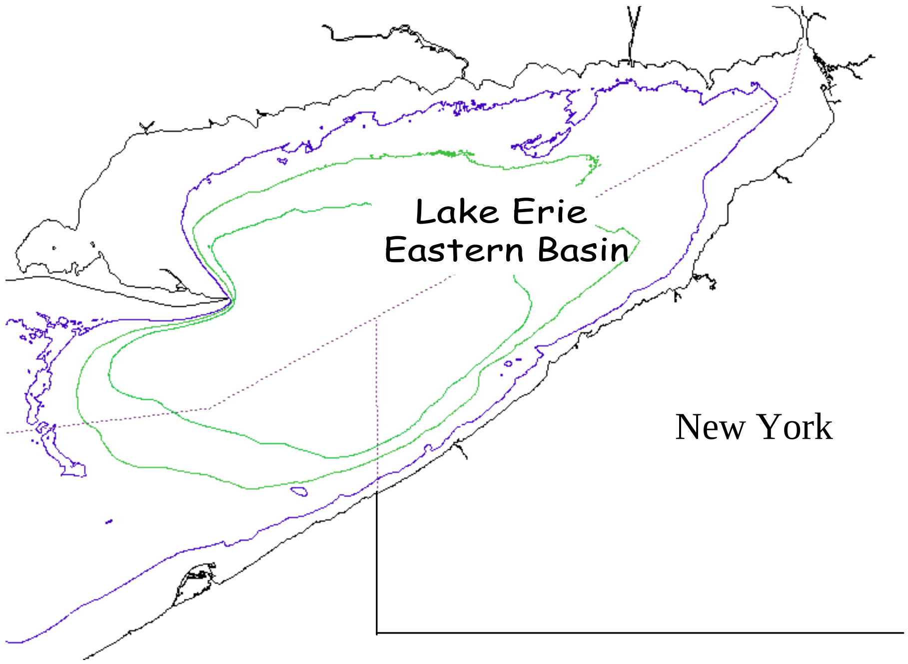
New York State
Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

NYS DEC LAKE ERIE
2012 ANNUAL REPORT

to the Lake Erie Committee
and the Great Lakes Fishery Commission



March 2013

New York State Department of Environmental Conservation
625 Broadway, Albany, New York 12233-4753

Andrew M. Cuomo, *Governor*

SPORT FISH RESTORATION

STUDIES REPORTED IN THIS DOCUMENT ARE SUPPORTED BY THE FEDERAL AID IN SPORT FISH RESTORATION PROGRAM

NYS DEC LAKE ERIE 2012 ANNUAL REPORT
to the
Lake Erie Committee

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Acknowledgments

New York's Great Lakes Fisheries Section is adeptly supervised by Steven LaPan. The Lake Erie Fisheries Unit also recognizes the contributions of seasonal staff which are essential to completing an ambitious field schedule. During the 2012 field year these individuals included Fish and Wildlife Technicians Mark Dusablon, Carrie Babcock, Jonathon Draves, Jonathan Townsend and Ann Wilcox-Swanson. We also acknowledge contributions of DEC's Chautauqua Fish Cultural Station, DEC's Region 9 Fisheries Office, and Buffalo State College's Great Lakes Center in support of various Lake Erie field activities.

Preface

The Lake Erie Annual Report is prepared by New York State Department of Environmental Conservation as a compilation of ongoing Lake Erie investigations mostly supported by Federal Aid in Sportfish Restoration. This annual report is intended as a resource document for other member agencies of the Great Lakes Fishery Commission's Lake Erie Committee, as well as information for Lake Erie's angling community and other interested stakeholders. Many initiatives reported under this cover are long term monitoring efforts which are updated each year. Other efforts may not always be updated annually if there were no new activities since the last report. In this regard, the Buffalo River Walleye Rehabilitation Summary, the Fisheries Acoustic Survey, and the Wild Steelhead Assessment Program are not reported in this year's edition. New initiatives included in this report include the Summary of the 2011-12 Tributary Angler Survey.

The summaries contained in this report are provisional although every effort has been made to insure their accuracy. We strongly encourage outside researchers to contact NYS DEC Lake Erie Unit before using or citing any specific data contained in this report.

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New York State Department of Environmental Conservation
Lake Erie Unit
Dunkirk, New York 14048

Presented at the Lake Erie Committee Meeting
Niagara Falls, New York
March 27, 2013

New York State Department of

ENVIRONMENTAL CONSERVATION

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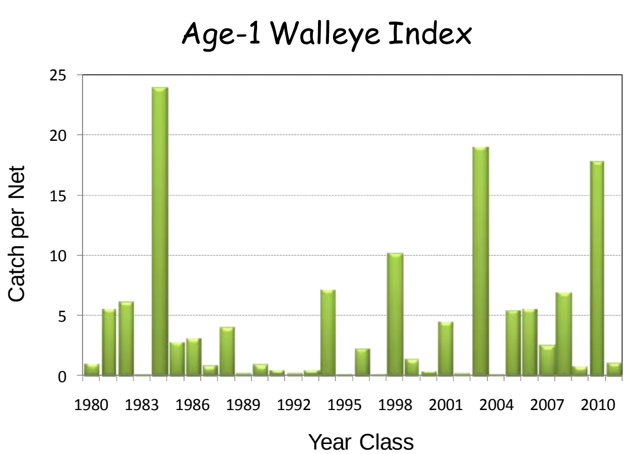
New York's 2012 Lake Erie Fisheries Program Highlights

The New York State Department of Environmental Conservation's Lake Erie Fisheries Unit is responsible for fishery research and assessment activities for one of New York's largest and most diverse freshwater fishery resources. A variety of annual programs are designed to improve our understanding of the Lake Erie fish community to guide fisheries management, and safeguard this valuable resource for current and future generations. This document shares just a few of the highlights from the 2012 program year. Our complete annual report is available on DEC's website at *http://www.dec.ny.gov/outdoor/32286.html*, or by contacting DEC's Lake Erie Unit office (contact information below).

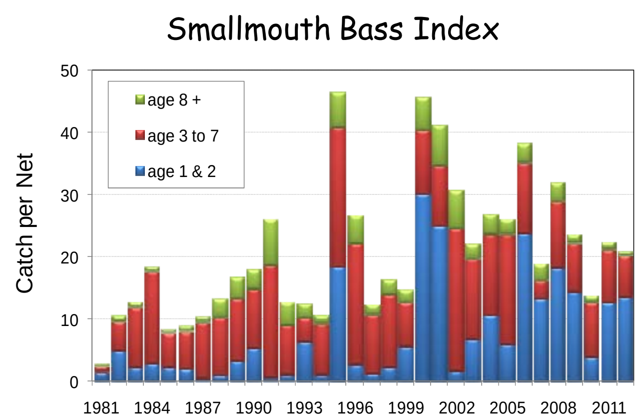
Walleye

Lake Erie's eastern basin walleye resource is composed of local spawning stocks, as well as contributions from summertime movements from western basin spawning stocks. The annual movement of western basin stocks is now well known via long-term tagging studies conducted throughout the lake. Walleye fishing quality in recent years has generally been very good and largely attributable to excellent spawning success observed in 2003. However, the dominant 2003 year class has now begun to wane. Nevertheless, walleye fishing activity and quality continues to be very good due to average to good spawning success that occurred from 2005 to 2008 and 2010. Our most recent juvenile walleye survey indicates only modest spawning success in 2011. However, overall good recruitment in recent years, especially from 2010, suggests adult walleye abundance in the eastern basin will be satisfactory over the next few years.



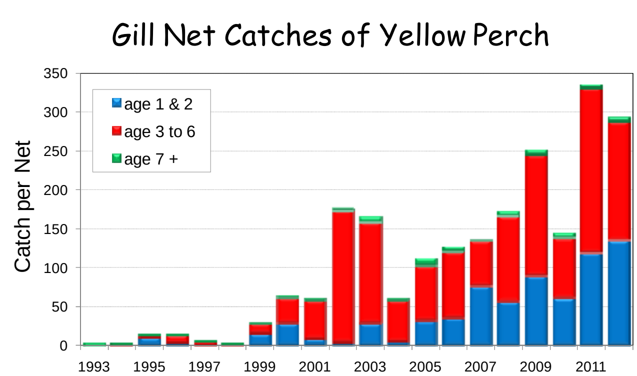
Smallmouth Bass

Lake Erie supports New York's, and perhaps the country's, finest smallmouth bass fishery. Generally stable spawning success, coupled with very high growth rates and acceptable survival, produce high angler catch rates and frequent encounters with trophy-sized fish. However, our most recent bass monitoring indicates a decline in particularly larger and older individuals. Our juvenile abundance measures indicate excellent recruitment from the 2010 year class, and we expect these age-3 fish will be a very prominent component of the fishable population in 2013.



Yellow Perch

Lake Erie yellow perch populations have experienced wide oscillations in abundance over the last 30 years, from extreme lows in the mid-1990s, to an extended recovery that has now lasted over a decade. A large adult population continues to produce good angler catch rates, especially during spring and fall seasons. Abundance of juvenile perch in trawling and gill net surveys has been high in recent years, with record-high abundance of age-1 perch observed in 2011. Overall, this pattern of recruitment suggests that higher and more stable yellow perch abundance will extend at least another few years.



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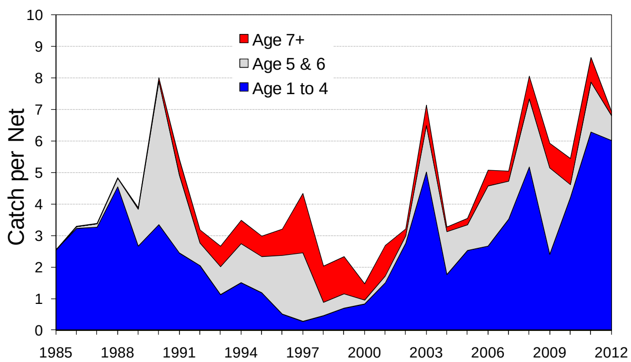
Lake Trout Restoration

Re-establishing a self-sustaining lake trout population in the eastern basin of Lake Erie continues to be a major goal of New York's Great Lakes coldwater fisheries management program. Lake trout have been stocked annually since 1978 and assessment programs monitor the status of progress. A revised lake trout rehabilitation plan was completed in 2008 and will guide future recovery efforts. Overall abundance of lake trout in the New York waters of Lake Erie remained high in 2012. The majority of the catch was young lake trout ages 1-4, mainly due to increased stocking levels over the past 5 years. Adult stocks (age 5 and older) remain at relatively low levels; survival of adults is low due to high sea lamprey predation on lake trout. Lakewide abundance estimates for all age groups still remain well below targets. Natural reproduction has not been detected in Lake Erie, and continued stocking and effective sea lamprey control are needed to build adult lake trout populations to levels where natural production is viable.

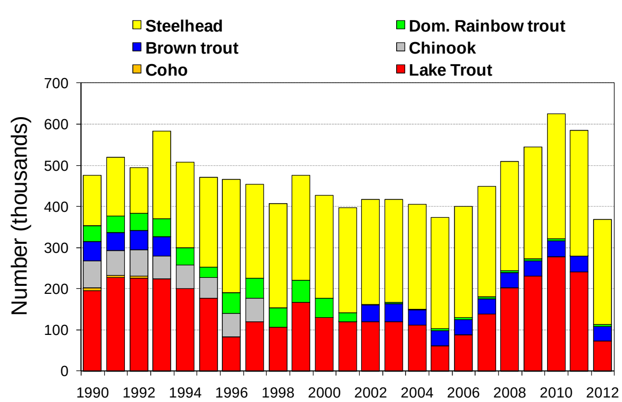
Gill Net Catches of Lake Trout



Salmonid Management

New York annually stocks approximately 270,000 steelhead and 35,000 brown trout into Lake Erie and its tributaries to provide recreational opportunities for both lake and stream anglers. Wild reproduction of steelhead also occurs which contributes to the fishery as well. Fall juvenile assessments conducted since 2001 confirmed substantial numbers of young-of-year steelhead present in many tributaries. Tributary angling for steelhead, assessed through an angler diary program, showed a sharp decline in fishing quality in 2010, but an increase in 2011. A tributary angler survey conducted during the 2011-12 fishing season on the major Lake Erie tributaries showed a 42% decline in salmonid catch rates and a 47% decline in overall catch compared to the 2007-08 survey.

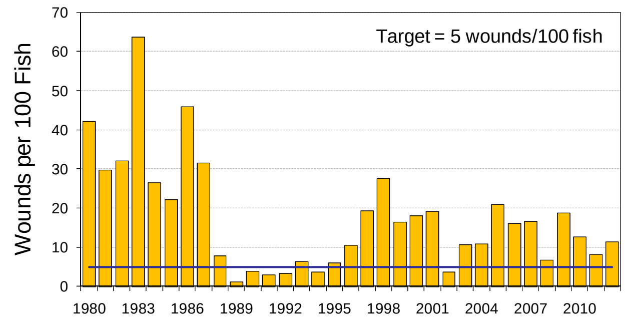
Trout & Salmon Stocking in NY



Sea Lamprey

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920s and have played an integral role in the failure of many native coldwater fish populations. Sea lamprey control in Lake Erie began in 1986 in support of lake trout rehabilitation efforts, and regular treatments are conducted to control lamprey populations. Annual monitoring consists of observations of sea lamprey wounds on lake trout and other coldwater fish species, and lamprey nest counts on standard stream sections. Wounding rates on lake trout increased in 2012 and nest counts continue to remain very high, indicative of a high sea lamprey spawning population. Surveys indicate that the consecutive lampricide treatments of all key Lake Erie tributaries in 2008 and 2009 were successful in those streams, but the sea lamprey population remains high due to an unknown source of production.

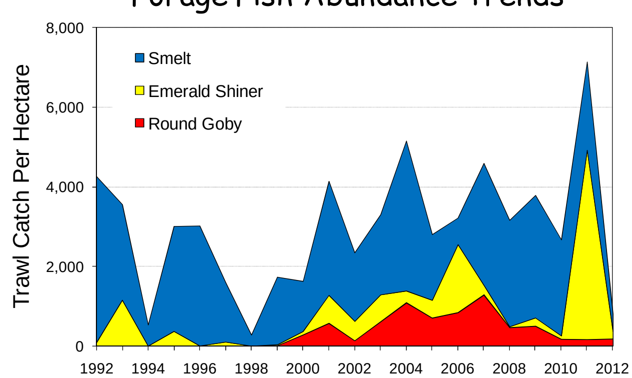
Sea Lamprey Wounding Rate
on Lake Trout >21 inches



Prey Fish

The Lake Erie Unit conducts a number of surveys to assess forage fishes and components of the lake's lower trophic ecosystem. These programs include trawl, sonar surveys of prey fishes, predator diet studies, and lower food web monitoring. A variety of prey fish surveys beginning approximately 20 years ago found rainbow smelt as the dominant component of the open lake forage fish community. Beginning in 2000, there has been a notable increase in prey species diversity accompanied by somewhat lower smelt abundance, and in some years especially high abundances of round gobies and emerald shiners were encountered in both prey fish collections and predator diets. In recent years, overall prey fish abundance trended slightly downward, particularly the contribution by gobies in trawl surveys. In 2012, emerald shiner and rainbow smelt abundance decreased sharply while gobies remained stable at lower abundance. Lower food web monitoring indicated the eastern basin was in its targeted mesotrophic status favorable for percid production. Over time we expect these investigations to be useful in furthering our understanding of factors shaping the fish community.

Forage Fish Abundance Trends



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B. RESEARCH PARTNERSHIPS

The Lake Erie Unit collaborates with investigators from other government and academic institutions to pursue a broad array of initiatives (Table B.1). The Lake Erie Unit's contribution to these partnerships usually includes vessel and staff time for field collections, and/or sharing archived data series spanning many years of standard sampling programs**.** Since 2008, the number of research partnerships has declined by 50%, in part due to staffing shortages at the Lake Erie Unit and accompanying limitations for making meaningful contributions to collaborative studies. The Lake Erie Unit remains amenable to pursuing additional partnerships to the extent such projects remain consistent with our mission, and practical for integrating any new effort with our ongoing programs.

TABLE B.1. 2012 list of active research partnerships with NYS DEC Lake Erie Unit.

Principal Investigator	**Project Name**
Adelman, D.	Assessing the sources and fates of toxic organic chemicals in Lake Superior, Erie, and Ontario
Clapsadl, M.	Lake Erie water chemistry monitoring
Coll, J.	Pathogen testing of Lake Erie salmonids
Keir, M.	Contaminant testing of Lake Erie lake trout
Maier, T. et al.	GLMRIS – Probability of ANS passage at East Mud Lake
Miner, J.	Origin and distribution of young-of-year white bass in Lake Erie
Murphy, E.	US EPA GLNPO Great Lakes Fish Monitoring Program
Riley, S., and J. Rinchard	Great Lakes lake trout thiamine monitoring
Stepien, C. et al.	Genetic stock structure of Lake Erie yellow perch and walleye spawning groups
Zhao, Y. et al.	Development of an east basin Lake Erie walleye stock assessment model

C. JUVENILE YELLOW PERCH TRAWL SURVEY

Donald W. Einhouse

Introduction

The Lake Erie Unit's long-term bottom trawling program has the principal objectives of assessing trends in abundance of juvenile yellow perch, and monitoring the status of the forage fish community. Results from this program are also merged with broader lake wide assessments of yellow perch and forage fish populations and reported with the inter-agency Forage Task Group (Forage Task Group 2013) and Yellow Perch Task Group Reports (Yellow Perch Task Group 2013). Aspects of this program that specifically describe forage status are described in more detail in Section M.

Methods

This fall trawling series was initiated in 1992 and replaced the **Juvenile Percid Assessment** conducted from 1986 to 1991 (Culligan et al. 1992). This trawling program is conducted during October at randomly selected stations between the 50- and 100-ft depth contours in New York's portion of Lake Erie. Standard tow duration is 10 minutes. Survey procedures generally follow those performed for an inter-agency, western basin Lake Erie assessment that is reported annually in Lake Erie's Forage Task Group Report (Forage Task Group 2013).

The standard gear for this trawling program is a 4-seam bottom trawl with the following characteristics:

Headrope length:	31.8 ft
Footrope length:	38.1 ft
Ground wire to doors:	60.4 ft
Trawl webbing:	2.0 inches
Twine diameter:	21 thread
Cod-end webbing:	0.4 inches

Overall standard daytime trawling effort in 2012 included 35 usable tows totaling 350 minutes (5.8 hours). This effort was distributed among stations ranging in depths between 50 ft to 100 ft. Five sample days, from October 2 to 19, completed the 2012 assessment.

Reported measures conform to a lake wide standard measurement of trawl densities as mean number per hectare (Forage Task Group 1998). A hectare is 2.471 acres. The area density is computed from known trawl fishing dimensions measured from previous calibrations and individual tow distances estimated from navigation equipment. Beginning in 2004, NYSDEC secured equipment to measure the fishing dimensions of each trawl sample. Our new monitoring capability indicates trawl wing spread is significantly wider than previously indicated by a late-1990's trawl measurement exercise. Nevertheless, for the analyses in this report we continued to apply the previous standard fishing dimensions to remain consistent with long term procedures.

Results

Summary statistics for trawl catches of 14 frequently encountered species are presented in Section M, Table M.1 of this volume. In 2012, the most abundant species encountered was rainbow smelt (comprised mostly of the age-0 life stage). Other species that made notable contributions to the trawl collections included trout-perch, yellow perch, emerald shiner and round goby.

The 2012 mean density estimate for age-0 yellow perch was higher than the average value, and the 5th highest value observed overall in the 21-year series (Table C.1). A more modest age-1 yellow perch index ranked 8th highest overall in the series, but below the long term average measure. Adult yellow perch (age 2+) abundance was well above the long term average, bolstered by a particularly abundant age-2 cohort.

TABLE C.1. CPE (number per hectare) of yellow perch collected with a 10-m bottom trawl from approximately 30 sites between 50 to 100 ft depth contours in New York waters of Lake Erie, October, 1992-2012.

	Trawl (yellow perch number per ha)		
Year	Age-0	Age-1	Age-2+
1992	10.4	2.3	9.3
1993	110.1	3.0	5.9
1994	47.7	8.4	1.0
1995	5.7	14.2	15.6
1996	106.3	0.3	7.0
1997	0.2	5.5	2.6
1998	1.5	0.2	0.5
1999	36.1	33.5	11.2
2000	23.1	6.6	27.8
2001	97.9	11.5	22.8
2002	9.3	15.5	37.0
2003	472.5	1.9	21.4
2004	1.5	28.7	60.1
2005	57.8	5.4	33.6
2006	283.2	39.9	29.0
2007	401.3	41.2	85.0
2008	1,088.3	44.3	54.9
2009	11.6	62.5	43.0
2010	192.7	4.0	38.9
2011	87.2	138.2	25.0
2012	272.9	16.3	61.0
(1992 - 2011)			
min.	0.2	0.2	0.5
max.	1,088.3	138.2	85.0
ave.	152.2	23.4	26.6

Trends in juvenile yellow perch growth rates are presented in Figure C.1. Both age-0 and age-1 yellow perch mean total length values in 2012 are near average. Growth rates for both age groups have been stable over the past seven years.

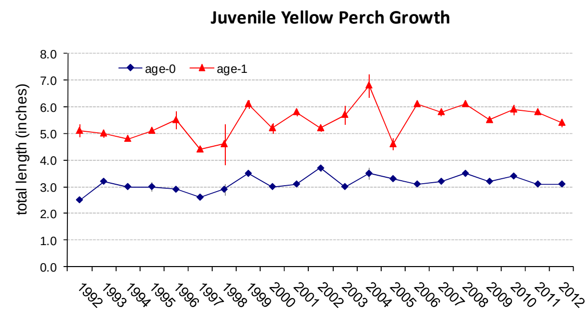


Figure C.1. Mean total length of age-0 and age-1 yellow perch collected by bottom trawl in New York waters of Lake Erie, October 1992-2012. Error Bars are 95 % confidence intervals. During 1997 only one age-0 yellow perch was collected and error bars could not be computed.

Discussion

This October trawling program continues to indicate robust yellow perch abundance relative to a period of particularly low abundance through the 1990's. These results also closely mirror findings from other Lake Erie jurisdictions and support the view that yellow perch abundance in eastern Lake Erie has rebounded and stabilized relative to the 1990's. Especially high age-1 yellow perch indices in five of the last seven years suggest favorable abundance of adult yellow perch (age-2+) will continue for the near future. These age-1 yellow perch measures correlate very well with subsequent age-2 abundance measures in this assessment, as well as those observed in the annual Warmwater Gill Net Assessment (see Section D). A broader, basin-wide summary describing yellow perch population trends is provided in the annual report of the Yellow Perch Task Group (Yellow Perch Task Group 2013).

References

Culligan, W. J., F. C. Cornelius, D. W. Einhouse, D. L. Zeller, and R. C. Zimar. 1992. 1992 Annual Report to the Lake Erie Committee. New York Department of Environmental Conservation, Albany. 52 pp.

Forage Task Group 1998. Report of the Lake Erie Forage Task Group, March 1999. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Forage Task Group. 2013. Report of the Lake Erie Forage Task Group, March 2013. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Yellow Perch Task Group. 2013. Report of the Lake Erie Yellow Perch Task Group, March 2013. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

D. Warmwater Gill Net Assessment

Donald W. Einhouse

Introduction

An annual gill net assessment of the warm water fish community represents the oldest, standard survey performed by New York's Lake Erie Fisheries Unit and 2012 marked the 32nd year of this ongoing effort. The principal objective of this September gill net survey is to produce measures of abundance, age composition and growth of walleye, smallmouth bass and yellow perch in New York's portion of Lake Erie. Walleye and yellow perch measures of abundance and age composition are also contributed to the Lake Erie Committee's (LEC) inter-agency Walleye and Yellow Perch Task Groups for broader lake wide assessment of these percid populations. A secondary objective is to monitor trends in abundance for other commonly encountered warm water fish species.

Methods

This annual, autumn gill netting survey commenced1981, and methods for conducting the program were significantly altered after 1992 to adopt a standard interagency approach to assessment of the fish community. A detailed description of current survey methods can be found in Ryan et al. 1993. As part of these current procedures, several fixed sampling stations from New York's former (< 1993) gill netting program on Lake Erie were retained to maintain continuity of a long-term data series for near shore (<50 ft) waters. Long-term catch rates presented in this report focus principally on the near shore (<50 ft) stratum, where a standard sampling strategy has been performed since 1981.

The current, overall sampling strategy for this program is a stratified, random approach with stations selected from a grid system. Both bottom and limnetic warmwater habitats were sampled with 700-ft monofilament gill nets from 1993 through 1995. Beginning in 1996, only bottom habitat has been sampled and all measures reported for this survey are for bottom gill nets. Fourteen individual gill net panels were 50 ft by 6 ft and consisted of stretch mesh sizes, ranging from 1.25 to 6.0 inches for a particular net. One minor change in gill net configuration was implemented in 2005 and thereafter by omitting the 6.0 inch mesh panel from New York's standard gill net. An examination of gill net catches from 1993 to 2004 found the 6-inch panel contributed miniscule catches for all commonly encountered species, but otherwise experienced excessive net damage. Excessive net damage to the 6.0-inch panel occurred because our interagency standard monofilament twine diameter is too weak to retain species large enough to be entangled in 6-inch stretch mesh. Beginning in 2005, New York's new configuration for a standard gill net became a 650-ft gang consisting of 13 panels ranging from 1.25 to 5.5 inches. Previous summary statistics were not re-analyzed with the deletion of 6.0-inch panel catches because separate evaluations confirmed the presence/absence of the 6.0 inch panel did not measurably change overall catch rates for all commonly encountered species.

The warm water gill net sampling period extends from September 1 until fall turnover. Target sampling effort is 40 overnight gill net sites, with four to six nets set each sample day. The 40 net target was achieved in 2012 and most other years of this survey. Nets are set between 12:00 PM and sunset and retrieved between sunrise and 12:00 noon the following day. Data from gill nets that sampled for more than 24 hours or from nets that became badly damaged, tangled, or fouled by filamentous algae or other debris are omitted from analyses used to measure abundance.

Catches from overnight sets are completely enumerated by species. Walleye, yellow perch, and smallmouth bass are examined in greater detail. These species are measured, weighed, sexed, and scales, spines or otoliths are removed for age determination. Large catches of walleye, smallmouth bass, and most often yellow perch, are sub-sampled as needed to process samples in a timely manner.

Results

Abundance measures (catch per gill net-night) for fifteen of the most commonly encountered species in the near shore component of this 32-year gill net series are reported in Table D.1. Most of these fifteen species were encountered well within observed, historic ranges of abundance. Rare catches of alewife in recent years, and stonecats for approximately a decade, are particularly noteworthy.

Walleye

The overall abundance index for walleye in 2012 was 10.0 fish per net, slightly below the long-term mean and the 21st highest observed in the history of the survey.

Table D.1. Catch rates (fish per gill net) of selected warmwater species per variable mesh gill net from near shore stations (<50 ft) in New York waters of Lake Erie, September-October, 1981-2012.

	Gill Net Index (1981-2011)			Gill Net Index 2012	
Species	min	max	mean	mean	conf. lmt.
walleye	2.1	33.1	13.8	10.0	7.7 - 12.3
smallmouth bass	2.7	46.1	21.8	25.0	21.3 - 28.7
rock bass	2.3	15.4	6.1	6.5	5.0 - 7.9
white perch	0.0	49.3	11.9	4.3	2.7 - 5.9
gizzard shad	0.8	183.7	25.5	29.7	24.7 - 34.7
redhorse	0.8	6.9	3.3	3.2	2.4 - 4.0
white sucker	0.2	9.2	2.7	1.0	0.5 - 1.6
white bass	0.0	27.3	6.9	14.4	9.0 - 19.9
drum	0.5	9.0	2.2	0.7	0.5 - 1.0
catfish	0.0	7.2	1.3	1.2	0.9 - 1.5
stonecat	0.0	3.8	0.7	0.2	0.1 - 0.3
quillback	0.0	1.5	0.5	0.4	0.2 - 0.6
carp	0.0	0.8	0.1	0.0	0.0 - 0.0
yellow perch	0.0	21.3	4.8	4.3	2.1 - 6.4
alewife	0.0	4.7	0.4	0.0	0.0 - 0.0

Walleye age distribution was dominated by age-2 individuals (58%) representing the 2010 year class (Figure D.2). However, age-0 (young-of-the-year (YOY) walleye were also regularly encountered during this survey which was notable because YOY walleye are too small to be fully vulnerable to gill nets.

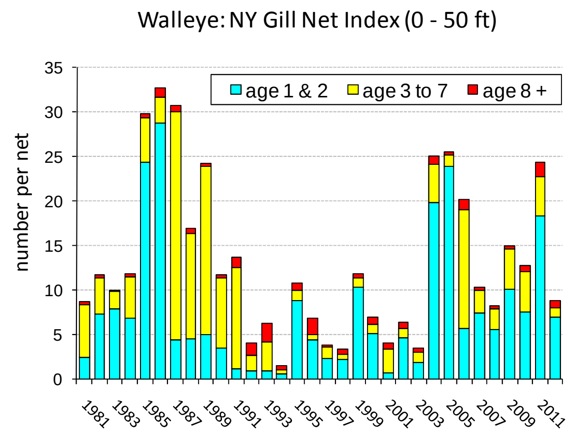


Figure D.1. Walleye catch by age category per gill net set from inshore stations (< 50 ft) in New York waters of Lake Erie, September-October, 1981 – 2012.

This gill net assessment has had a juvenile walleye emphasis since its inception, with age-1 and age-2 walleye typically comprising a large fraction of the overall walleye sample each year (Figure D.2). Offshore bottom gill net stations (Figure D.2) do not regularly encounter juvenile walleye, and adult walleye have proven difficult to sample effectively during September.

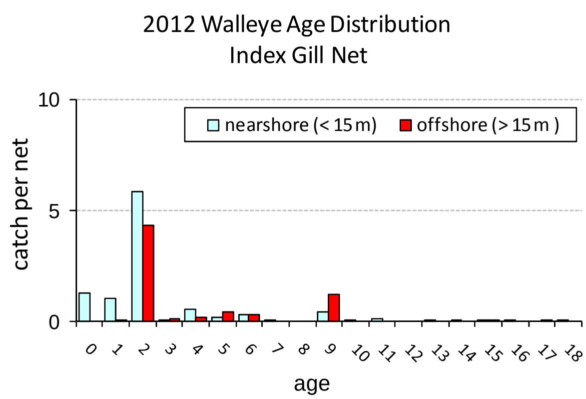


Figure D.2. Age composition of walleye collected from the New York waters of Lake Erie, September - October, 2012(15 m = 49.2 ft).

