Inland Seas Angler
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Highlights of the Annual Lake Committee Meetings
Great Lakes Fishery Commission proceedings, Ypsilanti, MI

This third of a series of annual special reports is a summary of Lakes Huron-Superior. These lake committee reports are from the annual Lake Committee meetings hosted by the Great Lakes Fishery Commission in March 2011. We encourage reproduction with the appropriate credit to the GLSFC and the agencies involved. Our thanks to the staffs of the GLFC, OMNR, USFWS, USGS and the Michigan DNR 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 Ypsilanti.

Lake Huron

Index of Reports

Lake Superior

Index of Reports

Key
DFO = Department Fisheries, Oceans
FWS = U.S. Fish & Wildlife Service
LHC = Lake Huron Committee
LSC = Lake Superior Committee
USGS = U.S. Geological Survey
CPE = Catch per effort
GB = (granular Bayluscide)
1 kiloton (kt) (1 kt = 1000 metric tons)

Lake Huron:
Status and Trends of Pelagic Prey Fishes in Lake Huron, 2010 (USGS

Abstract
The 2010 USGS Great Lakes Science Center survey was conducted during September and October, and included transects in Lake Huron's Main Basin, Georgian Bay, and North Channel. Main Basin estimates of pelagic fish density and biomass were lower in 2010 compared to 2009. While bloater densities and biomass did not change, we observed decreases in rainbow smelt and near absence of emerald shiner and threespine stickleback. Alewife remained nearly absent, and only one Cisco was captured. Unlike 2009, during 2010 we observed significantly higher fish density and biomass in the North Channel compared to Georgian Bay and the main basin. That spatial pattern was similar to trends we found during 2004-2007. Prey availability during 2010 will likely be comparable to other recent years, but size structure of rainbow smelt suggests that larger rainbow smelt will be available as forage during 2011.

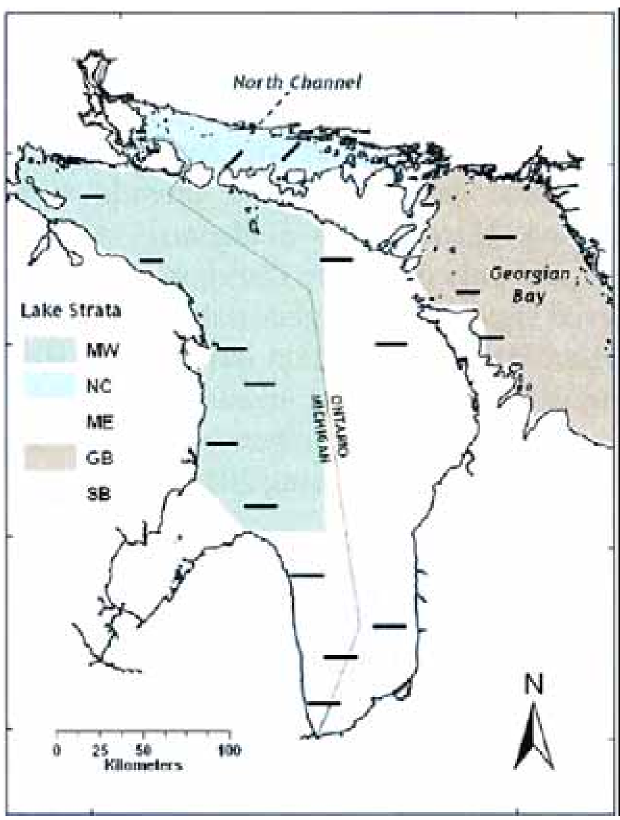


Fig 1-Hydroacoustic transects sampled during the 2010 lakewide acoustic/midwater trawl survey in Lake Huron

Alewife
Since 2004, we have captured few alewives, and all were age-O fish. During 2010, both alewife density and biomass remained near record lows (**Fig 2**). Assuming comparability of 2009 data with other years, main basin alewife density was significantly higher in 1997 compared to 2004, 2007, 2009, and 2010, and main basin alewife biomass was significantly greater in 1997 compared to all other years. Biomass differences among years were due to presence of adult alewife in 1997, with only age-O alewife captured between 2004 and 2010. Age-O alewife biomass remains chronically low, and since 2004 alewife have never comprised more than 2.5 % of main basin pelagic fish biomass. Alewife have shown no sign of returning to their former high abundance. During 2010, only two age-O alewives were captured in the midwater trawl; they were collected near Thunder Bay.

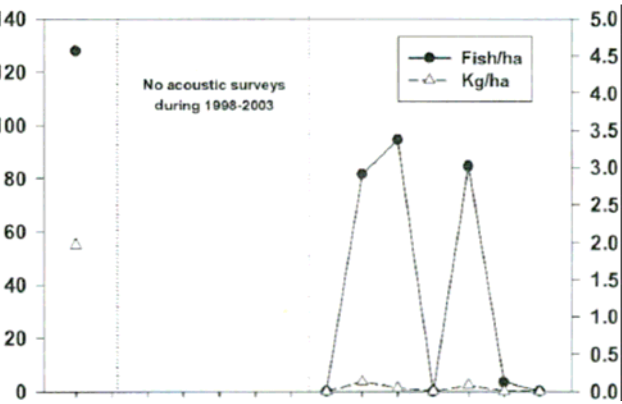


Fig 2-Acoustic estimates of alewife density and biomass in Lake Huron's Main Basin, 2004-2010

Rainbow smelt
Main basin rainbow smelt density and biomass were lower in 2010 compared to 2009 (**Fig 3).** Assuming comparability of 2009 data with other years, both density and biomass were significantly higher during 1997 and 2009 compared with other years for age-0 and age-l + fish, but 1997 and 2009 estimates did not vary significantly. The 2010 smelt year class was small compared to the high densities we observed during 2009, but size structure of rainbow smelt in the midwater trawl suggested that most captured fish originated from the 2009 year class (**Fig 4**).

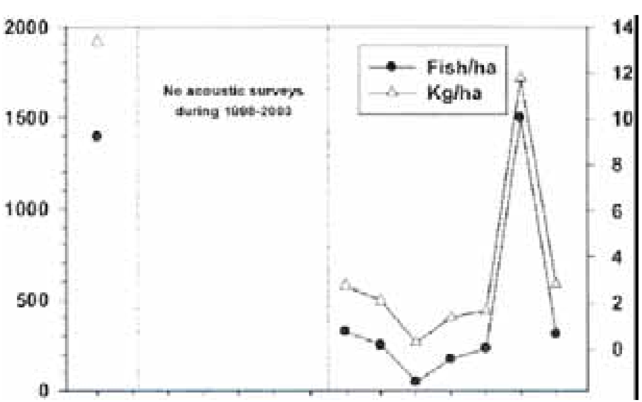


Fig 3-Acoustic estimates of age-1+ rainbow smelt density and biomass in Lake Huron Main Basin 2004-2010

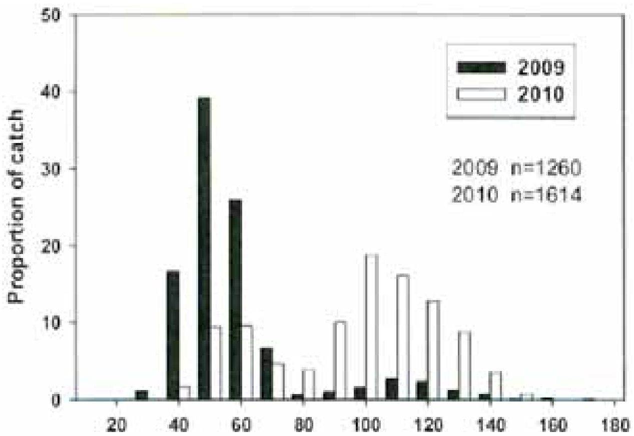


Fig 4-Length frequency of smelt, expressed as proportion of midwater catch, 2009-2010

Bloater

Age-O bloater density in the main basin was lower during 2010 compared with 2009 (**Fig 5).** Assuming comparability of 2009 data with other years, density of age-O bloater was highest in 2008, but both 2008 and 2009 densities were significantly greater than other years. Biomass of age-O bloater followed a similar trend; 2008 and 2009 estimates were higher than other years but did not differ from one another. Main basin density and biomass of age-1+ bloater did not differ among years.

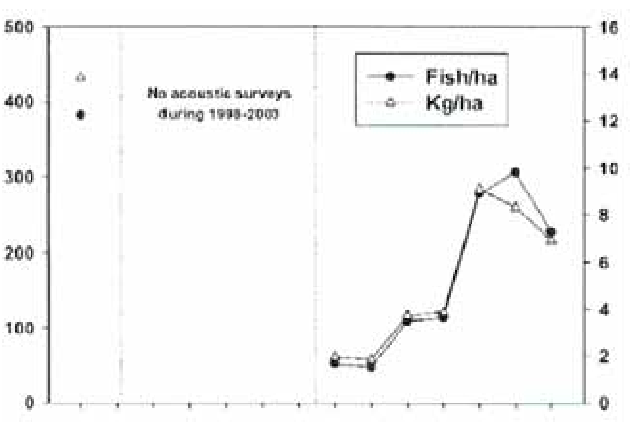


Fig 5-Acoustic estimates of age-l+ (> 120 mm) bloater density and biomass in Lake Huron 2004-2010

Emerald shiner

Emerald shiner were collected only rarely during 2010. They were not collected until 2005 but have been found each year since, albeit in lower numbers during recent years (**Fig 6**). The only significant trend in the data series is that mean main basin density and biomass of emerald shiner were higher during 2006 compared with other years. Again, the assumption of comparability of 2009 data remains.

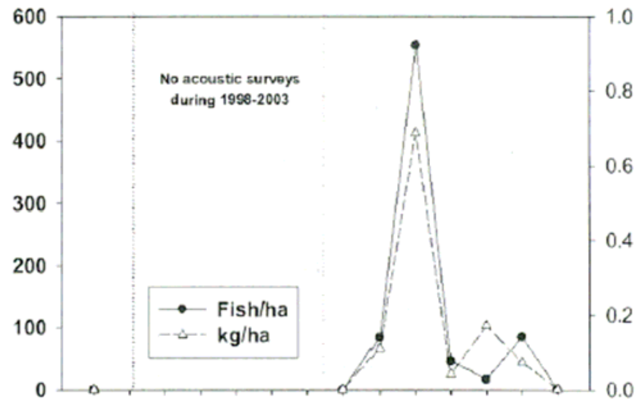


Fig 6-Acoustic estimates of emerald shiner density and biomass, 2004-2010

Cisco

No main basin Cisco were captured during 2010 (**Fig 7).** When present, they can comprise a significant proportion of pelagic biomass due to their large size, but they have been captured rarely, and likely remain uncommon in the areas we sampled. We did capture one Cisco in Georgian Bay.

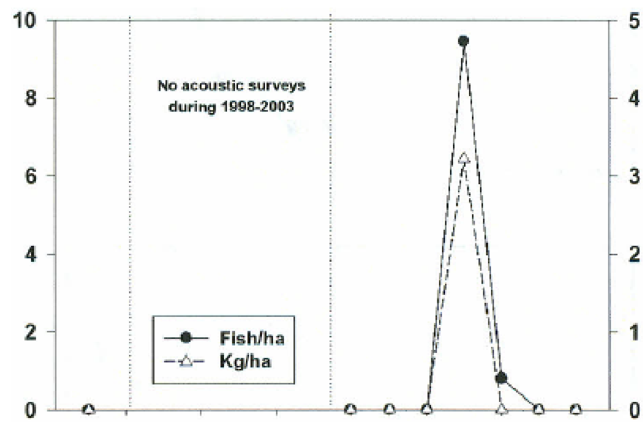


Fig 7-Acoustic estimates of Cisco (2004-2007, 2009, 2010) and unidentified coregonid (2008) density and biomass

Main Basin Fish Community

Main basin total pelagic fish density and biomass declined between 2009 and 2010 (**Figs 8, 9**). Within the time series, and assuming comparability of 2009 data, total fish density and total biomass were significantly higher during 1997 and 2009 compared with other years, but there were no density differences between the two higher years and all other density estimates were similar. We observed the identical pattern with total biomass estimates. Declines between 2009 and 2010 were primarily the result of lower rainbow smelt densities, combined with low densities of emerald shiners, sticklebacks, and Cisco.

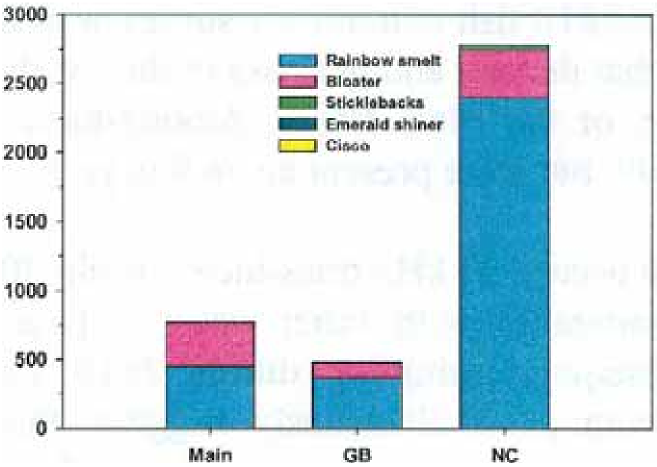


Fig 8-Acoustic estimates of total pelagic fish densities in Lake Huron's Main Basin (Main), Georgian Bay (GB) and North Channel (Ne), 2010

Among-Basin Comparisons

Total fish density and total fish biomass were significantly higher in the North Channel compared with the main basin and Georgian Bay **(Figs 8, 9).** That pattern was similar to what we observed during 1997-2007, and was consistent with historical surveys.

