Inland Seas Angler

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Highlights of the Annual Lake Committee Meetings

Great Lakes Fishery Commission proceedings, Windsor, ON

This first of a series of annual special reports is a summary of Lake Ontario. This lake committee report is from the annual Lake Committee meetings hosted by the Great Lakes Fishery Commission in March 2014. We encourage reproduction with the appropriate credit to the GLSFC and the agencies involved. Our thanks to Jana Lantry and Steve La Pan, NYSDEC; USFWS; Ontario Ministry of Natural Resources; and Brian Lantry, USGS for their contributions to these science documents. Thanks also to the Great Lakes Fishery Commission its staff, Chris Goddard & Marc Gaden, for their efforts in again convening and hosting all the Lake Committee meetings in Windsor.

Lake Ontario

Index of Reports

Key:
DFO = Department of Fisheries, Oceans
FWS = U.S. Fish & Wildlife Service
LSC = Lake Ontario Committee
USGS = U.S. Geological Survey
CPE = Catch per effort
CPUE = Catch per unit effort
GB = (Granular Bayluscide)
Kt = kilotonnes
1 kiloton (kt) = 1000 metric tons

NYSDEC Salmon Egg collections for 2013

As of October 21, NYSDEC Salmon River Hatchery staff have completed Chinook and coho salmon egg collections for 2013.

Target numbers of fertilized eggs were exceeded for both Chinook (4.12 million collected; target 3.4 million) and coho (1.68 million collected; target 1.6 million) salmon using fish exclusively from the Salmon River/Beaverdam Brook system. Subsequently there was no need for contingency egg collections from other Lake Ontario tributaries.

Lake Ontario Fishing Boat Survey, 1985 – 2013

Summary for April 15 - September 30, 2013

Since 1985, NYSDEC surveyed boats operating in New York waters of Lake Ontario's main basin April - September. Data collected from counts and interviews of fishing boats are used to manage Lake Ontario's multi-million dollar trout and salmon fishery and provide valuable data on other fish species.

Preliminary results indicate that fishing effort directed at trout and salmon has remained stable for more than a decade. Lake Ontario anglers experienced good fishing quality in 2013 (i.e. catch rate = total number of trout and salmon caught per boat trip). Chinook salmon catch rates remained well above the long term average for the 11th consecutive year (2003-2013). Anglers experienced the 6th consecutive year of excellent rainbow trout fishing. Lake trout catch rates were the highest since 2002, and brown trout fishing quality was average throughout most of the open lake season. Coho salmon catch rates varied over the 5½ month period, resulting in a seasonal, lake-wide rate comparable to the long term average (1985-2012).

Fishing effort targeting smallmouth bass remained low despite improved catch rates in 2013. Results presented here are preliminary, lake-wide averages, and therefore may not reflect fishing quality experienced in some NY areas of Lake Ontario. A final 2013 survey report will be available in spring 2014.

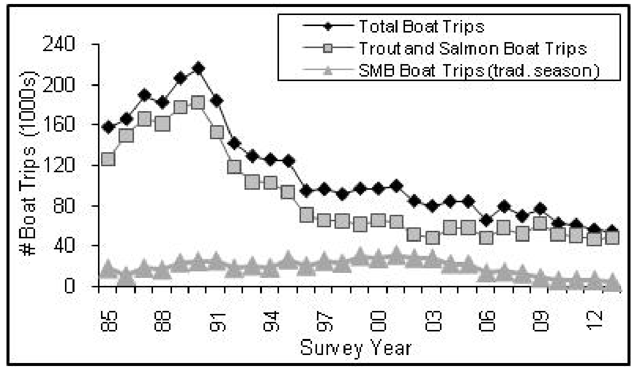

Fig 1- Seasonal estimates of total fishing effort, 2013

Fishing Effort

For more than a decade fishing effort specifically targeting trout and salmon has remained relatively stable, while total fishing effort has declined (Fig. 1; Table 1). The decline in total effort is attributed to a decline in effort targeting smallmouth bass since the early 2000s. In 2013, there were an estimated 54,605 fishing boat trips, 87.0% of which targeted trout and salmon (47,520 boat trips; comparable to previous 5- year [-8.2%] and 10-year [-9.8%] averages). Fishing effort directed at smallmouth bass declined from the early 2000s through 2010. Effort remained at a lower, relatively stable level since. From the start of the traditional bass season on June 15 through September 30, 2013, there were an estimated 4,273 boat trips targeting bass (7.8% of all fishing trips), the lowest on record (Fig. 1). Effort targeting bass during the preseason catch and release period remained low and similar to recent years (191 boat trips, April 15-June 14, 2013).

Trout and Salmon Catch, Harvest and Fishing Quality From April 15 - September 30 anglers caught an estimated 168,837 trout and salmon and, similar to recent years, harvested 59.3% of them (Fig.2; Table 1). Each year since 2003, Chinook salmon dominated catch (2013: 62,603 fish, 37.1% of total catch) and harvest (2013: 38,276 fish, 38.3% of total harvest). In recent years rainbow trout and brown trout represented the 2nd and 3rd most commonly caught and harvested species, and lake trout represented a relatively minor component of the fishery. In 2013, however, lake trout represented the 2nd most commonly caught species (35,533 fish), representing 21.1% of angler catch (highest since 2002 and well above the 2003-2012 average of 7.5%). Rainbow trout was also an important component of the fishery in 2013 (34,563 fish caught, 20.5% of total catch).

An estimated 27,721 brown trout were caught (16.4% of total catch), the lowest number since 2008. Coho salmon and Atlantic salmon each represented relatively small components of the fishery (4.6% and 0.4% of total, respectively).

Trout and salmon fishing quality, as measured by catch rate (3.6 per boat trip), was well above the long term average (+35.8%; Fig. 2) and is attributed to above average catch rates for Chinook salmon, rainbow trout, and lake trout (+37.1%, +67.4%, and +43.2% compared to respective long term averages). Brown trout and coho salmon catch rates were comparable to long term averages (+12.0% and -1.1%, respectively). Total trout and salmon harvest rate (2.1 fish per boat trip) was also well above the long term average (+32.8%; Fig. 2).

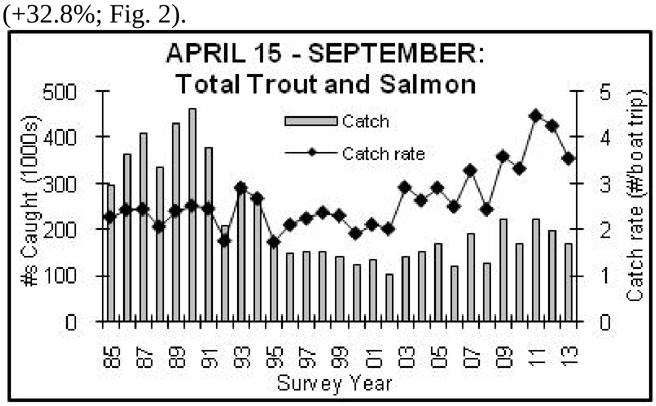

Fig 2- Total trout and salmon catch and catch rate, April 15-September 30, 1985-2013.

Chinook Salmon

Chinook salmon catch rates have been at or near record levels for eleven consecutive years (2003- 2013; Fig. 3, Table 1). Although the 2013 catch rate (1.3 Chinook salmon per boat trip) was among the lowest in the recent time series (-13.8% compared to the previous 10- year average), it remained 37.1% higher than the long term average and more than 2-fold higher than the 1985-2002 average. Harvest rate of Chinook salmon (0.8 fish per boat trip) was also higher than (+29.6%) the long term average.

Fishing quality for Chinook salmon during April was poor (69.9% below the long term April average), but improved later in the season with June and August catch rates among the highest for those months (6th best June and 5th best August in the 29-year data series).

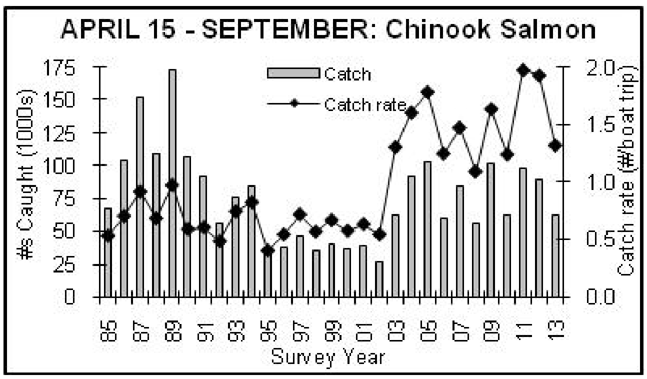

Fig 3- Chinook salmon catch and catch rate, April 15-September 30, 1985-2013.

Coho Salmon

The coho salmon catch rate (0.16 fish per boat trip) was comparable to (-1.1%) the long term average **(Fig. 4, Table 1**). Monthly coho salmon catch rates were at or below average in April (-69.6%), July (-1.0%), and August (-21.8%), were above average in May (+56.1%) and June (+14.1%), and was among the highest estimated for September (+72.3%).