Measures of adult walleye abundance from this gill net program remain highly variable and do not provide a sensitive index of adult abundance. Yearling walleye catch rates in 2012 ranked the 2011 year class as the 18th largest recorded at 1.0 age-1 walleye per net, the established threshold for a "moderately abundant" year class. This moderate 2011 year class followed an exceptional year class in 2010. Yearling measures of at least moderate or stronger year class abundance have now been observed in each of the last seven years (Figure D.3). The last weak year class (< 1.0 fish-net) was produced in 2004, and consecutive weak year classes have not been observed since the early 1990's.

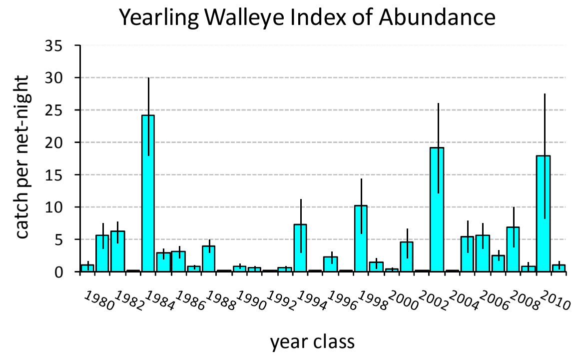


Figure D.3. Relative abundance of age-1 walleye collected from the New York waters of Lake Erie, September-October, 1981-2012.

Length-at-age trends for juvenile walleye are presented in Figure D.4. Age-1 and age-2 walleye in 2012 were slightly larger than the long-term average.

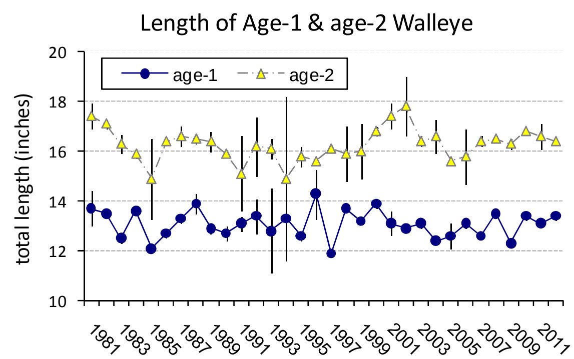


Figure D.4. Mean total length of age-1 & age-2 walleye collected form variable mesh gill nets in the New York waters of Lake Erie, September-October, 1981-2012. Error bars are 2 standard errors.

Smallmouth Bass

Smallmouth bass catch rates in 2012 were slightly above average (Table D.1, Figure D.5), ranking as the 12th highest observed catch in the series.

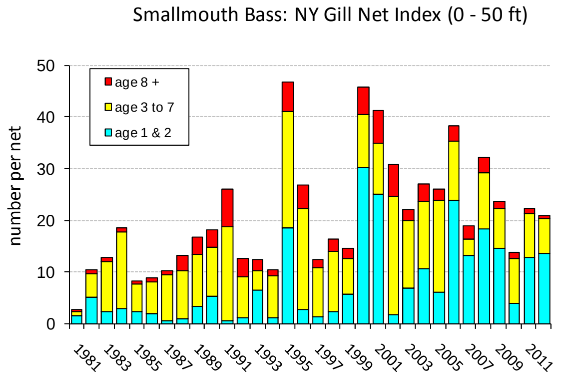


Figure D.5. Smallmouth bass catch rates by age category from inshore stations (< 50 ft) in New York waters of Lake Erie, September-October, 1981-2012.

Sub-adult smallmouth bass (age-0, age-1 and age-2) dominated the 2012 sample, which included 15 age groups from age-0 to age-14 (Figure D.6). Offshore gill nets caught notably fewer sub-adult smallmouth bass, and fewer smallmouth bass overall, than companion near shore gill nets.

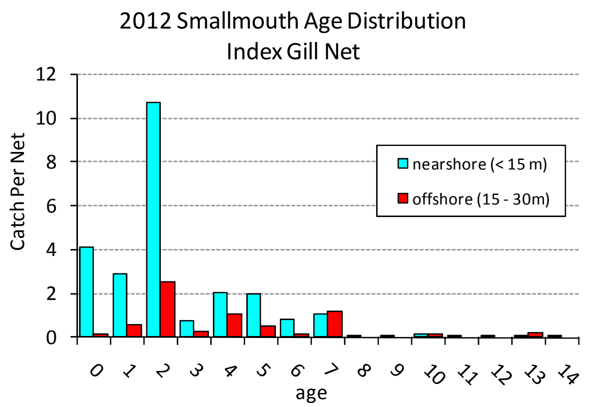


Figure D.6. Age composition of smallmouth bass collected from the New York waters of Lake Erie, September-October, 2012.

Overall smallmouth bass abundance in gill nets has remained generally stable for most of the last ten years, (Figure D.5). However, in 2010-2012 older cohorts of smallmouth bass have been less frequently encountered (Figure D.7).The greatest maximum age estimated using otoliths was an age-22 fish in 1995. Maximum ages exceeding age-15 were encountered every year from 1995 to 2009. Since adopting to otolith age determination to more accurately assess ages of older fish, the youngest maximum ages encountered were in 2010 (age-11), 2011 (age-13) and 2012 (age-14).

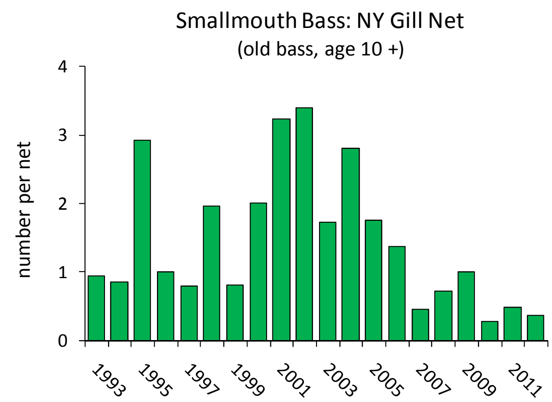


Figure D.7. Age-10 and older smallmouth bass catch rates from inshore stations (< 50 ft) in New York waters of Lake Erie, September-October, 1981-2012.

Point estimates of adult smallmouth bass survival were also computed for every year class from age-4 to age-6 for the period 1992-2006(Figure D.8). Although individual point estimates vary and the slope is not statistically significant, a slight declining trend in adult survival seems apparent.

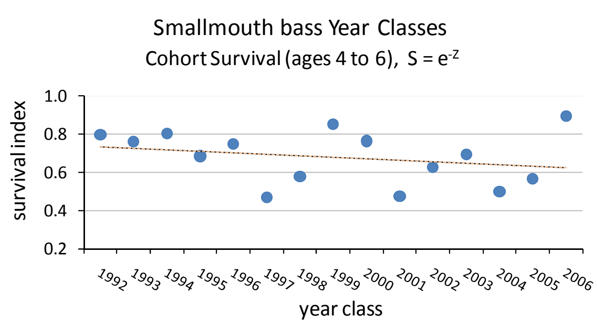


Figure D.8. Catch curve survival estimates from age-4 to age-6 for consecutive 1992 to 2006 smallmouth bass year classes encountered in standard a standard index gill net program (< 50 ft) in New York waters of Lake Erie, September, 1996-2012.

The long-term recruitment index for age-2 smallmouth bass ranks the 2010 year class well above long-term average abundance and the largest year class observed in the last 11 years (Figure D.9).

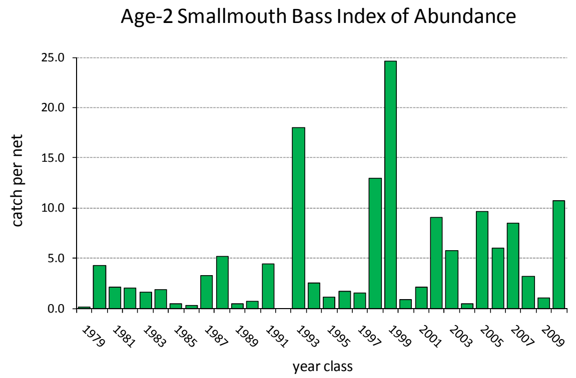


Figure D.9. Relative abundance of age-2 smallmouth bass collected from the New York waters of Lake Erie, September - October, 1981 - 2012.

Einhouse et al. (2002) related recruitment patterns of smallmouth bass in New York's portion of Lake Erie to mean summer water temperature, finding warmer than average summer water temperatures corresponded with production of larger smallmouth bass year classes. This data series has been updated annually and provides insight into one important environmental variable influencing recruitment, and is also useful for understanding potential recruitment impacts from other more recent events, such as the round goby invasion. Figure D.10 shows the highly significant (r^2 = 0.67; p<0.00001) regression of mean summer water temperature with the age-2 smallmouth bass recruitment index in the period before round goby abundance, plus ten additional plotted observations during the period round goby have been abundant in eastern Lake Erie. Nearly all observations of smallmouth bass recruitment during the period of goby abundance have been within the range expected based on summer water temperature. The most recent observation for the 2010 year class was beyond the prediction limits developed during the pre-goby period.

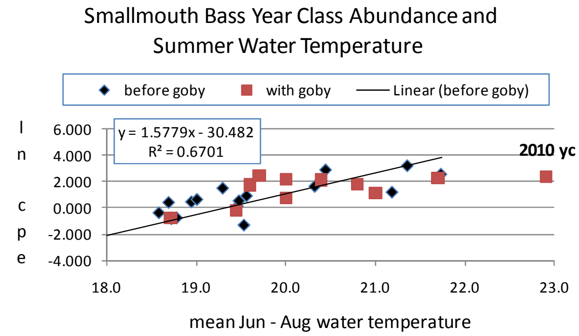


Figure D.10. Regression of the smallmouth bass age-2 abundance index with mean summer (June-September) water temperature from 1983 to 1999. Ten additional observations are plotted for the period that round goby have been abundant.

Age-2 and age-3 smallmouth bass cohorts averaged 12.1 in and 13.4 in total length, respectively. The age-2 mean total length measure in 2012 was the highest observed in the series (Figure D.11). Additionally, all of the highest measures recorded in this series were observed in recent years. Large sample sizes typically support this length analysis, with N = 274 for age-2, and N = 22 for age-3 smallmouth bass, respectively.

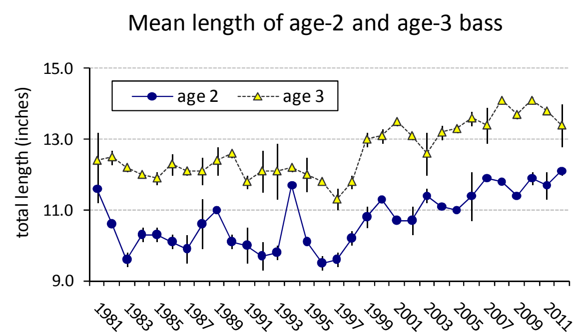


Figure D.11. Mean total length of age-2 and age-3 smallmouth bass collected from gill nets in the New York waters of Lake Erie, September-October, 1981-2012. Error bars are 95% confidence limits.

Yellow Perch

In the offshore stratum (50 to 100 ft), yellow perch were encountered at very high levels of abundance (Figure D.12). This deeper stratum has been sampled since the interagency index fishing protocol was implemented in New York, starting in 1993. Yellow perch are otherwise not encountered in high densities among the shallower (0 to 50 ft), long-term gill net locations. Very abundant age-2 and age-4 yellow perch together accounted for 75 % of the 2012 collection. The age-2 cohort (2010 year class) in 2012 was the largest sample of age-2 yellow perch since the inception of this program, and was twice as abundant as the second largest, 2007 sample. This very large 2010 year class is consistent with bottom trawl measures of yellow perch at age-1 in 2011 (see Section C). Yellow perch older than age-8 were scarce. Adult cohorts of yellow perch (age-3 to age-7) have contributed substantially to this annual sample for more than a decade (Figure D.12).

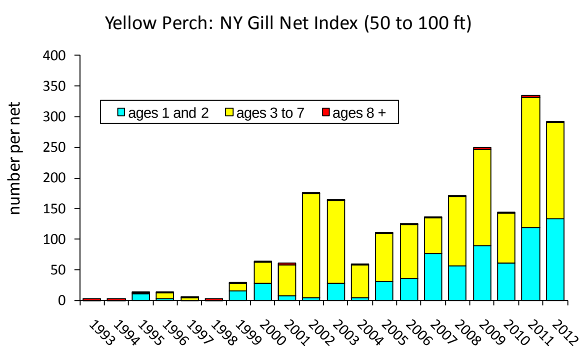


Figure D.12. Yellow perch catch rates by age category per variable mesh gill net set from sampling locations between 50 and 100 ft in New York waters of Lake Erie, September-October, 1993 - 2012.

Discussion

Overall walleye abundance in 2012 was near the long-term average, with the age-2 fish dominating the catch. As this gill netting survey is conducted in shallow, near shore regions, juvenile walleye are typically more abundant than adult walleyes in most sampling years. The index for yearling walleye (2011 year class) was a fairly low in 2012, ranking only 18th highest in this 32 year data series. Perhaps more noteworthy were frequent observations of YOY walleye in the 2012 survey, as YOY are not typically vulnerable to our survey gear.

Smallmouth bass abundance in 2012 was slightly above the long term average, with a strong 2010 year class (age-2) contributing the largest share to this sample. Standard recruitment measures suggest 2010 produced the largest smallmouth bass year class over the last decade. This observation is consistent with record high summer water temperatures in 2012, and a previous study indicating that recruitment patterns of smallmouth bass in New York's portion of Lake Erie appear to be strongly influenced by mean summer water temperature (Einhouse et al. 2002), with warmer summer water temperatures corresponding with production of larger smallmouth bass year classes. Mean summer water temperatures in 2011 were nearly 2^{o} C below average. Therefore, we have lower expectations for recruitment of the 2011 smallmouth bass year class. Most recently, summer water temperatures were much higher than average in 2012, with accompanying elevated expectations for the 2012 smallmouth bass year class.

One of the most conspicuous long term trends from our smallmouth bass data series is the measure of length-at-age for age-2 and age-3 smallmouth bass. This sub-adult smallmouth bass growth data series continues to show significantly elevated growth rates that began when round gobies became an abundant species in eastern Lake Erie. Gobies have now been abundant for over a decade in eastern Lake Erie (see Section C), which roughly corresponds to the period of elevated smallmouth bass growth rates. Presently the observed mean length of Lake Erie smallmouth bass after three and four growing seasons, respectively, exceed measures for New York's other fast growing populations by approximately 2 inches (Green et al. 1986). As such, these Lake Erie smallmouth bass growth data would ostensibly make an excellent candidate for a study of bass bioenergetics and fish community dynamics. With this, an additional signal that seems to be emerging with bass population dynamics in recent years is a relatively scarce contribution by older cohorts. Higher mortality rates are known to accompany more rapid growth rates in many fish populations and this phenomenon may now be occurring with the smallmouth bass resource in eastern Lake Erie.

The status of the yellow perch resource has improved considerably following an extended period of low abundance through the 1990's. Independent gill net and bottom trawling programs (see Section C) continue to corroborate observations of neighboring jurisdictions, and all measures agree that expanded and more stable abundance of yellow perch now occurs in the eastern Lake Erie. Excellent juvenile recruitment in recent years, coupled with a conservative harvest strategy by eastern basin jurisdictions (Yellow Perch Task Group 2012), seem to have fostered long term recovery of this resource inhabiting Lake Erie's eastern basin, the lake's least biologically productive zone.

Beginning approximately a decade ago, abundance trends for some other commonly encountered species began receiving closer scrutiny due to accompanying observations of fish kills. The species composition of those fish kills consisted largely of freshwater drum, and to a lesser extent, an assortment of benthic species, including rock bass, stonecats, and smallmouth bass. Despite those notable fish kills, we have not yet detected population level declines for freshwater drum in our gill net index. During 2005 we also observed an extensive summertime mortality of channel catfish but were unable to obtain suitable fresh samples for pathological examination. Subsequent gill net indices found channel catfish catches steadily dropped from 2004 through 2007, following progressive increases in abundance between 1999 and 2003. More recently, viral hemorrhagic septicemia virus (VHSv) has emerged in the Great Lakes as a potentially serious fish pathogen. In light of these continuing and unpredictable perturbations, long term index netting remains invaluable as a tool to quantify and understand any accompanying impacts on fish communities.

References

Einhouse, D. W., W. J. Culligan, and J. Prey. 2002. Changes in the smallmouth bass fishery of New York's portion of Lake Erie with Initiation of a spring black bass season. American Fisheries Society Symposium 31:603-614, 2002.

Green, D. M., B. L. Schonhoff, and W. D. Youngs. The New York State Bass Study 1977-1980, Use of angler Collected Data to Determine Population Dynamics. New York State Department of Environmental Conservation, Bureau of Fisheries report. April, 1986.

Ryan, P., S. Orsatti, D. Einhouse, D. Davies, R. Knight, M. Rawson, M. Turner, J. Murphy, and S. Nepszy. 1993. Interagency Protocol for Index Fishing with Gill Nets in Lake Erie. Report to the Standing Technical Committee and the Great Lakes Fishery Commission. September, 1993.

YPTG 2012. Report of the Lake Erie Yellow Perch Task Group. Presented to the Standing Technical Committee, Lake Erie Committee, and Great Lakes Fishery Commission.

E. Commercial Fishery Assessment

Donald W. Einhouse

Introduction

Since 1986 legislation prohibited the use of gill nets in New York waters of Lake Erie, a small commercial trap and hoop net fishery targeting yellow perch has remained. Three fishermen were issued licenses but only two reported commercial fishing activity during 2012.

Methods

Commercial fishermen are required to submit monthly reports summarizing daily fishing effort and catches. The standard unit of effort is the number of net lifts that occurred, irrespective of the amount of time the gear may have fished. Catches are reported as pounds harvested. Non-target species returned to the lake are not always reported. Due to increased fishing activity in the last eight years, we resumed collections of yellow perch aging structures (anal spines) beginning in 2005 to assess the age distribution of the commercial harvest. These data, along with harvest and effort totals are reported annually to the Yellow Perch Task Group (YPTG) to produce a comprehensive, basin-wide summary of yellow perch status in the eastern basin of Lake Erie (Yellow Perch Task Group 2012).

Results

Commercial landings reported by two fishermen in 2012 totaled 17,709 lbs. of yellow perch, 745 lbs. of burbot, 149 lbs. of suckers, 146 lbs. of rock bass, 83 lbs. of catfish, 78 lbs. of white perch, 16 lbs. of white bass, 4 lbs. of freshwater drum and 3 lbs. of bullhead. Yellow perch are the only species targeted by this fishery. The 2012 commercial yellow perch harvest increased 18 percent from 2011, and was the largest reported in 22 years; accompanying trap netting effort increased 12 percent (Figure E.1). The 2012 effort estimate represented a recent peak in fishing activity, but remained slightly below the mean 1986-2011 annual trap net effort. Seasonal fishing activity in 2012 extended from March through October, with the greatest yield during May; commercial fishing effort peaked in August (Table E.1).

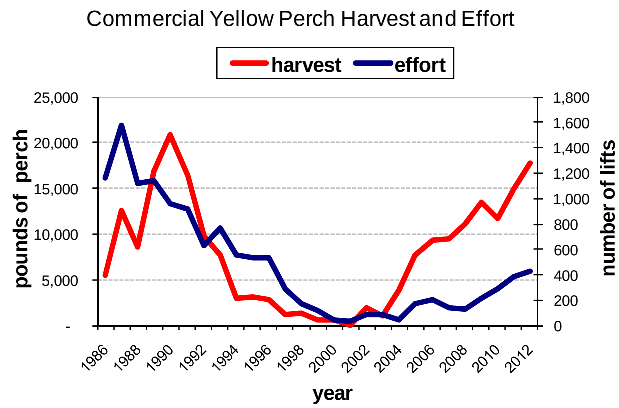


Figure E.1. Total commercial yield of yellow perch, and trap net lifts, reported by commercial fisherman operating in New York's portion of Lake Erie, 1986 to 2012.

TABLE E.1. The distribution of catch and effort of four prominent species in New York's 2012 Lake Erie commercial fishery.

	Commercial catch of four prominent species (lbs)				effort
Month	Yellow Perch	Burbot	Suckers	Rock Bass	(# of lifts)
Mar	258	10	3	1	7
Apr	2,906	50	5	2	56
May	7,520	135	8	-	86
Jun	1,700	115	7	2	50
Jul	1,833	315	110	125	68
Aug	1,696	95	12	4	96
Sep	1,342	15	2	7	43
Oct	454	10	2	5	22
total	17,709	745	149	146	428

We sampled yellow perch harvest on three occasions during periods of high commercial fishing activity in April and May to characterize the age distribution of the 2012 commercial harvest. Age determination from 150 yellow perch anal fin samples identified 8 cohorts ranged from age-3 to age-11, but age-4 through age-6 age groups comprised 82% of the sample (Figure E.2). The mean length of yellow perch from this sample was 9.6 inches and the sex ratio was strongly skewed to mature males (98% male; 2% female).

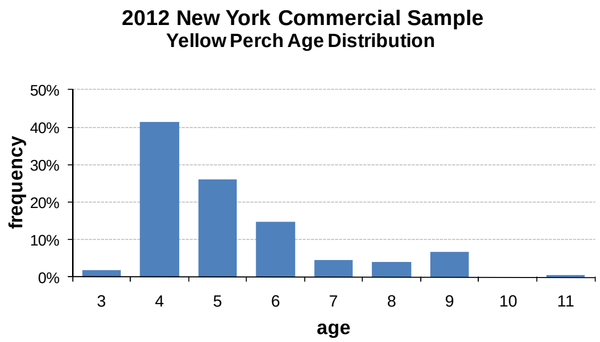


Figure E.2. Percent frequency age distribution of 150 yellow perch sampled from the commercial harvest in New York's portion of Lake Erie, April and May 2012.

Discussion

A small trap net fishery in the vicinity of Barcelona Harbor targeting yellow perch has continued since 1986 in New York's portion of Lake Erie. Commercial fishing activity increased during the most recent 8 year period (2005 to 2012), generally corresponding to a period of increased yellow perch abundance in Lake Erie's eastern basin. Despite recent increased commercial fishing activity, the recreational fishery harvest accounts for an estimated 83% of the total harvest (commercial and recreational combined) in New York's waters. Nevertheless, significant expansion of this commercial fishery is not recommended, as it would become increasingly difficult to maintain New York's long-term yellow perch harvest within internationally established limits if total allowable catches (TAC) had to be reduced sharply. In 2003, New York harvested 96 percent of its yellow perch TAC (YPTG 2012).

References

Yellow Perch Task Group. 2012. Report of the Lake Erie Yellow Perch Task Group, March 2013. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA

F. COLDWATER GILL NET ASSESSMENT

James L. Markham

Rehabilitation of a self-sustaining lake trout population in the eastern basin of Lake Erie continues to be the major thrust of New York's Great Lakes coldwater fisheries management programs, in cooperation with agencies of the Great Lakes Fishery Commission's Lake Erie Committee (LEC), the U.S. Fish and Wildlife Service (USFWS), and the Biological Research Division of USGS at Sandusky, Ohio. A lake trout management plan (Markham *et al.* 2008) was approved by the LEC in 2008 and serves as a guide for ongoing rehabilitation efforts.

New York's 2012 annual coldwater assessment program consisted of: (1) standardized deepwater gill netting in August, and (2) monitoring sea lamprey wounding activity as it impacts on lake trout (see Section G). Additional netting was conducted in November to sample the lake trout spawning population, and that assessment is reported in Section J herein.

Methods

A standardized, random transect design gill net sampling protocol has been employed to assess the lake trout population in the New York waters of Lake Erie since 1986. Sampling is conducted in August each year, following lake stratification. LORAN-C lines of position having a relative North/South orientation are used to establish 13 equidistant candidate transects in each of two areas from Dunkirk west to the New York/Pennsylvania boundary. This zone delineates summertime lake trout habitat in the New York waters of Lake Erie. Six randomly selected transects in each of the two areas are sampled each survey year. Five net gangs are fished per sampling night on each transect, yielding 60 lifts for the annual survey. However, if bias is encountered (i.e., major thermocline shift overnight), lifts are deleted and/or the entire transect may be reset another day.

On any given transect, the first net gang (#1) is fished parallel with shore (on contour), at or below the 50^{o}F isotherm. Each net gang consists of 10 randomly placed, 50 foot panels of monofilament mesh, ranging from 1.5 to 6.0 inch by 0.5 inch increments (standard mesh sizes). In 1996, additional 50 foot panels of 7.0 and 8.0 inch mesh were added to each net gang to improve collections of older-aged lake trout (Culligan *et al.* 1997). Each gang is 600 feet total length. Each of the next three successive net gangs are set on bottom along contours at increments of 5.0 feet greater depth or 0.5 miles distance from the previous gang, whichever occurs first, along the transect in a northerly (deeper) direction. The fifth gang is set 50 feet deeper than the shallowest gang (#1) or 1.0 mile distance from the fourth gang, whichever occurs first.

Data gathered from lake trout include total length, weight, sex, maturity, stomach contents, fin clips, and sea lamprey attacks. Snouts are retained from all lake trout for coded-wire tag retrieval. Otoliths are collected from any lake trout without a clip or coded-wire tag. Secondary targets (i.e. burbot, whitefish, and other salmonids) are processed using the same protocol. Otoliths and/or scales are collected from all secondary targets as needed.

Klondike strain lake trout are an offshore form from Lake Superior and are thought to behave differently than commonly stocked Lean strain lake trout. They were first stocked in Lake Erie in 2004. For assessment purposes, Klondikes are separated in most analyses to examine differences with all Lean strain lake trout. Lean strain lake trout comprise all other strains stocked, including Finger Lakes, Lake Champlain, Apostle Island, and Lewis Lake.

Results

Total standard gill net assessment of the lake trout population in New York's portion of Lake Erie in 2012 sampled 498 individuals in 60 lifts. Fourteen age classes, ranging from age 2 to 28, were represented in the sample of 443 known-age fish (Tables F.1 and F.2). Similar to 2011, ages 3, 4, and

5 were the most abundant cohorts, representing 87% of the total catch. Age 10-and-older fish remain in very low abundance. The oldest fish sampled in 2012 was a 28 year old male from the 1984 year class. This fish was in very poor condition and was the oldest lake trout ever sampled in the 28 year time series.

TABLE F.1. Number, mean total length (inches TL), mean weight (lbs.), and percent maturity of known age and sex lake trout (**Lean strain**) by age class collected in gill nets (all mesh sizes) from New York waters of Lake Erie, August 2012.

AGE	SEX	NUMBER	MEAN LENGTH (inches TL)	MEAN WEIGHT (pounds)	PERCENT MATURE
2	Male	10	16.0	1.6	0
	Female	7	16.3	1.8	14
3	Male	106	22.3	4.8	92
	Female	33	21.9	4.2	3
4	Male	61	24.6	6.2	98
	Female	24	24.5	6.2	38
5	Male	19	26.8	8.0	100
	Female	29	27.1	8.7	97
6	Male	6	27.3	8.8	100
	Female	14	28.6	10.2	100
9	Male	2	30.6	12.7	100
	Female	1	32.5	14.5	100
10	Male	1	33.0	14.4	100
	Female	1	30.8	16.7	100
11	Male	0	-----	-----	-----
	Female	1	31.1	15.6	100
12	Male	0	-----	-----	-----
	Female	1	32.7	13.8	100
18	Male	0	-----	-----	-----
	Female	1	31.9	15.2	100
19	Male	1	38.2	26.5	100
	Female	0	-----	-----	-----
25	Male	1	35.4	19.6	100
	Female	0	-----	-----	-----
28	Male	1	35.5	12.0	100
	Female	0	-----	-----	-----

TABLE F.2. Number, mean total length (inches TL), mean weight (lbs.), and percent maturity of known age and sex lake trout **(Klondike strain)** by age class collected in gill nets (all mesh sizes) from New York waters of Lake Erie, August 2012.

AGE	SEX	NUMBER	MEAN LENGTH (inches TL)	MEAN WEIGHT (pounds)	PERCENT MATURE
4	Male	65	22.4	4.6	98
	Female	23	22.7	5.0	74
5	Male	13	23.1	5.2	100
	Female	11	24.3	6.1	100
6	Male	4	24.7	6.4	100
	Female	4	24.3	6.2	100
8	Male	3	24.7	6.6	100
	Female	0	-----	-----	-----

Growth and Maturity

Mean length-at-age and weight-at-age of sampled Lean strain lake trout remains consistent with averages from the previous ten years (2002-2011) through age 12 (Figures F.1 and F.2). Variations in both mean length and weight compared to the ten year average occur at older ages and seem to be an artifact of low sample sizes. Consistent with past results, mean length and weight of Klondike strain lake trout were significantly lower than Lean strain lake trout at ages 4-and-older (two sample t-test; P<0.01). In general, Klondike strain lake trout are smaller in both length and weight at age-3+ compared to Lean strain lake trout. By age-8, Klondike strain lake trout average five inches smaller and nearly six pounds lighter than Lean strain fish.

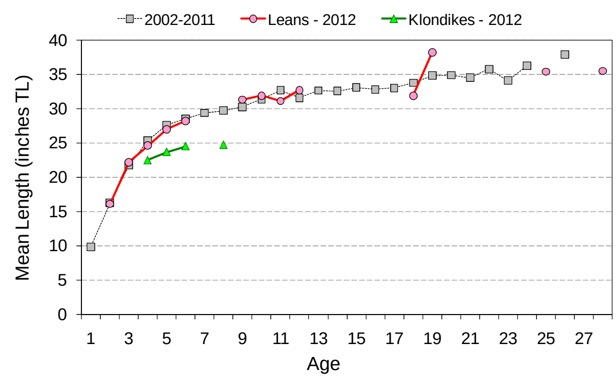


FIGURE F.1. Mean length-at-age of Lean strain and Klondike strain lake trout collected in gill nets from New York waters of Lake Erie, August 2012, and the 10-year average from 2002-2011 for current growth rate comparison.

