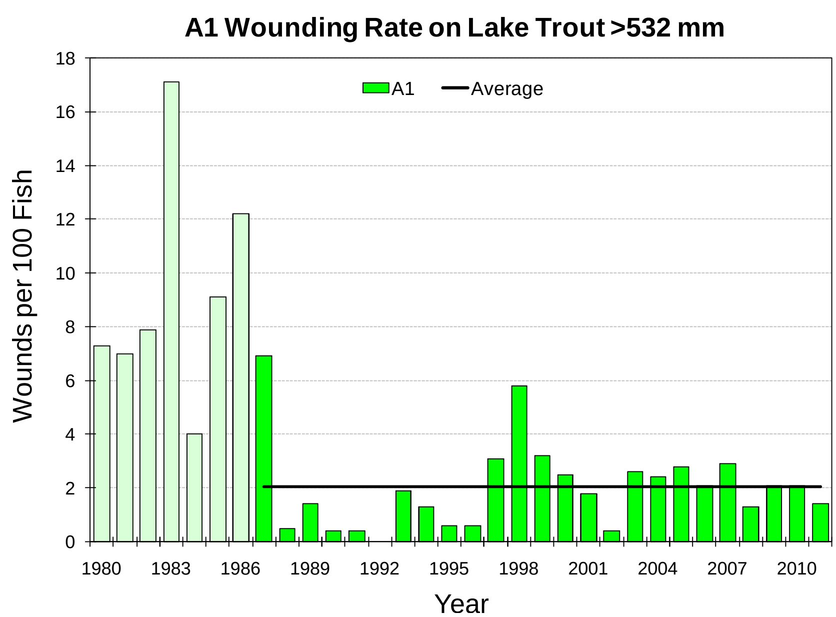

FIGURE 4.2. Number of A1 sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1980-2011. The post-treatment average includes 1987-2010. Lighter shading indicates pre-treatment years.

Cumulative attacks from past years are indicated by A4 wounds. A4 wounding rates slightly decreased in 2011 to 53.9 wounds per 100 fish (Figure 4.3). However, this was the third highest A4 wounding rate in the time series and over two times greater than the time series average of 24.2 wounds per 100 fish. Similar to last year, A4 wounds were observed across all length categories, increased in frequency with lake trout size and was an alarming 163 wounds per 100 fish in lake trout larger than 736 mm (25 inches) TL with many fish possessing multiple wounds (Table 4.1).

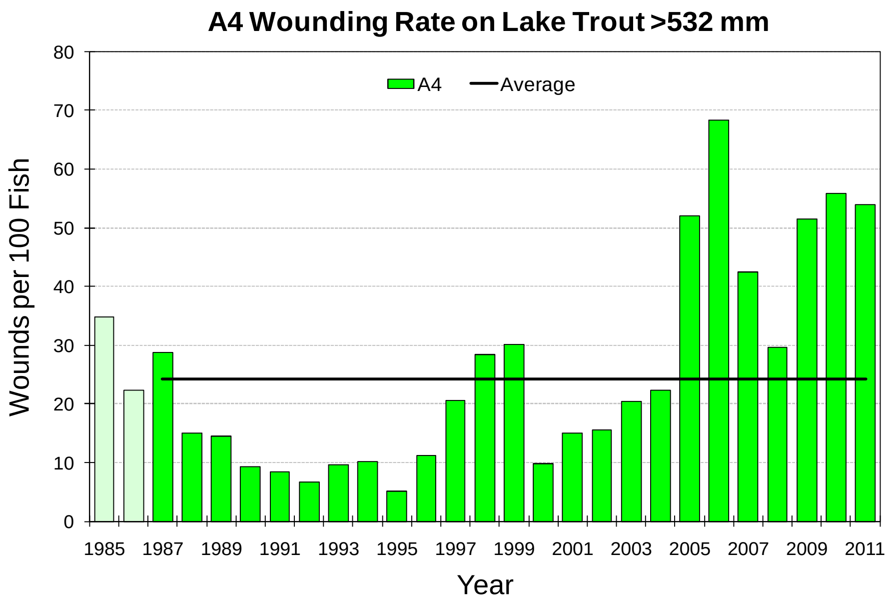

FIGURE 4.3. Number of A4 sea lamprey wounds per 100 lake trout greater than 532 mm (21 inches) sampled in assessment gill nets in the eastern basin of Lake Erie, August-September, 1985-2011. The post-treatment average includes 1987-2010. Lighter shading indicates pre-treatment years.

Finger Lakes (FL) and Klondike (KL) strain lake trout were the most sampled strains, and they accounted for the majority of the fresh (A1-A3) and healed (A4) sea lamprey wounds (Table 4.2). Overall, A1-A3 wounding rates were higher on KL strain lake trout compared to FL strain lake trout, while A4 wounds were slightly higher on FL strain fish. However, almost all lake trout >736 mm TL, which are the preferred prey size of sea lamprey, were FL strain fish. Lake Superior lake trout strains (KL, TI, AI, SUP) have higher wounding rates than Finger Lakes (FL) strain lake trout, indicative of higher susceptibility of these strains to sea lamprey attacks.

TABLE 4.2. Frequency of sea lamprey wounds observed on lake trout greater than 532 mm (21 inches), by strain, collected from assessment gill nets in the eastern basin of Lake Erie, August 2011. AI=Apostle Island, FL=Finger Lakes, KL=Klondike, LC=Lake Champlain, LE=Lake Erie, LL=Lewis Lake, SI=Slate Island, SUP=Superior, TI=Traverse Island.

Lake Trout Strain	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
AI	9	1	0	0	2	11.1	22.2
FL	269	0	4	9	146	4.8	54.3
KL	106	2	4	5	49	10.4	46.2
LC	8	0	0	0	2	0.0	25.0
LE	1	1	0	0	5	100.0	500.0
LL	2	0	1	1	4	100.0	200.0
SI	5	0	0	0	0	0.0	0.0
SUP	1	0	0	0	2	0.0	200.0
TI	18	0	0	2	22	11.1	122.2

Burbot Wounding Rates

The burbot population, once the most prevalent coldwater predator in the eastern basin of Lake Erie, has declined 80% (in relative abundance) since 2004 (see Charge 3). Coincidentally, both A1-A3 and A4 wounding rates on burbot have increased since 2004 in eastern basin waters of Lake Erie (Figure 4.4). Wounding rates on burbot increased again in 2011; A1-A3 wounds increased to 5.3 per 100 burbot while A4 wounds increased to 7.3 per 100 burbot. This was the highest A1-A3 wounding rate in the eleven year time series and the second highest A4 wounding rate.

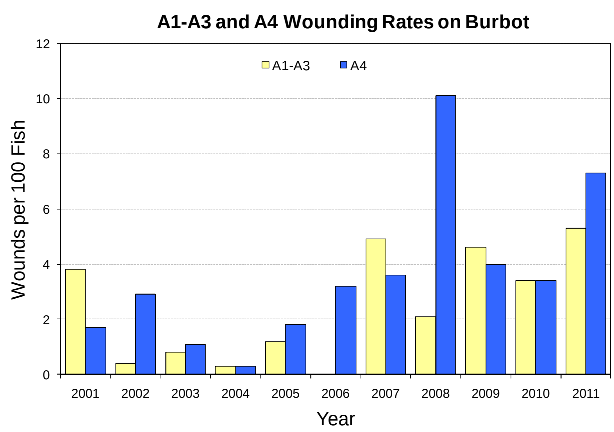

FIGURE 4.4. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot (all sizes) sampled in assessment gill nets in the eastern basin of Lake Erie, August, 2001-2011.

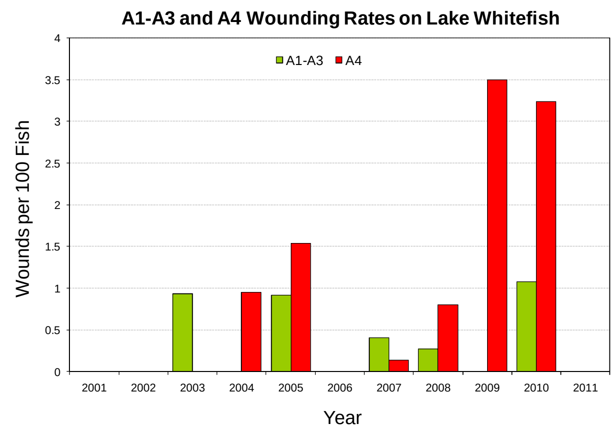

FIGURE 4.5. Number of A1-A3 and A4 sea lamprey wounds per 100 lake whitefish (all sizes) sampled in assessment gill nets in the New York waters of Lake Erie, August, 2001-2011.

Lake Whitefish Wounding Rates

Reliable counts of sea lamprey wounds on lake whitefish have been recorded in New York since 2001. Wounds on lake whitefish were first observed in 2003, coincident with depressed adult lake trout abundance (see Charge 1). No fresh (A1-A3) or healed (A4) wounds were observed on lake whitefish in 2011 assessment netting. However, the overall sample size was small due to low population abundance (see Charge 2). Wounding rates on lake whitefish are low compared to lake trout, which we speculate may be due to higher post-wounding mortality.