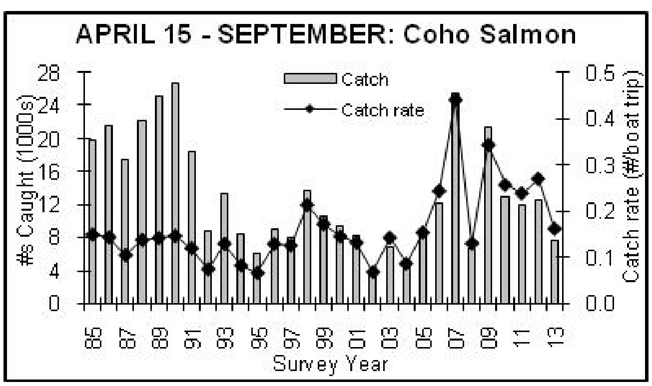

Fig 4- Coho Salmon catch and catch rate, April 15-September 30, 1985-2013.

Rainbow Trout

For the 6th consecutive year, rainbow trout catch rate remained at record high levels (0.73 fish per boat trip in 2013) and was 67.4% above the long term average (**Fig. 5, Table 1).** Monthly rainbow trout catch rates were below respective long term averages in April (-27.8%) and June (-41.9%), and were above respective long term averages in May (+34.0%), July (+160.5% and the 3rd best July), August (+72.1%), and September (+28.5%). Only 49.8% of rainbow trout caught in 2013 were harvested, the 5th lowest in the data series.

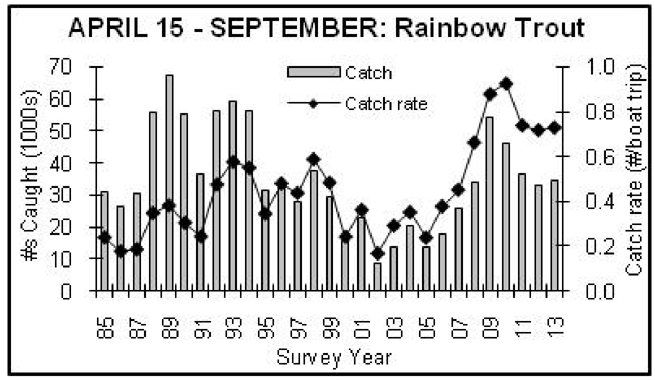

Fig 5- Rainbow trout catch and catch rate, April 15-September 30, 1985-2013.

Brown Trout

The 2013 seasonal brown trout catch rate (0.58 fish per boat trip) and harvest rate (0.40 fish per boat trip; 3rd highest) were slightly above the long term average (+12.0% and +14.3%, respectively; **Fig. 6, Table 1**). Catch rates were comparable to respective monthly averages in April (+2.8%), June (-6.6%), July (-0.4%), and August (+5.9%), and were above average in May (+24.2%), and September (+135.0% and the 2nd highest observed).

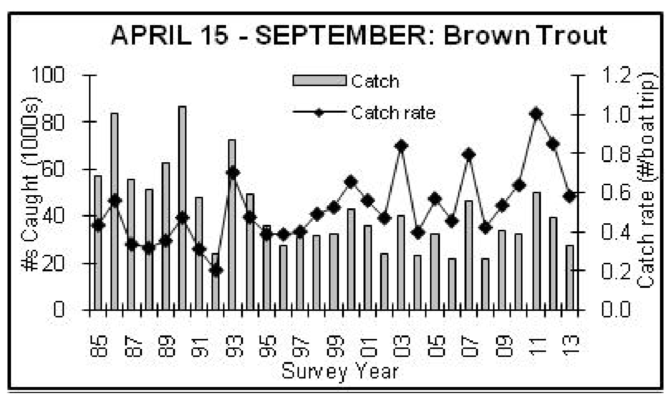

Fig 6- Brown trout catch and catch rate, April 15-September 30, 1985-2013.

Lake Trout

Trends in lake trout catch rates are influenced by lake trout abundance and fishing quality for other trout and salmon species. Lake trout catch declined during the mid-2000s due to the combined effects of anglers selectively targeting other salmonines and relatively low adult lake trout abundance during that time period. In recent years, lake trout catch rates have improved (**Fig. 7, Table 1**), coinciding with an increase in abundance as indexed by an annual September gill netting survey. The April 15 - September 30 lake trout catch rate was 0.75 fish per boat trip, the highest since 2002, and similar to rates observed throughout the 1990s when lake trout abundance was relatively high **(Fig. 7**). Anglers harvested 57.7% of lake trout caught, resulting in the highest harvest rate (0.43 fish per boat trip) observed since 1991 (0.58 fish per boat trip). This increase is attributed to both increased abundance (i.e. anglers are more likely to catch them) and the likely increased fishing effort directed at lake trout in response to relatively lower catch rates of others species in 2013 as compared to recent years.

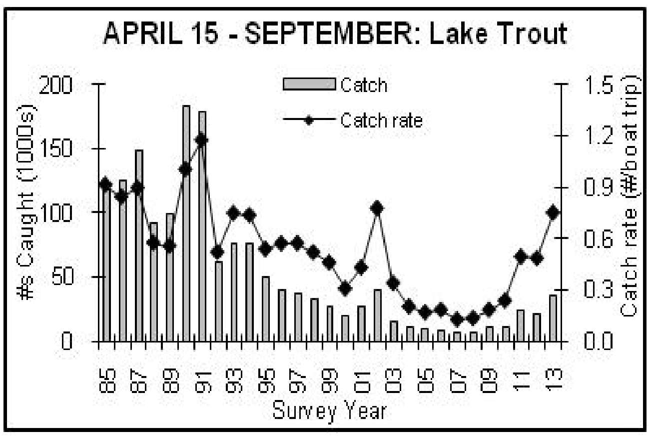

Fig 7- Lake trout catch and catch rate, and harvest and harvest rate April 15-September 30, 1985-2013.

Atlantic Salmon

Catch and harvest of Atlantic salmon in the boat fishery are rare, and estimates from 1995- 2008 were the lowest observed in the survey (i.e. catch and harvest estimates below 600 and 250, respectively). From 2009-2013, occurrences of Atlantic salmon in angler catch were the highest observed since the early 1990s **(Table 1).** In 2013, although estimated catch was only 687 fish, the catch rate of Atlantic salmon was more than 3 times higher than the 1995-2008 average.

The cause(s) of increased Atlantic salmon catch in recent years is not clear, however, recent natural reproduction occurring in the Salmon River and recent increased stocking levels by Canada may be contributing factors. Smallmouth Bass Catch, Harvest and Fishing Quality Smallmouth bass fishing quality in 2013 (June 15 - September 30; 4.3 bass caught per boat trip) was the best since 2007 and 2.2 times higher than the record low rate observed in 2010 **(Fig. 8).** Catch rate was, however, 69.5% below the 2002 record high (14.1 bass caught per boat trip). Smallmouth bass anglers harvested 1.7 bass per boat trip, the highest rate since 2003.

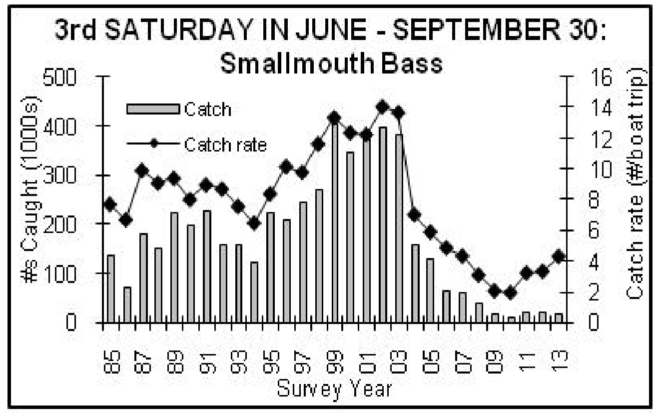

Fig 8- Smallmouth bass catch and catch rate, 1985-2013.

Yellow Perch Catch and Harvest

Estimated catch of yellow perch (15,345 fish in 2013) declined 80.1% from the highs observed during 2007- 2011 and was 49.0% below the long term average **(Fig. 9).** Yellow perch harvest (6,572 fish) also declined relative to the long term average (-50.3%). Yellow perch estimates in this survey are highly variable because relatively few boats target yellow perch, catch and harvest among these boats is highly variable, and the probability of interviewing perch anglers during this survey is low.

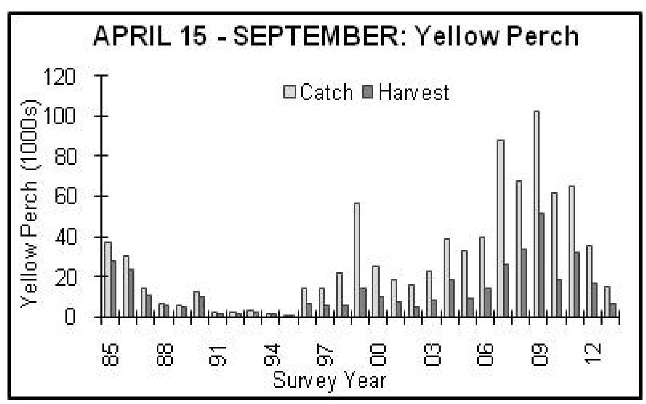

Fig 9- Yellow perch catch and harvest April 15– September 30, 1985-2013.