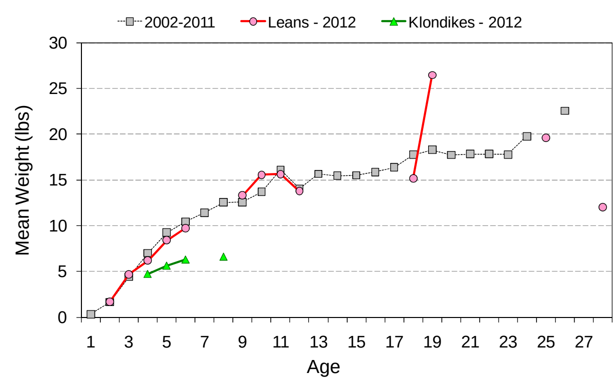


FIGURE F.2. Mean weight-at-age of Lean strain and Klondike strain lake trout collected in gill nets from New York waters of Lake Erie, August 2012, and the 10-year average from 2002-2011 for current growth rate comparison.

Lean strain lake trout males are nearly 100% mature by age-4, and females by age-5 (Table F.1). Despite differences in growth, Klondike strain lake trout have similar maturity schedules to Lean strain fish in Lake Erie (Table F.2).

Overall Abundance

The relative abundance of lake trout caught in long term standard size meshes of 1.5 - 6.0" was 7.8 lake trout/lift in 2012 (Figure F.3). This represents a 23% decrease from 2011, but remains high for the time series. This was the seventh consecutive year that lake trout abundance was above the time series average of 4.5 fish/lift. Overall abundance in New York was near the lake trout management plan objective of 8.0 fish/lift, but basinwide abundance estimates remain well below target (Markham *et al.* 2008; Coldwater Task Group 2012).

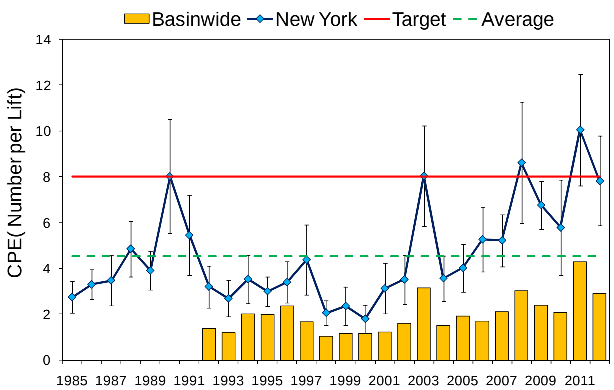


FIGURE F.3. Catch per effort (number fish/lift) and confidence limits (approximated as 2 SE's) of lake trout caught in standard assessment gill nets (mesh sizes 1.5 – 6 in) from New York waters of Lake Erie, August 1985-2012. Basinwide abundance, target basinwide abundance, and NY series average are also shown.

The burbot abundance index in 2012 was 0.8 fish/lift, which was a 34% decrease from the 2011 estimate and below the time series average of 2.1 fish/lift for the fourth consecutive year (Figure F.4). This was the lowest measure of burbot abundance in this survey since 1987. Burbot abundance has declined 83% since its' peak in 2004.

Whitefish catches continue to be highly variable in this survey (as depicted by large confidence limits), both between years and within years. Whitefish abundance increased in 2012 to 3.2 fish/lift (Figure F.5). This was the first increase since 2007. The 2012 abundance estimate was slightly higher than the time series average of 2.7 fish/lift. Other notable

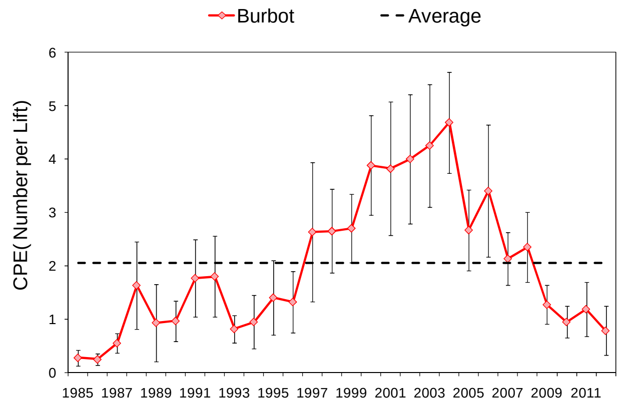


FIGURE F.4. Catch per effort (number fish/lift) and confidence limits (approximated as 2 SE's) of burbot caught in standard assessment gill nets (mesh sizes 1.5 – 6 in) from New York waters of Lake Erie, August 1985-2012. Dashed line indicates time series average.

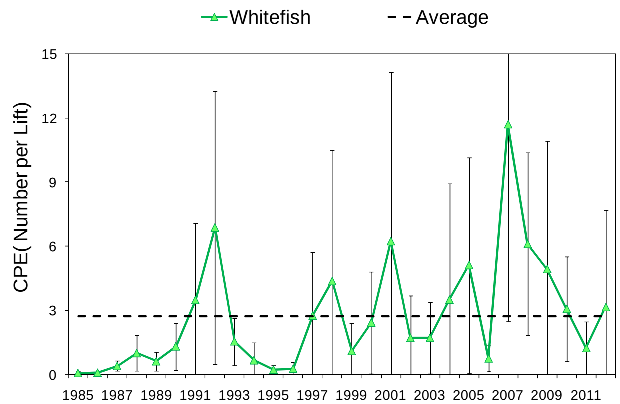


FIGURE F.5. Catch per effort (number fish/lift) and confidence limits (approximated as 2 SE's) of whitefish caught in standard assessment gill nets (mesh sizes 1.5 – 6 in) from New York waters of Lake Erie, August 1985-2012. Dashed line indicates time series average.

species caught during the survey included 1 steelhead, 8 brown trout, 56 yellow perch, and 46 walleye.

Abundance by Age

The relative abundance of lake trout by age illustrates higher abundance of sub-adult cohorts (< age-5) and relative absence of cohorts older than age-6 (Figure F.6). Similar patterns of younger age-classes dominating the catches have occurred since 2002 with a rapid decline beginning at age-5 and very low abundance by age-10 or younger. Since 1997, the abundance of lake trout age-7-and-older has shown steady decline, and with the exception of 2008 and 2009 has remained at low levels since 2004 (Figure F.7).

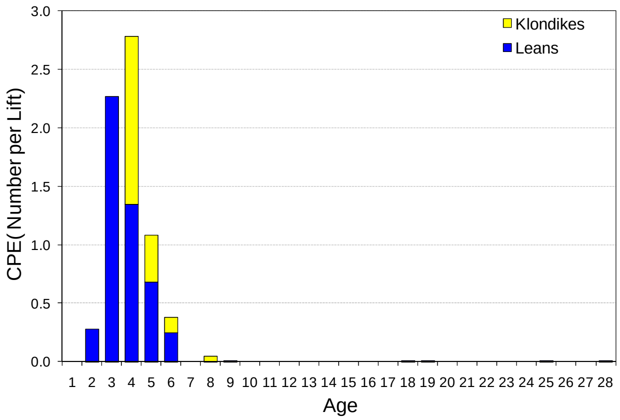


FIGURE F.6. Relative abundance by age of Lean strain and Klondike strain lake trout collected from standard assessment gill nets fished in New York waters of Lake Erie, August 2012. A lift consists of ten 50 foot panels of variable mesh size (1.5 - 6 in).

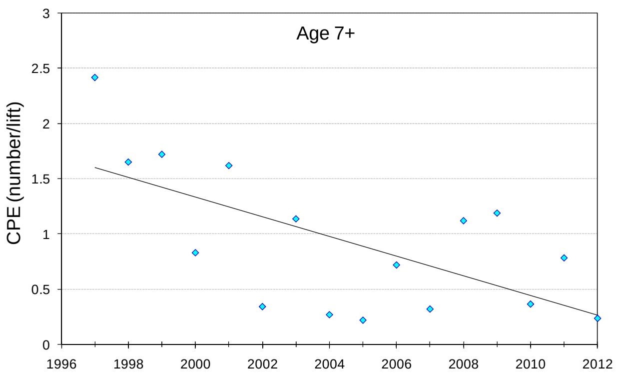


FIGURE F.7. Relative abundance of age 7 and older lake trout collected from assessment gill nets fished in New York waters of Lake Erie, August 1997-2012.

Adult Abundance

The relative abundance of age-5-and-older lake trout in the New York waters of Lake Erie decreased in 2012 to 1.6 fish/lift (Figure F.8). This represents a 33% decrease from 2011 but is near average (1.7 fish/lift) for the time series. Adult abundance in New York waters was below the objective of 2.0 fish/lift established in the lake trout management plan (Markham *et al.* 2008). Overall basinwide adult abundance remains below target levels (Coldwater Task Group 2012).

The catch per lift (CPE) of mature females >4500g in Lake Erie, representing mature, repeat spawning fish, was 0.23 fish/lift in 2012 (Figure F.9). This represented a 26% decrease over 2011 estimates, and remains below the time series average of 0.34 fish/lift. Both New York and basinwide abundance of mature females >4500g remain below the target of 0.50 fish/lift established in the lake trout

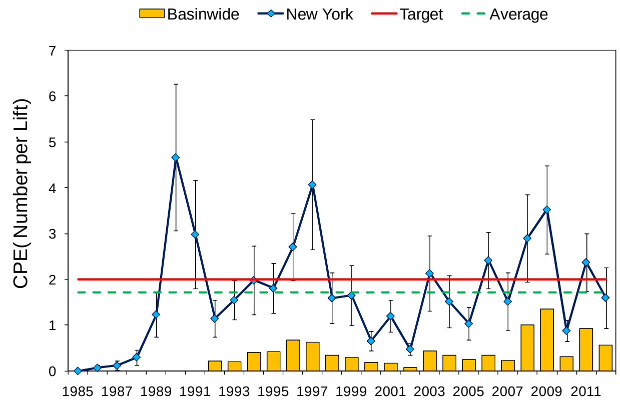


FIGURE F.8. Relative abundance of age-5–and-older lake trout collected from standard assessment gill nets fished in New York waters of Lake Erie, August 1985-2012. A lift consists of ten 50 foot panels of variable mesh size (1.5 - 6 in). Confidence intervals are approximated as 2 SE's. Basinwide abundance, target basinwide abundance, and NY series average are also shown.

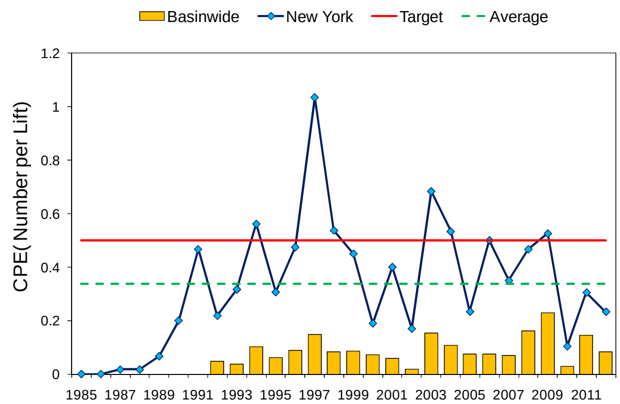


FIGURE F.9. Relative abundance of all mature females >4500g from standard assessment gill nets (mesh sizes 1.5 – 6 in) in New York waters of Lake Erie, August 1985–2012. Basinwide abundance, target basinwide abundance, and NY series average are also shown.

management plan (Markham *et al.* 2008, Coldwater Task Group 2012).

Stocking Performance

Stocking success is measured by the recruitment of age-2 fish. Lake trout that have survived from stocking to age-2 have adapted to the lake environment and have sufficiently grown out of vulnerability to most lake predators. Abundance at age-2 is dependent on both the numbers of fish stocked and their survival post-stocking. 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. Therefore, the SP index can be used to directly compare survival of stocked fish to age-2 between years without confounding effects from differing stocking totals.

The SP index decreased for the second consecutive year to 0.12 in 2012 (Figure F.10). This was below the time series average of 0.33 for the third time in the past four years. While the SP index is below average, actual age-2 abundances have remained high over the past five years due to the high numbers of fish stocked annually during this time period (Figure F.10).

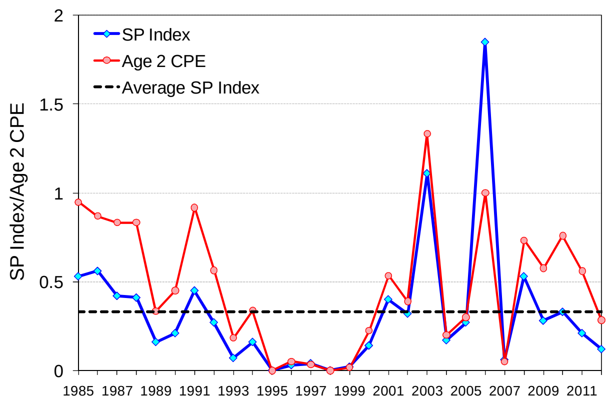


FIGURE F.10. Stocking Performance (SP) index and age-2 CPE for lake trout caught in standard assessment gill nets from New York waters of Lake Erie, August 1985-2012. The SP index is equal to the number of age 2 fish caught per lift for every 100,000 yearling lake trout stocked.

Survival

Estimates of annual survival (S) for individual cohorts 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. Survival estimates prior to 1986 are low due to excessive mortality from a large, untreated sea lamprey population. Dramatic increases in lake trout survival occurred following the first successful treatments of sea lamprey in Lake Erie in 1986. Survival estimates during this period (1987-91) ranged from 0.79 for the Superior (SUP) strain to 0.83 for the Finger Lakes (FL) strain (Table F.3).

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 0.23-0.44 (Table F.3). Survival estimates from the 1996, 1997, and 1999-2002 FL strain are much higher, but were generated from very low returns. More recent estimates from the 2003 year class of FL strain indicate lower survival rates. All recent survival estimates are below the ranges previously observed for these strains during the period of successful lamprey control. Preliminary estimates of the 2003 and 2004 year classes of Klondike (KL) strain fish indicate very low survival rates at adult ages that are comparable to survival rates of SUP strain lake trout from the 1997-2001 year classes. Mean overall survival estimates were above the target of 60% or higher (Lake Trout Task Group 1985; Markham *et al.* 2008) for Lake Erie (LE), Lake Ontario (LO), and FL strains but below target for the Lewis Lake (LL), SUP, and KL strains. The Finger Lakes strain, the most consistently stocked lake trout strain in Lake Erie, had an overall mean survival estimate of 0.74.

TABLE F.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, 1985–2012. 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 5-10 (FL 2002), 5-9 (FL 2003, KL 2003), or 4-8 (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	0.76	
2000				0.438	0.769	
2001				0.225	0.696	
2002*					0.712	
2003*					0.495	0.293
2004*						0.311
MEAN	**0.788**	**0.810**	**0.592**	**0.575**	**0.738**	**0.302**

Strains

Eight different lake trout strains were among the 439 fish caught with hatchery-implanted coded-wire tags (CWT's) or fin-clips (Table F.4). Lake Champlain (LC), KL, and FL strains remain the most numerous strains caught in Lake Erie in 2012. Lake Champlain strain have been the most stocked lake trout in Lake Erie in the past four years, and catches are just beginning to increase as they grow older and become more vulnerable to the sampling gear. Klondike strain lake trout have only been stocked in low amounts for five of the last nine years while FL strain has been the most numerous and consistent strain stocked (see Section H, Figure H.2). All other Lean lake trout strains (LL, Slate Island (SI), Traverse Island (TI), Apostle Island (AI), Michipocoten (MIC) remain minor contributors to the Lake Erie population. Superior (SUP) strain lake trout, also commonly stocked and the most prevalent strain only a few years ago, have been declining for several years and none were caught in 2012. The FL strain remains the most prevalent lake trout strain caught at older ages; all but three lake trout age-7-and-older were FL strain fish.

TABLE F.4. Number of lake trout per stocking strain by age collected in gill nets from New York waters of Lake Erie, August 2012. Stocking strain codes are: FL = Finger Lakes, SUP = Superior, KL = Klondike, LL = Lewis Lake, SI = Slate Island, TI = Traverse Island, AI = Apostle Island, LC = Lake Champlain, LE = Lake Erie, and MIC = Michipocoten. Shaded cells indicate cohorts with a stocking history.

AGE	FL	SUP	KL	LL	SI	TI	AI	LC	LE	MIC
1										
2					1			15		
3					2			131		5
4	39		88	2	4		19	21		
5	48		24							
6	17		8			3				
7										
8			3							
9	3									
10	2									
11	1									
12	1									
13										
14										
15										
16										
17										
18	1									
19	1									
20										
21										
22										
23										
24										
25	1									
26										
27										
28	1									
TOTAL	113	0	123	2	7	3	19	167	0	5

Diet

Stomach analysis of sub-adult and adult lake trout and burbot revealed diets exclusively comprised of fish in both species (Table F.5). Rainbow smelt have been the long-term main prey item for lake trout, but round gobies have become more prominent in recent years, especially when smelt are less abundant. Klondike strain lake trout have shown a higher preference for round gobies compared to lean lake trout strains (Einhouse *et al.* 2010).

In 2012, rainbow smelt was the dominant diet item in both Lean (92%) and Klondike (77%) strain lake trout (Table F.5). Round gobies were the second most common prey item, occurring more frequently in Klondike (18%) strain lake trout than Lean (9%) strain fish. Gizzard shad and emerald shiners were the only other identifiable fish species in lake trout stomachs in 2012.

TABLE F.5. Frequency of occurrence of diet items from non-empty stomachs of lake trout and burbot collected in gill nets from New York waters of Lake Erie, August 2012.

PREY SPECIES	Lean Lake Trout (N=186)	Klondike Lake Trout (N=61)	Burbot (N=27)
Smelt	171 (92%)	47 (77%)	13 (48%)
Round Goby	16 (9%)	11 (18%)	20 (74%)
Gizzard Shad	11 (6%)	7 (11%)	1 (4%)
Emerald Shiner		4 (7%)	
Unknown Fish	5 (3%)	2 (3%)	2 (7%)
Number of Empty Stomachs	146	44	19

Similar to Klondike strain lake trout, burbot stomachs had a higher incidence of round gobies, except during years when smelt are in high abundance. Consistent with that trend, round gobies were the most abundant prey species for burbot in 2012, occurring in 74% of burbot stomachs (Table F.5). Rainbow smelt were the only other prey item of significance, occurring in 48% of the burbot samples. Gizzard shad were the only other identifiable prey item in burbot stomachs.

Discussion

Despite a decline in 2012, the lake trout abundance index remained very high relative to the 28-year time series in the New York waters of Lake Erie. Relative abundances by age and metrics of age-5-and-older lake trout and mature females, however, indicate that the bulk of the population remains in young, pre-spawn fish. The combination of higher stocking rates since 2008 (see Section H) and good survival of stocked fish was likely responsible for the increased overall abundance index. However, very poor survival of lake trout at adult ages (age-5-and-older) has effectively negated transferring these gains to the adult spawning stock.

Mortality estimates indicate poor survival of various strains of adult lake trout since the 1997 year class. The lower survival estimates coincide with an increase in the Lake Erie sea lamprey population in 1997 (see Section G). Lake trout strains from Lake Superior, which include Superior and Klondike strains, continue to perform the poorest and appear to be more susceptible to attacks from sea lampreys than other strains from outside Lake Superior (i.e. FL strain) (Schneider *et al.* 1996). Klondike strain lake trout, which were in high abundance due to excellent post-stocking survival, have declined rapidly at adult ages. Adult survival estimates for this strain are very low (0.29 – 0.31). Likewise, Superior strain lake trout, which are no longer stocked in Lake Erie, had an average survival rate of 0.36 (range 0.23 – 0.44) for year classes stocked from 1997 – 2001. Comparatively, FL strain lake trout during this same time period had an average survival rate of 0.77 (range 0.70 – 0.85). The Lake Erie lake trout rehabilitation plan recommends a diversity of lake trout strains for successful re-establishment of lake trout stocks (Markham *et al.* 2008). However, with Lake Erie's continuing sea lamprey issues, it now appears most appropriate to eliminate stocking strains that are most susceptible to sea lamprey mortality as adults despite their favorable performance at younger ages. Instead, strains that survive sea lamprey attacks or avoid them altogether, such as the FL strain, should be emphasized to provide the best opportunity for re-establishment.

References

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.

Culligan, W. J., F. C. Cornelius, D. W. Einhouse, D. L. Zeller, R. C. Zimar, B. J. Beckwith, and M. A. Wilkinson. 1997. NYSDEC Lake Erie 1997 Annual Report to the Lake Erie Committee. New York Department of Environmental Conservation, Albany.

Einhouse, D.W., J.L. Markham, K.A. Kapuscinski, M.L. Wilkinson, M.T. Todd, D.L. Zeller, R.C. Zimar, and B.J. Beckwith. 2010. NYSDEC Lake Erie 2009 Annual Report. New York State Department of Environmental Conservation, Albany, New York, USA.

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

Markham, J., A. Cook, T. MacDougall, L. Witzel, K. Kayle, C. Murray, M. Fodale, E. Trometer, F. Neave, J. Fitzsimons, J. Francis, and M. Stapanian. 2008. A strategic plan for the rehabilitation of lake trout in Lake Erie, 2008-2020. Lake Erie Committee, Great Lakes Fisheries Commission, Ann Arbor, MI. Available at http://www.glfc.org/lakecom/lec/LEC_docs/other_docs/manplan2008.pdf [accessed 14 January 2008]

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

G. SEA LAMPREY ASSESSMENT

James L. Markham

Sea lamprey invaded Lake Erie and the Upper Great Lakes in the 1920's with the opening of the Welland Canal connecting Lakes Erie and Ontario. Although not totally to blame for the ultimate demise of the lake trout population in Lake Erie, sea lamprey undoubtedly played an integral part in the eventual failure of the original stocks. The Strategic Plan for Lake Trout Restoration in Eastern Lake Erie formulated in 1985 (Lake Trout Task Group 1985a) pointed to the lack of lamprey treatment as a bottleneck for re-establishment of a lake trout population. The Sea Lamprey Management Plan for Lake Erie (Lake Trout Task Group 1985b) followed with a set of goals to achieve lamprey control. Since 1986, the Great Lakes Fisheries Commission has conducted regular lampricide treatments of key Lake Erie tributaries to control lamprey populations and the damage they inflict on the Lake's coldwater fish community. More recently, as part of a two year experiment designed to reduce the number of sea lampreys in Lake Erie to target levels of abundance, nine major sea lamprey producing tributaries (5 US; 4 ON) were treated with lampricide for two consecutive years (2008 and 2009). Results of this experiment were expected to be evident beginning in 2010.

Methods

Lake trout are the only Lake Erie salmonine species used for sea lamprey wounding assessments due to availability throughout the Great Lakes and vulnerability to sea lamprey attacks. More recently, sea lamprey wounds on burbot are also reported due to their population decline. Samples are obtained from deepwater gill net assessments targeting lake trout, burbot and other coldwater species during August along New York's portion of Lake Erie from Dunkirk westward to the New York/Pennsylvania boundary.

Sea lamprey wounds on lake trout are classified as A1-A4 for evidence of active feeding and as B1-B4 wounds for non-active feeding, according to King and Edsall (1979). Standard wounding frequencies on lake trout are reported as the number of fresh (A1-A3) wounds per 100 fish. A1 and A4 wounds, specifically, are also reported as evidence of the current and previous year's wounding, respectively. Data are tabulated using lake trout total length (TL) categories: 17-21 inches, 21-25 inches, 25-29 inches, and fish greater than 29 inches. Burbot wounding rates are reported for fresh (A1-A3) and A4 wounds on all individuals.

Sea lamprey nest counts are conducted annually between June 1 and June 15 on standard sections of four streams: Delaware Creek, Clear Creek, North Branch of Clear Creek, and Canadaway Creek. Nest counts begin following peak adult lamprey catches in portable assessment traps operated on Cattaraugus Creek at the base of Springville Dam and at Spooner Creek under contract with the U.S. Fish and Wildlife Service. All Clear Creek count sites are located on Seneca Nation of Indian Territory, and activities there are conducted with permission of the Seneca Nation.

Results

A total of 50 A1-A3 wounds were observed on 444 lake trout greater than 21 inches TL in 2012, resulting in a wounding rate of 11.3 wounds per 100 fish (Table G.1; Figure G.1). This was an increase from the 2011 wounding rate of 8.2 wounds/100 fish. Wounding remains above the target rate of 5 wounds per 100 fish (Lake Trout Task Group 1985b), and has been for 17 of the past 18 years.

TABLE G.1. Frequency of sea lamprey wounds observed on several standard length groups of lake trout collected from gill nets in New York waters of Lake Erie, August 2012.

Size Class Total Length (inches)	Sample Size	Wound Classification				No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
		A1	A2	A3	A4		
17-21	41	1	0	0	5	2.4	12.2
21-25	313	6	3	25	71	10.9	22.7
25-29	110	2	1	6	63	8.2	57.3
>29	21	2	1	4	43	33.3	204.8
>21	444	10	5	35	177	11.3	39.9

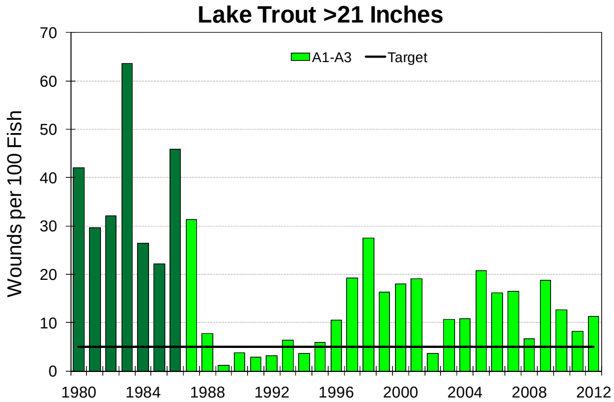


FIGURE G.1. Number of fresh (A1-A3) sea lamprey wounds per 100 adult lake trout greater than 21 inches sampled in gill nets from New York waters of Lake Erie, August - September, 1980-2012. The target wounding rate is ≤5%. Darker bars indicate pre-treatment period.

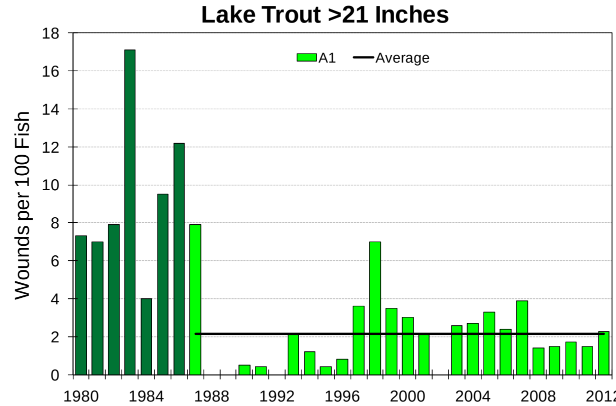


FIGURE G.2. Number of A1 sea lamprey wounds per 100 adult lake trout greater than 21 inches sampled in gill nets from New York waters of Lake Erie, August - September, 1980-2012. The post-treatment average includes 1987 through 2011. Darker bars indicate pre-treatment period.

Typically wounding rates tend to increase with increasing size class, with the highest wounding rates on lake trout >29 inches. In 2012, the >29 inch size class had the highest wounding rate (33.3 wounds/100 fish) (Table G.1). However, the 21-25 inch size class had a higher wounding rate (10.9 wounds/100 fish) than the 25-29 inch size class (8.2 wounds/100 fish). Lake trout smaller than 21 inches rarely show signs of attacks from sea lampreys, but one A1 and five A4 wounds were evident on this size class in 2012.

Fresh A1 wounds are considered indicators of the attack rate for the current year at the time of sampling (August). Ten A1 wounds were found across all size categories >21 inches in 2012; one A1 wound was also found on one lake trout <21 inches as well (Table G.1). The A1 wounding rate in 2012 was 2.3 wounds/100 lake trout greater than 21 inches (Table G.1; Figure G.2). This represents a slight increase in A1 wounding compared to 2011 (1.5 wounds/100 fish). A1 wounding rates were relatively steady over the previous four years but rose above the time series average of 2.14 wounds/100 fish for the first time since 2007.

Previous year's cumulative attacks are indicated by A4 wounds. Altogether 177 A4 wounds were found on 444 lake trout >21 inches in 2012, resulting in a wounding rate of 39.9 wounds/100 fish (Table G.1). A4 wounding rates decreased for the third consecutive year, but remained above the time series average of 29.6 wounds/100 fish for the eighth consecutive year (Figure G.3). Similar to past surveys, the highest A4 wounding rates were found on lake trout greater than 25 inches TL (Table G.1). A4 wounding rates on lake trout >29 inches TL remain very high (204.8 wounds/100 fish) with many fish possessing multiple wounds from previous attacks.

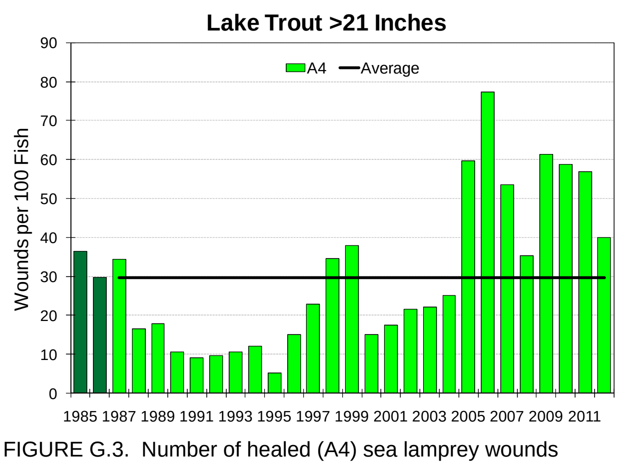


FIGURE G.3. Number of healed (A4) sea lamprey wounds observed per 100 adult lake trout greater than 21 inches sampled in gill nets from New York waters of Lake Erie, August, 1985-2012. The post-treatment average includes 1987 through 2011. Darker bars indicate pre-treatment period.