Steelhead Wounding Rates

Similar to burbot and whitefish, sea lamprey attacks on steelhead have not been consistently recorded in Lake Erie until recently. Unlike other coldwater species, steelhead are infrequently caught during August coldwater gill net assessment surveys, and observations of wounding must be derived from other sample collections such as tributary creel surveys or fish contaminant collections. Wounding rates on these surveys vary. In 2010, Pennsylvania began a more directed survey during their annual fall steelhead run to address this shortfall and this survey continued in 2011. A total of nine A1-A3 wounds and two A4 wounds were found on 150 adult steelhead in 2011, yielding wounding rates of 6.0 A1-A3 wounds per 100 fish and 1.3 A4 wounds per 100 fish, respectively (Table 4.3). It should be noted that an additional 16 B-type wounds were also found, which normally are not used in wounding rate calculations.

TABLE 4.3. Frequency of sea lamprey wounds observed on steelhead from various Lake Erie tributary surveys, 2003-2011.

Survey	State	Sample Size	# Wounds	Wounding Rate (%)	Comments
2003-04 Tributary Creel Survey	NY	249	31	12.5	All wounds combined
2004-05 Tributary Creel Survey	NY	89	15	16.9	All wounds combined
2007-08 Tributary Creel Survey	NY	88	12	13.6	All wounds combined
2008-09 Tributary Creel Survey	OH	418	30	7.2	13 A1-A3; 17 A4
Fall 2009 Cattaraugus Creek	NY	50	15	30.0	4 A1-A3; 11 A4
Fall 2009 Chautauqua Creek	NY	50	20	40.0	7 A1-A3; 13 A4
2009-10 Tributary Creel Survey	OH	108	11	10.2	7 A1-A3; 4 A4
Spring 2010 Cattaraugus Creek	NY	50	9	18	4 A1-A3; 5 A4
Fall 2010 Directed Wounding Survey	PA	142	26	18.3	4 A1-A3; 5 A4; 17 B1-B4
Fall 2011 Directed Wounding Survey	PA	150	27	18.0	9 A1-A3; 2 A4; 16 B1-B4

Ontario Partnership Program

The Ontario Partnership Index Fishing Program is an annual lakewide gillnet survey of the Canadian waters of Lake Erie and provides an additional and spatially robust assessment of fish species abundance and distribution. Although sea lampreys wounds have been recorded on fish species since the survey began in 1989, detailed information on type and category of wound were not recorded until 2011.

A total of 61 lake trout greater than 532 mm TL were examined for sea lamprey wounds in 2011. Altogether, eight A1-A3 wounds and two A4 wounds were recorded, yielding wounding rates of 13.1 and 3.3 wounds/100 fish, respectively. The majority of the lake trout, and wounds, were found in eastern basin waters (Figure 4.6). Sea lamprey wounds were also recorded on other fish species including gizzard shad, steelhead, white sucker, shorthead redhorse, channel catfish, smallmouth bass, and yellow perch.

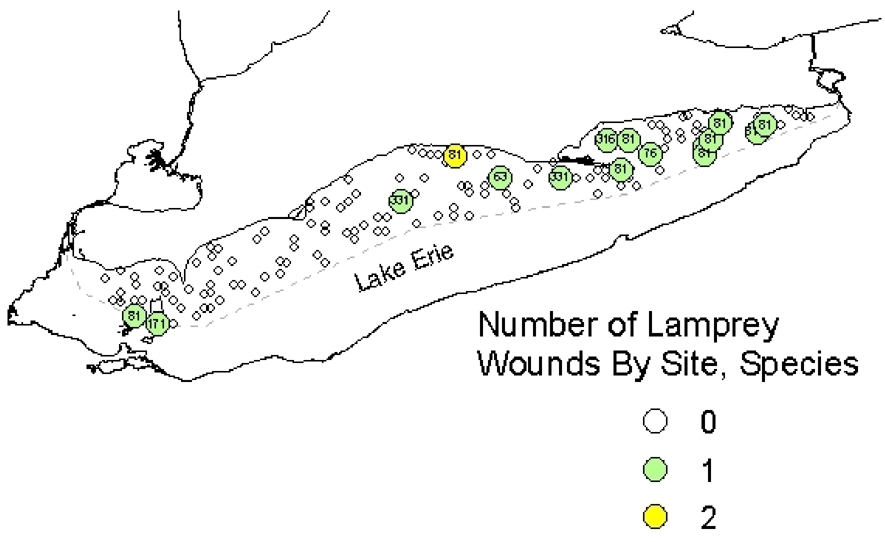

FIGURE 4.6. Number of wounds (A1-A4) on fish examined for lamprey wounds by site and species during Partnership Index gillnetting, 2011. Species codes in symbols include lake trout (81), rainbow trout (76), yellow perch (331), 171 (shorthead redhorse sucker), 316 (smallmouth bass) and channel catfish (234). Two symbols with single wounds (east basin species 81; west basin species 234) are not visible due to overlap. Total number of fish and species examined per site not shown. Includes all index and auxiliary gear.

2011 Sea Lamprey Control Actions

Following the back-to-back treatments of all streams known to be infested with lamprey in Lake Erie in 2008-2010, no streams were treated in 2011. Assessments for larval sea lamprey were conducted in 72 tributaries (61 U.S., 11 Canada) and offshore of 6 U.S. tributaries (Table 4.4). Surveys to detect new populations were conducted in 54 tributaries (49 U.S, 5 Canada). One new population was found in Chautauqua Creek, New York. Sea lamprey recruited to this stream in 2011, and hence this stream would not have been a source of parasitic lamprey to Lake Erie. Larval lampreys reside within the stream for three to four years prior to metamorphosing and migrating to the lake, so Chautauqua Creek will be considered for treatment in 2014.

The estimated number of spawning-phase sea lampreys decreased from 22,179 in 2010 to 20,638 in 2011 (Figure 4.7), a decrease of 7%. A total of 3,281 spawning-phase sea lamprey were trapped in four tributaries (2 U.S., 2 Canada).

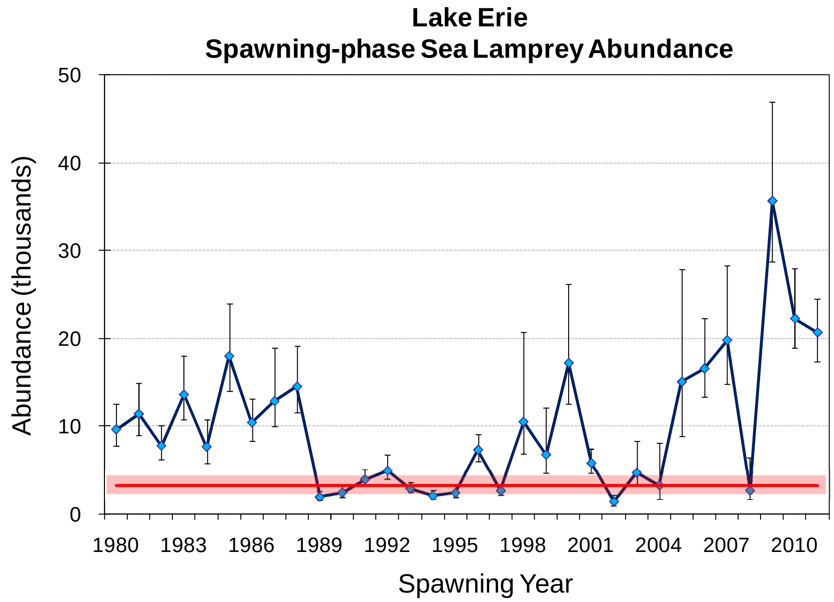

FIGURE 4.7. Lake-wide population estimates of spawning-phase sea lampreys in Lake Erie during 1980-2011 with 95% confidence intervals (black vertical lines). The target population level of 3,244 spawning adults (red horizontal line) with 95% confidence bounds (pink shading) is also shown.

A habitat-based larval sea lamprey population estimate was conducted in the St. Clair River during June. Bottom substrate was mapped and quantified using Roxann seabed classification sonar. Granular Bayluscide surveys were conducted in thirty-four 500m^2 plots throughout the river, yielding an abundance estimate of 150,000 larval sea lamprey. In addition, bottom substrate was mapped and quantified using Roxanne in the Detroit River estuary. No sea lamprey larvae were found in granular Bayluscide surveys of the estuary area.

Trapping for metamorphosed sea lamprey was conducted in the lower Detroit River between November 21st and December 22nd. A combination of floating fyke nets and stationary trawls were deployed at 20 sites in U.S. and Canadian waters. Four metamorphosed sea lampreys were collected during approximately 2500 hours of sampling effort.

Construction of the sea lamprey trap at the Scoby Hill Dam on Cattaraugus Creek began in early August 2011 and continued through the middle of December. During construction, a breach in the common dam wall between the forebay and spillway was discovered. This breach has halted work at the forebay/intake structure due to the inability to dewater the area. The majority of the work on the trapping structure in the tailrace is complete, but a re-design is necessary to supply water to the trap.

Back-to-back Treatment Evaluation

The second portion of Charge 4 is to evaluate the success of the back-to-back treatments. These treatments in 2008-2010 were very effective in reducing larval populations within treated streams. Very few residual sea lampreys were found following the treatments. Rates of re-establishment of sea lamprey in these previously infested streams appear to be substantially lower following the treatments: less than half (5 of 11 streams) have had sea lamprey larvae captured in them since treatment, but further evaluation is needed in 2012 to accurately assess post-treatment recruitment. The anticipated reduction of the lake-wide spawner population following these treatments has not been observed. This suggests sea lampreys are reproducing in another untreated source. Accordingly, efforts to detect this source have been substantially increased. Also, additional assessment work is being planned for the Huron-Erie corridor to determine if this is the source of the problem, as the St. Clair River is the only known un-treated population of sea lamprey larvae in the Lake Erie basin.