Table 1. NYSDEC Lake Ontario Fishing Boat Survey: 1985 – 2013

	28yr avg 85-12	prev 10yr 03-12	prev 5yr 08-12	2009	2010	2011	2012	2013
Boat Trips								
Total	114,161	71,829	65,151	76,838	62,104	60,943	56,182	54,605
Trout and Salmon	89,062	52,688	51,785	62,028	50,059	49,548	46,059	47,520
Smallmouth: Trad. Season	19,503	14,006	7,953	8,666	5,855	6,257	6,203	4,273
Number of Fish Harvested:								
Coho Salmon	9,747	8,044	8,541	12,931	9,223	7,380	8,259	4,871
Chinook Salmon	51,678	46,833	44,726	54,964	31,676	46,333	55,137	38,276
Rainbow Trout	22,690	14,714	19,270	24,060	23,856	16,131	12,617	17,203
Atlantic Salmon	324	201	389	532	624	398	310	200
Brown Trout	29,398	21,205	22,538	23,148	18,311	32,937	23,305	18,985
Lake Trout	25,662	4,654	5,593	4,842	5,403	7,017	7,829	20,511
Total Trout and Salmon	139,512	95,654	101,056	120,477	89,092	110,196	107,456	100,047
Smallmouth Bass	40,081	20,460	6,991	6,833	4,892	6,442	5,683	7,536
Yellow Perch	13,230	22,716	30,436	51,653	18,405	31,830	16,701	6,572
Walleye	594	588	187	123	106	458	130	318
Number of Fish Caught:								
Coho Salmon	13,348	12,365	13,072	21,376	12,908	11,915	12,494	7,704
Chinook Salmon	75,993	80,729	81,183	101,427	61,960	97,899	88,851	62,603
Rainbow Trout	34,872	29,570	40,840	54,501	46,249	36,533	32,975	34,563
Atlantic Salmon	1,148	624	1,089	1,273	1,826	1,519	592	687
Brown Trout	42,589	34,164	35,457	33,484	32,604	49,661	39,507	27,721
Lake Trout	55,852	12,917	15,259	11,241	11,753	24,336	22,206	35,533
Total Trout and Salmon	224,053	170,512	187,002	223,316	167,405	221,977	196,625	168,837
Smallmouth bass	202,802	103,091	29,819	30,494	18,048	25,795	24,032	21,464
Yellow Perch	30,105	55,578	66,566	102,442	61,816	65,394	35,836	15,345
Walleye	830	1,000	248	147	301	531	130	388
Harvest Rates Per Boat Trip Among Boats Fishing for Trout & Salmon								
Coho	0.12	0.15	0.16	0.21	0.18	0.15	0.18	0.10
Chinook	0.62	0.88	0.87	0.89	0.63	0.94	1.20	0.81
Rainbow	0.27	0.28	0.37	0.39	0.48	0.33	0.27	0.36
Atlantic	0.003	0.004	0.007	0.009	0.012	0.008	0.007	0.004
Brown	0.35	0.40	0.44	0.37	0.36	0.66	0.50	0.40
Lake Trout	0.22	0.09	0.11	0.08	0.11	0.14	0.17	0.43
Total Trout and Salmon	1.58	1.81	1.96	1.94	1.78	2.22	2.33	2.10
Catch Rates Per Boat Trip Among Boats Fishing for Trout & Salmon								
Coho	0.16	0.23	0.25	0.34	0.26	0.24	0.27	0.16
Chinook	0.96	1.53	1.57	1.63	1.24	1.97	1.93	1.32
Rainbow	0.43	0.56	0.78	0.88	0.92	0.74	0.72	0.73
Atlantic	0.012	0.012	0.021	0.021	0.036	0.031	0.013	0.014
Brown	0.52	0.65	0.69	0.53	0.64	1.00	0.85	0.58
Lake Trout	0.52	0.25	0.30	0.18	0.23	0.49	0.48	0.75
Total Trout and Salmon	2.61	3.24	3.62	3.59	3.33	4.47	4.26	3.55
Smallmouth Bass: Traditional Open Season								
Catch Rate per Boat Trip	8.02	4.95	2.72	2.05	1.93	3.22	3.33	4.31
Harv. Rate per Boat Trip	1.73	1.13	0.76	0.54	0.70	0.99	0.81	1.67

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Lake Trout Rehabilitation in Lake Ontario, 2013 (USGS)

Abstract

No lake trout from the 2011 year class were stocked into Lake Ontario during October 2011 or May 2012 therefore no stocked age-2 lake trout were available to bottom trawls during 2013. The catch per unit effort of adult lake trout in gill nets increased each year from 2008-2013, recovering from historic lows recorded during 2005-2007.

Adult abundance in 2013 exceeded the level of the 1999-2004 mean which at the time appeared to be the new stable abundance following from the 1993 stocking cuts. The 2013 rate of wounding by sea lamprey caught in gill nets was 2.26 fresh (A1) wounds per 100 lake trout and was slightly above target (2 wounds per 100 lake trout). Estimates from the NYSDEC fishing boat survey indicated 2013 angler catch and harvest rates were the highest estimated in more than 10 years. Adult lake trout condition (indexed from annual length–weight regressions) increased in 2007-2009 from relatively low values observed during 2000-2006, remained nearly constant during 2010-2012 at the highest values observed for the 30 year time-series, but declined in 2013.

The low condition values observed for juvenile lake trout during 2010-2012 continued during 2013. Reproductive potential for the adult stock, determined from the annual egg deposition index, rebounded from the 2007-2008 values that were the lowest observed since 1985 and stabilized during 2009-2013 at a mean value of 20.7. In 2013, five age-1 and three age-2 naturally produced lake trout were collected from trawl survey catches providing first evidence of a 2012 year class and continued evidence of a 2011 year class.

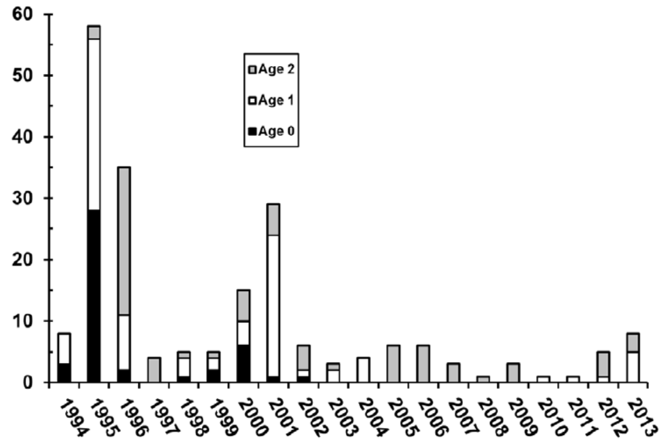

Figure 11. Numbers and ages of naturally produced (wild) lake trout captured with bottom trawls in Lake Ontario, 1994-2013. During 1980-1993, only one naturally produced lake trout was captured with bottom trawls.

Natural Reproduction

In 2013, five age-1 and three age-2 naturally produced (wild) lake trout were caught bottom trawling. Survival of naturally produced lake trout older than the fingerling stage in summer and fall occurred each year during 1993-2012 (**Figure 11**) except 2008, representing production of 19 year classes. No wild lake trout were caught as of yet from the 2008 year class. The wild yearlings captured in 2010-2013 were the first wild yearlings caught since 2005. Low numbers of small, wild fish captured in recent years (1997-2012) may be due in part to a change in our trawl gear that was necessary to avoid abundant dreissenid mussels. Our new bottom trawls are not as efficient at capturing small benthic fishes.

The distribution of catches of wild fish suggests that lake trout are reproducing throughout New York waters of Lake Ontario **(Figure 12**). Catches from at least 19 cohorts of wild lake trout since 1994 and survival of those year classes to older ages meets the plan objective to demonstrate the feasibility of lake trout rehabilitation in Lake Ontario. Although recent evidence of wild reproduction is encouraging, achieving the goal of a self-sustaining population requires improvement in production of wild lake trout.

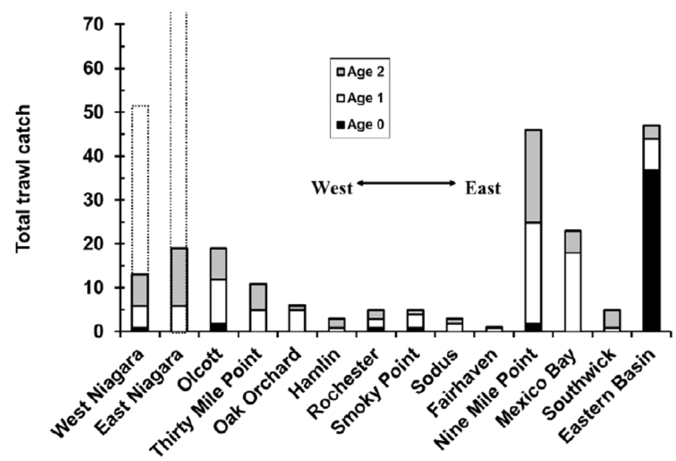

Figure 12. Numbers of wild lake trout (age 0 to 2) captured with bottom trawls at various locations in Lake Ontario, 1994 – 2013.