Lake Champlain (LC), Finger Lakes (FL) and Klondike (KL) strain lake trout were the most prevalent strains sampled and accounted for the majority of the fresh (A1-A3) and healed (A4) sea lamprey wounds observed in 2012 (Table G.2). Similar to the last two years, A1-A3 wounding rates were higher on Klondike strain lake trout while A4 wounding rates were highest on Finger Lakes strain fish. A1-A3 and A4 wounding rates were also very high on Apostle Island (AI), Slate Island (SI) and Traverse Island (TI) strain lake trout despite low sample sizes.

TABLE G.2. Frequency of sea lamprey wounds observed on lake trout >21 inches, by strain, in New York waters of Lake Erie, August 2011.

Lake Trout Strain	Sample Size	Wound Classification A1	A2	A3	A4	No. A1-A3 Wounds Per 100 Fish	No. A4 Wounds Per 100 Fish
AI	19	3	0	4	11	36.8	57.9
FL	115	3	1	6	74	8.7	64.3
KL	113	1	3	16	30	17.7	26.5
LC	133	2	1	2	28	3.8	21.1
LL	2	0	0	0	2	0.0	100.0
MIC	5	0	0	0	2	0.0	40.0
SI	5	0	0	2	2	40.0	40.0
TI	3	0	0	2	7	66.7	233.3

Burbot, once the most abundant coldwater predator, have declined to one-fifth of peak abundance observed in 2004 across the eastern basin of Lake Erie (See Section F). Coincidentally, both A1-A3 and A4 wounding rates on burbot have increased since 2004 in the New York waters of Lake Erie. In 2012, fresh A1-A3 wounding rates on burbot decreased to 4.3 wounds/100 fish while the A4 wounding rate increased to 14.9 wounds/100 fish (Figure G.4). Despite the decline, the A1-A3 wounding rate was the fourth highest in the 12 year time series while the A4 wounding rate was the second highest.

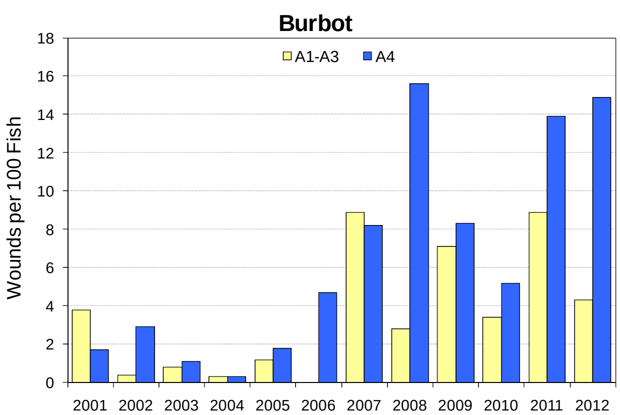


FIGURE G.4. Number of A1-A3 and A4 sea lamprey wounds per 100 burbot (all sizes) sampled in gill nets from New York waters of Lake Erie, August, 2001-2012.

Sea lamprey nest counts were conducted slightly earlier (30 May) in 2012 due to unseasonably warm and dry stream conditions. The overall index for sea lamprey nesting was 73.0 nests/mile (Figure G.5). This index was similar to the 2011 nesting rate of 76.1 nests/mile, and well above the post-treatment time series average of 20.0 nests/mile. This also represents the third highest nest count in the time series and the second highest nest count in the post-treatment era (1987 to present). Large numbers of nests were found on Clear Creek (386 nests; 96.5 nests/mile) and North Branch Clear Creek (37 nests; 74.0 nests/mile), both tributaries to Cattaraugus Creek (Table G.3). Clear Creek remains a major sea lamprey spawning stream despite continued treatments. High numbers were also found on Canadaway Creek (22 nests; 27.5 nests/mile), but none were found on Delaware Creek. Nesting rates on Clear Creek, N. Branch Clear Creek, and Canadaway Creek were all above their respective five year and time series averages (Table G.3). Supplemental sea lamprey nest counts were also performed on Chautauqua Creek on 5 June 2012, and six sea lamprey nests were found in a 1.1 mile section of the stream below the dams.

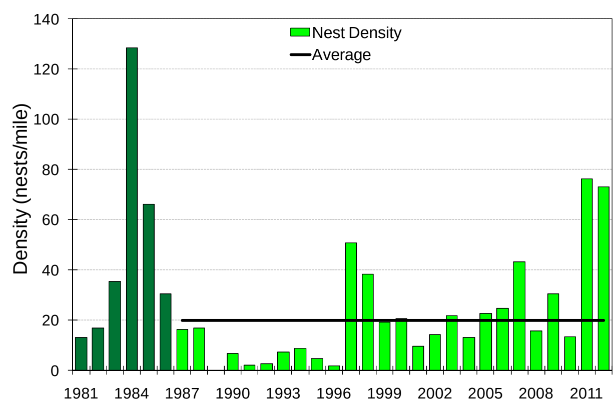


FIGURE G.5. Sea lamprey nest density (nests/mile) from standard stream sections on New York tributaries of Lake Erie, 1981-2012. No sampling was conducted in 1989. The post-treatment average includes 1987 through 2011. Darker bars indicate pre-treatment period.

TABLE G.3. Minimum, maximum, and mean indices from 1981-2007, and individual year and 5-year mean indices from 2008-2012, of sea lamprey nest density (nests/mile) from standard stream sections on New York tributaries of Lake Erie.

		1981 - 2007			2008-2012					
STD. STREAM SECTION	**Mile**	**Minimum**	**Maximum**	**Mean**	**2008**	**2009**	**2010**	**2011**	**2012**	**5- Year Mean**
Delaware Creek	0.8	0.0	148.8	10.4	0.0	1.3	0.0	0.0	0.0	0.3
Clear Creek	4.0	1.8	148.5	29.5	22.8	45.8	19.5	87.5	96.5	54.4
N. Br. Clear Creek	0.5	0.0	92.0	16.8	8.0	2.0	6.0	196.0	74.0	57.2
Canadaway Creek	0.8	0.0	30.0	7.5	1.3	0.0	0.0	20.0	27.5	9.8
OVERALL	**6.1**	**1.8**	**128.4**	**24.4**	**15.7**	**30.3**	**13.3**	**76.1**	**73.0**	**41.7**

Discussion

The consecutive 2008 and 2009 lampricide treatments of all key Lake Erie tributaries were expected to reduce sea lamprey wounding rates on lake trout towards target levels (5 wounds/100 fish) beginning in 2010. While post-treatment larval surveys of these tributaries indicated that these treatments were successful (Coldwater Task Group 2012), wounding rates on lake trout, sea lamprey nest counts, and spawning-phase sea lamprey trapping (see Coldwater Task Group 2012) indicated that a large population of sea lampreys is still present in Lake Erie. Larval assessments conducted in 2011 and 2012 revealed that Lake Erie's sea lamprey issues may be stemming from Lake St. Clair and the Detroit River instead of the traditional spawning tributaries located mainly in the eastern basin of the lake (Coldwater Task Group 2012). If these areas are the cause of Lake Erie's recently increasing sea lamprey population, then this trend of high sea lamprey abundance will likely continue as these areas are largely untreatable due to their size.

Strain-specific wounding rates continue to show that Lake Superior lake trout strains (KL, AI, TI) have higher wounding rates, and hence higher mortality rates (see Section F, this report), than FL strain lake trout. Finger Lakes strain lake trout may have evolved with sea lampreys and appear to not only avoid sea lamprey attacks but survive attacks better than other strains of lake trout (Schneider *et al.* 1996). The Lake Champlain strain, which has only recently been stocked in Lake Erie, is primarily derived from the Finger Lakes strain (T. Copeland, USFWS, Personal Communication) and may possess similar survival advantages in the presence of sea lamprey. If sea lamprey control in Lake Erie is not possible to the degree recommended in the Lake Erie Lake Trout Rehabilitation Plan (Markham *et al*. 2008), then select strains that better survive sea lamprey attacks, such as the FL strain and possibly the LC strain, may have to be exclusively used to achieve rehabilitation goals.

References

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.

King, L.E., Jr. and T.A. Edsall. 1979. Illustrated Field Guide for the Classification of Sea Lamprey Attack Marks on Great Lakes Lake Trout. Great Lakes Fishery Commission, Special Publication 79-1, Ann Arbor, Michigan. 41 pp.

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

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

Markham, J., A. Cook, T. MacDougall, L. Witzel, K. Kayle, C. Murray, M. Fodale, E. Trometer, F. Neave, J. Fitzsimons, J. Francis, and M. Stapanian. 2008. A strategic plan for the rehabilitation of lake trout in Lake Erie, 2008-2020. Lake Erie

Committee, Great Lakes Fisheries Commission, Ann Arbor, MI. Available at http://www.glfc.org/lakecom/lec/LEC_docs/other_docs/manplan2008.pdf [accessed 14 January 2013].

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

H. SALMONID STOCKING SUMMARY

James L. Markham and Michael A. Wilkinson

New York has stocked salmonids into Lake Erie annually since 1968 when the first coho salmon were introduced. Initial introductions were made to create a recreational fishery and to utilize the lake's sparsely inhabited hypolimnion. One exception is lake trout, which have been stocked by the US Fish and Wildlife Service (USFWS) since the mid-1970's to re-establish this native species. Pacific salmon are no longer stocked into Lake Erie by any jurisdiction and the majority of the stocking effort is concentrated on steelhead and lake trout.

Results and Discussion

A total of 295,480 salmonines were stocked into the New York waters of Lake Erie in 2012 (Table H.1). Stocking targets were achieved for both steelhead and domestic rainbow trout, but fell short for brown trout. No lake trout were stocked into the New York waters of Lake Erie in 2012. Overall numbers of stocked yearling brown, rainbow, and steelhead trout were at their lowest levels since 2004 (Figure H.1).

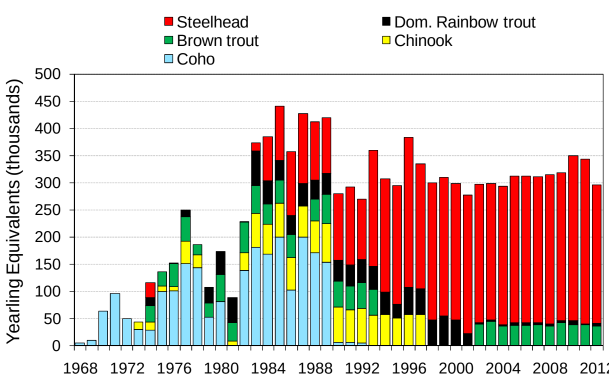


FIGURE H.1. Number (in yearling equivalent units) of Pacific salmon, brown trout, and rainbow trout (domestic and steelhead) stocked in New York waters of Lake Erie, 1968-2012.

No yearling lake trout from the 2011 year class were available for stocking into the US portion of Lake Erie in 2012. Lake trout planned for Lake Erie were reared at the White River National Fish Hatchery, a USFWS facility located in Vermont. However, in late August 2011 the hatchery experienced severe damage from flooding following tropical storm Irene, and the USFWS decided to depopulate the hatchery over serious concerns of contamination of raceway water with didymo (*Didymosphenia geminate*) from the adjacent White River. Subsequently, all lake trout being held in the facility were destroyed to avoid the risk of spreading didymo to Great Lakes waters.

While no lake trout were stocked in NY waters in 2012, a total of 55,330 yearlings were stocked by the Ontario Ministry of Natural Resources on Nanticoke Shoal in April 2012 (Figure H.2). In the fall, 123,700 surplus fall fingerlings became available from the recently renovated USFWS Allegheny National Fish Hatchery. These fish were stocked in the western and central basins of Lake Erie in early November.

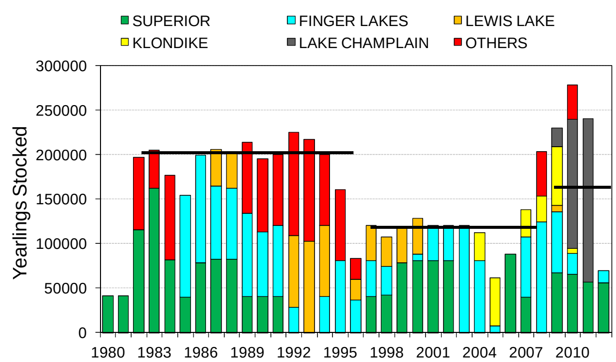


FIGURE H.2. Yearling and fall fingerling (in yearling equivalents) lake trout stocked by all jurisdictions in Lake Erie, 1980-2012, by strain. Stocking goals through time are shown by dark lines. Superior includes Superior, Apostle Island, Traverse Island, and Slate Island strains; Others include Clearwater Lake, Lake Ontario, Lake Erie, Lake Manitou, and Michipicoten strains. The current stocking goal is 160,000 yearlings per year.

Steelhead remain the most numerous salmonid species stocked in NY's portion of Lake Erie with 255,000 yearlings stocked in 9 tributaries in 2012 (Tables H.1 and H.2; Figure H.1). All tributaries achieved their stocking target in 2012; additional surplus steelhead were stocked in the South Branch Eighteen Mile Creek (2,000 surplus fish) and Cattaraugus Creek (18,000 surplus fish). All stocked steelhead were Washington strain fish; no Skamania strain steelhead were available in 2012. In addition to the steelhead, a small number of domestic rainbow trout yearlings (5,000) were also stocked at Erie Basin Marina in Buffalo, NY, and near the mouth of the Buffalo River.

Lastly, a total of 35,480 yearling brown trout were split between Barcelona Harbor, Dunkirk Harbor, the lower reach of Cattaraugus Creek, and Point Breeze Marina (Table H.1). This total did not meet the stocking goal of 45,000 yearlings due to shortages within the New York hatchery system. Shortages of brown trout are also expected in 2013 due to an outbreak of furunculosis and issues with poor quality feed.

The cooperative pen-rearing project by the Bison City Rod and Gun Club in the lower Buffalo River continued in 2012. A total of 10,000 unmarked yearling steelhead were stocked into two pens on 4 April and released on 30 April 2012. Fish weight during the 26-day time period increased from 22.0 fish/lb to 17.5 fish/lb, a 20% increase. Water temperatures during the project were low compared to previous years and may have slowed growth. The water temperature at release was only 48F. Club members reported that fish mortality in the pens was negligible. This was the eighth consecutive year of this project, and although this pen rearing program receives no formal assessment or evaluation, it remains popular with the Bison City Rod and Gun Club and the pen-reared fish have received good care. The program is scheduled to continue in 2013.

TABLE H.1. Summary of trout stocking in New York waters of Lake Erie in 2012.

Species	Location	Date Stk	YC	Hatchery	Strain	Mos	Stage	#/lb.	Clip/Mark	Num Stk.	Proposed 2013
Lake Trout Totals											
	Lake Trout Yearlings									**0**	**200,000**
Brown Trout	Point Breeze	4/2/2012	2011	CSFH	Domestic	16	Ylg	5.8	None	4,440	5,000
Brown Trout	Cattaraugus Creek	4/19/2012	2011	RSFH	Domestic	16	Ylg	4.6	None	8,870	10,000
Brown Trout	Barcelona Harbor	4/18/2012	2011	RSFH	Domestic	16	Ylg	4.6	None	8,870	10,000
Brown Trout	Dunkirk Harbor	4/27/2012	2011	RSFH	Domestic	16	Ylg	5	None	17,740	20,000
Brown Trout Totals											
	Brown Trout Yearlings									**35,480**	**45,000**
Rainbow Trout	Silver Creek	3/13/2012	2011	SRSFH	Washington	12	Ylg	23	None	10,000	10,000
Rainbow Trout	Walnut Creek	3/13/2012	2011	SRSFH	Washington	12	Ylg	23	None	10,000	10,000
Rainbow Trout	Canadaway Creek	3/13/2012	2011	SRSFH	Washington	12	Ylg	23	None	20,000	20,000
Rainbow Trout	18 Mile Creek	3/14/2012	2011	SRSFH	Washington	12	Ylg	24	None	20,000	20,000
Rainbow Trout	18 Mile Creek S. Branch	3/14/2012	2011	SRSFH	Washington	12	Ylg	24	None	20,000	18,000
Rainbow Trout	Chautauqua Creek	3/15/2012	2011	SRSFH	Washington	12	Ylg	23	None	40,000	40,000
Rainbow Trout	Cayuga Creek	4/4/2012	2011	SRSFH	Washington	12	Ylg	24	None	10,000	10,000
Rainbow Trout	Buffalo Creek	4/4/2012	2011	SRSFH	Washington	12	Ylg	24	None	15,000	15,000
Rainbow Trout	Cazenovia Creek	4/4/2012	2011	SRSFH	Washington	12	Ylg	24	None	10,000	10,000
Rainbow Trout	Cattaraugus Creek	3/19/2012	2011	SRSFH	Washington	12	Ylg	28	None	90,000	72,000
Rainbow Trout	Buffalo River Net Pens	4/30/2012	2011	SRSFH	Washington	13	Ylg	17.5	None	10,000	10,000
Rainbow Trout	Bison City R&G Club	3/21/2012	2011	CSFH	Domestic	16	Ylg	3.6	None	4,000	5,000
Rainbow Trout	Erie Basin Marina	3/21/2012	2011	CSFH	Domestic	16	Ylg	3.6	None	1,000	
Rainbow Trout Totals											
	Steelhead Yearlings (Washington and Skamania Strains)									**255,000**	**235,000**
	Domestic Rainbow Trout Yearlings (Randolph Strain)									**5,000**	**5,000**
TOTAL ALL SPECIES										**295,480**	**485,000**

Hatchery Codes: RSFH - Randolph State Fish Hatchery; CSFH - Caledonia State Fish Hatchery; SRSFH - Salmon River State Fish Hatchery

TABLE H.2. Approximate numbers (x 1000) of salmon and trout planted in New York waters of Lake Erie from 1970 through 2012. Lake trout numbers include those stocked in Pennsylvania, Ontario, and Ohio waters also. Totals do not include fry stockings.

	YEAR																					
Species/ Type	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Coho Y	64	96	50	30	29	100	87	149	144	50	81	0	139	181	169	200	102	200	169	148	0	0
Coho F	0	0	0	0	0	0	390	50	0	50	0	0	0	0	0	0	0	0	38	180	163	161
Coho f	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	0	0
Chin f	0	0	0	125	125	85	65	362	206	0	0	71	280	550	478	547	529	500	520	620	574	525
Lake Y	0	0	0	0	0	0	0	0	236	201	41	41	196	205	176	154	199	205	203	213	195	206
Lake F	0	0	0	0	0	150	186	125	0	508	474	0	39	17	0	0	0	0	0	60	0	127
Lake fry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	0
Lake adt	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0	0
Brown Y	0	0	0	0	28	0	42	42	0	26	50	34	53	50	38	42	40	0	38	53	47	44
Brown F	0	0	0	0	60	26	25	81	0	0	0	0	85	50	0	0	50	0	22	42	37	0
Brown f	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0
Rbow Y	0	0	0	0	15	0	0	12	19	29	43	46	0	61	39	34	32	41	34	38	37	39
Rbow F	0	0	0	0	0	0	25	0	0	0	0	40	0	50	28	32	49	0	22	25	38	0
Rbow f	0	0	0	0	0	0	0	0	0	0	0	0	0	0	110	120	148	0	0	0	0	0
Sthd Y	0	0	0	0	28	0	0	0	0	0	0	0	0	15	81	100	118	270	107	103	121	143
Sthd F	0	0	0	0	0	0	0	0	0	0	0	0	37	0	38	0	0	0	0	13	48	0
TOTAL	**64**	**96**	**50**	**155**	**285**	**361**	**820**	**821**	**605.1**	**864**	**689**	**232**	**829**	**1179**	**1157**	**1229**	**1267**	**1216**	**1253**	**1495**	**1260**	**1245**

	YEAR																				
Species/ Type	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Coho Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coho F	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coho f	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chin f	565	497	500	500	500	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Y	225	217	200	160	82.9	120	107	158	128	120	120	120	111.6	54.2	88	137.6	202.8	223.3	277.7	234.3	55.3
Lake F	0	42	0	82	0	0	0	40.5	7	0	0	0	0	58.4	0	0	0	0	0	0	123.7
Lake fry	0	150	200	0	0	301	81	0	262.7	130.2	283.5	109.2	0	0	0	0	0	0	0	0	0
Lake adt	0	0	0	2.7	1	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0
Brown Y	47	47	0	0	0	0	0	0	0	0	38.7	43.4	36	37.4	37.5	37.9	36	37.6	37.5	38.1	35.5
Brown F	0	0	0	0	0	0	0	0	0	0	33.6	39.5	0	0	0	0	0	25	0	7.4	0
Brown f	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	40	0	0
Rbow Y	43	43	42	2.5	42.5	46.9	47	55.3	47.5	21.3	2.2	2.5	2.4	5	5	4.5	5	4.7	4.9	1	5
Rbow F	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	15	0
Rbow f	0	0	0	0	90.6	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rbow adt	0	0	1	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sthd Y	105	214	208	218	274.8	228	253	255	250.8	255	255	251.3	255	270	270	268	265	272	303.7	304.3	255
Sthd F	130	0	0	0	20	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**1391**	**1060**	**951**	**986.2**	**1012**	**1019**	**407**	**509.8**	**433.5**	**431.3**	**449.5**	**456.7**	**405**	**425**	**400.5**	**448**	**508.8**	**562.6**	**709.8**	**600.1**	**474.5**

Legend: Y=Standard stocked yearling; F=Fall fingerling; f=Spring fingerling; fry=Advanced yolk-sac/swim-up fry; adt=Surplus broodstock

I. THE 2011 LAKE ERIE SALMONID ANGLER DIARY PROGRAM

James L. Markham

The Lake Erie Salmonid Angler Diary Program began in 1983 to gain additional data from the open water and tributary salmonid fishery. It provides a means of monitoring the quality of the salmonid fishery as well as the performance of various species and stockings. The program also serves as an outreach effort, connecting anglers to management of the resource. Catch per effort indices are obtained by individual angler, tributary, and for the overall fishery.

Methods

Volunteers participating in the Lake Erie Salmonid Angler Diary Program are encouraged to record information about each personal fishing trip every year. The data are recorded by each participating angler in a standard, DEC provided diary, according to established methods. Each new volunteer is given written instructions for proper data collection prior to receiving a diary. Anglers are recruited each year through public notification channels (i.e., newspaper columns, letters to sportsman's groups, hotlines, etc.). Through ongoing recruitment, we attempt to maintain a cadre of at least 70 to 75 active anglers each year.

The diary program is summarized for each calendar year. Diaries are intended to represent one full year of fishing activity for each diary holder and are limited to Lake Erie and its tributaries, upstream to the first barrier impassable to fish. Because diaries are not returned until after January each year, there is a one-year lag in diary summary results for this annual report.

Upon receipt, diary entries are coded to data sheets, and data are then entered into a spreadsheet for analysis. Once data entry is error-checked, diaries are returned to anglers for their personal use. An overall program summary is provided to each cooperator annually. Also, each cooperator receives a summary of his personal effort and catch for the year. Summaries only include trout and salmon-directed effort.

Results and Discussion

A total of 55 diaries were issued in 2011, the lowest number of diaries issued in the last ten years and below the time series average of 75. Of these, 34 diarists (60%) reported fishing specifically for trout and salmon in Lake Erie. A total of 32 anglers reported tributary angling while only six anglers reported angling on the open lake. Four anglers reported directed trips in both components of the fishery. Stream angling, primarily for steelhead, continues to dominate diarist effort.

Open Lake Waters

Six diarists spent a total of 307 angler hours on 49 trips targeting salmonids in Lake Erie in 2011 (Table I.1). Both trips and angler hours were below average for the 12th consecutive year, and this was the 6th lowest angler effort in the 28 year series. The average trip consisted of 6.3 angler-hours, which was also below average (7.1 angler-hours).

Only two of the six open water diarists reported landing fish in 2011. However, these two anglers were very successful, landing a total of 36 steelhead, 21 brown trout, and 24 lake trout. The average total length (TL) of the steelhead was 21.3 inches, brown trout 22.6 inches, and lake trout 21.1 inches. Of the 81 trout caught, 37 (46%) were harvested.

Overall mean targeted trout catch-per-unit effort (CPE) for 2011 was 0.26 fish/hour, which was above average (0.20 fish/hour) for the series (Figure I.1). CPE for the individual anglers ranged from 0.00 to 0.50 salmonids per hour. Similar to previous years, effort and catch was highest in Dunkirk Harbor, with lesser effort directed at Barcelona and Sturgeon Point (Table I.2).

TABLE I.1. Summary of directed trips for salmonids from the OPEN waters of New York's portion of Lake Erie reported by angler diary cooperators, 1983 - 2011.

YEAR	# DIARIES ISSUED	ANGLERS REPORTING	# OF TRIPS	TOTAL ANGLER-HOURS	AVG. HRS. PER TRIP	TOTAL SALMONIDS CAUGHT LT	BT	RT/SHD	CO	CH
1983	152	19	596	2,502	4.2	37	200	252	31	19
1984	151	31	974	3,531	3.6	201	115	389	1121	97
1985	86	26	283	2,077	7.3	37	41	141	44	13
1986	110	26	199	1,684	8.5	23	22	117	105	10
1987	75	9	78	531	6.8	0	28	106	2	4
1988	50	7	102	479	4.7	11	10	91	109	14
1990	72	11	58	352	6.1	23	2	26	2	2
1991	55	28	71	362	5.1	25	1	10	1	0
1992	104	20	83	553	6.7	32	3	108	15	7
1993	99	21	89	535	6.0	21	14	55	3	0
1994	78	16	70	341	4.9	18	3	44	1	1
1995	44	10	23	194	8.4	1	0	16	0	1
1996	45	8	42	348	8.3	6	0	63	1	4
1997	51	7	40	434	10.8	4	0	2	0	1
1998	47	7	37	262	7.1	10	0	10	0	0
1999	38	10	57	484	8.5	3	0	56	1	0
2000	39	9	23	148	6.4	9	1	29	0	1
2001	35	13	79	656	8.3	81	0	93	23	0
2002	91	15	95	1,072	11.3	30	1	88	4	2
2003	92	14	103	718	7.0	121	8	123	54	0
2004	90	12	84	628	7.5	42	4	78	8	0
2005	89	8	52	375	7.3	4	3	19	0	0
2006	82	6	35	283	8.1	14	1	25	0	0
2007	76	7	63	766	12.2	9	3	52	0	0
2008	64	9	52	395	7.6	6	9	74	0	0
2009	61	4	47	230	4.9	5	8	47	1	0
2010	58	11	58	290	5.0	3	13	14	2	0
2011	55	6	49	307	6.3	24	21	36	0	0

TABLE I.2. Trout and salmon catch and effort by OPEN water location on Lake Erie as reported in angler diaries for the 2011 calendar year.

			Catch by Species				
Water	**Trips**	**Angler-Hours**	**LT**	**BT**	**RT/STHD**	**COHO**	**CPE**
Barcelona - Open Lake	4	60.00	14	0	0	0	0.23
Barcelona Harbor	4	17.25	0	0	21	0	1.22
Dunkirk - Open Lake	6	93.00	10	1	0	0	0.12
Dunkirk Harbor	34	128.25	0	20	15	0	0.27
Sturgeon Pt. - Open Lake	1	8.00	0	0	0	0	0.00
TOTAL	**49**	**306.50**	**24**	**21**	**36**	**0**	**0.26**

Tributaries

A total of 32 anglers recorded 375 trips totaling 1,281 angler hours in 2011 (Table I.3). Angler hours were slightly below average (1,496 hours) for the series while angler trips were slightly higher than average (366 trips). The average trip length was 3.4 hours, below the series average of 4.1 hours.

A total of 902 salmonids were caught by cooperators in 2011. The vast majority of the catch (877 fish or 97%) was steelhead. Steelhead have dominated the angler diary program every year, even when significant numbers of other salmonid species (pre-1994) were stocked annually (see Section H, Figure H.1). The size of angled steelhead ranged from 3.0 to 34.5 inches TL, with an average length of 22.7 inches for legal-size fish (> 12" TL) (Figure I.2).

Steelhead between 24.0 and 27.0 inches comprised the bulk of the catch; catches of steelhead over 27.0 inches dropped dramatically. Only 18 steelhead

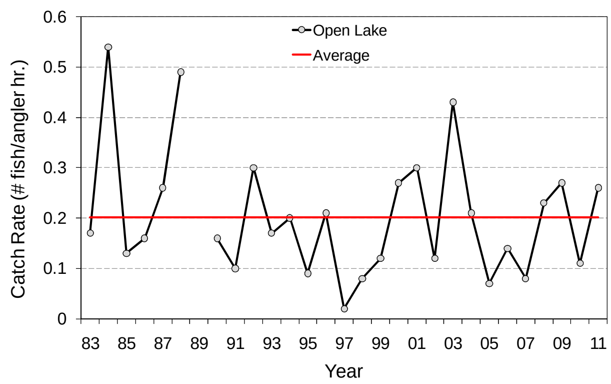


FIGURE I.1. Catch rates (fish/hour) of salmonids for the OPEN lake fishery reported in angler diaries, 1983 – 2011.

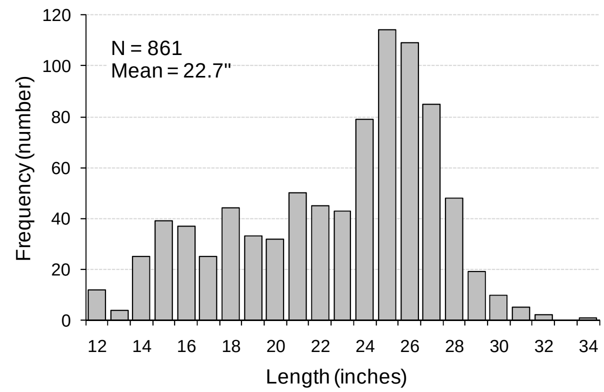


FIGURE I.2. Length frequency distribution of legal-size (12+ inches) steelhead caught by angler diary cooperators in the New York tributaries of Lake Erie, 2011.

(2%) were 30.0 inches or larger. A total of 23 brown trout (3%) were also recorded by diary anglers in 2011 along with one lake trout and one Chinook salmon. This was the first Chinook salmon recorded by diary anglers since 2006. The lone lake trout was caught in the Upper Niagara River.

Cattaraugus Creek continued to be the most popular creek fished by cooperators in 2011, totaling 24% of the trips, 30% of the effort, and 35% of the catch (Table I.4). Catch per effort (CPE) on Cattaraugus Creek was 0.81 fish/angler hour, above average and ending a four year declining trend (Table I.5). Other

TABLE I.3. Summary of directed trips for salmonids from New York TRIBUTARIES of Lake Erie reported by angler diary cooperators, 1983 - 2011.