2012 Sea Lamprey Control Plans

Due to the recent back-to-back treatments during 2008 - 2010, there are no Lake Erie streams scheduled for treatment in 2012. Larval assessment surveys are scheduled for 66 streams (52 U.S., 14 Canada; Table 4.4) to continue to detect and monitor larval sea lamprey populations and to guide 2013 treatments. Adult assessment traps will be operated on four streams (2 U.S., 2 Canada) to estimate lake-wide spawning-phase abundance.

The US Army Corps of Engineers will conduct a full study to assess the feasibility of repairing or rebuilding the Harpersfield Dam on the Grand River. Construction will be completed on a trap in Cattaraugus Creek, and efforts to identify a candidate site will continue on Big Otter Creek. A bioassay study will be conducted to determine the toxicity of TFM to juvenile snuffbox and ellipse mussels, and ellipse mussel glochidia.

Trapping for metamorphosed sea lampreys in the Huron-Erie Corridor is being proposed for 2012. This is in conjunction with a proposed mark-recapture study which will seek to determine if sea lampreys produced in the St. Clair River are capable of contributing to the spawning run in the eastern basin of Lake Erie.

TABLE 4.4. Larval sea lamprey assessments of Lake Erie Tributaries during 2011 and plans for 2012.

Stream	History	Surveyed in 2011	Survey Type[1]	Results	Plans for 2012
Canada					
St. Clair River	Positive	Yes	Evaluation*	Positive	Evaluation
Thames River	Positive	No			Evaluation
Sydenham River	Negative	No			Detection
Detroit River	Negative	Yes	Detection	Negative	None
Big Creek	Negative	Yes	Detection	Negative	None
Kettle Creek	Negative	Yes	Detection	Negative	None
Catfish Creek	Positive	No			Evaluation
Silver Creek	Positive	Yes	Evaluation	Negative	None
Big Otter Creek	Positive	Yes	Ranking/Dist	Positive	Ranking
South Otter Creek	Positive	Yes	Evaluation	Negative	Evaluation
Clear Creek	Positive	No			Evaluation
Big Creek	Positive	Yes	Ranking/Dist	Positive	Ranking
Dedrich Creek	Negative	No			Detection
Forestville Creek	Positive	No			Evaluation
Normandale Creek	Positive	No			Evaluation
Fishers Creek	Positive	No			Evaluation
Youngs Creek	Positive	Yes	Evaluation	Negative	Evaluation
Lynn Creek	Negative	No			Detection
Grand River	Negative	Yes	Detection	Negative	None
Frenchman Creek	Negative	Yes	Detection	Negative	None
United States					
Buffalo River	Positive	No			Evaluation
Cattaraugus Cr.	Positive	Yes	Evaluation	Positive	Ranking
(estuary)	Positive	No			Ranking
(lentic)	Positive	No			Evaluation
Big Sister Creek	Negative	Yes	Detection	Negative	None
Silver Creek	Negative	Yes	Detection	Negative	None
Merritt Winery Cr.	Negative	Yes	Detection	Negative	None
Beaver Cr.	Negative	Yes	Detection	Negative	None
Canadaway Cr.	Positive	Yes	Evaluation	Negative	None
Delaware Creek	Positive	No			Evaluation
Swede Rd. Cr.	Negative	Yes	Detection	Negative	None
Chautauqua Cr.	Negative	Yes	Detection	Positive	Evaluation
Vorce Cr.	Negative	Yes	Detection		None
Freelings Cr.	Negative	Yes	Detection	Negative	None
Spring Cr.	Negative	Yes	Detection (Visual)	Negative	None
Doty Cr.	Negative	Yes	Detection (Visual)	Negative	None
Twenty mile Cr.	Negative	Yes	Detection	Negative	None

Stream	History	Surveyed in 2011	Survey Type[1]	Results	Plans for 2012
Dewey Cr.	Negative	Yes	Detection	Negative	None
Woodmere Rd. Cr.	Negative	Yes	Detection	Negative	None
Seven mile Cr.	Negative	Yes	Detection	Negative	None
Mill Cr. (Erie, Pa.)	Negative	Yes	Detection	Negative	None
Cascade Cr.	Negative	Yes	Detection	Negative	None
Pasadena Rd. Cr.	Negative	Yes	Detection	Negative	None
Walnut Cr.	Negative	Yes	Detection	Negative	None
Trout Run Cr.	Negative	Yes	Detection	Negative	None
Wilkins Rd. Cr.	Negative	Yes	Detection	Negative	None
Melhorn Cr.	Negative	Yes	Detection	Negative	None
Camp Sherwin Cr.	Negative	Yes	Detection	Negative	None
Elk Cr.	Negative	Yes	Detection	Negative	None
Crooked Cr.	Positive	Yes	Evaluation	Positive	Ranking
Raccoon Cr. (Pa.)	Positive	Yes	Evaluation	Negative	Evaluation
Conneaut Cr.	Positive	Yes	Evaluation	Positive	Ranking
Wheeler Cr.	Positive	Yes	Evaluation	Negative	None
Arcola Cr.	Negative	Yes	Detection	Negative	None
Grand River	Positive	Yes	Evaluation	Positive	Evaluation
Euclid Cr.	Negative	Yes	Detection	Negative	None
Beaver Cr. (Oh.)	Negative	Yes	Detection	Negative	None
Brownhelm Cr.	Unknown	Yes	Detection	Negative	None
Sunnyside Cr.	Unknown	Yes	Detection	Negative	None
Vermillion River	Negative	Yes	Detection	Negative	Detection
Huron River (Oh.)	Negative	Yes	Detection	Negative	None
Edson Cr.	Unknown	Yes	Detection	Negative	None
Sawmill Cr.	Unknown	Yes	Detection	Negative	None
Plum Br.	Unknown	Yes	Detection	Negative	None
Pipe Cr.	Unknown	Yes	Detection	Negative	None
Raccoon Cr. (Oh.)	Unknown	Yes	Detection	Negative	None
Pickerel Cr.	Unknown	Yes	Detection	Negative	None
Sandusky River	Negative	Yes	Detection	Negative	None
Sandusky R. (lentic)	Unknown	No			Detection-gB
Muddy Cr.	Unknown	Yes	Detection	Negative	None
Muddy Cr. (lentic)	Unknown	No			Detection
Portage River	Negative	Yes	Detection	Negative	None
Toussaint R.	Negative	Yes	Detection	Negative	None
Maumee R.	Negative	Yes	Detection	Negative	Detection
Ottawa R.	Unknown	Yes	Detection	Negative	None
Halfway Cr.	Negative	Yes	Detection	Negative	None
Otter Cr.	Negative	Yes	Detection	Negative	None
Plum Cr.	Negative	Yes	Detection	Negative	None

Stream	History	Surveyed in 2011	Survey Type[1]	Results	Plans for 2012
River Raisin	Negative	Yes	Detection	Negative	None
Stony Cr.	Negative	Yes	Detection	Negative	None
Huron River (Mi.)	Negative	Yes	Detection	Negative	Detection
Detroit River	Negative	Yes	Detection	Negative	Detection
Clinton River	Positive	Yes	Evaluation	Positive	Evaluation
Belle River	Positive	Yes	Evaluation	Negative	None
Pine River	Positive	Yes	Evaluation	Negative	None
Black River	Positive	Yes	Evaluation	Negative	None
St. Clair River	Positive	Yes	Evaluation	Positive	Evaluation
Van Buren Cr. #2	Negative	No			Detection
Van Buren Cr. #3	Negative	No			Detection
Hall Rd. Cr.	Negative	No			Detection
Lake Erie Park Cr.	Negative	No			Detection
Corell Cr	Negative	No			Detection
Pratt Rd. Cr.	Negative	No			Detection
Bournes Cr.	Negative	No			Detection
Rogerville Rd. Cr.	Unknown	No			Detection
Shorehaven #2 Cr.	Negative	No			Detection
Shorehaven #3 Cr.	Negative	No			Detection
Forsyth Rd. Cr.	Unknown	No			Detection
Brockaway Rd. Cr. #1	Unknown	No			Detection
Brockaway Rd. Cr. #2	Unknown	No			Detection
Ripley Cr.	Negative	No			Detection
Camp Lambec No. 2	Unknown	No			Detection
Camp Lambec No. 3	Unknown	No			Detection
Conneaut Park Cr.	Unknown	No			Detection
Kingsville on the Lake	Unknown	No			Detection
North Kingsville Cr.	Unknown	No			Detection
Camp Wingfoot Cr.	Unknown	No			Detection
N. Perry Park Cr.	Unknown	No			Detection
Cmp Roosevelt #1 Cr.	Unknown	No			Detection
Chagrin River	Positive	No			Evaluation
Black River	Negative	No			Detection
Darby Cr.	Unknown	No			Detection
Sugar Cr.	Unknown	No			Detection
Mills Cr.	Unknown	No			Detection
Cold Cr.	Negative	No			Detection
Little Pickerel Cr.	Unknown	No			Detection
Turtle Cr.	Unknown	No			Detection
Crane Cr.	Unknown	No			Detection
Bay Cr.	Negative	No			Detection

Stream	History	Surveyed in 2011	Survey Type[1]	Results	Plans for 2012
Whitewood Cr.	Negative	No			Detection
Swan Cr. (Monroe Co)	Negative	No			Detection
Mouille Cr.	Negative	No			Detection
River Rouge	Negative	No			Detection

[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; gB denotes that Granular Bayluscide was employed.