Methods

During September 2013, USGS R/V *Kaho* and NYSDEC R/V *Seth Green* fished standard monofilament gill nets for adult lake trout at 14 geographic locations encompassing the entire U.S. shore in Lake Ontario.

Trawl Survey

From mid-July to early-August 1980-2012, crews from USGS and NYSDEC used the R/V *Kaho* and the R/V *Seth Green* to capture juvenile lake trout (targeting age-2 fish) with bottom trawls.

Effort in 2013 was reduced because no lake trout from the 2011 year class were stocked in U. S. waters during 2012 and thus no-U. S. stocked age-2 lake trout were present in 2013. During July 6-25, 2013, trawling was conducted only at 9 locations. Data collection from trawl-captured lake trout was the same as that described above for fish captured with gill nets.

Stocking

From 1973 to 1977 lake trout stocked in Lake Ontario were raised at several NYSDEC and USFWS (Michigan and Pennsylvania) hatcheries with annual releases ranging from 0.07 million for the 1973 year class to 0.28 million for the 1975 year class (**Figure 1**). By 1978 (1977 year class) the USFWS Alleghany National Fish Hatchery (Pennsylvania) was raising all lake trout stocked in U.S. waters of Lake Ontario and annual releases exceeded 0.60 million fish. In 1983, the first official Lake Ontario lake trout rehabilitation plan. The stockings of the 1979-1986 year classes approached that level, number of yearling equivalents released declined by about 22% between the stockings of the 1981 and 1988 year classes. Stocking declined by 47% in 1992 (1991 year class) due to problems encountered at the hatchery.

In 1993, fishery managers reduced the lake trout stocking target to the current level of 500,000 yearlings because of a predator-prey imbalance in Lake Ontario, and following recommendations from an international panel of scientists and extensive public review,. In the 21 years since the stocking cuts (1992-2012 year classes), the annual stockings were near the target level in only fourteen years (**Figure 1**).

The USFWS Alleghany National Fish Hatchery (ANFH) was closed in 2005 due to an outbreak of infectious pancreatic necrosis and remained closed for fish production through summer 2011. Completion of disinfection, renovation and disease trials permitted fish production to resume at ANFH in fall 2011.

Lake trout stocked in 2006 were raised at the NYSDEC Bath Fish Hatchery. Lake trout for 2007 and 2008 stockings were raised at the USFWS Pittsford (the name was changed in 2009 to: Eisenhower (ENFH)) and White River National Fish Hatcheries (WRNFH) in Vermont. In 2010, 94% of the stocked lake trout were raised at WRNFH and 6% were raised at NYSDEC Bath Fish Hatchery.

All lake trout from stockings in 2009 and 2011 were raised at the USFWS WRNFH. In late August 2011, flooding of WRNFH from the adjacent White River during tropical storm Irene led to the USFWS decision to depopulate the hatchery over serious concerns of raceway contamination with didymo from the adjacent White River. As a result, no lake trout from the 2011 year class were stocked into Lake Ontario in May 2012. Combined production of the 2012 year class at ANFH and ENFH resulted in stocking of nearly 123,000 fall fingerlings and over 520,000 spring yearlings.

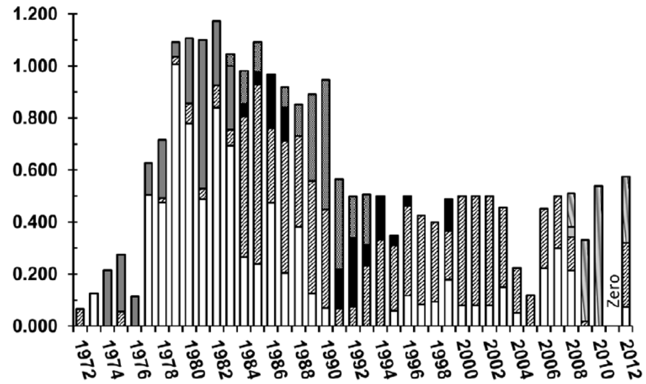

Figure 1. Total spring yearling equivalents (SYE) for lake trout 1972 – 2012 year classes. No lake trout from the 2011 year class were stocked in 2012.

Survival to age-2

(Figure 2) The survival index for the 2010 year class sampled in 2012 was the greatest observed since the 1990 year-class was sampled in 1992. No lake trout from the 2011 year class were stocked in U. S. waters during 2012 and thus no-U. S. stocked age-2 lake trout were present/captured in 2013.

Abundance of age-3 and older Lake Trout

A total of 780 lake trout were captured in the September 2013 gill net survey resulting in a total CPUE of mature adults of 12.5 **(Figure 3)**. Catches of lake trout among sample locations were similar within years. Adult abundance in 2013 (CPUE: 12.5) exceeded the 1999-2004 average (CPUE: 11.1). Similar to the catch of age-2 lake trout from bottom trawls, the CPUE for immature lake trout captured in gill nets (generally ages 2 to 5) declined by 64% between the 1989-1993 (CPUE: 8.0) and the 1995-2004 intervals (CPUE: 2.9). Low CPUEs continued in 2013 (CPUE: 2.3).

Schneider et al. (1983, 1997) established a target gillnet CPUE of 2.0 for sexually mature female trout ≥ 4,000 g reflecting the level of abundance at which successful reproduction became detectable in the early 1990s. As the adult population abundance increased during 2008-2013, the CPUE of mature females ≥ 4,000 g also increased and during 2010-2013 CPUEs have remained near or above target.

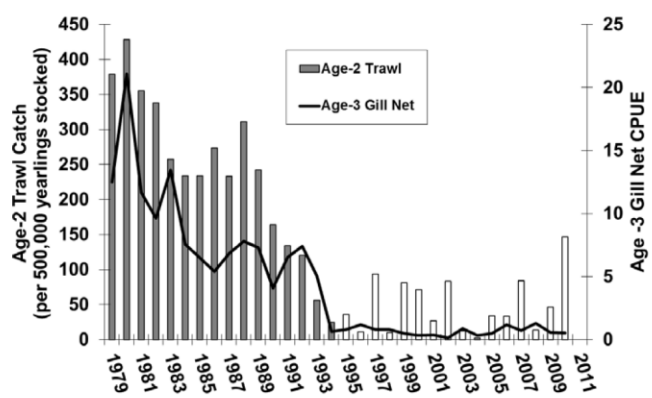

Figure 2. Survival indices for age-2 lake trout stocked in U.S. waters of Lake Ontario in 1980 – 2013

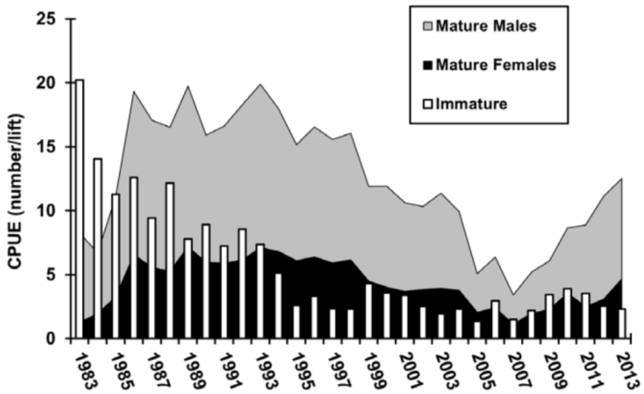

Figure 3. Abundance of mature (generally males ≥ age 5 and females ≥ age 6) and immature (sexes combined) lake trout calculated from catches made with gill nets set in U.S. waters of Lake Ontario, 1983-2013.

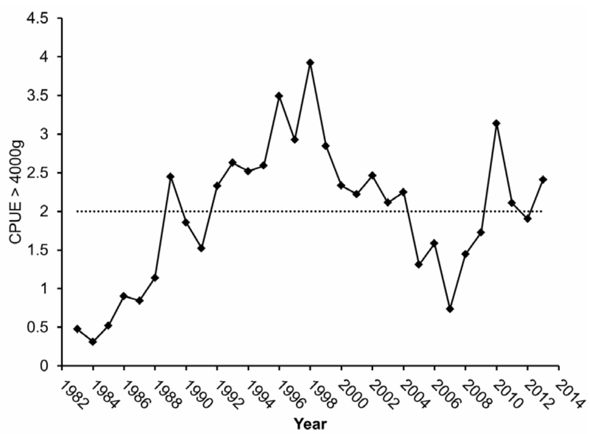

Figure 5 Abundance of mature female lake trout >3999g calculated from catches made with gill nets set in U.S. waters of Lake Ontario,1983-2013.