YEAR	# DIARIES ISSUED	ANGLERS REPORTING	# OF TRIPS	TOTAL ANGLER-HOURS	AVG. HRS. PER TRIP	TOTAL SALMONIDS CAUGHT				
						LT	BT	RT/SHD	CO	CH
1983	152	36	518	1,656	3.2	0	55	380	166	63
1984	151	26	282	952	3.4	1	26	204	72	49
1985	86	23	230	936	4.1	0	26	213	53	30
1986	110	29	351	1,271	3.6	0	14	357	89	26
1987	75	17	366	1,054	2.9	1	13	460	36	58
1988	50	14	305	858	2.8	1	18	455	50	42
1990	72	24	373	1,418	3.8	0	28	338	21	18
1991	55	28	303	1,367	4.5	0	24	441	50	2
1992	104	35	535	2,215	4.1	0	14	640	16	5
1993	99	36	573	2,365	4.1	0	66	992	39	34
1994	78	25	390	1,451	3.7	0	18	763	9	3
1995	44	18	198	677	3.4	0	0	338	2	3
1996	45	18	172	686	4.0	0	2	161	1	2
1997	51	24	233	907	3.9	0	4	332	0	1
1998	47	22	259	998	3.9	0	2	519	0	15
1999	38	21	196	866	4.4	0	0	406	4	20
2000	39	18	179	824	4.6	0	2	400	2	10
2001	35	22	222	979	4.4	0	1	610	1	0
2002	91	51	434	2,268	5.2	0	13	1,163	3	0
2003	92	56	549	2,424	4.4	0	121	1,293	15	13
2004	90	50	513	2,490	4.9	0	34	1,504	14	2
2005	89	53	530	2,334	4.4	0	57	1,498	1	4
2006	82	50	591	2,379	4.0	0	83	1,920	1	2
2007	76	37	331	1,346	4.1	0	14	1,024	0	0
2008	64	41	426	1,870	4.4	1	55	1,450	2	0
2009	61	45	439	2,068	4.7	0	31	1,423	0	0
2010	58	40	385	1,726	4.5	0	31	899	0	0
2011	55	32	375	1,281	3.4	1	23	877	0	1

popular creeks included Eighteen Mile Creek, Clear Creek, and the Buffalo River system (Buffalo, Cayuga, Cazenovia Creeks). CPE's on Eighteen Mile Creek remained low and identical to 2010, but were high on both Clear Creek and the Buffalo River streams in 2011 (Tables I.4 and I.5). Diary effort was surprisingly low on both Chautauqua and Canadaway Creeks; these two streams are historically popular with cooperators. Catch rates on these two streams were higher than in 2010, but below long term averages. As is typical, small streams listed in the "Other" category had a substantial amount of angler effort (133 angler-hours), trips (46), and catch (144 fish). CPE's on these streams were the highest in the 2011 survey at 1.08 fish/angler hour.

TABLE I.4. Trout and salmon effort and catch from Lake Erie TRIBUTARIES as reported in angler diaries for the 2011 calendar year.

			Catch by Species				
Water	Trips	Angler-Hours	BT	RT/STH	CH	LT	CPE
Chautauqua Creek	11	66.6	0	34	1	0	0.53
Canadaway Creek	38	117.0	10	73	0	0	0.71
Silver/Walnut Creeks	18	61.3	0	27	0	0	0.44
Cattaraugus Creek	90	384.2	4	308	0	0	0.81
Eighteen Mile Creek	77	239.7	1	94	0	0	0.40
Buffalo/Cayuga/ Cazenovia Creeks	47	89.3	0	69	0	0	0.77
Clear Creek	48	189.8	2	135	0	0	0.72
Other Streams	46	132.8	6	137	0	1	1.08
TOTAL	**375**	**1280.6**	**23**	**877**	**1**	**1**	**0.70**

TABLE I.5. Catch rates (fish/hour) of salmonids in major New York TRIBUTARIES as reported by diary cooperators, 2000-2011.

	2000 - 2010			
Water	High	Low	Average	2011
Chautauqua Creek	1.11	0.24	0.57	0.53
Canadaway Creek	1.21	0.25	0.83	0.71
Silver/Walnut Creeks	1.11	0.33	0.71	0.44
Cattaraugus Creek	0.89	0.44	0.63	0.81
Eighteen Mile Creek	0.94	0.40	0.64	0.40
Buffalo/Cayuga/ Cazenovia Creeks	0.86	0.08	0.42	0.77

Overall catch rates increased from 0.54 fish/angler hour in 2010 to 0.70 fish/hour in 2011(Figure I.3). This was identical to 2009 catch rates and well above the series average of 0.51 fish/angler hour. Individual catch rates ranged from 0.00 to 2.47 fish/angler hour with the majority of the catch rates ranging between 0.10 and 0.60 fish/angler hour. Only four anglers recorded catch rates of 1.0 fish/angler hour or more.

The overall harvest rate of salmonids from Lake Erie tributaries was 3.8% for steelhead and 4.3% for brown trout in 2011, supporting the ongoing trend that most diary tributary anglers practice catch-and-release. These are similar results to previous observations from the angler diary program and of tributary angler surveys conducted in 2003-04, 2004-05, 2007-08, and 2011-12 (Markham 2006; Markham 2008; Markham 2012).

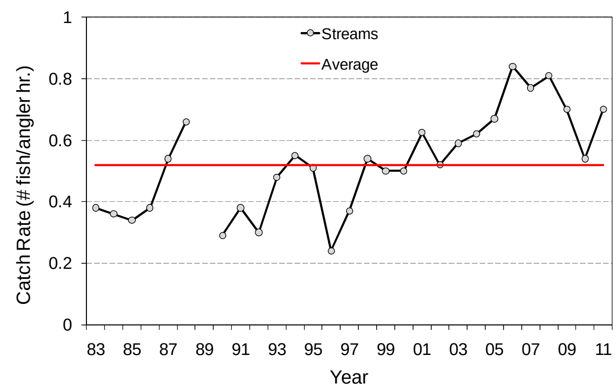


FIGURE I.3. Catch rates (fish/hour) of salmonids for the TRIBUTARY fishery reported in angler diaries, 1983 – 2011.

References

Markham, J. L. 2006. Lake Erie Tributary Creel Survey: Fall 2003-Spring 2004, Fall 2004-Spring 2005. Project #: F-48-R-8, Job 111. New York State Department of Environmental Conservation, Albany. 45 pp.

Markham, J. L. 2008. Lake Erie Tributary Creel Survey: Fall 2007-Spring 2008. Project #: F-55-R-1, Job 1. New York State Department of Environmental Conservation, Albany. 23 pp.

Markham, J. L. 2012. Lake Erie Tributary Creel Survey: Fall 2011-Spring 2012. Project #: F-61-R, Study 7. New York State Department of Environmental Conservation, Albany. 22 pp.

J. FALL LAKE TROUT SPAWNING SURVEY

James L. Markham

A bi-national Lake Erie lake trout management plan was adopted in 2008 and serves as a guide for rehabilitation efforts (Markham *et al.* 2008). As part of the Plan's identified assessment needs is the development of annual spawning surveys to investigate whether lake trout are utilizing potential spawning areas and assess whether adult abundances are adequate to meet plan objectives. In response to these needs, we began an annual fall gillnet survey in 2008 to assess the lake trout spawning population in the New York waters of Lake Erie.

Periodic lake trout spawning surveys have been conducted by the Lake Erie Unit in the past, mainly keying on Brocton Shoal, a historical deepwater spawning area located west of Dunkirk in 45-60 feet of water, and in the nearshore waters off Barcelona Harbor. Adult lake trout were regularly collected at Barcelona Harbor, especially during the early 1990s when lake trout were shore stocked at this location, but lake trout remained scarce at Brocton Shoal. Recent sidescan sonar and underwater video work by Lake Erie's Habitat Task Group (Habitat Task Group 2010) shows that Brocton Shoal is heavily encrusted by dreissenid mussels and may no longer be viable lake trout spawning habitat. As such, new surveys have explored other habitats in different areas to find concentrations of spawning lake trout (Table J.1).

Methods

Timing and duration of the fall spawning survey is dictated by water temperatures and weather. The survey commences when water temperatures near 50F, which is the beginning of spawning activity in temperate lakes (Martin and Olver 1980), and usually early to mid-November. Gill net gangs are set overnight on or at the edge of suspected spawning habitat. From 2008 to 2011, net gangs consisted of 50 foot panels of monofilament mesh ranging from 4.5 to 6.0 inches by 0.5 inch increments, plus 7.0 and 8.0 inch mesh (300 feet total per gang). In 2012, the 4.5 inch mesh size was eliminated due to excessive by-catch of non-target species. Each net gang in 2012 was 250 feet total.

Data collected for lake trout include total length, sex, maturity, fin clips, and sea lamprey attacks. Snouts are retained from all lake trout for coded-wire tag retrieval. Otoliths are collected from any lake trout without a clip or coded-wire tag. Eggs from female lake trout were also saved for thiamine analysis. All other fish species are counted.

TABLE J.1. List of sites surveyed for spawning lake trout in the eastern basin of Lake Erie, 2001-2012.

SITE	DATE SAMPLED	SITE DEPTH (ft)	LOCATION TYPE	BOTTOM TYPE	NUMBER OF NETS	NUMBER OF LAKE TROUT
Brocton Shoal	11/7/2001	50-54	Offshore, deep	cobble, rock	2	1
Van Buren Bay	11/7/2001	14-18	Nearshore, shallow	rock	2	16
Brocton Shoal	11/5/2008	52-68	Offshore, deep	cobble, rock	2	3
Van Buren Bay	11/5/2008	13-17	Nearshore, shallow	rock	2	7
Brocton Shoal	11/13/2009	50-65	Offshore, deep	cobble, rock	2	0
Brocton Shoal	11/24/2009	50-65	Offshore, deep	cobble, rock	2	0
Barcelona Harbor	11/19/2009	8	Nearshore, shallow	breakwall	2	15
Van Buren Bay	11/24/2009	16	Nearshore, shallow	rock	1	0
Battery Point	11/24/2009	20	Nearshore, shallow	rock, sand	1	2
Dunkirk Offshore	11/25/2009	80	Offshore, deep	soft bottom	2	0
Brocton Shoal	11/9/2010	61	Offshore, deep	cobble, rock	2	2
Lake Erie State Park	11/9/2010	15	Nearshore, shallow	rock	2	3
Van Buren Bay	11/10/2010	10	Nearshore, shallow	rock	1	3
Point Gratiot	11/10/2010	24	Nearshore, shallow	bedrock	1	16
Dunkirk Breakwalls	11/10/2010	8-20	Nearshore, shallow	breakwall	2	11
Presque Isle Bay, PA	11/10/2010	13-20	Nearshore, shallow	breakwall, rock	2	31
Eighteen Mile Creek	11/7/2011	11-18	Nearshore, shallow	cobble, rock	4	18
Eighteen Mile Creek	11/15/2012	6-18	Nearshore, shallow	cobble, rock	4	22

Results

Underwater bottom video work conducted in 2011 revealed a large area of rocks off the mouth of Eighteen Mile Creek near Hamburg, NY. Rock formations at this site appeared to be favorable for spawning lake trout – cobble sized rocks in piles with interstitial spaces (Figure J.1). Furthermore, the rocks did not appear to be as heavily encrusted with

FIGURE J.1. Underwater photo of bottom habitat off Eighteen Mile Creek in Lake Erie, July 2011.

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. November 2011 gill net sampling at this location caught 18 lake trout (Einhouse *et al.* 2012), an indication that lake trout were possibly using this as a spawning location.

Surveys in 2012 in the same locations off Eighteen Mile Creek were conducted to confirm the continued presence of lake trout at this possible spawning area. A total of four gangs (1000 gill net feet total) were fished overnight on 14 November, 2012 in locations similar to the previous year (Figure J.2). Two sets were made at the east end of the rocky area in 6-16 foot depths, and two at the west end at 7-18 foot depths. Bottom water temperature during all sampling was 44F, which was six degrees colder than the previous year. Underwater bottom video of the site prior to setting the nets revealed that much of the *Cladophora* that was present in the July 2011 video was gone. However, the rocks in the area were still partially encrusted in dreissenids.

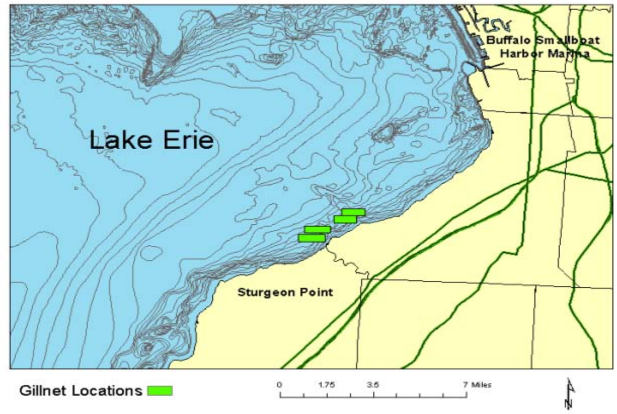


FIGURE J.2. Gill net survey locations off Eighteen Mile Creek sampled for spawning lake trout, November 2012.

A total of 22 lake trout were caught in the four nets. The fish were generally scattered over the site with twelve fish caught in the two western nets and ten fish in the two eastern nets. Eight of the lake trout were females and fourteen males. All of the lake trout were mature and five of the females had ripe, flowing eggs. Nearly all the lake trout were Finger Lakes (FL) strain, with the exception of two 3-year old Lake Champlain (LC) strain fish. Ages ranged from 3-22 years old with ages 4, 5, and 10 years old being the most common (Figure J.3). Seventeen of the lake trout caught were stocked offshore of Dunkirk and the remaining fish had been stocked offshore at Barcelona.

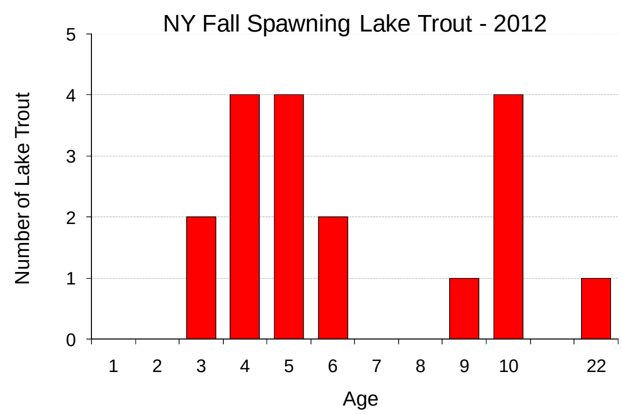


FIGURE J.3. Age distribution of lake trout sampled off Eighteen Mile Creek in the New York waters of Lake Erie, November 2012.

Discussion

Underwater video surveys revealed a potential high quality lake trout spawning area off 18 Mile Creek. This nearshore site is relatively large and appears to possess many of the necessary attributes that lake trout need for successful reproduction, including cobble sized rock piles, a substrate relatively clean of silt, and large interstitial spaces. The notable negative characteristic of this site, which is also true of all other known sites along New York's Lake Erie coastline, is that it is subject to the strong westerly winds and waves that buffet the area during fall and winter months. However, because this site is shallower and closer to the eastern end of the lake, it often becomes ice covered during winter, potentially diminishing some of these effects. Fall gillnetting in both 2011 and 2012 found that spawning-phase lake trout visited this site, and while the numbers of lake trout caught were not as high as on other nearshore sites sampled in recent years (see Table J.1), sampling confirmed that spawning lake trout did find this habitat and were apparently using it despite its distance from stocking locations. Moreover, the presence of ripe female lake trout indicates that it is a probable spawning location. To date, this site appears to have the best quality lake trout spawning habitat surveyed in the NY waters of Lake Erie.

Finger Lakes (FL) strain lake trout appear to be the most viable strain for potential reproduction. Of the 133 lake trout caught in fall spawning surveys over the past five years, only one lake trout was not a FL strain or a hybrid FL strain cross (LE, LO, LC strains). The one other lake trout was a Klondike (KL) strain fish caught in 2010 in Presque Isle Bay, PA. Studies from Lake Michigan and Lake Huron found that the FL strain contributed a disproportionately high percentage of young-of-year lake trout compared to their proportion within the spawning stock (Page *et al.* 2003). In Lake Erie, the percentage of FL strain or FL strain hybrids caught in fall spawning surveys over the past five years (99%) is much higher than their proportion (45%; mature fish only) of catches during August coldwater assessment netting. In contrast, KL strain comprised 40% of the catches of mature lake trout in summer assessment surveys but less than 1% of the catches during fall spawning surveys. These traits, combined with their higher survival rate and increased resistance to sea lamprey mortality (Eshenroder *et al.* 1995; Schneider *et al.* 1996), suggests the FL strain, or hybrids of it, offer the greatest potential of the strains stocked in Lake Erie.

Efforts to locate suitable lake trout spawning substrates should continue throughout Lake Erie, including the central and western Basins, to determine where suitable habitat exists. Once these are located, stocking programs should be focused in these areas to maximize the potential for natural reproduction.

References

Einhouse, D.W., J.L. Markham, K.A. Kapuscinski, M.T. Todd, D.L. Zeller, R.C. Zimar, and B.J. Beckwith. 2012. NYSDEC Lake Erie 2011 Annual Report. New York State Department of Environmental Conservation, Albany, New York, USA.

Eshenroder, R.L., N.R. Payne, J.E. Johnson, C. Bowen II, and M.P. Ebener. 1995. Lake trout rehabilitation in Lake Huron. Journal of Great Lakes Research 21(Supplement 1):108-127.

Habitat Task Group. 2010. Report of the Lake Erie Habitat Task Group, March 2010. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Markham, J., A. Cook, T. MacDougall, L. Witzel, K. Kayle, C. Murray, M. Fodale, E. Trometer, F. Neave, J. Fitzsimons, J. Francis, and M. Stapanian. 2008. A strategic plan for the rehabilitation of lake trout in Lake Erie, 2008-2020. Lake Erie Committee, Great Lakes Fisheries Commission, Ann Arbor, MI. Available at http://www.glfc.org/lakecom/lec/LEC_docs/other_docs/manplan2008.pdf [accessed 20 January 2012]

Martin, N.V., and C.H. Olver. 1980. The lake charr, *Salvelinus namaycush*. Pages 205-280 i*n* E.K. Balon, ed. Charrs: salmonid fishes of the genus *Salvelinus*. Dr. W. Junk bv Publishers, The Netherlands.

Page, K.S., K.T. Scribner, K.R. Bennett, and L.M. Garzel. 2003. Genetic assessment of strain-specific sources of lake trout recruitment in the Great Lakes. Transactions of the American Fisheries Society 132:877-894.

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

K. Beach Seine Survey

Donald W. Einhouse

Introduction

A midsummer beach seine survey was initiated by the Lake Erie Unit (LEU) from 1998 to 2000 to assess whether juvenile walleye and smallmouth bass abundance indices could be achieved through a long term, standardized beach seine assessment. That investigation consistently encountered young-of-the-year (YOY) life stages of both target species. However, we also found it difficult to maintain survey standards across years due to erratic occurrence of filamentous algae and other debris at standard survey locations. Also, the requirement of especially calm wind conditions for effective beach seining was an additional limiting factor for executing this survey. As such, we concluded beach seining to be a flawed method for producing a long term abundance index of YOY walleye and YOY smallmouth bass in Lake Erie (Culligan et al. 2001). In the ensuing years, we experimented with near shore boat electrofishing as another approach to achieve a YOY index for these species. Unfortunately, those pilot electrofishing surveys also proved unsatisfactory mainly due to the requirement of especially calm weather while working in very shallow water.

In 2011, an opportunity to re-visit the beach seining survey occurred due to cancellation of a longstanding mid-summer acoustic survey due to administrative constraints. Despite the shortcomings of the previous beach seining effort as a standard, long term survey to produce abundance indices, we did gather a great deal of information about the inshore fish community which we otherwise do not monitor in any other survey conducted by the LEU. As such, due to ongoing constraints for reinstituting the acoustic survey and the accompanying opportunity provided for beach seining, we continued the beach seine survey during summer 2012.

Methods

We used a 150-ft beach seine (5-ft. high, 0.25-in delta bar mesh, 5-ft x 5-ft bag size, and 0.125-in bag mesh) deployed during daytime hours from an 18-ft skiff in a semi-circle over approximately 3 to 5 ft depths and retrieved the seine toward the beach. Before reaching the shore or a debris zone, the seine was pursed together and the catch collected in the bag of the seine.

Five beach sites were sampled in 2012 (Barcelona, Dunkirk, Hanover, Sturgeon and Woodlawn) for two repetitions during the month of July. The first and second repetitions were separated by 2-weeks. The number of seine hauls completed for each site visit ranged from three to thirteen. In all, 55 individual seine hauls were completed for the 2012 beach seining effort.

Fish species from each seine haul were identified to the extent possible in the field and binned into categories of abundant (> 100), common (10 – 100) or rare (< 10). YOY walleye, smallmouth bass and yellow perch were counted and measured. We also recorded observations for wind speed & direction, cloud cover, substrate, turbidity and water temperature.

Table K.1. Daytime catch rates (number per seine haul) of young-of-the-year (YOY) walleye and YOY smallmouth bass collected with a 46 m bag seine at selected beach locations along the New York's portion of Lake Erie, July 1998-2000 and 2011-2012.

	YOY WALLEYE CATCH Per HAUL					YOY SMALLMOUTH CATCH Per HAUL				
	BARCELONA	DUNKIRK	HANOVER	STURGEON	WOODLAWN	BARCELONA	DUNKIRK	HANOVER	STURGEON	WOODLAWN
1998	0.0	5.3	0.0	0.0	-	16.7	2.0	1.2	0.0	-
1999	0.3	0.0	1.7	0.0	-	1.9	32.7	44.5	21.9	-
2000	0.0	0.0	0.0	1.0	-	0.2	0.0	0.0	0.4	-
2011	0.0	0.0	0.0	-	-	1.2	0.3	0.3	-	-
2012	0.6	1.0	1.5	3.1	1.3	3.9	1.1	0.2	0.2	0.5

Results

Beach seine collections in 2012 consisted mostly of minnow species (emerald and spottail shiners), and YOY white perch. Minnow species were also the most encountered taxa during previous beach seine investigations from 1998 to 2000, and 2011. Beach seine surveys in 2011 and 2012 also encountered abundant round goby which were scarcely detected during earlier surveys. Spottail shiner and brook silverside are notable as two species abundant in seine catches, but otherwise scarcely detected in all other LEU survey work.

The principal targets of this survey were YOY walleye and YOY smallmouth bass and they were scarce in 2011, but more commonly encountered in the 2012 survey. Catch rates in 2012 of YOY walleye and YOY smallmouth bass by site indicate these target species and life stages were distributed in similar abundance along all survey locations (Table K.1).

The mean length of YOY walleye encountered for the first beach seining effort from July 10-13, 2012 was 2.5-in (63 mm). The second repetition occurred from July 23-25, 2012 and YOY walleye mean length increased by 37 % to 3.4 in, while the accompanying walleye sample decreased from 70 to just 18 individuals. Similarly, mean length of YOY smallmouth bass increased markedly between the first and second surveys while the number of individuals sampled decreased between the first and second survey (Table K.2).

Table K.2. Mean length of YOY walleye and YOY smallmouth bass collected during two sampling periods from a July, 2012 beach seine survey.

repetition	YOY Walleye		YOY smallmouth bass	
	mean len (in)	N	mean len (in)	N
July 10-13	2.5	70	1.4	49
July 23-15	3.4	18	1.9	7

Discussion

The 2011 beach seine survey produced disappointing results for the principal targets of this investigation. Earlier results (1998 – 2000) found readily measurable densities of both YOY target species in 1998 and 1999, but scarce encounters during 2000. Subsequent recruitment measures showed 2000 produced a very weak year class for both walleye and smallmouth bass. These results suggested that the beach seine survey did provide some measure of year class strength, albeit not a sensitive index. Our new beach seine effort reinstituted in 2011 produced results very similar to observations from 2000. Additional evidence from another ongoing survey (see Section D) suggests YOY smallmouth bass should have been detectable in 2011, but not particularly abundant. Also, a long term gill net survey has now measured the 2011 walleye year class as small relative to long term abundance measures. While we had the misfortune of initially re-evaluating our beach seine survey during a year (2011) when our principal targets were scarce, the subsequent 2012 beach seine survey did provide contrasting results that perhaps reflect stronger walleye and smallmouth bass year classes.

The 2012 beach seine measures for both YOY walleye and YOY smallmouth bass were higher than those of 2011. Gill net surveys to be conducted in 2013 and 2014 should validate whether the 2012 year class was more abundant than the 2011 year class, and such validation will help determine the usefulness of this survey in providing long-term indices of year class strength. Accompanying 2012 observations of a large difference in mean size of YOY fishes spanning only a 2-week sampling window suggest annual survey timing would be a critical factor for achieving abundance measures that maintain consistent size-based selectivity to sampling gear over time.

We concede there are likely more effective approaches to implement a YOY walleye or YOY smallmouth bass assessment in eastern Lake Erie that remain either untested or impractical within the limitations of our overall field program. For example, we hypothesize perhaps an August electrofishing or bottom trawl survey might achieve generally higher catch rates for YOY smallmouth bass and YOY walleye because these juvenile fish have attained larger sizes, and become generally more vulnerable to these sampling gears. However, the August through September period is already committed to long term gill net surveys that utilize all available field staff at the LEU (see Sections D and F).

Finally, it remains uncertain whether this survey will be conducted in 2013. If the longstanding mid-summer acoustic survey is restored, then the opportunity to pursue beach seining as a long term program may no longer be available.

References

Culligan, W. J., D. W. Einhouse, J.M. Markham, D. L. Zeller, R. C. Zimar, and B.J. Beckwith 2001. 2000 Annual Report to the Lake Erie Committee. New York Department of Environmental Conservation, Albany. 67 pp.

L. WALLEYE DIET STUDY

Donald W. Einhouse

Introduction

A component of forage fish investigations at the Lake Erie Unit includes ongoing predator diet analysis. In 1993 we began annually examining angler-caught adult walleye at fish cleaning stations for dual objectives of 1) characterizing walleye diet and 2) estimating the age distribution of the sport harvest. Information describing the age distribution of the sport harvest is contributed to the Lake Erie Committee's Walleye Task Group for catch-at-age analysis population estimation. The 20-year series of walleye diet data collected from this effort are presented here as a component of Lake Erie's forage assessment.

Methods

From 1993 to 2012, intermittent, summertime (June-August) visits were made to fish cleaning stations to gather stomach content information from angler caught walleye. In recent years, recreational angling contributions by NYSDEC staff have sometimes added measurably to this annual collection. These data collection efforts were also augmented by a NYSDEC fish cleaning service provided adjacent to launch ramps, which provided an additional incentive for walleye anglers to contribute information for this investigation. Data collected at fish cleaning locations included the location of capture, walleye total length, sagittal otoliths for age determination, walleye sex and stage of maturity, and number and volume (measured to the nearest milliliter) of readily identifiable prey taxa. The effort committed to this program and samples obtained has varied widely among years due to fluctuating walleye fishing quality and availability of staff to support this effort.

Results

The number of walleye stomachs examined annually has varied widely from a high of 339 in 2000 to a low of 34 in 2004. The number of non-empty stomachs ranged from 127 in 1995 to only 9 in 2004. During 2012 we examined 276 walleye stomachs; 97 contained food remains, and 63 of these stomachs had food items identifiable to genus or species.

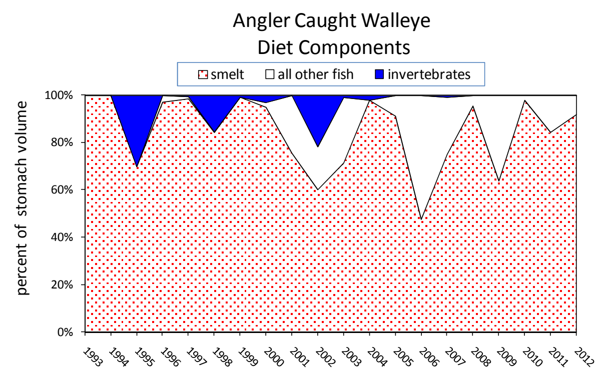


Figure L.1.The percent contribution (by volume) of identifiable prey in stomachs of adult walleye caught by summertime anglers in New York's portion of Lake Erie, 1993 to 2012.

Throughout most of the 1993 to 2012 time series, rainbow smelt represented the majority of the summertime angler caught adult walleye diet(Figure L.1). Infrequently, mayfly nymphs (*Hexagenia* spp.) were observed in June and early-July stomach samples in some years; however mayfly nymphs have not been encountered since 2003. The 2001 collections were the first occasion that prey fish other than rainbow smelt made a notable contribution to the diet. From 2001 to 2003, most of the observed prey fish taxa other than smelt were clupeid species and emerald shiners. During both 2006 and 2007 at least five fish species were identified in walleye stomachs. In 2012 samples, the contribution by volume of identifiable species included four fish species; rainbow smelt (92.0 %), round goby (5.6 %), emerald shiner (1.7 %) and yellow perch (0.1 %). Also in some walleye stomachs were small, unquantifiable amounts of spiny water fleas (*Bythotrephes sp.)*. These observations of spiny water fleas were only found in stomachs of age-2 walleyes less than 16-inches in total length.

Discussion

Ongoing summertime adult walleye diet investigations continued to find smelt as the most abundant prey. However, collections in 2006 and 2007 were especially noteworthy because several other prey fish species contributed measurably to walleye diets. During those years increased prey species diversity was coupled with lower smelt abundance as a consistent observation between independent walleye diet and forage fish trawling programs (see Section M). In 2008 and 2010 diet diversity declined, and was more similar to observations of the 1990's when rainbow smelt dominated the diet. In 2011 and 2012, additional species again appeared in walleye diets, with contributions by emerald shiner and yellow perch consistent with notable catches of these species in the bottom trawling program (see Section M). We expect this summertime walleye diet series to be useful in furthering our understanding of factors contributing to walleye fishing quality in eastern Lake Erie. These collections also represent the longest continuous data series to describe the summertime diet of adult walleye found among any eastern Lake Erie jurisdiction. As such, these collections will be maintained as an ongoing program of NYSDEC's Lake Erie Unit.