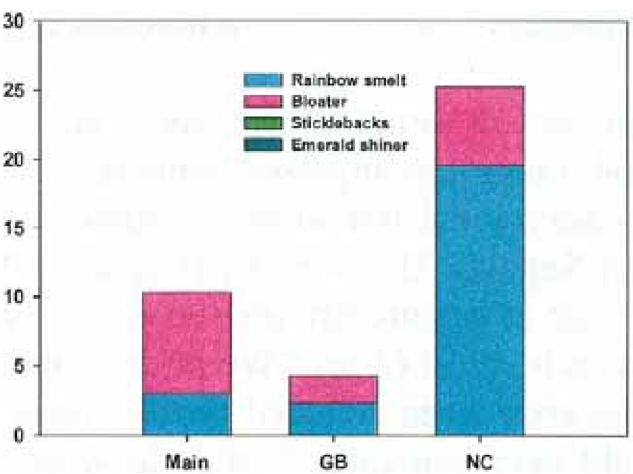


Fig 9-Acoustic estimates of total pelagic fish biomass in Lake Huron's Main Basin (Main), Georgian Bay (GB) and North Channel (Ne), 2010

Among Lake Comparisons

During 2009, Lakes Michigan and Huron had similar estimates of total pelagic biomass, but the fish communities were different. During 2010, total pelagic biomass in Lake Michigan was significantly higher than Lake Huron. **Alewife biomass was significantly higher in Lake Michigan, but biomass of bloater and rainbow smelt did not differ among the lakes.**

Discussion

Lake Huron's Main Basin pelagic fish density and biomass decreased during 2010 when compared to 2009 estimates. This occurred primarily through a much smaller rainbow smelt year class, lower densities of yearling and older smelt, and near-absence of emerald shiner, both threespine and ninespine sticklebacks, and Cisco. Emerald shiners were scarce compared to their peak lakewide abundance during 2006, but they have returned as part of the pelagic fish community. Their recent lower abundance may be due to high piscivore densities combined with low abundance of alternative prey.

During 2011, forage availability for piscivores will likely be similar to recent years. Alewife remain nearly absent, and pelagic fish abundance and biomass are no different than most recent years when forage biomass has been generally considered low. Alternatively, rainbow smelt size structure has increased; the majority of rainbow smelt are now of a size preferred by piscivores. But generally, the Lake Huron forage base remains low compared to previous decades when both alewife and rainbow smelt were likely much more abundant, and differences between Lakes Huron and Michigan were heightened by appearance of high age-0 alewife densities in Lake Michigan during 2010. Piscivore biomass and growth in Lake Huron will likely continue to be limited by this condition. ✧

Status/Trends of Lake Huron Offshore Demersal Fish Community, 1976-2010

Abstract

The primary purpose of this report is to present estimates of the abundance and biomass of offshore demersal fish species that are important as prey to common predators in the lake (i.e., lake trout and Chinook salmon).

The USGS Great Lakes Science Center has conducted trawl surveys to assess annual changes in the offshore demersal fish community of Lake Huron since 1973. Sample sites include five ports in U.S. waters with less frequent sampling near Goderich, Ontario. The 2010 fall bottom trawl survey was carried out between 22 October- 12 November 2010. The 2010 main basin prey fish biomass estimate for Lake Huron was 29.09 kilotonnes, the second lowest estimate in the time series, and less than 5% of the maximum biomass estimated in 1987.

The estimated biomasses of adult alewife and rainbow smelt in 2010 were higher than 2009, but remained near the

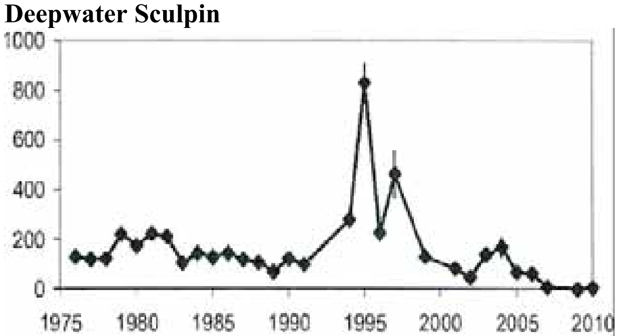
lowest observed in the time series, and populations were dominated by small fish. Estimated adult bloater biomass in Lake Huron has been increasing in recent years, and the 2010 biomass estimate was the highest observed since 1997. Biomass estimates for trout-perch and ninespine stickleback were the lowest observed in the time series.

Deepwater & Slimy Sculpin

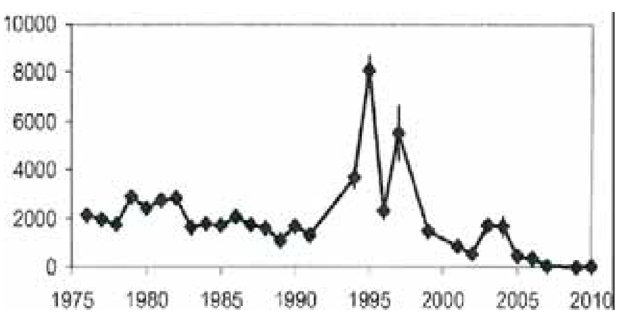
Abundance and biomass estimates for deepwater sculpins in Lake Huron in 2010 were higher than 2009 but were the second lowest observed in the time series (**Fig. 1**), and represented 5 % of the maximum estimate. Slimy sculpins have not been captured in the Lake Huron bottom trawl survey since 2006 (**Fig 2**).

The 2010 biomass estimate for round goby was higher than in 2009 but remains relatively low. Wild juvenile lake trout were captured again in 2010, suggesting that low levels of natural reproduction by lake trout may be occurring. High variability in the abundance and biomass of several species may indicate that the offshore demersal fish community in Lake Huron is in an unstable state. Low prey fish abundance may have continuing negative implications for populations of lake trout and Chinook salmon in the lake.

Deepwater Sculpin



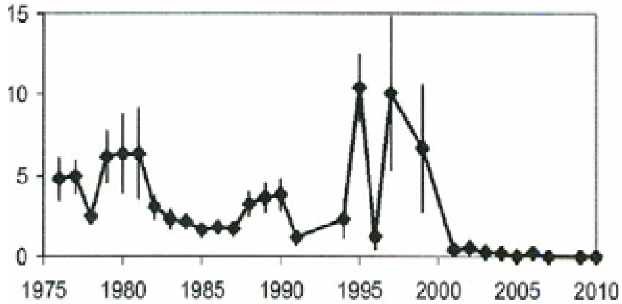
Abundance



Biomass

Fig 1-Deepwater sculpins density as number (top panel) and biomass (bottom panel) of fish per hectare, 1976-2010

Slimy Sculpin



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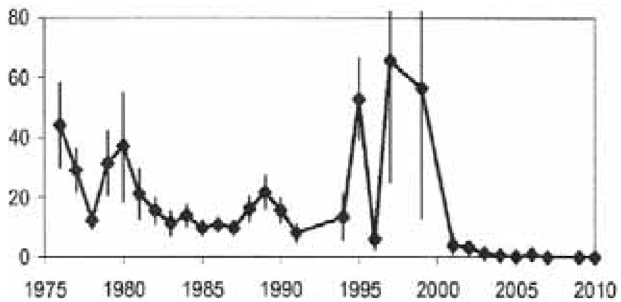


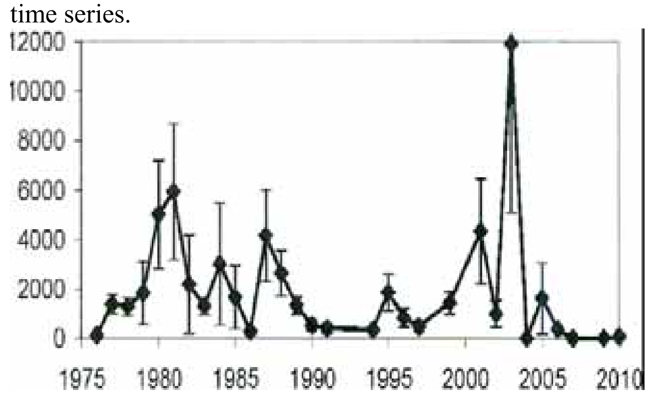
Biomass

Fig 2-Slimy sculpins density as number (top panel) and biomass (bottom panel) of fish per hectare, 1976-2010

Lake Huron supports valuable recreational and commercial fisheries that may be at risk due to recent widespread ecological changes in the lake. Recent major ecosystem changes in Lake Huron include the invasion of dreissenid mussels, drastic declines in the abundance of the native amphipod *Diporeia*, decreases in lake whitefish and Chinook salmon catches, significant changes in the abundance and species composition of the zooplankton community, invasion by round goby, and the collapse of the offshore demersal fish community.

Alewife

Alewife abundance in Lake Huron remained low in 2010. Adult alewife density and biomass estimates increased over 2009, but were the fourth lowest observed in the time series **(Fig. 3).** Age-O alewife density and biomass also showed an increase in 2010 but remain near the all-time low for the time series.



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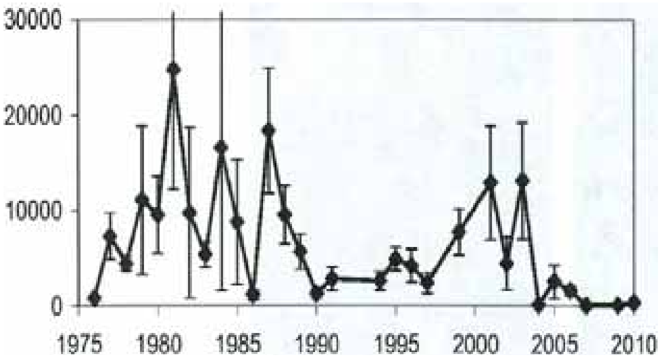
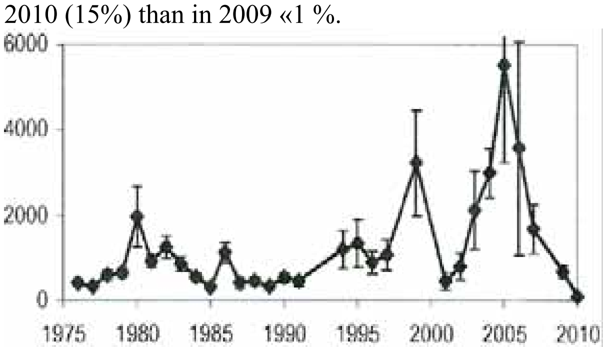


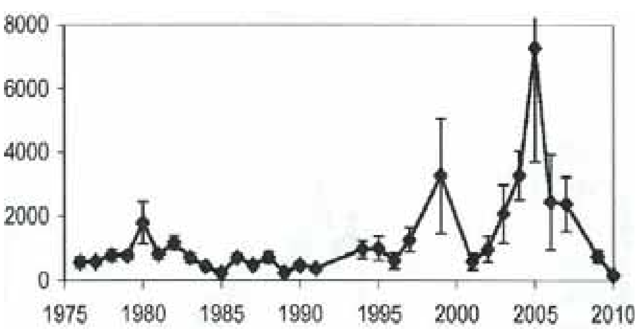
Biomass

Fig 3-Density of young- of-the-year alewives as number (top panel) and biomass (bottom panel) of fish per Hectare, 1976-2010

Adult rainbow smelt

Adult (YAO) rainbow smelt density in Lake Huron increased over 2009, but remained low (5.6% of the maximum**; (Fig. 4).** YOY rainbow smelt abundance and biomass were reduced compared to recent years, with 2010 estimates being the lowest observed in time series. The rainbow smelt population in Lake Huron was dominated by age-O fish in 2010, but a greater proportion of the population was greater then 100 mm in length in 2010 (15%) than in 2009 «1 %.