Angler Catch and Harvest

The annual harvest of lake trout from U.S. waters of Lake Ontario (Figure 6) declined over 90% since the protected slot limit was re-instated in 1992 compared to years without size limits. The protected slot regulation was a limit of three lake trout harvested outside of the protected length interval of 635 to 762 mm (25 to 30 in). In October 2006, this regulation was changed reducing the creel limit to two fish per angler and allowed for one of those fish to be within the 635 to 762 mm slot. Angler harvest rates of lake trout in U.S. waters declined immediately during 1991-1992-as a result of the 1992 regulation. Angler harvest and catch rates declined further from the early to mid-2000s, coinciding with the lake trout population decline (Figure 3) and good fishing quality for other salmonids (i.e., anglers targeted other salmonids more frequently because of their relatively high catch rates. In 2007, catch and harvest rates (0.12 and 0.05 lake trout per boat trip, respectively) and total harvest (2,570 fish) reached the lowest levels in the NYSDEC Fishing Boat Survey data series. Harvest at that time was 85% below mean for the 1992-1999 levels. Since then, catch and harvest rates increased for five consecutive years.

In 2013, angler catch (35,533 fish) and harvest (20,511 fish) were the highest estimated since the mid- to late-1990s. Catch and harvest rates (0.75 and 0.43 lake trout per boat trip, respectively) were the highest estimated since 2002 and 1991, respectively. The 2013 catch and harvest rates were more than six times higher than the lows observed in 2007. This increase was due, in part, to an increased number of fish recruiting into the fishery in recent years (Figure 3), and a fishing regulation change. Prior to October 2006, anglers were permitted to harvest three lake trout outside of a protected length interval of 635 to 762 mm (25 to 30 in). The October 2006 regulation change reduced the creel limit to two fish per angler, but allowed for one of those fish to be within the 635 to 762 mm slot.

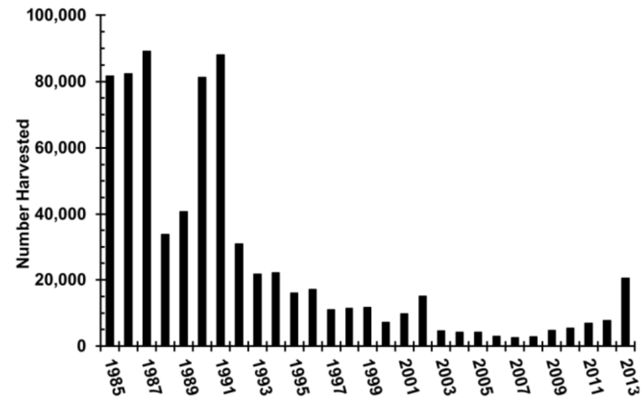

Figure 6. Estimated numbers of lake trout harvested by boat anglers from U.S. waters of Lake Ontario, April 15 – September 30, 1985 – 2013 .

Sea Lamprey Predation

Percentage of fresh (A1) sea lamprey marks on lake trout has remained low since the mid-1980s, however, wounding rate rose above target in 2005, reaching a maximum of 4.7 wounds in 2007 which was 2.35 times the target level. Rates fell below target again in 2008 (1.47) and remained there through 2011 (0.62). However, the rate rose above target again in 2012 (2.41) and 2013 (2.26).

Adult Survival

Survival of Seneca strain lake trout (ages 7 to 11) had been consistently greater (20-51%) than that of the Superior strain for the 1980-1995 year classes. Lower survival of SUP strain lake trout was likely due to higher mortality from sea lampreys. Survival of both JEN and LEW strains was similar to the SUP strain, suggesting that those strains may also be highly vulnerable to sea lampreys. Ontario strain (ONT) lake trout were progeny of SEN and SUP strains and their survival was intermediate to that of their parent strains.

Survival for all strains combined (hereafter referred to as population survival) was based on all fish captured for the 1983 – 1995 cohorts as all fish stocked during that period received coded wire tags. Population survival was not calculated for the 1978-1982 and 1996-2002 cohorts because only a portion of those stockings received coded wire tags. Population survival generally increased with successive cohorts through the 1985 year class, exceeded the restoration plan target value of 0.60 beginning with the 1984 year class, and remained above the target for most year classes thereafter. The population survival of the 2003 year class is currently based only on ages 7-10 fish from stockings of 67% SEN and 33% SUP strains.

Growth and Condition

The predicted weight of a 700-mm lake trout (from length-weight regressions) decreased during 1983 to 1986, but increased irregularly from 1986 to 1996 and remained relatively constant through 1999 (Figure 8). Predicted mean weight declined by 158.8 g (5.6 oz) between 1999 and 2006, but increased again in 2007 and was relatively stable through the 2009 value of 3647.1 g (8.0 lb). The 2007-2009 mean (3653.4 g, 8.0 lb) was similar to the 1996-1999 mean (3679.6 g, 8.1 lb). Predicted mean weight rose sharply after 2009, and remained nearly constant during 2010-2012 at highest values observed for the time series (2010-2012 mean =3734.0 g). The trend of improving condition through 1996 corresponded to increased abundance of older lake trout in the population. Both predicted weight and condition in 2013 fell below values from 2007-2012.

Predicted weight increased during 2005-2008 paralleling increases in round goby abundance which are now common in lake trout diets. Condition of immature fish fell again in 2009 (591.3 g, 1.3 lb.) to a level near the long term mean for the data series, but condition during 2010 - 2013 was among the lowest recorded for the data series.

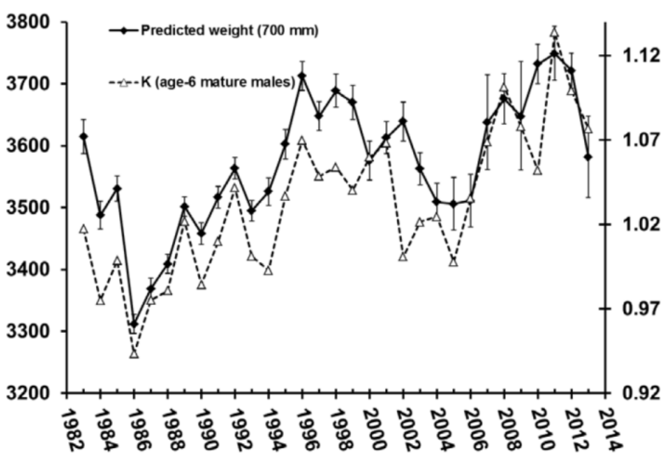

Figure 8. Lake Ontario lake trout condition for age-6 mature males and predicted weight at 700-mm (27.6") from weight-length regressions calculated from all fish collected, 1983 – 2013

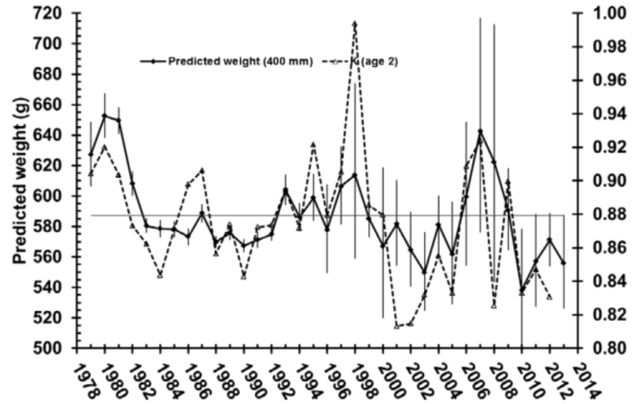

Figure 9. Lake Ontario lake trout predicted weight at 400-mm (15.8 in) TL from annual weight-length regressions calculated from fish 250 mm-500 mm (9.8 to 19.7 in), July - August 1978 – 2013. The horizontal line represents the mean predicted weight across all years.

Reproductive Potential

The CPUE of all mature females suggested that reproductive potential quadrupled from 1983 to 1986 and then fluctuated around a high level through 1998. Strain composition of the eggs was mostly SUP during 1983-1990 and mostly SEN during 1991-2002. After 2002, it became increasingly difficult to assess strain-specific contribution to the egg deposition index because many fish stocked since 1997 were not marked with coded wire tags. In most recent years SEN strain dominated stockings and we assumed that they continued to contribute the greatest proportion to the egg index.

The index value increased in 2009 and remained relatively constant through 2012. The 2009-2012 mean was 25% below the mean for 2001-2004. In 2013 egg deposition was similar to 2001-2004 level and, for the first time, included contributions from age-5 Klondike strain (SKW) lake trout from the 2008 year class (see appendix 1 from strain descriptions). ✧

Status of Prey Fishes in U.S. Waters of Lake Ontario, 2013 (USGS)

Lake Ontario Prey Fish Assessments, 2013

Introduction and Methods

History and Description

Lake Ontario has a mean depth of 86 m (282 ft) and a maximum depth of 244 m (801 ft). The southern, New York portion of the lake has the deepest water (**Figure 1).** In New York waters, about 67% of the lake is <160 m (525 ft) deep and about 82% of the lake is <180 m (591 ft) deep. The U.S. Geological Survey and New York State Department of Environmental Conservation have cooperatively assessed Lake Ontario prey fishes each year since 1978. Bottom trawl assessments were initially focused on Alewife, Rainbow smelt and Slimy Sculpin. Seasonal survey timing corresponded to the peak catches in 1972 when collections were made every month May to October. Twelve transects were established at approximately 25-km intervals along the U.S. shoreline **(Figure 2**). Alewife assessment was conducted at all transects, Rainbow smelt assessment at all transects except Fair Haven, and six transects representing eastern, southern, and western lake areas were sampled for Slimy Sculpin **(Figure 2**). Changes in the Lake Ontario ecosystem (species invasion, oligotrophication, native species rebound) require ongoing evaluation of current methods which sometimes necessitate redistribution of trawl effort, or changes in sampling designs and/or gear. For instance, the spring Alewife assessment is now used also to assess invasive Round Goby population dynamics. Likewise, the fall benthic fish assessment (formerly sculpin assessment) now also tracks dynamics of the rebounding native Deepwater Sculpin population, the apparent declining population of Slimy Sculpin, and fall distribution of Round Goby.