M. FORAGE TRAWL SURVEY

James L. Markham and Donald W. Einhouse

Introduction

Annual bottom trawling to characterize the forage fish community has been conducted since 1992. This survey has an additional objective of assessing the status of yellow perch and those results are presented in Section C of this report. New York's annual forage fish abundance measures are also merged with other Lake Erie agencies' forage assessments and are reported with the inter-agency Forage Task Group (Forage Task Group 2013).

Methods

This fall trawling series was initiated in 1992 and replaced the Juvenile Percid Assessment conducted from 1986 to 1991 (Culligan *et al.* 1992). This trawling program is conducted during October at randomly selected stations between the 50- and 100-ft. depth contours in New York's portion of Lake Erie. Standard tow duration is 10 minutes. Additional detail for trawl specifications can be found in Section C of this report. Survey procedures generally follow those performed for an inter-agency, western basin Lake Erie assessment (Forage Task Group 2013).

Results

A total of 35 usable trawl tows were completed in 2012. Summary statistics for 14 frequently encountered species are presented in Table M.1. Rainbow smelt and trout-perch were the most abundant species in 2012. Other species that made significant contributions to trawl collections included age-0 yellow perch, alewife, white bass, emerald shiners and round goby.

TABLE M.1. Catch per effort (number per hectare (2.471 acres)) of selected species collected with a 10-m bottom trawl from approximately 30 sites between 50 to 100 ft. depth contours in New York waters of Lake Erie, October, 1992-2012.

	Index (#/ha) (1992 to 2011)			Trawl (#/ha)
Species	Min	Max	Mean	2012
Yellow Perch				
Age 0	0.2	1088.3	152.2	272.9
Age 1	0.2	138.2	23.4	16.3
Age 2+	0.5	85.0	26.6	61.0
Walleye				
Age 0	0.0	5.7	0.5	1.3
White Perch				
Age 0	0.0	431.5	58.6	18.3
White Bass				
Age 0	0.0	129.0	18.1	44.8
Rainbow Smelt				
Age 0	64.9	4154.0	1492.7	413.6
Age 1+	25.5	3016.6	691.2	22.1
Alewife				
Age 0	0.0	617.6	69.3	183.8
Gizzard Shad				
Age 0	0.0	40.9	10.4	4.7
Trout-Perch				
All ages	27.0	1392.6	632.8	338.9
Sm. Bass				
Age 0	0.0	1.1	0.2	0.1
Age 1+	0.1	2.4	1.0	1.1
Emerald Shiner				
Age 0	0.0	2930.1	291.6	94.3
Age 1+	0.0	1826.2	279.9	93.8
Spottail Shiner				
Age 0	0.0	137.8	11.1	1.8
Age 1+	0.0	34.2	6.8	2.0
Round Goby				
Age 0	0.0	1059.5	240.4	134.7
Age 1+	0.0	313.2	102.8	45.5
Burbot				
Age 0	0.0	0.2	0.0	0.0
Age 1+	0.0	3.2	0.9	0.1
Whitefish				
Age 0	0.0	6.2	0.4	0.0
# of Samples	26	39	32	35

Each year, including 2012, soft-rayed fishes dominated trawl catches in the New York waters of Lake Erie (Figure M.1). This group includes rainbow smelt, emerald shiners, spottail shiners, trout-perch, and round goby. Spiny-rayed forage fishes (yellow perch, white perch, white bass) increased in abundance during the mid-2000s but have declined during the past three years. Clupeids (gizzard shad, alewife) have been minor contributors to the New York forage fish assessment over the past decade. Overall forage fish abundance in the New York trawl survey declined sharply in 2012. The estimated abundance of forage-sized fish was 1,674 fish/ha (677 fish/ac), which was the third lowest value in the 21-year series.

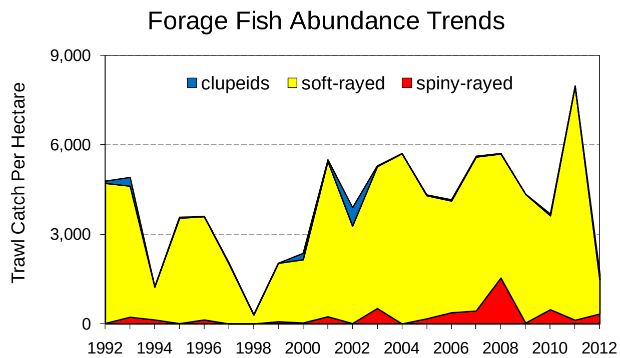


Figure M.1. Catch-per-hectare (2.471 acres) of functional groups of forage fishes collected with a standard trawl from approx. 30 sites in the New York waters of Lake Erie, October, 1992 to 2012.

Rainbow smelt are typically the dominant species within the soft-rayed forage group. From 1992 through 2000, an alternating yearly cycle of high and low yearling and older (YAO) smelt abundance was predictable (Figure M.2). During these years, yearling smelt (age-1) comprised the majority of this age group; smelt older than yearlings were scarce. Young-of-the-year (YOY) smelt typically were the most abundant forage fish component in the absence of an abundant yearling cohort of smelt.

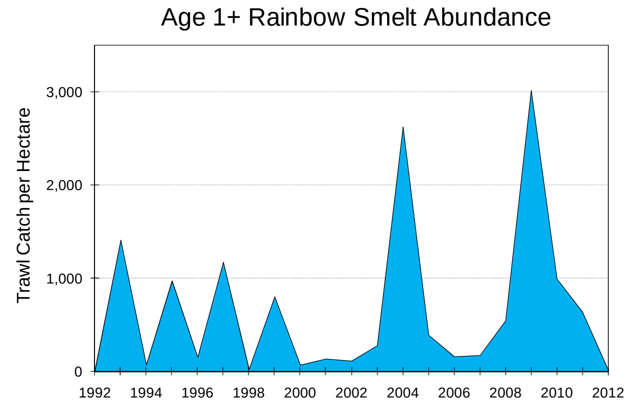


Figure M.2. Catch-per-hectare (2.471 acres) of yearling-and-older (Age 1+) rainbow smelt collected with a bottom trawl from approximately 30 sites between the 50 and 100 ft. depth contours in the New York waters of Lake Erie, October, 1992 to 2012.

From 2000 through 2003, YAO smelt abundance remained lower, along with the absence of the previously notable alternate-year abundance cycle (Figure M.2). The YAO age group also began to expand into a wider range of ages. During 2004, YAO smelt abundance increased dramatically, then subsided to lower abundances from 2005 to 2008. However, in 2009 YAO smelt again emerged as a dominant component of the forage fish community, only to subside in the 2010 through 2012 assessments. With a few exceptions, YOY smelt abundance remained consistently high throughout this period.

Beginning in 1999, several other species also began to make significant contributions to the soft-rayed segment of the forage fish community, including emerald shiners, trout-perch and round gobies (Figure M.3). Round goby were first collected in the late 1990's and generally increased in abundance, peaking in 2007 (Figure M.3). Thereafter, round goby abundance declined through 2010, and has been stable since.

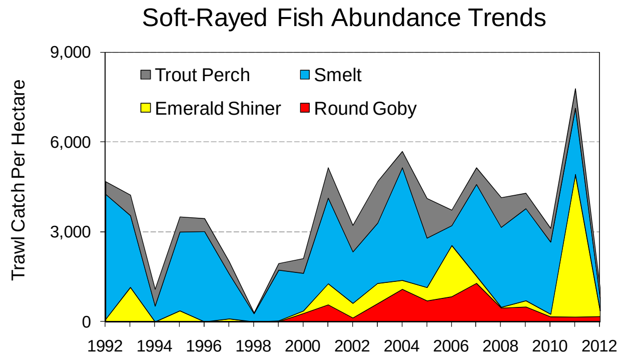


Figure M.3. Catch-per-hectare (2.471 acres) of common soft-rayed forage fishes (all ages combined) collected with a bottom trawl from approximately 30 sites between the 50 and 100 ft depth contours in the New York waters of Lake Erie, October, 1992 to 2012.

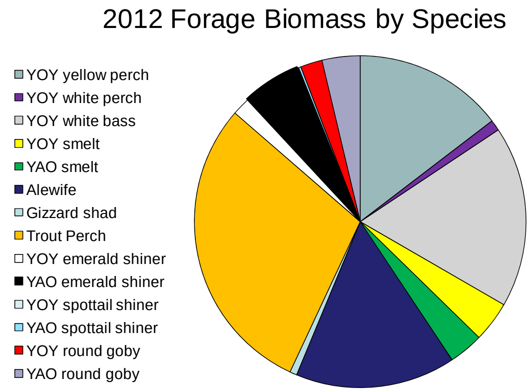


Figure M.4. Biomass (grams-per-hectare (2.471 acres)) of forage fishes by life stage collected with a bottom trawl from 31 sites between the 50 and 100 ft depth contours in the New York waters of Lake Erie, October 2012.

Beginning in 2001, emerald shiners consistently contributed to forage biomass and abundance (Figure M.3). Emerald shiner abundance declined notably between 2007 through 2010, then increased dramatically to a time-series high in 2011 when they were the most abundant forage species. However, much of this increase was attributable to a single trawl haul. Emerald shiner abundance estimates declined once again in 2012, but they remain an important component of the eastern basin forage community.

Trout-perch (all life stages) comprised the largest contribution to the weight of our 2012 collections, followed by YOY white bass, YOY yellow perch, and alewife (Figure M.4). Rainbow smelt typically comprise the most biomass of all forage species, but were in relatively low abundance in 2012. Despite high variability in annual measures of individual species, overall forage fish abundance and diversity in 2012 remained at high levels relative to the entire time series.

Discussion

Bottom trawling suggests that autumn forage fish densities in the New York waters of Lake Erie have been high since 2001, but showed a sharp decline in 2012. During the 1990's large annual fluctuations in forage fish abundance observed in both acoustic and bottom trawl assessments have been attributed to an alternate-year cycle in rainbow smelt abundance.

Beginning in 2000, other species such as round gobies and emerald shiners emerged as important prey items. Round gobies have recently declined and their abundance appears to have since stabilized. Emerald shiners contributed to overall forage fish abundance during the early portion of the time period, and again in 2011. During most recent years, the contribution by smelt to overall forage fish abundance was somewhat diminished relative to earlier years of the survey. However, the 2009 forage fish index was especially dominated by YAO rainbow smelt, and by YAO and YOY smelt in 2010 collections. Despite being consistently high each year in this bottom trawling program, trout-perch are rarely observed in the diets of any major predators in the eastern basin of Lake Erie (See Sections F and L, this report). Alewife was also abundant in 2012, which is typically observed following particularly warm winters with little ice cover.

While New York's fall bottom trawling survey showed a relatively large decline in overall forage abundance in 2012, other surveys in the eastern basin of Lake Erie did not. A similar bottom trawling survey conducted in Long Point Bay, Ontario by the Ontario Ministry of Natural Resources showed high abundance of rainbow smelt, emerald shiners, and clupeids in 2012 (Forage Task Group 2013). Moreover, a summertime eastern basin acoustic survey showed high forage fish density throughout the basin, especially in the warmer epilimnion layers (Forage Task Group 2013). It is possible that the distribution of forage fishes changed between the summertime acoustic survey and the fall trawling survey in the New York waters of the eastern basin, especially for species such as rainbow smelt. However, it is also possible that New York's bottom trawling survey failed to accurately survey pelagic species such as emerald shiners and YOY smelt. Abundance of emerald shiners in our survey typically increases following lake turnover. Because differing proportions of samples are collected pre- and post-turnover from year to year, this is a known source of bias for indexing abundance of pelagic species, such as emerald shiners.

References

Culligan, W. J., F. C. Cornelius, D. W. Einhouse, D. L. Zeller, and R. C. Zimar. 1992. 1992 Annual Report to the Lake Erie Committee. New York Department of Environmental Conservation, Albany. 52 pp.

Forage Task Group 2013. Report of the Lake Erie Forage Task Group, March 2013. Presented to the Standing Technical Committee, Lake Erie Committee, Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

N. OPEN LAKE SPORT FISHING SURVEY

Donald W. Einhouse

Introduction

Since 1988, a direct contact sport fishing survey has been conducted to monitor boat fishing activity. This has been a standard, annual program that extends from May through October along the entire New York portion of Lake Erie. From 1993 to 1997 this survey was augmented by a spring creel survey of the nighttime walleye fishery, and those results were reported annually in earlier editions of this report (Einhouse et al. 2007). This nighttime survey component was suspended from 1998 to 2005, and then resumed during 2006 to update the status of this fishery. This nighttime survey is expected to occur intermittently in future years as resources permit.

Beginning in 2002 standard creel survey methodology no longer included an aerial boat count component. Since 2002, fishing activity has been measured from the five major harbors bordering New York's portion of Lake Erie. A limited number of aerial boat counts were conducted from 2002 to 2004 to evaluate whether the change in survey methodology affected absolute measures of fishing effort and harvest. This investigation found that previous and current survey procedures produced very similar results, but the current methodology was more administratively efficient and remained statistically robust (Einhouse 2005).

Methods

Survey Procedures

Standard survey methods from 1988 to 2001 were patterned after a study by Schmidt (1975). Schmidt's approach collects effort and catch information as independent samples with two collection schedules of stratified random sampling. Aerial counts of fishing boats were conducted to measure daytime fishing effort. Catch and harvest data were obtained by roving between five to six representative fishing access sites to conduct interviews of boat anglers who had just completed their fishing trip. Angler interviews were conducted between 0900 EDT and 1 hour after sunset.

During 1991, and for all surveys after 2001, a new standard methodology was implemented. Our current method to estimate fishing effort is an "access approach" described by Pollock et al. (1994). The specific procedures for this access method of creel design as applied to the New York waters of Lake Erie are described in a separate report (Einhouse 2005).

The sampling period to assess the daytime open lake sport fishery occurs from May through October each year. Data collection for our current methodology is now stratified by day type (weekday-weekend day), harbor, and month. Although survey procedures changed after 2002, some independent measures of fishing and boating activity (annual paid launch totals at municipal ramps) suggest our results remain directly comparable for the entire 1988 to 2012 time series (Einhouse 2005).

Data Analysis

Daytime creel survey estimates for fishing effort, harvest, and catch rates, with associated precision (standard error) measures, were calculated for each stratum using the formulae described in Einhouse 2005.

Survey Results

Overall 2012 open water sport fishing effort in New York waters of Lake Erie was estimated at 337,770 angler-hours. Peak fishing activity occurred during July and the most frequently used site was the Buffalo Small Boat Harbor, which accounted for approximately 30 percent of measured boat fishing effort in 2012 (Table N.1). The remaining four major access harbors each had approximately similar angler effort totals.

TABLE N.1. The distribution of 2012 open water boat fishing effort in New York's portion of Lake Erie.

Distribution of Boat Fishing Effort (angler-hours)							
Harbor	May	Jun	Jul	Aug	Sep	Oct	Total
Barcelona	3,831	26,509	13,648	15,498	1,111	200	60,797
Dunkirk	12,507	9,545	27,520	9,367	1,513	1,221	61,673
Cattaraugus	7,317	10,945	16,415	12,059	6,603	1,258	54,597
Sturgeon Pt.	6,044	14,006	15,235	11,333	11,108	122	57,848
Small Boat Harbor	27,886	16,372	32,451	17,402	8,467	278	102,856
Total angler-hrs (2 std err.)	57,585	77,378	105,267	65,659	28,803	3,079	337,770 (49,617)

The 2012 fishing effort estimate was the highest total measured total since 2005; but only a slight increase (4 %) from 2011(Figure N.1). This was also the third consecutive year boat fishing effort increased on Lake Erie. The overall boat fishing effort in 2012 ranked as the 19th highest of 25 observations from 1988 to 2012.

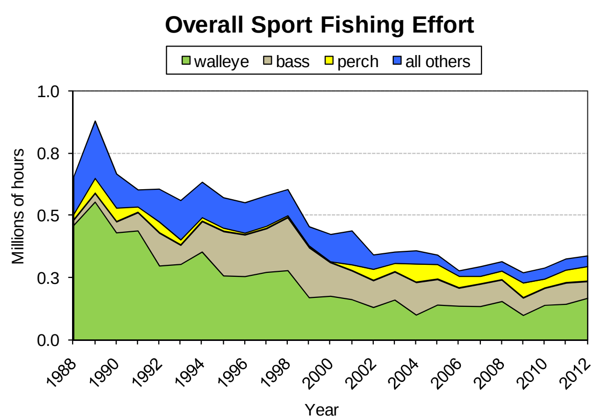


FIGURE N.1. Open water sport fishing effort in New York waters of Lake Erie by walleye anglers, bass anglers, perch anglers and all others, May-October, 1988-2012.

During the 2012 fishing season, walleye angling was the largest component of the boat fishery accounting for 50 percent of the overall angling effort (Figure N.2). Smallmouth bass angling ranked second in boat fishing effort with 20 percent of the total. Among the remaining effort, anglers fishing for yellow perch contributed 17 percent of the overall effort. Most of the remaining 2012 fishing effort was by anglers fishing for "anything".

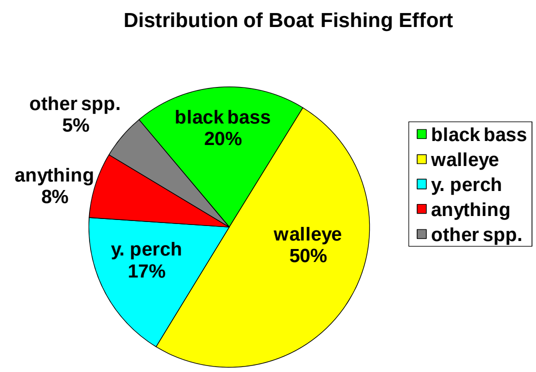


FIGURE N.2. Distribution of directed sport fishing effort by boat anglers in New York waters of Lake Erie, May-October, 2012.

In 2012 the total estimated daytime walleye harvest was 36,973 fish (Table N.2), the second highest total during the last 6 years, but near the 25-year survey series average (Figure N.3).

TABLE N.2. Harvest of selected species by boat anglers fishing on the New York waters of Lake Erie, May-October, 2012.

SPECIES	HARVESTED	Conf. lmts.	CAUGHT	Conf. lmts.
yellow perch	147,631	24%	221,613	24%
walleye	36,973	22%	49,810	24%
smallmouth bass	3,903	43%	87,009	20%
white bass	1,047	43%	26,378	20%
lake trout	528	53%	1,345	44%
white perch	509	73%	6,702	31%
** 20 other species	3,194		49,019	

* approx. 95 % conf. limits as % of point estimate, (2 std err)
** > 50 % of catch & harvest of other species were goby and sheepshead

Estimated 2012 walleye fishing effort was 168,622 angler-hours, above the previous 10 year average. Walleye fishing effort over the last 10 years has been low relative to earlier observations (Figure N.3).

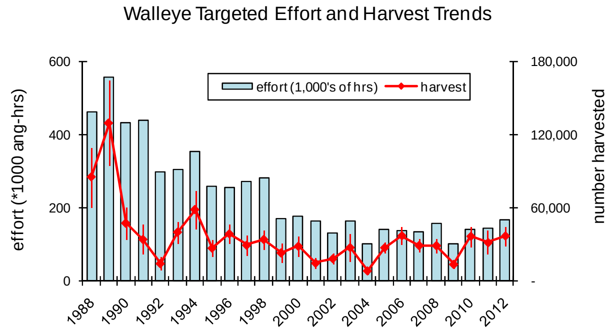


FIGURE N.3. Annual trends in walleye sport fishing effort (angler-hours) and number harvested from May-October, 1988- 2011.

The 2012 walleye sport fishery peaked during July, and the June through August period contributed 96 percent of the total catch and harvest estimates (Table N.3). The Buffalo Small Boat Harbor survey location contributed the largest share of the walleye catch during 2012.

TABLE N.3. Distribution of daytime walleye catch and harvest totals in the New York waters of Lake Erie during 2012.

		2012 walleye catch and harvest distribution						
		May	June	July	August	September	October	Total
Barcelona	catch	68	3,125	2,971	3,613	96	-	9,874
	harvest	68	2,925	2,513	3,165	96	-	8,767
Dunkirk	catch	55	295	7,023	2,993	117	-	10,484
	harvest	25	258	5,788	2,575	110	-	8,756
Cattaraugus	catch	6	1,068	2,837	2,200	184	-	6,295
	harvest	6	793	1,928	2,043	184	-	4,954
Sturgeon	catch	52	788	3,527	2,715	658	-	7,740
	harvest	39	603	3,088	2,084	597	-	6,411
Buffalo	catch	626	4,746	8,781	1,263	-	-	15,417
	harvest	337	1,615	5,366	767	-	-	8,085
Total	catch	807	10,022	25,140	12,785	1,055	-	49,810
	harvest	475	6,195	18,683	10,635	986	-	36,973

The overall targeted walleye catch rate during the 2012 fishing season was 0.26 fish per hour, the third highest observed (Figure N.4). Walleye catch rates have been above average in seven of the past ten years. The average total length of harvested walleye in 2012 was 22.9 inches (Figure N.4).

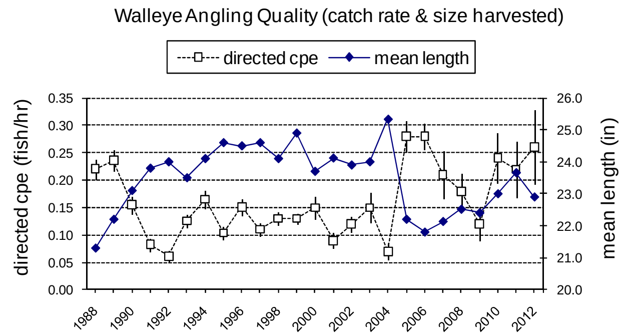


FIGURE N.4. Annual trends in walleye sport fishing quality as measured by mean length harvested (inches) and catch rate (number per hour or cpe) from 1988 to 2012.

Measures of walleye angler success can also be expressed as frequency of boat limit catches and frequency of zero catches for targeted walleye fishing trips. Table N.4 shows that boat limit catches of walleye remain an uncommon occurrence across all years, while complete lack of success (zero catch) is a much more common occurrence. During 2012, only 5 percent of non-charter walleye fishing boats achieved a party limit, while 43 percent failed to harvest any walleye.

TABLE N.4. Walleye fishing boat metrics for mean catch rates, mean catch per boat party and percentage of limit and zero boat catches from 2002 to 2012.

	Walleye Angler Success measures for New York's portion of Lake Erie						
	ave. walleye / ang-hr		ave. walleye / boat trip		Walleye boat trips		daily limit
Year	HPE	CPE	harvest	catch	% Limits	% Zero	regulation
2002	0.11	0.12	1.4	1.5	1.7%	52.8%	5
2003	0.14	0.15	2.2	2.3	4.5%	44.7%	4
2004	0.07	0.07	0.8	0.8	0.8%	69.6%	4
2005	0.17	0.28	2.4	3.9	10.9%	48.2%	4
2006	0.23	0.28	3.2	3.8	15.2%	35.8%	4
2007	0.19	0.21	2.6	2.9	4.3%	40.8%	5
2008	0.16	0.18	2.2	2.5	2.9%	47.3%	5
2009	0.12	0.13	1.5	1.7	2.5%	55.8%	5
2010	0.21	0.24	2.9	3.4	6.8%	40.7%	5
2011	0.19	0.22	2.7	3.1	5.4%	43.1%	5
2012	0.19	0.26	2.8	3.7	5.2%	43.3%	5

The age distribution of the walleye harvest was determined from otolith samples taken at fish cleaning stations, and was extrapolated to estimate total number of fish caught by age class (Figure N.5). Age-9 and older walleye, mostly comprised of the dominant 2003 year class, was the most abundant age category contributing 53 percent of the overall walleye harvest. Age-2 walleye were the second most abundant age group accounting for approximately 18 percent of the harvest. The age 4 (2008 year class) and age 5 (2007 year class) cohorts also contributed measurably to the 2012 harvest.

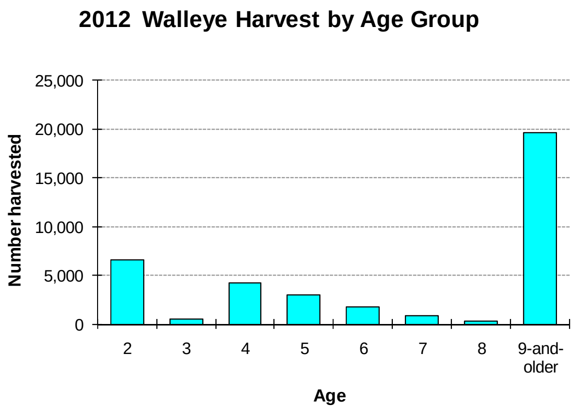


FIGURE N.5. Age distribution of the 2012 walleye harvest estimated by expanding the age distribution of samples at fish cleaning stations with the 2012 walleye harvest estimate.

Smallmouth bass harvest was estimated at 3,909 fish in 2012, which amounted to only 4 percent of the total bass catch (Table N.2). In 2012, approximately 48 percent of the catch and 52 percent of the harvest was reported from the Buffalo Small Boat Harbor survey location (Table N.5).

TABLE N.5. Distribution of smallmouth bass catch and harvest totals in the New York waters of Lake Erie during 2012.

		2012 smallmouth bass catch and harvest distribution						
		May	June	July	August	September	October	Total
Barcelona	catch	2,892	3,025	497	168	67	53	6,701
	harvest	-	623	248	-	-	-	871
Dunkirk	catch	24,774	2,989	571	688	-	-	29,022
	harvest	6	65	74	-	-	-	144
Cattaraugus	catch	986	885	1,866	251	160	255	4,403
	harvest	-	244	200	-	24	-	468
Sturgeon	catch	1,513	1,123	1,211	849	360	12	5,068
	harvest	-	117	133	90	31	-	371
Buffalo	catch	20,027	6,002	8,693	5,075	2,017	-	41,815
	harvest	48	196	1,020	451	332	-	2,047
Total	catch	50,192	14,024	12,838	7,032	2,604	319	87,009
	harvest	54	1,244	1,676	541	387	-	3,903

The smallmouth bass harvest estimate was the lowest value measured during this 25-year survey. The accompanying bass fishing effort estimate was the 4th lowest value observed (Figure N.6).

Smallmouth bass was the second most frequently caught species (87,009 fish) by boat anglers (Table N.2). The 2012 overall catch rate by bass anglers was 1.25 bass per hour, and mean length of harvested smallmouth bass was 17.4 inches in 2012 (Figure N.7). However, very few smallmouth bass were sampled (N = 19) for this measure of average harvested length.

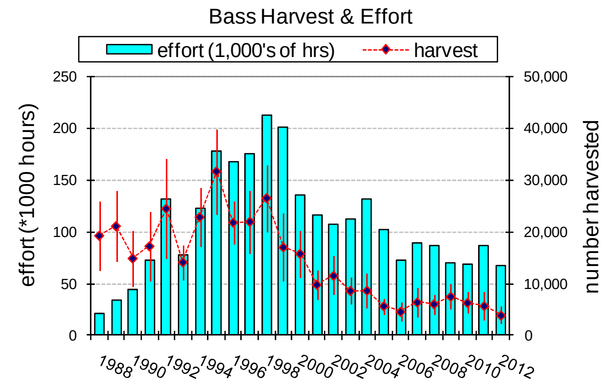


FIGURE N.6. Annual trends in smallmouth bass sport fishing effort (angler-hours) and number harvested from May through October 1988 to 2012.

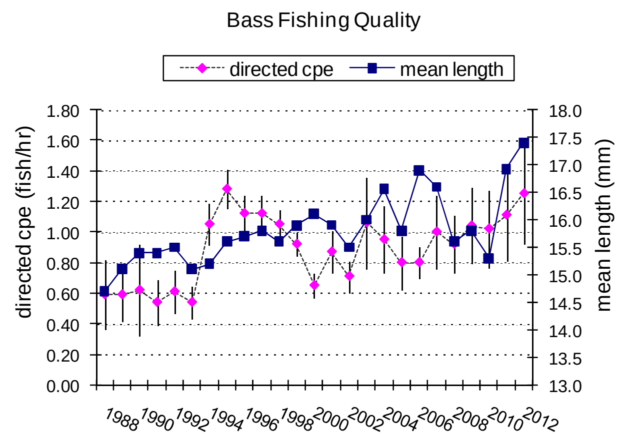


FIGURE N.7. Annual trends in smallmouth bass sport fishing quality as measured by mean length harvested (inches) and catch rate (number per hour or cpe) from 1988 to 2012.

In 2012, ages were determined from only 19 smallmouth bass scale samples. Ages ranged from age-4 to age-14, with a modal value of age-7.

Yellow perch was the most caught and harvested species by boat anglers in 2012 (Table N.2). Yellow perch harvest (147,631 fish) and effort (58,620 ang-hrs) were the 2nd and 6th highest recorded, respectively (Figure N.9).

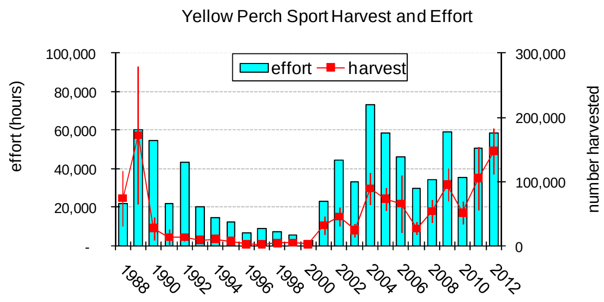


FIGURE N.9. Annual trends in yellow perch sport fishing effort (angler-hours) and number harvested from May through October 1988 to 2012.

Approximately 83 percent of the 2012 yellow perch harvest was reported from Cattaraugus Creek and Sturgeon Point Harbors collectively (Table N.6). Seasonally, the month of September accounted for most (33 percent) of the 2012 harvest of yellow perch.

TABLE N.6. Distribution of yellow perch catch and harvest totals in the New York waters of Lake Erie during 2012.