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.

References

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

Chuck Murray (PFBC) and James Markham (NYSDEC)

Lake Trout Stockings

The current lake trout stocking goal for Lake Erie (160,000 yearlings) was met for the fourth consecutive year (Figure 5.1). In 2011, lake trout were stocked in New York waters (184,259 yearlings) and Ontario waters (55,874 yearlings). Combined, the 240,133 yearlings stocked in 2011 were the second highest number of lake trout stocked into Lake Erie in a single year since rehabilitation efforts began in 1969, and the fourth consecutive year that total stocking numbers exceeded 200,000 yearlings.

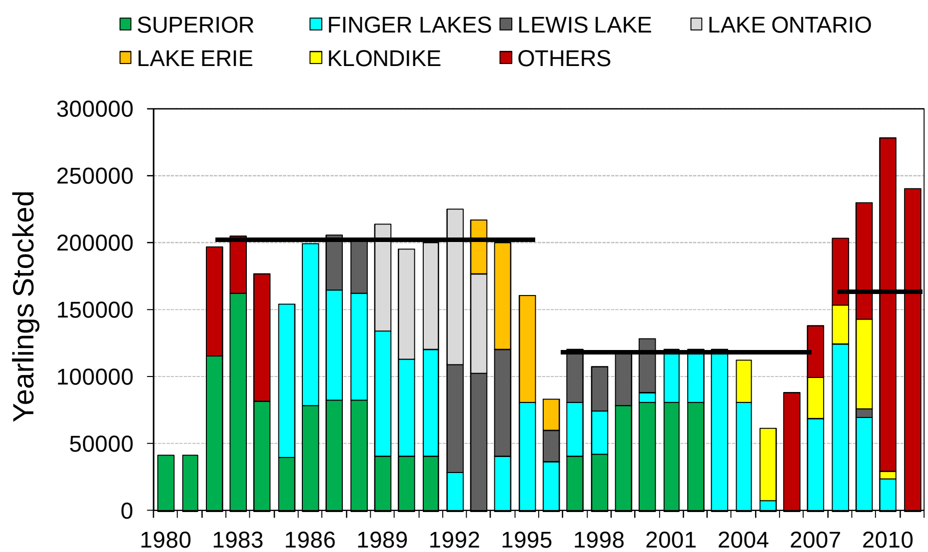

FIGURE 5.1. Yearling lake trout stocked (in yearling equivalents) in eastern basin waters of Lake Erie, 1980-2011, by strain. The current stocking goal (black line) is 160,000 yearlings per year. OTHERS = Clearwater Lake (1982-84), Slate Island (2006, 2009, 2010, 2011), Traverse Island (2007), Lake Manitou (2008), Apostle Island (2009), Lake Champlain (2009, 2010, 2011), and Michipocoten (2010).

While the Allegheny National Fish Hatchery (ANFH) remains closed for renovations, lake trout stocked in New York waters continued to be raised at White River National Fish Hatchery (WRNFH), a USFWS facility located in Vermont. These lake trout were stocked by New York State Department of Environmental Conservation (NYS DEC) staff offshore of Dunkirk in approximately 70 feet of water via the R/V ARGO between 25 April and 5 May, 2011. All of these were Lake Champlain strain fish. The WRNFH is scheduled to raise lake trout for Lake Erie until renovations at the ANFH are complete. Production is expected to be resumed at the ANFH in 2013. The Ontario Ministry of Natural Resources (OMNR) boat stocked Slate Island strain lake trout off Nanticoke Shoal from 19-21 April 2011. This was the fifth lake stocking in Ontario waters in the last six years.

Stocking of Other Salmonids

In 2011, over 2.1 million yearling trout and salmon were stocked in Lake Erie, including rainbow/steelhead trout, brown trout and lake trout (Figure 5.2). Total salmonine stocking decreased 9% from 2010 and the long-term average (1989-2010). Annual summaries for each species stocked within individual state and provincial areas are summarized in Table 5.1, and are standardized to yearling equivalents.

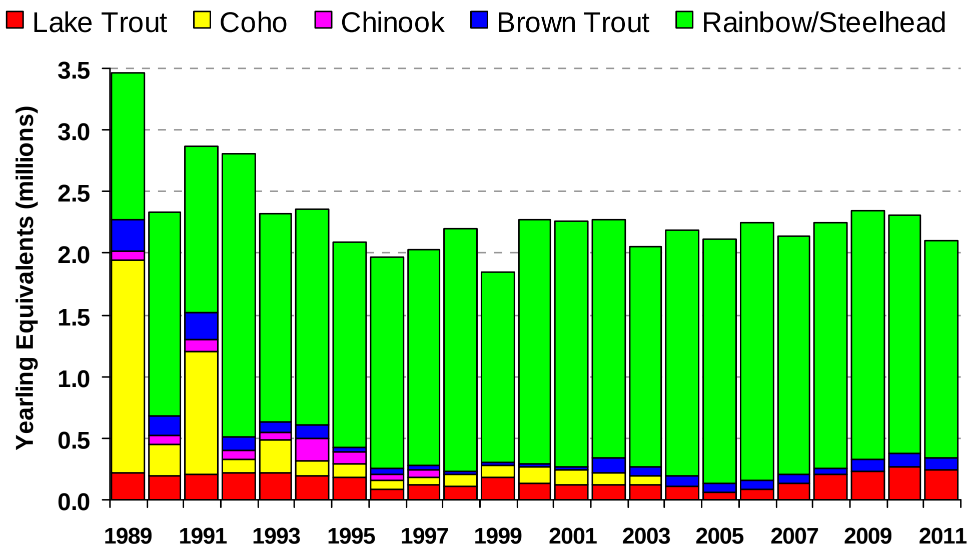

Figure 5.2. Annual stocking of all salmonid species (in yearling equivalents) in Lake Erie by all agencies, 1990-2011.

All of the US fisheries resource agencies and a few non-governmental organizations (NGO's) in Ontario and Pennsylvania currently stock rainbow/steelhead trout in the Lake Erie watershed. A total of 1,761,217 yearling rainbow/steelhead trout were stocked in 2011, accounting for nearly 84% of all salmonids stocked. This represented a 9% decrease from 2010, and 4% below the long-term average. The decrease in rainbow trout stocking is primarily due to a temporary reduction in yearling steelhead stocking by the Ohio Division of Wildlife (ODOW), due to hatchery renovations at the Castalia State Fish Hatchery. The ODOW will resume full production in 2012. Rainbow trout/steelhead stocking increased 10% in Ontario waters and 1% in Pennsylvania waters from 2010, and decreased 39% in Ohio waters, 8% in Michigan waters and 1% in New York waters from 2010. A full account of rainbow/steelhead trout stocked in Lake Erie by jurisdiction for 2011 can be found under charge 6 of this report, and details the location and strain of rainbow trout stocked across Lake Erie.

Brown trout stocking in Lake Erie totaled 100,370 yearlings in 2011. This was a 2% decrease from 2010, but an 18% increase from the long-term average. Recent increases are attributed to the stocking of yearlings and advanced fingerlings in the New York and Pennsylvania waters of Lake Erie. The purpose of these stocking efforts is the development of a trophy brown trout fishery to enhance and diversify the stream and offshore trout fisheries. Some brown trout (18%) are also stocked to provide adult trout for the opening day of trout season in Pennsylvania. Brown trout stocking is expected to continue at this rate for 2012 in both New York and Pennsylvania.

Between 22 April and 29 April the NYSDEC stocked 38,100 yearling brown trout in Cattaraugus Creek, Barcelona Harbor, Point Breeze and Dunkirk Harbor. An additional 7,440 fall fingerlings were stocked on 17 November in Dunkirk Harbor. 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.

Between 12 April and 28 April, 17,710 adult brown trout were stocked by the PFBC to provide catchable trout for the opening of Pennsylvania trout season. Yearling and fall fingerling brown trout were also stocked in Pennsylvania waters in support of a put-grow-and-take brown trout program that was initiated in 2009. This program is currently being supported through the annual donation of 100,000 certified IPN-free eggs from the NYDEC. Various NGO's stocked 43,000 yearling brown trout in May which were adipose clipped. The PFBC stocked an additional 33,037 fall fingerlings between 27 September and 3 October; 7,825 (24%) were stocked in Presque Isle Bay and were left ventral (LV) clipped; 25,212 (76%) were stocked in nursery streams and marked with a right ventral (RV) fin clip.

TABLE 5.1. Summary of salmonid stockings in numbers of yearling equivalents, Lake Erie, 1990-2011.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
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**
ONT.			--		85,235	85,235
NYS DEC	143,320		--		310,300	453,620
PFBC	40,000	100,000	--	20,780	835,931	996,711
ODNR			--		238,467	238,467
MDNR			--		69,234	69,234
1999 Total	**183,320**	**100,000**	**0**	**20,780**	**1,539,167**	**1,843,267**
ONT.	--	--	--	--	10,787	10,787
NYS DEC	92,200	--	--	--	298,330	390,530
PFBC	40,000	137,204	--	17,163	1,237,870	1,432,237
ODNR	--	--	--	--	375,022	375,022
MDNR	--	--	--	--	60,000	60,000
2000 Total	**132,200**	**137,204**	**0**	**17,163**	**1,982,009**	**2,268,576**

TABLE 5.1. (Continued) Summary of salmonid stockings in number of yearling quivalents, 1990-2011.