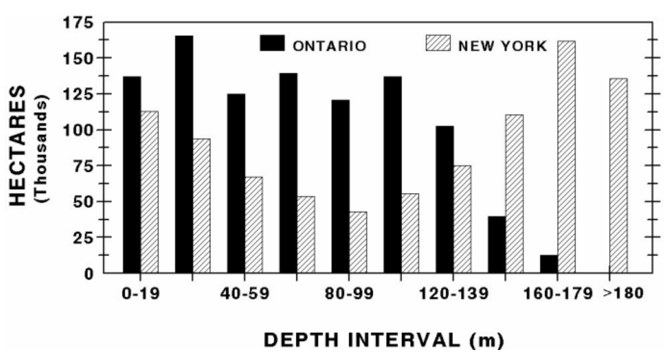

Figure 1. Area of Lake Ontario in various depth strata in the province of Ontario and New York.

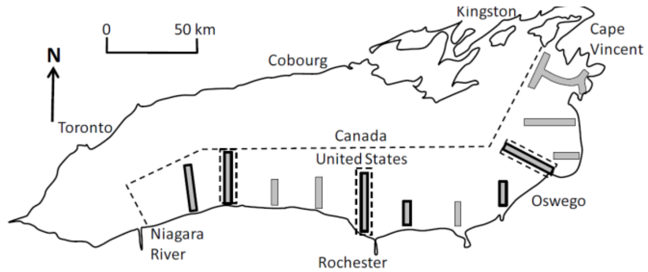

Figure 2. Lake Ontario showing 12 transects sampled by USGS and NYSDEC with bottom trawls.

Status of Alewife in U.S. Waters of Lake Ontario, 2013

Abstract

The adult Alewife abundance and weight indices in 2013 were very similar to 2012 levels. Condition of adult Alewives decreased relative to 2012, but remained relatively high and within the range of recent years. Yearling abundance was above average for the fourth consecutive year, and represents the strongest year class in this time series since 1978. Alewife year class strength at age-1 is related to the number of spawners, summer temperatures and winter duration in the first year after hatching. The number of spawners increased from 2012, but summer temperatures in 2013 were slightly below average and we anticipate a high winter severity so year class size could be well below average for 2013. Because of moderate year classes in 2007-2008, above average year classes in 2009-2011, and the very large year class in 2012, we expect adult Alewife abundance and biomass to continue to increase in 2014, barring significant impacts of the harsh winter.

Status of Alewife

In 2013, standard sampling conducted annually by the USGS was reduced due to hydraulic system failure on the USGS R/V *Kaho* and delays getting the system adequately repaired to resume sampling,. The R/V *Seth Green* was able to assist and allow completion of Rochester and Thirty Mile transects, but transects at Olcott, Smoky Point, and Fair Haven were not sampled. Four of five of the western transects were sampled, but only two eastern transects (Sodus and Oswego) were sampled where depths exceed 70 m. For depths <70 m, surveillance collections could be substituted for missed random tows within depth strata.

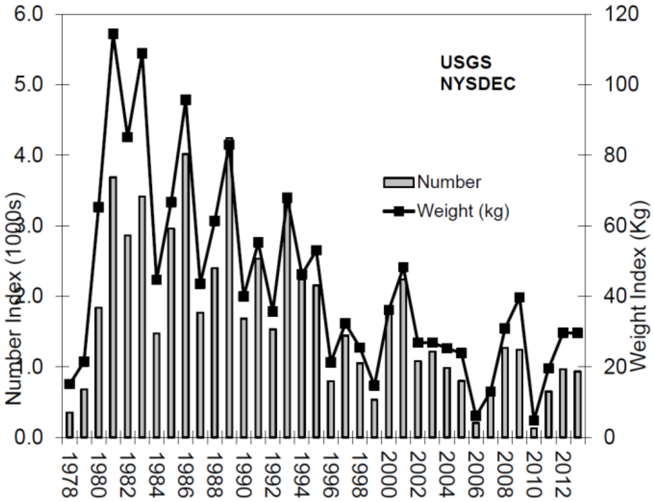

Figure 1. Abundance and weight indices for adult (age-2 and older) Alewife in the U.S. waters of Lake Ontario during late April – early May, 1978-2013. 1 kg = 2.205 lbs.

In April – May 2013, both the abundance (number) and weight (kg) indices for adult Alewife (age-2 and older) in U.S. waters of Lake Ontario were similar to 2012 values **(Figure 1).** The 2013 abundance index (935) was equal to 55% of the long-term mean (1702), 25% of the record high of 1989 (4247), and is seven times higher than the record low from 2010 (128). The 2013 biomass index (30) was equal to 68% of the long-term mean (43), 26% of the record high of 1981 (114), and is six times higher than the record low from 2010 (5).

The predicted weight in spring and fall 2013 remained relatively high and within the range of recent years, but was less than peak values observed during 2009-2010 **(Figure 3).** Generally since 2004, condition in spring and fall has been higher than in any other period since the late 1970's. Persistent high condition of adult alewives indicates that food availability is not limiting the population at current densities.

The age-1 Alewife abundance index in spring 2013 (1428) was well above the long term mean (390) and represents the largest year class ever observed in this time series **(Figure 4).** The year class exceeded predictions from our recruitment model. With moderate year classes in 2007 and 2008, above average year classes in 2009-2011, and this large 2012 year class, the adult stock should continue building.

In 2013, the summer temperature index (341) was slightly below the long-term average (359), indicating moderate conditions for reproduction and larval survival. Spawning stock has increased the last three years following low levels in 2010.

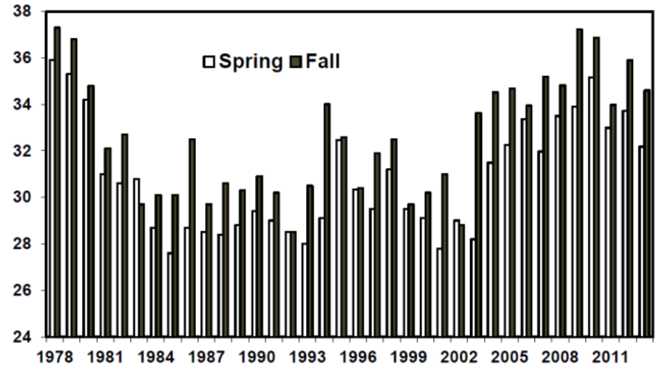

Figure 3. Wet weight of a 165-mm (6.5 in) Alewife (Lake Ontario, 1978-2013

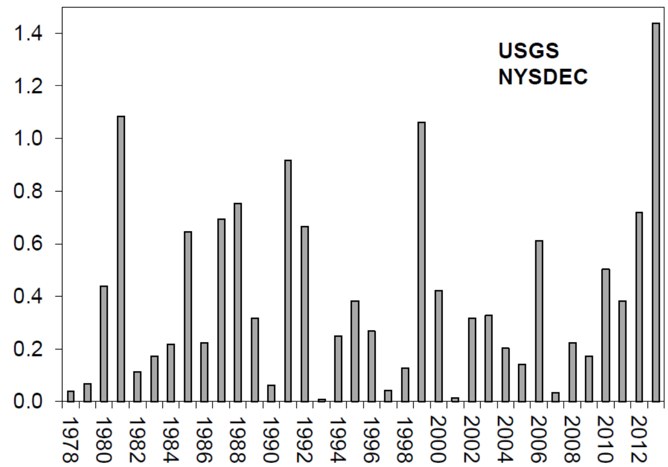

Figure 4 . Abundance for yearling (age-1) Alewife in U.S. waters of Lake Ontario,April – May, 1978-2013.

However, harsh winter conditions during 2013-2014 could adversely affect the 2013 year class. Twenty days in December 2013 had water temperature < 4° C, as well as likely all days in January-March, leading to a predicted winter index in the range of 109-139 days. Only five winters since 1977 have exceeded a winter duration index of 120 days. Our spawn recruit model predicts a below average year class based on anticipated winter severity.

Status of Rainbow Smelt in U. S. Waters of Lake Ontario, 2013

Abstract

Rainbow Smelt are the second most abundant pelagic prey fish in Lake Ontario after Alewife. The 2013 bottom trawl assessment indicated the abundance of Lake Ontario age-1 and older Rainbow Smelt decreased by 69% relative to 2012. Length frequency-based age analysis indicated that age-1 Rainbow Smelt constituted approximately 50% of the population, which is similar to recent trends where the proportion of age-1 has ranged from 95% to 42% of the population. While they constituted approximately half of the catch, the overall abundance index for age 1 was one of the lowest observed in the time series, potentially a result of

cannibalism from the previous year class. Combined data from all bottom trawl assessments along the southern shore and eastern basin indicate the proportion of the fish community that is Rainbow Smelt has declined over the past 30 years. In 2013 the proportion of the pelagic fish catch (only pelagic species) that was Rainbow Smelt was the second lowest in the time series at 3.1%. Community diversity indices, based on bottom trawl catches, indicate that Lake Ontario fish community diversity, as assessed by bottom trawls, has sharply declined over the past 36 years and in 2013 the index was the lowest value in the time series. Much of this community diversity decline is driven by changes in the pelagic fish community and dominance of Alewife.