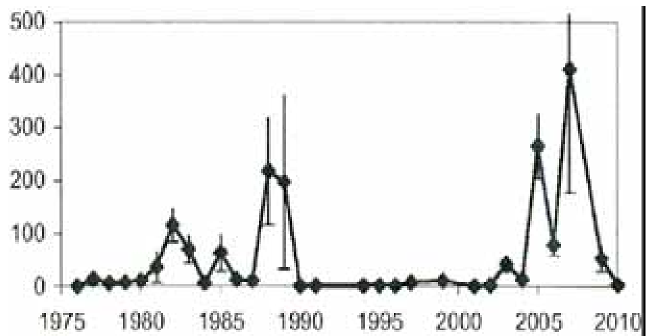
Abundance

Biomass

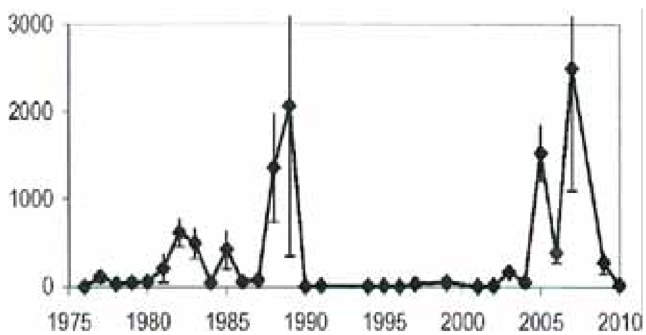
Fig 4-Density of young- of-the-year rainbow smelt as number (top panel) and biomass (bottom panel) of fish per hectare, 1976-2010

Adult bloater densities

Adult (YAO) bloater densities in Lake Huron have been increasing in recent years, but the 2010 abundance estimate was slightly lower than 2009. Bloater biomass, however, increased over 2009 due to higher abundance of larger fish, and was the highest biomass observed since 1997 **(Fig. 5**). YOY bloater abundance was lower than 2009 and the lowest observed since 2002. Nearly 20% (19.55%) of bloaters captured in the 2010 survey were greater than 100 mm.



Abundance



Biomass

Fig 5-Density of bloater as number (top panel) and biomass (bottom panel) offish per hectare 1976-2010

Other Prey fish

The 2010 abundance and biomass estimates for ninespine stickleback were the lowest in the time series. Trout-perch abundance was also the lowest estimate in the time series; biomass was the second lowest (after 2009). The 2010 biomass estimates for ninespine stickleback and trout-perch were 1.3% and 1.1 % of the maxima, respectively. Round goby abundance and biomass estimates for 2010 were slightly higher than 2009 and were the second lowest since 1998, the year after the species was first captured in the survey.

The total main basin prey biomass estimate was 29.1 kilotonnes, the second-lowest estimate in the time series (**Fig. 6**, which represents 7.9 % of the highest lakewide biomass estimated in 1987. Approximately 65 % of the 2010 biomass estimate was made up of YAO bloater. Three wild juvenile lake trout were captured in the 2010 fall survey. Aside from the 2009 survey, when no wild juvenile lake trout were captured, this represents the lowest density of juvenile lake trout since they started appearing in the catches in 2004.

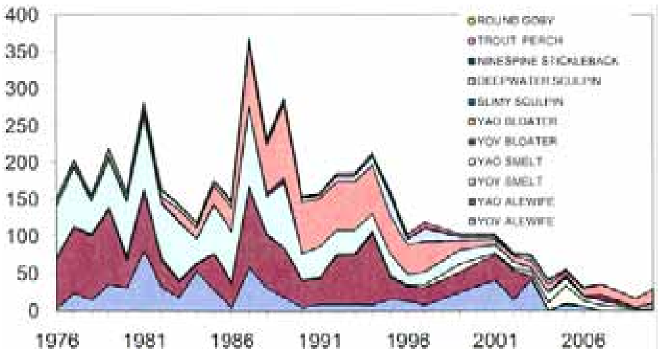


Fig 6-Offshore demersal fish community biomass in the main basin, 1976-2010

Summary

The abundance of prey fish in Lake Huron has remained at very low levels since the collapse of the offshore demersal fish community. The estimated lakewide biomass of prey fish in 2010 was higher than reported in 2009, but is nevertheless the second lowest recorded since the survey began, and is less than eight percent of the maximum biomass estimated in 1987. Estimated biomass of YAO alewife and rainbow smelt in 2010 were higher than 2009 estimates, but remained low compared to earlier data. Populations of alewife and rainbow smelt during 2010 were dominated by small fish. The reduction in the abundance of these exotic species is consistent with fish community objectives for Lake Huron, but does not bode well for lake trout and Chinook salmon populations in the lake, which rely on these species as prey.

YAO bloaters are the only offshore demersal fish species in Lake Huron to show a positive trend in abundance in recent years. YAO bloater biomass has been increasing since approximately 2001, and the 2010 biomass estimate was the highest observed since 1997. The abundance of this native species appears to be approaching the levels observed in the 1980s and 1990s, but biomass remains lower due to a relative lack of larger fish.

Abundance and biomass of all three of the primary prey species (alewife, rainbow smelt, and bloater) in Lake Huron were very low in 2010. All of these species have shown the highest estimated abundance of YOY fish in the time series since 2003. These observations suggest that recent conditions in the lake have been intermittently conducive to the production of large year-classes of these species, but not to their long-term survival. The fact that all three species showed very low YOY abundance in 2010 indicates that conditions in Lake Huron were not suitable for YOY benthopelagic planktivore production in 2010.

Deepwater and slimy sculpins, ninespine sticklebacks, and trout-perch are currently minor components of lake trout diets in the Great Lakes, but were probably more important before the invasion of the lakes by alewife and rainbow smelt. Biomass estimates for sculpins, sticklebacks, and trout-perch in 2010 were the near the lowest observed in the time series. As these species are all benthic feeders, this observation may be related to changes in the benthic environment associated with the invasion of dreissenid mussels, which occurred previous to these anomalously high observations. The fact that all of these native species are currently at or near record low abundance suggests that benthic offshore conditions in Lake Huron may have changed in a way that does not favor their survival.

Round gobies have recently become a significant part of the diet of lake trout in some areas of the Great Lakes, including Lake Huron. Round gobies were first captured in the Lake Huron trawl survey in 1997, reached peak abundance in 2003, and have declined in abundance since. Our results suggest that round goby are currently at low abundance in the offshore waters of Lake Huron.

The estimated lakewide biomass of common offshore prey species in Lake Huron has increased since 2009, but remains near the lowest level observed since the survey began. **The peak estimated biomass of prey fish in Lake Huron occurred in the late 1980s, and has declined steadily since then; a similar decline has occurred in Lake Michigan**. It is possible that these declines are associated with the invasion of the lakes by several exotic species including zebra mussels, quagga mussels, and round gobies, all of which have been introduced since approximately 1990. Similar declines in some species (particularly coregonids) have occurred in Lake Superior, however, where these exotic species have not invaded.

Naturally produced juvenile lake trout were first captured in relatively large numbers by the Lake Huron fall survey in 2004, the year after the alewife population collapsed. Catches have generally declined since then, and were relatively low in 2010. This suggests that the conditions that were conducive to natural reproduction of lake trout in Lake Huron may have been temporary, and that natural reproduction of lake trout may be less widespread in Lake Huron in recent years. We note, however, that this survey was not designed to catch juvenile lake trout, and the lack of catches in our survey does not necessarily mean that naturally-produced juvenile lake trout are not present in some areas of the lake, especially in rocky high-relieve habitats not sampled by our trawl.

The results of this survey show that there has been great variability in the abundance or biomass of a number of fish species (YOY benthopelagic planktivores, round goby, wild juvenile lake trout) over the last decade, while the overall abundance and biomass of prey species in the main basin of Lake Huron remain near the lowest levels observed since the inception of the survey. These very low levels of prey fish abundance have persisted since approximately 2006. These results, along with other analyses of these data, may indicate that the offshore demersal fish community in Lake Huron is currently in an unstable state. Continuing low levels of prey fish abundance may have serious implications for the growth, condition, and survival of lake trout and Chinook salmon populations in the lake. ✧

Summary of Fish Stocking in Lake Huron, 1968 to 2010 (OMNR)

Table 1- Number of predators stocked into the Lake Huron basin, 1968-2010

Year	Chinook Salmon	Coho Salmon	Brown Trout	Rainbow Trout*	Lake Trout*	Backcross	Walleye*	Atlantic Salmon	Brook Trout	Splake	Lake Herring	Total
1968	265,000	402,000	45,000	70,000	0	0	0	0	0	0	0	782,000
1969	250,000	667,000	0	151,020	0	0	0	0	0	35,410	0	1,103,430
1970	643,000	571,000	81,870	1,280,666	0	0	0	0	0	247,422	0	2,823,958
1971	894,000	975,000	159,291	507,022	0	0	0	0	0	468,782	0	3,004,095
1972	514,545	249,046	160,000	378,877	5,000	0	0	0	0	332,700	0	1,640,168
1973	967,330	100,026	496,552	1,779,304	631,915	486,000	0	0	0	411,610	0	4,872,737
1974	767,294	500,048	420,109	770,840	799,000	250,000	0	0	0	299,352	0	3,806,643
1975	655,484	627,362	155,025	488,697	1,055,500	0	0	0	0	523,099	0	3,505,167
1976	830,536	690,529	446,842	366,014	1,027,000	0	0	0	0	658,107	0	4,019,028
1977	733,430	415,568	210,014	286,167	1,048,000	310,819	0	0	0	879,004	0	3,883,002
1978	1,417,578	84,176	258,232	473,400	1,232,000	174,500	25,000	0	0	0	0	3,664,886
1979	1,325,033	1,082,216	90,000	246,700	1,357,228	798,489	334,427	0	1,500	0	0	5,235,593
1980	1,877,645	375,130	90,000	393,013	1,428,500	560,515	9,989	0	0	0	0	4,734,792
1981	1,522,745	135,132	45,000	333,443	1,388,060	680,035	294,656	0	0	0	0	4,399,071
1982	2,000,787	452,589	250,000	483,381	1,360,192	925,610	269,540	0	0	0	0	5,742,099
1983	2,695,800	425,138	685,214	514,050	1,078,500	855,948	869,390	0	0	0	0	7,124,040
1984	3,146,997	470,051	571,520	642,418	840,626	1,069,961	947,796	0	8,000	0	0	7,697,369
1985	3,140,892	671,733	633,291	1,152,152	2,008,397	1,011,701	1,382,754	0	0	0	0	10,000,920
1986	3,609,052	675,259	823,738	2,224,438	1,870,014	907,925	1,518,319	0	14,848	0	0	11,643,593
1987	4,143,730	581,649	581,880	1,854,736	1,095,872	996,628	972,734	0	242,939	196,749	0	10,666,917
1988	4,693,327	702,034	637,084	1,820,789	2,062,079	810,593	757,777	0	252,900	0	0	11,736,583
1989	5,017,748	350,097	484,852	1,510,821	2,201,630	950,129	1,318,362	18,596	0	0	0	11,852,235
1990	4,767,931	0	899,101	1,406,562	870,005	558,414	1,011,977	33,235	67,024	0	0	9,614,249
1991	3,897,944	0	845,894	1,511,152	1,719,154	724,230	797,757	32,804	48,500	0	0	9,577,435
1992	3,975,852	0	588,636	2,165,046	3,309,533	751,075	1,159,912	42,203	0	24,790	0	12,017,047
1993	4,290,811	0	516,733	985,569	2,917,338	245,415	188,271	70,164	0	45,700	0	9,260,001
1994	4,403,507	0	557,819	1,162,232	3,182,441	486,439	1,963,970	33,275	0	37,493	0	11,827,176
1995	4,678,127	0	590,031	1,073,847	3,192,266	87,383	802,138	68,066	0	37,500	0	10,529,358
1996	4,236,069	0	587,526	1,207,411	3,564,546	0	573,421	43,725	0	50,271	0	10,262,969
1997	4,095,744	0	531,771	852,793	3,702,626	0	1,038,833	43,568	0	30,480	0	10,295,815
1998	3,990,079	0	446,509	881,172	4,113,777	0	5,241,505	52,174	0	32,600	0	14,757,816
1999	3,390,984	0	582,278	755,164	3,431,031	0	642,269	26,185	0	34,000	0	8,861,911
2000	3,441,989	0	360,486	653,045	4,655,132	0	681,589	46,220	0	30,000	0	9,868,461
2001	3,657,505	0	422,059	787,608	3,609,739	0	1,024,913	35,909	0	30,820	0	9,568,553
2002	3,200,453	0	649,606	495,410	3,421,479	0	1,328,369	41,093	0	32,200	0	9,168,610
2003	3,487,722	0	473,316	680,824	3,148,904	0	2,391,662	54,743	0	32,900	0	10,270,071
2004	3,469,027	0	413,822	487,752	3,421,360	0	2,487,983	24,811	0	33,600	0	10,338,355
2005	3,206,496	0	464,535	477,980	3,698,946	0	426,911	29,665	0	37,500	0	8,342,033
2006	1,706,984	0	569,322	526,440	2,965,167	0	710,325	38,032	0	37,500	0	6,553,770
2007	1,636,498	0	571,624	597,430	3,749,023	0	388,824	20,437	0	28,700	0	6,992,536
2008	1,883,476	0	540,710	609,738	3,914,775	0	367,702	29,079	0	37,500	0	7,382,980
2009	1,672,971	0	138,726	822,646	3,861,729	0	734,082	28,400	0	37,500	40,012	7,336,066
2010	1,599,566	0	252,543	1,018,776	3,620,029	0	273,178	38,999	0	33,200	0	6,836,291
Totals	111.801.688	11.202.783	18.328.561	36.886.545	92.558.513	13.641.809	32.936.335	851.383	635.711	4.716.489	40.012	323.599.829

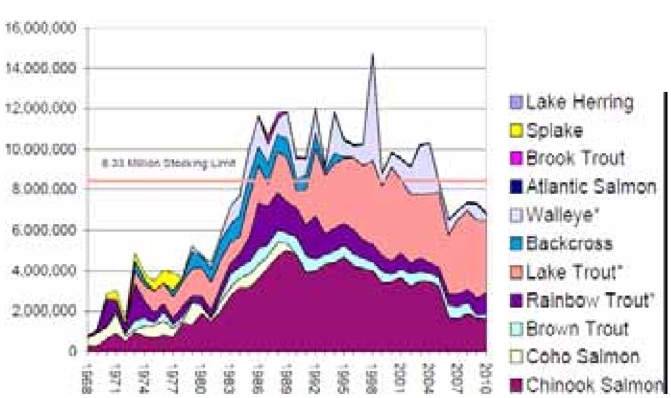


Fig 1-Predators stocked from 1968 to 2010, includes both American and Canadian plantings

Harvest of the Commercial Fisheries of Lake Huron, 1900- 2010 (OMNR)

Lake Huron continues to support an important and valuable commercial fishery. Commercial fisheries exist in the jurisdictions of all three management agencies on Lake Huron and in all three basins.