	Lake Trout	Coho	Chinook	Brown Trout	Rainbow/Steelhead	Total
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**
ONT.	50,000	--	--	--	18,610	68,610
NYS DEC	173,342	--	--	38,452	276,720	488,514
PFBC	6,500	--	--	64,249	1,186,825	1,257,574
ODNR	--	--	--	--	458,823	458,823
MDNR	--	--	--	--	70,376	70,376
2009 Total	**229,842**	**0**	**0**	**102,701**	**2,011,354**	**2,343,897**
ONT.	126,864	--	--		33,447	160,311
NYS DEC	144,772	--	--	38,898	310,194	493,864
PFBC	1,303	--	--	63,229	1,085,406	1,149,938
ODNR		--	--		433,446	433,446
MDNR		--	--		66,536	66,536
2010 Total	**272,939**	**0**	**0**	**102,127**	**1,929,029**	**2,304,095**
ONT.	55,874	--	--		36,730	92,604
NYS DEC	184,259	--	--	38,363	305,780	528,401
PFBC		--	--	62,007	1,091,793	1,153,800
ODNR		--	--		265,469	265,469
MDNR		--	--		61,445	61,445
2011 Total	**240,133**	**0**	**0**	**100,370**	**1,761,217**	**2,101,719**

Charge 6. Continue to assess the steelhead and other salmonid fisheries, age structure, growth, diet, seasonal distribution and other population parameters

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

Stocking

All Lake Erie jurisdictions stocked lake-run rainbow trout (or steelhead) in 2011 (Table 6.1). Yearling plants take place each spring, between February and May, when smolts average about 150 mm in length. Additionally, a small number of adult domestic and golden rainbow trout were stocked to provide a put-and-take trout fishery in Pennsylvania.

TABLE 6.1. Rainbow trout/steelhead stocking by jurisdiction and location for 2011.

Jurisdiction	Location	Strain	Number	Life Stage	Yearling Equivalents	
Michigan	Flat Rock	Manistee River, L. Michigan	61,445	Yearling	**61,445**	**Sub-Total**
Ontario	Mill Creek	Ganaraska River, L. Ontario	35,075	Yearling	35,075	
	Erieau Harbour	Ganaraska River, L. Ontario	1,650	Yearling	1,650	
	Young's Creek	Ganaraska River, L. Ontario	500	Fry	5	
					36,730	**Sub-Total**
Pennsylvania	Conneaut Creek	Domestic	375	Adult	375	
	Conneaut Creek (East Branch)	Domestic	210	Adult	210	
	Temple Run	Domestic	56	Adult	56	
	Conneaut Creek	Golden	2	Adult	2	
	Fourmile Creek	Golden	20	Adult	20	
	Sevenmile Creek	Golden	10	Adult	10	
	Sixmile Creek	Golden	20	Adult	20	
	Bear Creek	Trout Run, L. Erie	24,000	Yearling	24,000	
	Conneaut Creek	Trout Run, L. Erie	90,000	Yearling	90,000	
	Crooked Creek	Trout Run, L. Erie	73,200	Yearling	73,200	
	Elk Creek	Trout Run, L. Erie	247,050	Yearling	247,050	
	Fourmile Creek	Trout Run, L. Erie	18,300	Yearling	18,300	
	Godfrey Run	Trout Run, L. Erie	46,800	Yearling	46,800	
	Presque Isle Bay	Trout Run, L. Erie	82,350	Yearling	82,350	
	Raccoon Creek	Trout Run, L. Erie	23,400	Yearling	23,400	
	Sevenmile Creek	Trout Run, L. Erie	36,600	Yearling	36,600	
	Trout Run	Trout Run, L. Erie	74,250	Yearling	74,250	
	Twelvemile Creek	Trout Run, L. Erie	36,600	Yearling	36,600	
	Twentymile Creek	Trout Run, L. Erie	146,400	Yearling	146,400	
	Walnut Creek	Trout Run, L. Erie	192,150	Yearling	192,150	
					1,091,793	**Sub-Total**
Ohio	Chagrin River	Manistee River, L. Michigan	60,537	Yearling	60,537	
	Conneaut Creek	Manistee River, L. Michigan	44,719	Yearling	44,719	
	Grand River	Manistee River, L. Michigan	60,871	Yearling	60,871	
	Rocky River	Manistee River, L. Michigan	61,058	Yearling	61,058	
	Vermilion River	Manistee River, L. Michigan	38,284	Yearling	38,284	
					265,469	**Sub-Total**
New York	Erie Basin Marina	Domestics	1,000	Yearling	1,000	
	Barcelona Harbor	Domestics	15,000	Fall Fing	530	
	18 Mile Creek	Washington	23,130	Yearling	23,130	
	18 Mile Creek (South Branch)	Washington	23,130	Yearling	23,130	
	Buffalo Creek	Washington	17,340	Yearling	17,340	
	Buffalo River Net Pens	Washington	11,560	Yearling	11,560	
	Canadaway Creek	Washington	23,130	Yearling	23,130	
	Cattaraugus Creek	Washington	104,070	Yearling	104,070	
	Cattaraugus Creek	Skamania	9,400	Yearling	9,400	
	Cayuga Creek	Washington	11,560	Yearling	11,560	
	Cazenovia Creek	Washington	11,560	Yearling	11,560	
	Chautauqua Creek	Washington	46,250	Yearling	46,250	
	Silver Creek	Washington	11,560	Yearling	11,560	
	Walnut Creek	Washington	11,560	Yearling	11,560	
					305,780	**Sub-Total**
					1,761,217	**Grand Total**

TABLE 6.2. Rainbow trout fin-clip summary for Lake Erie, 1999-2011.

Year Stocked	Year Class	Michigan	New York	Ontario	Ohio	Pennsylvania
1999	1998	RP	ADRP	RV; AD; ADRV	-	-
2000	1999	RP	RV	LP	-	-
2001	2000	RP	AD	-	-	-
2002	2001	RP	ADLV	-	-	-
2003	2002	RP	RV	LP	-	-
2004	2003	RP	-	LP	-	-
2005	2004	RP	ADLP	RP	-	-
2006	2005	-	-	LP	-	-
2007	2006	-	ADLP	-	-	-
2008	2007	-	ADLP	-	-	-
2009	2008	RP	-	-	-	-
2010	2009	-	-	-	-	-
2011	2010	-	ADLP	-	-	-

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

A total of 1,761,217 yearling steelhead/rainbow trout were stocked in 2011, representing a 9% decrease from 2010 and a 4% decrease below the long-term (1989-2010) average. Nearly all of the rainbow trout stocked in Lake Erie originated from naturalized Great Lakes strains. A Lake Erie strain accounted for 62% of the strain composition, followed by a Lake Ontario strain (19%), a Lake Michigan strain (19%), and a small amount (0.1%) of rainbow trout that were of domestic origin. New York fin-clipped 9,400 Skamania strain steelhead trout in 2011 (Table 6.2).

Exploitation

While 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. All agencies provide annual measurements of open lake summer harvest by boat anglers, whether by creel surveys or by angler diary reports. These provide some measure of the relative abundance of adult steelhead in Lake Erie.

TABLE 6.3. Estimated harvest by open lake boat anglers in Lake Erie, 1999-2011.

Year	Ohio	Pennsylvania	New York	Ontario	Michigan	Total
1999	20,396	7,401	1,000	13,000	100	41,897
2000	33,524	11,011	1,000	28,200	100	73,835
2001	29,243	7,053	940	15,900	3	53,139
2002	41,357	5,229	1,600	75,000	70	123,256
2003	21,571	1,717	400	N/A*	15	23,703
2004	10,092	2,657	896	18,148 **	0	13,645
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	N/A*	39	5,431
2009	7,662	857	96	N/A*	150	8,765
2010	3,911	5,155	109	N/A*	3	9,178
2011	2,996	1,389	92	N/A*	3	4,480
1999-2010 Average	17,195	4,278	758	33,025	47	33,286

* no creel data collected by OMNR in 2003, 2005-2011

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

Rainbow trout harvest by open lake boat anglers varied greatly across jurisdictions. Low directed effort at rainbow trout in the open water fishery and small sample sizes can lead to wide variations in annual estimates. The estimated harvest from the summer open-water boat angler fishery in 2011 was 4,480 steelhead in all US waters; a 51% decrease from the estimated 2010 steelhead harvest (Table 6.3). Annual declines in harvest were greatest in Pennsylvania (-73%), followed by Ohio (-23%) and New York (-17%).

Trends in harvest rates were contrasting; 2011 steelhead boat angler harvest rate in Ohio waters (0.43 steelhead/angler hour) increased exponentially from 2010 and was nearly three times higher than the average of 0.14 steelhead/angler hour in the 1999-2010 time series. Conversely, the 2010 harvest rate in Pennsylvania (0.03 steelhead/angler hour) dropped to less than one quarter the long-term average of 0.13 steelhead/angler hour. The 2011 rainbow trout harvest rate of 0.07 steelhead/angler hour by Ontario anglers (areas combined) also decreased from 2010, but declines were not as significant. Small amounts of targeted effort for steelhead and small numbers of interviews contributing to the catch rate statistics confound these results. Combined harvest rates in 2011 across all reporting agencies (0.18 steelhead/angler hour) were 50% above the long term interagency average of 0.12 steelhead/angler hour (Figure 6.1).