Results and Discussion

The Rainbow Smelt assessment conducted in June 2013, consisted of 96 bottom trawls at 11 transects extending from Olcott, NY into the eastern basin and covered a depth range of 8 - 170m. In 2013, the abundance index for age-1 and older Rainbow Smelt fell relative to 2012 and abundance was similar to 2011 observations (**Figure 1).** The abundance index was about half of the 10-year average. Only 1.4% of the Rainbow Smelt caught on the assessment were greater than 150mm (approximately 6 inches). The percentage of Rainbow Smelt over 150 mm varied from 6-28% during the period 1978-1985 however, since 1986 the percentage of Rainbow Smelt over 150 mm has been consistently low, averaging slightly higher than 2% of the population.

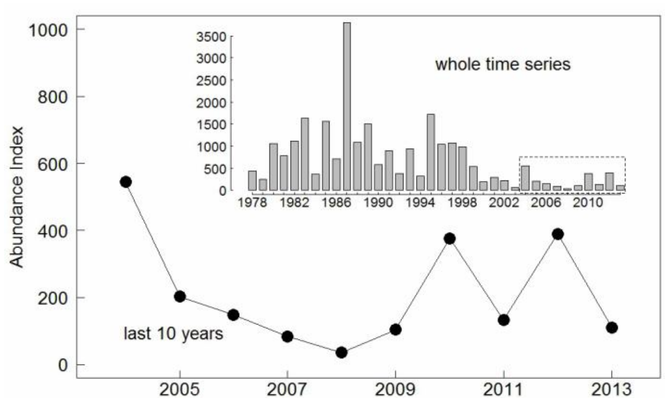

Figure 1. Stratified mean catch of Rainbow Smelt (age-1 and older) from bottom trawls in U.S. waters of Lake Ontario, late May-early June, 2004 - 2013.

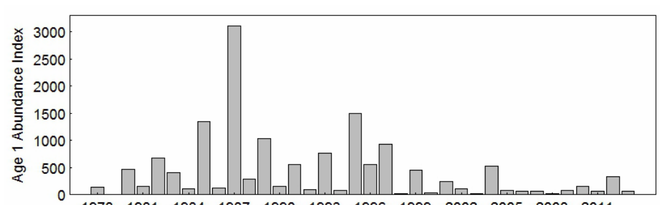

Figure 3. Stratified mean catch of age-1 Rainbow Smelt from bottom trawls in U.S. waters of Lake Ontario, May-early June, 1978 - 2013.

Length frequency-based age analysis indicated that age-1 Rainbow Smelt abundance index declined in 2013 relative to 2012, and was among the lowest age-1 abundance indices measured (**Figure 3**). The low abundance of the yearlings in 2013 is likely a result of cannibalism by abundant age-1 smelt in 2012. The two year cyclic pattern of smelt abundance is common for species such as Rainbow Smelt when abundant age-1 fish reduce the following year class abundance (Lantry and Stewart 2000).

Diversity in the pelagic prey fish community has been identified as a Lake Ontario fisheries management objective. For instance, in the most recent version of the Lake Ontario fish community objectives Stewart et al. (2012) included the offshore pelagic objective 2.3 which addresses prey fish diversity in the lake: "*Increase prey-fish diversity - maintain and restore a diverse prey-fish community that includes Alewife, Lake Cisco, Rainbow Smelt, Emerald Shiner, and Threespine Stickleback".* Generally fish community diversity and especially pelagic prey fish community diversity has declined over the past 30 years. Weidel et al. (2013) highlighted the declining diversity in Lake Ontario bottom trawl catches and specifically noted changes in the previously prevalent Rainbow Smelt population. In 2013, the proportion of Rainbow Smelt in all trawls was near the lowest in the 36 year time series (3.1%, **Figure 4**). This decline follows a similar decline in the diversity of all species caught, which is heavily influenced observed changes in the pelagic fish community where Rainbow Smelt are increasingly rare and catches are dominated by Alewife.

Benthic Prey Fish Assessment, Lake Ontario 2013

Abstract

Over the past 34 years, Slimy Sculpin abundance in Lake Ontario has fluctuated, but ultimately decreased by two orders of magnitude, with a substantial decline occurring in the past 10 years. The 2013 Slimy Sculpin mean bottom trawl catch density and mean biomass density were the lowest recorded in the 27 years of sampling using the original bottom trawl design. From 2011-2013, the Slimy Sculpin density and biomass density has decreased by approximately 50% each year. Spring bottom trawl catches illustrate Slimy Sculpin and Round Goby winter habitat overlaps for as much as 7 months out of a year, providing opportunities for competition and predation. Invasive species, salmonid piscivory, and declines in native benthic invertebrates are likely all important drivers of Slimy Sculpin population dynamics in Lake Ontario.

Deepwater Sculpin, considered rare or absent from Lake Ontario for 30 years, have generally increased over the past eight years. For the first time since they were caught in this assessment, Deepwater Sculpin density and biomass density estimates declined from the previous year. The 2013 abundance and density estimates for trawls covering the

standard depths from 60m to 150m was 0.0001 fish per square meter and 0.0028 grams per square meter. In 2013, very few small (< 80 mm) Deepwater Sculpin were caught and most sculpin were at sites of 150 meters or greater, which is in contrast to previous years when juvenile fish were caught around 80-100 meters. The reduced effort and late seasonal timing of the 2013 assessment make it difficult to have high confidence in declines observed in 2013, however observed Alewife Alosa psuedoharengus abundance increases and reduced juvenile Deepwater Sculpin catches are consistent with the hypothesis that Alewife negatively influence Deepwater Sculpin recruitment.

Nonnative Round Gobies population has expanded and they are now found along the entire south shore of Lake Ontario, with the highest densities in U.S. waters just east of the Niagara River confluence. In the 2013 spring-based assessment, both the abundance and weight indices increased slightly as compared to 2012. The number index value of 16.6 was 30% of the maximum number observed in 2008 when the number index was 95.2. Round Goby density estimates from the 2013 fall benthic prey fish survey were 33 times greater than fall Slimy Sculpin density, indicating Round Goby are now the dominant Lake Ontario benthic prey fish.

Slimy Sculpin – Results and Discussion

The 2013 Slimy Sculpin density and biomass density were the lowest recorded in the time series. For comparison, these statistics are relatively similar to Slimy Sculpin bottom-trawl based biomass density estimates for Lake Michigan in 2012, where time series indicate Slimy Sculpin have experienced a substantial decline over the past 8-10 years. Interestingly, the maximum biomass densities observed in Lake Michigan were similar to those observed in Lake Ontario, yet in Lake Michigan those maximums were observed in 1976 and 2006, where Lake Ontario maxima were observed in the 1980's and 1990 (**Figure 1).**

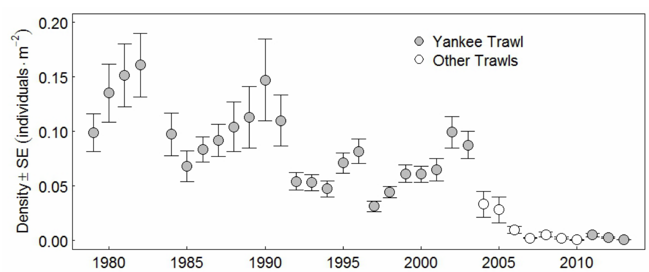

Figure 1. Slimy Sculpin density for U.S. waters, of Lake Ontario, covering depths from 8-175m, 1978–2013. Open circles denote years when alternative bottom trawls were used.

The Slimy Sculpin density decline is most drastic between 2003 and 2004. Since 2011, the assessment returned to the original trawl gear, and over those three years, catches indicated Slimy Sculpin density has declined, by approximately 50% each year. To help demonstrate this density change, in the area encompassed in an American football field there would have been 750 Slimy Sculpin in the 1980's, in 2013 there would have been 5 Slimy Sculpin.

Evidence exists for both top-down and bottom-up forces driving the Slimy Sculpin density changes. Previous studies suggested that predation by ever-increasing numbers of stocked juvenile Lake Trout accounted for sculpin declines in the early 1980's, but during the past 20 years juvenile Lake Trout abundance has declined concurrently with Slimy Sculpin declines.

Deepwater Sculpin – Results and Discussion

Deepwater Sculpin, once considered extirpated from Lake Ontario, have increased substantially over the past seven years. These native, deep water prey fish were absent or rare in all bottom trawls surveys from 1979-2004 and were first captured on the fall prey fish assessment in 2005. In 2013 the USGS fall benthic assessment, density and biomass density declined to 0.0001 indivduals·m^{-2} and biomass density of 0.0028 g·m^{-2}.