Lake-wide harvest of all species combined was down again in 2010 and was among the lowest total harvest reported for the past 30 years **(Figs 1 and 2**). Market conditions continue to play an influential role in the behavior of the fisheries of Lake Huron as increasing production costs have reduced fishing effort in some locations, especially more remote areas of the lake. Additionally, widespread ecosystem change and shifting food-web dynamics continue to be in important consideration in the management of the commercial fisheries on Lake Huron.

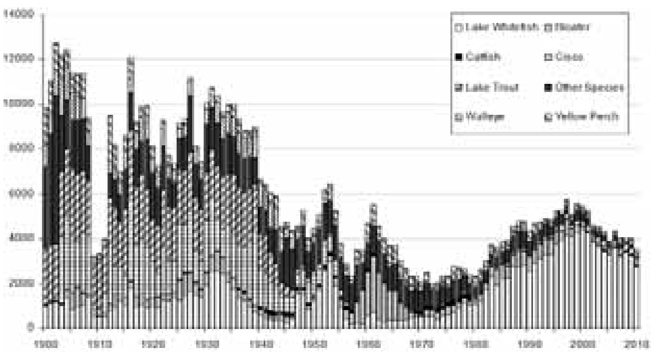


Fig 1-Total lake-wide commercial harvest by species, 1900-2010

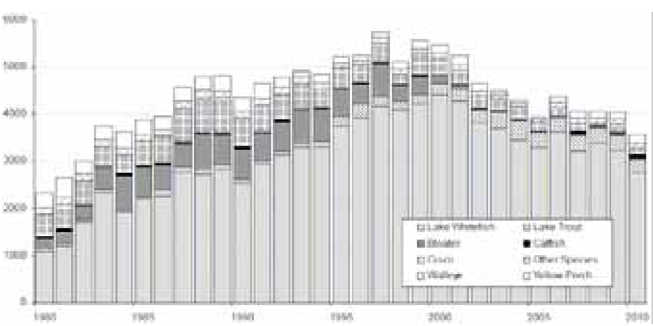


Fig 2-Total lake-wide commercial harvest by species, 1980-2010

Current Harvest versus Historical Harvest

Lake-wide harvest continues to be below levels reported in the first half of the 20th century but still noticeably higher than the period between 1940 and 1980 **(Fig 1**). The current species composition of the harvest continues to be dominated by Lake Whitefish with other species contributing less than 25% to the overall harvest (**Fig 2**). This is markedly different than species composition during the early to middle part of the twentieth century when lake herring, deepwater chub, and lake trout where large components of the Lake Huron commercial fisheries landings (**Fig 1**).

Most of the commercial landings continue to come from the Ontario side of the main basin, although substantial landings are reported in the fisheries licensed by CORA and MDNR. Lake–wide harvest of all species was down in 2010. Trap net effort was down again in 2010, continuing a downward trend that extends back to at least the 1990's. Large-mesh gill net effort continues to be the dominant gill net gear in Lake Huron. Large-mesh gill net effort was down slightly from 2009.

Recent Trends in Yellow Perch Harvest

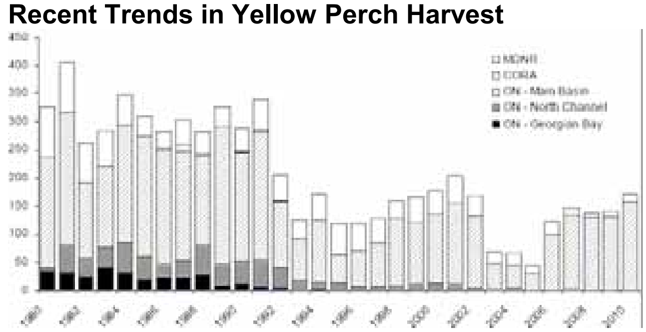


Fig 3- Total lake-wide commercial harvest of yellow perch by management agency and lake basin, 1980-2010

Overall harvest of yellow perch in 2010 was up from 2009, and is still noticeably higher than the period between 2003 and 2005. Most of the yellow perch harvest continues to be from the Ontario side of the main basin. The harvest of yellow perch from Saginaw Bay increased in 2010 and was noticeably higher than the three previous years.

Recent Trends in Walleye Harvest

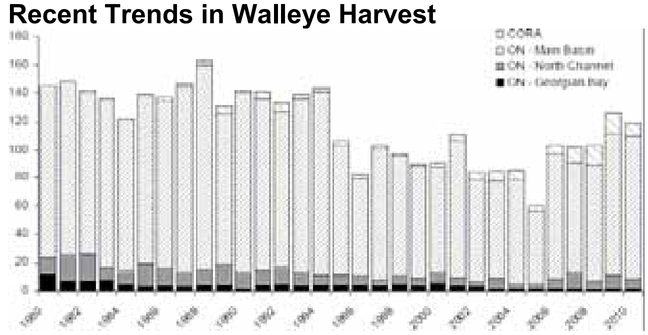


Fig 4-Total lake-wide commercial harvest of walleye by management agency and lake basin, 1980-2010

Overall, the harvest of walleye in 2010 was down slightly from 2009 **(Fig 4).** Walleye harvest is relatively high compared to the past 15 years, due to increased harvest in the Ontario side of the main basin. Most of the walleye harvest was reported from the Ontario side of the main basin, which was essentially unchanged from the previous year.

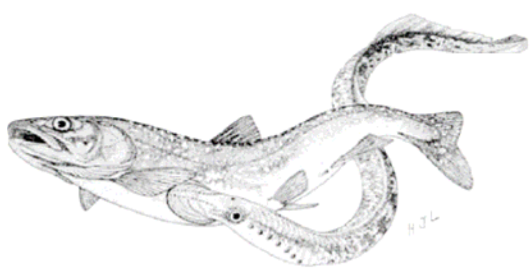
Trends in other fish Harvests

Harvest of Lake Whitefish was down in 2010 relative to 2009. Reduced harvest was reported in all regions of the lake, although the largest declines occurred in MDNR waters of the main basin and in Georgian Bay. Harvest in 2010 was comparable to the levels reported throughout most the 1980's.

Lake Trout harvest in 2010 was down noticeably relative to the previous 7 years. Reduced harvests were reported in most regions of the lake, although harvest from the North Channel actually increased in 2010. The harvest from Georgian Bay has steadily declined since 2004. ✧

Management of Sea Lampreys in Lake Huron, 2010

Spawning-phase sea lamprey abundance in Lake Huron during 2010 was estimated to be 139,676, which was an increase from the 2009 estimate and remains greater than target abundance. Sea lamprey abundance in Lake Huron has been greater than target levels throughout the last 20 years. During the 1990s there were more sea lampreys in Lake Huron than in all the other Great Lakes combined. Since 2001, the population estimates have been significantly lower than estimates during the previous 10 years.



Tributary Information

Lake Huron has 1,761 tributaries (1,334 Canada, 427 U.S.). One hundred eighteen tributaries (57 Canada, 61 U.S.) have historical records of larval sea lamprey production. Of these, 73 tributaries (35 Canada, 38 U.S.) have been treated with lampricide at least once during 2001 - 2010. Forty-seven tributaries (22 Canada, 25 U.S.) are treated on a regular cycle.

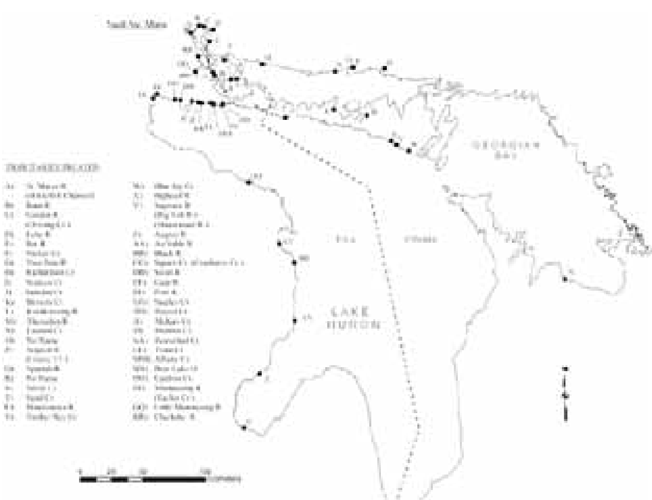


Fig 1-Locations of tributaries treated with lampricides during 2010

Lampricide Control

Lampricide treatments were completed in 44 tributaries (24 Canada, 20 U.S.) and 3 lentic areas (1 Canada, 2 US). This was the first year of a large-scale treatment strategy in the North Channel of Lake Huron. Thirty-five sea lamprey producing tributaries were scheduled for treatment, (24 Canada, 11 U.S.) to suppress and maintain abundance at or below the targeted number of sea lampreys in Lake Huron.

All streams are scheduled to be re-treated in 2011 to eliminate larvae that may have survived 2010 treatments, with the exception of the streams that have already been treated for two consecutive years.

● The Pine and Little Munuscong rivers and Trout Creek (US) along with Two Tree and Root rivers and Watsons Creek (Canada) were treated for the second consecutive year in 2010. Carlton Creek (US) was added to the North Channel strategy for treatment in 2011.

● As part of the North Channel large-scale treatment strategy, the Charlotte River and Bear Lake Outlet were treated for the first time since 1977 and 1981, respectively. Treatment of the Charlotte River was completed at very low discharge, which resulted in extended flow times and the need for numerous boost applications to reach minimum lethal concentration throughout the stream.

● Treatment of 874.6 ha (266.7 Canada, 607.8 U.S.) of larval habitat in the St. Marys River with GB was made possible through the deployment of a second new spray boat by the USFWS in 2010. These state-of-the-art craft use technology adapted from agricultural applications and are equipped with real-time navigation and a delivery system that mixes GB with water before delivering it under high pressure to boom-mounted spray nozzles.

Application rates are more than double those of conventional rotary spreaders and are automatically adjusted according to boat position and speed. The Chippewa-Ottawa Resource Authority assisted in the treatment of the St. Marys River by providing temporary storage for 94,500 lbs of GB in preparation for delivery to the U.S. and Canadian spray boats.

● The St. Marys River Whitefish Channel was treated with TFM for the first time in 2010. Treatment of the main Garden River was postponed when road washouts, caused by late spring floods, limited access. The treatment was rescheduled for early fall, however, excessive discharge caused by heavy rains resulted in deferral to 2011.

● The Spanish River system was treated in its entirety in 2010; the main river was deferred from treatment in 2009 due to excessive discharge.

● Treatments of the Mississagi, Wanapitei, and Magnetawan rivers were deferred due to lower than normal discharge caused by early spring run-off and lack of rain. These streams have been scheduled for treatment in 2011.

● Treatment of Marl Creek was deferred for the second consecutive year due to extreme flow variations caused by a large scale irrigation system operating within the stream. The treatment was scheduled for April 2010, prior to the anticipated start-up of irrigation; however, the pumps were activated even earlier because of early spring run-off and a lack of precipitation. Marl Creek treatment is scheduled for April '11.

● A large number of residual larvae were collected in the mouth area of H-114 during post treatment assessment surveys. The treatment was ineffective due to very low flows and seiche caused by heavy winds. This area of concern was re-treated with GB later in the year.

● The Shiawassee River was treated when discharge was higher than normal and diel pH cycling presented a challenge. Treatment timing had to be coordinated around the five-day Curwood Festival in Owosso, MI and a Michigan DNR aquatic sampling protocol.

● Suppression of pH was observed during treatments of the Big Salt River and its tributary, Bluff Creek. Some non-target mortality of white suckers, rainbow darters, common shiners, and creek chubs occurred in the lower reach of Bluff Creek.

● The Carp River was selected as one of two study streams for ongoing research examining distribution of TFM in a stream undergoing lampricide treatment. A 15-hour TFM bank was applied to accommodate the study.

● Despite relatively high stream discharge during the Carp River lampricide treatment, beaver activity in Taylor and Ozark creeks delayed flow times and required additional lampricide applications at remote and poorly accessible sites.

● Treatment of the Pine River was hindered by beaver activity in several tributaries including Trout Brook, Biscuit Creek, and the North Branch upstream of the junction with Sullivan Creek, which made it difficult to maintain minimum lethal concentrations of lampricide.