		2012 yellow perch catch and harvest distribution						
		May	June	July	August	September	October	Total
Barcelona	catch	-	167	306	728	10	-	1,210
	harvest	-	122	162	417	-	-	701
Dunkirk	catch	2,784	2,279	3,484	1,119	921	1,652	12,240
	harvest	1,889	1,578	2,507	674	461	1,542	8,650
Cattaraugus	catch	9,491	12,296	3,747	32,691	29,507	3,109	90,842
	harvest	7,524	9,794	2,560	25,965	17,834	2,106	65,782
Sturgeon	catch	10,744	16,898	4,086	7,604	49,725	515	89,572
	harvest	7,615	12,925	2,169	4,233	29,971	185	57,098
Buffalo	catch	19,626	2,463	2,195	2,256	1,210	-	27,750
	harvest	12,726	294	732	1,624	24	-	15,399
Total	catch	42,645	34,102	13,818	44,398	81,373	5,276	221,613
	harvest	29,754	24,713	8,130	32,912	48,289	3,833	147,631

The 2012 overall yellow perch catch rate was 3.31 perch per hour, the highest observed in the time series (Figure N.10). The mean length of harvested yellow perch was 10.8 inches in 2012, and has remained very similar in recent years.

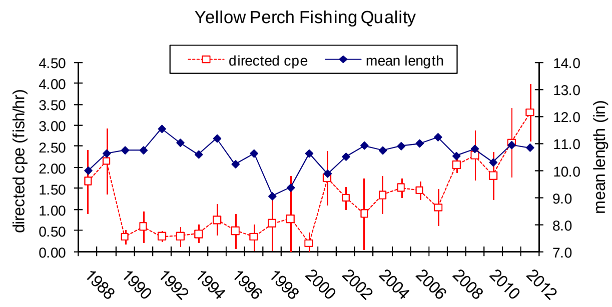


FIGURE N.10. Annual trends in yellow perch sport fishing quality as measured by mean length harvested (inches) and catch rate (number per hour or cpe) from 1988 to 2012.

The age distribution of the yellow perch harvest was determined from anal spine samples, and was extrapolated to estimate total number of fish caught by age class. Age-4 through age-6 yellow perch, from consecutive strong 2006 through 2008 year classes, accounted for approximately 74 percent of the yellow perch harvest (Figure N.11).

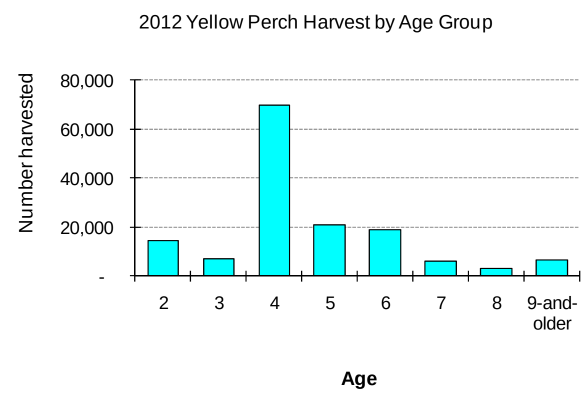


FIGURE N.11. Age distribution of the 2012 yellow perch harvest estimated by expanding the age distribution of samples collected during the angler survey with the 2012 yellow perch harvest estimate.

Sport catch and harvest estimates for other prominent species are presented in Table N.2. Round gobies remained a commonly encountered nuisance species for anglers in 2012. Lake trout, rainbow trout, brown trout, coho and pink salmon were the salmonids identified among harvested species in the 2012 survey. Lake trout was the most caught (1,345 fish) and harvested (528 fish) of these five salmonid species. Rainbow trout harvest estimates during the most recent four years of this survey were among the lowest observed. In all, at least 20 species were reported caught, representing an estimated total catch of 441,874 individual fish from the 2012 angler survey. Smallmouth bass, yellow perch and walleye comprised approximately 97 percent of the total 2012 harvest. These same three species accounted for 81 percent of the 2012 catch.

Discussion

A declining trend in boat fishing effort began in 1999, however, small increases have been observed over the past 3 years. Lake Erie's overall decline in boat fishing effort from the 1980's remains consistent with broad trends observed in other waters and is likely attributable to factors independent of fishing quality. Other contributors to these declines in fishing effort may include high fuel prices and aging of the boat angling population.

In 2012, walleye fishing quality was excellent compared to the 25 year survey period. Walleye fishing quality peaked in July, but was generally good throughout the summertime period. The dominant 2003 walleye year class has been largely responsible for the excellent quality fishing, which first emerged as this exceptional cohort began recruiting to the sport fishery in 2005. Walleye in New York's portion of Lake Erie typically make their peak contribution to the sport fishery as age-4 individuals. As such, the impact to the walleye fishery by this single year class was expected to begin to wane beginning in 2009 and thereafter. The 2009 walleye catch rates did decline as expected, but then sharply rebounded from 2010 through 2012. More recent, moderately abundant year classes (see Section D) were not expected to compensate for continued attrition of the 2003 year class. However, another well known factor contributing to walleye fishing quality in the eastern basin of Lake Erie are summertime movements of walleye from more westerly Lake Erie waters into the central and eastern basins. The segment of the western basin walleye population largely responsible for this seasonal (summertime) movement is generally larger and older walleye, and the magnitude of this seasonal immigration varies between years and may be attributable to factors independent of walleye densities (Einhouse and MacDougall 2010).

Bass angling quality has been reasonably constant in recent years, as measured by angler catch rates and average size of harvested smallmouth bass. These measures characterize Lake Erie's bass angling quality as excellent. Conversely, smallmouth bass harvest totals have plummeted in recent years to the lowest observed in the time series. A notable trend of increasing catch-and-release fishing preferences by bass angling specialists is partly responsible for the disconnect between trends in harvest totals and catch rates. In addition, some of the smallmouth bass harvest from Lake Erie's sport fishery includes anglers not targeting black bass, which at times has contributed as much as 70 percent of the total smallmouth bass harvest in any given year. As such, smallmouth harvest estimates for the entire sport fishery do not necessarily mirror targeted catch or harvest rates experienced by bass specialists, who primarily release black bass. Since 2001, catch rates experienced by smallmouth bass anglers began to diverge from overall harvest totals for Lake Erie. Initially we attributed declining harvest rates to the emerging knowledge of botulism induced fish kills, particularly from 2001 to 2003, which likely reduced motivation to harvest smallmouth bass among some anglers. However, more recently, botulism outbreaks have faded along with accompanying angler concerns about fish consumption. Instead, the emergence of excellent quality yellow perch fishing seems to present a more plausible alternative for anglers interested in consuming their day's catch. Independent measures of the smallmouth bass population (Section D) suggest the adult bass population has remained reasonably abundant through recent years. However, these same indicators also suggest increased growth and perhaps elevated natural mortality rates for smallmouth bass in recent years.

Beginning in 2001 excellent yellow perch fishing quality returned after a full decade of poor fishing through the 1990's. Improvements in yellow perch fishing quality are consistent with other population indicators (Sections C and D) indicating greatly improved status from the low, 1990's levels. In 2012, yellow perch fishing effort and harvest were both very high and reflective of excellent fishing quality. However, as recently as 2007, yellow perch fishing activity declined in springtime but eventually rebounded by late-summer that year. The recent 2007 dip in perch fishing activity corresponded with implementation of restrictive bait fish regulations enacted to slow the spread of the fish pathogen Viral Hemorrhagic Septicemia virus (VHSv). Independent evidence that angler attitudes about bait fish regulations influenced yellow perch fishing effort, especially in 2007, were found in other elements of our angler survey. We measured the rate of refused angler interviews, which doubled between 2006 and 2007, and again between 2007 and 2008, another relatively low fishing effort year. Although the absolute "refused interview" total remained a small fraction of all our angler contacts, increased encounters with non-cooperative anglers was a very apparent change, and coincident with implementation of those unpopular bait fish regulations. Although yellow perch fishing effort subsequently rebounded, and fishing quality remained well within an acceptable range, dissatisfaction concerning bait fish regulations has been clearly the most prominent issue encountered by angler survey technicians through recent years. In 2011 a significant relaxation of bait regulations was implemented easing transportation restrictions within a Lake Erie corridor. This change was strongly supported by the Lake Erie perch angling community and measured increases in yellow perch fishing activity along with robust yellow perch fishery performance in 2012 have accompanied this new regulation.

During 2004, angler survey methodology became a major focus for both NYSDEC and the Lake Erie fisheries management community. Specifically, New York's Lake Erie angler survey methods were subject to an independent scientific review of Lake Erie's walleye and yellow perch harvest estimation methods, sponsored by the Great Lakes Fishery Commission (GLFC). In response to GLFC's independent review, the Lake Erie Unit prepared a comprehensive report thoroughly documenting past and present angler survey procedures (Einhouse 2005). The findings of the GLFC independent review have been published (Lester et al. 2005) and New York is making every reasonable effort to adopt recommendations toward advancing a defensible, scientifically sound creel survey methodology. The first independent review recommendation was implemented in spring 2006 by monitoring a subordinate component of the walleye fishery. The 2006 nighttime survey found 7 percent of overall walleye fishing effort and 10 percent of the harvest occurred at night (Einhouse et al. 2007). The spring (May-June), nighttime walleye fishery was scheduled for a regularly programmed survey at 3-year intervals, with subsequent surveys to be conducted in 2009 and 2012; however these planned surveys have not occurred due to ongoing staffing constraints which will delay this survey for the foreseeable future.

References

Einhouse, D. W. 2005. Angler Survey Methods for Lake Erie's Open Water Sport Fishery. New York State Department of Environmental Conservation, Albany, New York. 68 pp.

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

Einhouse, D. W. and T. M. MacDougall. 2010. An emerging view of stock contributions to Lake Erie's eastern basin walleye resource. In Status of walleye in the Great Lakes: proceedings of the 2006 Symposium. Great Lakes Fish. Comm. Tech. Rep. 69. pp 151 -164..

Lester, N., A. Bingham, W. Clark, K. Pollock, and P. Sullivan. 2005. Report of the Blue Ribbon Panel for Review of Procedures Used to Estimate Percid Harvest in Lake Erie. Great Lakes Fishery Commission Special Publication.

Pollock, K. H. 1994. Angler survey methods and their application in fisheries management. American Fisheries Society Special Publication 25. American Fisheries Society, Bethesda, Maryland.

Schmidt, B. R. 1975. Results and Evaluation of an Aerial Creel Survey Technique on Lake Sharpe, South Dakota. Master's Thesis, South Dakota State U., Brookings, SD, USA.

O. SUMMARY OF THE 2011-12 TRIBUTARY ANGLER SURVEY

James L. Markham

The 2011-12 angler survey was conducted to continue efforts to monitor and obtain current information on the attributes of New York's Lake Erie tributary salmonid fishery, including estimates of effort, catch, and harvest, angler demographics, and opinions on management issues. This information serves an important function to objectively assess fishing quality, angler characteristics and angler views used in fisheries management decisions. Although this survey covered both the tributary and harbor fisheries, only results of the tributary fishery are summarized in this report (see Markham 2012 for full results; http://www.dec.ny.gov/outdoor/32286.html).

This was the fourth angler survey conducted on New York's Lake Erie tributaries since 2003 (Markham 2006; Markham 2008). The only prior survey was the benchmark Great Lakes angler survey conducted in 1984 (NYSDEC 1984). The 1984 survey covered Chautauqua, Canadaway, Cattaraugus, and Eighteen Mile Creeks as well as the winter fishery in Dunkirk Harbor, obtaining estimates of overall effort, catch, and harvest. The results indicated that spring tributary effort was mainly directed at steelhead while fall fishing was distributed among a variety of salmonid species. Recent angler surveys conducted in 2003-04, 2004-05, and 2007-08 revealed high steelhead angler effort and success from fall through spring.

STUDY AREA

This survey covered the eight Lake Erie tributaries in New York stocked with steelhead (Figure O.1). These include: Chautauqua Creek, Canadaway Creek, Cattaraugus Creek, Eighteen Mile Creek, Silver Creek, Walnut Creek, Buffalo Creek, and Cayuga Creek. Although anglers fish in other non-stocked tributaries, the 2003 Lake Erie angler diary data show 93% of angler cooperator effort was directed to these eight tributaries (Einhouse *et al.* 2005). Silver and Walnut Creeks, because of their close proximity and small size, were treated as one

Angler Survey Tributaries and Harbors

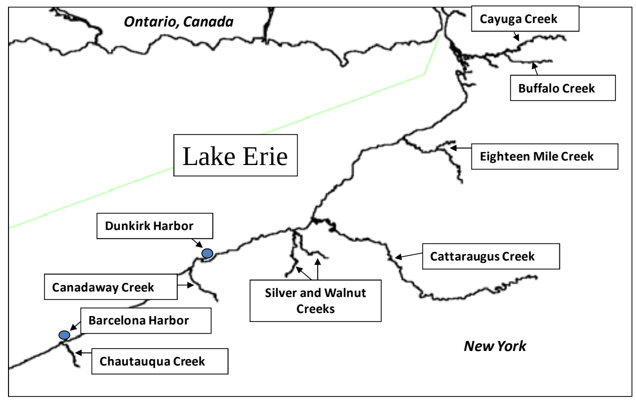


FIGURE O.1. Map of New York water of Lake Erie showing locations of tributaries and harbors sampled during a salmonid angler survey from 15 September 2011 – 15 May 2012.

creek for survey design purposes. Conversely, Cattaraugus Creek, because of its large size, was split into Upper and Lower Sections for efficient sampling, but combined as one system for reporting results. One of the more popular angling destinations on Cattaraugus Creek is the Seneca Nation of Indians (SNI) Reservation which encompasses approximately 14 of the creek's 34 miles downstream of the first barrier impassable by fish. Anglers fishing on SNI territory are subject to a separate fishing license. SNI granted permission to conduct the angler survey on their lands, and all results were included as part of Cattaraugus Creek. The entire sample area for each tributary varied, but the survey generally covered from the mouth upstream to the first impassible barrier. Major access sites along each creek were selected for both car counts and angler interviews.

METHODS

Standard survey methods have been employed throughout the survey's history. Occasionally individual sites have been either added or deleted based on new knowledge and experiences to obtain the most accurate estimates of angler effort and maintain an efficient survey design. No sites were altered for the 2011-12 angler survey.

The design chosen for this survey is a roving-roving methodology described by Pollock *et al.* (1994). The design requires survey technicians to conduct both angler counts and interviews, which were conducted separately to provide the best estimate of instantaneous effort (Malvestuto 1983). The survey was conducted from 15 September 2011 through 15 May 2012, encompassing the majority of the tributary fishing season. All weekends and holidays were sampled as well as three weekdays (on average) by each creel agent per week. Each day was further separated into secondary sampling units (divided into two equal, non-overlapping segments) and labeled as AM or PM shifts. Daily hours encompassed sunrise to sunset, which approximated legal fishing hours. The specific methods for this creel survey are described in a separate report (Markham 2012).

CALCULATIONS

Estimates for fishing effort, catch, and harvest along with appropriate measures of error were made following the formulae and examples for the roving-roving creel design of Pollock *et al.* (1994), Lockwood *et al.* (1999), and Schmidt (1975). Further details of the calculations are described in the full creel report (Markham 2012).

RESULTS

Survey technicians conducted a total of 1,612 interviews at 73 sites along Lake Erie tributaries between 15 September 2011 and 15 May 2012 (Table O.1). A large majority of the interviews (1,440; 89%) were from anglers targeting salmonids. The non-salmonid effort was mostly from anglers targeting bass or "anything that bites", and occurred mainly at the end of the spring period. For analysis purposes, all results include only anglers targeting salmonids although total angler effort and catch rates were used to determine total catch and harvest estimates. Similar to previous surveys, the most interviews were obtained from Cattaraugus Creek (680) with high numbers of interviews also obtained from Chautauqua, Canadaway, and Eighteen Mile Creeks (Table 1). As in previous surveys, Cayuga and Silver/Walnut Creeks produced the fewest angler interviews.

TABLE O.1. Total number of angler interviews conducted between 15 September 2011 - 15 May 2012 on New York's Lake Erie streams.

	Interviews	
Tributaries	**Total**	**Targeting Salmonids**
Chautauqua	223	216
Canadaway	145	139
Silver/Walnut	38	34
Cattaraugus	680	577
Eighteen Mile	355	318
Buffalo	104	93
Cayuga	67	63
Tributary Total	**1,612**	**1,440**

Angler Effort

Total tributary salmonid angling effort was estimated at 181,985 angler-hours (*ah*) in 2011-12. Based on a mean tributary trip length of 3.13 hours, as calculated from complete trip interviews (N=273), the targeted individual stream trips for salmonids in 2011-12 equaled 76,411.

Cattaraugus (62,798 *ah*), Eighteen Mile (53,242 *ah*), Chautauqua (26,693 ah), and Canadaway Creeks (18,626 ah) received the majority (89%) of angler effort (Figure O.2). Silver/Walnut and Cayuga Creeks, the smallest of the stocked tributaries, received the least angler effort (4,301 and 4,381 *ah*, respectively).

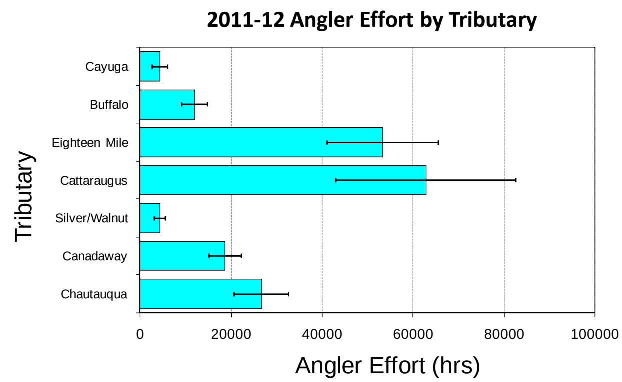


FIGURE O.2. Total angler effort (angler-hrs) targeting salmonids in tributaries of New York waters of Lake Erie, 15 September 2011 – 15 May 2012. Error bars show 2 standard errors of the total effort.

The months of October, November, and March combined for 63% of the targeted tributary angling effort (Figure O.3). Angling effort declined during the winter months when fishing conditions were less favorable.

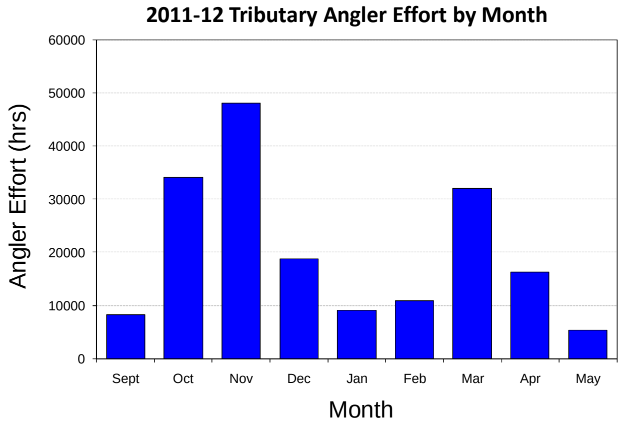


FIGURE O.3. Total angler effort (angler-hrs) targeting salmonids by month in the New York tributaries of Lake Erie, 15 September 2011 – 15 May 2012.

Catch and Harvest Rates

The overall tributary catch rate for anglers targeting salmonids averaged 0.35 fish per angler-hour; the accompanying harvest rate was 0.06 fish/hr. Based on these rates, an angler caught a salmonid, on average, every 2.9 hours or 171 minutes. The overall catch rate for steelhead was 0.34 fish/hr.

Catch rates were highest in the western-most streams (Figure O.4). Chautauqua Creek anglers experienced the greatest overall catch rate at 0.62 fish/hr, followed by Silver/Walnut Creeks at 0.55 fish/hr. Cattaraugus Creek, the most-fished water, produced an overall catch rate of 0.31 fish/hr. Catch rates in the lower section (0.36 fish/hr) were greater than those in the upper portion (0.27 fish/hr). Buffalo Creek had the lowest tributary catch rate (0.20 fish/hr).

Harvest rates followed the same general patterns as catch rates with the exception of Silver/Walnut and Cayuga Creeks, where harvest rates were lower than expected (Figure O.4). The greatest harvest rates were from Canadaway (0.07 fish/hr) and Chautauqua (0.07 fish/hr) Creeks.

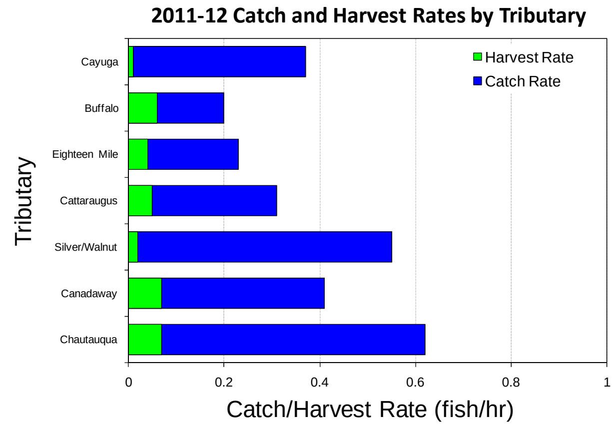


FIGURE O.4. Targeted catch and harvest rates (fish/hr) of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2011 – 15 May 2012.

Tributary catch rates increased throughout the autumn and peaked in November, then gradually declined throughout the winter months (Figure O.5). Catch rates rebounded in April before declining again in May. Peak catch rates occurred in November (0.45 fish/hr) and April (0.43 fish/hr). Harvest rates did not follow the same patterns as catch rates. Harvest rates were similar from October through January, and then declined throughout the rest of the survey period (Figure O.5).

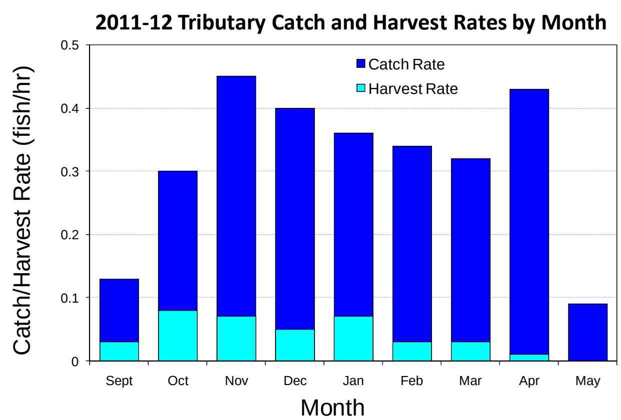


FIGURE O.5. Targeted monthly catch and harvest rates (fish/hr) of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2011 – 15 May 2012.

Overall Catch

Lake Erie tributary anglers caught an estimated 66,009 salmonids during the 2011-12 fishing season. Steelhead continued to be the most caught species (63,835 fish; 97%) while both brown trout (1,749 fish; 3%) and Chinook salmon (425 fish; >1%)

remained minor contributors. Cattaraugus (19,913 fish; 30%), Chautauqua (18,757 fish; 28%), Eighteen Mile (11,539 fish; 17%), and Canadaway (9,805 fish; 15%) Creeks accounted for over 90% of the total catch (Figure O.6).

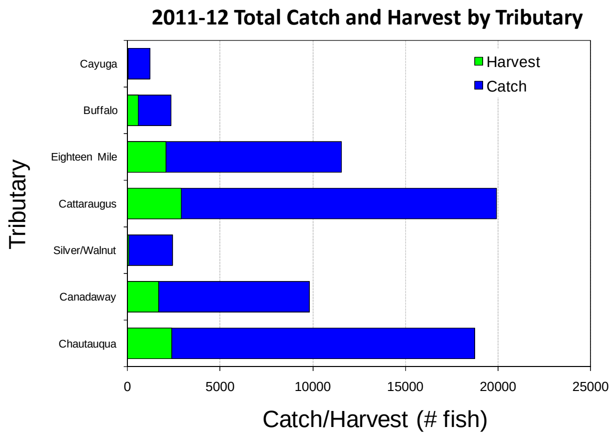


FIGURE O.6. Total catch and harvest of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2011 – 15 May 2012.

Overall tributary catch by month generally followed the same trend as angling effort. The months with the highest angler effort (October, November, and March; Figure O.3) were those with the highest catch (Figure O.7). Almost 65% of the total catch was recorded during these three months. As seen in previous angler surveys, lower catches occurred at the beginning (September) and end (May) of the 2011-2012 season, and during the winter months when the weather conditions were less than ideal for many anglers.

Overall Harvest

Overall harvest from the tributary fishery was estimated at 9,720 salmonids, which was 15% of the total estimated catch. Steelhead comprised the majority of the overall harvest (98%) with brown trout and pacific salmon comprising the remaining proportion. As a percentage of their total catch, steelhead had the highest harvest rate (15%), while 10% of the brown trout and salmon were harvested. Not surprisingly, the four tributaries that accounted for 90% of the total catch (Cattaraugus, Chautauqua, Eighteen Mile and Canadaway Creeks) also accounted for 93% of the tributary harvest (Figure O.6). Only minor harvests were recorded at all other surveyed streams.

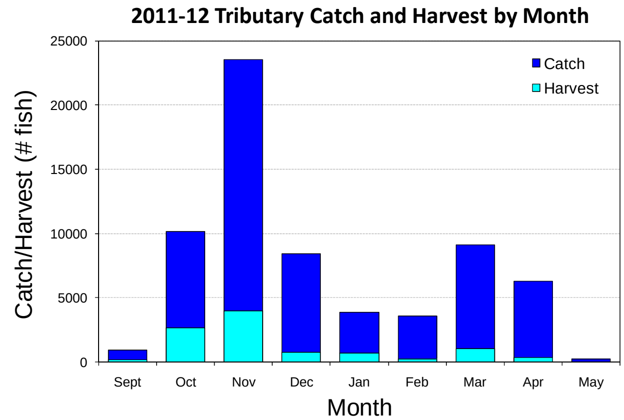


FIGURE O.7. Monthly catch and harvest of salmonids by anglers fishing the New York tributaries of Lake Erie, 15 September 2011 – 15 May 2012.

Overall harvest by month mirrored overall catch. The highest harvests occurred in October, November, and March (Figure O.7). Modest numbers of fish were also harvested during December and January, with lesser amounts in all other months.

Trends in the Fishery

While previous surveys documented stable, high quality fisheries, the 2011-12 angler survey indicated significant declines occurred in both catch rates and total catch. Estimated angler effort in 2011-2012 declined 10% relative to the 2007-08 survey (Figure O.8). Catch rates, which were previously stable at around 0.60 fish/hr, declined 42% to 0.35 fish/hr in 2011-12 (Figure O.9). Consequently, overall catch plummeted 47% from 2007-08 to 2011-12 (Figure O.10).

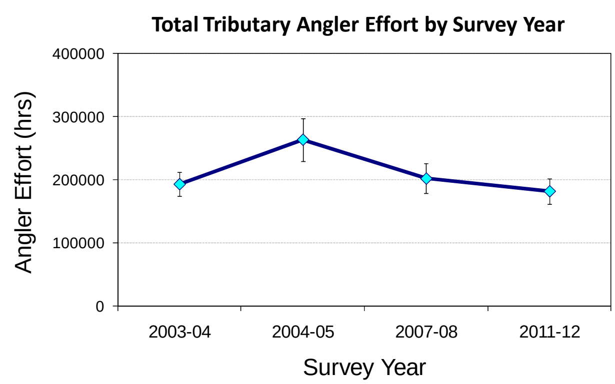


FIGURE O.8. Total salmonid angler effort (angler-hrs) from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, and 2011-12. Error bars show 2 standard errors of the total effort.

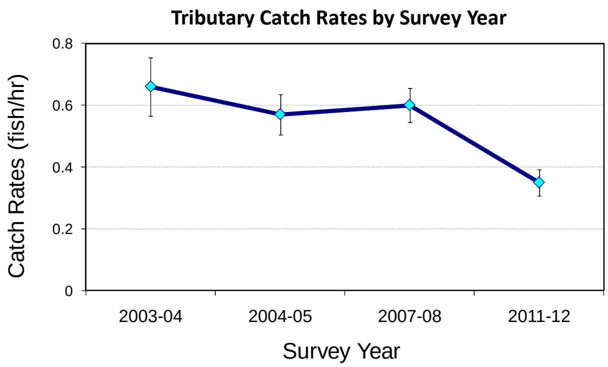


FIGURE O.9. Targeted catch rates (fish/hr) of salmonids from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, and 2011-12. Error bars show 2 standard errors of the catch rate.

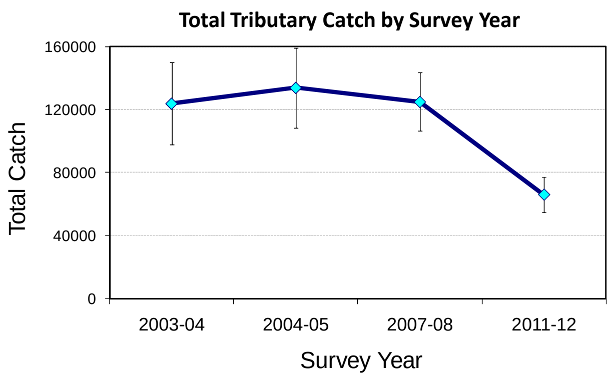


FIGURE O.10. Total catch of salmonids from New York's Lake Erie tributaries estimated from creel surveys in 2003-04, 2004-05, 2007-08, and 2011-12. Error bars show 2 standard errors of the total catch.

DISCUSSION

The 2011-12 angler survey indicated a decline in tributary angler effort and salmonid fishing quality from previous surveys. Average catch rates decreased from 0.60 fish/hr in 2007-08 to 0.35 fish/hr in 2011-12, a 42% decline, and total catch declined 47% over this same time period. Five of the seven streams (exceptions being Chautauqua and Silver/Walnut Creeks) surveyed had catch rates below 0.50 fish/hr.

Despite the decline in the fishery, some aspects of the 2011-12 tributary angler survey were very similar to previous surveys (see Markham 2006 and Markham 2008). Four tributaries (Cattaraugus, Eighteen Mile, Canadaway, Chautauqua Creeks) continue to receive the bulk of the effort, catch, and harvest despite quality fishing in other surveyed streams. Catch rates remain highest in western-most streams and generally decline eastward, possibly due to influences from high steelhead stocking rates in Pennsylvania streams.