For comparison, Lake Michigan Deepwater Sculpin biomass density ranged from 2.0 to 0.5 g·m^{-2} from the 1970's through the early 2000's, but have declined recently. Bunnell et al. (2013) attribute this recent decline to depth distribution change rather than a true lake wide density decline. It should be noted the 2013 benthic fish assessment was delayed and shortened as a result of the U.S. Government shutdown, however the assessment collected 51 of the 62 planned bottom trawls. The reduced effort and late seasonal timing of the 2013 assessment make it difficult to have high confidence in declines observed in 2013.

This species has been described as an "indicator of well being of the deepwater ecosystem". The presence of juvenile Deepwater Sculpin in the 2010-2012 assessments indicated favorable conditions for young Deepwater Sculpin survival, which are often caught in depths of 70-100m. That increase in juveniles may have been a result of reduced Lake Ontario Alewife abundance, which has been linked to depression of Deepwater Sculpin in Lake Michigan. The lack of such young fish or catches in the 70-100m range in the 2013 assessment is consistent with the hypothesized negative influence of Alewife, as Alewife abundance has increased over the past 2 years.

Round Goby – Results and Discussion

Round Goby a suspected ballast water introduction, were first detected in the Great Lakes Basin in the St. Clair River between Lakes Huron and Erie in 1990. Round Goby were first reported in southwestern Lake Ontario in 1998 near the entrance to the Welland Canal. The first collection of Round Gobies occurred in 2002. Since then, the Round Goby population has expanded substantially and Round Gobies are now found along the entire south shore of Lake Ontario, with the highest population densities in U.S. waters just east of the Niagara River mouth.

Based on the basic mean density observed in all trawl catches during the fall assessment Round Goby were 33 times more dense than Slimy Sculpin. In addition, the fall assessment -based time series for Round Goby shows a different pattern of peak abundance than the spring assessment data. ✧

Sea Lamprey Control in Lake Ontario, 2013

Lampricide Control

Lake Ontario has 659 tributaries (405 Canada, 254 U.S.). Sixty-six tributaries (31 Canada, 35 U.S.) have historical records of larval sea lamprey production, and of these, 38 tributaries (17 Canada, 21 U.S.) have been treated with lampricides at least once during 2004-2013. Twenty-eight tributaries (14 Canada, 14 U.S.) are treated on a regular cycle. Figure 1 provides details on the application of lampricides to Lake Ontario tributaries and lentic areas during 2013.

- Lampricide applications were conducted in eight streams (two Canada, six U.S.).
- Larval sea lamprey were detected upstream of the dam at Cedar Springs on Bronte Creek necessitating a treatment from Carlisle, Ontario.
- Covert and Grindstone creeks and Trout Brook were treated further upstream from the historical upper distribution of larvae.
- Orwell Brook was treated for the first time since construction of the sea lamprey barrier was completed in 2012. This stream will be treated again in 2014 due to concerns of residual populations resulting from beaver impoundments located upstream from the barrier.

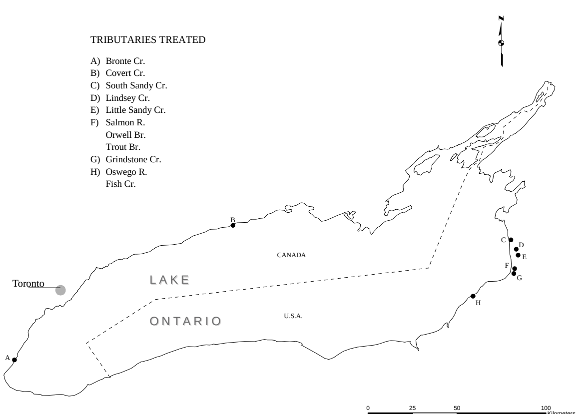

Figure 1. Location of Lake Ontario tributaries treated with lampricides (corresponding letters in Table 1) during 2013.

Barriers

Ensure Blockage to Sea Lamprey Migration

- Duffins Creek – An investigation is underway to improve safety around the dam while restoring the sea lamprey control function of the barrier.
- Credit River –Efforts are underway to address sea lamprey escapement at the Kraft Mill Dam and through the fishway. Redesign and replacement of an overhanging plate that was lost as a result of ice damage in main weir section has been completed. Consultation with the Ontario Ministry of Natural Resources (OMNR) to address escapement at the fishway is underway.

New Construction

- Orwell Brook – Construction of the sea lamprey barrier and trap on Orwell Brook was completed. Trapping operations began in spring 2013 and a total of 435 sea lampreys were captured, the most from any trap operated on the U.S. side of Lake Ontario. Two level loggers have been installed up- and downstream of the dam to monitor flow characteristics and evaluate the hydraulic performance of the barrier. Larval assessment surveys conducted during August 2013 revealed no young-of-year larvae upstream of the dam.

ASSESSMENT

Larval Assessment

Tributaries considered for lampricide treatment during 2014 were assessed during 2013 to define the distribution and estimate the density and size structure of larval sea lamprey populations. Assessments were conducted with backpack electrofishers in waters <0.8 m deep, while waters ≥0.8 m in depth were surveyed with GB. Survey sites were randomly selected in each tributary, larval sea lamprey catches were adjusted for gear efficiency, and lamprey lengths were forecast to the estimated end of the growing season. The number of large larval sea lampreys in each infested area was estimated by multiplying the mean density of larvae ≥100 mm (number per m^2) by an estimated area of suitable habitat (m^2). Infested areas were ranked for treatment during 2014 based on the lowest cost per kill of larval sea lampreys ≥100 mm, as estimated using this index of abundance and average treatment costs. Additional surveys are used to define the distribution of sea lampreys within a stream, detect new populations, evaluate lampricide treatments, and to establish the sites for lampricide application.

- Larval assessments were conducted on a total of 38 tributaries (18 Canada, 20 U.S.).

- Surveys to estimate abundance of larval sea lampreys were conducted in 12 tributaries (5 Canada, 7 U.S.).

- Surveys to detect the presence of new larval sea lamprey populations were conducted in five tributaries (four Canada, one U.S.). No new populations were detected.

- Post-treatment assessments were conducted in nine tributaries (two Canada, seven U.S.) to determine the effectiveness of lampricide treatments conducted during 2012 and 2013.

- Surveys to evaluate barrier effectiveness were conducted in seven tributaries (six Canada, one U.S.).

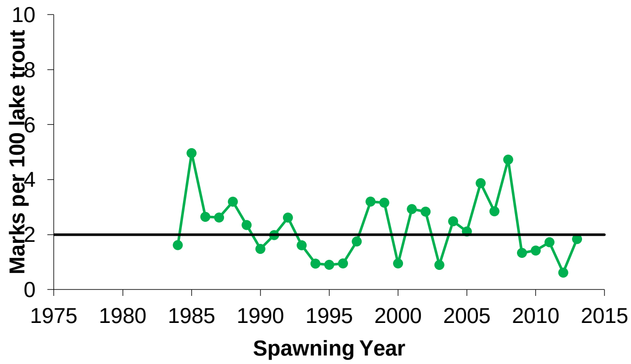

Figure 3. Number of A1 marks per 100 lake trout >431 mm from standardized fall assessments, plotted in the year that the juvenile cohort returned as adults (marking recorded in the fall is inflicted by the cohort of sea lampreys that spawns the next spring). The horizontal line represents the target of 2 A1 marks per 100 fish.

End

Juvenile Assessment

- Lake trout marking data for Lake Ontario are provided by the U.S. Geological Survey, the OMNR, and the New York State Department of Environmental Conservation, and analyzed by the Service's Green Bay, Wisconsin, Fish and Wildlife Conservation Office.

- The number of A1 marks per 100 lake trout >431 mm from standardized fall assessments during 2013 has not yet been analyzed.

- Based on standardized fall assessment data, the marking rate during 2012 was 2 A1 marks per 100 lake trout >431 mm. The marking rate is less than the target and has been for the previous four years (Figure 3).

Adult Assessment

- A total of 6,434 sea lampreys were trapped at 12 sites on 11 tributaries (Figure 4).

- The estimated population of adult sea lampreys was 29,098 , which was within the target range of 31,000 ± 4,000 (Figure 4).

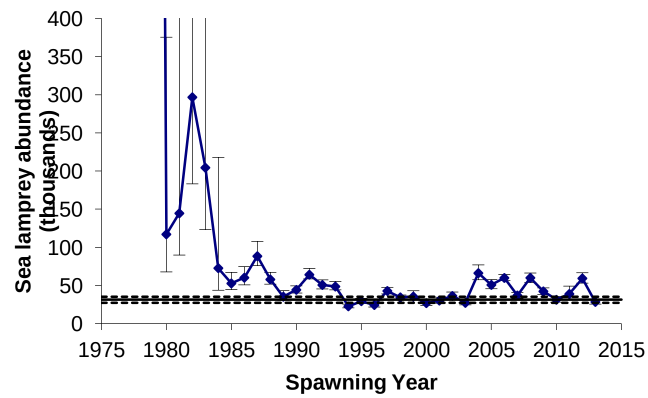

Figure 5. Annual lake-wide population estimates of adult sea lampreys in Lake Ontario, 1980 – 2013.

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