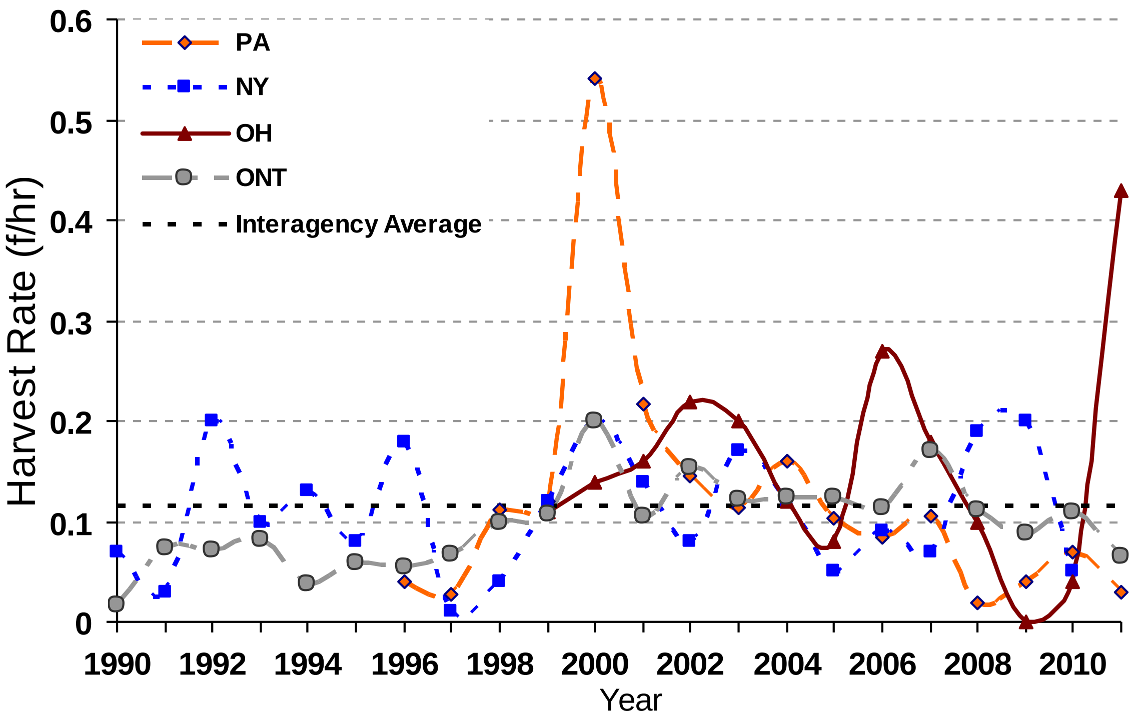

FIGURE 6.1. Targeted steelhead harvest rates (fish/angler hour) in Lake Erie by open lake boat anglers in Ohio, Pennsylvania, New York and Ontario 1990 – 2011.

The Ontario Ministry of Natural Resources did not conduct open water angler surveys during 2011 that could provide comprehensive estimates of rainbow trout harvest, effort or catch rates in open lake waters of Lake Erie. However, they collected angler diary reports that detail trends over time by area of the lake. In 2011, diarists reported 100 targeted rainbow trout trips in west-central basin and 52 targeted trips in the east-central basin waters of Lake Erie. Only one trip targeting rainbow trout was recorded through the diary program in the east basin for 2011 and no rainbow trout were caught.

Angler diary reports from Ontario show that rod-hours for rainbow trout increased in the west central basin for the first time in five years (Figure 6.2). Catch rates in the west central basin (0.13 fish/rod-hour) were 46% lower than 2010 values, but remained near the long-term average (0.15 fish/rod-hour).

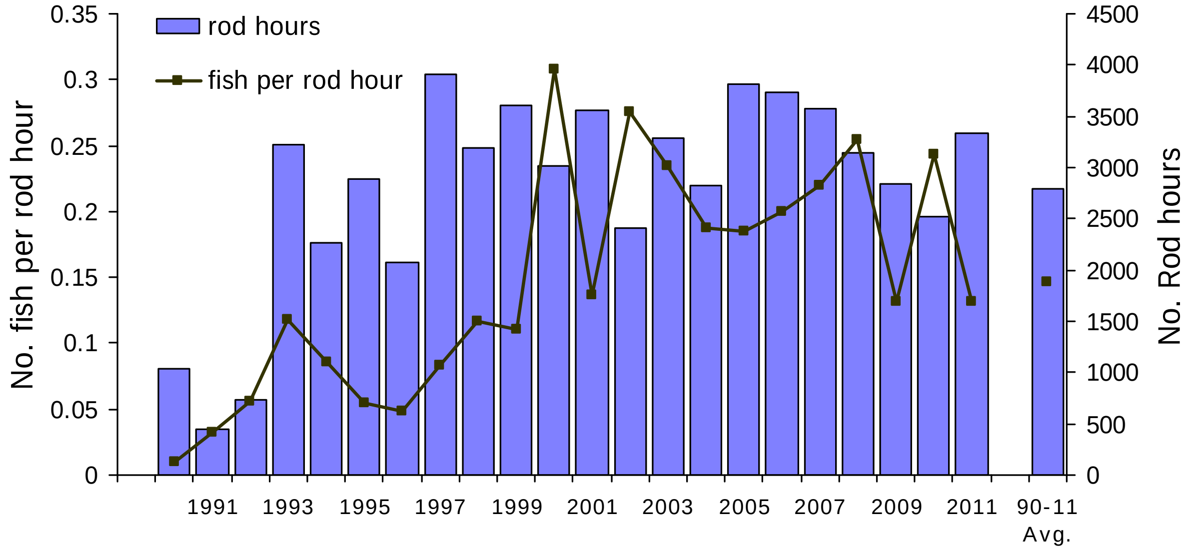

FIGURE 6.2. Targeted steelhead effort and catch rates in Lake Erie's west-central basin as reported in angler diaries by open lake boat anglers in Ontario from 1990 - 2011.

Rod hours for rainbow trout increased in the east central basin for the second consecutive year (Figure 6.3). Rainbow trout catch rates by Ontario diarists in the east-central basin (0.06 fish/rod hour) were 24% lower than 2010, and were slightly lower than the long-term average (0.08 fish/rod hour).

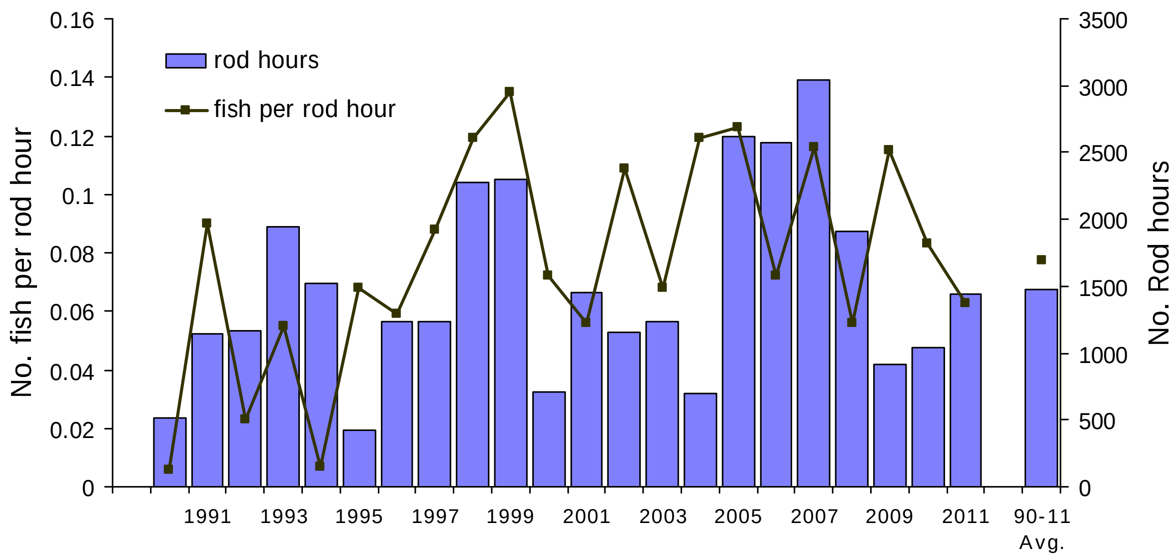

FIGURE 6.3. Targeted steelhead effort and catch rates in Lake Erie's east-central basin as reported in angler diaries by open lake boat anglers in Ontario from 1990 - 2011.

Tributary Creel Surveys

The Lake Erie tributaries are the focal point of the steelhead fishery. Unfortunately, data on this segment of the sport fishery is fragmented, preventing a comprehensive review of annual trends in targeted effort and catch rate by stream anglers across all areas of Lake Erie.

An angler diary program maintained by the NYSDEC Lake Erie Fisheries Unit provides the best review of annual catch rates by tributary anglers through 2010. This data shows that catch rates by steelhead anglers in New York streams had steadily increased throughout most of the last two decades and peaked in 2006. Catch rates remained high through 2008, but sharply declined in 2009 and 2010 (Figure 6.4). Diary cooperator catch rates in 2010 were 0.52 steelhead/hour, declining 33% over the past two years. Despite the decline, catch rates remained slightly above the long-term average of 0.47 steelhead/angler hour.