Alternative Control

Sterile-Male-Release Technique

Highlights of the sterile male release program during 2010 include the following:

● 21,814 spawning-phase male sea lampreys were delivered to the sterilization facility (Figure 2) from trapping operations in Lakes Superior (741), Michigan (6,395), Huron (13,378), and Ontario (1,300).

● A total of 19,390 sterilized male sea lampreys were released in the St. Marys River from mid-May to mid-July (Table 2). The estimated resident population of spawning-phase sea lampreys in the St. Marys River was 25,234. Assessment traps removed 7,644 sea lampreys, an estimated reduction in reproduction of 28% through trapping. The ratio of sterile to resident male sea lampreys remaining in the St. Marys River was estimated at 1.7:1 (19,390 sterile: 11,348 estimated resident after trapping).

● The theoretical reduction from trapping and enhanced sterile-male-release was estimated at 74% during 2010. The theoretical reduction in reproduction from trapping and the enhanced SMRT averaged 85% between 1997-2010. Prior to the enhanced program, from 1991-1996, the theoretical reduction in reproduction averaged 58%.

● The release of sterile males combined with the removal of sea lampreys by traps reduced the theoretical number of effective fertile females in the St. Marys River from 9,398 to 2,498 during 2010.

● In the St. Marys River rapids, one unsterilized male sea lamprey was observed spawning and eggs were collected from 20 nests. Approximately 4,750 eggs were assessed to determine the mean percent egg viability. Average egg viability in nests was 41.7%, and ranged from 0% to 96%. Average egg viability weighted by nests per year from 1997-2010 was 31.5%.

● A four-year field study of the sterile-female-release technique concluded in 2010. The primary objective of the study, conducted in the Trout River (Rogers City, MI), was to determine if release of sterilized female sea lampreys could delay or prevent lampricide treatment. In 2010, a total of 4,985 sterilized female sea lampreys were released in the Trout River from May 19-May 31. Observations of 747 sterile females, 9 untreated females, and 72 untreated males were made during the spawning migration. Type of activity was recorded as resting, nest building, or actively spawning. In 2010, a total of 116 nests were located and 94 nests were sampled to assess the percentage of viable eggs found in nests. The average percent egg viability for all nests combined (n=88) was 10.2% (range 0% - 100%). Egg viability in nests where only sterile female lampreys were observed (n=52) averaged 7.6% (range 0%-44.9%). A completion report for the four-year study will be submitted in 2011.

Barriers

There are 17 sea lamprey barriers on Lake Huron. Thirteen of these were purposebuilt by the Commission to block sea lamprey spawning migrations and four were modifications to existing structures or barriers constructed by others that ensure sea lampreys remain blocked at those sites.

Operation and Maintenance

● Routine maintenance, spring start-up, and safety inspections were performed on 11 barriers (4 Canada, 7 U.S.).

● Repairs or improvements were conducted on one Canadian barrier, Koshkawong Creek - Repairs completed to barrier access route on private landowner's property.

● The electrical field of the combination low-head/electrical barrier in the Ocqueoc River operated continuously between April 21- April 27, May 9-May 19, and June 12-June 21. A new computer and software were installed at the weir by Smith Root prior to the start of the season. Problems with calibrating the new software to the tailwater elevation sensor led to manual operation of the electrical field during most of the season.

Ensure Blockage to Sea Lamprey Migration

● Saugeen River - Denny's Dam currently ranks third on the Ontario MNR dam rehabilitation project list, and although the Commission has committed approximately $800,000 to the project over two years, lack of provincial funding is projected to delay the start of reconstruction until 2013. In the meantime, OMNR plans to address an area of scour under the north toe of the spillway and lower the level of the head pond to mitigate the risk that ice load will destabilize the structure.

● An intensive effort to inventory and ground truth the information contained in the National Inventory of Dams was continued for barriers located on U.S. tributaries to the Great Lakes. During 2010, field crews visited 166 potential barrier sites on tributaries to Lake Huron. Sites were inspected that were either previously inaccessible or where additional information was needed. Field crews re-visited streams where, historically, no sea lamprey larvae were found and inspected at least one more barrier upstream from the first sea lamprey barrier encountered in the system. This will allow the program to respond effectively to future barrier removal proposals on those systems. The initial inventory is nearly complete and in the future, barrier sites will be monitored on a rotating schedule.
 Consultations to ensure blockage at barriers were conducted with partner agencies on seven U.S. tributaries.

New Construction

Construction projects were initiated, ongoing, or completed on one Canadian tributary; the Still River – The construction and clean-up of a new two km-long road into the barrier site is complete. Fencing along the road, required to protect the landowner's thoroughbred horses from vehicular traffic, was completed in May 2010. The contract to re-construct the barrier was tendered and awarded in August. Construction commenced in September. Project completion is expected in early 2011 prior to the sea lamprey spawning run.

Assessment of Candidate streams

Fish community assessment surveys of barrier candidate streams were conducted on one Canadian tributary; the Bighead River – Fish surveys were conducted in the watershed during 2010. These surveys are a continuation of a multiple year assessment study designed to determine the fish community in the Bighead River. The cumulative results of these surveys have identified 40 fish species in the watershed. Round goby have been observed in the lower stem of the main river. No provincially or federally listed species at risk have been observed during the course of recent sampling. Historically, the Department has documented northern brook lamprey in the Bighead River.

Assessment

Larval assessment surveys were conducted on a total of 109 tributaries (58 Canada, 51 U.S.) and offshore of 8 U.S. tributaries.

● Surveys to estimate abundance of larval sea lampreys were conducted in 19 tributaries (4 Canada, 15 U.S.) and offshore of 2 tributaries (1 Canada, 1 U.S.).

● Surveys to detect the presence of new larval sea lamprey populations were conducted in 53 tributaries (31 Canada, 22 U.S). A new larval population was discovered in Marcellus Creek (H-115).

● Post-treatment assessments were conducted in 29 tributaries (11 Canada, 18 U.S.) to determine the effectiveness of lampricide treatments during 2009 and 2010.

● Surveys to evaluate barrier effectiveness were conducted in eight tributaries (1 Canada, 7 U.S.).

● Monitoring of larval sea lampreys in the St. Marys River continued in 2010. Approximately 850 geo-referenced sites were sampled using deepwater electrofishing gear. Surveys were conducted according to a stratified, systematic sampling design. The larval sea lamprey population in the St. Marys River was estimated to be 0.6 million. This is the lowest population estimate in the St. Marys River on record. Data were compiled exploring the use of historical data to inform the selection of lampricide plots on the St. Marys River.

Spawning-phase

A total of 27,274 sea lampreys were trapped at 17 sites in 16 tributaries during 2010.

● The estimated population of spawning-phase sea lampreys during 2010 was 139,676, which was greater than the fish-community objective target of 73,000 **(Fig 2).** A total of 7,644 spawning-phase sea lampreys were captured in traps operated in the St. Marys River at the Clergue Generating Station (formerly known as Great Lakes Power) in Canada and the U.S. Army Corps of Engineers and

Cloverland Electric (formerly known as Edison Sault Electric) in the U.S. The estimated population in the river was 25,234 sea lampreys and trapping efficiency was 30%.

● A total of 13,378 spawning-phase male sea lampreys were delivered to the sterilization facility from trapping operations on the Lake Huron tributaries Au Sable (778), Cheboygan (5,856), East AuGres (135), Echo (324) Thessalon (1,085), Trout (4), Ocqueoc (984), and St. Marys (4,207) rivers and Greene Cr. (2). The total includes 3 lampreys that were grouped for transport from a combination of Lake Huron tributaries.

● A three-year field-scale management experiment using the mating pheromone to enhance trap captures was conducted in 20 Great Lakes tributaries, including the St. Marys, East AuGres, Echo, Thessalon, and Little Thessalon rivers on Lake Huron.

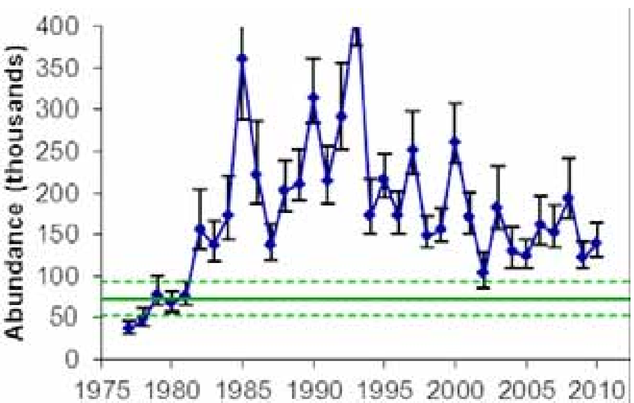


Fig 2-Estimates of spawning-phase sea lampreys during 1977-2010; Target level is solid horizontal line

● The Bighead and Nottawasaga rivers were not trapped in 2010 due to expected low spawning runs after recent treatments. The Bighead River was treated in 2010 and the Nottawasaga River in 2009. The Beaver River was not trapped in 2010 as it is a new trap and a low catch rate was expected. A lack of experienced people to run these traps was also a contributing factor. None of these rivers will be trapped in 2011 due to the same factors that caused them not to run in 2010.

Parasitic-phase

The target rate for sea lamprey marking on lake trout in Lake Huron is five fresh (A1-A3) wounds per 100 fish >533mm **(Fig 3).** Lake trout wounding data for Lake Huron are provided by DNR and tribal agencies. USFWS, USGS and OMNR. Past wounding data are currently being reviewed and reanalyzed which could result in changes to the information presented here. Spring 2010 wounding data (2010 spawning year) have not been reported, but will be included in the 2010 Annual Report to the Commission.

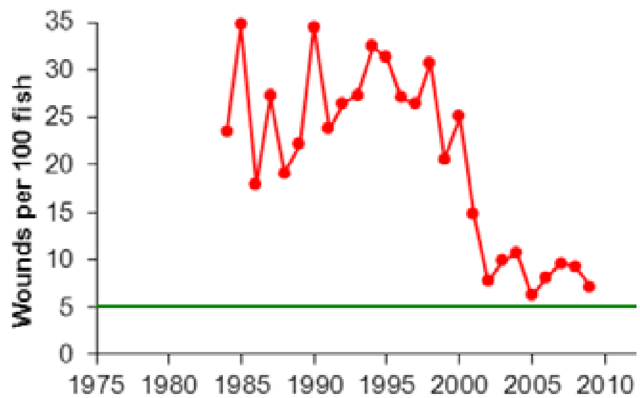


Fig 3-Number of wounds per 100 lake trout >533mm on sea Lamprey; horizontal line represents target of five wounds per 100 fish

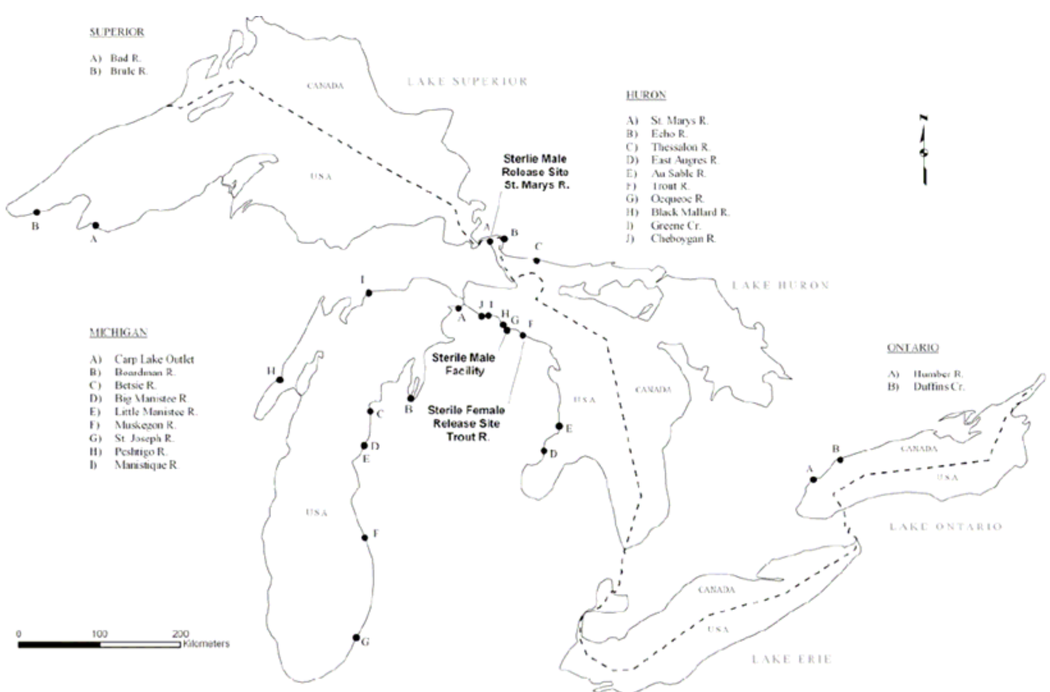


Fig 4-Locations of trapped tributaries that contributed spawning-phase sea lampreys for sterilization during 2010, release sites, and the sterilization facility

Lake Superior:

Status and Trends of prey fish populations in Lake Superior, 2010 (USGS)

Abstract

The 2010 estimate of fish community biomass was 1.37 kg/ha, the second lowest in the 33-year survey history. The low biomass estimate continues a trend of declining fish community biomass since 2005. The distribution of biomass across jurisdictions was uneven; levels in Canada East, Canada West, Michigan, Minnesota and Wisconsin waters were 2.65,0.51,0.42,0.03, and 3.94 kg/ha, respectively. Dominant species in the catch, in order of relative abundance, were Cisco, rainbow smelt, lake whitefish, bloater, short jaw Cisco, and siscowet lake trout. This is the first year that short jaw Cisco ranked in the top tier of prey species. Compared to 2009 levels, Cisco, bloater, lake whitefish, and short jaw Cisco increased while rainbow smelt, lean lake trout and siscowet biomass decreased. Year-class strengths for the 2009 Cisco and bloater cohorts were below average but ranked as the tenth strongest year class in the past 33 years. The 2010 Cisco age structure was dominated by yearlings, which accounted for 98% of the ciscoes captured. Remaining ciscoes captured were composed of adults mostly from 2003 and 1998 year classes. Year class strength of smelt was the weakest in the survey record, continuing a decline that began in 2008.