The 10% decline in tributary angler effort observed in 2011-12 compared to the 2007-08 survey was mainly attributable to Cattaraugus Creek. In 2007-08, Cattaraugus Creek accounted for 91,327 *ah* while combined angler effort on other surveyed tributaries equaled 110,815 *ah*. In 2011-12, angler effort was nearly 30,000 *ah* less on Cattaraugus Creek (62,798 *ah*) while combined effort on other tributaries totaled 119,187 *ah*. As seen in previous surveys, high water conditions in Cattaraugus Creek are unsuitable for angling, causing an increase in angler effort in other tributaries. Slight increases in overall angler effort from the 2007-08 survey to 2011-12 survey occurred in Canadaway, Silver/Walnut, Eighteen Mile, Buffalo, and Cayuga Creeks while angler effort in Chautauqua Creek only dropped slightly (539 *ah*).

Comparisons of monthly angler effort between the two surveys indicate that the months of October and April accounted for the greatest differences in Cattaraugus Creek angler effort. In October, the 2007-08 survey recorded 15,868 *ah* more than the 2011-12 survey, mainly due to heavy rain events in October 2011 that generated water flows in excess of 1,000 cfs five times (fishable conditions are generally <500 cfs). In contrast, October 2007 was very dry and water flow exceeded 1,000 cfs on only one occasion. Differences in April angler effort were likely due to winter severity. The winter of 2011-12 was warm with virtually no snow to cause a spring melt and subsequent high water conditions. Record temperatures in March 2012 caused an increase in angler effort and early spring steelhead runs. Consequently, the majority of the steelhead runs were over by April 2012. This was not the case in April 2008 when the creek was not fishable in March, and most of the spring fishing activity occurred in late April.

Overall salmonid catch rates (0.35 fish/hr) declined from the 2007-08 survey and were similar to those in Ohio tributary angler surveys conducted in 2008-09 (0.387 fish/hr) and 2009-10 (0.354 fish/hr) (Kayle 2011). Angler catches in the open waters of Lake

Erie, despite being largely incidental, also indicate a decline in the steelhead fishery since 2009, especially in New York waters (Coldwater Task Group 2012). Similarly, tributary catch rates from an angler diary cooperator program show sharp declines in catch rates in both 2009 and 2010 (Einhouse *et al.* 2012; see Section I this report). The reasons behind the large decline are not evident. Steelhead stocking in all jurisdictions has remained stable at around 1.9 million yearlings annually for over a decade (Coldwater Task Group 2012), and stocking methods remain unchanged. No jurisdictions have reported disease outbreaks or die-offs that might have affected the adult population. An increase in sea lamprey abundance in Lake Erie since 2009 may be the most likely cause of decline in adult steelhead stocks (Coldwater Task Group 2012), but long-term wounding statistics on steelhead are not available to assess trends.

October and November continue to be the most popular months for tributary salmonid anglers. March was the most fished spring month in the 2011-12 survey, compared to April in previous surveys. Again, unusually warm temperatures and a lack of snow caused earlier steelhead runs during the 2011-12 fishing season.

RECOMMENDATIONS

Despite the recent declines in the fishery, we recommend that current Lake Erie tributary stocking policies and fishing regulations should remain in effect. However, further decline may warrant a change to these policies in the near future. In this regard, we also recommend that this angler survey should continue on a regular three year cycle to monitor the performance of the fishery. Due to the pelagic nature of steelhead in the open lake, fishery independent assessment of the adult population is not practical. Regular monitoring of the tributary fishery provides managers with critical information when considering management actions.

REFERENCES

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.

Crawford, S.S. 2001. Salmonine introductions to the Laurentian Great Lakes: an historical review and evaluation of ecological effects. Can. Spec. Publ. Fish. Aquat. Sci. 132. 205 pp.

Einhouse, D.W., J.L. Markham, K.L. Kapuscinski, M.T. Todd, D.L. Zeller, R.C. Zimar, and B.J. Beckwith. 2012. NYSDEC Lake Erie Unit 2011 Annual Report to the Lake Erie Committee. New York State Department of Environmental Conservation, Albany.

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

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

Goehle, M. A. 1998. Assessment of natural recruitment in the mixed rainbow/steelhead fishery of Cattaraugus Creek and tributaries. MS Thesis. State University of New York - Buffalo. 45 pp.

Kayle, K. 2011. Lake Erie steelhead tributary creel survey. Project Final Report. Ohio Department of Natural Resources, Division of Wildlife. Columbus, Ohio.

Lockwood, R.N., D.M. Benjamin, and J.R. Bence. 1999. Estimating angling effort and catch from Michigan roving and access site angler survey data. Michigan Department of Natural Resources, Fisheries Research Report No. 2044, Ann Arbor.

Malvestuto, S. P. 1983. Sampling the recreational fishery. Pages 397-419 *In* L.A. Nielson and D.L. Johnson, editors. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

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

Markham, J.L. 2008. Lake Erie tributary creel survey: fall 2007-spring 2008. New York State Department of Environmental Conservation. Lake Erie Fisheries Unit, Dunkirk, New York, USA.

Markham, J.L. 2012. Lake Erie tributary creel survey: fall 2011-spring 2012. New York State Department of Environmental Conservation. Lake Erie Fisheries Unit, Dunkirk, New York, USA.

Mikol, G. F. 1976. Investigation of population dynamics of the lake-run rainbow trout (*Salmo gairdneri*) of the upper Niagara River and tributaries of eastern Lake Erie. MS Thesis. State University of New York - Buffalo. 157 pp.

NYSDEC. 1984. 1984 New York State Great Lakes Angler Survey. New York State Department of Environmental Conservation, Albany.

Pollock, K. H., C. M. Jones, and T. L. Brown. 1994. Angler Survey Methods and Their Applications in Fisheries Management. American Fisheries Society Special Publication 25, American Fisheries Society, Bethesda, Maryland.

Roth, R. N., Jr. 2002. Steelhead (*Oncorhynchus mykiss*) smolt production in the Lower Cattaraugus Creek Watershed. MS Thesis. State University of New York - Fredonia. 69 pages.

Schmidt, B. R. 1975. Results and Evaluation of an Aerial Creel Survey Technique on Lake Sharpe, South Dakota. Master’s Thesis, South Dakota State University, Brookings, South Dakota, USA.

P. PUBLIC INFORMATION AND EXTENSION

Michael T. Todd

Lake Erie Fishing Hotline

DEC's Lake Erie Fishing Hotline provides a very popular service to both open lake and tributary anglers. The hotline was started in 1985 to provide up-to-date fishing information for anglers seeking tips about Lake Erie's fishing opportunities. The hotline is updated each Friday, and anglers can access the report by phone or on the DEC website.

Automated answering systems provide a recording of the weekly fishing hotline to Dunkirk/Fredonia area anglers at (716-679-ERIE) and Buffalo area anglers at (716-855-FISH). The total number of calls to the Dunkirk line was 7,451 in 2012 (Figure P.1). The total number of calls to the Buffalo line was 17,227 in 2012 (Figure P.1), for a combined annual total of 24,678 calls between the two systems. This call total was up slightly (3%) from the 2011 total. Angler call counts had not been available for the Buffalo line between 1991 and 2008.

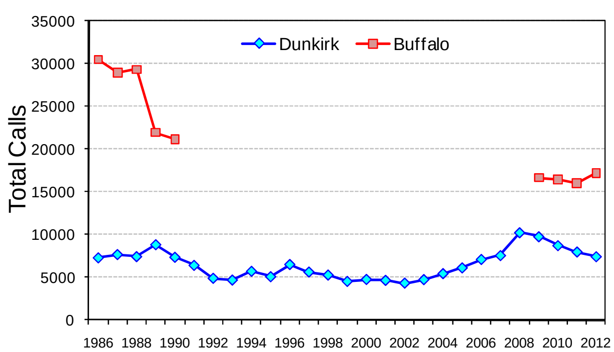


FIGURE P.1. Annual phone calls to the Buffalo and Dunkirk numbers of the Lake Erie/Upper Niagara River fishing hotline, 1986-2012. Estimates were made for any months where call totals were not available using averages from the previous two years.

Since 1999, the Lake Erie Fishing Hotline has also been available on the NYSDEC's website at www.dec.ny.gov/outdoor/9217.html. During 2012, the hotline page had 80,067 total visits (Figure P.2). This is the highest annual total recorded to date, and a 10% increase in page visits over 2011. The Lake Erie Fishing Hotline continues to be one of the more popular pages on the DEC website, consistently ranking in the top 10 fisheries pages by page views. The hotline page also appears to be bookmarked by many anglers. For instance, the hotline page is one of the top "single access" pages, a page where the user only visits that single page on a visit to the DEC website. Altogether, anglers accessed the Lake Erie Fishing Hotline by phone or internet a total of 104,745 times in 2012.

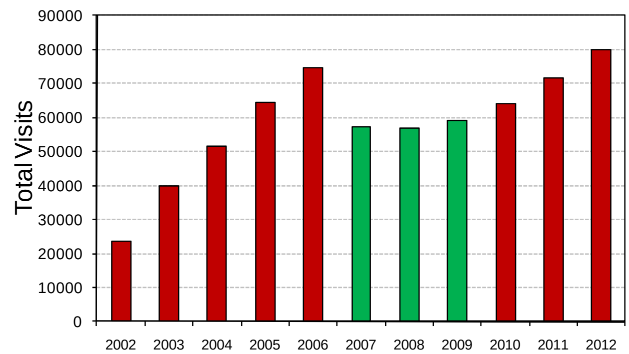


FIGURE P.2. Annual number of visits to the Lake Erie Fishing Hotline on the NYSDEC website, 2002-2012. A web page navigation and URL locator change was made on 27 April, 2007 that impacted the visits to the website.

Additional Online Resources

Public Fishing Rights (PFR) maps for Chautauqua, Canadaway, Cattaraugus and Eighteenmile Creeks are available on the DEC website at www.dec.ny.gov/outdoor/44879.html. The PFR maps are intended to aid anglers in locating public fishing and angler parking areas on the popular Lake Erie tributaries.

Species specific fishing information is also available on the DEC website for Lake Erie and tributary anglers. Lake Erie smallmouth bass and steelhead fishing pages can be accessed on the website at www.dec.ny.gov/outdoor/47535.html. These pages describe the excellent fishing opportunities for these popular sportfish, as well as providing information on techniques, equipment, fishing locations and seasonal movements.

Current and past DEC Lake Erie Annual Reports are available for download from the Lake Erie Fisheries Research page at www.dec.ny.gov/outdoor/7967.html. Links to interagency Lake Erie reports are also provided.

Fishing Education & Outreach

Region 9 Fisheries staff are committed to teaching the next generation of Lake Erie anglers how to fish. DEC staff participate in a number of regional free fishing clinics each year. These youth fishing clinics have a strong educational component where participants can learn fish ID, knot tying, casting and other basic fishing skills. The popular family fishing days at Tifft Nature Preserve (Buffalo) and Chestnut Ridge Park (Orchard Park) are cooperative efforts between DEC and the Erie County Federation of Sportsmen's Clubs.

Lake Erie Unit and Region 9 Fisheries personnel annually provide a variety of other extension services, such as participation in DEC exhibits at county fairs and sportsman shows. Staff also routinely speak at meetings of conservation and service organizations.

Q. LOWER TROPHIC LEVEL MONITORING PROGRAM

James L. Markham

In 1983, the Lake Erie Fisheries Unit began a lower trophic level monitoring program as part of a broader statewide effort. Three nearshore sites were sampled initially (Barcelona, Dunkirk, and Buffalo) once a month from May through September for transparency (Secchi), water temperature, and zooplankton. In 1988, sampling efforts shifted to two sites off Dunkirk; one shallow (36 feet), and one deep (70 feet), with an accompanying sampling frequency increased to every two weeks from May through September.

In 1999, a lakewide lower trophic level assessment program was initiated (see Forage Task Group 2013). A total of 18 stations in Lake Erie, three offshore and three inshore per basin, were established to gain an understanding of lakewide ecosystem trends and to monitor lake production. Variables collected include water temperature, dissolved oxygen, water transparency, total phosphorus, chlorophyll *a*, phytoplankton, and zooplankton. Results from New York's program are merged with lakewide lower trophic level data and reported within the inter-agency Forage Task Group annual report.

Lake Erie's bi-national fish community goals and objectives for the eastern basin fish community target maintaining mesotrophic conditions that favor a cool-water percid (walleye and yellow perch) fish community in nearshore waters (Ryan *et al.* 2003). Within this trophic state, summer water transparencies should range between 10-20 feet (3-6 m), total phosphorus between 9 and 18 µg/L, and chlorophyll *a* between 2.5 and 5 µg/L (Leach *et al.* 1977). Fish community objectives for the offshore waters of the eastern basin target maintaining oligotrophic conditions (Secchi > 20 feet (6 m); total phosphorus < 9 µg/L; chlorophyll *a* < 2.5 µg/L) that favor a cold-water salmonid fish community. Our ongoing measures of Secchi, total phosphorus and chlorophyll *a* in nearshore and offshore habitats assess whether prevailing tropic conditions remain consistent with Lake Erie's favored fish communities.

Methods

Samples are collected at fixed shallow (36') and deep (70') sites adjacent to Dunkirk every two weeks from May through September, totaling 12 sampling periods annually. During each site visit, water depth, date, and time of day are recorded along with basic sampling conditions such as cloud cover and wind speed. Water transparency to the nearest 0.5 meter is determined using a Secchi disk. A HydroLab meter is used to record temperature and oxygen at one meter depth increments and to determine the thermocline depth. Composite water samples are collected above the thermocline for chlorophyll *a*, phosphorus, and phytoplankton samples. A 0.5m, 64 µm conical plankton net is lowered and retrieved vertically from one meter off the bottom, or above the thermocline, to the surface to obtain a zooplankton sample. Zooplankton, chlorophyll *a*, and phosphorus samples are outsourced for processing. Phytoplankton samples have been preserved and archived for many years.

Results

A total of 11 of 12 planned sampling dates were completed at both shallow and deep sites between 8 May and 24 September, 2012.

<u>Surface Water Temperature</u>

The average summer (June – August) surface water temperature, weighted by month, was calculated for the offshore station by year (Figure Q.1). Summer water temperature should provide a good index of relative system production and growth rate potential for fishes, assuming prey resources are not limiting. Average summer surface water temperatures ranged from 66.9 F (19.4 C) in 2000 to 72.8 F (22.7 C) in 2010. The warmest average summer water temperatures were measured in 2005, 2010, and 2011 and coolest temperatures in 2000 and 2004. Average summer surface water temperature in 2012 was 70.1 F (21.2 C), which was slightly above the time-series average of 69.7 F (20.9 C). Summertime average water temperatures over the past seven years

(2005-2012) are 1.6 F (0.9 C) higher than the previous six years (1999-2004); perhaps evidence of a warming trend consistent with other broad indicators of climate change.

FIGURE Q.1. Average summer (June – August) surface water temperature (F), weighted by month, at an offshore (70') site at Dunkirk, NY in Lake Erie, 1999-2012. Time series average is also shown (red line).

Bottom Dissolved Oxygen

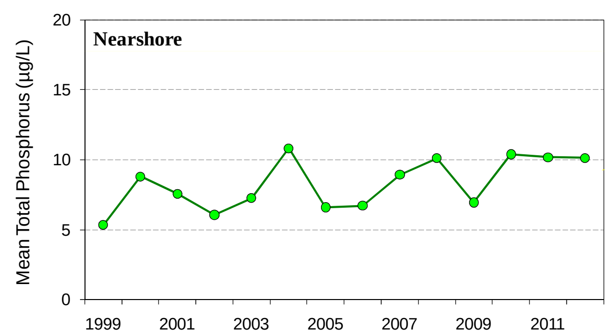
Dissolved oxygen (DO) levels less than 2 mg/L are considered stressful to fish and other aquatic biota (Craig 2012, Eby and Crowder 2002). Hypolimnetic DO can become low when the water column becomes stratified, which can begin as early as June and continue through September in the eastern basin. However, hypolimnetic DO is rarely limiting in the eastern basin due to greater water depths, a large hypolimnion, lower productivity, and cooler water temperatures (Forage Task Group 2013).

Dissolved oxygen measurements have only been recorded since 2007 in our lower trophic data series and some of those years have few observations due to equipment malfunctions. No values were recorded in 2008. Dissolved oxygen measures have never been below the 2.0 mg/L level at our offshore sampling site during the five sampling years (Figure Q.2). The lowest DO reading recorded was 4.3 mg/L in 2009. Summertime bottom DO ranged from 7.6 to 9.7 mg/L in 2012.

FIGURE Q.2. Summer (June – August) bottom dissolved oxygen (mg/L) readings at an offshore (70') site at Dunkirk, NY in Lake Erie, 2006-2012. 2.0 mg/L line represents the level at which oxygen becomes limiting for many temperate fishes.

Phosphorus

Total phosphorus (TP) levels across Lake Erie have generally increased over the past decade, particularly in the Western Basin (Forage Task Group 2012). At the nearshore site off Dunkirk, mean annual TP levels were generally below the mesotrophic target range (9-18 µg/L) but exhibiting a gradually increasing trend (Figure Q.3). In offshore waters, total phosphorus levels have been stable and within the targeted oligotrophic range (< 9 µg/L). In 2012, the nearshore TP level was 10.1 µg/L, which was within the target mesotrophic range and nearly identical to TP levels measured in both 2010 and 2011(Figure Q.3). Offshore TP levels (10.2 µg/L) increased in 2012 and were slightly higher than their target oligotrophic range for only the second time in this time-series. Compared to other portions of the lake, phosphorus levels in the east basin have remained fairly stable over the past decade (see Forage Task Group 2012).



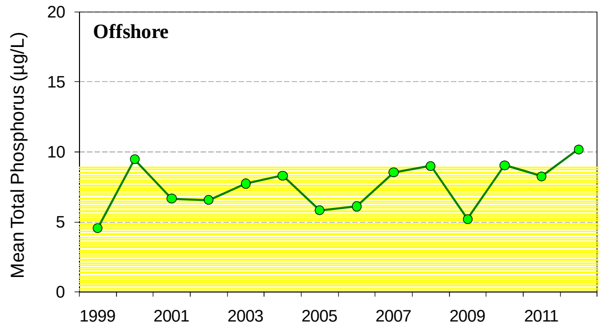


FIGURE Q.3. Mean total phosphorus (µg/L), weighted by month, at nearshore (36') and offshore (70') sites at Dunkirk, NY in Lake Erie, 1999-2012. Shaded areas represent trophic state targets.

Transparency

Transparency has been measured since the original 1983 survey in the nearshore waters, and since 1988 in the offshore waters. The long-term data series documents changes in water transparency that accompanied the invasion of dreissenids into eastern Lake Erie in 1990. In the nearshore waters, summer water transparency increased into the oligotrophic range by 1992 and remained on the threshold between this trophic state and the targeted mesotrophic range until the late 2000s (Figure Q.4). In more recent years, transparency decreased as pelagic productivity increased, and is now within the mesotrophic range (10-20 feet) favorable for stable percid communities. The mean summer Secchi depth reading at the nearshore site increased to 18.4 feet in 2012 but remains within the target range.

In offshore waters, water transparency increased to the targeted oligotrophic range during the dreissenid invasion, and remained within that range until recently (Figure Q.4). Similar to the nearshore waters, summer water transparency in the offshore waters has decreased over the past four years and is no longer in the targeted oligotrophic range (< 20 feet) favorable for salmonid communities. Mean summer Secchi depth readings were 18.4 feet at the offshore site in 2012, which was identical to the nearshore site and slightly above the target range.

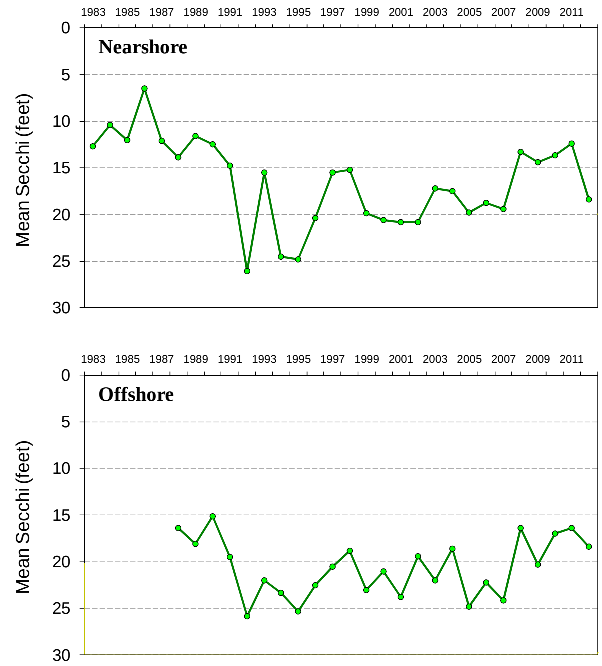


FIGURE Q.4. Mean summer (June – August) Secchi depth (feet), weighted by month, at nearshore (36') and offshore (70') sites at Dunkirk, NY in Lake Erie, 1983-2012. Shaded areas represent trophic state targets.

Chlorophyll *a*

Chlorophyll *a* concentrations indicate biomass of the phytoplankton resource, ultimately representing production at the lowest level. Chlorophyll *a* levels in nearshore waters have been below the targeted mesotrophic level (2.5 – 5.0 µg/L) for the entire time series (Figure Q.5). This may be due to high levels of grazing by dreissenids (Nicholls and Hopkins 1993). Conversely, chlorophyll *a* levels in the offshore waters remain in the targeted oligotrophic range (< 2.5 µg/L). Chlorophyll *a* concentrations were at their lowest levels in this survey in 2012 at both the nearshore (0.56 µg/L) and offshore (0.52 µg/L) sites.

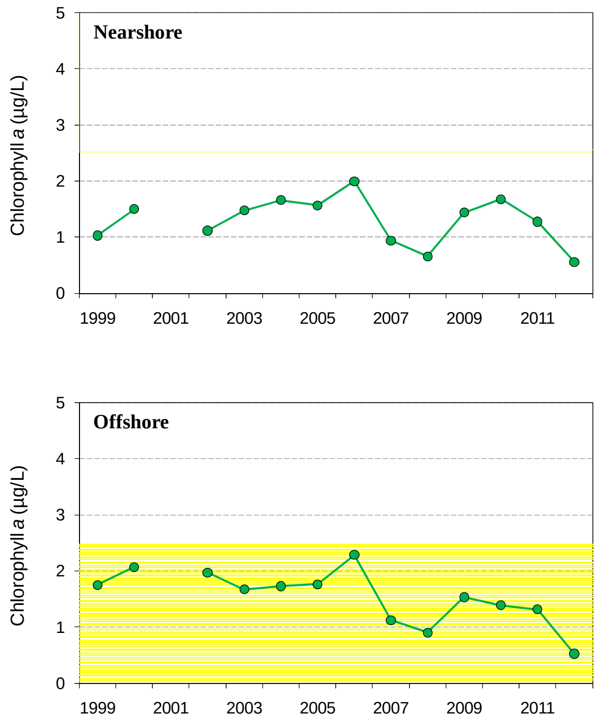


FIGURE Q.5. Mean chlorophyll *a* (µg/L), weighted by month, at nearshore (36') and offshore (70') sites at Dunkirk, NY in Lake Erie, 1999-2011. Shaded areas represent trophic state targets.

Zooplanktivory Index

Planktivorous fish are size-selective predators, removing larger prey with a resultant decrease in the overall size of the prey community that reflects feeding intensity (Mills *et al*. 1987). Johannsson *et al.* (1999) estimated that a mean zooplankton length of 0.57 mm or less sampled with a 64-µm net reflects a high level of predation by fish. Based on these parameters, the zooplanktivory index is generally stable at the Dunkirk sampling sites over the time series (Figure Q.6). Fish predation was considered less intense in 2000 and 2003, but otherwise has been near the critical 0.57 line for all other years in the time series. Zooplankton data for 2009 and 2011 are not yet available.

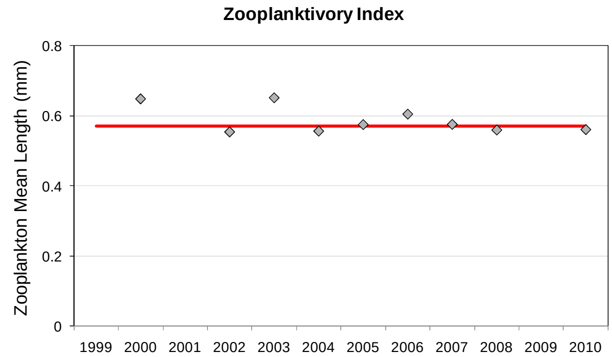


FIGURE Q.6. Mean length (mm) of crustacean zooplankton sampled with a 63 µm plankton net in the epilimnion at nearshore (36') and offshore (70') sites at Dunkirk, NY in Lake Erie, 1999-2010. The threshold line (0.57 mm) represents the size at which predation by fish is considered less intense (above the line) or more intense (below the line) (Mills *et al.* 1987; Johannsson *et al.* 1999). 2009 and 2011 data not yet available.

Discussion

Slightly over a decade of sampling has shown general stability of the lower trophic levels of the eastern basin of Lake Erie ecosystem. With a few exceptions, average summer water temperatures have ranged within a few degrees over the time series but with an overall slightly increasing trend, and dissolved oxygen is not limiting as fish habitat. In the nearshore waters, measures of total phosphorus and water transparency are within targeted mesotrophic conditions according to Leach *et al.* (1977) while chlorophyll *a* measures remain well below targets. In the offshore waters, total phosphorus and water transparency measures are slightly higher than the targeted oligotrophic trophic range, but chlorophyll *a* remains well within its target levels. Overall, both the nearshore and offshore waters of the eastern basin of Lake Erie are near their targeted trophic states and remain stable compared to measures in other basins of Lake Erie (Forage Task Group 2013).

Profound effects of dreissenids are evident in the nearshore waters of the eastern basin. Dreissenids invaded the eastern basin in the early 1990s and water transparency increased sharply in both nearshore and offshore sites. Transparency more recently has gradually declined. However, grazing pressure on phytoplankton remains high in the nearshore waters, and in more recent years offshore waters, as indicated by lower measures of chlorophyll *a*. Dreissenid mussels may be the dominant source of grazing in infected waters (Nichols and Hopkins 1993). In 2002, dreissenid biomass was highest in the eastern basin with quagga mussels displacing zebra mussels in all basins (Patterson *et al.* 2005). Recent measures of chlorophyll *a* indicate that dreissenid biomass remains high in the eastern basin.

Overall productivity appears to be increasing in the eastern basin, especially in the nearshore waters. Oligotrophic conditions that were present nearshore in the 1990s and early 2000s are gradually shifting to targeted mesotrophic conditions. The increase in lower trophic productivity may have triggered responses in the eastern basin fish community, especially yellow perch (see Section D). Walleye recruitment has also been relatively more stable in recent years, perhaps as a response to increasing mesotrophic conditions.

References

Craig, J.K. 2012. Aggregation on the edge: effects of hypoxia avoidance on the spatial distribution of brown shrimp and demersal fishes in the Northern Gulf of Mexico. Marine Ecology Progress Series 445: 75-95.

Eby, L.A., and L.B. Crowder. 2002. Hypoxia-based habitat compression in the Neuse River Estuary: context-dependent shifts in behavioral avoidance thresholds. Can. J. Fish. Aquat. Sci. 59:952-965.

Forage Task Group. 2013. Report of the Lake Erie Forage Task Group, March 2013. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA.

Johannsson, O.E., C. Dumitru, and D. Graham. 1999. Estimation of zooplankton mean length for use in a index of fish community structure and its application to Lake Erie. J. Great Lakes Res. 25: 179-186.

Leach, J.H., M.G. Johnson, J.R.M. Kelso, J. Hartman, W. Numan, and B. Ents. 1977. Responses of percid fishes and their habitats to eutrophication. J. Fish. Res. Board. Can. 34:1964-1971.

Mills, E.L., D.M. Green, and A. Schiavone. 1987. Use of zooplankton size to assess the community structures of fish populations in freshwater lakes. N. Am. J. Fish. Manage. 7: 369-378.

Nicholls, K.H., and G.J. Hopkins. 1993. Recent changes in Lake Erie (north shore) phytoplankton: cumulative impacts of phosphorus loading reductions and the zebra mussel introduction. J. Great Lakes Res. **19**: 637-647.

Patterson, M.W.R., J.J.H. Ciborowski, and D.R. Barton. 2005. The distribution and abundance of *Dreissena* species (Dreissenidae) in Lake Erie, 2002. J. Great Lakes Res. **31**(Suppl. 2): 223-237.

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

APPENDIX I

Common and scientific names of fish potentially mentioned in text, tables, and/or figures.

Common Name	Scientific name
Alewife	*Alosa pseudoharengus*
Banded Killifish	*Fundulus diapphanus*
Blacknose Shiner	*Notropis heterolepis*
Bluntnose Minnow	*Pimephalesnotatus*
Bridle Shiner	*Notropis bifrenatus*
Brook Silverside	*Labidesthes sicculus*
Brown Trout	*Salmo trutta*
Bullheads	*Ictaluridae spp.*
Burbot	*Lota lota*
Carp	*Cyprinus carpio*
Channel Cat	*Ictalurus punctatus*
Chinook Salmon	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*
Darter spp.	*Percidae spp.*
Emerald Shiner	*Notropis atherinoides*
Freshwater Drum	*Aplodinotus grunniens*
Gizzard Shad	*Dorosoma cepedianum*
Goldfish	*Carassius auratus*
Lake Sturgeon	*Acipenser fulvescens*
Lake Trout	*Salvelinus namaycush*
Lake Whitefish	*Coregonus clupeaformis*
Largemouth Bass	*Micropterus salmoides*
Muskellunge	*Esox masquinongy*
Northern Hog Sucker	*Hypentelium nigricans*
Northern Pike	*Esox lucius*
Quillback	*Carpiodes cyprinus*
Rainbow Smelt	*Osmerus mordax*
Rainbow Trout/Steelhead	*Oncorhynchus mykiss*
Redhorse Sucker spp.	*Moxostoma spp.*
Rock Bass	*Ambloplites rupestris*
Round Goby	*Neogobius melanostomus*
Rudd	*Scardinius crythrophthalmus*
Sea Lamprey	*Petromyzon marinus*
Smallmouth Bass	*Micropterus dolomieui*
Spottail Shiner	*Notropis hudsonius*
Sticklebacks	*Gasterosteidae spp.*
Stonecat	*Noturus flavus*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus*
White Bass	*Morone chrysops*
White Perch	*Morone americana*
White Sucker	*Catastomus commersoni*
Yellow Perch	*Perca flavescens*