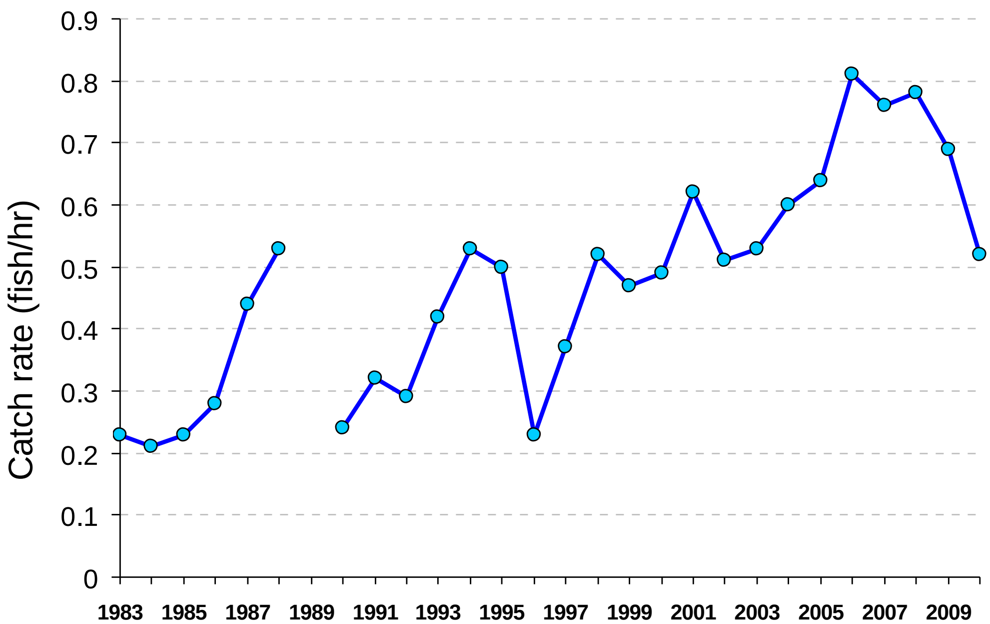

FIGURE 6.4. Targeted steelhead catch rates (fish/angler hour) in Lake Erie tributaries by New York angler diary cooperators, 1983-2010.

Sources of Adult Steelhead Trout in Lake Erie Tributaries

Concluding a study of adult steelhead trout spawning distribution patterns in Lake Erie tributaries, researchers at Bowling Green State University (Ohio Sea Grant funding) found that many of the steelhead trout caught by fisherman in NY tributaries come from OH and PA stocking programs. John Farver and Jeff Miner with PhD student, Chris Boehler, used the unique chemical signatures in the otoliths of steelhead trout smolts released from hatcheries (MI, OH, PA, NY) and naturally reproduced fish from NY and ONT tributaries to identify the sources of adult steelhead in rivers from MI to NY. As expected, relatively few (~15%) adult steelhead trout caught in OH and PA tributaries were strays stocked as smolts in other states (or were of unknown origin), but different results were found in NY and MI streams (Figure 6.5). In NY tributaries, approximately 75% of the adult steelhead trout collected were stocked as smolts into OH and PA streams (i.e., from OH and PA hatchery stock). They hypothesize that this may occur because 1) OH and PA stock about 70% of the almost two million smolts placed in Lake Erie tributaries each year, 2) OH and PA stock numerous streams near river mouths, and sometimes over extended periods (Feb-April); high flow occurring at the time of some stockings may force many newly-stocked smolts into Lake Erie shortly after stocking and thus affect straying, 3) NY-stocked smolts are relatively small (110-130 mm) compared to desirable stocking sizes based on literature (>160 mm), so the fate of these NY-stocked fish is not clear, and 4) the NY-stocked fish are stocked upstream where they may compete with naturally reproduced steelhead trout fingerlings. In the Huron River (MI), 45% of adults clearly assign to the MI hatchery source, while remaining fish assign to Ontario (Grand River), NY, or their origin was unknown. They suspect that some of these strays may have come from Lake Huron sources, but a lack of source chemical signatures prevents clarification.

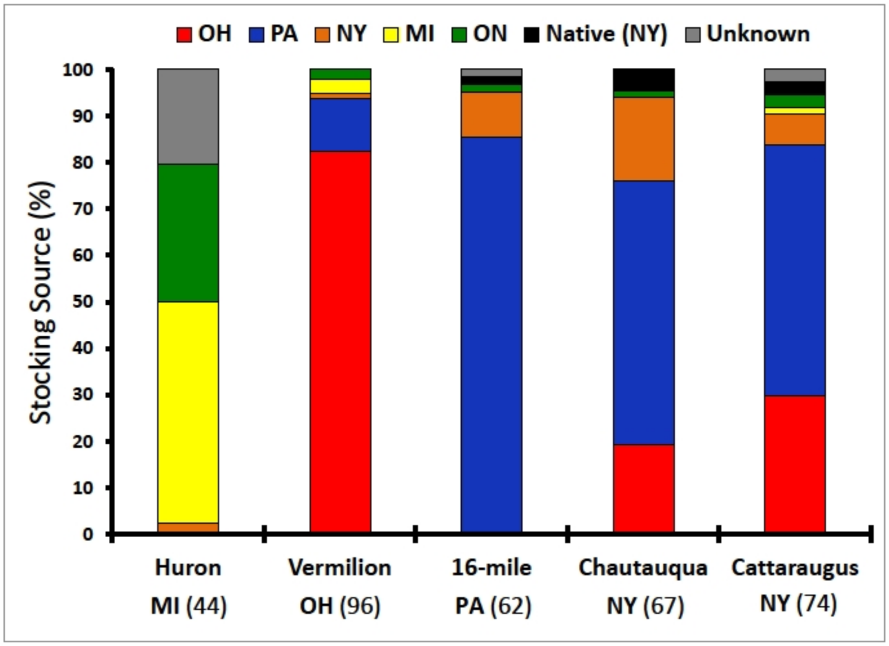

FIGURE 6.5. Origin of adult steelhead trout in five Lake Erie tributaries, determined by otolith chemical signatures from stocked and native (naturally reproduced in streams) smolts. Sample sizes are in parentheses and consist of adults collected in both spring and fall spawning runs. Ontario-identified adults are based on yearling fish collected in the Grand River, ON.

Charge 7: Prepare Lake Erie Cisco Management Plan. Report on the status of Cisco in Lake Erie and potential for re-introduction and/or recovery.

Elizabeth Trometer (USFWS), Tom MacDougall and Kurt Oldenburg (OMNR),
Jim Markham (NYSDEC) and Richard Kraus (USGS)

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 collapse 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, Evans and Loftus 1987).

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 Forage Task Group 2012). Alewife have never been persistently abundant in Lake Erie due to overwinter temperatures that frequently prove lethal (Ryan et al. 1999). The apparent natural recovery from historic lows of other coldwater species (i.e. lake whitefish and burbot) together with the current, relatively low abundance of rainbow smelt had suggested an opportunity for the recovery of cisco in Lake Erie. Unfortunately, recruitment problems identified in both of whitefish and burbot over the past 10+ years have called into question the success of their recovery and thus qualified the potential for cisco to recover on their own. It should be recognized that, although rainbow smelt population abundance in Lake Erie has declined from past decades, densities of this offshore pelagic feeder are still relatively high compared to other predator species (Forage Task Group 2012).

Cisco – Recent Observations

Commercial fishermen have reported cisco in 10 of the last 15 years. It is difficult to assess relative abundance from these reports however as they represent the passive surrendering of bycatch by two commercial fishers who recognize their importance. Recent reports and collections are summarized in Table 7.1 with locations shown in Figure 7.1. Although there were no reports of cisco in 2009, four were reported from the commercial fishery in both 2010 and 2011. While young cisco (age 1 and 2) were observed in the early part of the 2000's, none have been observed lately. The most recent year class confirmed is that of 2003, although the two collected in 2011 are estimated to be of 2005 and 2008 year class.

Surveys complete during 2010 and 2011 in the Huron-Erie corridor have collected young coregonids (Figure 1). Two cisco larvae were collected (12.0 mm TL) on May 11/12 2010 (Edward Roseman, USGS-GLSC, pers. comm.). One was collected in the St. Clair River off Pine River at the wall in the shipping channel by the town of Clair, MI. The other cisco larvae was taken in the North Channel, just downstream of the Mid-Channel split near Algonac, MI. Positive identification was verified by genetic analysis. In December 2011, eight young coregonids (51-71 mm TL) were collected in floating fyke nets in the Livingstone Channel of the Detroit River just downstream of Wyandotte, MI (Peter Hrodey, USFWS, pers. comm.). Their taxonomic identification is presently unknown and awaiting confirmation from genetic testing.