Densities of small- (< 226 mm TL) and intermediate-size (226-400 mm TL) wild (lean) lake trout continued a decreasing trend observed since 1996-1998. Density of large (> 400 mm TL) lean lake trout declined to the lowest level since 1983, prior to the period of recovery. Siscowet lake trout has shown a stable pattern of variable density since 2000. For 2010, densities of small- and intermediate-size siscowet decreased slightly while densities of large siscowet increased slightly. In the 2010 survey, proportions of total lake trout density that were hatchery, lean and siscowet were 5, 33, and 62%, respectively.

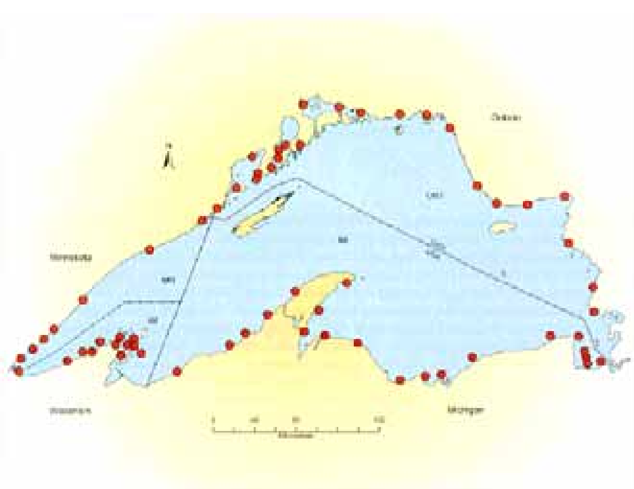


Fig 1-Locations of 62 stations (red dots) sampled during the 2010 annual spring bottom trawl survey of Lake Superior

Cisco

Year-class strength for the 2009 Cisco cohort was estimated at 18.82 fish/ha, the tenth strongest year-class observed over the 33-year survey and the strongest year-class to appear since 2005 **(Fig. 2)**. The 2009 cohort was 27% of the survey record mean density and was 2% of the largest 1984 year class (885.62 fish/ha). Year- class strength for the 2009 cohort in U.S. waters was 30.23 fish/ha and 0.50 fish/ha in Canadian waters. For comparison, the density of the strong 2003 year class was estimated at 182.25 fish/ha and moderate 2002 and 2005 year classes were estimated at 35.12 and 24.66 fish/ha, respectively **(Fig. 2)**.

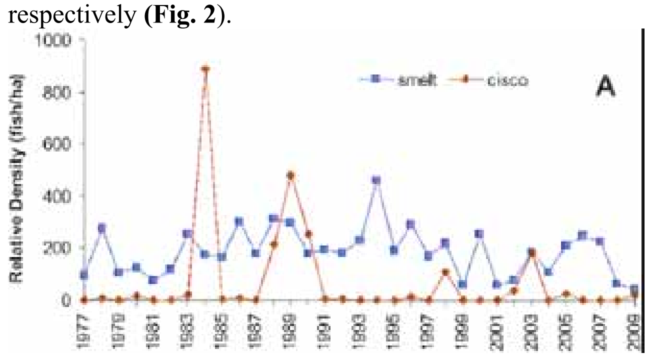
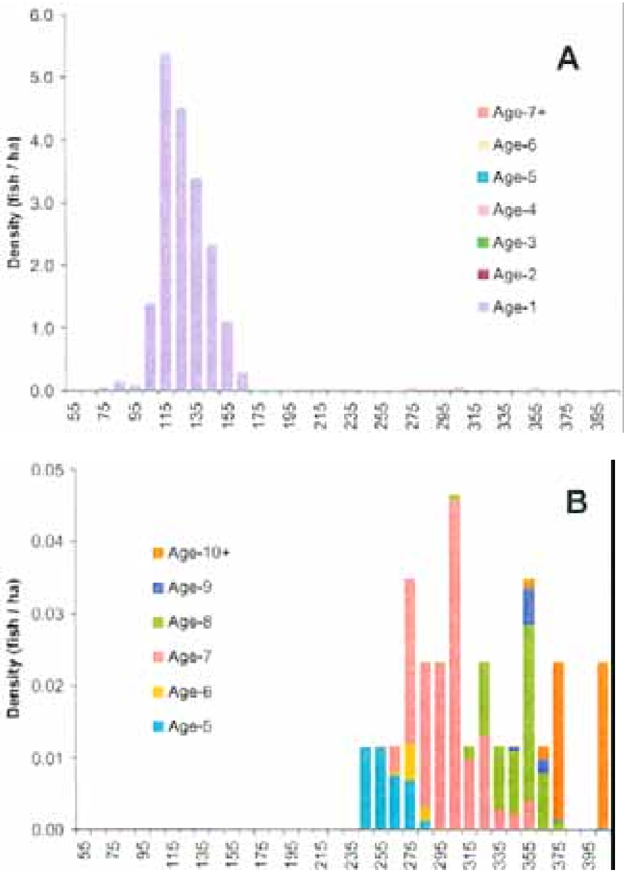


Fig 2-Year-class strength (number of age-1 fish/ha) for Cisco and rainbow smelt for all nearshore sampling stations for cohorts produced from 1977 to 2009

Biomass of age-l and older Cisco (0.30 kg/ha) in 2010 was higher than in 2009 (0.02 kg/ha), due largely to the appearance of the moderate 2009 year class. Despite the increase in biomass, the trend in population biomass has continued downward since 2004-2006 when biomass averaged > 1.80 kg/ha and is well below the long term 1978-2006 average of 2.90 kg/ha.

Biomass of Cisco increased slightly in Wisconsin and Michigan waters owing to the appearance of the 2009 cohort. The weak showing of the 2009 cohort in Minnesota and Canadian waters contributed to a continuation of low biomass in those jurisdictions. If yearlings are removed from our 2010 biomass estimates, all jurisdictions would be similar and show declining biomass across all jurisdictions since 2004-2006. Biomass estimates as a percent of long-term means was low in Wis. (24.72%), very low in W. Ontario (4.19%) and Mich. (2.61 %), and extremely low in E. Ontario (0.76%) and Minnesota (0.00%). This pattern is consistent with low Cisco recruitment since 2003.

The 2010 Cisco age structure was dominated by the 2009 year class and accounted for 98% of the mean relative density **(Fig. 3A)** and the remaining 2% were adults age 5 and older **(Fig. 3B).** The moderate to large 1998, 2002, 2003, 2005 cohorts accounted for 15, 20, 47, and 12% of the mean relative density, respectively, of adults age 5 and older.



Figs 3AB-Estimated age-length distribution of Cisco caught at all nearshore sampling stations in Lake Superior in 2010; Panel A, all ages, panel B, >4 yrs

Rainbow Smelt

Year-class strength of the 2009 rainbow smelt cohort dropped to a record low of 41.03 fish/ha. This continues a declining trend following the last peak of246.58 fish/ha for the 2006 cohort **(Fig. 2)**. Year-class strength for the 2009 cohort was 22.1 % of the average over the 33-yr survey period (185.3 fish/ha). The 2009 year-class was stronger in U.S. waters (58.8 fish/ha) compared to Canadian waters (12.50 fish/ha).

Mean relative biomass for age-1 and older rainbow smelt was 0.22 kg/ha, the third lowest in the 33 surveys record, and continued a declining trend following the most recent maximum of 1.29 kg/ha in 2007. The 2009 biomass estimate was 17% of the 33-year mean of 1.26 kg/ha. Biomass of rainbow smelt declined 83% in Michigan waters, remained unchanged in Minnesota waters and increased 273% in Wisconsin waters. Rainbow smelt biomass decreased 55% in W. Ontario waters and 91% in E. Ontario waters **(Fig. 4)**. In all jurisdictions except Wisconsin, relative biomass estimates were <10% of the long-term average; in Wisconsin, the estimate was 84% of the long-term average.

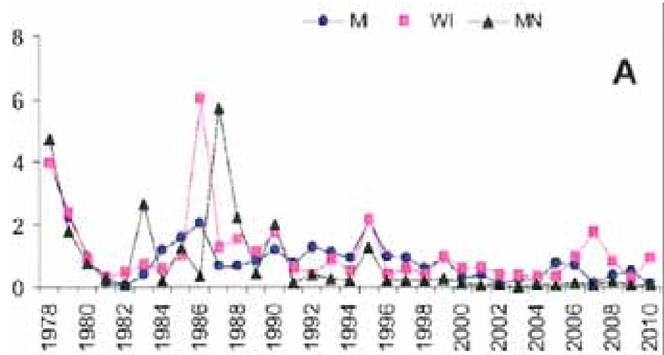


Fig 4-Biomass (kg/ha) of age-l and older rainbow smelt in nearshore waters of Michigan, Wisconsin, and Minnesota, 1978-2010

Bloater

The 2009 bloater year-class strength was relatively weak (2.45 fish/ha) and well below the 33-year average of 10.5 fish/ha, though about five times larger than the previous 3 year classes (average of 0.46 fish/ha). By comparison the 2005 cohort strength was 15.84 fish/ha (**Fig. 5**). Year-class strength was greater in U.S. waters (3.97 fish/ha) compared to Canadian waters (0.00 fish/ha).

Although mean relative lake-wide biomass of age-I and older bloater increased modestly from 0.09 kg/ha in 2009 to 0.19 kg/ha in 2010, the overall trend has been downward since 2006 when buoyed by the appearance of the moderate 2005 year class, lake-wide biomass was 1.36 kg/ha (**Fig. 8A**). Following the lowest estimated biomass in the 33-year survey in 2009, the estimate for 2010 was the second smallest.

Between 2009 and 2010, bloater biomass declined in Michigan, Minnesota, and W. Ontario waters to levels <0.04 kg/ha but increased in Wisconsin and E. Ontario waters to >0.33 kg/ha **(Fig. 9).** Overall, bloater biomass was relatively low in all jurisdictions, at or below levels observed at the beginning of the survey record in 1978.

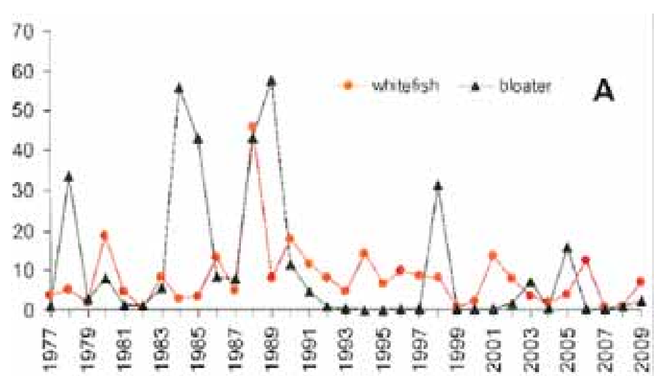


Fig 5-Year-class strength (number of age-I fish/ha) for bloater and lake whitefish for all nearshore sampling stations for cohorts produced from 1977 to 2009. Only U.S. waters were sampled for 1977-1988

Lake Whitefish

Lake whitefish year-class strength increased lake-wide from lows of 0.54 and 0.98 fish/ha for the 2007 and 2008 cohorts, respectively, to 6.89 fish/ha for the new 2009 cohort (Fig. 7A). RSE for lake whitefish year-class strength was 76%, which is within the 33-year survey range of 35-98% (Fig. 7B). The 2009 year-class was substantially stronger in U.S. (11.15 fish/ha) than in Canadian waters (0.05 fish/ha). For comparison, average lake-wide year-class strength for lake whitefish over the 33-year survey period was 8.01 fish/ha.

Biomass for age-1 and older lake whitefish in all waters increased slightly from 0.09 kg/ha in 2009 to 0.19 kg/ha in 2010, but does not reverse the decline from the peak of2.04 kg/ha in 2008 (**Fig. 6).** The low biomass estimates of2009-2010 represent a departure from the long-term trend of relatively stable biomass from 1996 to 2008.