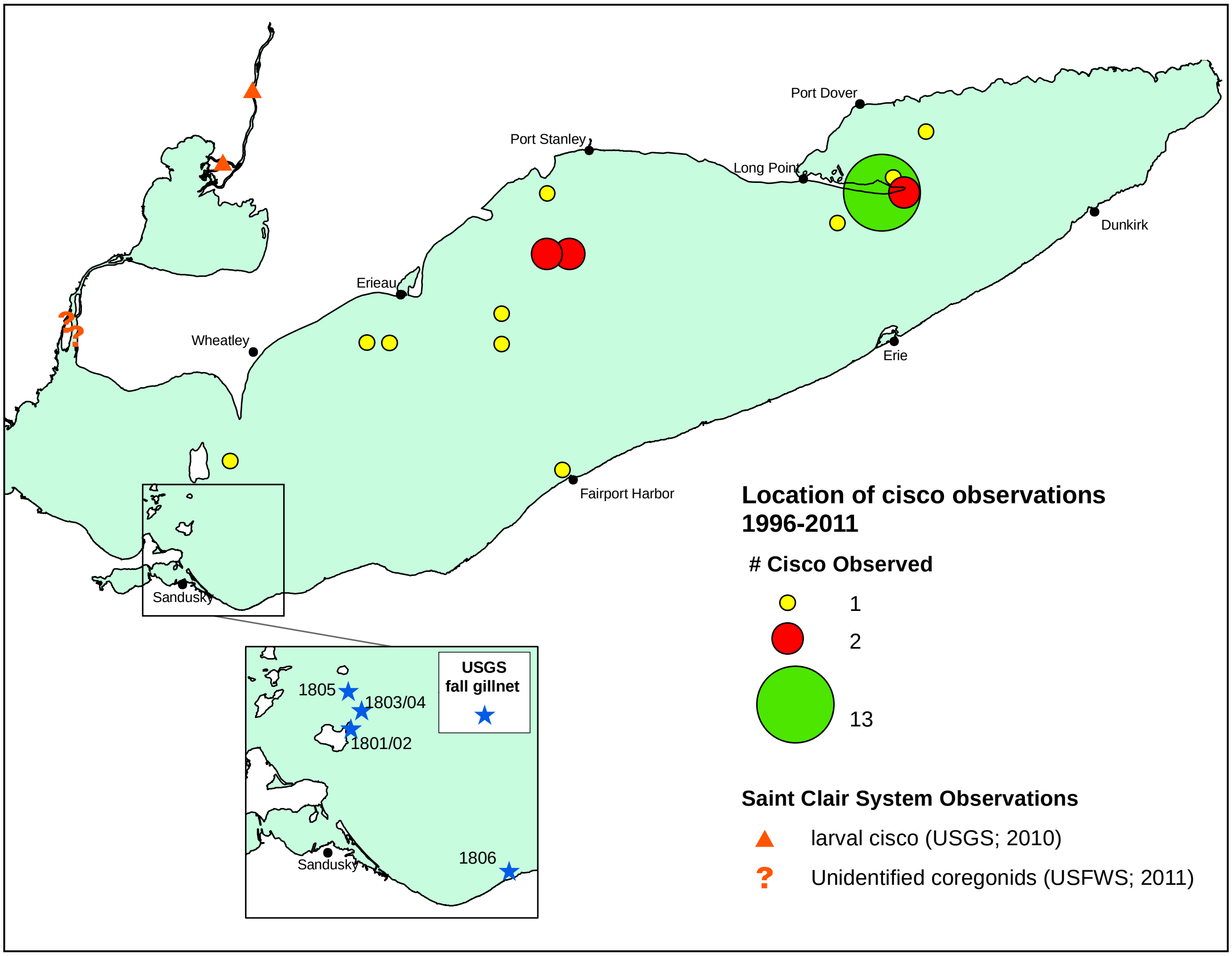

FIGURE 7.1. Cisco in Lake Erie and the Lake St. Clair system. Relative abundance of adult specimens from the commercial fishery and agency surveys is indicated with proportional, colored circles; Observations of planktonic larval and juvenile specimens from the Huron Erie Corridor are shown in orange; Gillnet sites (set numbers shown) from USGS fall 2011 surveys, near Kelley's Island and Vermillion OH, are indicated with blue stars in the inset.

TABLE 7.1. Sampling details from a selection of cisco captured during commercial and fishing efforts, 1996-2011.

Observation Year	Basin	Year Class	Sex	Number
1996	Central	1991	F	1
1999	Central	1998	F, M	3
	East	1997	F	1
		1998	F, M	2
2002	East	1996*	F	1
		2001*	F	1
2003	Central	1998*	U	1
		2001	M	1
		2002	M	1
	East	1999*	F	1
2004	East	U	U	1
2005	Central	2001	F	2
2007	East	2000	F	2
2008	Central	2001	F, M	2
2010	West	2001	F	1
	East	1998	F	1
		2001	F	1
		2003	M	1
2011	East	2008*	U	2
		2005*	U	2

* indicates age extrapolated from total length measure

F = female; M = male; u = unknown

Rehabilitation Efforts

Efforts to address the re-establishment of cisco in Lake Erie have been ongoing for a number of years and are highlighted in previous annual reports of the Coldwater Task Group. 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 sent 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 1955-1965, 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 may exist (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.

In recognizing that stocking is one possible outcome of the management decision process, and realizing that a long lead time is necessary between the decision to stock and the first stocking event, proactive disease testing of potential broodstock from viable sources has begun. 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 2009 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 or Lake Michigan 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; however, after several drafts, the exercise has stalled due to several outstanding issues which include:

- 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 Lake 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?

Efforts toward addressing the two basic issues (accurate assessment of the current Lake Erie population and characterizing the population as to its relation to the historic stock) continued in 2011. As a strategy to address outstanding questions, the task group sought the advice of external cisco experts from around the Great Lakes, beginning with a conference call in May of 2011 and followed by email correspondence. One goal of these discussions was to better understand how cisco are sampled elsewhere and determine whether the spatial and temporal distribution of fishing and scientific sampling efforts on Lake Erie would be effective for capturing cisco. These exchanges highlighted the fact that current fisheries assessments on Lake Erie may not be sufficient for detecting and assessing the presence and abundance of cisco. Based on assessments in the upper great lakes, cisco are most vulnerable when in spawning aggregations from mid-October through December in shallow areas (<10m) associated with historic cisco and whitefish spawning. It was discovered that many of the historical spawning sites for cisco in Lake Erie, especially around the islands in the western basin, are not currently targeted by scientific monitoring or commercial fishing.

2011 Sampling of Historic Cisco Spawning Sites

At the request of the CWTG, USGS personnel set a few gill nets near Kelley's Island and Vermilion, OH, to characterize the fish assemblage at historical cisco spawning locations (Figure 7.1). Sites in these areas included the northeast site of Kelley's Island, Kelley's Island Shoal, Gull Island Shoal, and hard bottom areas southwest of the mouth of the Vermilion River. This sampling was done in conjunction with ongoing walleye gill net comparison studies, and therein constrained spatially and temporally to areas adjacent to planned walleye gill net sets. Sites were sampled during late October and early November, corresponding with early cisco spawning period for Lake Erie. The gill nets used for sampling cisco spawning sites consisted of 6-ft high by 50-ft long of monofilament mesh panels ranging from 1.75 to 3 inches. Net panels were arranged in random order and there were unequal numbers of each mesh size (1.75" n=4, 2" n=5, 2.25" n=3, 2.5" n=4, 2.75" n=4, 3" n=3) for a total length of 1150 feet.

Gill nets were set overnight on bottom at 6 locations (Figure 7.1) ranging between 10 and 12 feet depth. Water temperature ranged between 10C and 12C. The catches were primarily comprised of white perch, gizzard shad, white bass, walleye, and suckers (Table 7.2). Historically, cisco utilized the same or similar spawning areas as lake whitefish. That only a few lake whitefish were captured (n=5), provides ambiguous evidence that these sites are currently utilized by whitefish for spawning. Additional sampling of shallow historic cisco spawning areas is being considered. Maumee Bay is highlighted as a current spawning area for lake whitefish, and potentially suitable for cisco spawning.

Limited November gillnetting by OMNR, targeting lake trout on Nanticoke Shoal in the eastern basin of the lake, did capture one pre-spawn whitefish, thus providing another potential location for future fall assessments.

TABLE 7.2. Species composition of gill net samples from historical cisco spawning locations.

Species	%	catch per lift
White perch (+hybrids)	27.9	65.8
Gizzard shad	23.4	55.2
White bass	21.5	50.6
Walleye	17.7	41.8
Shorthead redhorse	5.2	12.2
White sucker	1.4	3.4
Channel cat	1.1	2.6
Lake whitefish	0.4	1.0
Smallmouth bass	0.4	1.0
Freshwater drum	0.3	0.6
Rock bass	0.3	0.6
Yellow perch	0.3	0.6
Black crappie	0.1	0.2
Quillback	0.1	0.2
Total Count	1179	

2011 Genetics Assessment Research Strategy

To further our understanding of the genetic relationships among historic and contemporary Lake Erie and Lake Huron cisco populations, task group members have recently partnered with Wendy Stott (USGS Great Lakes Science Centre) to develop a research strategy that will: i) revisit the question of whether recent observations represent a true remnant stock (see above) and ii) determine the similarity of any remnant stocks and historical stocks to potential sources of broodstock from Lake Huron. This work will build on the previous genetic examination (above). It will utilize the previous samples and will greatly increase the sample size by incorporating tissue samples collected from the commercial fishery in the interim as well as DNA extracted from a large archive of historic scale samples. The investigators are currently seeking funding for this work.

Additional Cisco Samples in 2012

As Maumee Bay is recognized as a known spawning location and which supports a significant commercial fishery for lake whitefish, it may be possible to enlist the assistance of commercial fishermen to deliberately look for cisco in their catches. In addition, OMNR has initiated talks with the Ontario Commercial Fisheries Association to solicit additional samples from the Ontario commercial fisheries, to date the most consistent source of samples. We are hopeful that this may result in both additional samples for genetic analysis and identify additional locations for standardized assessment.

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