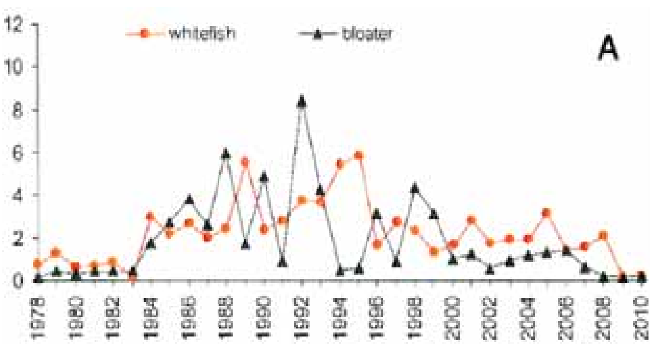


Fig 6-Biomass (kg/ha) of age-1 and older bloater and lake whitefish for all nearshore sampling stations, 1978-2010

Whitefish biomass remained low across all U.S. and Canadian jurisdictions. In Wisconsin, biomass increased slightly from 0.24 to 0.78 kg/ha between 2009 and 2010, but remains well below the 2005- 2008 average of 9.68 kg/ha. Biomass estimates in Michigan, Minnesota and E. Ontario waters continued a decline that started in 2008 and remained below 0.05 kg/ha. Like Wisconsin, biomass in W. Ontario waters increased slightly, from 0.18 to 0.21 kg/h between 2009 and 2010, but well below the 2005-2008 average of 1.04 kg/ha.

Other Species

Ninespine stickleback

The lake-wide estimate of mean relative biomass for ninespine stickleback was a low 0.01 kg/ha in 2010 and similar to 2009 (**Fig. 7).** The low 2010 estimate continues a declining trend in stickleback biomass compared to an average of 0.03 kg/ha for 2005-2008 and contrasts with 1978 and 1996 lake-wide average of 0.21 kg/ha (**Fig.** 7).

Sculpins

Mean relative biomass for all three sculpin species combined (spoonhead, slimy and deepwater) increased in 2010, punctuating a declining trend paralleling that observed for ninespine sticklebacks since 1993 **(Fig. 7**). The 2010 increase was caused by a sharp increase in abundance of slimy sculpin, which represented 81% of sculpin biomass. Deepwater sculpins represented 13% and spoonhead sculpins represented 6% of the estimated biomass. The sharp increase in slimy sculpin abundance reverses a recent trend where deepwater sculpins dominated the assemblage (2006-2009).

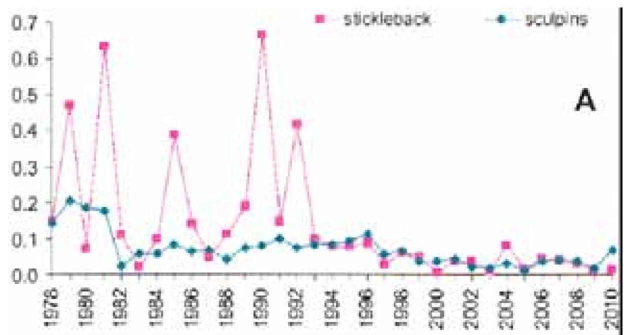


Fig 7-Biomass (kg/ha) of age-I and older ninespine stickleback and sculpins (slimy, spoonhead, and deepwater combined), for all nearshore sampling stations in Lake Superior, 1978-2010

Prior to 2006 slimy sculpins were the dominant species in the group, with the exception of 1984 when deepwater sculpins represented 55% of the biomass. Slimy sculpins averaged 68% of the total sculpin biomass across all years, but represented a higher percentage from 1978 to 1983 (81 %) compared to 1984 to 2001 (64%) and 2002-2009 (37%).

Lake Trout

After the near-zero record in 2009, biomass of hatchery lake trout remained low in 2010 (0.01 kg/ha) **(Fig. 8**). Biomass of wild (lean) lake trout decreased from 0.24 kg/ha in 2009 to 0.04 kg/ha in 2010, the fourth lowest recorded biomass for wild lake trout. All previous low values «0.10 kg/ha) were observed prior to 1984, a time when wild lake trout populations were recovering. Between 2009 and 2010, biomass of siscowet lake trout decreased from 0.12 to 0.08 kg/ha, continuing a declining trend beginning 2007 (**Fig. 8).**

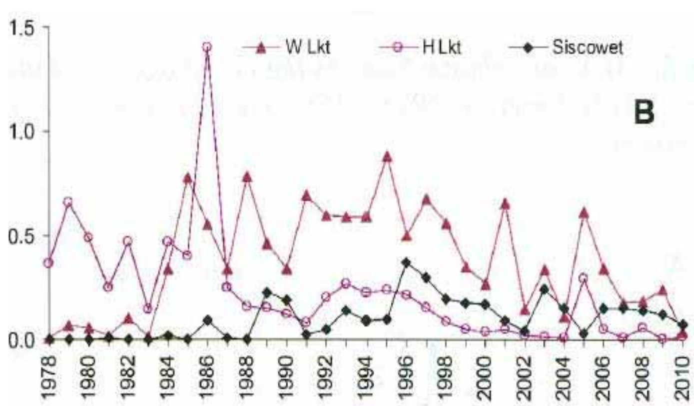


Fig 8-Biomass (kg/ha) of age-I and older lake trout (wild-lean, hatchery, and siscowet) for all nearshore sampling stations, 1978-2010

Densities of small, intermediate and large hatchery lake trout decreased to 0.01, 0.01, and 0.02 fish/ha in 2010, respectively, consistent with the decline beginning in 1993-1996. Densities of all sizes of wild (lean) lake trout decreased in 2010, continuing a declining trend that started in 1996-1998 **(Fig. 9**. From 2008 to 2010, density of small wild lake trout declined from 0.15 to 0.06 fish/ha; these values represent the lowest in the 1978-2010 time series. Density of intermediate-size lean trout decreased from 0.24 in 2009 to 0.07 fish/ha in 2010, the lowest in the time series after 1978.

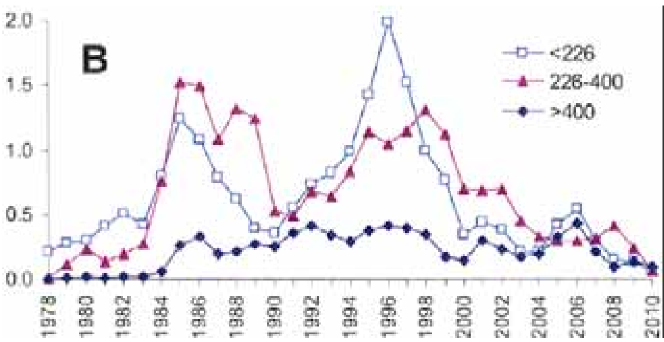


Fig 9-Density (fish/ha) of age-1 and older wild (lean) lake trout for all nearshore sampling stations, 1978-2010

Density of large wild lake trout decreased from 0.14 kg/ha in 2009 to 0.10 kg/ha in 2010, continuing a decline from a recent peak of 0.43 kg/ha in 2006. Siscowet lake trout showed a pattern of variable but generally increasing density since 1980 **(Fig. 10.** From 2006 to 2008, densities of small- and intermediate-size siscowet lake trout increased from 0.10 to 0.12 and 0.08 to 0.15 fish/ha, respectively. In 2009 and 2010, densities of siscowet lake trout were lower; 0.07 kg/ha for small fish and 0.11-0.12 kg/ha for intermediate-size fish. Densities of large siscowet lake trout have fluctuated between 0.10 and 0.07 fish/ha since 2000. In 2010 the proportions of total lake trout density that were hatchery, wild and siscowet were 10, 30, and 60%, respectively.

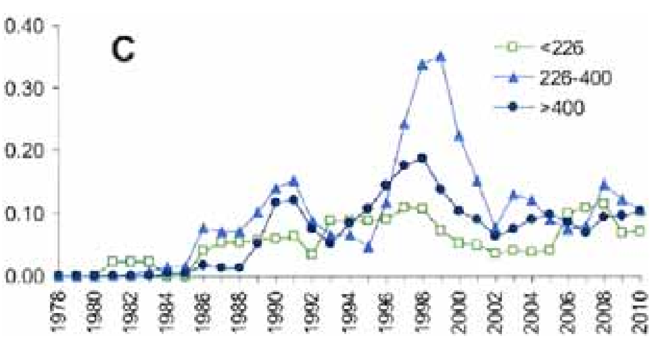


Fig 10-Density (fish/ha) of age-1 and older siscowet lake trout for all nearshore sampling stations in Lake Superior, 1978-2010.

Lake Superior Fish Community

Mean biomass of all fish species caught during the spring bottom trawl survey declined 87% since 2005 when it was 9.16 kg/ha to 1.37 kg/ha in 2010 (**Fig. 11**). Decreased biomass in 2006-2010 was a result of declines in estimated biomass of Cisco, bloater, lake whitefish, rainbow smelt and lake trout. In 2010, principal species contributing to community biomass were Cisco (22%), rainbow smelt (16%), lake whitefish (14%), bloater (12%), siscowet lake trout (11%), and shortjaw Cisco (8%). The remaining 17% of the community biomass was composed of slimy sculpin (4%), longnose sucker (4%), lean lake trout (2%), pygmy whitefish (2%), trout-perch (2%) and Burbot (2%). Each of the remaining species (ninespine stickleback, hatchery lake trout, spoonhead sculpin, and deepwater sculpin) represented <1% of the community biomass. This structure contrasts with the 2006 community when Cisco represented the highest percentage of biomass for any species (26%), followed by bloater (20%), lake whitefish (20%), and rainbow smelt (12%).

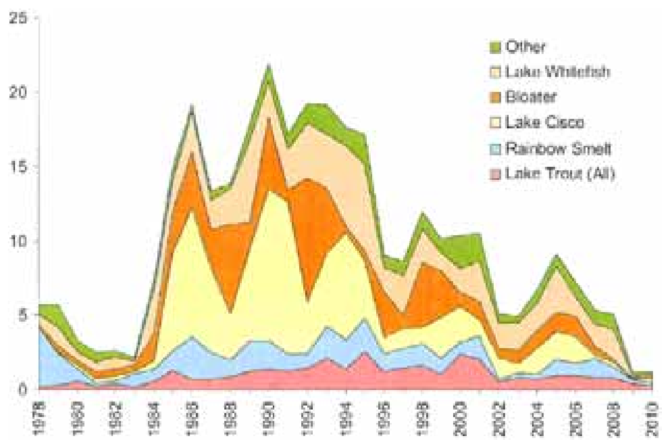


Fig 11- Biomass (kg/ha) of the fish community caught in bottom trawls at all nearshore sampling stations, 1978-2010; Canadian waters were not sampled until 1989

Changes in estimated community biomass over the 33-year time series have been largely the result of changes in abundance of major prey species **(Fig. 11).** Rainbow smelt was the dominant prey fish prior to 1981 and afterwards dominance shifted to native prey species; Cisco, bloater, and lake whitefish. Principal factors associated with changes in the community have been recovery of lake trout, increased mortality of rainbow smelt, sustained recruitment of lake whitefish, and variable recruitment of large year classes of Cisco and bloater. Annual variation in community biomass since 1984 has been driven by recruitment variation in Cisco, bloater and lake whitefish. Recruitment of large year classes of Cisco in 1984, 1988-1990, and 1998 resulted in subsequent short-term increases in prey fish biomass **(Fig. 11).** Recruitment of the most recent large year class in 2003 yielded smaller and less sustained increases in biomass than previous years. The appearance of the weak 2009 year class of Cisco in 2010 resulted in a slight increase in community biomass. Unlike previous strong year classes of Cisco that showed lake-wide synchrony, the 2009 year class was limited largely to Wisconsin waters. These yearling Cisco represented 75% of total Cisco biomass; if that fraction (0.23 kg/ha) were deducted from the 2010 estimate of community biomass (1.37 kg/ha), the result (1.15 kg/ha) would be less than the 2009 estimate (1.22

kg/ha), the lowest value in the 33-year survey record. Since 2006, densities of adult Cisco (2:4 yrs) in our spring bottom trawl samples have declined to levels at or below levels observed prior to recovery of Cisco before 1984.

Recent declines in lake-wide biomass of Cisco, bloater, and lake whitefish to levels near or below that observed prior to recovery in the late 1970s - mid-1980s is consistent with a hypothesis of strong lake trout predation. In Wisconsin waters, whitefish biomass in 2009 and 2010 was the lowest in the 33-yr survey record for this jurisdiction (and also lake-wide). The reduction of prey fish biomass, reduced recruitment of large Cisco year classes, reduced mean sizes and younger age structure of rainbow smelt all support the hypothesis of strong predation pressure by lake trout stocks and that lake trout populations may now be food limited. For the first time, short jaw Cisco, a species of special concern in the U.S. and Canada, has been included in the top six species contributing to community biomass. The resurgence of short jaw Cisco was most evident in E. Ontario waters, where short jaw Cisco have always persisted and in Wisconsin waters, primarily the Apostle Islands region, where short jaw Cisco has shown strong recruitment from the 2003 year class.

Gorman (2011) predicted that under sustained predation pressure from recovered lake trout populations, short jaw Cisco should become the predominant deepwater Cisco because its large size provides protection from predation that smaller bloaters lack. Thus, the apparent comeback of short jaw Cisco may be indicative that lake trout are exerting strong predation pressure on the Lake Superior fish community. The abundance of small and intermediate-size lean (wild) lake trout dropped to the lowest levels in the 33-year survey record. These trends suggest that cannibalism of younger life stages by adult lake trout may be causing recruitment failure. Declines in lean lake trout lipid content reported by Paterson et al. (2009) are also consistent with declines in prey fish biomass and resulting food limitation in Lake Superior. In the future, we expect prey fish biomass to continue to fluctuate as a result of recruitment variation, however, predation mortality will likely dampen those fluctuations and maintain the relatively low prey fish biomass observed in recent years. ✧

2010 Range of Ruffe in the Great Lakes

No range expansion was detected during 2010.

Lake Superior Ruffe range spans the entire south shore from the Duluth-Superior Harbor on the border of Minnesota/Wisconsin to Whitefish Bay, Michigan, and along the north shore from the Duluth-Superior Harbor to Thunder Bay, Ontario, Canada.

St. Marys River: Ruffe remain undetected in the St. Marys River. Lake Huron: In the mid to late 1990s Ruffe were detected in one area of northwest Lake Huron- Thunder Bay (Thunder Bay River and Thunder Bay). Ruffe have not been captured there since 2003.

Lake Michigan: The Ruffe range consists of Green Bay. Lakes Erie and Ontario: Ruffe remain undetected in the Lower Great Lakes. Inland lakes and streams: Ruffe remain undetected from inland lakes and streams within the Great Lakes Basin.

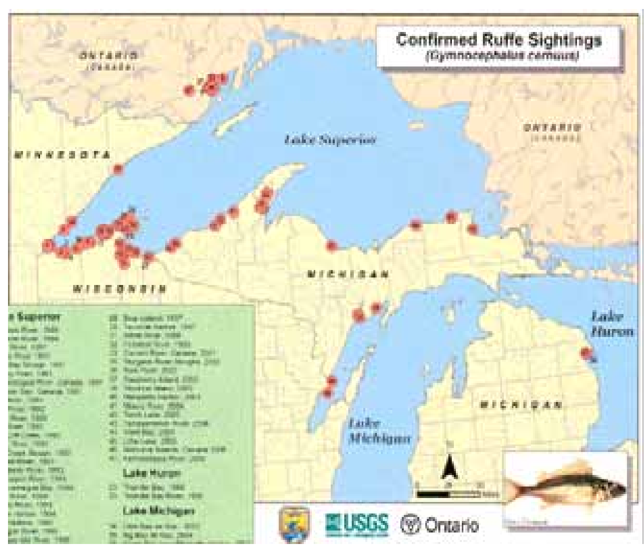
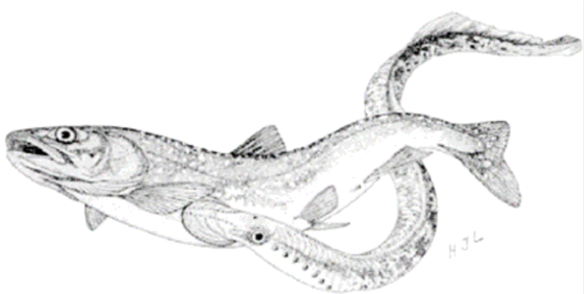


Fig 1-Great Lakes locations where Ruffe have been detected

✧

Management of Sea Lampreys in Lake Superior, 2010

The calculated target abundance of sea lamprey in Lake Superior is 37,000. Sea lamprey abundance in Lake Superior was within target levels during 2010. The estimated population of spawning-phase sea lampreys during 2010 was 36,414 and was within the fish-community objective target range for the third consecutive year.



Tributary Information

Lake Superior has 1,566 tributaries (833 Canada, 733 U.S.). One hundred fifty-six tributaries (57 Canada, 99 U.S.) have historical records of larval sea lamprey production. Of these, 98 tributaries (38 Canada, 60 U.S.) have been treated with lampricides at least once during 2001-2010. Fifty-nine tributaries (18 Canada, 41 U.S.) are treated on a regular cycle.

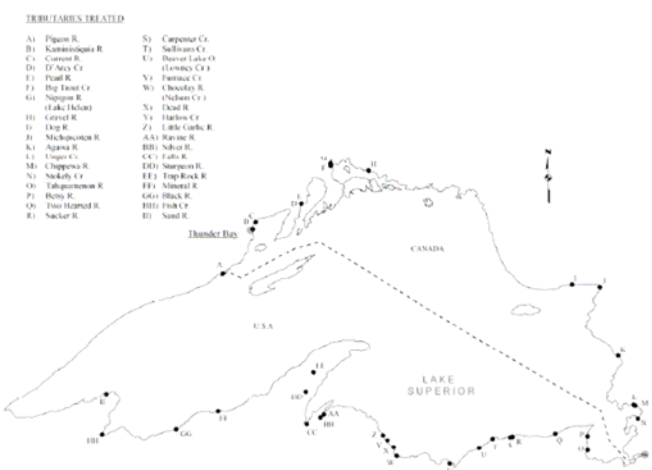


Fig 1-Locations of tributaries treated with lampricides during 2010

Lampricide Control

Lampricide treatments were completed in 24 tributaries (6 Canada, 18 U.S.) and in 17 lentic areas (9 Canada, 8 U.S.).

- Lentic areas of Pigeon, Current, Dog and Michipicoten rivers (Canada) and the Trap Rock River and Carpenter Creek (U.S.) were treated with GB for the first time in 2010.
- Two tributaries to the Kaministiquia River, Oliver and Slate creeks, were not treated in 2010 due to insufficient discharge. Both have been scheduled for treatment in 2011.
- Corbett Creek, a tributary to the Kaministiquia River, was treated for the first time since 1973. Very high densities of sea lamprey larvae were noted during the treatment, however, low water levels and large beaver impoundments resulted in sub-lethal concentrations of lampricide in a significant portion of the stream. Post-treatment assessment surveys confirmed the presence of high numbers of residual lampreys. A second treatment was scheduled for later in the year, but due to time constraints only the area of highest noted densities was retreated. This stream has been rescheduled for treatment in 2011.
- Unger and D'Arcy creeks were treated for the first time in 2010.
- Big Trout Creek was re-treated in 2010, as it was only partially treated in 2009 due to low discharge and numerous impoundments.
- Pearl River was treated in 2010 after being deferred due to low discharge in 2009.
- Agawa River and Sheppard Creek (a tributary to the Goulais River system) were not treated during 2010 due to time constraints. Both streams have been rescheduled for treatment in 2011.
- Nelson Creek, a tributary to the Chocolay River, was treated for the second consecutive year due to very low discharge during the 2009 treatment and presence of residual lampreys.
- During the annual treatment of the Ravine River, rain caused a fall in pH resulting in some non-target mortality of white suckers, longnose dace, mottled sculpin, Coho salmon and stonecats.
- The first treatment of the Mineral River was successfully completed during 2010. The stream was added to the treatment schedule after surveys in early June revealed the presence of at least three year classes of larval sea lampreys.
- The Black River was treated with TFM for the first time since 1981. A 15-hour TFM block was applied to the stream, and GB was applied in the harbor to counteract strong seiche action near the river mouth. High densities of large ammocetes were observed during the treatment.
- Fish Creek was selected for an ongoing study examining dissipation of TFM in bottom sediments in the estuary of streams undergoing lampricide treatments. The study was conducted by personnel from the USGS Upper Midwest Environmental Science Center.
- Studies evaluating lampricide toxicity to lake sturgeon and stonecats were conducted by the USFWS and USGS during the lampricide treatment of the Two Hearted River.

Alternative Control

Barriers

There are 15 sea lamprey barriers on Lake Superior. Eleven of these were purpose built by the Commission to block sea lamprey spawning migrations and four were modifications to existing structures or barriers constructed by others that ensure sea lampreys remain blocked at those sites.

Operation and Maintenance

• Routine maintenance, and safety inspections were performed on 11 barriers (5 Canada, 6 U.S.).

• Repairs or improvements were conducted on three barriers (1 Canada, 2 U.S.): Betsy River – Modifications were made to the stop logs on each side of the spillway and rip rap below the dam was repositioned to improve flows through and around portable assessment traps; Miners River – Rip rap was repositioned below the barrier to improve flows through and around portable assessment traps; and Big Carp River – New rip-rap was installed to stabilize the downstream side of the barrier and fishway.

Assessment

Larval-phase

Larval assessment surveys were conducted on 136 tributaries (46 Canada, 90 U.S.) and offshore of 24 tributaries (11 Canada, 13 U.S.).

• Surveys to estimate abundance of larval sea lampreys were conducted in 32 tributaries (11 Canada, 21 U.S.) and offshore of 13 tributaries (7 Canada, 6 U.S.).

• Surveys to detect the presence of new larval sea lamprey populations were conducted in 36 tributaries (13 Canada, 23 U.S.). Three new populations were discovered in the Mineral and Big Iron rivers and Tourist Park Creek (U.S.).

• Post-treatment assessments were conducted in 27 tributaries and lentic areas (13 Canada, 14 U.S.) to determine the effectiveness of lampricide treatments conducted during 2009 and 2010.

• Surveys to evaluate barrier effectiveness were conducted in four tributaries (3 Canada, 1 U.S.).

• Biological collections for researchers or training purposes were conducted in nine tributaries (5 Canada, 4 U.S).

• RoxAnn© sonar was used to map 1,312 hectares of lentic substrate off the mouths of Big Trout Cr. (111 ha), Nipigon R. (Cash Creek; 52 ha), Gravel/Little Gravel R. (113 ha), St. Louis R. (556 ha), and Slate/Silver/Ravine R. (345 ha).

Spawning-Phase

A total of 3,801 sea lampreys were trapped in 22 tributaries during 2010.

• The estimated population of spawning-phase sea lampreys during 2010 was 36,414, and was within the fish-community objective target range of 37,000 for the third consecutive year.

• Spawning-phase sea lamprey migrations were monitored in the Amnicon, Poplar, Middle, Bad, Firesteel, Misery, and Silver rivers.

• A total of 741 spawning-phase male sea lampreys were delivered to the sterilization facility from trapping operations on the Bad (310) and Brule (431) rivers.

• A three-year field-scale management experiment using the mating pheromone to enhance trap captures was conducted in 20 Great Lakes tributaries, including the Tahquamenon, Betsy, Miners, Rock, Misery, and Carp rivers and Stokely Creek on Lake Superior.

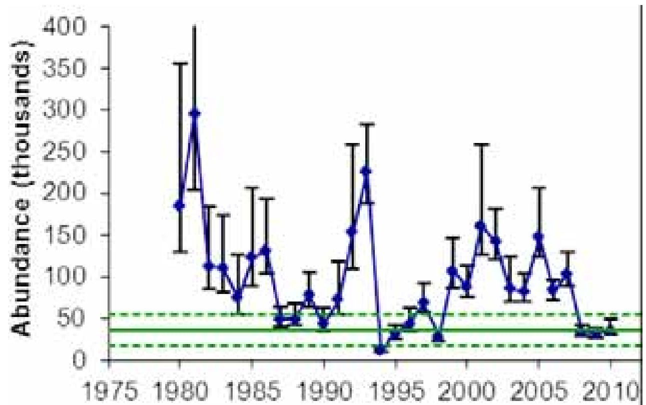


Fig 2-Estimates of spawning-phase sea lampreys, 1980-2010; Target level is indicated by the solid horizontal line

Parasitic-phase

The target rate for sea lamprey marking on lake trout in Lake Superior is five fresh (A1-A3) wounds per 100 fish >533mm (**Fig 3**).Past wounding data are currently being reviewed and re-analyzed which could result in changes to the information presented here. Spring 2008-2010 wounding data have not been reported, but will be included in the 2010 Annual Report to the Commission.

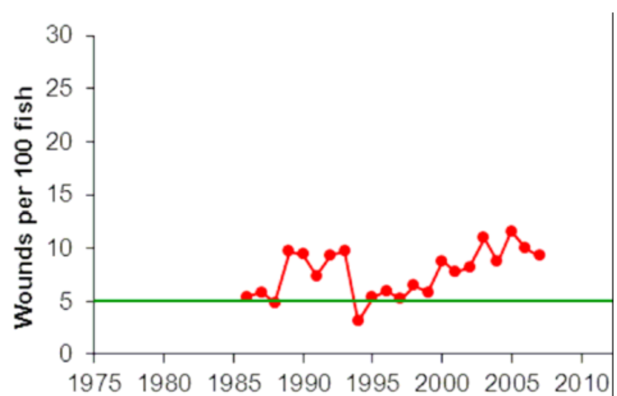


Fig 3-Number of A1-3 wounds per 100 lake trout >533mm; horizontal line represents target of five wounds/100 fish

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Resurgence of native Great Lakes fish welcomed

A lost native fish, the reef Cisco has reappeared in Lake Michigan in increasing numbers after 20 to 30 years out of biologists' view.

On the trail

Discoveries of grass carp in the Milwaukee River and in the Lower Wisconsin River are very concerning, according to state fisheries officials.

DNR paying anglers $100 for landing tagged walleye

The Michigan DNR will pay you $100 to hook a fish, but there's a catch: It has to be a specially tagged, electronically enhanced walleye. ✧